University of Nairobi

School of Engineering

USING GEOGRAPHIC INFORMATION SYSTEMS (GIS) FOR INVENTORY OF SAFARICOM FOUNDATION PROJECTS.

A CASE STUDY: NAIROBI COUNTY

BY

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DECLARATION

I, Edemba Churchill Mbulika, hereby declare that this project is my original work. To the best of my knowledge, the work presented here has not been presented for a degree in any other Institution of Higher Learning.

Signature …………………………   Date …………………

Edemba Churchill Mbulika

This project has been submitted for examination with my approval as the university supervisor.

Signature …………………………   Date …………………

Mr J. N. Mwenda

DEDICATION

I dedicate this project to my family for the support they gave me, not only during the period of doing this project but also during my entire academic and life journey.

ACKNOWLEDGEMENT

I wish to express immense gratitude to my project supervisor **Mr J. N. Mwenda** of the Department of Geospatial and Space Technology, University of Nairobi for his invaluable advice, guidance, and moral support.

I am grateful to **Immaculate Otieno** of Safaricom Foundation for her support and provision of data sets from the foundation.

To my friends and classmates I wish to express my appreciation for their invaluable and immeasurable encouragement and support throughout the period of undertaking this project.

ABSTRACT

The Safaricom Foundation provides a formal process for charitable contributions to communities, community groups and Non-Governmental Organisations in Kenya who are key partners in responding to social and economic development issues in the country. It supports initiatives and projects that provide sustainable solutions to the most pressing social challenges. The study demonstrated the application of Geographic Information System (GIS) for inventory of the Safaricom Foundation projects in Nairobi County. The projects that the foundation has funded in Nairobi County were mapped to determine their distribution. A geo-database for the projects was created and analysis on the distribution of the projects in the county done.

The study revealed that the projects were clustered in distribution. The directional distribution pattern revealed that the overall direction of growth of the projects in the county is tending towards the divisions to the west of the County. The study also revealed that the distribution of the education facilities funded by the foundation is random but appear to be clustered in Central Nairobi. It was further revealed that the distribution of health centres that have been funded by the Safaricom Foundation was fairly dispersed but concentrated in three divisions of Central Nairobi, Westlands and Dagoretti.

It was concluded that mapping using GIS is a flexible, time-efficient and cost-effective method for use in inventory for a Corporate Social Responsibility (CSR) program like the Safaricom Foundation. It was concluded that GIS is a powerful decision support tool that can be employed by the CSR for fund allocation and project distribution.

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LIST OF ACRONYMS

CSR – Corporate Social Responsibility

DHS - Demographic and Health Surveys

DSI - Department of Special Investigation

ETACS - Extended Total Access Communications System

GIS - Geographic Information System

GPS – Global Positioning System

GSM - Global System for Mobile Communications

KCDF - Kenya Community Development Foundation

KODI - Kenya Open Data Initiative

MDGs - Millennium Development Goals

MYSA - Mathare Youth Soccer Association

NGO – Non-Governmental Organisation

UNDP - United Nations Development Program

WHO - World Health Organization

CHAPTER ONE: INTRODUCTION

1.1 Background

1.1.1 Safaricom Foundation

Safaricom started as a department of Kenya Posts & Telecommunications Corporation and launched operations in 1993 based on an analogue Extended Total Access Communications System (ETACS) network. It was upgraded to Global System for Mobile Communications (GSM) in 1996 and was awarded a licence in 1999. Incorporation of Safaricom Limited was done on 3rd April, 1997 under the Companies Act as a private limited liability company. It was converted into a public company with limited liability on 16th May, 2002. Currently the company is owned by Vodafone (40% stake), the Government of Kenya (35% stake) and the public (25% stake). It is one of the leading integrated communications companies in Africa with over 17 million subscribers. It provides a comprehensive range of services which include voice services, data services and mobile money transfer service (M-PESA) on a variety of platforms (Safaricom Limited, 2013).

The Safaricom Foundation was established in August 2003 and is a registered charity funded by Safaricom Limited and the Vodafone Group Foundation. The Foundation provides a formal process for charitable contributions to communities, community groups and Non-Governmental Organisations (NGOs) in Kenya who are key partners in responding to social and economic development issues in the country. It supports initiatives and projects that provide sustainable solutions to the most pressing social challenges. Its specific focus areas are Education, Health, Economic Empowerment, Environmental Conservation, Arts and Culture, Music and Sports. The Foundation also responds to disasters and humanitarian emergencies. The projects it has supported are distributed throughout the country (Safaricom Foundation, 2013).

1.1.2 Geographic information Systems (GIS)

Geographic Information System (GIS) is a special type of information system that is used to input, store, retrieve, process, analyse and visualize geospatial data and information in order to support decision making. It is essentially a spatial decision support tool. GIS is the merging of cartography, statistical analysis, and database technology. The ability to separate information in layers, and then combine it with other layers of information distinguishes GIS

from other information systems and is the reason why GIS holds such great potential as a research and decision-making tool.

As observed by Foote *et al*., (2009), GIS is now used extensively in government, business, and research for a wide range of applications including environmental resource analysis, land use planning, location analysis, tax appraisal, utility and infrastructure planning, real estate analysis, marketing and demographic analysis, habitat studies, and archaeological analysis. It has been extensively used in natural resources management, facilities management, lands management and in the management of street networks like address matching, location analysis or site selection, development of evacuation plans.

The use of Geographic Information Systems (GIS) for the measurement of physical accessibility is well established and has been applied in many areas including retail site analysis, transport, emergency service and health care planning, as indicated by Ebener *et al*., (2005). GIS allows policy makers to easily visualize problems in relation to existing health and social services and the natural environment and thus more effectively target resources. GIS enables researchers to locate high prevalence areas and populations at risk, identify areas in need of resources, and quickly make decisions on resource allocation. Geographical Information Systems are highly suitable for analysing all forms of data, revealing trends and interrelationships that would be more difficult to discover in tabular format.

1.2 Problem Statement

Since the inception of the Safaricom Foundation in 2003, it has funded several projects in various locations in Kenya (Safaricom Foundation, 2013). The Safaricom Foundation stores all the data about the projects they have, they are and they intend to fund in Excel spread sheets that do not have a spatial component attached to the projects. The location information about the projects is based on the place names of the organisation in which the projects are based.

GIS can play a vital role on mapping the projects and creating a geo-database that is easily accessible and that can be linked to other socio-economic data of the areas in which the projects are based for effective decision making. Foote *et al*., (2009) also observed that GIS can provide a means of visualising and analysis of the projects data on location, proximity,

accessibility and interdependencies of the projects with the communities in which they are based.

1.3 Objectives

The main objective of this project was to demonstrate the role of GIS in creating an inventory for the Safaricom Foundation projects in Nairobi County.

The following were the specific objectives of the project:

i. To map the projects funded by the Safaricom foundation in Nairobi county to aid in understanding the distribution of the projects.

ii. To prepare a geo-database to visualize the projects funded by the Safaricom foundation in Nairobi county.

iii. To investigate equity in of distribution of the projects.

iv. To demonstrate how GIS can be used as a Decision Support System for fund allocation for future funding.

1.4 Justification for the Study

The Safaricom Foundation is in the process of implementing better ways of managing the projects it has funded and on future allocations. This project intends to introduce the use of GIS in the inventory and management of projects to the Safaricom Foundation. If adopted, it can be expanded to all the projects the Safaricom Foundation has funded within the country for effective decision making on future fund allocations.

1.5 Scope and limitations of the study

The study was limited to demonstrating the use of GIS for inventory of the projects funded by the Safaricom Foundation. This was achieved through mapping the projects, creating a geo-database for the projects and analysis of the distribution of the projects. The study was also limited to only the facilities that have been funded by the foundation within Nairobi, with emphasis on the education and health facilities, and whose GPS coordinates were picked using a handheld GPS receiver.

1.6 Organization of the report

The report is organized into five chapters. Chapter one deals with the background to the study, problem statement, the objectives of the project, justification for the project, scope and limitations of the study and organization of the report.

Chapter two covers the literature review. Chapter three gives an overview of the study area, materials and methodology applied to come up with the results in the project. Chapter four outlines the results and analysis from the project. Finally conclusion and recommendation are presented in chapter five.

CHAPTER TWO: LITERATURE REVIEW

2.1 Corporate Social Responsibility (CSR)

Corporate Social Responsibility is an effort by organizations to deploy their resources in a way that helps the organizations build a mutually productive and sustainable business relationship between them and the communities with which they do business. It is a massive force for social change and it works by producing and offering services that improve the lives of users of the services, and communities in which these companies operate. A true Corporate Social Responsibility gives an opportunity to the businesses involved to make the world a better place by ensuring their activities have a sustainable impact on the society. Measuring the impact of Corporate Social Responsibility in the Kenyan market is difficult because very few companies issue sustainability reports, and it is not compulsory to indicate how much they give under the banner of Corporate Social Responsibility. No legislation exists to compel them to do so (Africa Brains, 2012).

Corporate Social Responsibility is a concept born of the premise that both for profit and not for profit organizations have various stakeholders whose different interests are affected one way or the other by an organization's goals, operations or the behaviour of its members (Infotrack East Africa, 2013). The extent to which a company and its products are accepted in society is highly dependent on the extent to which the products and services meet the needs of the clients and generally the level to which the company is involved in meeting the real needs of the community. A firm working with the poor will boost its image consequently opening up new business opportunities for new products. The community will seamlessly support a firm that cares for them. Having the poor at heart is likely to generate political good-will from government through incentives such as tax relief and favourable policies. Neglecting Corporate Social Responsibility issues can lead to tarnishing the image of the firm and mass boycott of the firm's products and services. Generally, a socially responsible business will create a win-win situation that will seek to offer the employees the best terms possible while pursuing its own profit objective in order to maximize shareholder value.

2.2 The Millennium Development Goals

The United Nations Millennium Declaration which was adopted on 8th September 2000 brought together world leaders at the United Nations Headquarters in New York in the 8th

plenary meeting. The leaders committed their nations to a new global partnership to reduce extreme poverty and set out a series of targets with a deadline of 2015 (United Nations, 2013). The declaration set out eight goals that became known as the Millennium Development Goals. The goals are:

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a Global Partnership for Development

To ensure the goals are achieved, there is need for all the nations to galvanize unprecedented efforts to meet the needs of the poorest in the world (UNDP, 2013). Several organisations, Safaricom Foundation being an example, through their corporate social responsibility programs (CSR), world over have collaborated with both governmental and non-governmental organisations to help attain some of the millennium development goals.

2.3 The Safaricom foundation CSR Program

The Safaricom Foundation's objective is to contribute towards Kenya's development agenda and the Millennium Development Goals. It is involved and funds various projects within the country and the areas in which it involved include:

Disaster Relief

Kenya has continually experienced unpredictable weather patterns that have resulted in drought and crop failure resulting in loss of life and livelihoods. The Safaricom Foundation partners with various organisations in providing long lasting solutions to some to such disasters thus increased food security in the country. The projects it supports under this initiative are tailored towards responding to disasters and humanitarian emergencies. The Foundation has partnered with such organisations as Kenya Community Development Foundation (KCDF), Amiran Kenya and KickStart, to start the Ustawi initiative that seeks to enhance food security in the country (Safaricom Foundation, 2013).

Sports

As a means of promoting cohesion amongst groups and communities, the Foundation supports sports. This provides alternative opportunities for young people, integrates education and life skills into sport and helps build Kenya's national pride (Safaricom Foundation, 2013). Some of the projects it has sponsored are:

i. In Kilifi the Foundation supported the "Moving The Goalposts" project where teenage girls have formed an active football league as well as trained a team of peer educators to provide life skills and health information after their training sessions and matches.

ii. The "Alive and Kicking" project makes footballs and netballs bearing awareness messages and has also conducted a series of road shows providing educative messages targeting the youth.

iii. The Mathare Youth Soccer Association (MYSA), an organization that uses sports to rehabilitate and empower youth from the Mathare slum in Nairobi and whose football team has won the premier league, has also benefitted from the Foundation's support.

Art, Culture & Music

The Foundation partners with various organisations in creation of awareness about music and promotion of innovative ideas that bring into light Kenya's talent in music, arts and culture. This is fundamental in preservation of Kenya's history and heritage for prosperity (Safaricom Foundation, 2013).

Water

Each and every person requires access to clean and portable water, but much of Kenyan population does not have access to clean water. The Safaricom Foundation supports projects that conserve water sources and explore new methods of harvesting rain water and underground water for sustenance of life and prevention of water-borne diseases (Safaricom Foundation, 2013).

Health

According to the United Nations Development Program (UNDP), the key to achieving the Millennium Development Goals (MDGs) is focus on health provision (UNDP, 2013). Many Kenyans do not have access to affordable or specialized healthcare. The Foundation has partnered with several health providers and communities to increase access to healthcare

services. This has led to the ability of thousands of people to have access to healthcare through community initiatives supported by the Foundation (Safaricom Foundation, 2013).

Environmental Conservation

One of the MDGs calls for ensuring environmental stability by increasing forest cover and protecting water catchment areas, among other actions (UNDP, 2013). The Safaricom Foundation supports environmental conservation by partnering with and supporting innovative community projects in initiatives such as protection and fencing of forests, tree planting, protection and conservation of wildlife, mitigation against human/wildlife conflict and community clean-up campaigns (Safaricom Foundation, 2013).

Education

There has been an increased in the enrolment of children in both primary and secondary schools since the introduction of the free primary and secondary education in Kenyan public schools. This increase has been done without an increase in the physical infrastructure that is needed to support the initiative. The Safaricom Foundation has partnered with several educational institutions to equip them in order to support the achievement for education for all (Safaricom Foundation, 2013). These efforts contribute towards the Millennium Development Goal of increasing access to education at the primary level by 2015 (UNDP, 2013).

Economic Empowerment

The Millennium Development Goals aim to eradicate extreme poverty and hunger by 2015. This can only be achieved if all sectors collaborate on income generation, food security, job creation and poverty alleviation initiatives (UNDP, 2013). The Safaricom Foundation has partnered with communities to implement activities that contribute towards their economic self-sufficiency. The Foundation supports income generating projects such as animal rearing and small-scale industries and works with people with disabilities to help them generate income (Safaricom Foundation, 2013).

2.4 The role of GIS in conducting inventories

2.4.1 Introduction

Geographically referenced information was first included in digitally processed computer files in the early 1960's. The data which were usually referenced to a grid overlaying a map of some sort were stored and processed by the computer and the results were output as line printer map or plotter drawn grid cell maps. Modern vector and raster based GIS have evolved from these beginnings. GIS technology is now used by thousands of public and private organizations throughout the world for a wide application of uses and in different disciplines and professions.

2.4.2 Graphical representation of objects

Graphical information on objects may be entered in terms of:

a) **Points**

A point is the simplest graphical representation of an object. Points have no dimension but may be indicated on a map or displayed on screens by using symbols. The scale of viewing determines whether an object may be shown as a point or an area. The geometric location is specified through a set of coordinates.

b) **Lines**

A line segment is a one dimensional object that is a direct line between two end points. They are used to represent objects, which may be defined in one dimension such as roads or rivers.

c) **Areas**

Areas are used to represent objects defined in two dimensions. An area is delineated by at least three connecting lines, each of which comprises points. In databases, areas are represented by polygons.

2.4.3 Simplified data analysis and presentation

Corporate Social Responsibility (CSR) stakeholders and other interested parties are often interested in knowing the following:

i.   Where the projects are located

ii.   The distribution of the projects in a particular area

iii.   Possible areas of funding or establishing new facilities

iv.   Characteristics of different areas in their area of operation

v.   The status of the projects: In progress, completed or yet to commence

These require extensive research and analysis of maps and related data. A GIS provides the managers with automatic tools to answer analysis questions, making it much easier to analyze special studies and reports.

2.4.4 GIS contribution to linking public health and physical locations

Where people live affects their health, nutrition, and access to health care services. To promote a better understanding of these issues, MEASURE Demographic and Health Surveys (DHS) has routinely collected geographic information in nearly all surveyed countries since 1996. MEASURE (2010) has shown that there is an intimate link between public health and location. For example, geographic accessibility to health facilities is important factor in ensuring patients receive necessary care. The spread of diseases, such as HIV and malaria, can be affected by geographic factors. Geographic information systems (GIS) supported by a strong spatial data infrastructure and vibrant routine health data can give planners valuable information to address these issues and support monitoring and evaluation and planning. MEASURE Evaluation produced a series of maps showing the location of health facilities in Tanzania. When these maps were combined with data from the World Health Organization (WHO), it was possible to show the locations of those facilities that provided such HIV/AIDS treatment options as antiretroviral therapy, prevention of mother-to-child transmission of HIV, and voluntary counseling and testing services.

According to Gibson *et al.*, (2006), in a study done in China to derive a measure of access to health centres, the methods applied were based on Network Analysis, a branch of GIS whose functions rely on the use of a network of topologically connected linear structures such as roads. The use of GIS enables researchers to model travel scenarios (by incorporating factors such as the features of the road, natural geographic barriers and estimates of both manmade and environmental impediments en-route) to simulate the travel distances that people face. These distance estimates can also be converted into estimates of travel time if assumptions

are made about the speed of travel over each segment of the network and the mode of transport used by the population.

In addition to the travel distance, with the aid of the Service Area tool in ESRI's ArcGIS 9.1, Network Analyst extension can be used to generate catchment area around a facility that denotes its service coverage for travel via road. Using this tool, a service area for each facility is formed. It has been demonstrated by Gibson *et al.*, (2006), that GIS network analysis attempts to locate the best situated facility on the network to reach in the shortest travel distance required. In cases where either a health center or (more typically) a household's dwelling was not located exactly on a roadside, the road distance calculations include as a component the simulated distance to the nearest road edge.

2.4.5 Contribution of GIS in disaster relief

Modern society is at risk from numerous types of disasters. In response to the threat of such events, most communities attempt to plan, but planning is made particularly difficult because the magnitude and location of the event can rarely be anticipated. Disaster relief mainly entails planning for escape routes and easier exit routes from the disaster.

According to Longley *et al.*, (2004), Tom Cova, an academic expert on GIS in emergency management, has developed a planning tool that allows neighbourhoods to rate the potential for problems associated with evacuation, and to develop plans accordingly. The tool uses a GIS database containing information on the distribution of population in the neighbourhood, and the street pattern. The result is an evacuation vulnerability map. Because the magnitude of a disaster cannot be known in advance, the method works by identifying the worst-case scenario that could affect a given location. Cova's method works by looking further and further from the disaster location, to find the most important bottleneck - the one that has to handle the largest amount of traffic. In an area with a dense network of streets traffic will disperse among several exits, reducing the bottleneck effect. But a densely packed neighbourhood with only a single exit can be the source of massive evacuation problems, if a disaster requires the rapid evacuation of the entire neighbourhood.

2.4.6 The role of GIS in Agricultural inventory

Comprehensive planning is becoming increasingly important to reduce or avoid land use conflict. Many local governments actively encourage and support agricultural development in

a number of ways. However in order for agriculture to be sustained for future generations, proactive planning is needed to integrate settlement and resource planning in meaningful way and promote compatibility. GIS technology can ensure a better understanding of agriculture and adjacent land uses in a community. This understanding can assist in dealing with negative impacts on farming that can result from urban, rural residential and other non-farm use encroachments. British Columbia, in Canada, implemented the Pitt Meadows Pilot Project that explored the benefits of adding agricultural data and tools to a GIS. It provided an opportunity to demonstrate how GIS technology can be combined with resource information to strengthen farming in British Columbia communities. It led to the development of a quick way to locate areas of crop suitability within a municipality among other applications. (British Columbia, Ministry of Agriculture, Food and Fisheries, 2001)

2.4.7 GIS and Schools' Inventory

It was observed by Anshupriya, (2011), that, Manipur, a small state in the north-eastern part of India, successfully used Geographic Information System (GIS) for mapping schools located in remote areas. The state launched the system with technical support from Mission of Geo-Spatial Application, a Central government, Delhi-based agency of the Centre. This will help in keeping a check on the utilization of funds sanctioned by both the Centre and the state for building new infrastructure as well as developing the existing one. It is all the more important in context of Manipur as many remote areas are difficult to reach owing to bad roads and transport infrastructure and security reasons. The system has helped map 4640 primary and upper primary schools across the State. Information about their longitudes and latitudes were gathered beforehand using the Global Positioning System (GIS). The system has also identified areas in the state in need of schools.

2.4.8 GIS and Forests Management

It has been observed by Thanya, (2012), that Thailand's Department of Special Investigation (DSI) had recently introduced 'DSI Map' for wider use among public agencies and citizens across the country to fight against forest encroachment and avoid land conflict in the country. DSI Map is an online mapping portal created based on data provided by Ministry of Natural Resources and Environment. This program together with the basic law on conservative forest will prevent citizen to encroach into the preserved forest as well as preventing illegal commercial activities to happen over prohibited area.

2.5 Geo-database design

The geo-database is the native data structure for ArcGIS and is the primary data format used for editing and data management. It is a collection of geographic datasets of various types held in a common file system folder, a Microsoft Access database, or a multiuser relational database (such as Oracle, Microsoft SQL Server, or IBM DB2). A geo-database is a database with extensions for storing, indexing, querying, and manipulating geographic information and spatial data. While some geo-databases have functions built in to allow geo-processing, the primary benefit of a geo-database is in the "database type" capabilities that it gives to spatial data (ESRI, 2013).

Geo-databases work across a range of Database Management Systems (DBMS) architectures and file systems, come in many sizes, and have varying numbers of users. They can scale from small, single-user databases built on files up to larger workgroup, department, and enterprise geo-databases accessed by many users. Some of these capabilities include easy access using standard database drivers, the ability to easily link or join data tables, also indexing and grouping of spatial datasets independent of software platform. An efficient geo-database accurately models the structure of the data being utilized, ensures that no excess (or duplicate) information will be stored, and that no inconsistencies will occur due to changes being made in one area and not in another related area. A geo-database can protect data from unauthorized access and place limitations on the sort of information that can be input, so the datasets remain internally consistent (ESRI, 2013).

Types of geodatabases

There are three types of geo-databases:

i. **File geo-databases**: Stored as folders in a file system. There is no limit on the geo-database size. Each dataset is held as a file that can scale up to 1TB in size. This limit can be extended to 256TB for very large raster datasets. The file geo-database supports one editor and many readers (as many users as file systems can typically handle before performance degrades). Long transactions and versioning are not supported.

ii. **Personal geo-databases**: all datasets are stored within a Microsoft Access data file, which is limited in size to 2GB. However, the effective limit before performance

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degrades is typically between 250 and 500MB per Access database file. A personal geo-database is not as fast, efficient, or scalable as file geo-databases; however, it supports attribute manipulation and string handling in Microsoft Access. Long transactions and versioning are not supported.

iii. **ArcSDE geo-databases** Stored in a relational database such as Oracle, Microsoft SQL Server, IBM DB2, or IBM Informix. ArcSDE geo-databases support multiple users and editors and support long transactions in GIS using versioning. These multiuser geo-databases require ArcSDE technology, which is included in ArcGIS Desktop and ArcGIS Server. In ArcSDE geo-databases, there is no limit to size or numbers of users (ESRI, 2013).

An illustration of a geo-database is as shown in Figure 2.1

2.6 Buffering

One can use the Buffer tool in ArcGIS to identify or define an area within a specified distance around a feature (polygon, line, point or node). For example, one can create a buffer to define an area around a river to identify land that can't be developed or to create a buffer to select features within a specified distance of a feature (ESRI, 2013).

The width of the buffer can be specified in one of three ways:

i. With a fixed distance - specify a constant buffer distance to apply to all input features.
ii. With an item - specify a numeric buffer item from the input coverage. Each feature in the input coverage will be buffered according to its value in the buffer item.
iii. With a distance table - Specify a buffer item common to both the input coverage and a buffer table that contains a numeric item named DIST. Every feature with a common buffer item value will be buffered by the associated DIST value (ESRI, 2013).
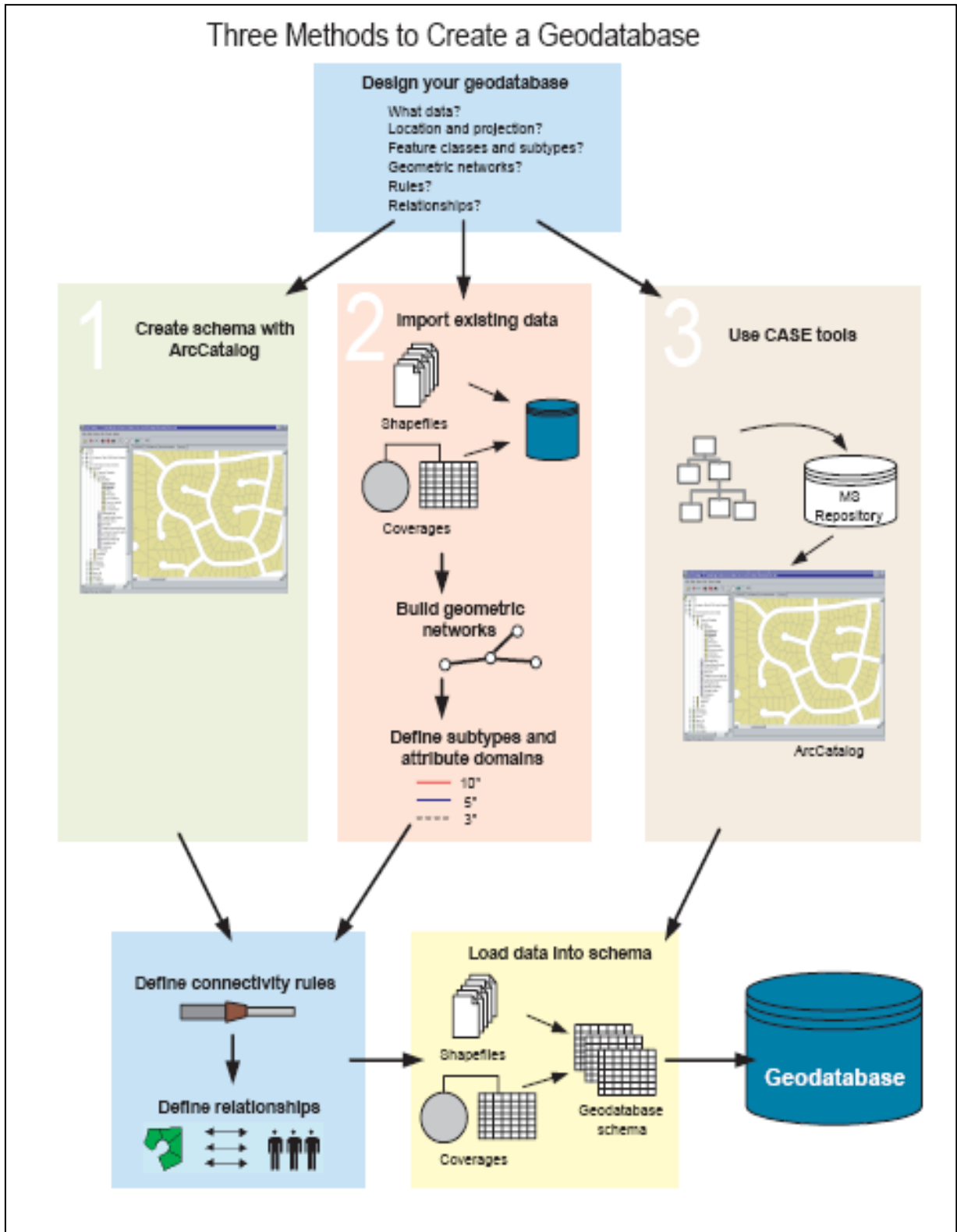
Figure 2.1: Illustration of geo-database (source, ESRI)

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Area of Study

The area of study was Nairobi County, formerly known as the Nairobi province or Nairobi District prior to promulgation of the new constitution and one of the administrative counties in Kenya. The Nairobi County is formed by the area surrounding Nairobi City whose name comes from a Maasai phrase Enkare Nairobi, which translates to cold water which is the Maasai name of the Nairobi River that flows through the County. It is also popularly known as the Green City in the Sun. It was founded in 1899 as 'Mile 327', a supply depot for the Uganda Railway which was being constructed between the coast of Mombasa and Uganda. It replaced the port city of Mombasa as the capital of the British East Africa Protectorate in 1905. Nairobi was granted city status in 1954 and became the capital city of Kenya at independence in 1963. The residents of Nairobi County are popularly known as Nairobians. The country occupies an area of 696 square kilometres (270 square miles). The main administrative districts of Nairobi County are; Nairobi West, Nairobi South, Nairobi North and Westlands. Nairobi is the most populous city in East Africa, with a current estimated population of 3,138,369 according to the 2009 Census. Nairobi is currently the 12th largest city in Africa.

At 1,795 meters (5,889 ft.) above sea level, Nairobi enjoys a moderate subtropical highland climate. The altitude makes for some cool evenings, especially in the June/July season when the temperature can drop to 10 °C. The sunniest and warmest part of the year is from December to March, when temperatures average the mid-twenties during the day. The mean maximum temperature for this period is 24 °C. There are two rainy seasons but rainfall can be moderate. The cloudiest part of the year is just after the first rainy season, when, until September, conditions are usually overcast with drizzle. As Nairobi is situated close to the Equator, the differences between the seasons are minimal and the timing of sunrise and sunset varies little throughout the year. The seasons are referred to as the wet season and dry season.

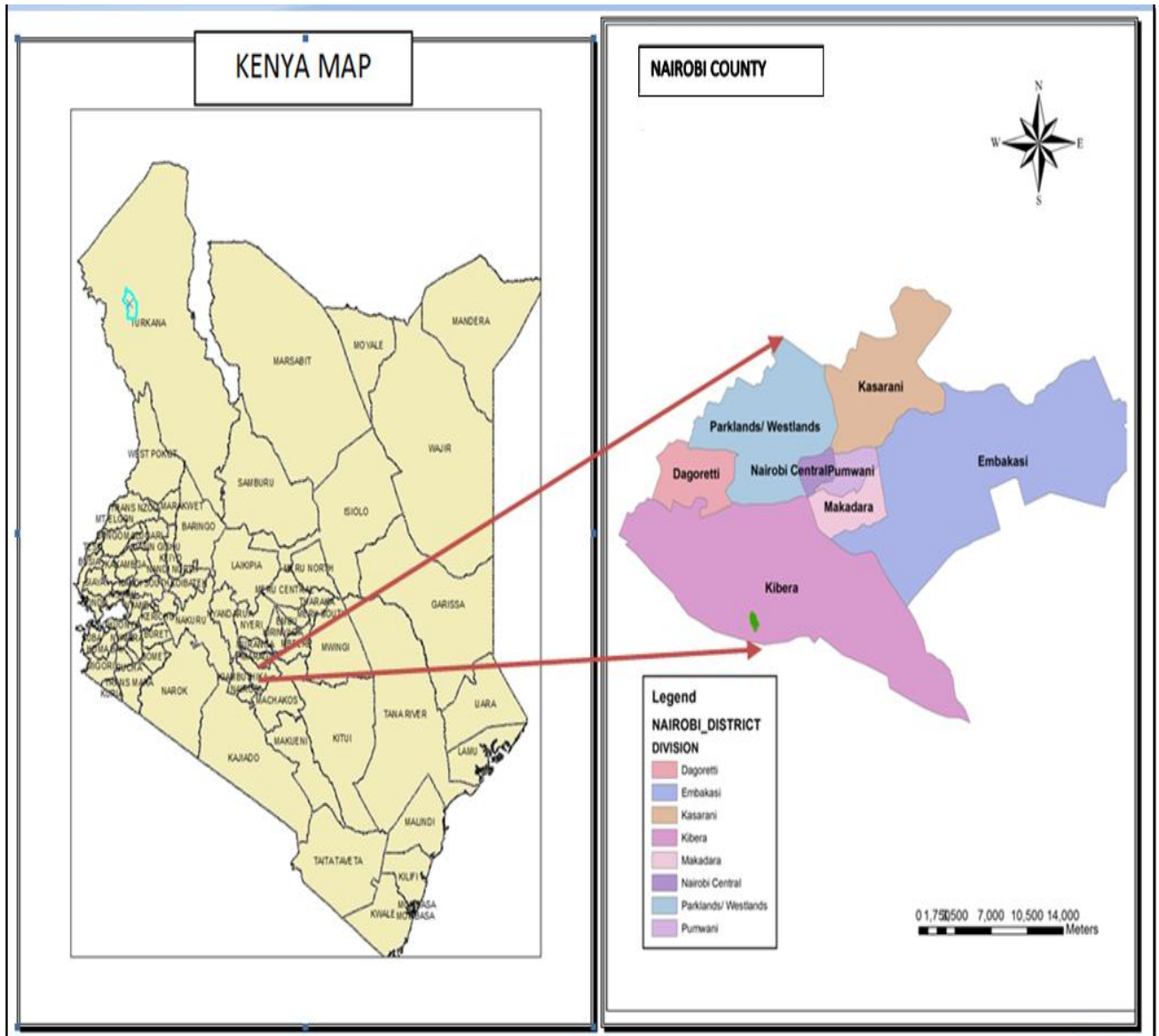The figure below shows Nairobi County.

Figure 3.1:Nairobi County

Demography

The demographic data for Nairobi County is represented in table 1 below with reference to the 2009 population census.

Division	Population
CENTRAL- NAIROBI	274,607
MAKADARA	218,641
KASARANI	525,624
EMBAKASI	925,775
PUMWANI	261,855
WESTLANDS	247,102
DAGORETTI	329,577
KIBERA	355,188

Table 1: Demographic data for Nairobi County

3.2 Data sources and tools

The datasets used in this research project was obtained from different sources and have various characteristics as summarized in the table below:

Dataset	Characteristics	Data source
Boundary	Shape file	Survey of Kenya
Road network	Scanned topographic map	Survey of Kenya
Safaricom funded projects	Discrete Coordinates	Field survey
Health Centres	Discrete Coordinates	Kenya Open Data Initiative (KODI)
Schools	Shape files	Kenya Open Data Initiative (KODI)
Towns	Shape files	Survey of Kenya

Table 2: Datasets and data source

3.2.1 Foundation data

Information about the projects funded by the foundation was obtained from the Safaricom Foundation.

3.2.2 Point coordinates

Field surveys, with funding from the Safaricom Foundation, were conducted using a handheld GPS device to collect point coordinates of the projects that the foundation funds. Data on education and health facilities in Nairobi were obtained from the Kenya Open Data Initiative (KODI), while data on Nairobi roads, boundaries and towns were obtained from Survey of Kenya.

3.2.3 Tools

The tools used in the project can be broadly divided into hardware and software as described below.

A. Hardware:

The hardware used in the study includes:

- A laptop with the following specifications;
    - 2.3 GHz Processing speed.
    - 4.00 GB RAM.
    - 500 GB Hard Disk.
- External storage
    - 500 GB External Hard Drive
    - 700 MB Compact Disk
- Hp Laser Printer and Hp Ink jet Printer

B. Software:

The softwareware used in the study includes:

- ArcMap10
- Microsoft office (2007) suite
- Adobe Photoshope

3.3 Overview of methodology

The procedure of achieving this project the steps as outlined in the figure below:
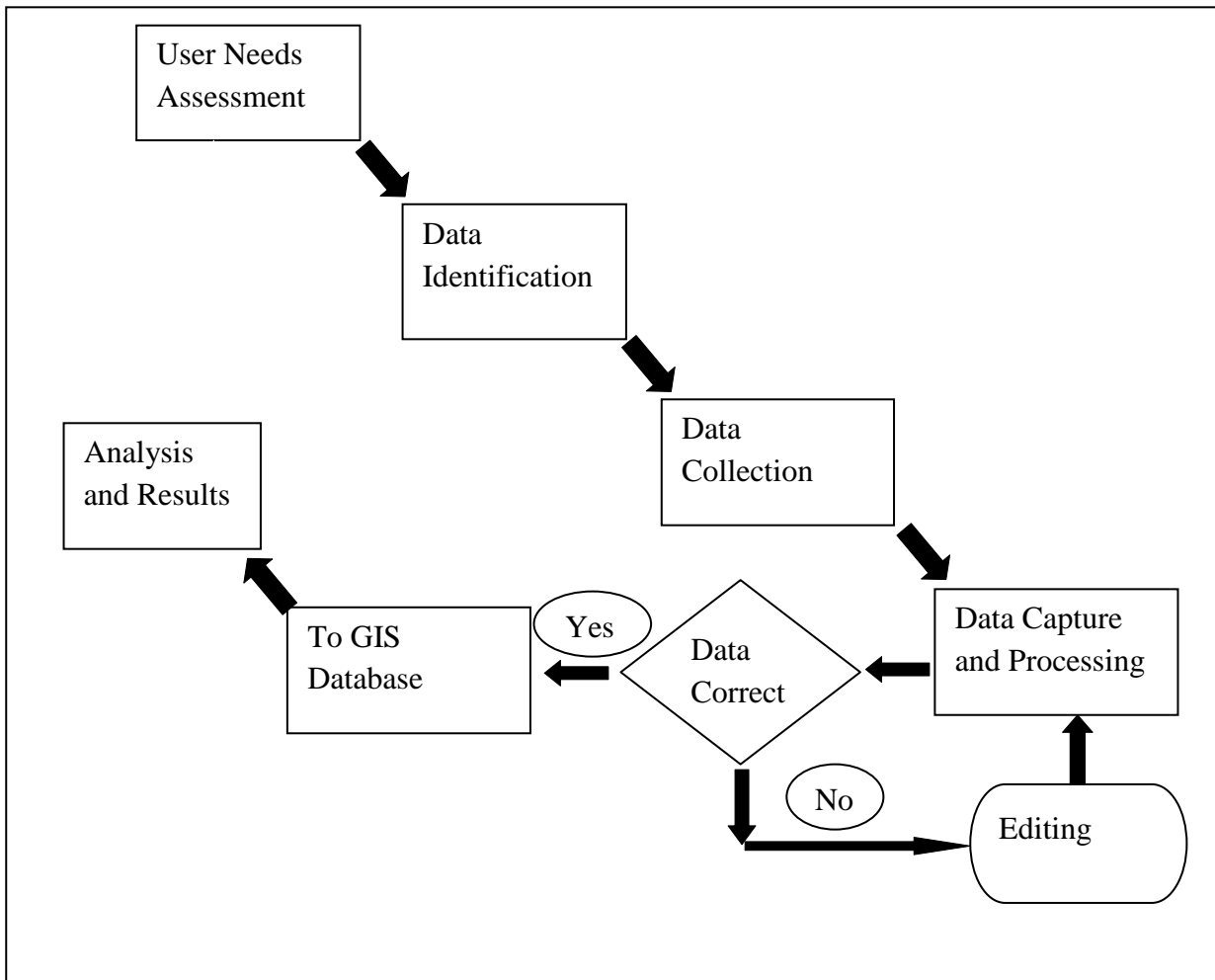

Figure 3.2: Overview of the methodology

A user assessment study was carried out to identify user information needs concerning the application of GIS in infrastructure and resource mapping for planning purposes. Data for use in the research was identified and it involved determining the various datasets to be used in the analysis such as boundary data, roads, health and education facilities in Nairobi and Safaricom Foundation funded projects. Data collection was from relevant departments and other sources such as Survey of Kenya headquarters, Safaricom Foundation and Kenya Open Data Initiative. This involved spatial data and non-spatial data. Digitizing and editing was done using ArcMap software.

3.3.1 Mapping of the projects

Using the GPS coordinates and a geo-referenced map, a map showing the location of the projects was generated using GIS.

3.3.2 Generation of a Geo-database

A geo-database was formed using ArcMap software. The database contents were joined to their respective polygons, lines and point feature attributes. The data that was included in the database included:

    i.   Name of the project funded by the Safaricom Foundation

    ii.   The point coordinates

    iii.   The amount allocated per project, if any

    iv.   The major roads network in Nairobi County

    v.   The divisions of Nairobi County

    vi.   The health facilities in Nairobi County

    vii.   Education facilities in Nairobi County

3.3.3 Analyzing the spatial distribution of the projects

From the generated map, an analysis of the spatial distribution of the projects was carried out. This was aimed at identifying regions where the projects had been concentrated or sparsely distributed.

Buffering

The Buffer command was used to create a buffer around health facilities and education facilities to determine the closeness of the health facilities or the education facilities to each other. The buffer distance was set to 2 kilometres for the health facilities as KEMRI Welcome Trust recommends that each health facility should cover an area of about 2 kilometres in radius to effectively serve existing population demands. The buffer distance for the education facilities was also set to 2 kilometres as a child walking to a primary school should generally not walk for more than 2 kilometres to the school.

The Edit tool on the Editor Toolbar was clicked together with the health facilities or education facilities of interest (Health facilities and education facilities funded by the Safaricom Foundation) and the Editor menu was selected to create the buffer zones around

the health facilities and the education facilities. This was used to determine the proximity of the health facilities in the buffer of the 2 kilometres radius from the specified health facility and the proximity of the education facilities in the buffer of the 2 kilometres radius from the specified education facility.

Pattern of distribution of the projects

The average nearest neighbour distance was used to determine the pattern of distribution of the projects funded by the foundation. The Average Nearest Neighbour Distance tool is a Spatial Statistics tool in ArcMap that measures the distance between each feature centroid and its nearest neighbour's centroid location, then averages all these nearest neighbour distances. The distribution of the features being analysed are considered clustered if the average distance is less than the average for a hypothetical random distribution. The features are considered dispersed if the average distance is greater than a hypothetical random distribution.

Direction of growth

This was done using the Directional Distribution (standard Deviational Ellipse) tool of ArcMap to determine the overall distribution of the projects funded by the foundation and thus help determine the general direction of growth from the centre (Safaricom headquarters), in terms of projects funded by the foundation. The Directional Distribution (standard Deviational Ellipse) tool is a Spatial Statistics tool in ArcMap that measures whether a distribution of features exhibits a directional trend (whether features are farther from a specified point in one direction than in another direction).

CHAPTER FOUR: RESULTS AND ANALYSIS

4.1 Results

The project aimed to demonstrate the use of GIS for inventory of Safaricom Foundation projects in Nairobi County. To best illustrate the impact and distribution of the projects funded by the foundation, there was need to include data on the education and health facilities within the county. Also a network of the major roads in the county was included in the project. The infrastructure included in the map were the major roads, Police Stations, Colleges, Schools (both primary and secondary schools), health centres and the projects that had been funded by the Safaricom foundation. The minor roads in the County were omitted as they were clustering the map and thus affecting the visibility of the other infrastructure types. Figure 4.1 is a representation of the distribution of the major infrastructure in Nairobi County including the projects funded by the Safaricom Foundation.

Distribution of the projects funded by the Safaricom Foundation

The study considered a sample of 40 projects, from all categories of projects, funded by the Safaricom Foundation in Nairobi County. The locations of the projects were mapped to depict the general distribution of the projects in the eight divisions of Nairobi County. The distribution of the 40 projects in the county is shown in Table 3 and Figure 4.2.

Division	Number of projects
CENTRAL- NAIROBI	3
MAKADARA	3
KASARANI	3
EMBAKASI	5
PUMWANI	1
WESTLANDS	13
DAGORETTI	7
KIBERA	5

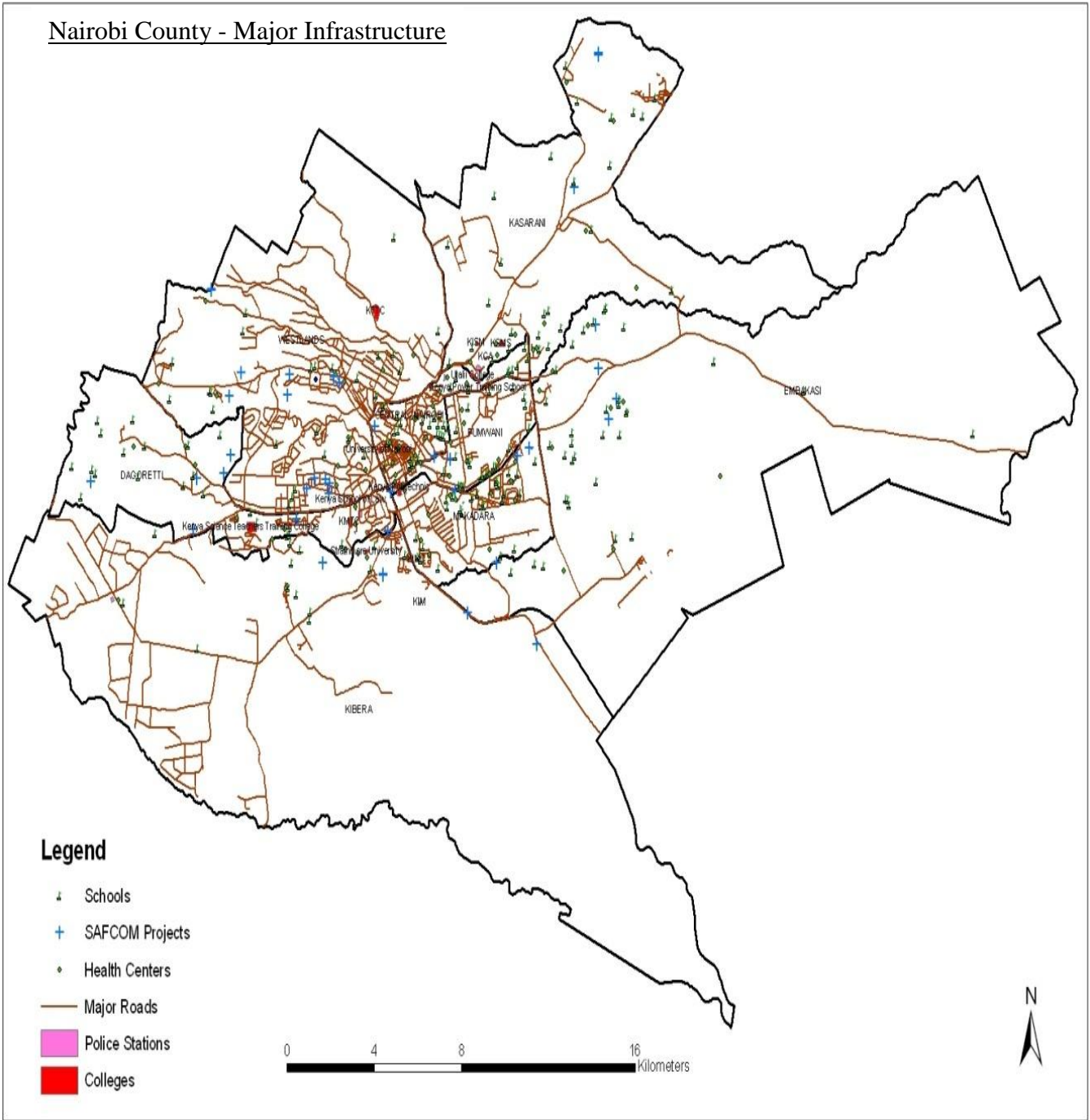Table 3: Number of projects per division

Figure 4.1: Major infrastructure distribution

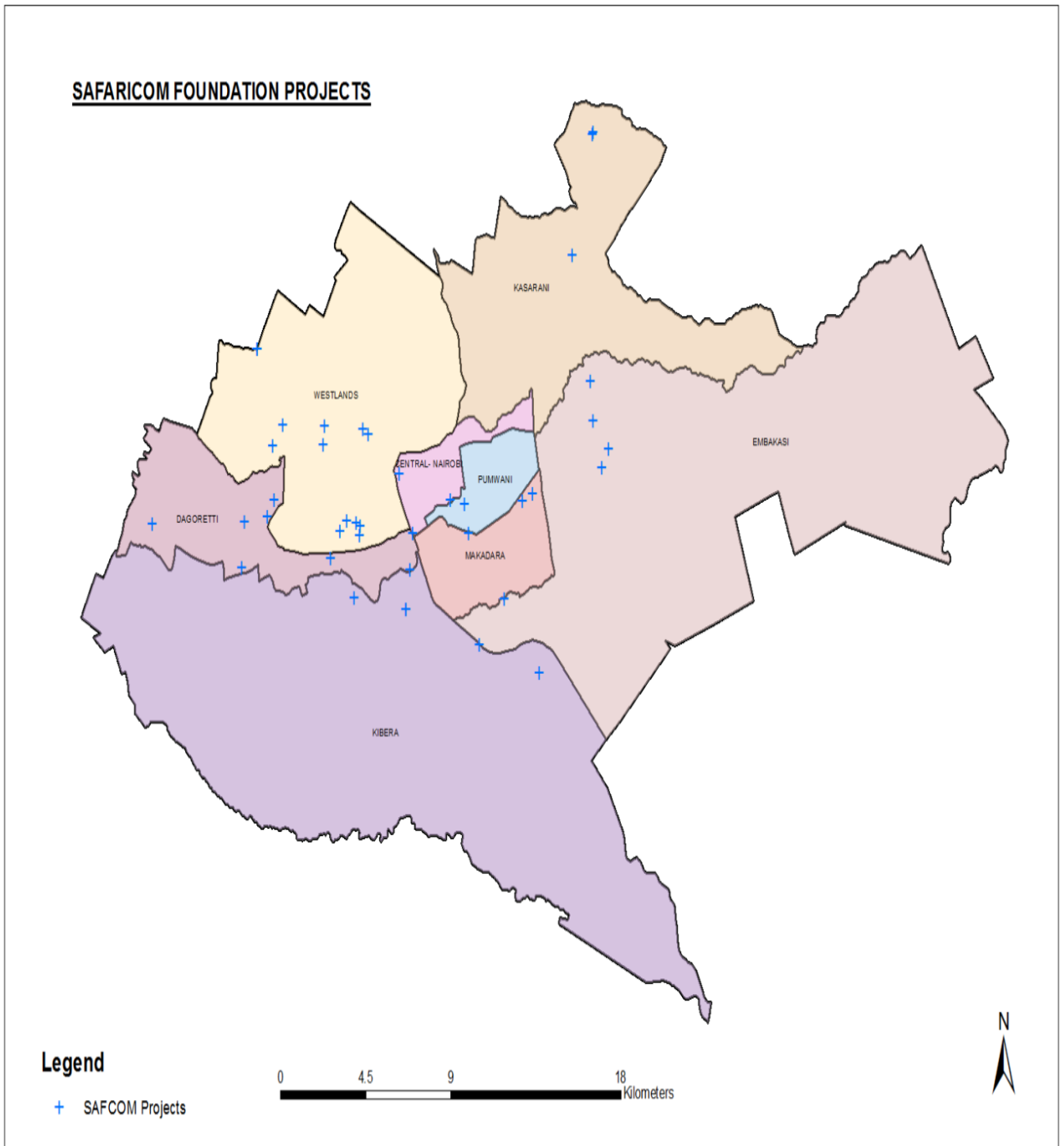The distribution of the 40 projects in the county is shown in the figure below.

Figure 4.2: Safaricom Foundation funded projects

It was evident from the results that the projects covered all division of the county, namely Westlands, Dagoretti, Kasarani, Embakasi, Pumwani, Makadara, Central Nairobi and Kibera. The number of projects in each division however differed from one division to the other with Pumwani having one project while Westlands had quite a number of projects that had been funded by the Safaricom Foundation. This was indicative of uneven distribution of the projects that were funded in each division of the County. It further indicates a clustered pattern of distribution of the projects that have been funded (as shown in appendix 1) with less than 1% likelihood that it is as a result of a random chance. This could be as a result of the foundation receiving more applications for funding from some areas than others. It could also be an indicator to the foundation that there is still room for funding of more facilities in the county to help meet its aim of alleviating poverty.

Number of projects funded per division

A statistical view of the number of projects funded by the Safaricom Foundation was necessary to help in identification of weaker regions in terms of distribution of projects. The data used for the statistics are as shown in the table below.

Division	Population	Number of projects	Amount Given (Kshs.)
CENTRAL- NAIROBI	274,607	3	15,850,000
MAKADARA	218,641	3	14,250,500
KASARANI	525,624	3	2,393,754
EMBAKASI	925,775	5	4,043,120
PUMWANI	261,855	1	450,000
WESTLANDS	247,102	13	25,049,302
DAGORETTI	329,577	7	8,027,917
KIBERA	355,188	5	11,196,540

Table 4: Data on the population, Divisions, the projects funded and amount allocated

To help depict the number of projects funded in each of the division a graph on the number of projects funded per division was generated. A graph representing the number of projects funded by the Safaricom Foundation per division is as shown in the figure below.
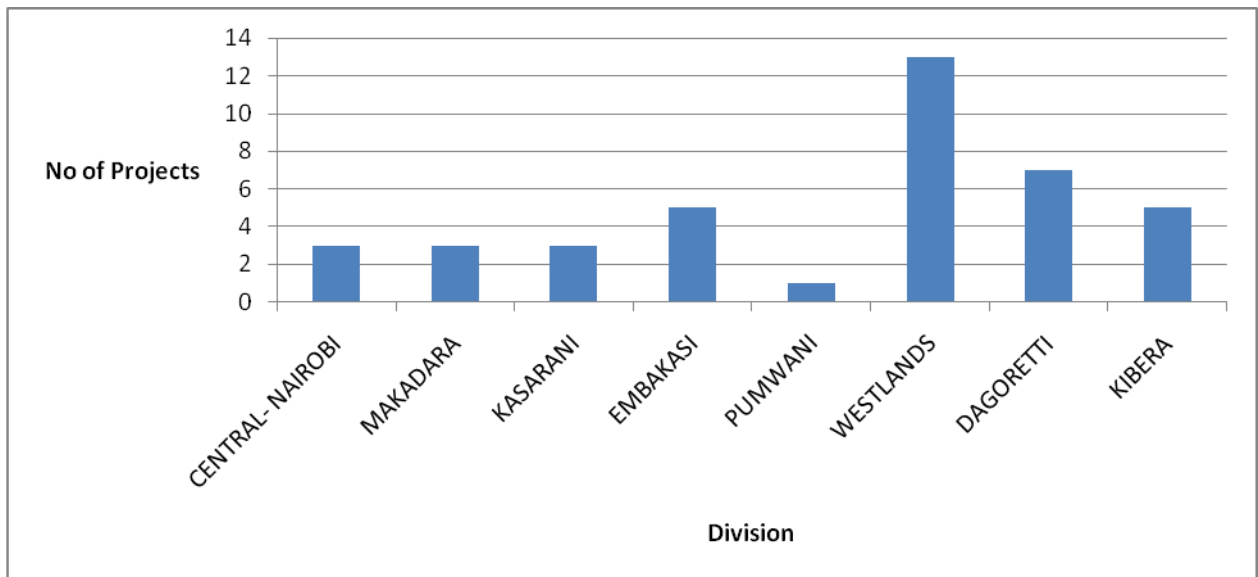
Figure 4.3: Graphical representation of Safaricom Foundation funded projects

The graph indicates that the division with the least number of projects funded by the organization is Pumwani division where only one project has been funded. Central Nairobi, Makadara and Kasarani divisions had 3 projects funded in each of the divisions. Embakasi and Kibera divisions had 5 projects that were funded by the Safaricom Foundation. Dagoretti division had 7 projects that were funded by the Safaricom Foundation. Westlands division on the other hand has the most number of projects funded where 13 projects have received funding from the Safaricom Foundation. The above results indicate uneven distribution of the projects that the foundation has been able to fund in each of the divisions. Using such data, the Foundation can come up with a better method of determining which projects it is to fund in the future to ensure evenness in the distribution.

An analysis based on the amount of money allocated per division as compared to the population in the divisions was carried out. The analysis criterion was used because in a highly populated area there is a greater need for the scarce resources as compared to a lowly populated area. It is thus generally expected that areas that highly populated receive more resources than lowly populated areas. A graphical representation for the amount of money allocated for the projects versus the population of each division was generated as shown in the figure below. The population is given in tens of thousands while the amount is given in hundreds of thousands of Kenya Shillings.
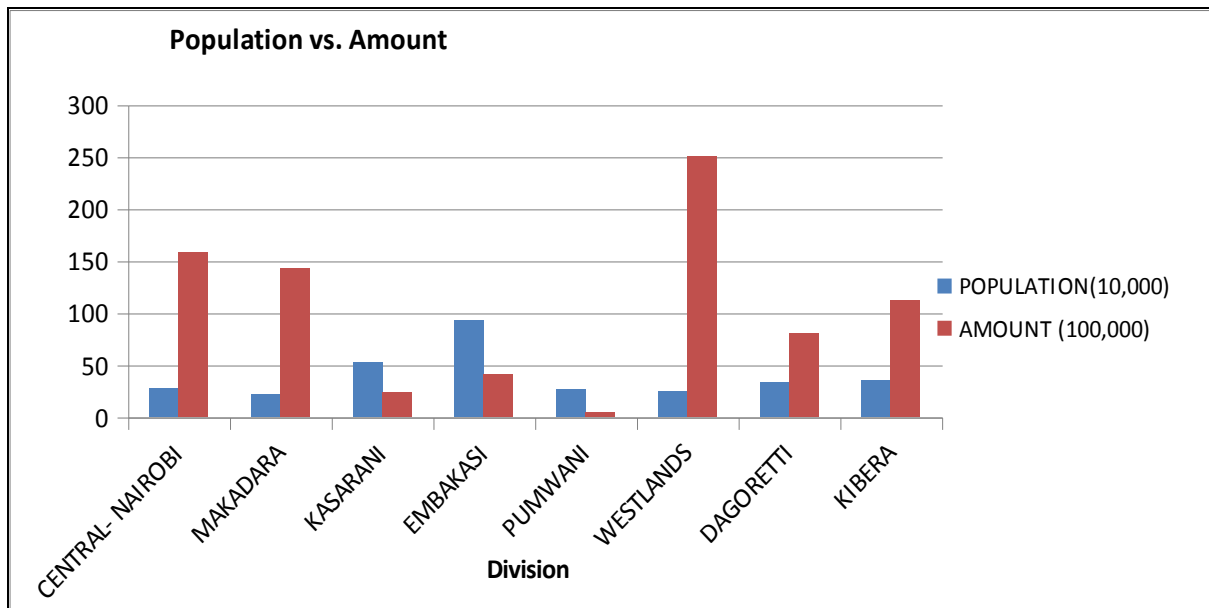
Figure 4.4: Population versus the amount of money per division

The results indicate that the population size was not a factor in consideration of the projects that were to be funded. This is evident as Pumwani which has a population of 261,855 was allocated Kshs.450, 000 for the project that was funded while Westlands division which has a population of 247,102 was allocated Kshs.25,049,302. The Foundation can use such information to come up to come up with a criterion for allocating funds based on the population per division. This will greatly enhance their efficiency in fund allocation and equity in distribution of the funds.

Another criterion based on the population, the number of projects and the amount of money allocated for the projects per division was used to analyse the results. This criterion was selected with the intention to better understand the number of projects in each division as compared to the size of the population in the division and the amount of funds that had been allocated to each division in terms of funding the projects. Generally, it is expected that the higher the population in a division, the higher the number of projects that have been funded and the higher the amount of money that has been allocated for the projects. A graph representing the population, the number of projects funded by the Safaricom Foundation and the amount allocated for the projects in each of the divisions was also generated as shown in the figure below. The population is given in tens of thousands while the amount is given in hundreds of thousands of Kenya Shillings.
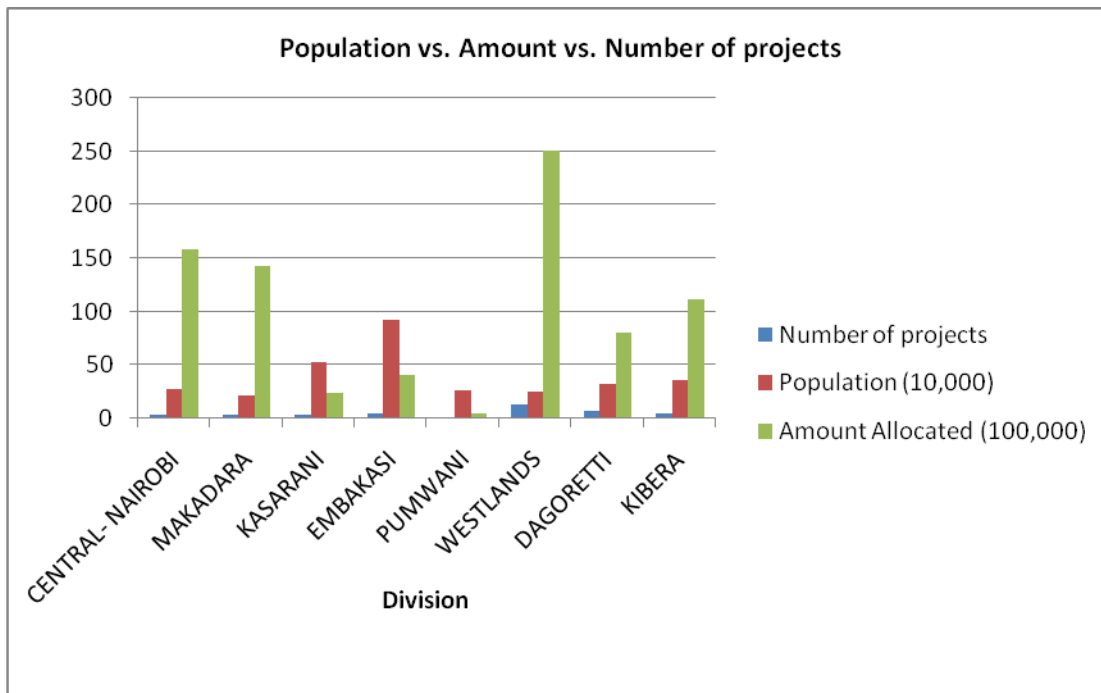
Figure 4.5: Population versus amount allocated and number of projects funded

From the results as depicted in the graph, it is evident that Westlands division has the most number of projects that have been funded by the Safaricom Foundation and has received the highest amount in support from the foundation. Pumwani division on the other hand has the least number of projects that have been funded and has received the least amount in support from the Safaricom Foundation. This is consistent with the general expectation that the higher the number of projects, the higher the amount of money allocated for the projects. However, as in the previous section, it was evident that the population size was not a factor in consideration of the projects that were to be funded. Such information about the population, the number of projects funded and the amount of funds allocated per division should be considered by the foundation in future allocations of the projects it intends to fund to help in bridging the gap in the difference for equitable funding of the projects in all the divisions of the county.

DIRECTION OF GROWTH

The Safaricom Foundation funds various projects within the country and the selection of the projects to be funded is based on the user needs analysis of the communities that the project is expected to benefit. The analysis is generally based on the description of the expected project to be funded in a proposal that is submitted to the foundation by the individuals requesting for the assistance. The foundation reviews all the applications received and if there is satisfaction that the request is valid based on the explanation in the proposal, funding is allocated to the project. This implies that the groups or institutions that come up with appealing proposals have a better chance of being funded as compared to those that do not come up with elaborate proposals. The distribution of the projects is not a major factor that is considered during the allocation of the funds and this might result in the clustering of the projects funded in a certain region while the other regions might be neglected.

To help determine the overall direction of growth in terms of distribution of the projects funded by the Safaricom Foundation, an analysis was done using the Directional Distribution (standard Deviational Ellipse) tool of ArcMap. This criterion was intended to predict the likelihood of a project in a certain area receiving funds, thus influencing the general direction of growth of the projects funded from a central place. This was aimed at trying to foresee the possible pattern of distribution of the projects the foundation will eventually fund in case the status quo was maintained. The direction of growth that emerged for the projects funded by the Safaricom Foundation since inception to date is as shown in Figure 4.6.

The results indicated that the Safaricom Foundation is funding more projects in the divisions towards the west from its headquarters as compared to the other divisions. This could be coincidental and a result of random chance. This seems to indicate a skewed distribution of the projects that are funded as opposed to one where the distribution should be rather random. If the status quo is maintained in future funding, this might result in the clustering of the projects that have been funded in the divisions towards the west while the other divisions will be neglected. This indicates to the foundation that there is need to also consider the area from which the proposals come from and use the information to better distribute the funding and thus prevent the skewed growth.
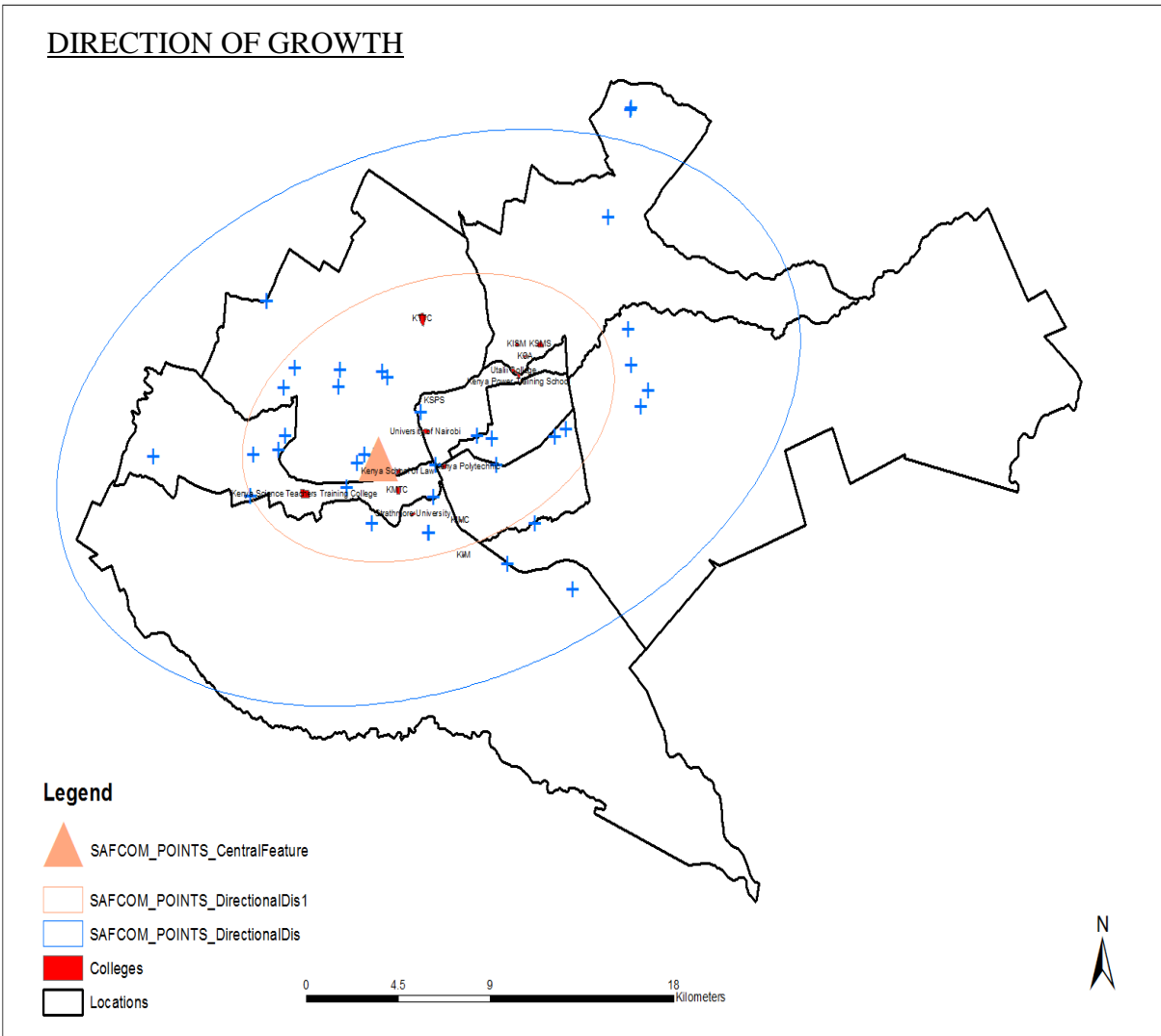
Figure 4.6: Direction of growth for the Safaricom Foundation funded projects

EDUCATION BASED DISTRIBUTION MAPPING

Mapping of education facilities in Nairobi County was done and this was overlaid with the data on the education facilities that have been funded by the Safaricom Foundation. This was intended to help depict the general distribution of the projects the foundation had funded while comparing then to the established education facilities within the county. The distribution of education facilities in Nairobi County and those that have been funded by the Safaricom Foundation is as shown in Figure 4.7.
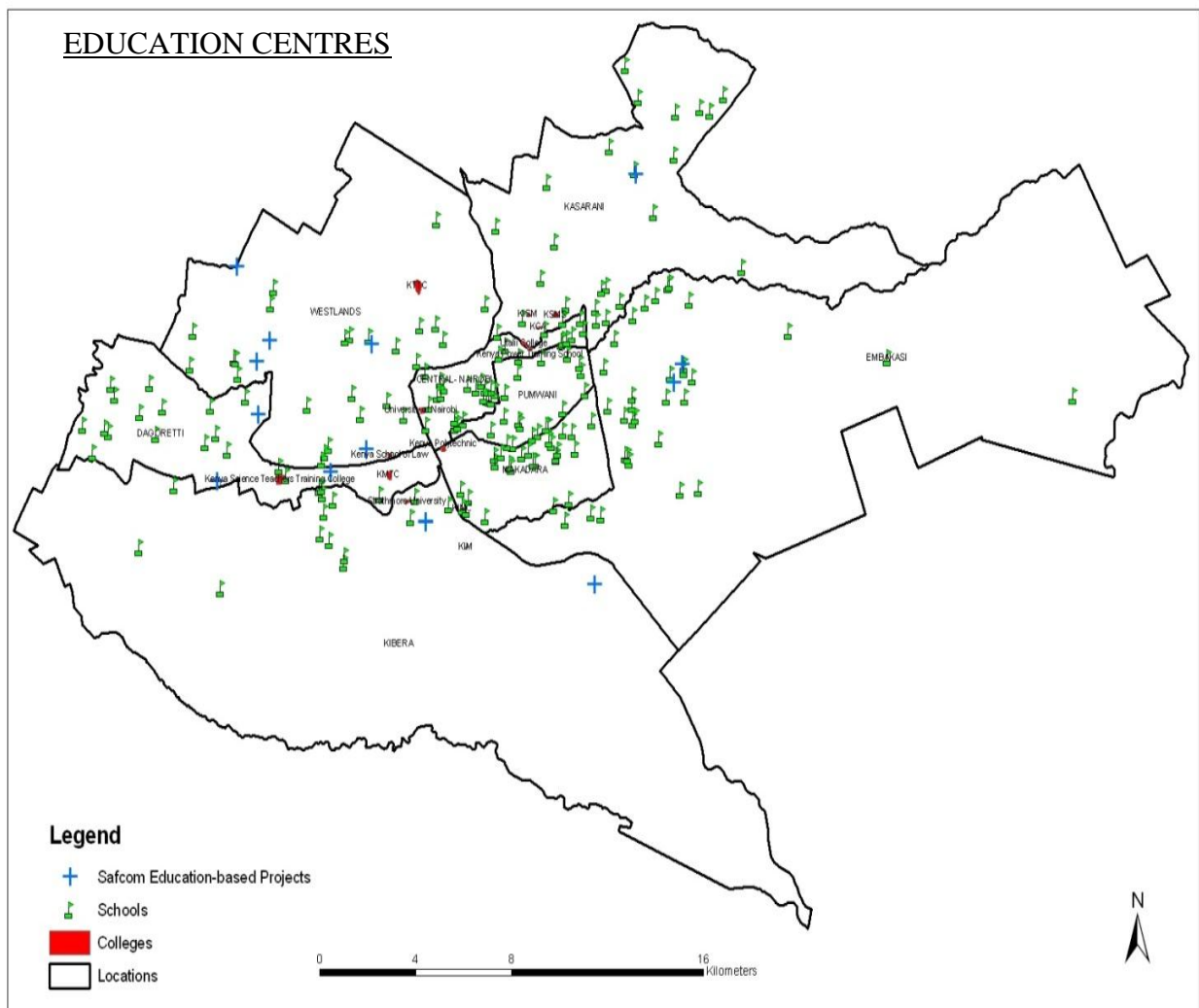
Figure 4.7: Distribution of education facilities in Nairobi County

From the data on the projects the Safaricom Foundation had funded, the study revealed that out of 191 schools and seven colleges, the foundation has supported thirteen educational facilities. The funding of any project by the foundation is reliant on the institution or community making an application by submitting a proposal to the foundation. Though it is within its own right to determine the number of education facilities it is able to fund, the Safaricom Foundation, using the distribution mapping and comparing the same to the established education facilities, can do more in terms of funding more facilities. This can be done by conducting independent user needs analysis and proposing funding to institutions or communities that have needs but may not have applied for the funding from the foundation. This will help bridge the gap in the number of facilities it has funded in comparison to the established institutions in the county.

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The results indicate the funding of the education facilities by the foundation was random (as shown in appendix 2). This was a good sign for the distribution of the facilities it had funded but further comparisons with socio-economic data like poverty rates and the population in each division should be a factor in future allocations. This will ensure equity in distribution and allocation of the funds for the projects in the County.

HEALTH BASED DISTRIBUTION MAPPING

Mapping of health facilities in Nairobi County was done and this was overlaid with the data on the health facilities that have been funded by the Safaricom Foundation in the County. Overlaying the foundation funded projects with the established health facilities in the county was vital in determining the areas that could have been neglected by the funding. Figure 4.8 shows the distribution of health facilities in Nairobi County.

The results of the study revealed that out of 136 health centres, the foundation has supported fourteen health facilities. This is likely due to the number of applications received by the foundation requesting for assistance in funding by the health facilities. This was a small number as compared to the number of health facilities in the county, but the number of facilities it could fund is at their discretion. This however should not limit the foundation in using the information for decisions on future allocations and funding to help bridge the gap and ensure equity in distribution. Socio-economic data of the divisions should also be considered in future allocations for the effect of the funding to be well felt by the populace whom the projects are expected to benefit.

The results also indicate a dispersed pattern of distribution (as shown in appendix 3). Information on the pattern of distribution and the socio economic data of the various divisions could be used by the foundation for future allocations to ensure equity in distribution and to help bridge the gap in the number of persons and the available health facilities to serve them. An independent user needs analysis should also be carried out by the foundation in collaboration with the health sector in the division to help come up with better funding strategies that are not solely reliant on the proposals submitted to the foundation.
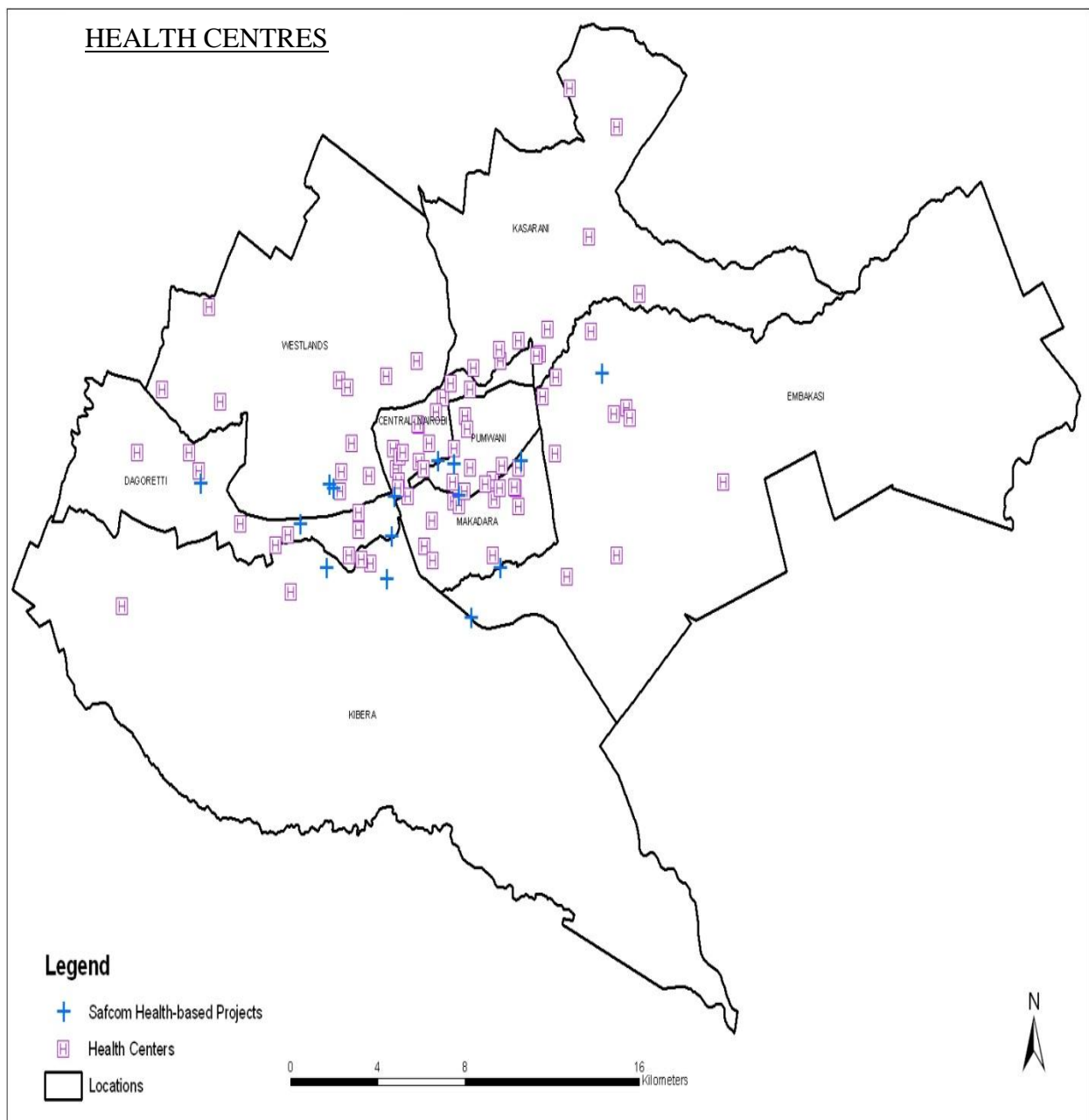
Figure 4.8: Distribution of health facilities in Nairobi County

PROXIMITY ANALYSIS

Buffering was used to determine the catchment area for the health facilities and the education facilities that the Safaricom Foundation had funded in Nairobi County. This was done to help indicate the proximity of the facilities to each other and thus the general distribution in the county.

Education based facilities

A buffer was set with a 2 kilometres radius for all the education facilities the Safaricom Foundation had funded to help determine the proximity of the institutions to each other. Figure 4.9 shows the proximity to the education facilities funded by the Safaricom Foundation
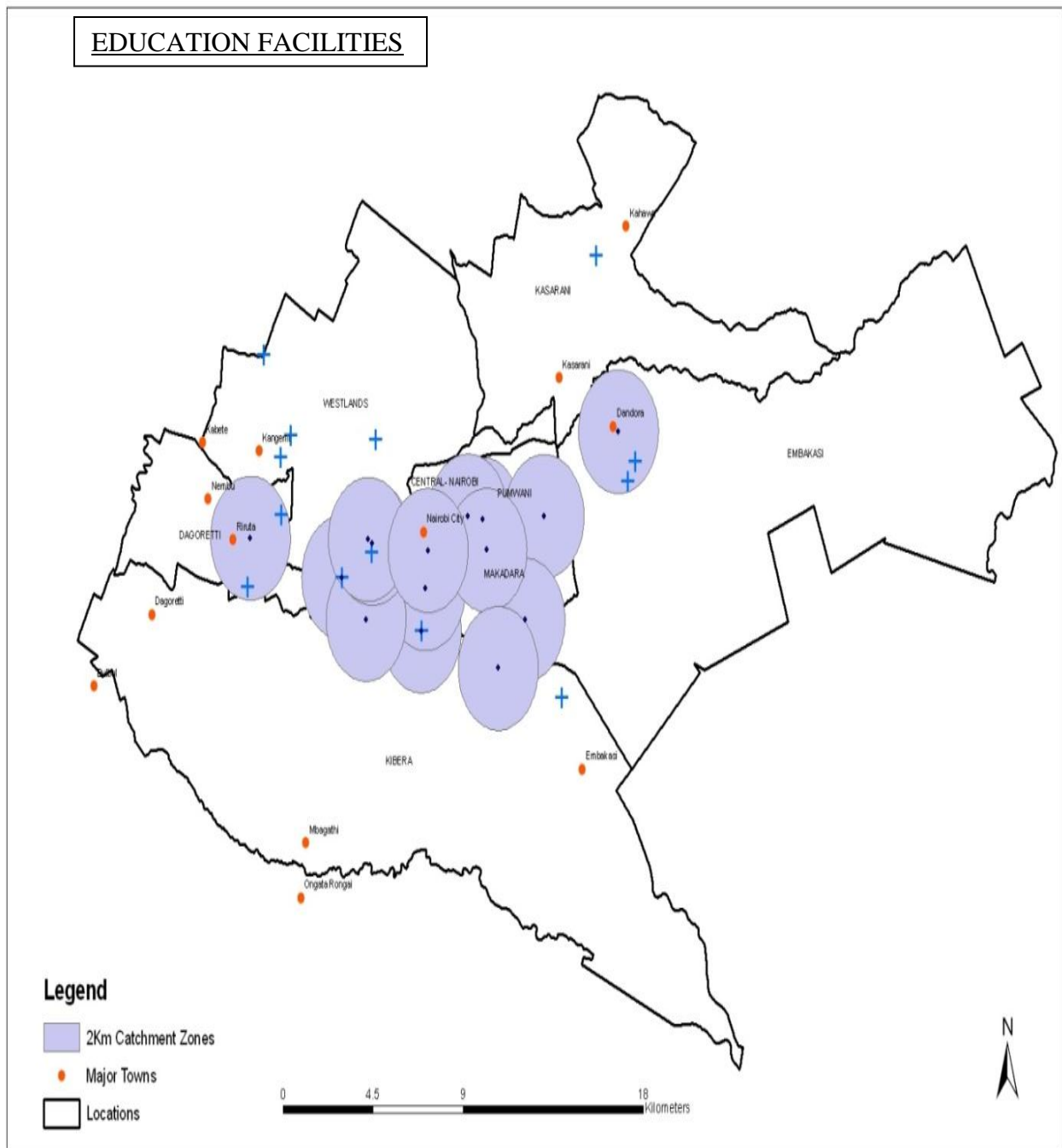

Figure 4.9: Proximity to the education facilities funded by the Safaricom Foundation

The results show that with a 2 kilometres catchment area for a standard school, the projects that the Foundation had funded appear clustered in a central Nairobi. This information is vital in determination of future allocations. If considered with the population figures and the poverty rates in each division, a better decision on allocations on the funding will be reached not only to avoid the clustering but also to enhance equity in distribution.

Health based facilities

A buffer was set with a 2 kilometres radius for all the health facilities the Safaricom Foundation had funded to help determine the proximity of the institutions to each other. Figure 4.10 shows the proximity to the health facilities funded by the Safaricom Foundation

Figure 4.10: Proximity to the health facilities funded by the Safaricom Foundation

From the results, it is evident that with a 2 kilometres buffer zone for health centres supported by the Safaricom Foundation, the spread is fairly dispersed but concentrated in three divisions of Central, Westlands and Dagoretti. For future allocations, the socio-economic data for the divisions and the status quo on the distributions should be used by the foundation to help in the equitable allocations and distributions of the projects.

GEO-DATABASE DESIGN

A geo-database was formed using ArcMap software. Appendix 4 shows a screenshot of a sample geo-database that was created from this study. A file geo-database was chosen for the study as there is no limit on the geo-database size. The data that was included in the database included:

i.	Location data for the projects funded by the Safaricom Foundation
ii.	Name of the project or facility funded by the Safaricom Foundation
iii.	The amount allocated per facility, if any
iv.	The major roads network in Nairobi County
v.	The divisions of Nairobi county
vi.	The health facilities in Nairobi county
vii.	Education facilities in Nairobi County

A geo-database is a vital inclusion in any GIS managed program as it enables integration of various datasets for optimal decision making.

Sample queries that can be performed in the geo-database

The screenshots below show some of the queries that were successfully performed in the geo-database that was created.

The screenshot in Figure 4.11 shows an attribute query to highlight all health centres supported by the foundation and found in Dagoretti Division. The same query can be used for other health centres funded by the Safaricom foundation in other divisions of Nairobi County.
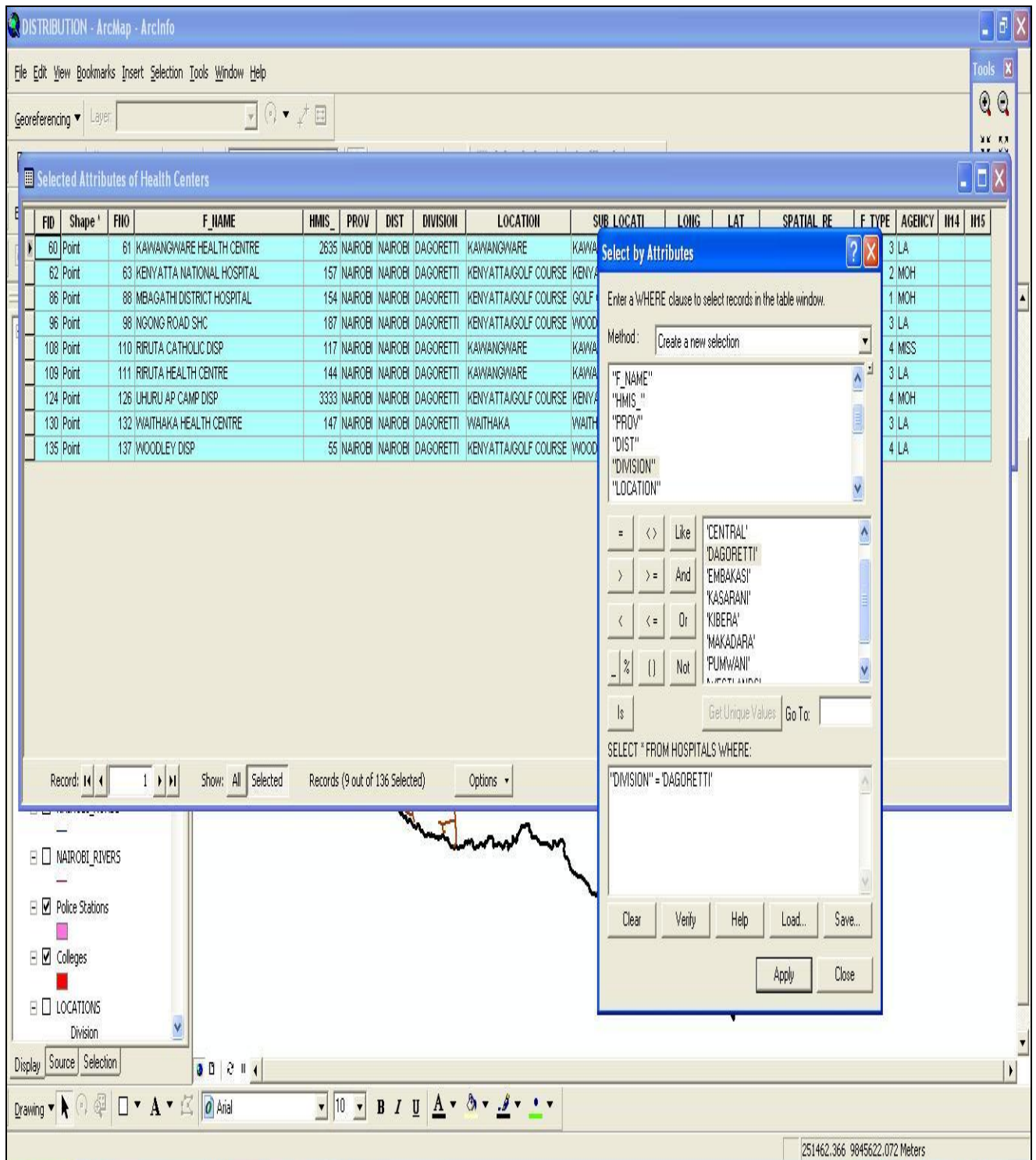
Figure 4.11: Health centers funded by the Safaricom Foundation in Dagoretti Division
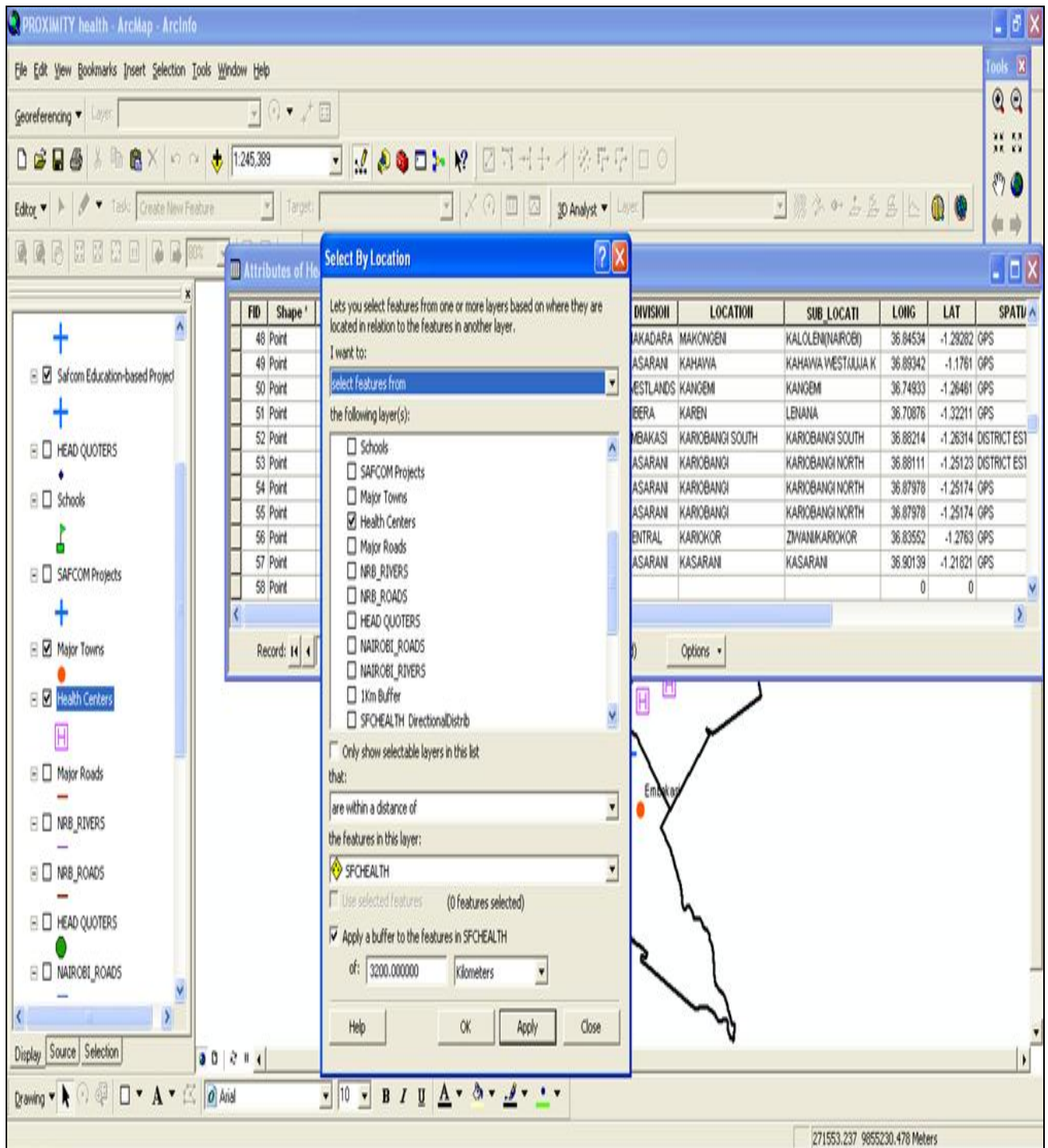
Figure 4.12: Health centers within a 2 kilometer radius of those funded by the Safaricom Foundation

The above screenshot shows a result of a spatial query to highlight all the health centers that are within a 2 kilometer radius of those that are funded by the Safaricom Foundation.
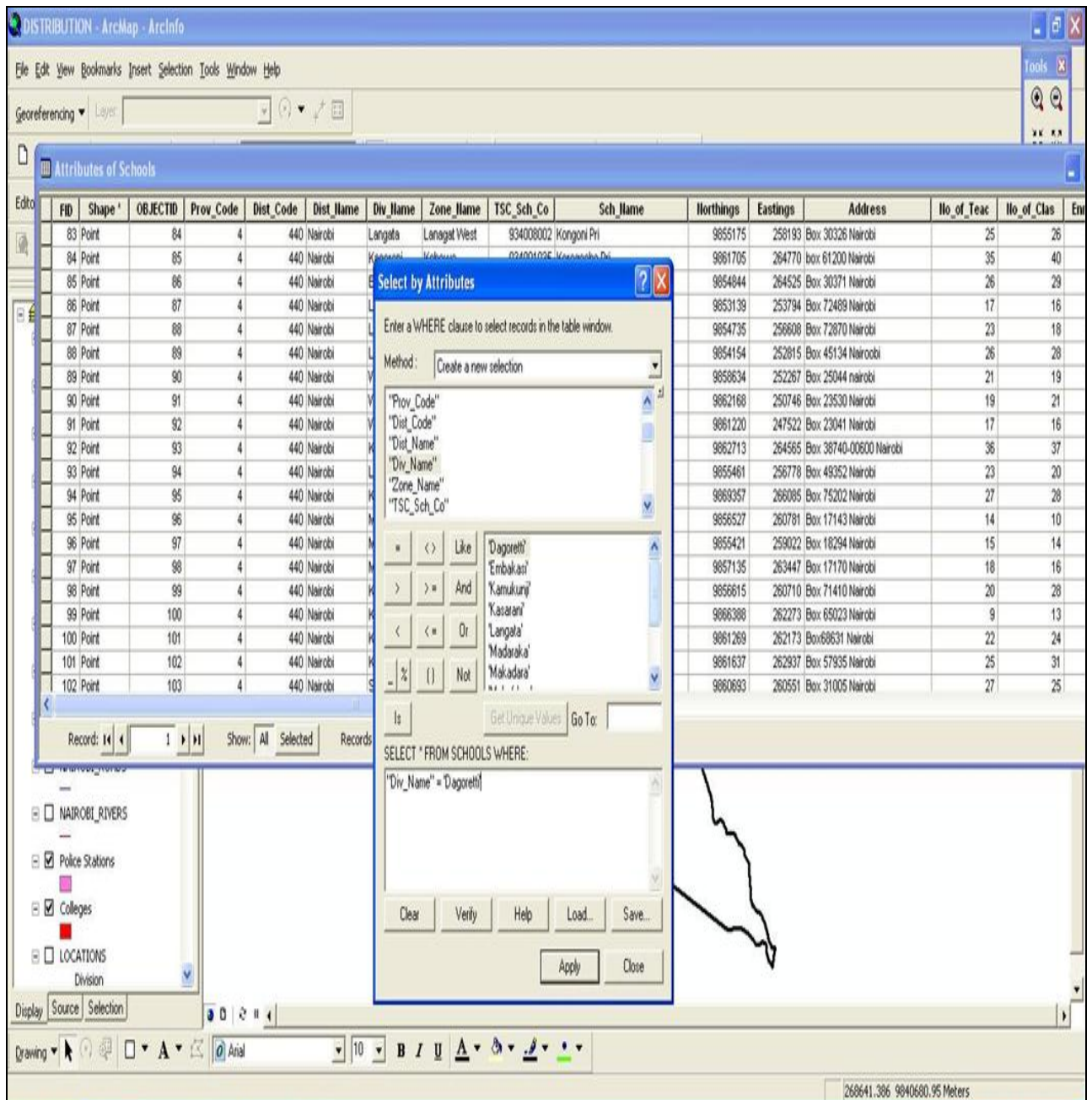
Figure 4.13: Schools in Dagoretti Division

The figure above shows results of an attribute query to highlight all schools found in Dagoretti Division. The information can be used to compare the number of schools in the division with the number of schools funded by the organization in the same Dagoretti division. This information can be used for decision making on future funding.
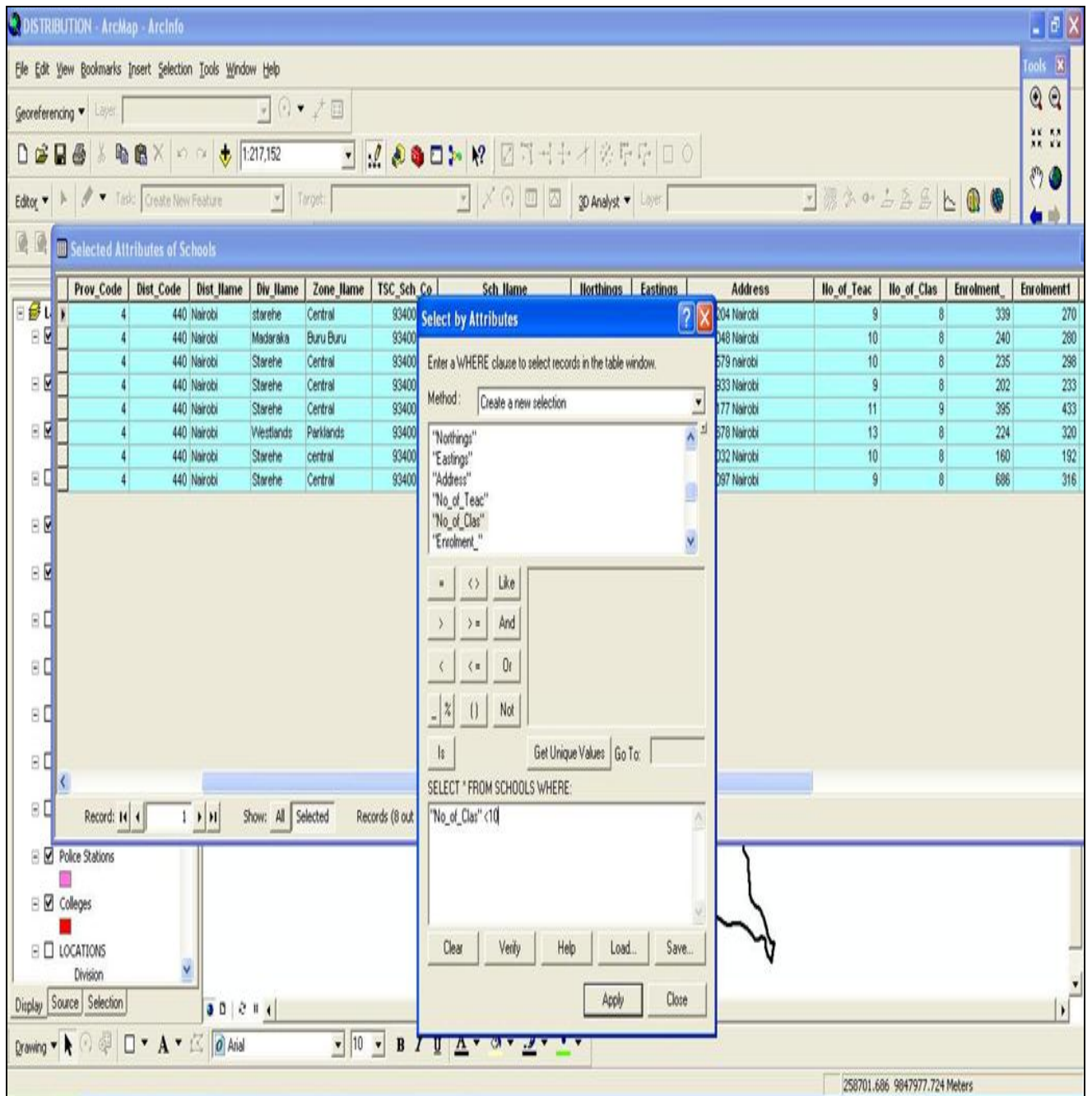
Figure 4.14: Schools with less than 10 classes

The figure above shows an attribute query to highlight all schools with less than ten classes. This information can be used by the Safaricom Foundation to aid in decision making for priority in future funding of schools.

4.2 Overview of the results and analysis

The Safaricom Foundation supports initiatives and projects that provide sustainable solutions to the most pressing social challenges. However, from the project, it was evident that due to lack of appropriate design mechanisms for funding, essential efforts to support growth and sustainability are marginalized, and resources are deployed in a fragmented and often wasteful and ineffective manner. The result of the marginalization is that improvement efforts continue to pay little attention to the need for and potential impact of rethinking how these resources can be used to enable the society by doing more to address financial barriers. A comprehensive form of fund allocation and distribution assessment is vital and resource mapping should be paired with surveys of the unmet needs of beneficiaries of such funding.

Mapping is an essential step in coordinating and enhancing the use of resources. It is important to complete the process as quickly as feasible. However, because mapping often is time consuming and some forms are complex, it probably should be done in stages over time.

The Safaricom Foundation Resource Coordination through mapping can perform essential functions related to the implementation and on-going development of a comprehensive, multifaceted, and cohesive approach for addressing and promoting healthy development. Examples of key advantages include:

i. Aggregating data across platforms to analyse trends in funding.
ii. Mapping resources at school and in the community.
iii. Analyzing resources available.
iv. Identifying the most pressing program development needs.
v. Coordinating and integrating resources and connecting with community resources.
vi. Establishing priorities for strengthening and developing new programs.
vii. Planning and facilitating ways to strengthen and develop new programs and systems.
viii. Recommending how resources should be deployed and redeployed.
ix. Developing strategies for enhancing resources.

Subsequent challenges are to evolve existing programs so that they are more effective and then to enhance resources as needed, for instance, by working with community resources, volunteers, and professionals-in-training. As resources are enhanced, these challenges

encompass solving problems related to sharing space and information, building working relationships, allocating time, and modifying policies to foster her funding projects. Maintaining the involvement of key administrators is essential in all this. Through the use of GIS, it has been shown how well the various activities are coordinated and integrated, for example schools and health facilities. It can also help pinpoint which activities need to be improved (or eliminated) and what is missing – especially any activity that seems more important than those in operation. For instance, health funding by the organization is least felt in Pumwani division as it is in Westlands division.

Important in the Safaricom Foundation funding is effectiveness and priorities. The immediate challenge is to move from piecemeal approaches by coordinating and integrating existing activities. Resources must be redeployed from poorly conceived activities to enhance the potency of well-conceived programs and to fill gaps in the continuum of interventions like schools. The project has clearly illustrated that the use of GIS in their allocations and fund distribution would greatly enhance their operations.

Through the use GIS, the Safaricom Foundation will be capable of coming up with systems for promotion of healthy development and prevention of problems, systems for intervening early to address problems as soon after onset as is feasible and systems for assisting those with chronic and severe problems. GIS is an effective tool in auditing resource allocation and indexing the priority level for Infrastructure development in Nairobi County.

Mapping Community Resources

The research considered various examples of resources that may be in a community and may be invaluable to the Safaricom foundation as it is concerned with improving livelihoods, mentoring, and training. Some of the resources include information sharing and dissemination, networking, recognition and public relations; mutual support, shared responsibility for planning, implementation, and evaluation of programs and services, building and maintaining infrastructure, expanding opportunities for assistance, community service, internships, jobs, recreation. GIS can play a vital role in helping the Safaricom Foundation to integrate most, if not all, of the resources in its operations to enhance equity in fund allocation and distribution of the projects it funds in all sectors.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This study aimed at demonstrating the use of GIS for inventory of projects funded by the Safaricom Foundation in Nairobi County.

The objectives set for the study were all achieved through:

i. The development of a geo-database for the projects that have been funded by the Safaricom Foundation in Nairobi County.

ii. Mapping of the projects funded by the Safaricom Foundation were mapped and demonstrated in chapter four.

iii. The application of GIS in analysis of distribution of the education and health facilities, comparing them to the established facilities in the county as demonstrated in chapter four.

This project was successful in mapping the projects funded by the Safaricom foundation. The distribution of the health and education projects was compared to the established facilities to determine the weaker regions in terms of the distribution and funding. It was demonstrated that the funding was not evenly distributed as the projects were generally clustered and the overall growth or spread of the projects tended to be westwards.

The health based facilities that had been funded were randomly distributed while the education facilities that had been funded were dispersed in distribution. It was also demonstrated that the distribution of the funds allocated to the projects was not even with Westlands division receiving the largest amount while the least amount was allocated to Pumwani division.

5.2 Recommendations

Having demonstrated the use of GIS for inventory of projects funded by the Safaricom Foundation in Nairobi County:-

i.   The Safaricom Foundation should consider using GIS for inventory of all its projects within the country.

ii. The Foundation should embrace the use of GIS in funds allocation to necessitate equity in allocation of funds and distribution of the projects it funds across the country.

iii. They should also use the socio-economic data with the facilities they intend to fund to ensure equity in distribution while maintaining its desire to alleviate human suffering. This will ensure areas with greater needs are well catered for.
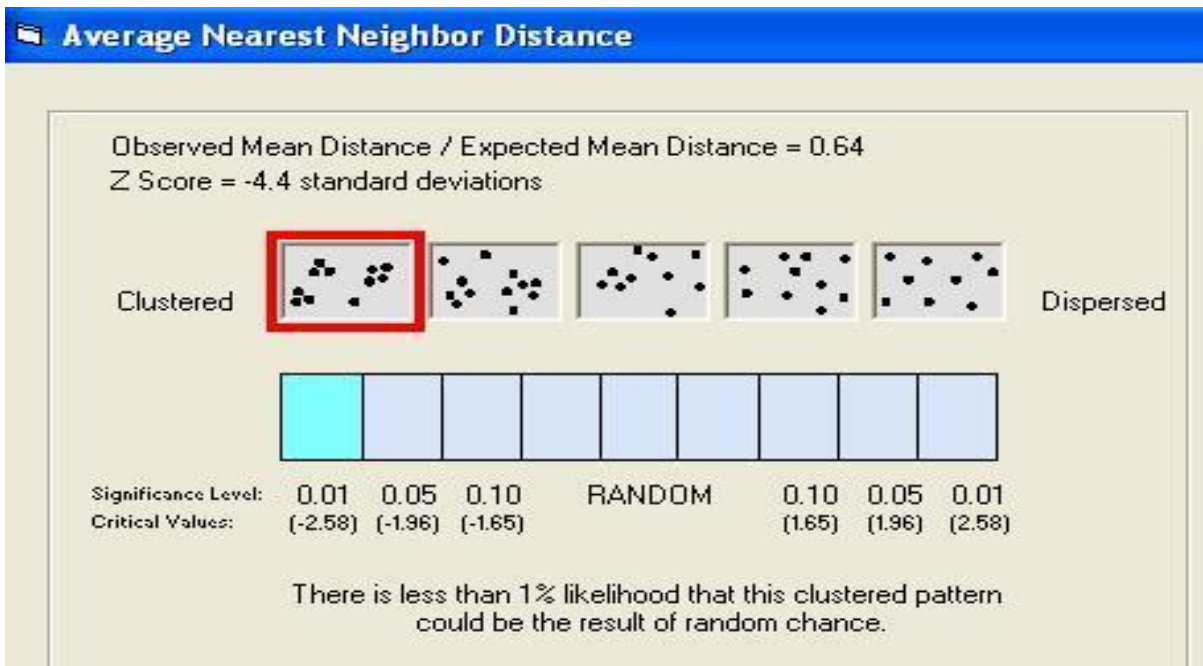

Since the study only considered projects that have been funded by the Safaricom Foundation in Nairobi County, with emphasis on the health and education facilities, a representative study of all the projects within the country should be done to determine the overall distribution. The same study should also be done with reference to all categories of the projects funded as the study considered the education and health categories alone. This will help bring out an overall view of the distribution of the funding in the various categories.

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APPENDICES

Appendix 1: Pattern of distribution of projects funded by the Safaricom Foundation

A clustered pattern of distribution indicates that the projects are concentrated in certain areas while other areas seem neglected.
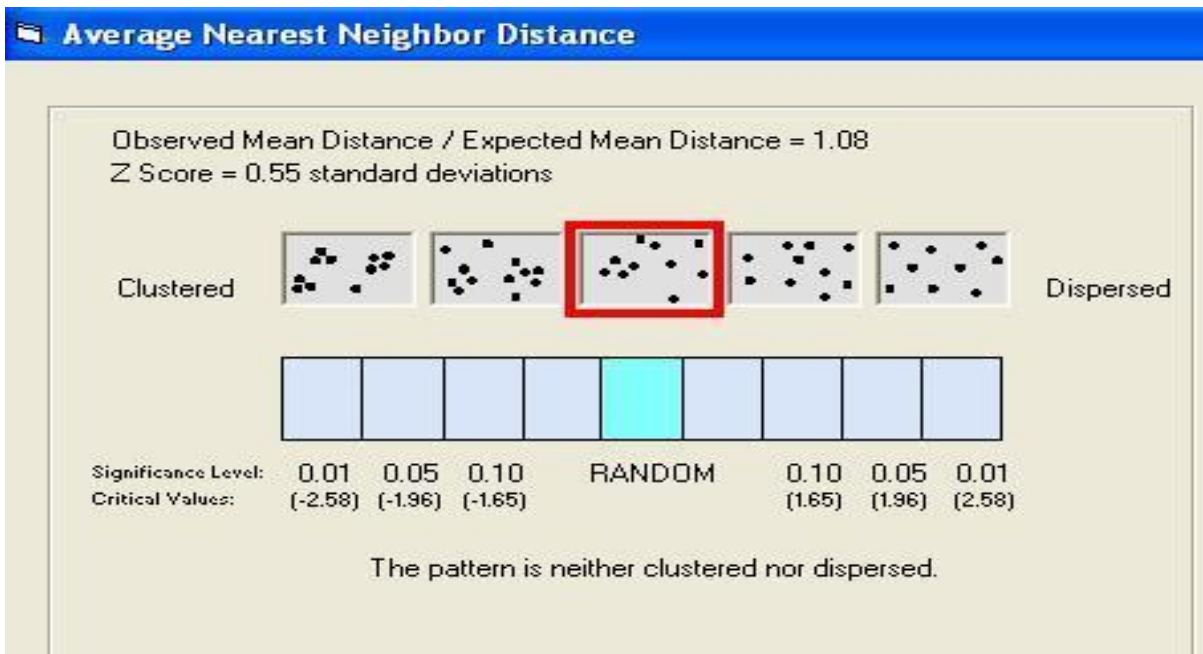
Appendix 2:   Pattern of distribution of Foundation Education Based Facilities

A random pattern of distribution indicates general evenness in distribution which is more acceptable as compared to clustered pattern of distribution.

Appendix 3: Pattern of distribution of Safaricom Foundation health based projects

A dispersed pattern of distribution indicates limited number of projects that have been funded in a large area. This is indicative of less concentration on the category affected in terms of funding.

Appendix 4: Screenshot of a sample geo-database that was created from the study.