University of Nairobi

School of Engineering

DEPARTMENT OF GEOSPATIAL AND SPACE TECHNOLOGY

USE OF GEOSPATIAL TECHNOLOGY FOR MONITORING AND EVALUATION OF COUNTY DEVELOPMENT FUNDS: A Case Study of Kericho County.

BY

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F56/68945/2013

A PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN GEOGRAPHIC INFORMATION SYSTEMS, IN THE DEPARTMENT OF GEOSPATIAL AND SPACE TECHNOLOGY OF THE UNIVERSITY OF NAIROBI

JUNE, 2015

Declaration

I, Kiprono Justice Korir, 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 university.

…… ……

Signature Date

KIPRONO JUSTICE KORIR

F56/68945/2013

This project has been submitted for examination with my approval as a University Supervisor.

…… ……..……

Signature Date

B.M OKUMU

School of Engineering: Department of Geospatial and Space Technology of the University of Nairobi

DEDICATION

I dedicate this project to my family; my loving wife Gladys Korir and to my children Allan, Bertha and Kate, for the support they gave me during the entire academic journey.

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I would like to express my sincere gratitude to all those who contributed in one way or another to making the completion of this project a success. First and foremost my appreciation goes to my Supervisor Mr. B. M OKUMU of the Department of Geospatial and Space Technology, University of Nairobi for his invaluable advice, guidance, patience and moral support.

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ABSTRACT

As per the The Constitution of Kenya, 2010, several functions were devolved from the National government to the County government. Each financial year the National government through The Commission on Revenue Allocation allocates funds to all the 47 counties in the Republic of Kenya. Allocations of revenue to the county governments are disbursed each financial year for recurrent expenditure and development funds. Each county government aims to spend these development funds to bring meaningful development in all the county assembly wards under its jurisdiction. Spending these development funds and their fair distribution to all county assembly wards in a county is a great challenge.

The need to bring accountability, transparency and check corruption on development funds requires monitoring and evaluation of these funds on development projects using Geospatial technology, a trend gaining momentum in the current world. The study demonstrated the use of Geospatial Technology (GIS- Geographic Information System) to monitor and evaluate the use of county development funds in a county. The road projects that the County Government of Kericho developed during the first half of the FY 2014/2015 were mapped and their distribution and the amount of funds used were determined.

A geodatabase was created and analysis on the distribution of funds to county assembly wards within a county was done. Queries were developed to generate required information for monitoring and evaluation of county development funds in the county. The procedures were discussed in displaying the results of GIS. Generation of maps, reports, charts, and graphs from the created database for analysis process reveals that some county assembly wards were underfunded as compared to others. Also some county assembly wards received more road project funds than others hence there were uneven distribution on the number of road projects carried out. The analysis process gives the County government monitoring and evaluation reports and better visualization mechanism for better decision making. The project study noted that GIS and Remote Sensing is a powerful tool as it combines both the spatial and attribute data for monitoring and evaluating use of development funds.

It was recommended that the system be upgraded to cover all the other devolved departments in the county and eventually to all the counties in the Republic of Kenya.

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LIST OF ACRONYMS

Const - Constituency

CPU - Central Processing Unit

CRA - Commission on Revenue Allocation

CTRCTOR – Contractor

DUR_MNTHS – Duration in months

ESRI - Environmental Systems Research Institute

FY - Financial Year

GB - Gigabytes

GIS - Geographic Information System

GPS – Global Positioning System

IEBC – Independent Electoral and Boundaries Commission

INTOSAI - International Organization of Supreme Audit Institutions

ISSAI - International Standards for Supreme Audit Institutions

KENAO - Kenya National Audit Office

KES - Kenya Shillings

KM - Kilometre

KNBS – Kenya National Bureau of Statistics

LTD – Limited

MAX - Maximum

MB – Megabytes

MIN – Minimum

M&E - Monitoring and Evaluation

NGO – Non Governmental Organization

PRO_MGER – Project Manager

RAM - Read Access Memory

RD – Road

RD_LENGTH – Road length

ROM – Read Only Memory

SQL – Structured Query Language

TB - Terabytes

UNDP – United Nations Development Program

USAID – United States Aid for International Development

UTM - Universal Traverse Mercator

WBG - World Bank Group

WRK_PRGRES – Work progress

CHAPTER ONE: INTRODUCTION

1.1 Background

The Constitution of Kenya, 2010 chapter eleven stipulates devolution of government. Among the objectives and principles of devolution of government are –

(i) To promote democratic and accountable exercise of power

(ii) To give powers of self-governance to the people and enhance the participation of the people in the exercise of the powers of the State and in making decisions affecting them;

(iii) To recognize the right of communities to manage their own affairs and to further their development;

(iv) To promote social and economic development and the provision of proximate, easily accessible services throughout Kenya.

(v) To ensure equitable sharing of national and local resources throughout Kenya;

(The Constitution of Kenya, 2010)

The Constitution of Kenya, 2010, gave National Government and the County Governments as well as The Commission on Revenue Allocation the mandate to deliver several of the above duties as per the Constitution. The Commission on Revenue Allocation (CRA), which is an independent Commission, was set up under Article 215 of the Constitution of Kenya 2010. Its core mandate was to recommend the basis for equitable sharing of revenues raised nationally between the national and the county governments.

The Office of the Auditor General draws its mandate from the Constitution of Kenya.

The Auditor-General under Article 229 has the mandate to audit and report every financial year among others the accounts of the national and county governments, the Auditor-General may audit and report on the accounts of any entity that is funded from public funds and compile an audit report that shall confirm whether or not public money has been applied lawfully and in an effective way.

Audit reports shall be submitted to Parliament or the relevant county assembly. Within three months after receiving an audit report, Parliament or the county assembly shall debate and consider the report and take appropriate action.

County governments receive billions of shillings each financial year for running the affairs of the county which ranges from recurrent expenditure to development projects. In financial year 2014/2015 budget for revenue allocation for the counties was KES 226.7 billion and the total revenue allocation for Kericho County during the same financial year was KES. 5.55 billion. (Ministry of Finance, Kenya). The spending of the allocated funds requires constant monitoring and evaluation for every county to achieve meaningful development. This would be achieved through knowing the exact location of the development project as well as a visualization reports which are well understood by the general public. Geospatial Technology (GIS and Remote Sensing) provides a higher level of monitoring and evaluation which helps in auditing development funds for every county.

1.2 Problem Statement

- Billions of development funds are allocated each financial year to the County Governments by the National treasury within the Republic of Kenya for development projects and recurrent expenditure. However, several County Governments are faced with huge challenges of mismanagement, lack of accountability, transparency, monitoring and evaluation that leads to wastage, fraud, corruption and unequal distribution of development funds to county assembly wards.

- Most County Governments lack visualization and communication approach to deliver the development evaluation report to the Senate, county residents and the general public. Most residents and the general public does not understands the books of accounts but given evaluation reports and analysis of development projects generated using GIS makes understanding and communication easier.

1.3 Justification for the Study

County Governors have been accused of not providing a clear monitoring and evaluation reports of the development projects with respect to allocated funds. The Senate assembly had been having a rough time in monitoring and evaluating county development projects. For example;

"……. And whereas, despite the invitation by the Committee, the said governors who were duly invited have failed and/or refused to appear before the Committee to answer the audit

queries raised by the Auditor General with respect to whether or not public monies have been applied lawfully and in an effective manner by the respective county governments;
Now therefore, the Senate resolves that pursuant to Article 228(4) and (5) of the Constitution, the Controller of Budget should not authorize any withdrawal of public funds by the following county governments until they have responded to the audit queries to the satisfaction of the Senate" (The Senate, Debates, 2014).

With regard to the above geospatial technology will be used to monitor and evaluate development projects with respect to allocated funds amounting to billions of shillings. GIS gives a good visualization approach, disseminating and communicating reports easily to the intended audience or authority. Use of geospatial technology in solving issues affecting the public and the community as a whole will be of great benefit.

GIS benefits all stages of monitoring and evaluation of county development funds from assessing relevant risks and designing, conducting, and analyzing the development projects achieved to communicating the results:

- **Assessing relevant risks;** GIS can analyze the geographic spread of projects that are behind schedule, the use of certain contractors in a county, and the geographic spread of funds allocated. Remotely sensed data can be used to quickly verify information in databases with information from the field, for example, whether houses registered as finished actually appear to be on current imagery.
- **Designing the audit;** GIS can be used to focus on projects behind schedule in order to audit contract management risks or focuses on projects on schedule to audit performance, such as the quality of the roads. Field visits by the auditors can be planned more effectively through establishing the locations to which teams need to be sent.
- **Conducting the audit;** by combining geographic data from GPS and satellite-based maps with audit field data, the data can be analyzed immediately. The data can then be used throughout the project.
- **Analyzing the audit;** analyzing large quantities of data is possible and understandable with GIS.

- **Communicating the results;** GIS provides a visual means of communicating that is immediately understood by the audience and the general public.

1.2 Objectives

1.4.1 Main objective

The main objective of the study was to demonstrate the use of Geospatial Technology for monitoring and evaluation of county development funds.

1.4.2 Specific objectives

- To map development projects developed by Kericho County Government Roads Department and check on its impacts to the society
- To develop a GIS database that demonstrates the visual representation and distribution of development projects.
- To demonstrate how GIS can be used for monitoring and evaluation of county development funds and for decision making support
- To investigate on how much funds were spent on development projects by Kericho County Government Roads Department during the first half of FY 2014/2015.

1.5 Scope and limitation of the study the study

The study was limited to demonstrating the use of geospatial technology in monitoring and evaluation of project development funds as well as distribution of development projects in various county assembly wards within Kericho County. Since the development funds were meant for broad development projects, this project researches on development funds allocated to the department of public works, roads and transport within Kericho County Government and the development record achieved using the same funds. Due to the scope and limitation of project duration, the project study covered development of road projects done within first half of the financial year 2014/2015 (1^{St} July – 31^{St} December 2014).

1.6 Organization of the report

The report comprises of five chapters. Each chapter consists of several sub-topics as outlined in the table of contents. Chapter one is an introduction of research study; detailing the background information, the problem statement, justification of the study, the objectives of study, scope and limitation of the study and organization of the report.

The second chapter details the literature review. Chapter three gives an overview of the study area, materials and methodology that were used to come up with the results. Chapter four outlines the results obtained from the study, with a view of demonstrating how geospatial technology was used for monitoring and evaluating development funds in a county government. Chapter four also contains the interpretation and explanation of the results.

Chapter five gives the conclusions that were made from the research study and recommendations as a course of action

CHAPTER TWO: LITERATURE REVIEW

2.1 Study area

Figure 2.1a: Location of Kericho County

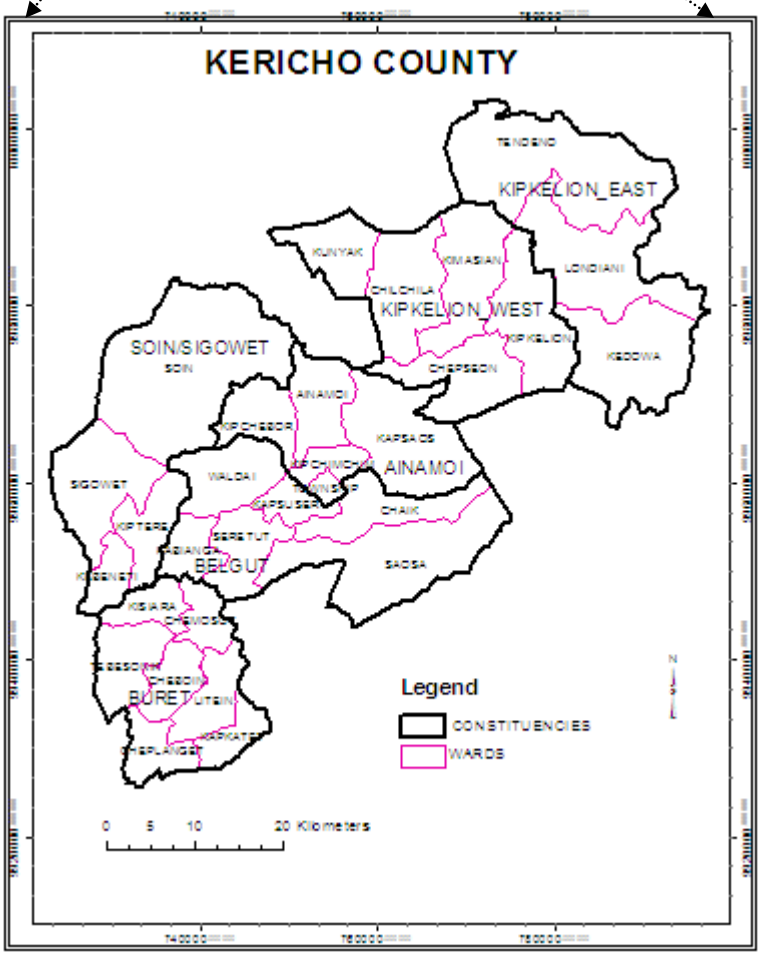


Figure 2.1b: Kericho County; Study Area

Kericho County (see figures 2.1a and 2.1b) is located in the Rift Valley, it borders the following counties; Nandi to the North, Uasin Gishu and Baringo to the North East, Nakuru to the East and South East, Bomet to the South, Nyamira and Homa-Bay to the South West, and Kisumu County to the West and North West. It has an area of 2,479.0 Square Km.

Climate/Weather: Temperatures range from a minimum of 16°C to a maximum of 20°C. The average rainfall ranges between 1,400 mm and 2,000mm per annum.

Road Network: Bitumen Surface (184.9 Km), Gravel Surface (96.4 Km), Earth Surface (846 Km)

Figure 2.2: Tea plantation and forest cover at the background

Kericho County is situated in the Republic of Kenya along the Great Rift Valley. It is among the forty seven counties. It has a population of 752 396 (2009, National census). It has 6 sub-counties namely; Buret, Ainamoi, Belgut, Kipkelion West, Kipkelion East and Soin/Sigowet. Kericho town is the capital headquarters of Kericho County and it is the major centre of commerce in the county. Kericho County has thirty (30) county assembly wards.

Kericho County is characterized by undulating topography. The overall slopes of the land is towards the west, consequently drainage is in that direction, with temperatures ranging from 16℃ to 27℃.

Table 2-1: Constituencies within Kericho County

No.		Name	Population (2009 National Census)	Area (Sq. Km)
1	**0188**	Kipkelion East	111, 832	746.40
2	**0189**	Kipkelion West	94,758	360.90
3	**0190**	Ainamoi	147,741	258.50
4	**0191**	Buret	167,649	321.10
5	**0192**	Belgut	125,292	294.50
6	**0193**	Sigowet/Soin	105,124	473.10

Source: Independent Electoral and Boundaries Commission (IEBC)

Leadership as at 2015

Governor: Paul Kiprono Chepkwony, Deputy Governor: Susan C. Kikwai, Senator: Charles Keter

Some strengths of Kericho County include:

- Natural resources as Mau Forest, Arable land, Water, Livestock
- Tourist attractions as Monkey Sanctuary, Bird Watching, Chagaic Botanic Garden. Mau Forest, Tulwap Kipsigis a cultural attraction site
- Main Economic Activities include Tea Growing and Processing, Dairy Farming, Horticulture and Floriculture, Wheat, Fish Farming, Commercial Businesses and ***Soin Sugar Company*** (private)

The county has a potential of minerals such as gold and silica. The Number of Institutions (2007) are primary (461), secondary (106) with an enrolment of 163,133 pupils and teacher to pupil ratio of 1: 43 in public primary schools. While in public secondary schools the enrolment is 30,375 students with a teacher to student ratio of 1:33.

The county has over 15 tertiary colleges which comprised of University Satellite Campus, Youth Polytechnics, Teacher Training Colleges, Medical Training College, Technical Colleges, and Several Commercial Colleges. There are 136 health centres which comprises of District Hospitals (4), Sub-District Hospitals (2), Dispensaries (105), Health Centres (9), Medical Clinics (7), VCT Centres (3), Others (7). The Doctor to population ratio is 1:15,000 and the prevalent diseases are malaria, skin infections, and upper respiratory tract infections. The notable hospitals are Kericho, Kapkatet, Sigowet and Londiani (District Hospitals)

2.2 Public Works, Roads and Transport

Kenya Vision 2030 aspires for a country with integrated and firmly interconnected communication infrastructure consisting of roads, railways, airports, ports, waterways and communications and provision of adequate energy which is critical for country's competitiveness as it reduces the cost of doing business. The sector is a key backbone to other economic sectors like agriculture, manufacturing and tourism. Road network links various sectors and allow access to inputs for production and others for consumption. Infrastructural improvements also provide direct employment opportunities for work personnel during construction and maintenance.

Kenya roads Act, 2007 further defines national class roads and the county roads. Each class is defined by the functional criteria related to administrative level of centers the roads connect.

County roads are defined as:

- Roads within the counties that serve a city, municipal, towns and markets
- Roads that serve social amenities such schools, colleges, hospitals and dispensaries
- Roads that serve economic entities such as factories, industries, and quarries.
- All other roads within County boundaries that have not been defined as National Trunk Roads.

2.2.1 Kericho Road Network

Kericho County Government is blessed with several major tarmac roads such as Total- Kericho-Nyamasaria road which is classified as class B1. Kericho-Kaplong road (class C23), Chemosit-Kisii road (class C21), Londiani Junction - Fort Ternan road (class C35) all are fully tarmacked and maintained by the national government. Also under construction to tarmac standard by national government are Sotik – Roret - Kebeneti road (class D226).

The Department of Roads, Transport and Public Works has been working to develop and build the county road network within Kericho County. The major works entails road opening up, improvement, and maintenance as well as bridge construction. During the financial year 2013/2014 the county government built 450 km of new roads, while in the financial year 2014/2015 the County Government of Kericho targets to construct 600 km of roads to murram standard, with each ward getting 20 km of new murram road.

Figure 2.3: Initial state of the access road and the current state

2.2.2 County roads

In the FY 2014/2015 the departments aims to continue maintaining access roads and drainage structures in urban areas. Construction of County roads in the rural areas specifically in ward locations as well as construction of major drainage structures across the County. Purchase of constructional equipment, assessing County roads condition through Inventory Survey. Future plans for the county's roads include: maintenance of current roads, road marking and beautification and development of new roads.

2.2.3 Department's allocation and budgetary performance

During the FY 2014/2015 Kericho County Government received KES 4.553 billion from the share of Revenue Allocation to counties by the Commission on Revenue Allocation. The Department of Roads, Transport and Public Works received KES 764 million which represented 17 % of the total county budget estimates.

2.3 Geographic Information System (GIS)

2.3.1 Definition of GIS

Geographic Information System (GIS) is a computer based information system that deals only with spatially referenced, land related data. GIS provides the following set of capabilities for handling spatially referenced, land related data and information (Goodchild et al, 1997).
GIS can store geographically referenced data in raster or vector formats as points, lines and polygons. GIS also store topology pertaining to various spatial features which are stored typically as attributes in tabular form.

2.3.2 Use of Geospatial information

The use of geospatial information and GIS in the public sector has increased for several reasons. One of the main reasons is the extent and complexity of information that has to be considered and analyzed whilst making decisions. Many decisions need geospatial information and a GIS supports the analysis of geospatial information. The use of geospatial information in the public sector has also been stimulated by the increase of computer and server capacity (for storing and handling data) at decreasing prices and the fact that GIS-software has become more customer-friendly. Geospatial information plays a crucial role in the various stages of the policy-cycle.
(ISSAI 5540, "Use of Geospatial Information in Auditing Disaster Management and Disaster-related Aid" (www.issai.org)
Geographic Information Systems (GIS) holds a unique power to create accountability and transparency, combating corruption and mismanagement in several ways. Storing information in geocoded databases makes that information concrete and bound to reality. Statistics and table data often simply remain abstract and less easily communicated and understood. Maps are innately understood, and useable to create fairness in distribution of development projects.

GIS provides the analytical tools to understand the impacts of development projects and meet the requirements of laws created to secure equity and hold governments accountable to the entire citizens when undertaking projects.

GIS is not only about maps, it is about data and rather importantly it can provide a tool to ensure that reality of what's happening with government money and initiatives on the ground matches the intentions of policy and the requirements of laws put in place. There are still many more opportunities for the strengths of GIS to build in accountability and transparency where it is lacking.

Budgeting departments could have their activities enhanced through logging the spending of funds geospatially both for the sake of guaranteeing equal investment across different areas. Maps when combined with demographic data, issues of equity can become concrete, and shortcomings can be revealed and remediated. Layering and analysis of data gives real accountability.

Use of GIS has also been used in monitoring donor aid flow, right from the donor country to the recipient country or region. In rebuilding effort after the Tsunami earthquake of December 26, 2004, billions of funds were donated by several international countries and agencies. The application of geospatial technology applied during the Tsunami to account, monitor and evaluate the donor aid could also be used to apply the same principle for county development funds in Kenya. Geospatial information and technologies are systematically and extensively used. GIS application provides users with data viewing, editing, and analysis capabilities.

According to Darwin Rasul, Assistant Secretary at the ARMM's (Autonomous Region in Muslim Mindanao - Philippine) Office of Special Concerns (OSC), local officials discovered awarded contracts for the construction of school buildings worth millions of pesos but was recently found out to be non-existent.

"When you look at the project report, you can see the projects that have already been awarded and bid out, the mobilization funds already released. But when you check on the ground there is nothing," he said.

By using GIS technology, national and county governments would be able to improve their project monitoring efforts by geo-tagging projects to inform decision makers on what projects have been implemented, their exact location and how they are progressing.

2.3.3 The power of geospatial data

INTOSAI (International Organization of Supreme Audit Institutions) was quick to acknowledge the fact that one of the main lessons from auditing was the added value of geospatial data for planning, coordination, monitoring, accountability and audit of disaster-related aid. It concluded that "in order to ensure long-term accountability and transparency, geospatial data should be immediately included in the information structure of agencies involved".

INTOSAI is now urging nations and agencies to use geo-information and GIS, and in its XXI INCOSAI (its triennial Congress) endorsed a set of International Standards for Supreme Audit Institutions (ISSAI) with regard to the use of geospatial information in auditing disaster management and disaster-related aid. (www.intosai-tsunami.org)

It was noted by Simon Thompson, Director, Global Commercial Solutions, ESRI; that "Understanding where the money flows and how people are connected and geographical spatial analysis of all this is the ultimate connector." ESRI has been pioneering the use of geo-information in audit space and in addition to providing solutions, has tied up with various audit institutions and independent organizations to forward the cause of transparency in public finances and welfare programmes.

2.3.4 Open spending and transparency

With government spending increasingly coming under the lens and effective governance taking centre stage, authorities are moving towards opening funding data and making it freely available on the Web. While this means more transparency, this also means greater audited work involving maps and visualization. But open spending enables the people for whom the money is meant to see how much money is coming their way, what is the meaning of that money and if that really makes a difference. Plotting this data in real-time on a map brings transparency to the whole process.

Location is the key element in a lot of government policies. "So if we could combine public finance policy with geotechnology, it could not only help in implementing a better policy but

also help us know more about the spending," underlines Saskia J. Stuiveling (President, Court of Audit, The Netherlands, who was also the chair of the INTOSAI Tsunami Task Force).
"Open data funding allows citizens to see what is being done with their tax money; it also helps prevent fraud, waste and abuse of this money," points out Di Paolo. Also, such a system provides complete data to oversight officials, enabling them to prioritize work and have more complete audits. "Consistent and accurate open data eases access to spending information at the federal, state and local levels," she adds. Kenya is reaping the fruits of its transformative devolution program and also from increased investment in infrastructure to improve its prospects for economic growth and shared prosperity, according to a new World Bank Group (WBG) report.

2.4 Monitoring and Evaluation

A well-functioning monitoring and evaluation (M&E) system is a critical part of good project management and accountability. Monitoring and evaluation is important due to the following factors;

- **Support project implementation** with accurate, evidence-based reporting that informs management and decision-making to guide and improve project performance.
- **Contribute to organizational learning and knowledge sharing** by reflecting upon and sharing experiences and lessons so that the full benefit from what can be done and how it can be done.
- **Uphold accountability and compliance** by demonstrating whether or not the work has been carried out as agreed and compliance with established standards.
- **Provides opportunities for stakeholder feedback,** especially beneficiaries, to provide input into and perception of the work, modeling openness to criticism, and willingness to learn from experiences and to adapt to changing needs.
- **Promote and celebrate work** by highlighting accomplishment and achievements, building morale and contributing to resources mobilization.

2.4.1 Monitoring is the routine collection and analysis of information to track progress against set plans and check compliance to established standards. It helps identify trends and patterns, adapt strategies and inform decisions for project management. The log frames objectives of monitoring are inputs, activities, outputs and outcomes.

Monitoring and Evaluation (M & E) is necessary to improve future allocation to projects policy, to provide accountability and to assist on-going work on the ground. Although many government and institutions are involved in funding of several development projects, the executing agencies and donors conduct development and logistical work and require data for operational reasons. To inform decision making and situational understanding, and to identify issues as they arise. The governments and donors require information and data to provide accountability and transparency to their stakeholders and to ensure their objectives are being met on time and to budget to provide immediate and long-term funds allocation formula.it has been noted by the World Bank, it has been spending a large sum of money aiding recovery efforts and the complexity of the work being conducted are currently no standard framework or methodologies that can be adopted to monitor and evaluate the process.

Monitoring and auditing can use GISs for designing monitoring programs, for processing and storage of monitoring data, for the comparison of actual outcomes with predicted outcomes, and for data presentation showing the variation of the location of pollutants with time.

2.4.1.1 Common types of monitoring

- **Results monitoring** tracks effects and impacts. This is where monitoring merges with evaluation to determine if the project is on target towards it intended results (outputs, outcomes, impact) and whether there may be any unintended impact (positive or negative).
- **Process (activity) monitoring** tracks the use of inputs and resources, the progress of activities and the delivery outputs. It examines how activities are delivered – the efficiency in time and resources. It is often conducted in conjunction with compliance monitoring and feeds into the evaluation of impact.
- **Compliance monitoring** ensures compliance with National and County Governments regulations.

2.4.2 Evaluation

Evaluation is the systematic collection and analysis of information about programmes and projects, their purpose and delivery; it derives knowledge on their impact as a basis for judgments. Evaluations are used to improve effectiveness and inform decisions about current and future programming.

2.5 Role of GIS in Monitoring and Evaluation

The concept of using GIS in M&E has been used by several governmental organizations to check on where funds are spent and the impacts these funds brings to the society. Most notable is USAID. (www.ibi-usa.com/projects/Uganda_monitoring_evaluation)

Current USAID policy had placed renewed emphasis on the implementation of solid monitoring and evaluation (M&E) processes to quantify results, measure impact and inform planning, which has increased reporting requirements for USAID Missions around the world. USAID has placed concrete measures in project planning, estimate cost of projects, M&E, public information and donor reporting.

2.5.1 Project Planning

Maps layers contains information such as population, infrastructure and physical characteristics like rivers and mountains. They can also depict where projects have previously been implemented, extent and the type of project. Displaying features like locations of public facilities in relation to proposed projects can add a new dimension to decision making. All of these maps provide representation of data and are valuable communication tools for program managers for use in decision-making.

2.5.2 Estimates

GIS has spatial computing capabilities, which can calculate the area of a polygon or line. Computing the area of a county assembly ward, constituency or county, the length of a road, or the distance between point A and point B – such as the distance to a market is much easier using GIS. All of these factors can help to estimate the cost of projects. It was noted in Aceh by GIS staff working with engineering to estimate the cost for a drainage project by mapping total area. In this instance, the cost of the project was found to be too high and it was cancelled.

2.5.3 Monitoring and Evaluation

GIS has display capabilities, projects could be displayed on a map: completed, ongoing, and projected. It can also display attribute information such as amount spent, number of beneficiaries, and project type. This is a valuable tool for helping project staff to monitor and evaluate all projects. These maps can also be utilized for participatory monitoring and evaluation with the county government, to share and discuss with the communities, senate, county

assembly, partners, and stakeholders. Thematic GIS maps are also very useful when evaluating a program or project or when doing specific case studies to assess a topic more in-depth.

Another example of a case study type evaluation is a map that displays all infrastructures built or rehabilitated in target communities, cost of projects and number of beneficiaries.

2.5.4 Public Information

GIS can be used for public information to make maps that show roads and names, trading and markets, health centres, schools, forest cover and tea processing factories. These are valuable tools to provide to communities so they can make more informed decisions when proposing projects.

2.5.5 Government/Donor Reporting

GIS maps can be included in government or donor reports to visually display where money is being put to work. For example, for a Midwife Clinic Project in Indonesia, GIS provided a map that illustrated clinic locations and identified donors associated with each clinic. Another effective use of GIS maps is for government/donor visits. The maps help government/donors to orient themselves and understand where the projects are.

2.6 Geo-database design

A geo-database is a "container" used to hold a collection of datasets. Each dataset is held as a file that can scale up to 1 TB in size.

2.6.1 Types of geo-databases

There are three kinds of geo-databases from which to choose:

- A **file geo-database** stores datasets in a folder of files on your computer. Each dataset is held as a file and can be up to 1 TB in size (and one can optionally configure a file geo-database to store much larger datasets). File geo-databases can be used across platforms and can be compressed and encrypted for read-only, secure use.

A File Geo-database used has the following advantages

- Provided a widely available, simple, and scalable geo-database solution for all users.

- Provided a portable geo-database that works across operating systems.
- Can be scaled up to handle very large datasets.
- Provides excellent performance and scalability, for example, to support individual datasets containing well over 300 million features and datasets that can scale beyond 500 GB per file with very fast performance.
- Uses an efficient data structure that is optimized for performance and storage. File geo-databases use about one third of the feature geometry storage required by shape files and personal geo-databases. File geo-databases also allow users to compress vector data to a read-only format to reduce storage requirements even further.
- Outperform shape files for operations involving attributes and scale the data size limits way beyond shape file

- A **personal geo-database** stores its datasets in a Microsoft Access .mdb file on disk. The storage sizes of personal geo-databases are effectively limited to between 250 and 500 MB for the entire geo-database and are only supported on Windows. Users often need larger storage for their datasets, so they choose file or ArcSDE geo-databases.
- An **ArcSDE geo-database** stores datasets in a number of optional DBMSs including the following:
    - IBM DB2
    - IBM Informix
    - Microsoft SQL Server
    - Oracle
    - PostgreSQL

CHAPTER THREE: MATERIALS AND METHODS

3.0 Methodology

3.1. User needs assessment

A user needs assessment was taken into consideration by identifying the expected users and their information needs, functionalities and datasets.

The main intended users of this project study are as follows;

- For use by the Senate assembly in assessing, evaluating and monitoring use of county development funds for development projects in counties.
- For use by The Commission on Revenue Allocation (CRA) to efficiently and effectively monitor and rate funds allocated to counties with respect to development achieved.
- For use by Kenya National Audit Office (KENAO), Auditor-General, to assess and audit the utilization of county development funds.
- For use by County residents/community to gauge, assess and monitor fair distribution of development projects within the county.
- For use by County Government for sourcing more funds and attracting investors
- For use by county assembly for decision making and determining the distribution of development projects in all the county assembly wards.
- For use by County Government in evaluating and monitoring non-performing contractors and suppliers.
- For use by County Governments in dissemination of county development projects achieved to county residents.
- For use by County Governors as a campaign tool detailing development records during re-election period.

3.2 Tools and equipment

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

3.2.1 Hardware

The hardware to be used in this study includes:

- A personal laptop computer with the following specifications;
    - Processor: Intel (R) core (TM)
    - CPU @ 2.3 GHz
    - RAM 4.0 GB
    - 500 GB Hard Disk
- External storage:
    - 500 GB External Hard drive
    - 700 MB Compact Disk (CDs)
- Printers: Hp laser printer and Hp Ink jet printer
- Hand-held GPS: Garmin (type GPSmap 60) receiver
- Scanner: Map Master (paper size Ao)

3.2.2 Software

The software used in the study includes:

- ArcGIS 10.1
- Microsoft office (2010)
- Adobe Photoshope

The analysis of the data for the study was being conducted under ArcGIS 10.1 GIS.

3.3 Data

3.3.1 Sources of data

The dataset and data used were obtained from two sources: primary and secondary data sources.

Table 3-1: Datasets and data sources

Dataset	**Type/Characteristics**	**Data source**
Map of Kenya-boundary	Shapefile	Survey of Kenya
Topographical map sheets	Scanned images	Survey of Kenya
Kericho Towns	Shapefile	Survey of Kenya
Road network	Scanned topographic maps	Survey of Kenya
Project locations	Discrete coordinates	Ground field survey
Project details	Tables and figures	Kericho County Government
County funds	Tables and Figures	Ministry of Finance

3.3.2 Data acquisition, collection and input

The primary data source involves direct collection of information on the field; using hand held GPS (Global Positioning System) receiver. The data collected from primary sources, therefore include: the geographic coordinates of location of development projects.

The secondary data source involves sourcing information from existing records. The map of Kenya was obtained from Survey of Kenya as a shapefile, the topographical map Muhoroni sheet 117/1, 117/2, 117/3, 117/4, 118/2. Such data includes list of development projects carried out during first half of financial year 2014/2015 (1^{st} July – 31^{st} December 2014) within the department of roads in Kericho County Government. The data includes lists of contractors, cost of each project and several contract and project details which were collected from Kericho County Government.
The database was then structured in a format for implementation in a software environment, using the application of Arc GIS 10.1 for digitizing the topographical map and the images.

3.3.3 Attribute data

Attributes are the characteristics of the map features and hold the descriptive information about the geographic features (development projects). Attributes are the non-spatial data associated with time and area entities.
The development project data obtained from the Kericho County Government contained information such as project identification, project title, total project cost, project objectives, location, contractor's details, start date, duration of projects in months.
Field surveys were carried out using hand held Garmin GPS receiver at project location of the study area.

Similarly, Microsoft Word was used for writing reports in textual format and Arc GIS 10.1 with the network analysis extension was used for the building the database, processing of the maps and performing the analysis.

3.4 Digitization of data and data input

All the topographical maps (117/1, 117/2, 117/3, 117/4 113/1, 118/1) of the study area were scanned using scanner type map master. The existing major road network, tea zones (plantation), railway line, tea factories, trading and market centres were digitized from the topographic maps. Data digitized consisted of points, lines and polygons, using digitizing modules for the raster and vector data structures. Digitization errors were minimized. Attribute data were of two types; manual format and digital format.

3.5. Data processing

Data processing was necessary to clean up the spatial data of any topological and geometric errors, undershoots were extended, offshoots were trimmed using ArcGIS software. Shapefiles for each theme were used in GIS for processing where all spatial data and datasets and spatially referenced to UTM Projection (Arc 1960). Also geo-referencing was performed on all the topographical map sheets (117/1, 117/2, 117/3, 117/4 113/1, 118/1) of the study area. *See Appendix 1*

3.6 Overview of the Methodology

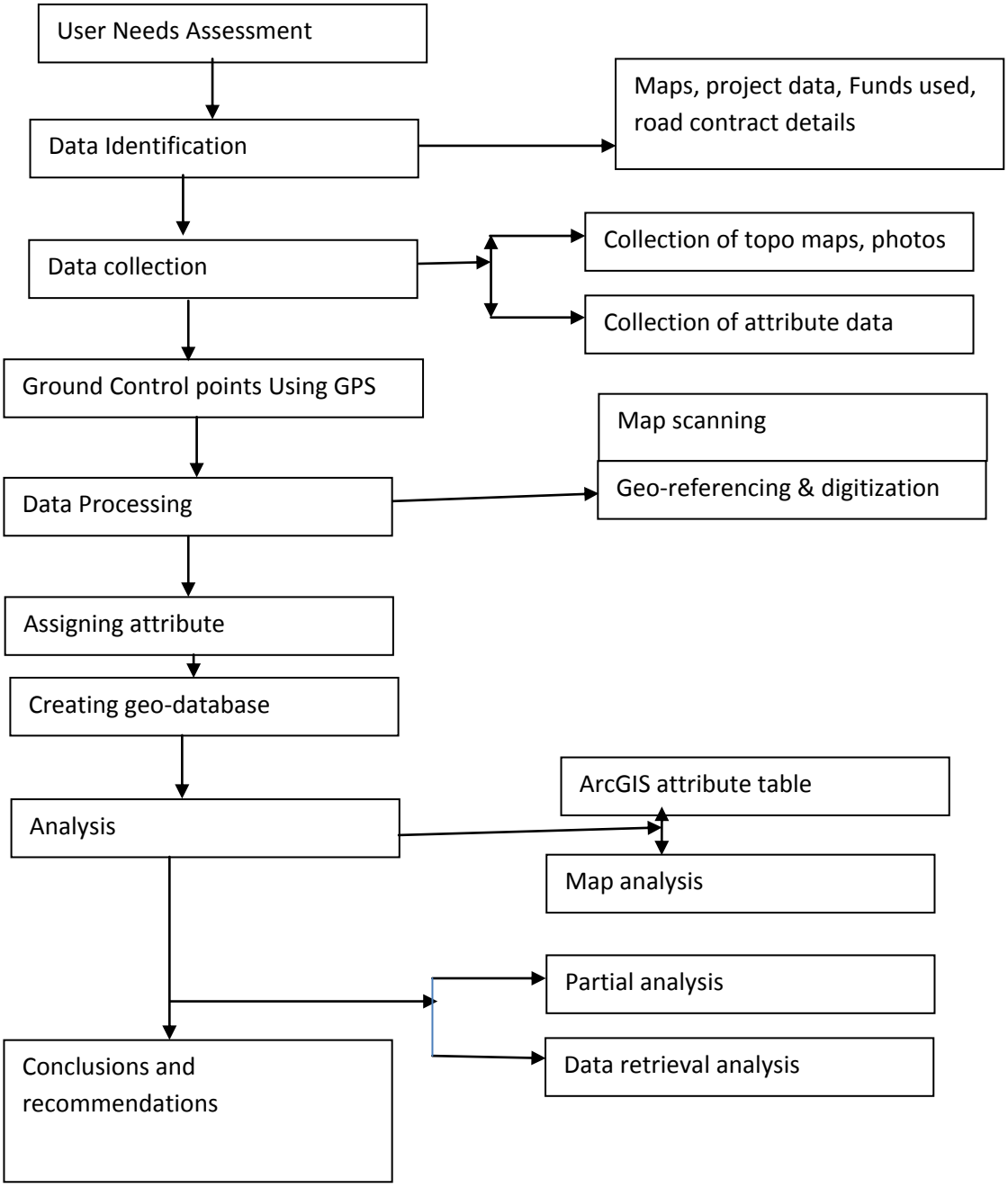


Figure 3.1: Overview of the methodology

3.6.1 Mapping of the projects

Using a geo-referenced map and the GPS coordinates of the projects locations; a map showing the location of the road projects was generated using ArcGIS software.

3.6.2 Designing and Creating a GIS database

Database design has a major impact on the efficiency of the GIS implementation. A geo-database was designed and created using Arc Map software. A File Geo-database was preferred for this project study as it stores folders in a file system.

The thematic layers for the project's study were identified as major roads based on class of the road, county boundary, constituencies' boundary, county assembly wards boundaries, tea plantations, forest cover road projects funded, railway line, trading and market centres and location of tea processing factories. The data that were included in the database includes:

- Project title
- Project ID
- Project length/ extent
- Project objectives
- Constituency
- Ward
- Locational position
- Total project cost (KES)
- Approved date
- Start date (Planned)
- End date (Planned)
- Duration (Months)
- Contractor's name/details
- Contract number
- Implementing agency (County Roads Department)
- County Project Supervisor's name

- Work plan progress (%)

3.6.3 Analysis of the spatial distribution of the road projects

From the generated map and geo-database, analyses of the spatial distribution of the road projects were carried out. This was to determine the distribution of road projects between constituencies as well as between county assembly wards. These gave the general trend of the distribution of the county development funds between county assembly wards.

CHAPTER FOUR: RESULTS AND ANALYSIS

4.1 Results and analysis of results

The main objective of the study was to use geospatial technology for monitoring and evaluation of county development funds. In order to achieve the objective, the funds used in the Department of Roads, Transport and Public Works for development projects within County Government of Kericho were considered. The road projects developed by Kericho County Government within the first half of FY 2014/2015 were 117 projects. The results of the study were listed as figure 4.1 to figure 4.22 and tables also listed as table 4-1 to table 4-6.

The analyses of the results were based on the results achieved and the set objectives of the study.

Distribution of funded road projects by Kericho County Government

The study considered all the 117 road projects funded by Kericho County Government. The locations of the projects were mapped to depict the distribution in all the six constituencies and in all the 30 county assembly wards. The distribution of the 117 road projects in the county was as shown in Table 4-1 and Figure 4.1

Table 4-1: Number of funded road projects per constituency

Constituency	Number of projects
AINAMOI	**19**
BELGUT	**27**
BURET	**36**
KIPKELION EAST	**7**
KIPKELION WEST	**20**
SOIN/SIGOWET	**8**

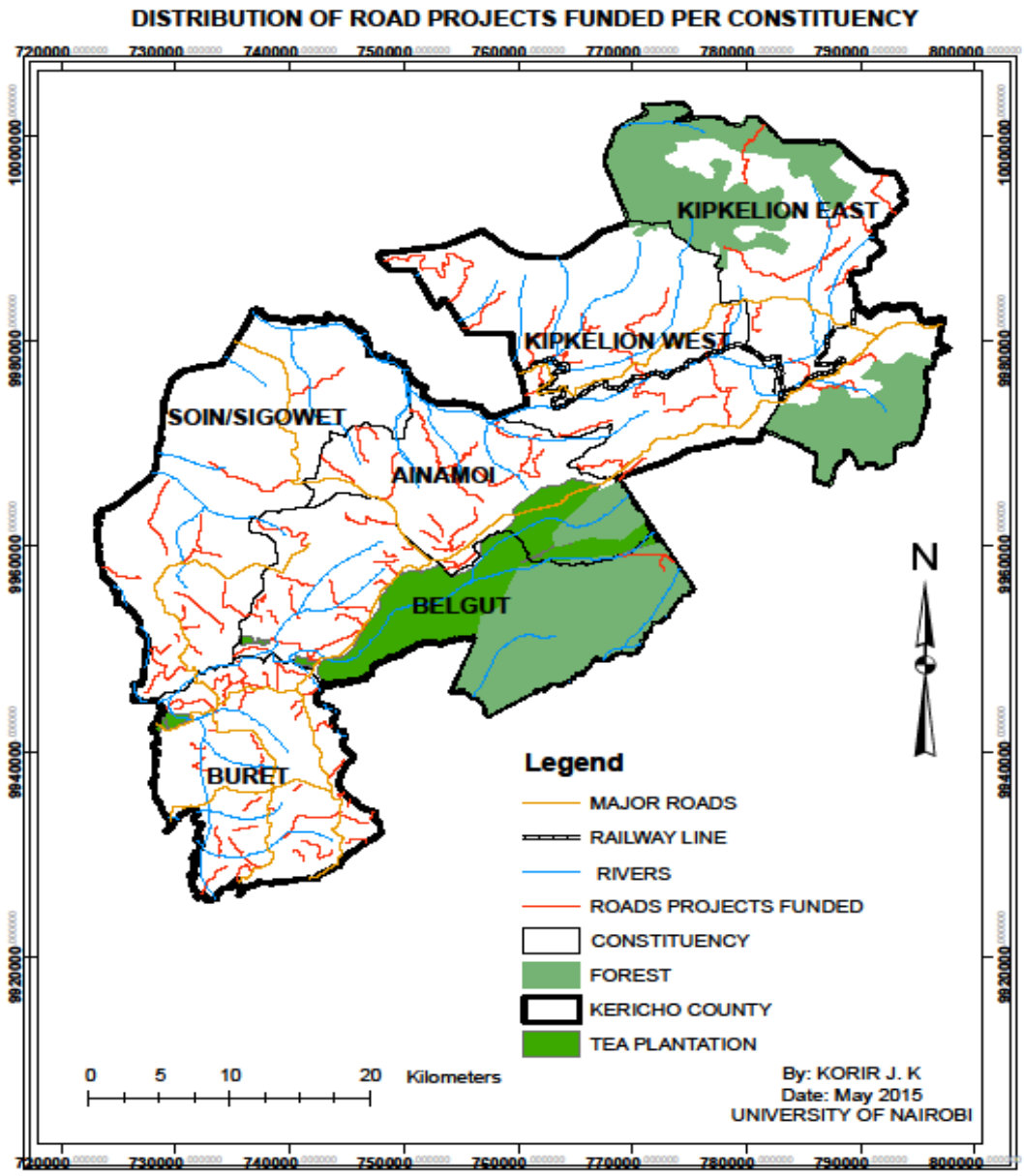


Figure 4.1: 117 Road projects funded by Kericho County Government

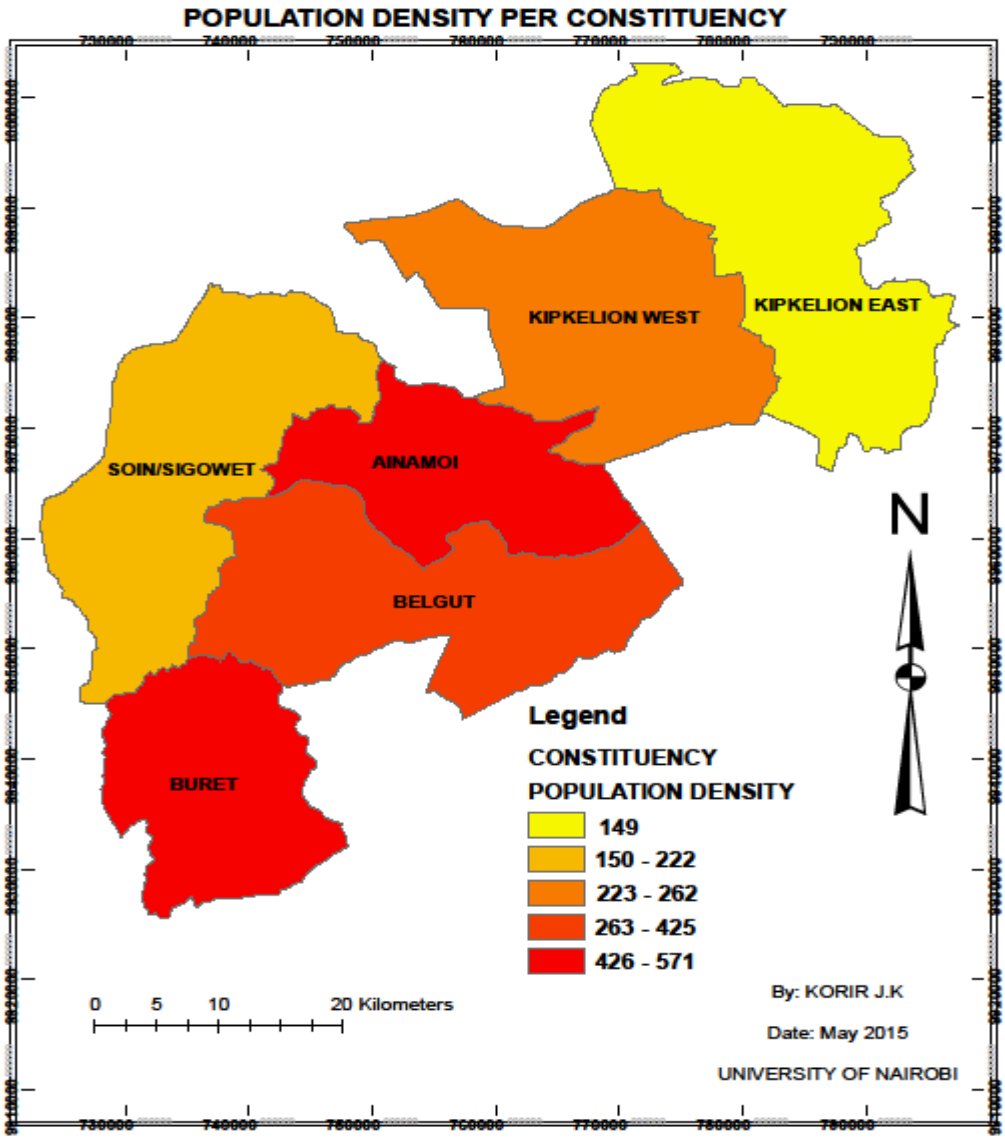


Figure 4.2: Distribution of population density per constituency in Kericho County

Source: (2009, National census)

From the map in figure 4.2 it depicts that BURET and AINAMOI constituencies had the highest population densities, while KIPKELION EAST constituency had the lowest population density.

4.2 IMPACTS OF THE DEVELOPED ROAD PROJECTS TO THE SOCIETY.

In checking the impacts of the developed road projects to the society, the following factors were considered in relation to developed road projects;

- Location of trading and market centres
- Location of tea processing factories
- Nearness or connection of developed road projects to the main road.
- Tea plantations
- Forest cover, Population

For the first five factors, map layers were created consisting of trading and market centres, tea processing factories and major main roads, tea plantations, forest cover within the county and were overlaid to map of road funded projects, *see Figure 4.4.* It was found out that;

- Most road projects developed were connecting trading and market centres.
- Several developed road projects were connecting main roads this implied that development of access roads were from main roads towards small urban centres then to villages in the county.
- Developed road projects were connecting tea processing factories outside large areas of tea plantations. Picked tea leaves were perishable commodities hence requires faster delivery from tea buying centres to the tea processing factories. Thus constituencies of BURET and BELGUT received a larger number of road projects as compared to other constituencies. Large tea plantations were owned by private companies and they build and maintain access roads within their private tea plantations.
- Areas of forest cover received minimum road projects. This indicated that the county had no priority to develop road projects within forest.
- Population was viewed as the main determining factor in the distribution of development funds. It is thus generally expected that areas that are highly populated receive more

development funds than low populated areas. Buret constituency has the highest population. S*ee Figure 4.2.*

From the photograph in figure 4.3 it was found out that the road projects developed had a positive impact to the society since it creates links to the tarmac road (at the foreground) and tea buying centres (at the background).

Figure 4.3: BANDA PILIS – SACHANGWAN RD. [at the fore front tarmac road (Kericho-Kaplong road), background was a tea buying centre].

Figure 4.4 shows map overlays of constituencies, county assembly wards, road projects funded, forest cover, tea plantation, tea processing factories, trading and marketing centres, major roads and railway line. Map overlays were done to determine impacts of the developed road projects to

the society.

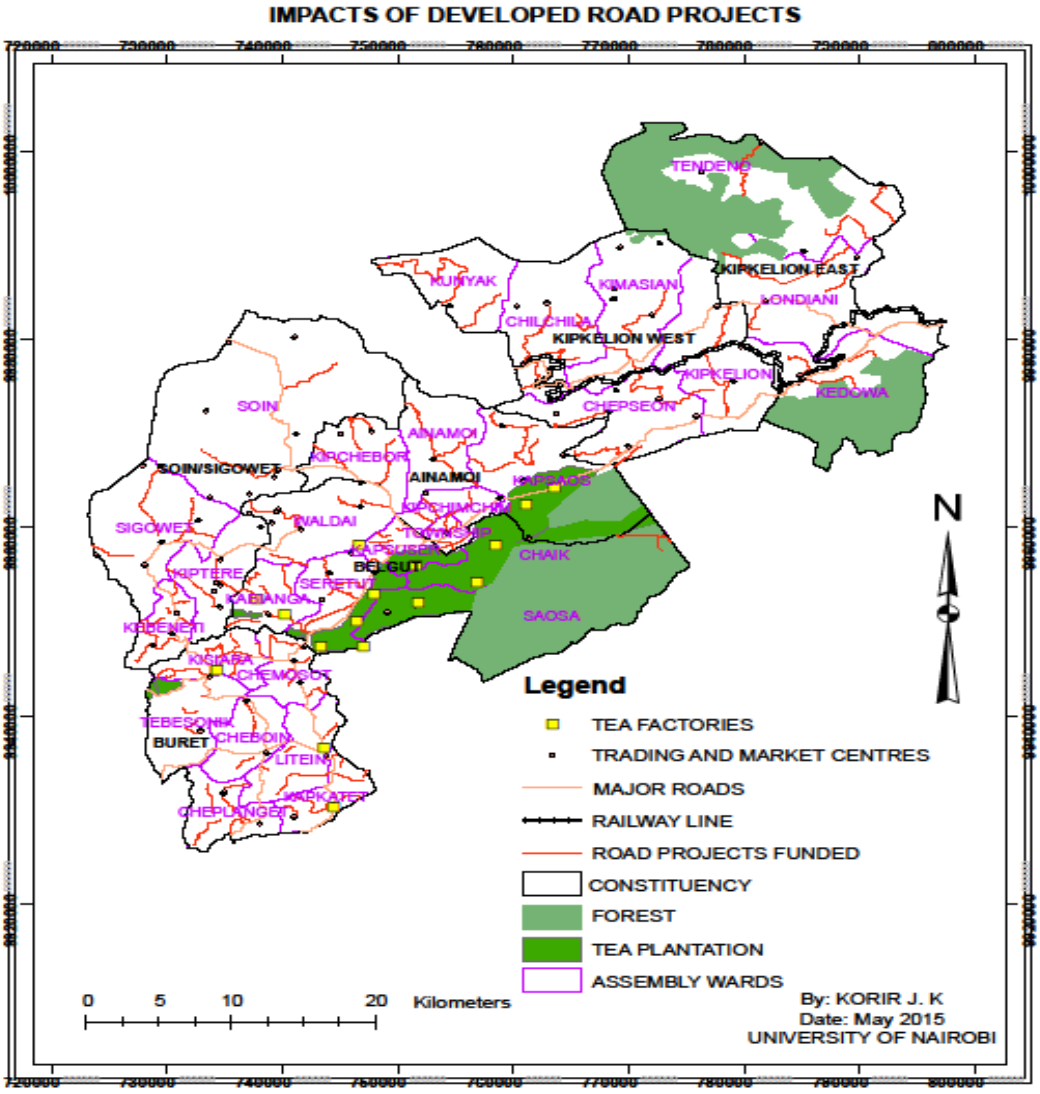
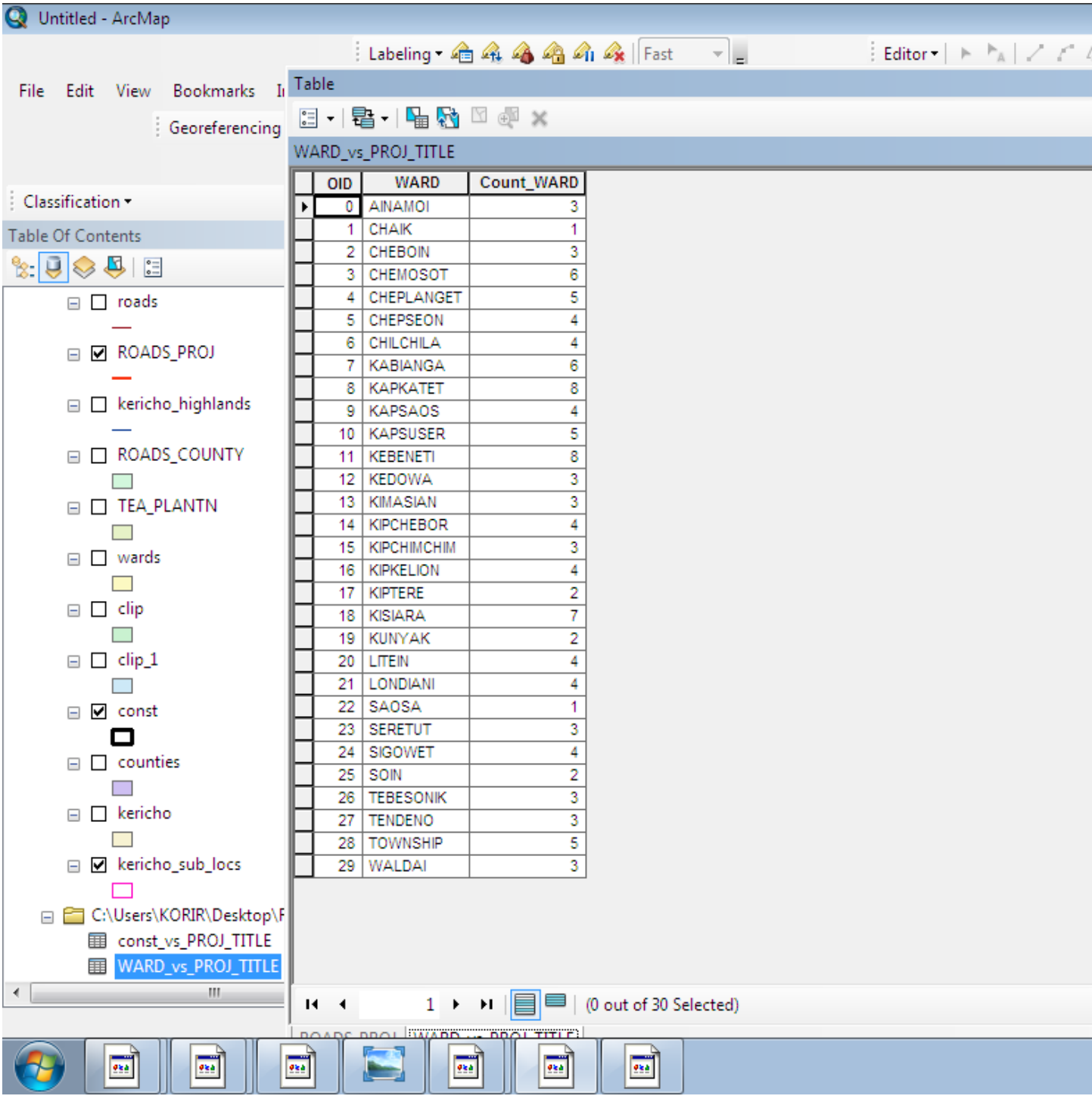


Figure 4.4: Impacts of developed road projects.

Figure 4.5 and Table 4-2 shows screen display of number of projects funded by Kericho County in various county assembly wards



OID	WARD	Count_WARD
0	AINAMOI	3
1	CHAIK	1
2	CHEBOIN	3
3	CHEMOSOT	6
4	CHEPLANGET	5
5	CHEPSEON	4
6	CHILCHILA	4
7	KABIANGA	6
8	KAPKATET	8
9	KAPSAOS	4
10	KAPSUSER	5
11	KEBENETI	8
12	KEDOWA	3
13	KIMASIAN	3
14	KIPCHEBOR	4
15	KIPCHIMCHIM	3
16	KIPKELION	4
17	KIPTERE	2
18	KISIARA	7
19	KUNYAK	2
20	LITEIN	4
21	LONDIANI	4
22	SAOSA	1
23	SERETUT	3
24	SIGOWET	4
25	SOIN	2
26	TEBESONIK	3
27	TENDENO	3
28	TOWNSHIP	5
29	WALDAI	3

Figure 4.5: Number of road projects per county assembly wards in Kericho County

Table 4-2: Data distribution of road projects per county assembly ward

WARD	TOTAL_COST (Million Kshs	RD_LENGTH (Km)
AINAMOI	15098799.8962	18.8735
KAPSAOS	16528480.1483	20.6606
KIPCHEBOR	13320719.9096	16.6509
KIPCHIMCHIM	6588080.0248	8.2351
TOWNSHIP	8478319.7402	10.5979
KABIANGA	14785359.9548	18.4817
KAPSUSER	6435519.9814	8.0444
KEBENETI	20850639.7248	26.0633
SERETUT	12330480.0034	15.4131
WALDAI	14272560.1196	17.8407
SAOSA	2285919.9524	2.8574
CHAIK	2957439.9948	3.6968
KISIARA	19475679.9698	24.3446
CHEMOSOT	11065599.9183	13.832
LITEIN	13118239.9749	16.3978
KAPKATET	24339279.6516	30.4241
TEBESONIK	5325040.0543	6.6563
CHEBOIN	5076240.158	6.3453
CHEPLANGET	14012480.1636	17.5156
KEDOWA	10759120.3689	13.448901
LONDIANI	11257439.9948	14.0718
TENDENO	16910479.7364	21.1381
CHEPSEON	17889839.9353	22.3623
CHILCHILA	16606799.6979	20.7585
KIMASIAN	10059919.9295	12.5749
KIPKELION	16769039.9171	20.9613
KUNYAK	6304480.0758	7.8806
KIPTERE	9098960.1136	11.3737
SIGOWET	16067520.3323	20.0844
SOIN	11918079.7577	14.8976

Table 4-2 above was generated from the GIS database; it depicts the total amount of funds used and the total road length developed in each county assembly ward.

Figure 4.6 shows the distribution of development funds per county assembly wards

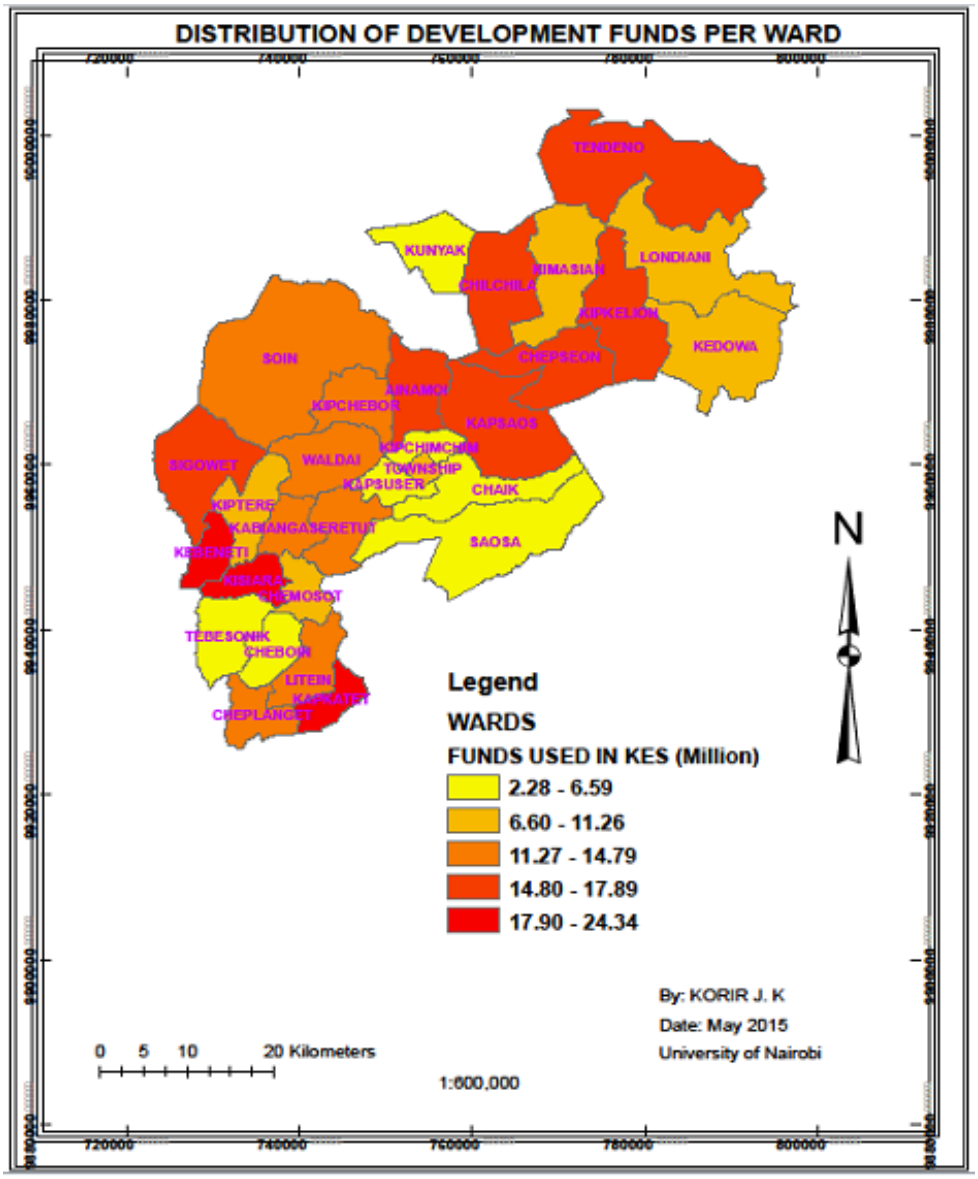


Figure 4.6: Distribution of development funds per county assembly ward

The map above depicts that KEBENETI, KISIARA and KAPKATET county assembly wards received the highest development funding whereas TEBESONIK, CHEBOIN, SAOSA, CHAIK, KIPCHIMCHIM, KAPSUSER and KUNYAK county assembly wards received the lowest development funding for road projects.

It was evident from the results that the road projects funded by the county government covered all the thirty (30) county assembly wards within Kericho County. However, the distribution of road projects varies from one county assembly ward to the other. CHAIK and SAOSA county assembly wards had the least number of road projects. This could have been mostly attributed to the presence of large private tea plantations and forest cover, see figure 4.4. Hence, the County Government never gave priority to these county assembly wards.

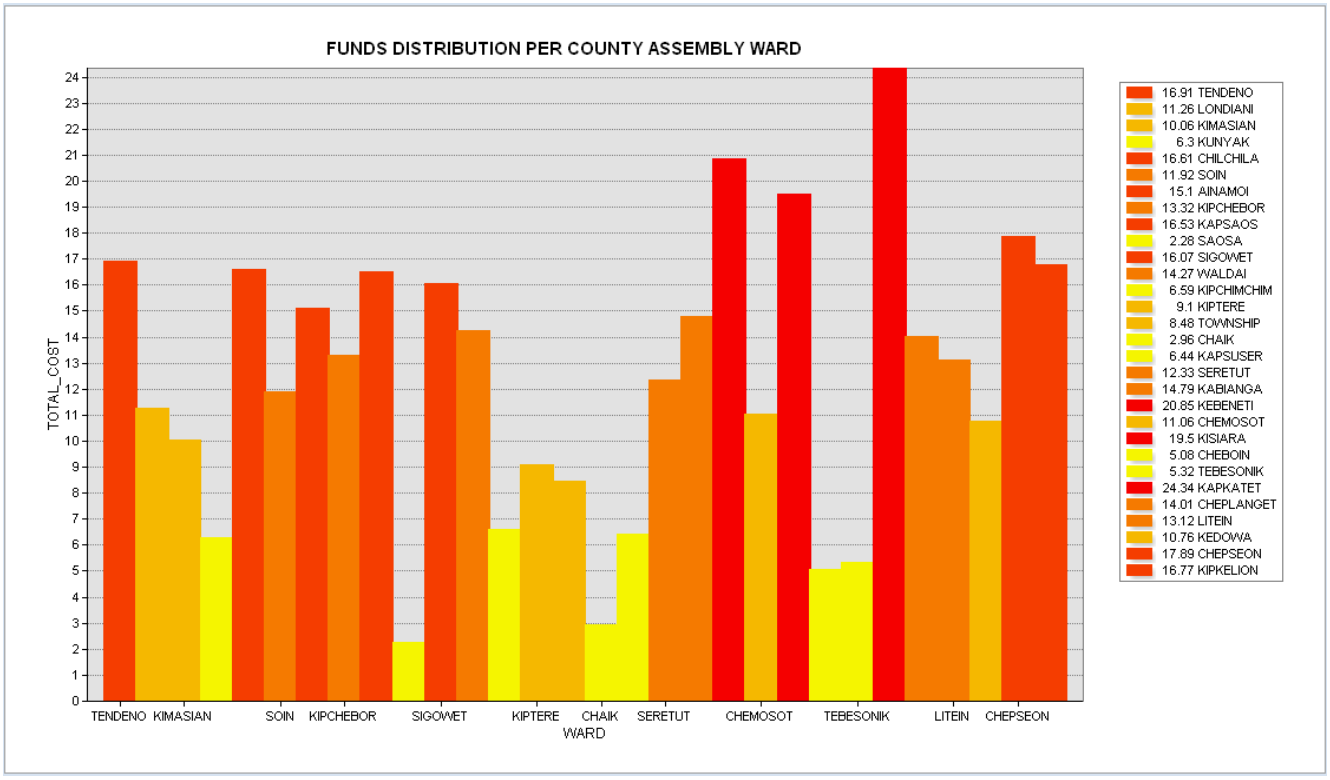


Figure 4.7: Graphical representation of funds distribution per county assembly ward

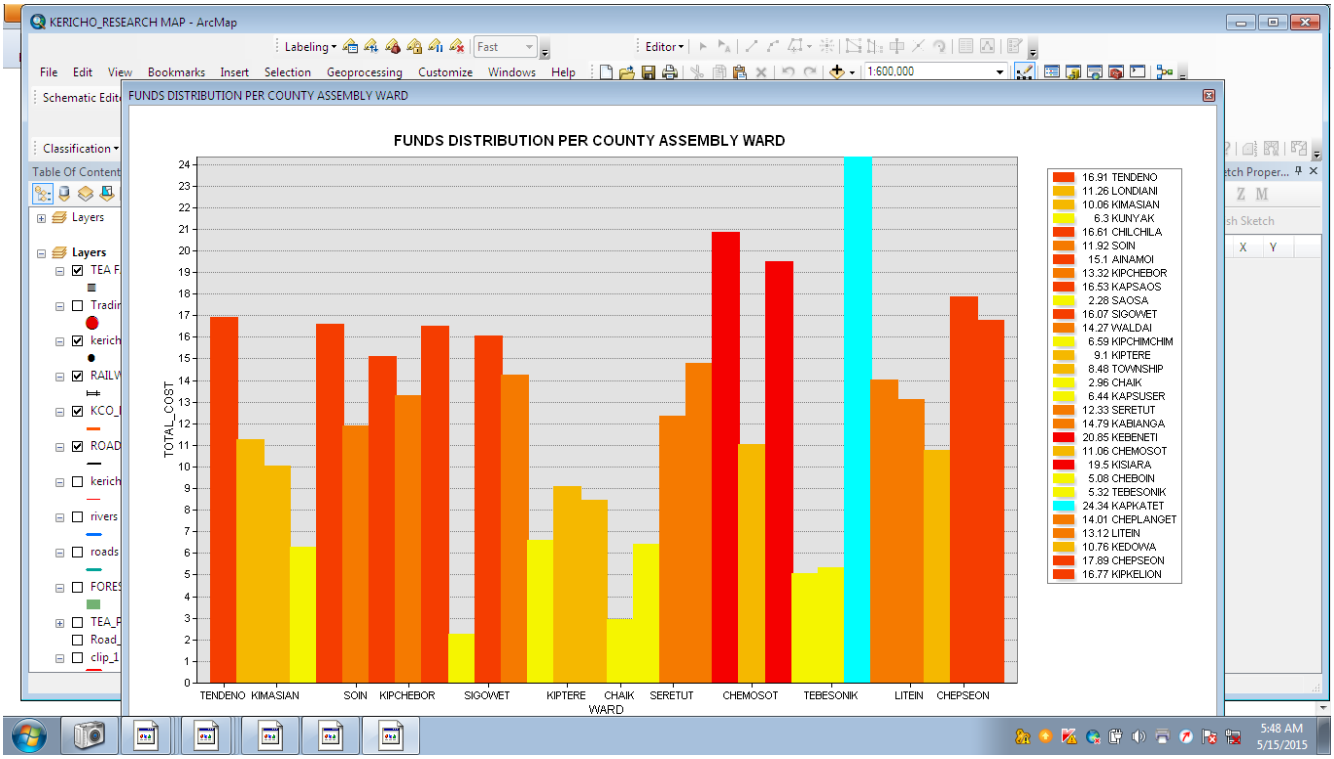


Figure 4.8a: Display of county assembly ward which received largest development funding

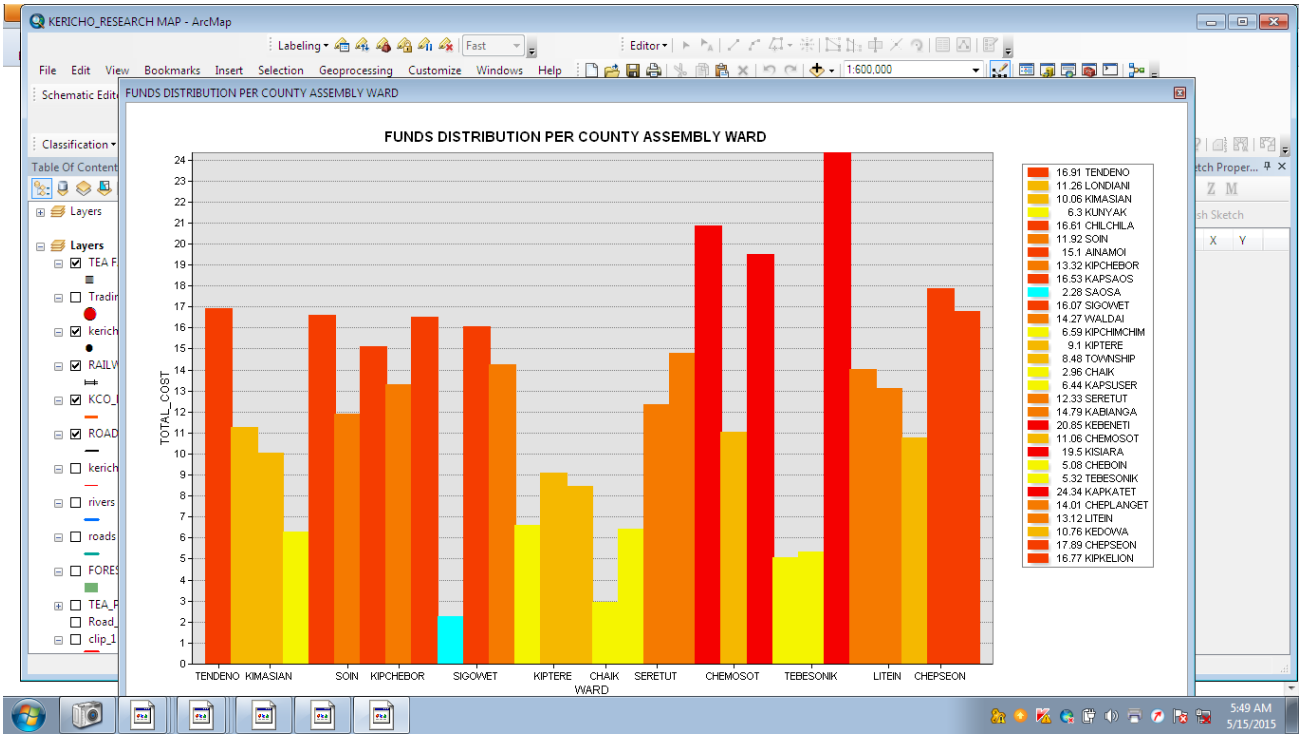


Figure 4.8b: Display of county assembly ward which received least development funding

DATABASE DISPLAY, BROWSING, QUERY AND OVERLAY

Simple display:

GIS function supports the generation of maps and its attribute data.

Screen shot display of the study area

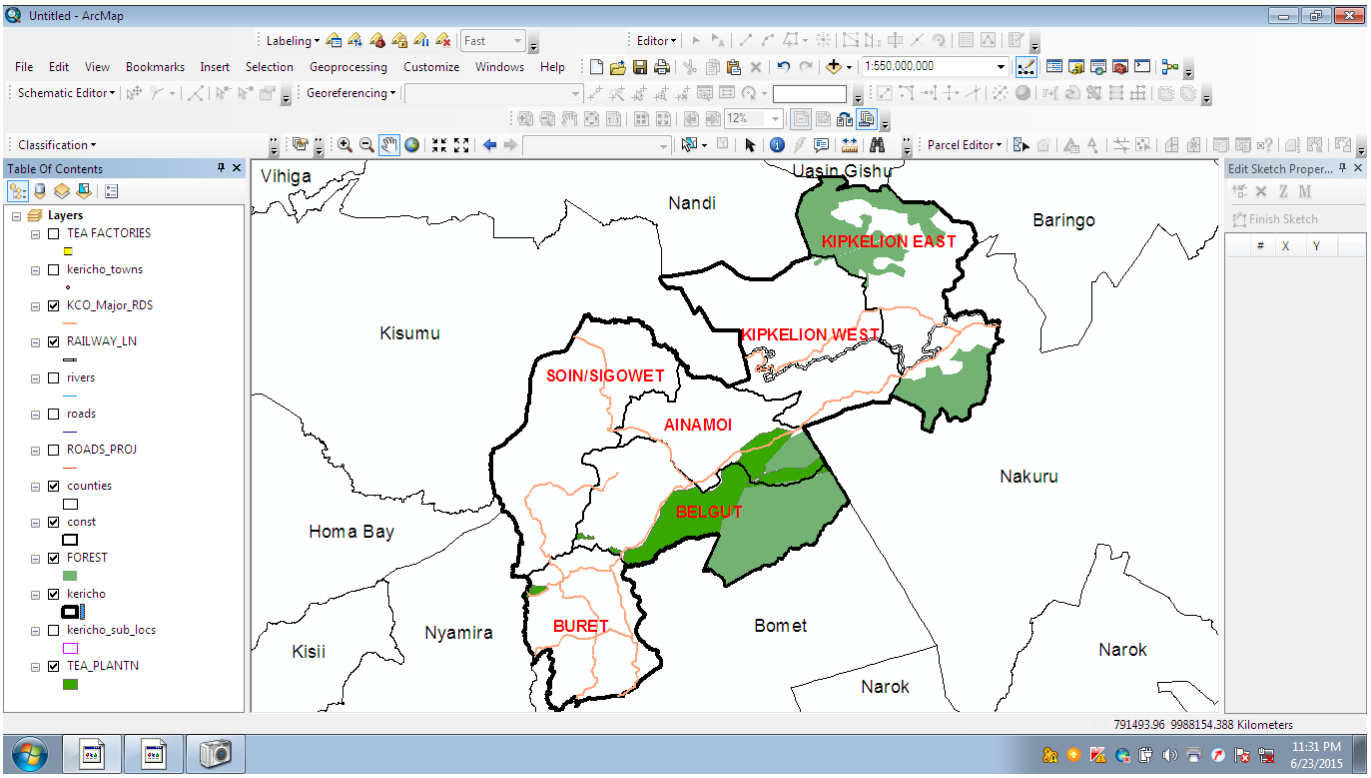


Figure 4.9: Display of the study area

Query: This function supported the posing of specific questions to the database in an interactive format. The database displays the results of the query.

The figure below shows a query to the question "what projects were carried out within AINAMOI constituency?"

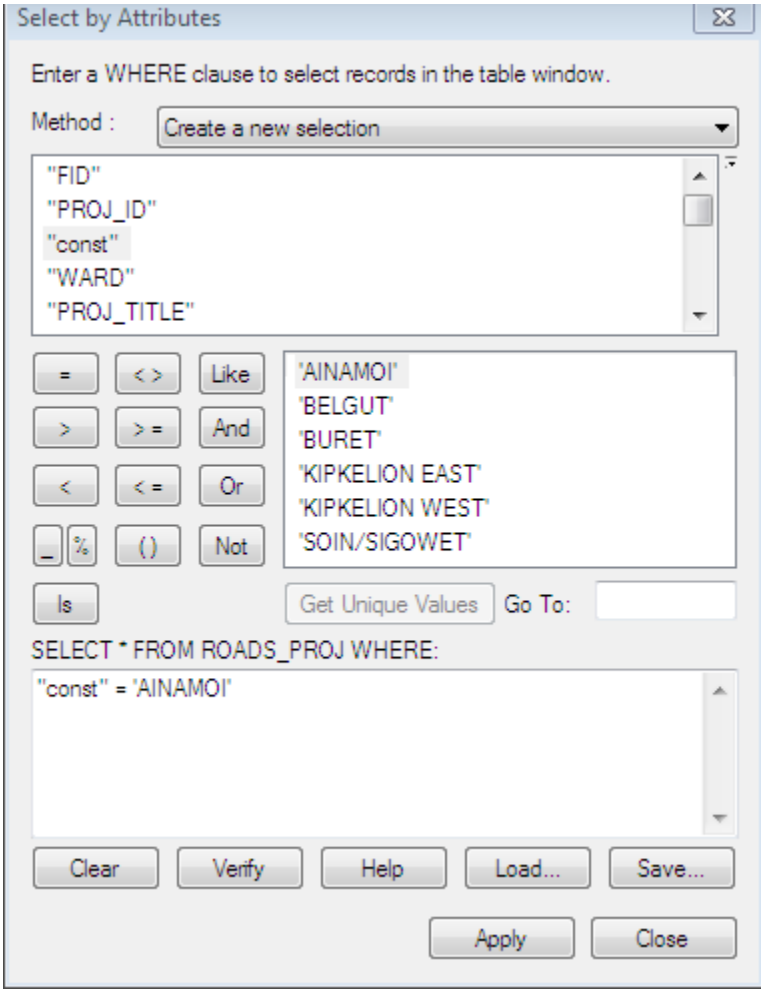
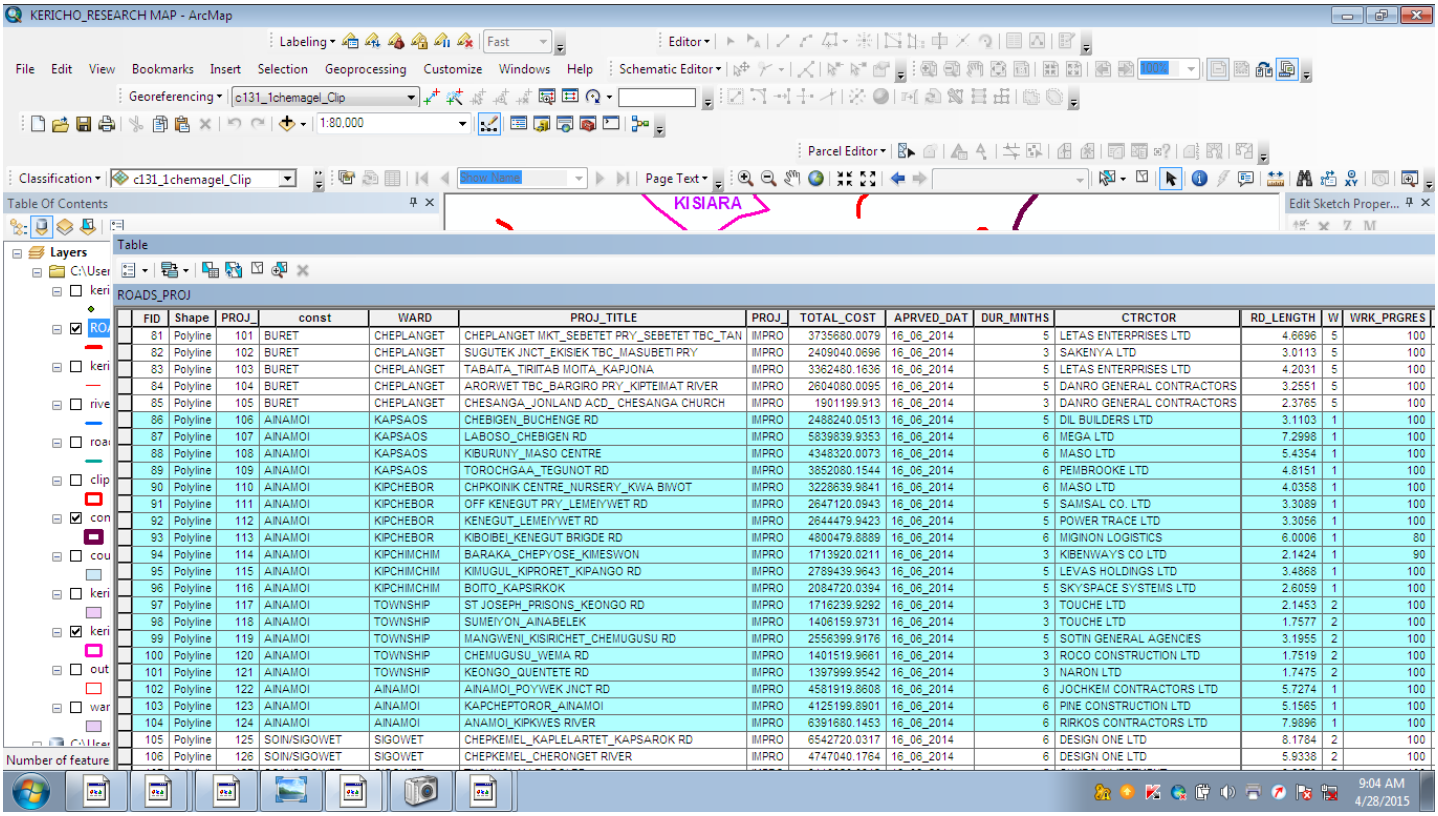


Figure 4.10: An SQL query for projects that were carried out within AINAMOI constituency

Figure 4.11 shows the highlighted attributes of road projects that were carried out within AINAMOI constituency.



FID	Shape	PROJ_	const	WARD	PROJ_TITLE	PROJ_	TOTAL_COST	APRVED_DAT	DUR_MNTHS	CTRCTOR	RD_LENGTH	W	WRK_PRGRES
81	Polyline	101	BURET	CHEPLANGET	CHEPLANGET MKT_SEBETET PRY_SEBETET TBC_TAN	IMPRO	3735680.0079	16_06_2014	5	LETAS ENTERPRISES LTD	4.8696	5	100
82	Polyline	102	BURET	CHEPLANGET	SUGUTEK JNCT_EKISIEK TBC_MASUBETI PRY	IMPRO	2409040.0696	16_06_2014	3	SAKENYA LTD	3.0113	5	100
83	Polyline	103	BURET	CHEPLANGET	TABAITA_TIRITAB MOITA_KAPJONA	IMPRO	3362480.1636	16_06_2014	5	LETAS ENTERPRISES LTD	4.2031	5	100
84	Polyline	104	BURET	CHEPLANGET	ARORWET TBC_BARGIRO PRY_KIPTEIMAT RIVER	IMPRO	2604080.0095	16_06_2014	5	DANRO GENERAL CONTRACTORS	3.2551	5	100
85	Polyline	105	BURET	CHEPLANGET	CHESANGA_JONLAND ACD_ CHESANGA CHURCH	IMPRO	1901199.913	16_06_2014	3	DANRO GENERAL CONTRACTORS	2.3765	5	100
86	Polyline	106	AINAMOI	KAPSAOS	CHEBIGEN_BUCHENGE RD	IMPRO	2488240.0513	16_06_2014	5	DIL BUILDERS LTD	3.1103	1	100
87	Polyline	107	AINAMOI	KAPSAOS	LABOSO_CHEBIGEN RD	IMPRO	5839839.9353	16_06_2014	6	MEGA LTD	7.2998	1	100
88	Polyline	108	AINAMOI	KAPSAOS	KIBURUNY_MASO CENTRE	IMPRO	4348320.0073	16_06_2014	6	MASO LTD	5.4354	1	100
89	Polyline	109	AINAMOI	KAPSAOS	TOROCHGAA_TEGUNOT RD	IMPRO	3852080.1544	16_06_2014	6	PEMBROOKE LTD	4.8151	1	100
90	Polyline	110	AINAMOI	KIPCHEBOR	CHPKOINIK CENTRE_NURSERY_KWA BIWOT	IMPRO	3228639.9841	16_06_2014	6	MASO LTD	4.0358	1	100
91	Polyline	111	AINAMOI	KIPCHEBOR	OFF KENEGUT PRY_LEMEIYWET RD	IMPRO	2647120.0943	16_06_2014	5	SAMSAL CO. LTD	3.3089	1	100
92	Polyline	112	AINAMOI	KIPCHEBOR	KENEGUT_LEMEIYWET RD	IMPRO	2644479.9423	16_06_2014	5	POWER TRACE LTD	3.3056	1	100
93	Polyline	113	AINAMOI	KIPCHEBOR	KIBOIBEI_KENEGUT BRIGDE RD	IMPRO	4800479.8889	16_06_2014	6	MIGINON LOGISTICS	6.0006	1	80
94	Polyline	114	AINAMOI	KIPCHIMCHIM	BARAKA_CHEPYOSE_KIMESWON	IMPRO	1713920.0211	16_06_2014	3	KIBENWAYS CO LTD	2.1424	1	90
95	Polyline	115	AINAMOI	KIPCHIMCHIM	KIMUGUL_KIPRORET_KIPANGO RD	IMPRO	2789439.9643	16_06_2014	5	LEVAS HOLDINGS LTD	3.4868	1	100
96	Polyline	116	AINAMOI	KIPCHIMCHIM	BOITO_KAPSIRKOK	IMPRO	2084720.0394	16_06_2014	5	SKYSPACE SYSTEMS LTD	2.6059	1	100
97	Polyline	117	AINAMOI	TOWNSHIP	ST JOSEPH_PRISONS_KEONGO RD	IMPRO	1716239.9292	16_06_2014	3	TOUCHE LTD	2.1453	2	100
98	Polyline	118	AINAMOI	TOWNSHIP	SUMEIYON_AINABELEK	IMPRO	1406159.9731	16_06_2014	3	TOUCHE LTD	1.7577	2	100
99	Polyline	119	AINAMOI	TOWNSHIP	MANGWENI_KISIRICHET_CHEMUGUSU RD	IMPRO	2556399.9176	16_06_2014	5	SOTIN GENERAL AGENCIES	3.1955	2	100
100	Polyline	120	AINAMOI	TOWNSHIP	CHEMUGUSU_WEMA RD	IMPRO	1401519.9661	16_06_2014	3	ROCO CONSTRUCTION LTD	1.7519	2	100
101	Polyline	121	AINAMOI	TOWNSHIP	KEONGO_QUENTETE RD	IMPRO	1397999.9542	16_06_2014	3	NARON LTD	1.7475	2	100
102	Polyline	122	AINAMOI	AINAMOI	AINAMOI_POYWEK JNCT RD	IMPRO	4581919.8608	16_06_2014	6	JOCHKEM CONTRACTORS LTD	5.7274	1	100
103	Polyline	123	AINAMOI	AINAMOI	KAPCHEPTOROR_AINAMOI	IMPRO	4125199.8901	16_06_2014	6	PINE CONSTRUCTION LTD	5.1565	1	100
104	Polyline	124	AINAMOI	AINAMOI	ANAMOI_KIPKWES RIVER	IMPRO	6391680.1453	16_06_2014	6	RIRKOS CONTRACTORS LTD	7.9896	1	100
105	Polyline	125	SOIN/SIGOWET	SIGOWET	CHEPKEMEL_KAPLELARTET_KAPSAROK RD	IMPRO	6542720.0317	16_06_2014	6	DESIGN ONE LTD	8.1784	2	100
106	Polyline	126	SOIN/SIGOWET	SIGOWET	CHEPKEMEL_CHERONGET RIVER	IMPRO	4747040.1764	16_06_2014	6	DESIGN ONE LTD	5.9338	2	100

Figure 4.11: Display of results of the attribute table as per the SQL query on figure 4.10

Figure 4.12 shows the screen shot display of road projects done within AINAMOI constituency.

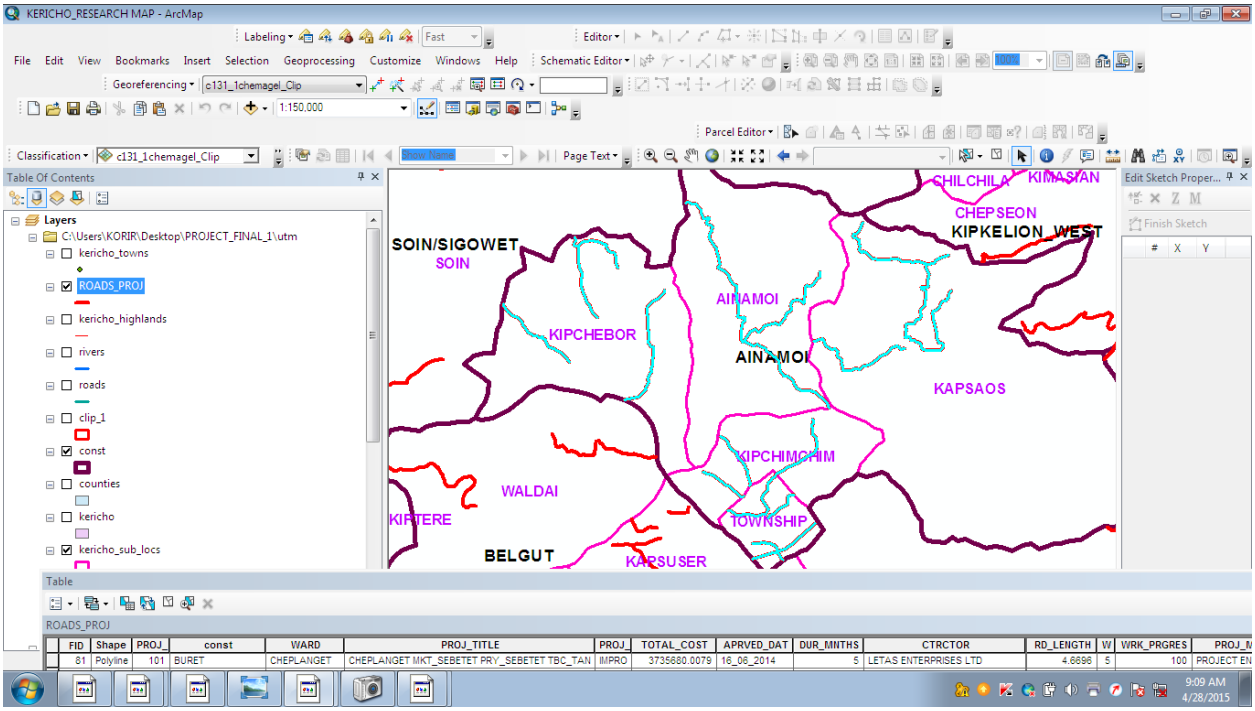


Figure 4.12: Highlighted map display of road projects that were carried out within AINAMOI constituency

Monitoring progress of road projects behind schedule of construction period

The database was queried to find out road projects that were behind schedule in construction period. The road projects were rated according to progress of construction. Complete road projects were rated 100% and less than 100% for other road projects depending on the level and progress of construction. Projects which had not commenced at all after the expiry of the duration of construction period were given progress level of 0%.

Some projects never commenced at all during the recommended construction period. Figure 4.13 shows an SQL query of projects that never commenced within the duration of recommended construction period.

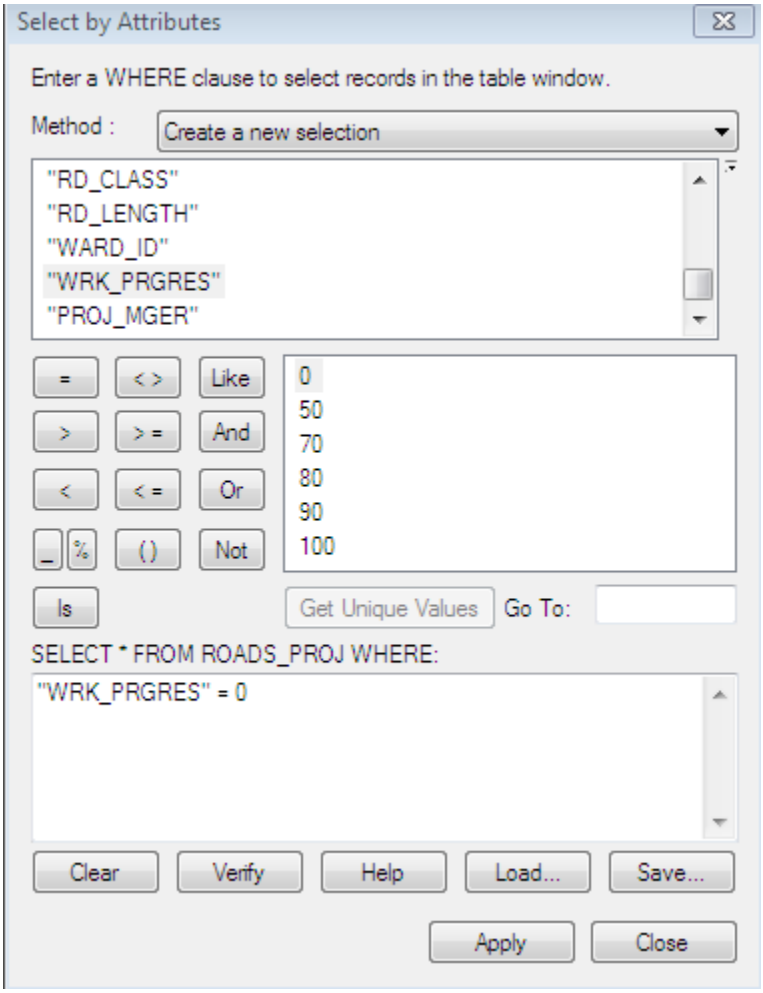
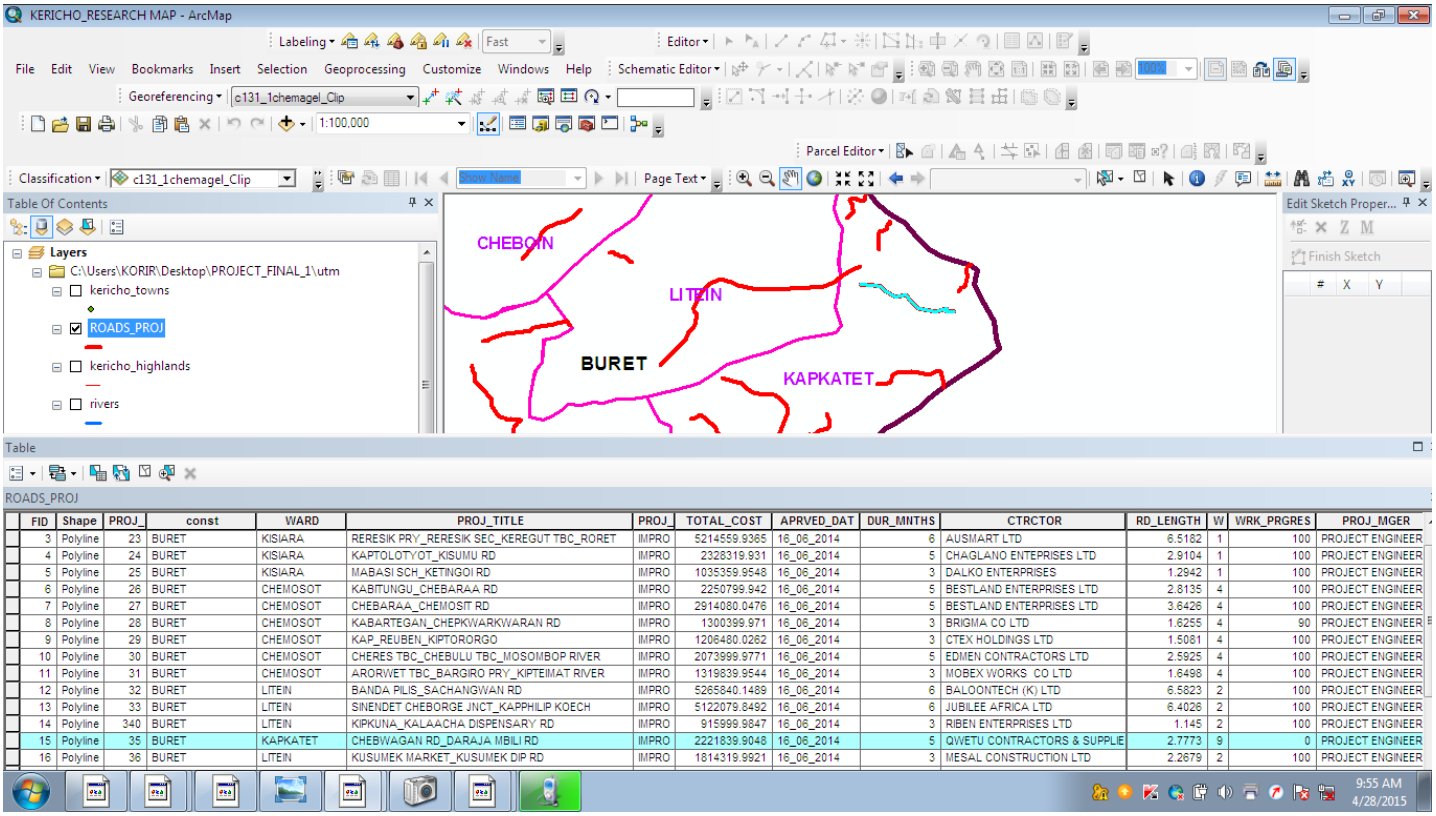


Figure 4.13: SQL query for projects that had zero work progress

Figure 4.14 shows a highlighted map and attribute table of road projects that never commenced after the expiry of the recommended construction duration.



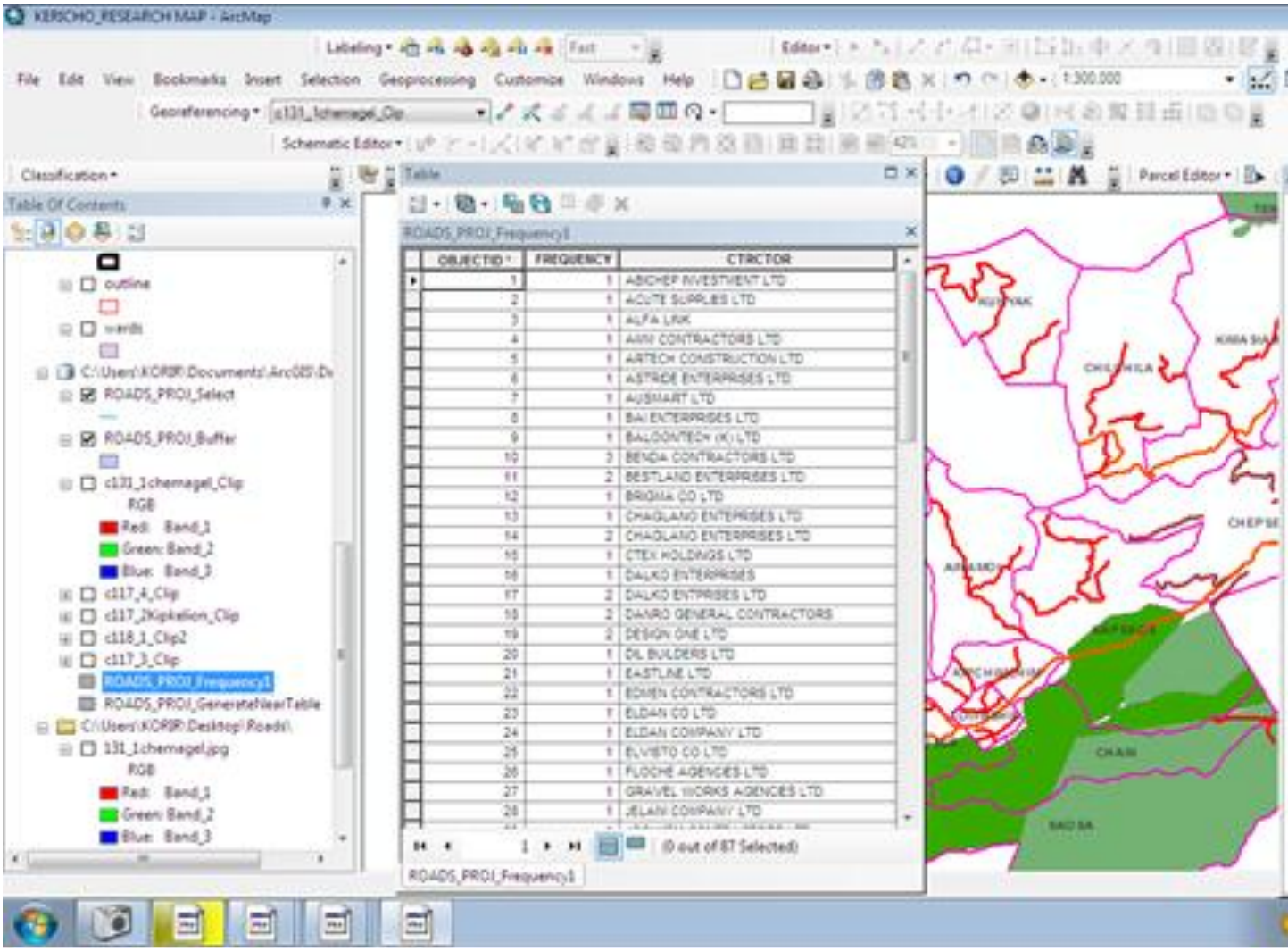
FID	Shape	PROJ_	const	WARD	PROJ_TITLE	PROJ_	TOTAL_COST	APRVED_DAT	DUR_MNTHS	CTRCTOR	RD_LENGTH	W	WRK_PRGRES	PROJ_MGER
3	Polyline	23	BURET	KISIARA	RERESIK PRY_RERESIK SEC_KEREGUT TBC_RORET	IMPRO	5214559.9365	16_06_2014	6	AUSMART LTD	6.5182	1	100	PROJECT ENGINEER
4	Polyline	24	BURET	KISIARA	KAPTOLOTYOT_KISUMU RD	IMPRO	2328319.931	16_06_2014	5	CHAGLANO ENTEPRISES LTD	2.9104	1	100	PROJECT ENGINEER
5	Polyline	25	BURET	KISIARA	MABASI SCH_KETINGOI RD	IMPRO	1035359.9548	16_06_2014	3	DALKO ENTERPRISES	1.2942	1	100	PROJECT ENGINEER
6	Polyline	26	BURET	CHEMOSOT	KABITUNGU_CHEBARAA RD	IMPRO	2250799.942	16_06_2014	5	BESTLAND ENTERPRISES LTD	2.8135	4	100	PROJECT ENGINEER
7	Polyline	27	BURET	CHEMOSOT	CHEBARAA_CHEMOSIT RD	IMPRO	2914080.0476	16_06_2014	5	BESTLAND ENTERPRISES LTD	3.6426	4	100	PROJECT ENGINEER
8	Polyline	28	BURET	CHEMOSOT	KABARTEGAN_CHEPKWARKWARAN RD	IMPRO	1300399.971	16_06_2014	3	BRIGMA CO LTD	1.6255	4	90	PROJECT ENGINEER
9	Polyline	29	BURET	CHEMOSOT	KAP_REUBEN_KIPTORORGO	IMPRO	1206480.0262	16_06_2014	3	CTEX HOLDINGS LTD	1.5081	4	100	PROJECT ENGINEER
10	Polyline	30	BURET	CHEMOSOT	CHERES TBC_CHEBULU TBC_MOSOMBOP RIVER	IMPRO	2073999.9771	16_06_2014	5	EDMEN CONTRACTORS LTD	2.5925	4	100	PROJECT ENGINEER
11	Polyline	31	BURET	CHEMOSOT	ARORWET TBC_BARGIRO PRY_KIPTEIMAT RIVER	IMPRO	1319839.9544	16_06_2014	3	MOBEX WORKS CO LTD	1.6498	4	100	PROJECT ENGINEER
12	Polyline	32	BURET	LITEIN	BANDA PILIS_SACHANGWAN RD	IMPRO	5265840.1489	16_06_2014	6	BALOONTECH (K) LTD	6.5823	2	100	PROJECT ENGINEER
13	Polyline	33	BURET	LITEIN	SINENDET CHEBORGE JNCT_KAPPHILIP KOECH	IMPRO	5122079.8492	16_06_2014	6	JUBILEE AFRICA LTD	6.4026	2	100	PROJECT ENGINEER
14	Polyline	340	BURET	LITEIN	KIPKUNA_KALAACHA DISPENSARY RD	IMPRO	915999.9847	16_06_2014	3	RIBEN ENTERPRISES LTD	1.145	2	100	PROJECT ENGINEER
15	Polyline	35	BURET	KAPKATET	CHEBWAGAN RD_DARAJA MBILI RD	IMPRO	2221839.9048	16_06_2014	5	QWETU CONTRACTORS & SUPPLIE	2.7773	9	0	PROJECT ENGINEER
16	Polyline	36	BURET	LITEIN	KUSUMEK MARKET_KUSUMEK DIP RD	IMPRO	1814319.9921	16_06_2014	3	MESAL CONSTRUCTION LTD	2.2679	2	100	PROJECT ENGINEER

Figure 4.14: Display of map and attribute table of road projects that had zero work progress.

Screen shot display of the attribute table and map showing the road project that never commenced after expiry of the construction period. It was found out that only one road project; CHEBWAGAN RD-DARAJA MBILI RD (see figure 4.15) within BURET constituency, Kapkatet ward that never commenced after the expiry of five (5) months recommended construction period. The contractor was QWETU CONTRACTORS & SUPPLIES LTD.

Figure 4.15: CHEBWAGAN RD – DARAJA MBILI RD; road project that did not commence during the construction period.

Analysis tools were used to get the statistics of frequency of contractor or contractors. From this analysis it was found out that several contractors were given one or two road project contracts.



However, there were two conractors with more than two road projects. BENDA CONRACTORS LTD was found to have been awarded three road projects whereas MASO LTD was awarded nine (9) road projects. The SQL query and results was as shown on figure 4.17, 4.18 and table 4-3.

Assessing the number of contractors awarded three or more road project contracts.

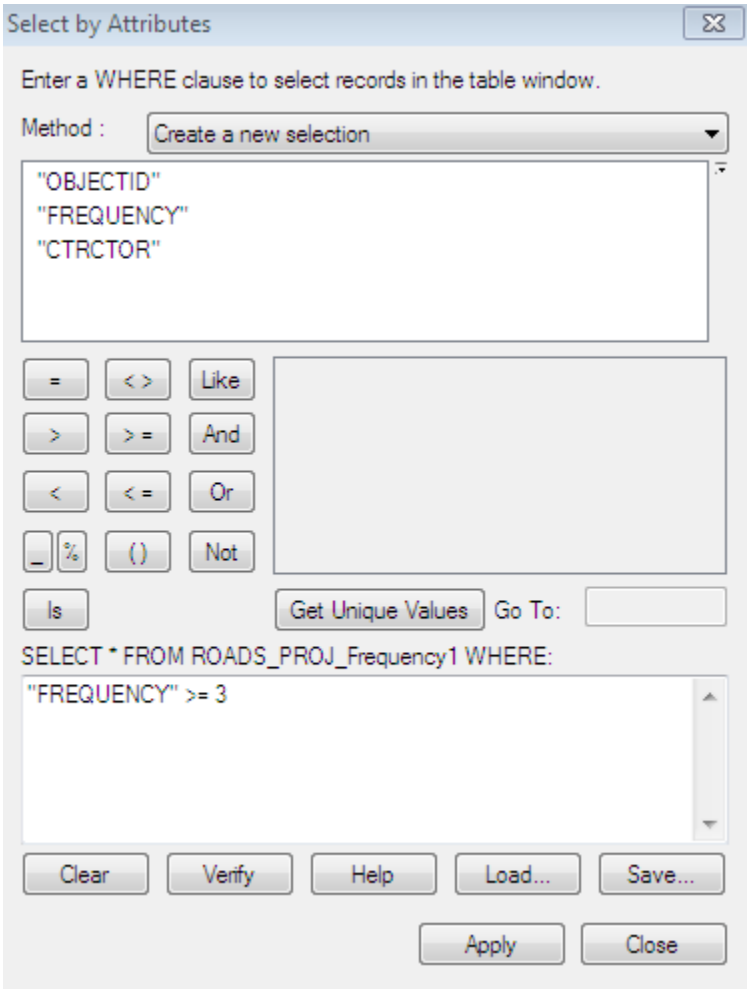


Figure 4.17: SQL query to determine contractors awarded three or more road project contracts

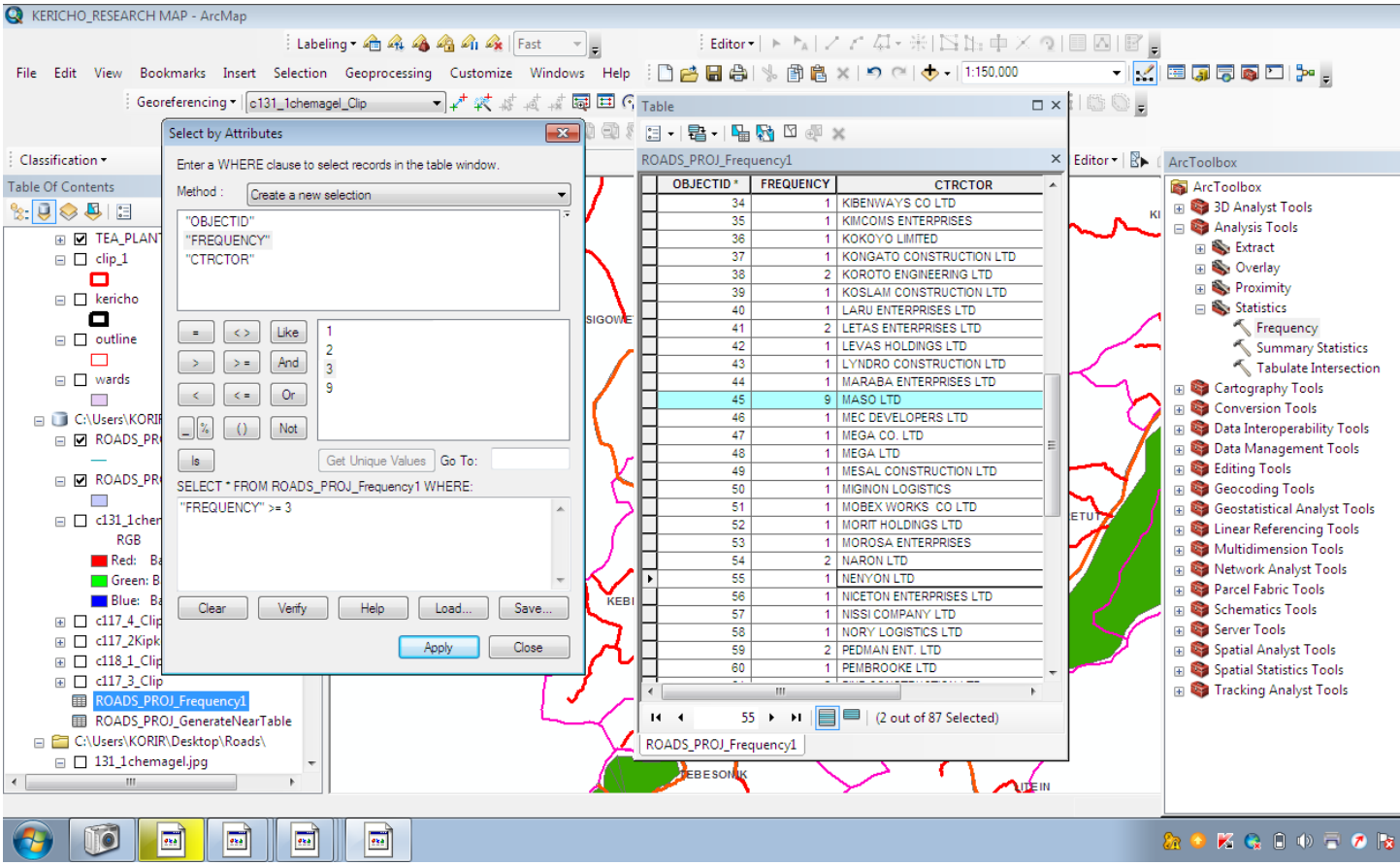
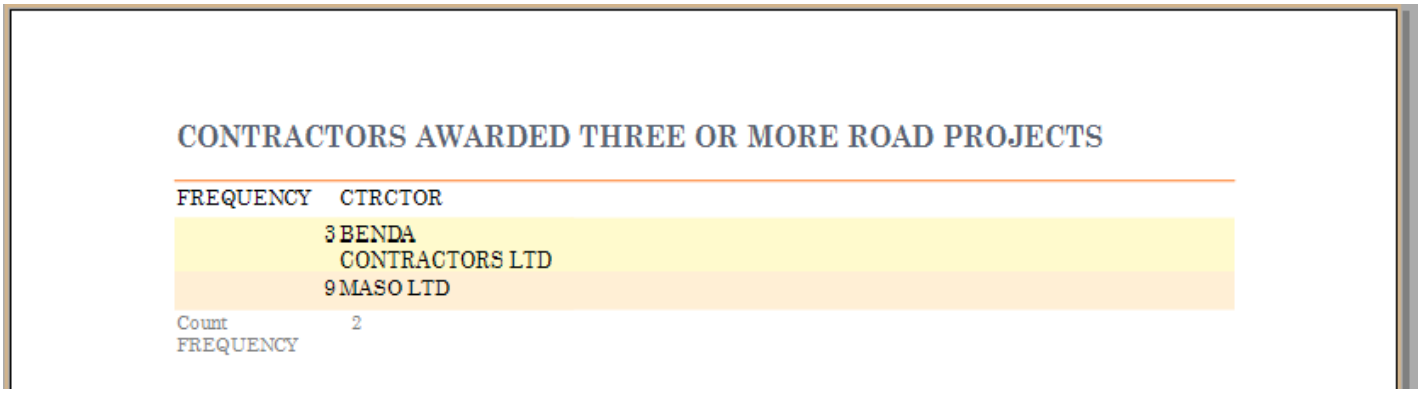


Figure 4.18: SQL query and results display of contractors awarded more than two contracts

A generated report showing contractors who were awarded three or more road project contracts

Table 4-3: Contractors awarded three or more road project contracts.



CONTRACTORS AWARDED THREE OR MORE ROAD PROJECTS

FREQUENCY	CTRCTOR
3	BENDA CONTRACTORS LTD
9	MASO LTD

Count 2
FREQUENCY

It was found out that two contractors were awarded more than two road project contracts. BENDA CONTRACTORS LTD was awarded three (3) road project contracts while MASO LTD was awarded nine (9) road project contracts. These reports were used to evaluate contractors who received more than two road project contracts.

Table 4-4: Summary of road projects behind construction schedule

ROAD PROJECTS BEHIND SCHEDULE

const	WARD	PROJ_TITLE	TOTAL_	DUR_MN	CTRCTOR	RD_LEN	WRK_	PROJ_MGER
BURET	CHEMOSOT	KABARTEGAN_CHEPKW-ARKWARAN	1300399 KES	3	BRIGMA CO LTD	1.62 km	90%	PROJECT ENGINEER
BURET	KAPKATET	CHEBWAGANRD_DARAJAMBILI RD	2221839 KES	5	QWETU CONTRACTORS & SUPPLIES LTD	2.78 km	0%	PROJECT ENGINEER
BURET	KAPKATET	KAPBOSSMAN_KAPJOSEASANG GATE	1770079 KES	3	MORIT HOLDINGS LTD	2.21 km	70%	PROJECT ENGINEER
KIPKELION EAST	TENDENO	WAMBARETEGAT_TENDENO_KAPSABET RD	4439839 KES	6	LARU ENTERPRISES LTD	5.55 km	90%	PROJECT ENGINEER
KIPKELION WEST	KEDOWA	OFF B1_KWADC_EWAT_SCHOOL RD	3606320 KES	6	GRAVEL WORKS AGENCIES LTD	4.51 km	80%	PROJECT ENGINEER
KIPKELION WEST	KIMASIAN	KEBENETIJNCT_NYAIROBI_ZONGONYET RD	3755759 KES	5	MASO LTD	4.69 km	50%	PROJECT ENGINEER
AINAMOI	KIPCHEBOR	KIBOIBEI_KENEGUT	4800479 KES	6	MIGINON LOGISTICS	6.00 km	80%	PROJECT ENGINEER
AINAMOI	KIPCHIMCH	BARAKA_CHEPYOSE_KI	1713920 KES	3	KIBENWAYS	2.14 km	90%	PROJECT ENGINEER
BELGUT	SAOSA	TINET_CHEYMEN ARD	2285919 KES	3	PEDMAN ENT. LTD	2.85 km	70%	PROJECT ENGINEER

Max TOTAL_COST M	4800479 KES	Min TOTAL_COST	1300399 KES	Sum TOTAL_COST	25894559 KES
Max DUR_MNTHS	6	Min DUR_MNTHS	3	Max RD_LENGTH	6.00 km
Min RD_LENGTH	1.62 km	Sum RD_LENGTH	32.36 km	Max WRK_PRGRES	90 %
Min WRK_PRGRES	0 %				

The table 4-4 was generated from the GIS database, shows road projects that were incomplete or ongoing depending on the progress level as depicted by the percentage level of progress.

From the table it was found out that only one road project; CHEBWAGAN RD – DARAJA MBILI RD with a length of 2.78 Km which had been awarded to QWETU CONTRACTORS & SUPPLIES LTD within KAPKATET WARD in BURET constituency had not commenced (it reflected zero level of work progress) after the expiry of the recommended construction period. *See also figure 4.15.*

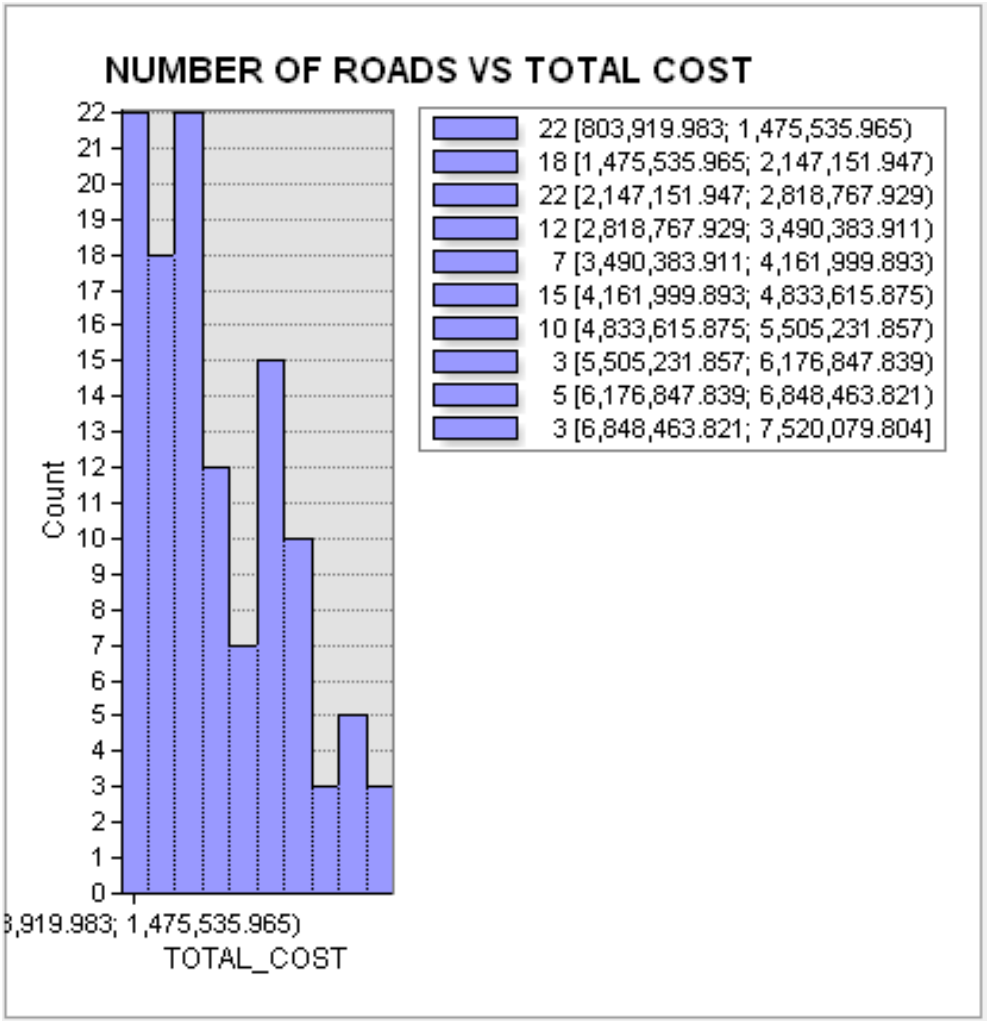
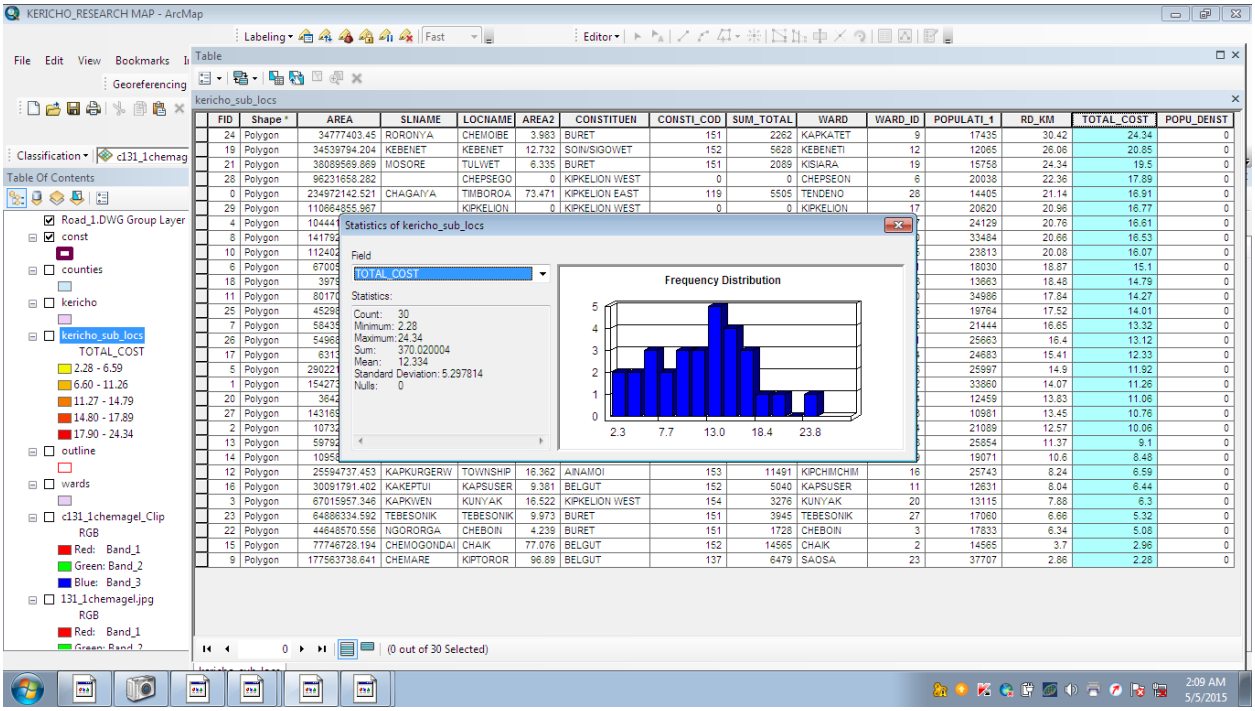


Figure 4.19: Graphical representation of number of roads vs amount of funds used



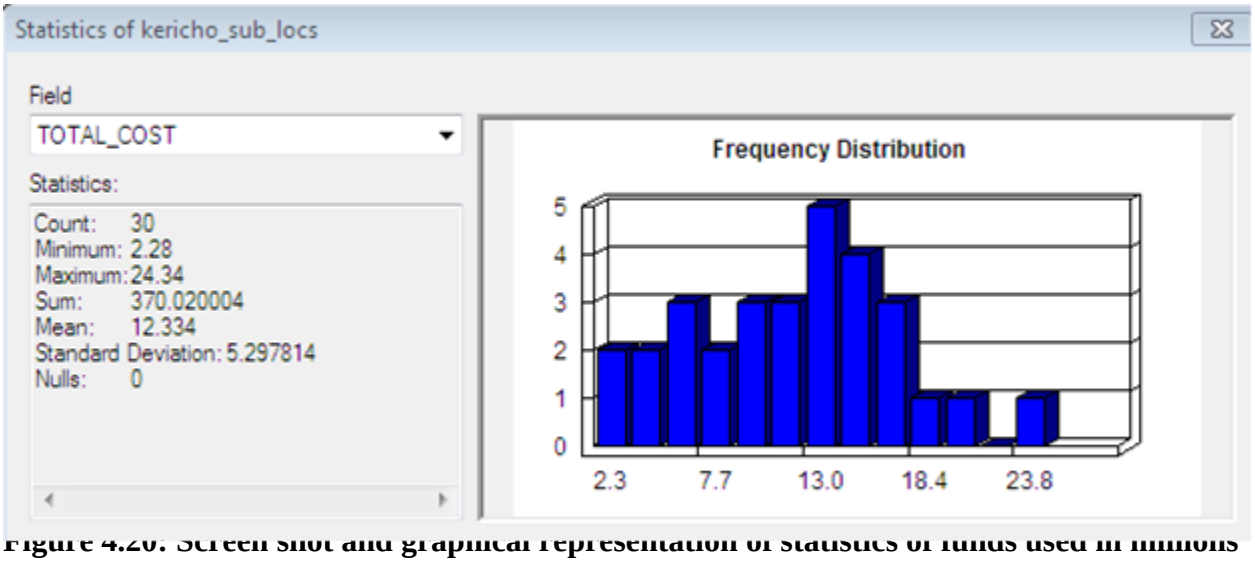


Figure 4.20: Screen shot and graphical representation of statistics of funds used in millions (KES)

From the analysis of statistics using GIS the total amount of funds used for the development of road projects were KES 370 million. The lowest amount of funds used in a ward for road projects were KES 2.28 million whereas the highest amount of funds used for road project amounted to KES 24.34 million in another county assembly ward.

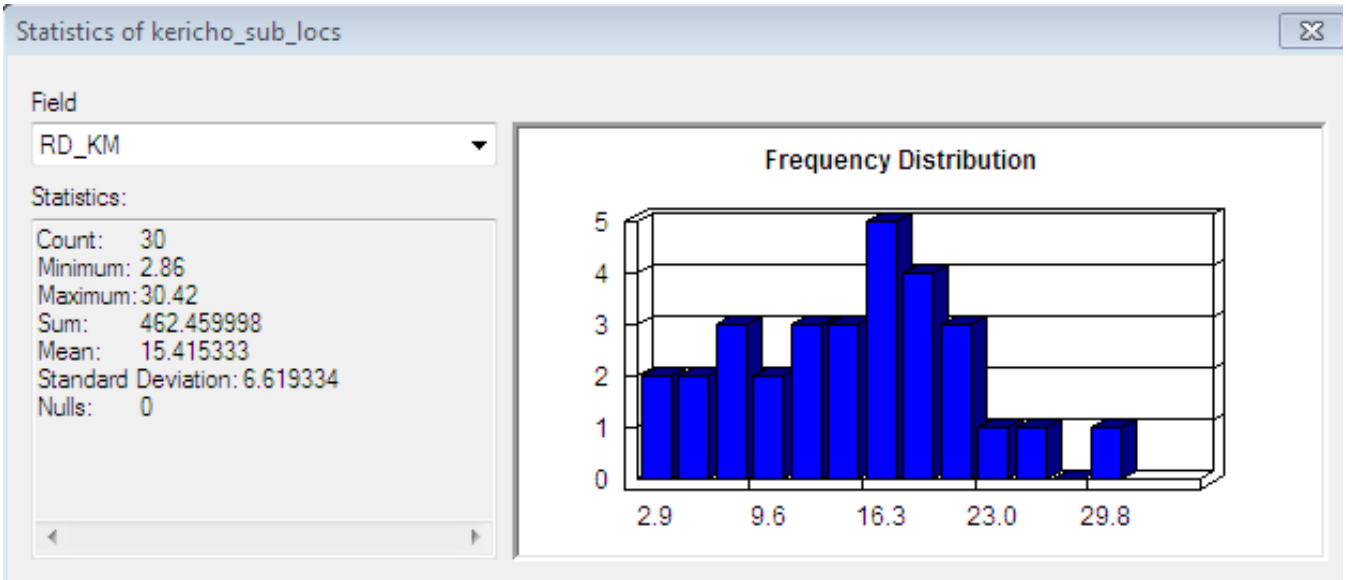


Figure 4.21: Graphical representation of road length developed in Kilometers

From the above statistics, a total of 462.46 kilometers of road projects were developed within the whole of Kericho County using county development funds. The minimum sum of road length for road projects developed in a county assembly ward was 2.86 kilometers, whereas the maximum sum of road length developed in a county assembly ward was 30.42 kilometers.

From the statistics generated using GIS, the county government can monitor and evaluate on the county's set targets of road development projects. In the financial year 2014/2015 the County Government of Kericho had targeted to construct 600 km of roads to murram standard, with each ward getting 20 km of new murram road. Comparing the target of 600 km of road length to that was to be constructed in the FY 2014/2015 and the results obtained (462 km) in the first half of FY 2014/2015 it was found out that a deficit of 138 km were to be constructed in the second half of financial year 2014/2015.

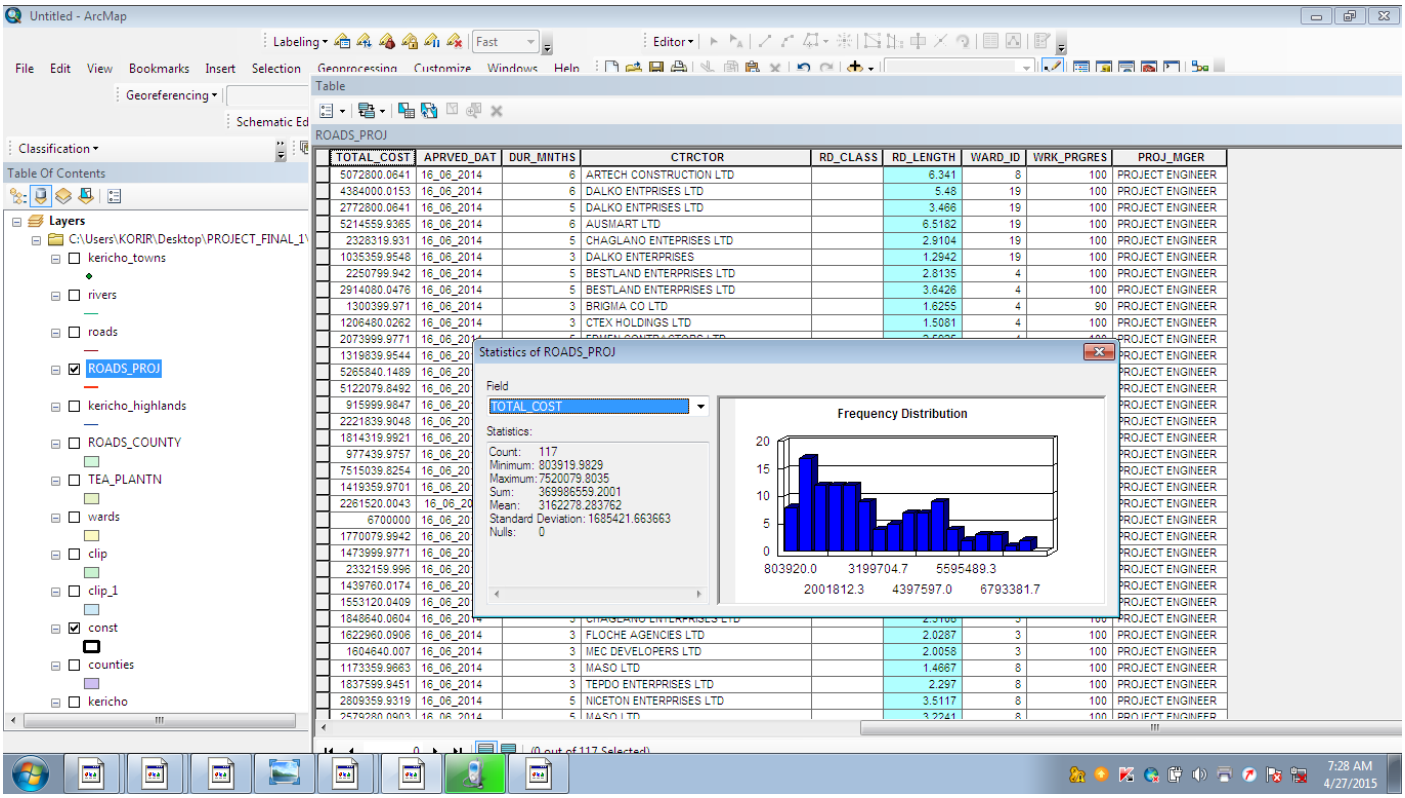


Figure 4.22: Graphical representation of projects distribution versus cost

From the results as depicted in the graph, it was evident that BURETI constituency has the highest number of projects that have been funded by the County Government of Kericho. A total of 115.51 Km of road was funded at a cost of KES 92, 412,559.89 within BURETI constituency. However, SOIN/SIGOWET constituency was the least funded with a total of 46.35 Km at a cost of KES 37,084,560.2

SUMMARY REPORTS

The GIS were used to generate reports in table format for the projects funded.

Table 4-5: Summary report for road projects

ROAD FUNDS USED IN KERICHO COUNTY

const	WARD	PROJ_TITLE	TOTAL_COST
BELGUT	KABIANGA	KABIANGA TEA FARM_KAPLONG RD	5072800.0641
BURET	KISIARA	RORET_MABASI ROAD	4384000.0153
BURET	KISIARA	OFF C24_KAPCHELACH ROAD	2772800.0641
BURET	KISIARA	RERESIK PRY_RERESIK SEC_KEREGUT TBC_RORET	5214559.9365
BURET	KISIARA	KAPTOLOTYOT_KISU	2328319.931
BURET	KISIARA	MABASI SCH_KETINGOI RD	1035359.9548
BURET	CHEMOSOT	KABITUNGU_CHEBA	2250799.942
BURET	CHEMOSOT	CHEBARAA_CHEMOSI	2914080.0476
BURET	CHEMOSOT	KABARTEGAN_CHEP	1300399.971
BURET	CHEMOSOT	KAP_REUBEN_KIPTO	1206480.0262
BURET	CHEMOSOT	CHERES TBC_CHEBULU TBC_MOSOMBOP RIVER	2073999.9771
BURET	CHEMOSOT	ARORWET TBC_BARGIRO PRY_KIPTEIMAT RIVER	1319839.9544
BURET	LITEIN	BANDA PILIS_SACHANGWAN RD	5265840.1489
BURET	LITEIN	SINENDET CHEBORGE JNCT_KAPPHILIP KOECH	5122079.8492
BURET	LITEIN	KIPKUNA_KALAACHA	915999.9847
BURET	KAPKATET	CHEBWAGAN RD_DARAJA MBILI RD	2221839.9048
BURET	LITEIN	KUSUMEK MARKET_KUSUMEK DIP RD	1814319.9921
BURET	KAPKATET	LITEIN DC JNCT_MORIT RIVER	977439.9757

Table 4-6: Summary report for road projects with total cost greater than KES 5 million

ROADS PROJECTS IN BURET CONST. WITH TOTAL_COST >Kshs 5000000

const	WARD	PROJ_TITLE	TOTAL_CC	DUR_MNT	CTRCTOR	RD_LENG	WRK_PF
BURET	KISIARA	RERESIK PRY_RERESIK SEC_KEREGU T TBC_RORET	5214559.9365	6	AUSMART LTD	6.5182	100
BURET	LITEIN	BANDA PILIS_SACHA NGWAN RD	5265840.1489	6	BALOONTECH (K) LTD	6.5823	100
BURET	LITEIN	SINENDET CHEBORGE JNCT_KAPPHI LIP KOECH	5122079.8492	6	JUBILEE AFRICA LTD	6.4026	100
BURET	KAPKATET	OFF C24 NURU VILLAGE_MUT URI TBC_MUTURI VILLAGE	7515039.8254	6	WISE SYSTEMS LTD	9.3938	100
BURET	KAPKATET	OFF C24_ALICE KOECH RD	6700000	6	BENDA CONTRACTOR S LTD	8.375	100

Sum TOTAL_COST 29817519.76 Max DUR_MNTHS 6 Min DUR_MNTHS 6

Max RD_LENGTH 9.3938 Min RD_LENGTH 6.4026 Max WRK_PRGRES 100

Min WRK_PRGRES 100

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The main objective of the study was to demonstrate use of Geospatial Technology in monitoring and evaluation of county development funds. All the objectives set for the study were well achieved.

All the road projects developed by Kericho County Government during the first half of the FY 2014/2015 were mapped. The mapped projects were overlaid to map layers containing trading centres and tea factories. These were used to analyze some of the impacts of these road projects to the society. From the statistics generated using GIS, the county government can monitor and evaluate on the county's set targets of road development projects.

The County Roads Department surpassed its half year target of 300 km of road length by 162.46 km. It was found out that a deficit of 137.54 km were to be constructed in the second half of financial year 2014/2015.It was found out that the target in most county assembly wards were surpassed.

With availability of more county development funds the County Roads Department will surpass the target construction of 600 km road length during full FY 2014/2015.

All road projects funded by Kericho County Government within Soin/Sigowet constituency were completed within the recommended construction period. Buret constituency had the highest (three) road projects which were behind the recommended (scheduled) construction period. All the road projects with construction cost greater than five million Kenya shillings were in Buret constituency

Demonstrating the use of Geospatial Technology from the findings of this study, it can be concluded that;

Generation of reports, maps, queries and display of the database were used to monitor and evaluate the use and distribution of county development funds. It reveals the visual representation of development projects distribution. The higher the population the greater the county development funds to those wards. Considering the impact of the society the improved roads mostly linked market centers and/or trading centres. The most funded constituencies are

BURET and BELGUT. These two constituencies are producing tea as a cash crop and since tea leaves are highly perishable raw products it requires urgent transportation to the tea processing factories. Decision making using maps, reports and queries from GIS were excellent as it displays, analyzes, stores, disseminate information in a friendlier manner as compared to other methods which have no spatial information.

Geographic Information Systems (GIS) provides monitoring and evaluation and a textured picture of funded road projects that enables decision makers to target resources, better address road equity, and work towards stronger overall road network infrastructure performance.

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5.2 Recommendations

The project study demonstrated use of Geospatial Technology in Monitoring and Evaluation of County Development Funds.

1. The County Government of Kericho and other County governments should adopt the use of Geospatial Technology (GIS and Remote Sensing) for monitoring and evaluation of county development funds.
2. The county governments should use GIS to determine county development funds distribution to all county assembly wards.
3. Generation of reports, maps, charts, graphs, query and display of results through GIS should be disseminated to all county assembly wards offices for public viewing and scrutiny. Web mapping could be used to disseminate information and maps to reach more users.
4. The reports of development projects developed using county development funds by County Governments and generated from GIS are useful to the Senate Assembly and county assembly when doing oversight role to the County Governments.
5. The socio-economic data should be considered and included in future to share county development funds to all county assembly wards.
6. Since the study only covered projects developed by the Department of Roads, Public Works and Transport within Kericho County, all development projects done by other departments within the county should be included in the GIS database so as determine the overall distribution of county development funds in the county.

7. For each financial year a GIS database, GIS reports and maps of development projects achieved through county developments funds be generated using GIS and filed in layers and comparison made for the subsequent years through overlays and analysis. This will give the general development trend of the county over years. Hence, monitoring and evaluation of the effectiveness and trend of distribution of county development funds within a county.

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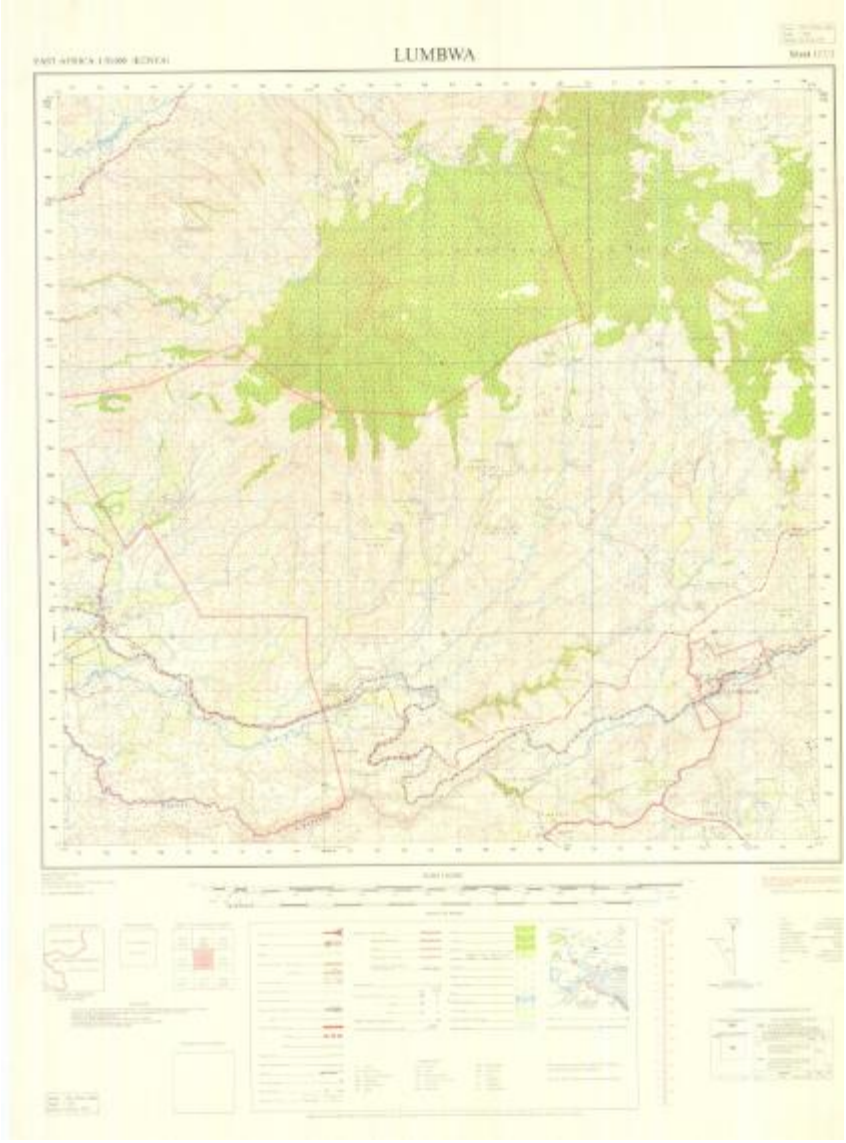
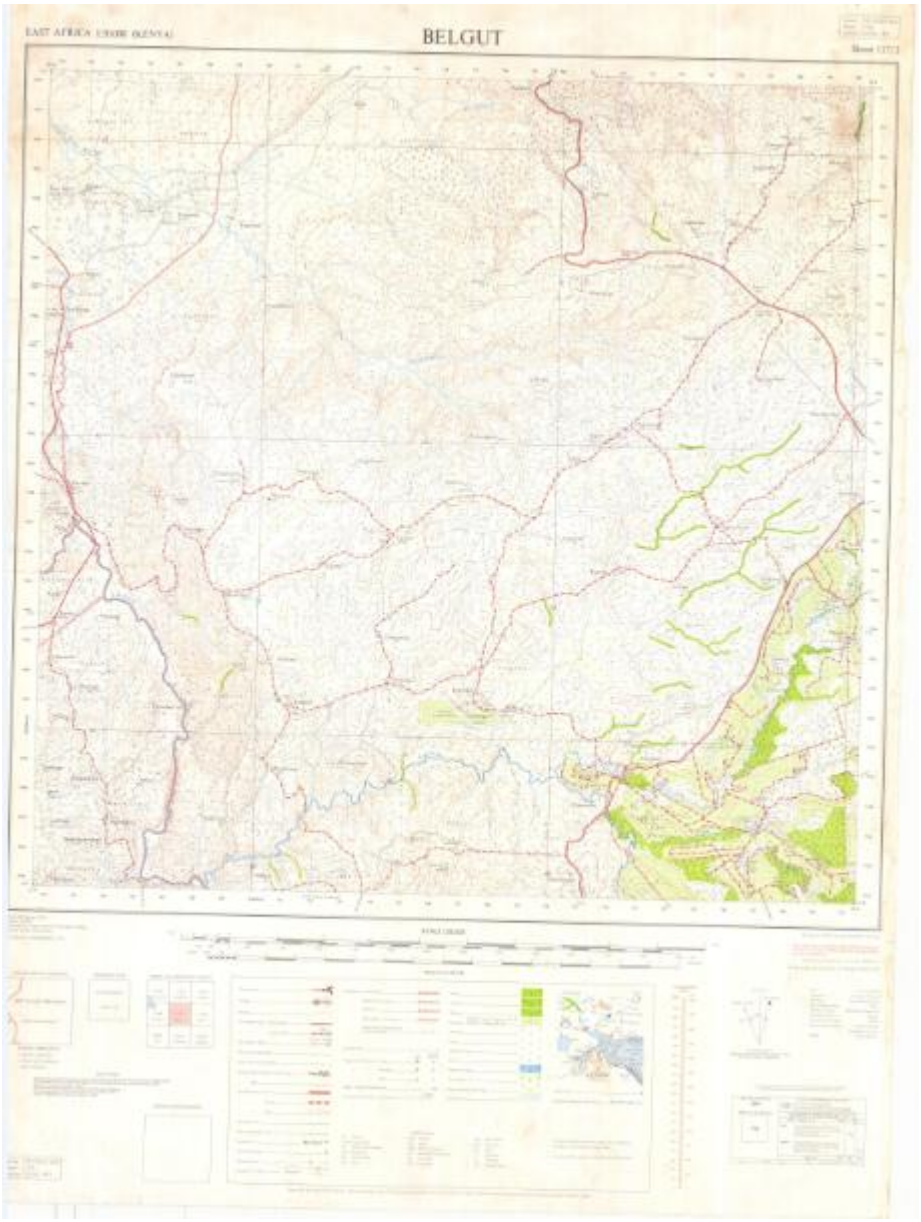
APPENDICES

Appendix 1 ……Topographic maps

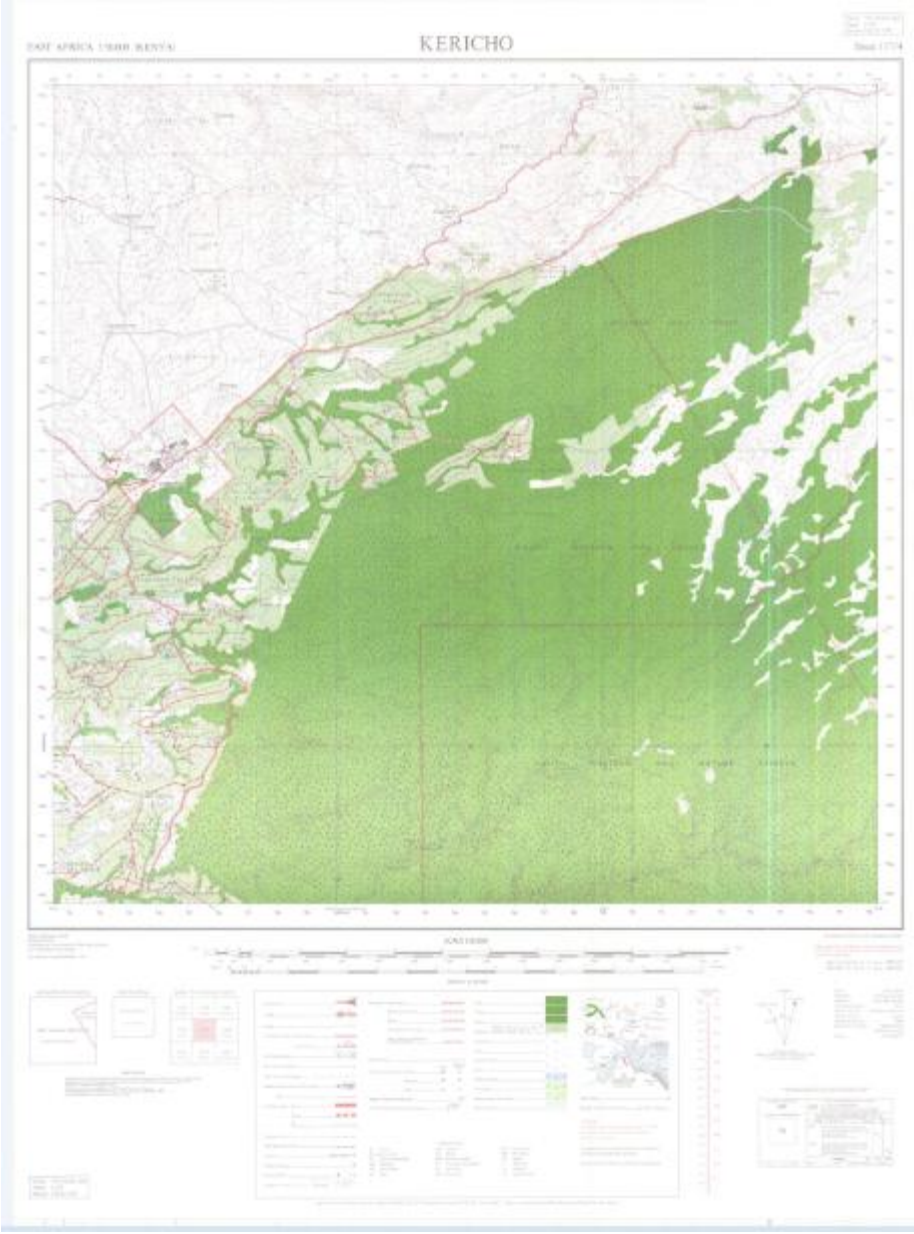
A topographical map sheet 117/1 - MUHORONI



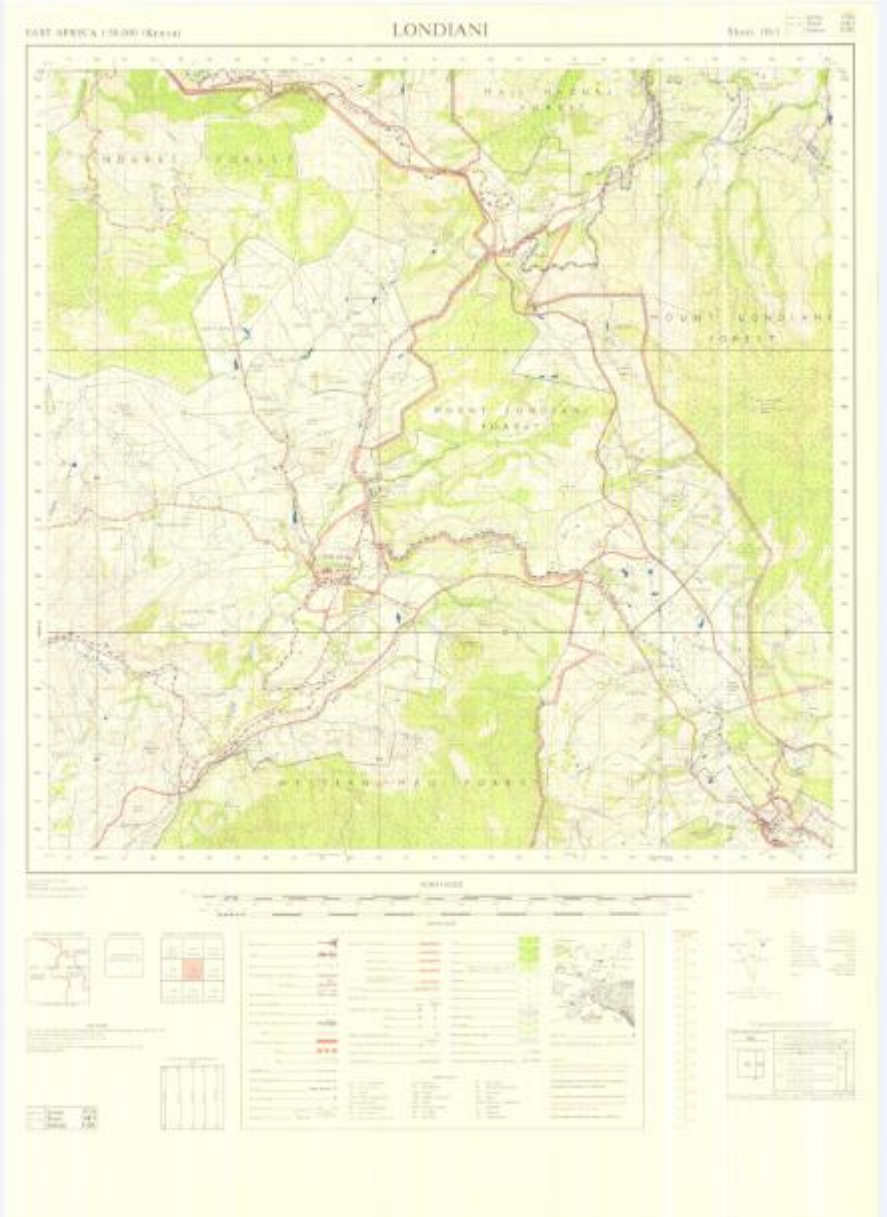
A topographical map sheet 117/2 - LUMBWA



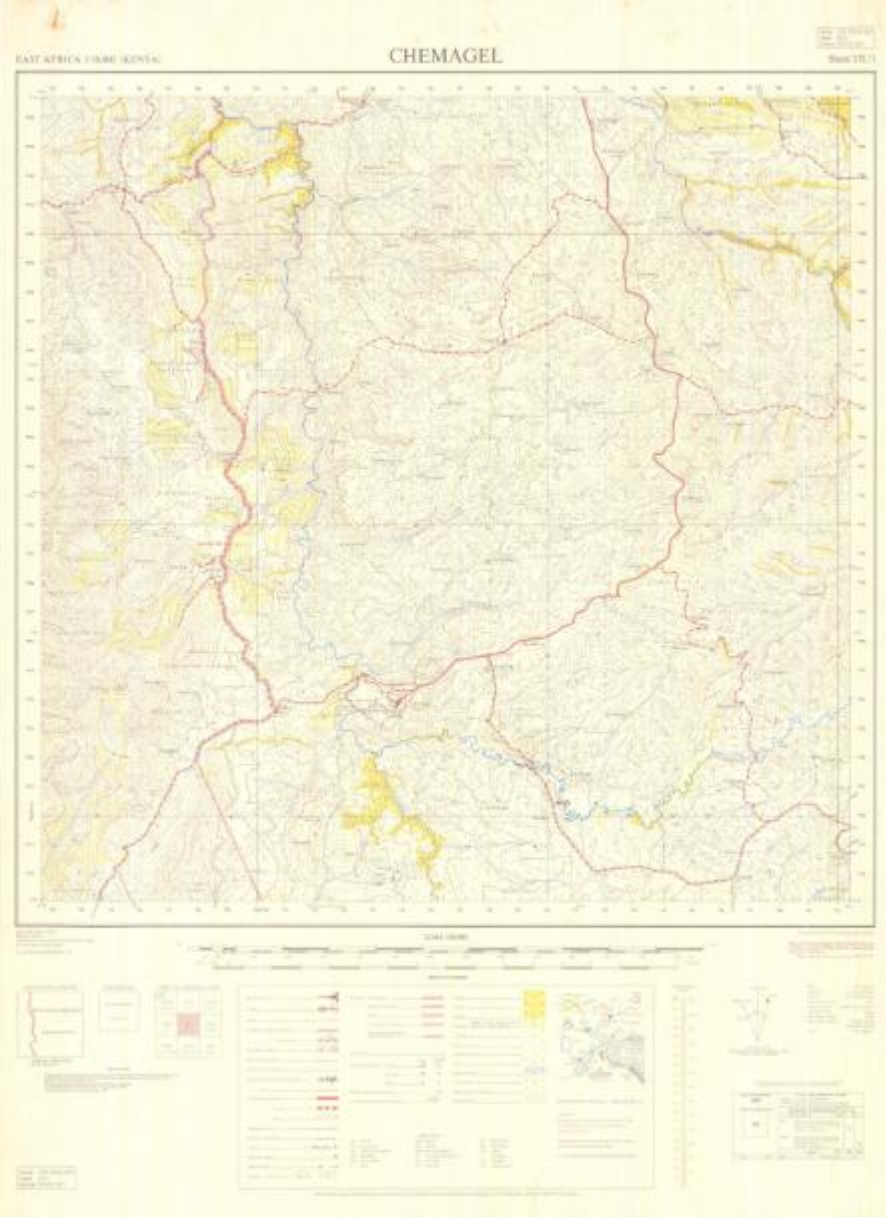
A topographical map sheet 117/3 - BELGUT



A topographical map sheet 117/4 - KERICHO



A topographical map sheet 118/1 - LONDIANI



A topographical map sheet 131/1 - CHEMAGEL

ROAD FUNDS USED IN KERICHO COUNTY

const	WARD	PROJ_TITLE	TOTAL_COST
BELGUT	KABIANGA	KABIANGA TEA FARM_KAPLONG RD	5072800.0641
BURET	KISIARA	RORET_MABASI ROAD	4384000.0153
BURET	KISIARA	OFF C24_KAPCHELACH ROAD	2772800.0641
BURET	KISIARA	RERESIK PRY_RERESIK SEC_KEREGUT TBC_RORET	5214559.9365
BURET	KISIARA	KAPTOLOTYOT_KISU	2328319.931
BURET	KISIARA	MABASI SCH_KETINGOI RD	1035359.9548
BURET	CHEMOSOT	KABITUNGU_CHEBA	2250799.942
BURET	CHEMOSOT	CHEBARAA_CHEMOSI	2914080.0476
BURET	CHEMOSOT	KABARTEGAN_CHEP	1300399.971
BURET	CHEMOSOT	KAP_REUBEN_KIPTO	1206480.0262
BURET	CHEMOSOT	CHERES TBC_CHEBULU TBC_MOSOMBOP RIVER	2073999.9771
BURET	CHEMOSOT	ARORWET TBC_BARGIRO PRY_KIPTEIMAT RIVER	1319839.9544
BURET	LITEIN	BANDA PILIS_SACHANGWAN RD	5265840.1489
BURET	LITEIN	SINENDET CHEBORGE JNCT_KAPPHILIP KOECH	5122079.8492
BURET	LITEIN	KIPKUNA_KALAACHA	915999.9847
BURET	KAPKATET	CHEBWAGAN RD_DARAJA MBILI RD	2221839.9048
BURET	LITEIN	KUSUMEK MARKET_KUSUMEK DIP RD	1814319.9921
BURET	KAPKATET	LITEIN DC JNCT_MORIT RIVER	977439.9757
BURET	KAPKATET	OFF C24 NURU VILLAGE_MUTURI TBC_MUTURI VILLAGE	7515039.8254
BURET	KAPKATET	OFF C23_KAPMOSCOW RD	1419359.9701