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REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER
OF SCIENCE IN GEOGRAPHIC INFORMATION SYSTEMS**

**TITLE: "Use of Geographical Information Systems to enhance
revenue collection in Local Government:
Case study of Town Council of Kilifi "**

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DECLARATION

This project is my original work and has not been presented for a degree in any other University



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DEDICATION

This project is dedicated to my loving wife AGNES WANJIRU MWAURA for her continued support and encouragement throughout the period of study; and to my children Charles, Grace and Florence. You all gave me ample time to read and excel.

ABSTRACT

The need to raise sufficient finance for local government administrations to function effectively is perhaps the main objective of local governance. Service delivery master plans and programs are irrelevant if there is no sustainable source of income to facilitate their implementation. Also to be noted, local government handles a colossal amount of data needed for efficient administration and to support critical decision making processes. However, this may not be realizable where available data cannot be matched with necessary management tools to create desired results. For instance, property taxation is the main source of income for local governments. There is therefore need for a management system that will bring about desired efficiency and effectiveness in the administration of property taxation. A land information system (LIS), a kind of Geographical Information System (GIS), can provide the required data management capabilities for property tax administration. This project looks into the use of GIS to enhance revenue collection in local government, and particularly the collection of property tax which is the most critical source of revenue. It develops time and cost effective procedures and methods for its implementation vis-a-vis building the required database and developing relevant users' applications. For this study, Town Council of Kilifi, one of the 175 local authorities in Kenya was taken as a sample application. Procedures were discussed in displaying the results of GIS work using real data collected for Town Council of Kilifi. Queries were developed to generate required information for administration of property tax in the local authority. From the analytical process carried out, it is evident that planning for revenue collection can best be carried out by a system that combines spatial and attribute data management capabilities like GIS. The project notes the role of GIS as a veritable application tool in the administration of property tax in any geographical area. It is recommended that the system be upgraded to cover other applications such as collection of business permit fees and development approval fees which basically use the same spatial data, since developments and business are carried out within a property. These can be easily achieved by taking an inventory of all developed properties and the business being carried out within those parcel units. It is also recommended that the Ministry of Local Government create an enabling environment for Local Authorities to uptake and maintain GIS technology.

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CHAPTER ONE

INTRODUCTION

1.1 Background to study

Local Governments worldwide are elaborate systems of public administrative authorities over areas that are smaller than a state. The term local is used to contrast with offices at nation state level, which are referred to as the Central Government or National Government.

In Kenya, Local Government system is divided into four categories. These are: County Councils, Town Councils, Municipal Councils and City Councils. These are more often referred to as Local Authorities, which are corporate bodies established through an Act of Parliament Cap 265, through which they derive their powers.

Currently (2011) the system has 175 Local Authorities composed of the following: One (1) City Council, forty five (45) Municipal Councils, Sixty Seven (67) County Councils and Sixty two (62) Town Councils. Local Authorities are established with the aim of providing basic social services to the local community. Generally they have the power to among other things make laws enforceable locally within their areas of jurisdiction, and raise revenue locally to support their budgetary requirements.

Besides, they are planning and management authorities as they are supposed to ensure there is harmonious development within their areas of jurisdiction. Among their broad mandate, local authorities are charged with the responsibility of ensuring local governance, provide basic services such as health, refuse collection, primary education, water and sanitation, road construction etc.

All these service delivery activities and other Council operations require financial resources for their implementation and hence call for the local authorities to raise revenue. Normally, local authorities in Kenya obtain funds from Central Government in form of grants. Other sources include single business permits, development approval fees, property taxation, fines and charges, assistance from development partners etc.

The main source of revenue collected by local authorities comes from property taxation. The advantage of collecting property tax over other types of revenue collection is that properties are permanent and can be easily identified. The efficiency of collecting these revenues highly depends on how well land records are kept, accessed and the number of properties captured in the database.

To implement an effective property taxation system, up-to-date information is needed. Ideally, a land information system such as a cadastre needs to be developed. At its heart is a database that records all the properties in a town registering the size, usage, location, ownership and site value. Such a database will assist local governments in equitably and comprehensively collecting property tax.

Property tax collection requires spatial data, typically involving positional data. Positional data determines 'where' things are, or perhaps, where they will be. More precisely property tax collection deals with questions related to 'geographic space', which can informally, be characterized as having data relative to the Earth's surface. This is therefore data that can be handled by a Geographic Information System (GIS). A GIS is a computer based information system that enables the input, management, manipulation, analysis, output and dissemination of all kinds of spatially referenced, land related data and information at all (mapping) scales. This is its primary purpose.

The role of GIS in Local Government setting is more than simply automating a few obvious tasks for the sake of efficiency. A Local Authority should view the GIS as an opportunity to introduce fundamental changes into the way its business is conducted. As with the adoption of management and executive information systems in the business world, the adoption of GIS effectively reorganizes the data and information the Local Authority collects, maintains and uses to conduct its affairs. This can, and arguably should, lead to major changes in the institution, to improve both effectiveness and efficiency of operations.

GIS belongs to the class of computer systems that require the building of large data bases before they become useful. Unlike many micro-computer applications where a user can begin use after the purchase of the Hardware and software, the use of a GIS requires that a large spatial database be created, appropriate hardware and software be

purchased, applications be developed, and all components be installed, integrated and tested.

According to findings of the urbanization studies to inform the formulation of an 'Urban Development Policy for Kenya', land information in both local authority and Government offices is mostly filed in manual systems: paper files, maps and plans that are stored in drawers and cabinets. This has been a major cause of delays in land surveying, development plan approval and in providing current information on land availability and the land use planning process (Matrix Development Consultants, 2009). The kind of system developed in this study is a Land Information System (LIS), which is a particular kind of GIS as observed by Mulaku, providing the same capabilities for handling mainly land parcel based data and information at mainly large scales (Mulaku, 2000)

The Town Council of Kilifi is one of the 175 Local authorities in Kenya. It is located in Bahari Division in Kilifi District in the Coast Province of the Republic of Kenya. The primary focus of the council just like the rest in the country is to provide basic social services to its residents within its area of jurisdiction. However, the Council faces various challenges in fulfilling its primary task. One of the major challenges is poor collection of property tax. The problems are further compounded by lack of geospatial data to assist in locating the properties. The Council also has no records of all registered properties within its area making it difficult to collect property tax.

1.2 Statement of the problem

Despite the enormous benefits realised in the use of GIS technology as a management tool in local governments worldwide, Town Council of Kilifi has not embraced GIS technology. This project therefore advocates the strengthening and usage of GIS in enhancement of revenue collection in our local authorities. Kilifi Town Council will be used as a case study area.

1.3 Project justification

Over the years, Local Authorities have been accused of poor service delivery by the local residents despite collecting taxes from them. On the other hand, the local

authorities have been complaining of lack of funds to finance service delivery programs.

Property taxes accounts for over sixty percent of the local authorities' annual budget in Kenya (Matrix, 2009). It is also the most reliable source of income due to its permanent nature.

The challenge is to set up an efficient tax collection system, based on property taxation in local authorities where the land information is limited, land record management is poor, the institutional capacity is weak, and the capacity of professionals needs to be built.

Town Council of Kilifi collects less than thirty percent of land rates from all rateable properties within its jurisdiction due to lack of an efficient land information system that will manage land records effectively (Minutes, 2009). Installation of a land information system and digital cadastral records will enhance collection of property tax, and hence improve the council revenue. GIS provides the capability for dynamic query and analysis, display of information and a more understandable representation.

1.4 Objectives of the project

1.4.1 General objective

To demonstrate use of GIS in local authorities by showing that it enables better workflow of information, high quality information for decision- making, better integration among different departments and offices within the organization, and more efficient information dissemination. These will lead to possible higher revenue collection, cost reduction in operations, increased efficiency and effectiveness in the service delivery.

1.4.2 Specific objectives

The specific objectives of the Kilifi town GIS project:

- User needs assessment.
- Land Information System development.
- Query demonstration.

1.5 Scope of the project

GIS has a lot of functionality that is useful to Local Government operations such as land-use planning, disaster management, development control, infrastructure planning, revenue collection etc. The study focuses on developing a GIS database with a limited number of attributes for each registered property to enhance collection of property taxes. All other aspects of the GIS were left out due to time constraints.

It was estimated, through enquiries at lands registry that there are more than five thousand registered properties within Town Council of Kilifi eligible for taxation. The current valuation roll captured more than three thousand registered taxable properties. Ideally, the study should have included all registered properties within the Council boundaries. However, due to time limitations, the study digitized five hundred properties appearing in the current valuation roll to demonstrate the benefits of using GIS in property tax collection.

1.6 Organization of the report

This report is organized into five chapters. Each chapter consists of several sub-topics as outlined in the table of contents. Chapter one is the introduction of the study; detailing the background information, the objectives and problem statement. The second chapter gives an outline of the literature review, which basically highlights similar efforts and milestones achieved in other parts of the world in use of GIS. The literature review is divided into two sections, one discussing local government and property taxation while the other part outlines use of GIS in enhancing property taxation. The methodology used in the study to achieve the objective is discussed in chapter three. Chapter four shows the results of the study, including analysis of the results. The final chapter gives conclusions and recommendations based on the findings of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Local governments and property taxation

Local governments world-wide depend on their respective central governments for their powers and functions. Their local prerogative is defined by the constitution and legislation and therefore they have the responsibility to design their revenue generation, control and management methods within the law. Thus, a local government area refers to a political sub-division of a state constituted by law, and having substantial control of local affairs.

The local governments do have some general characteristics, and must of necessity possess the following attributes;

- i. **A representative outlook:** The wheel of the council must be kept going, controlled, and supervised by people who are elected or appointed.
- ii. **A definite geographical area:** It must reconstruct its exercise of powers and functions within a particular geographical jurisdiction which must be a well defined territorial area.
- iii. **A clientele or population:** Local government administration has to do with services aimed at improving the lots of the local people.
- iv. **Viability:** Must be able to generate some funds internally for its services.
- v. **Active involvement in community matters:** Since the local government is partially financed by the local people, their interest must be protected by it.
- vi. **Multipurpose attribute:** No local government has a single purpose. This means that a local government performs wide and varied functions which it must render if the people are to support and sustain it.

In Kenya, local authorities function through structured departments. The numbers of departments vary from one local authority to the other depending on the size. Some of the departments include; Town Clerk-administration, Treasurer-finance/Revenue collection, Engineering- Infrastructural works, Planning- Land-use planning and Development Control, Water and sanitation (currently under water boards), Education, Environment and Social services.

The operations of these departments have geospatial link and hence a central network of geospatial database accessible to all departments is critical to the efficiency and effectiveness of the service delivery.

Local governments require money in order to provide services and address other urban development mandates. Unlike the Central government that obtains funds through sales, income tax and other assorted taxation regimes, local governments mainly depend on property taxes, development approval fees, business permits, fines, advertisement etc.

Property tax can be defined as a “tax” imposed by local authorities upon owners of real property within their jurisdiction based on the value of such property. The tax rate is often given as a percentage of the property value. Under a property tax system, the government performs an appraisal of the monetary value of each property and tax is assessed in proportion to that value.

Property tax is the main source of income for local government and has many advantages such as;

- i. Properties can be identified easily
- ii. Property cannot be hidden
- iii. There is a reasonable correlation between the value of property held and the wealth of the owners
- iv. Unpaid tax can be set as a charge (debt) against the property and in extreme cases the property can be sold to recover the unpaid tax.
- v. There is a reasonable relationship between the value of the property and the services consumed by the occupiers.

However, the challenge is how to set up an efficient tax collection system, based on property taxation, in a country where the land information is limited, the institutional capacity of the local authorities is weak, and the capacity of the professionals is inadequate.

Taxes on land and property have both fiscal and non-fiscal effects. The revenue such taxes produce is often an important source of finance for local governments. The extent to which those governments have control over property taxes is thus often an

important determinant of the extent to which they are able to make autonomous expenditure decisions. The level, design, and control of property taxation are thus, in many countries critical elements in effective decentralization policy.

Dependence on property taxes as a source of local government revenue varies across jurisdictions depending upon many factors, such as the expenditure responsibilities assigned to local authorities, the other revenue available to them, the degree of freedom local governments have with respect to property taxation, the size and growth of the tax base available to them, and their willingness and ability to enforce such taxes.

Not only are there significant differences in how property is taxed across countries, there are often significant differences within countries. The greater the degree of local discretion in establishing the tax base and setting the rates, the more diversity there will be in property taxes within a country. In some countries, one property tax covers all types of property. In others, there are different taxes for different types of real property. A country may, for example, have separate taxes on land and buildings, separate taxes on residential and non-residential property, or separate taxes for urban and rural areas.

Kenya has property taxes known as land rent, stamp duty (Paid at the time a property is sold) and land rates. Land rates and frequency of payment is determined by the respective local authorities that values the land's worth. The properties' worth is the value of the land only (unimproved site value). It does not include the existing improvements on the property.

Many provinces in Canada levy property tax on real estate based upon the current use and value of the land. This is the major source of revenue for most municipal governments in Canada (Wikipedia, 2011)

In India, property tax or 'house tax' is a local tax on buildings, along with appurtenant land, and imposed on owners. The tax power is vested in the states and it is delegated by law to the local authorities, specifying the valuation method, rate band, and collection procedures. Vacant land is generally exempted from this tax (ibid).

In the United States, property tax on real estate is usually levied by local government. The assessment is made up of two components – the improvement or building value, and the land or site value (ibid).

Property tax in Netherlands is levied on homes on a municipal basis in two parts; for the one who lives in the house, and for the owner of the house. When one has a rental home, they are only liable for the living part of the tax (Wikipedia, 2011)

Property taxes are assessed in all fifty states of United States of America and account for 73% of local government revenue. The taxes pay for vital services such as schools, local roads construction and maintenance, police, fire, and other emergency services, libraries, water and sewer, and a host of other services provided primarily by local government (Klein, 2006)

In February 2002, Tennessee Advisory Commission on Intergovernmental Relations (TACIR) released a report on the local property tax in Tennessee as part of local government finance. The report presented a lengthy analysis of the local property tax in Tennessee and included among other details the importance of the property tax to local government finance in Tennessee. According to the Department of Revenue collection data for fiscal years 1999 and 2005, the property tax collection had grown by 44.5% between those periods. The property tax revenues accounted for over 72% of the combined total revenue in 2005 (Green, 2006).

Improved property taxation as a means of addressing the problems of the urban poor is perhaps a concept that many would support. Robin Hood robbed the rich to give to the poor, because the poor were paying excessive taxes and received no benefits from them. The rich can use their economic and political power to obtain services, but for the poor the unit cost of services is much higher than for the rich, the classic example being water (Corker, 2001).

In conclusion, by using property taxes to fund the supply of services to the urban poor, the local authorities can reduce the unit cost of service provision. The provision of

services to the urban poor also increases their opportunities for wealth creation. The result is a virtuous circle of cost reduction and wealth creation.

By contributing to property taxes the urban poor also legitimise the political power of the poor. For many, “no representation without taxation” is more relevant than “no taxation without reorientation” (Corker, 2001).

2.2 The study area

The Town Council of Kilifi was chosen for the case study. It is located in Bahari Division in Kilifi District in the Coast Province of the Republic of Kenya. The town is situated along the shorelines about 40km from Mtwapa on the Mombasa -Malindi road. It is 60km North of Mombasa and approximately 480km East of Nairobi. Kilifi Town is sub-divided into a Southern and Northern part by Indian Ocean creek which extends for about two kilometres to the mainland.

The Council is one of the 175 local authorities in Kenya and consists of six (6) electoral wards, namely: Mnarani, Mavueni, Takaungu/Shaurimoyo, located in the southern part of the creek and Hospital/Sokoni, Kibarani and Ngala wards located on the northern part of the creek. The northern and southern parts of the township are connected by the modern Kilifi Bridge which spans over the creek making transportation link to Malindi, Mombasa and Nairobi convenient.

The intention of the researcher was to cover the area stretching from Vipingo sisal farm on the southern part of the town to Tezo settlement scheme on the northern part of the town. But due to limited time, the project concentrated on the northern part of the town and specifically the area around the Central Business District (CBD). This area has been chosen since the land tenure is formalised and there exists a valuation roll for the registered properties.

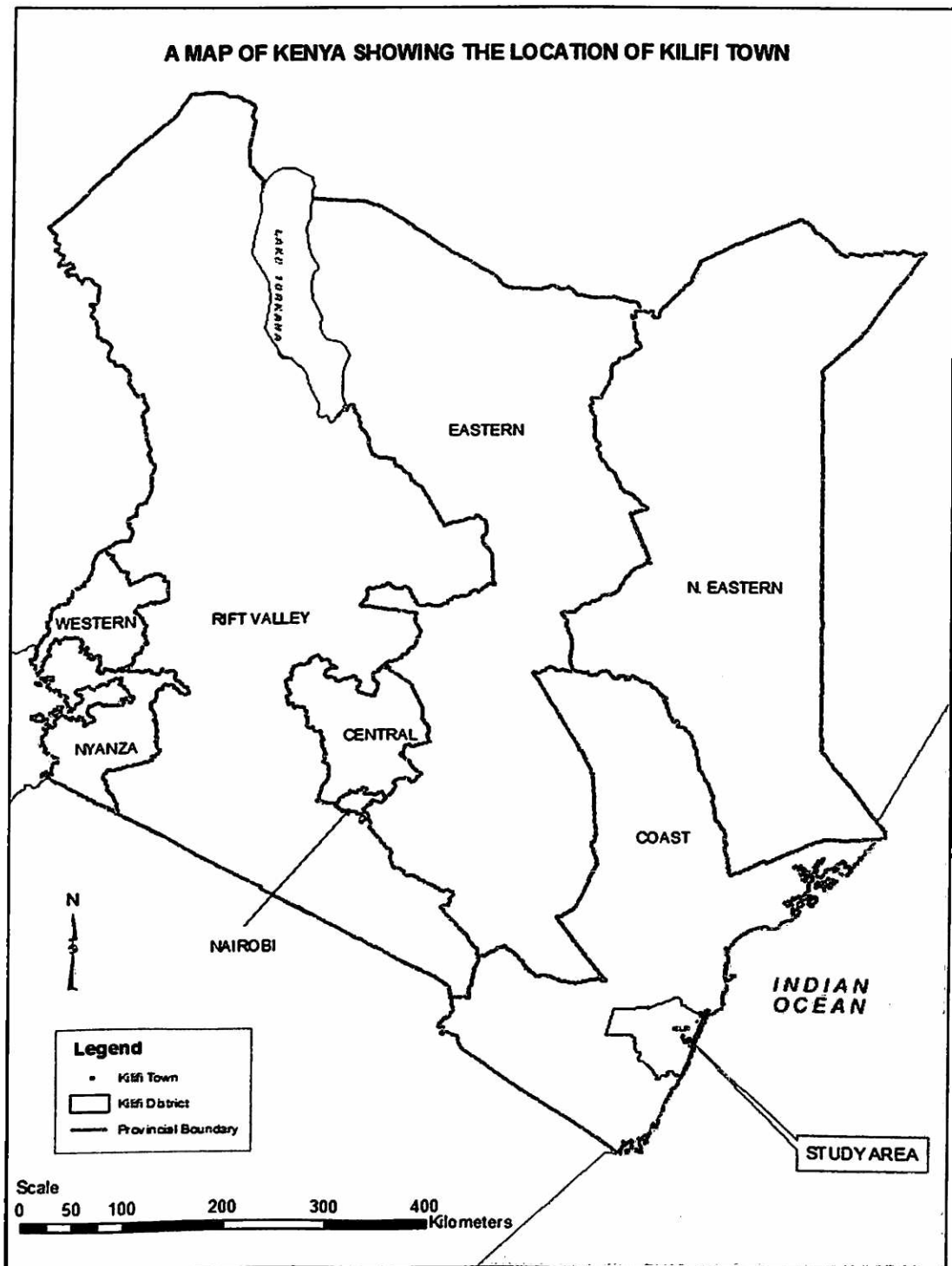


Figure 2.1a: Map of Kenya showing Kilifi County

KILIFI

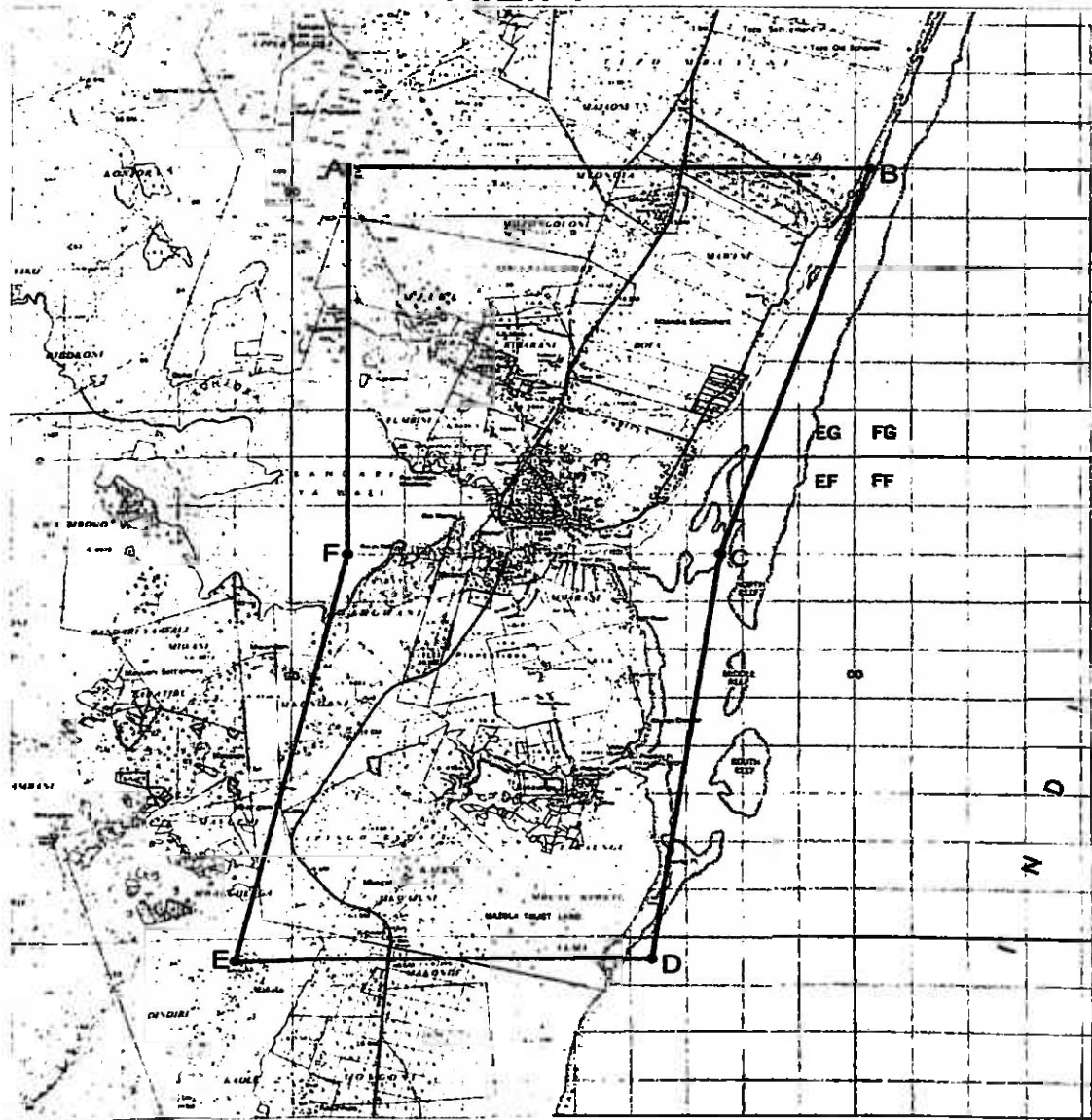


Figure 2.1 : Map showing Town Council of Kilifi

2.3 Property taxation in Town Council of Kilifi

2.3.1 Current status

Local authorities in Kenya are empowered through an act of parliament (Rating Act chapter 267), to impose property tax (land rates) within their areas of jurisdiction.

Town Council of Kilifi has an established Land Rates payment section which is under the Town Treasurer's Department and it is headed by a Senior Revenue Clerk. The section is responsible for collecting taxes on all properties appearing in the council's Valuation Roll, keep all records relevant for the same and issue tax demand notes to the property owners.

Over the years, the Council has been using an unapproved valuation roll which was prepared in 1992 and had a list of approximately 2000 properties. Currently, the Council is in the process of operationalising a new valuation roll that was approved by the Minister for Local Government in the year 2010. The new valuation roll has captured 3437 registered properties and it is available in both hard and soft copy.

In Kilifi Town Council, property taxation is categorised into five different groups based on land use and the location of the property. These categories are as follows;

NO.	CATEGORY	TAX PERCENTAGE (%)
1	Residential property	2
2	Agricultural land	2
3	Residential Creek/Beach plots	3
4	Commercial plots	4
5	Beach Hotels	5

Table 2.1: Property taxation rates in Kilifi Town Council

Although the agricultural land is supposed to be charged at two percent of the site value, the council has not been able to collect much from the same due to an existing council resolution which imposed a fixed annual rate of Khs. 3600 per 50 acres parcels of land. This council resolution has been revised by the new valuation roll which has imposed two percent tax on the agricultural land within the township.

2.3.2 Shortcomings

Some of the factors affecting collection of property tax in the Town Council of Kilifi are;

- Lack of spatial data necessary for locating the properties. The valuation roll is available in the form of a spread sheet without adequate information that can be used to locate the properties.
- Not all properties eligible for taxation have been captured in the valuation roll
- Informal change of user of the properties categorised as residential creek/beach plots to commercial use. This should attract a higher taxation rate.
- Payment records are updated manually and not regularly. This makes it hard to recover the arrears of the unpaid tax
- Lack of responsiveness from the property owners when tax demand notes are posted to them. The council relies on the postal addresses appearing on the valuation roll to contact the tax payers. This is outdated method of disseminating information to members of public.
- Poor coordination within the council offices. All cash payments in the council are done at the cash office. The cashiers are supposed to inform the property tax section to update their records for such payments. This is rarely done.
- Lack of political goodwill to enforce property tax payment.
- Conflict of interest. Most of the properties within the council are owned by the influential people and their cronies who run the affairs of the council.
- Lack of elaborate mechanism to capture the newly registered properties and the transfers taking place within the area.
- The council does not have a qualified valuer to update the valuation roll from time to time.

2.4 Use of GIS to enhance property taxation

The frequency with which Geographical Information Systems (GIS) are being used both consciously and unconsciously increases daily. GIS organizes geographic data so that a person reading a map can select data necessary for a specific task. Now more than three decades old, GIS technology is maturing and branching into new areas. As is the case with innovations such as the radio, television, and personal computers,

people are constantly finding new and original ways to leverage the power of digital maps and land information in decision making.

Making decision based on geography is basic to human being. By understanding geography and people's relationship to location, we can make informed decisions about the way we live on our planet. In his book, John O'Looney states, "at least 70 to 80 percent of the average local government's work involves land or geographically related issues of tasks" (O'looney, 1997).

In many countries, real property taxation revenue is one of the most important sources of local government revenue. Land property taxes in the U.S. are primarily collected at the local government level. Tax record systems are established in these jurisdictions to document information for each piece of property. Significantly, the hard copy tax records systems that were common place 20 years ago are rapidly being replaced by digital systems, especially those utilizing GIS methodology and software (Kalsbeek et, 2003)

The basic unit in property tax record systems is the land 'parcel,' a piece of land usually in the shape of a simple two-dimensional polygon that defines the legal boundaries of each owned property. The availability of GIS mapping software in tax record systems allows one to overlay maps of parcels with established reference points of topographical information, and then integrate with the attribute database.

Today, the existing real property assessment and tax collection system is under pressure to increase efficiency. Traditionally, manual workflows cause delays and inconveniences for the tax paying public – a fact that certainly does not increase willingness of property owners to pay their taxes regularly and on time. World over, National governments are usually very interested that local governments increase their property tax collection efficiency, hoping to reduce their dependency on national transfers and grants. Therefore, they often provide financial and technical assistance to modernize and increase the efficiency of the local government revenue generation system.

In order to streamline the efficiency and lessen the administration costs, the computerization of the property tax administration system has gained high priority (GTZ Philippines, 2002). Usually two connected elements or modules are at the core of the automation of a property taxation system:

- i. *A digital data management system* for the storage of all taxation relevant records and automation of routine functions, such as printing of tax collection reminder letters, generation of summary assessments, tax collection and other reports.
- ii. *A digital Tax parcel mapping component* connected to the data management system.

Digital Parcel mapping is the process of converting the parcel paper maps into a digital form and maintaining and managing the tax maps of local government units with the help of a Geographical Information System. Usually this is done parallel to the introduction of a computerised property taxation management system.

In Hargeisa, the capital of the self-declared Republic of Somaliland, though there was a rudimentary property tax system – the institutional and financial capacity was lacking, as were reliable topographical maps, clear land ownership documents and land legislation. Because Hargeisa’s local authorities lacked the data and resources to put into action an effective property taxation system, their revenue was severely limited and they were unable to play their part in developing urban infrastructure, yet private investment was high.

With the goal of using property taxation to generate municipal revenue for public works, UN-HABITAT and the municipalities decided to implement a property survey in Hargeisa, which started in mid- 2004. The plan was to create a database of all the properties in the city, and a methodology of classifying them and developing tax bills. A satellite image was used to create a base map identifying all buildings in Hargeisa, and through rapid surveys, the characteristics of the structures were collected. All data were stored in a GIS for quick retrieval and mapping. This process proved to be fast and relatively cheap.

The project illustrated how a GIS property survey to facilitate property taxation can be done rapidly and cost- effectively, allowing local governments to raise revenue that will fund service delivery activities (Turkstra, 2009).

The heart of a local government database is the property records. In Mirzapur, these records were woefully out of date. The 23,950 property database had to be first located, computerized and restored. A computerized tax billing system was set up to use the existing tax records. This made it possible to issue tax bills in the first year of the programme. Property records were updated through a property enumeration and assessment survey. When the detailed maps were linked with the property tax records the first municipal GIS in India was established. The enumeration identified 44 percent more properties than currently on the tax records (Jolly, 2000)

An efficient real property tax administration depends on data that is accurate, timely, and economical to maintain. Building and maintaining the property inventory and attribute database are the most labour- intensive and costly functions of the property tax administration. Digital parcel mapping is a core element of any integrated real property administration and management system. It establishes the link between the real properties in the field and the property assessment and tax records of the tax administration.

CHAPTER THREE

METHODOLOGY

3.1 User needs assessment

A user needs assessment was principally about identifying the expected users and their information needs before functionalities and datasets. The proposed GIS targeted the property taxation section of the Town Council of Kilifi. The section has been using manual methods in administering property taxation. Although the valuation roll is available in soft copy, the system was found not to have provisions for capturing records of tax payments such as, the amount paid, date of payment, arrears, accrued interest, alternative conducts of tax payers etc. In order to increase efficiency of property tax administration in the council, the valuation roll needed to be linked with a digital parcel map to create a GIS system.

A needs assessment was conducted to establish the following;

- i. Computers required within the section to perform the task.
- ii. The Council staffing level, computer literacy level of the officers working in the section and any further training required.
- iii. GIS basic functions that will be needed to achieve the intended purpose.
- iv. Both spatial and attribute datasets needed for the task

Due to logistics and limitation in this study, the researcher dealt with the GIS functions and datasets needs assessment necessary for the intended GIS.

Two main datasets needed in this study were the existing valuation roll in spread sheets format that contained the attribute data of the properties, and the spatial data compiled from cadastral plans that created the digital tax parcel map layer. Also required was a topographical map of the town with the main landmark features that could assist in locating the properties.

The GIS functionalities needed are;

- i. *Browse*: equivalent of map reading to find peculiar features or patterns. Browsing led to identification of items of interest and subsequent retrieval and manipulation such as updating the records.

- ii. *Display*: to support generation of maps or attribute data by computer for viewing.
- iii. *Query*: to support the posing of specific questions to the database in an interactive manner.
- iv. *Map overlay/analysis*: to define relationship between layers of spatial data by super-imposition of one map upon another. Used to determine the location of properties or monitoring the emerging land sub-division.

3.2 Database design

The database design has a major impact on GIS project implementation as it determines how data is organized. The design endeavoured to optimize on the available resources, and other parameters such as storage space, application convenience, access speed and ease of use. The objective was to have a customised system that is user-oriented and offering practical solutions to tax managers and decision makers.

Three entities which had some relationships were identified for the database design. These were;

- I. "PARCELS" – this was taken as the unit of taxation. The parcels were digitized from cadastral plans as polygon features to represent the spatial data. Each parcel had a unique identification representing property registration. The unique identification was digitized as a field in the entity. Other fields created in the entity were the cadastral plan reference number while the area of the polygon was computed automatically.
- II. "OWNERS" – each parcel had owner/owners. One owner could own many parcels, each with a unique identification. Owners details were captured as tabular information to be linked to the parcel details through the unique identify.
- III. "TAXATION" - tax is based on a parcel (property) which has unique identification, and imposed on an owner of the parcel. The taxation details were also captured as attribute information and linked to the other entities through the unique identifier.

Figure 1 shows the entities and their relationships. The Parcel Identifier (PID) was used as the primary key for linkages.

ENTITY – RELATIONSHIP DIAGRAM

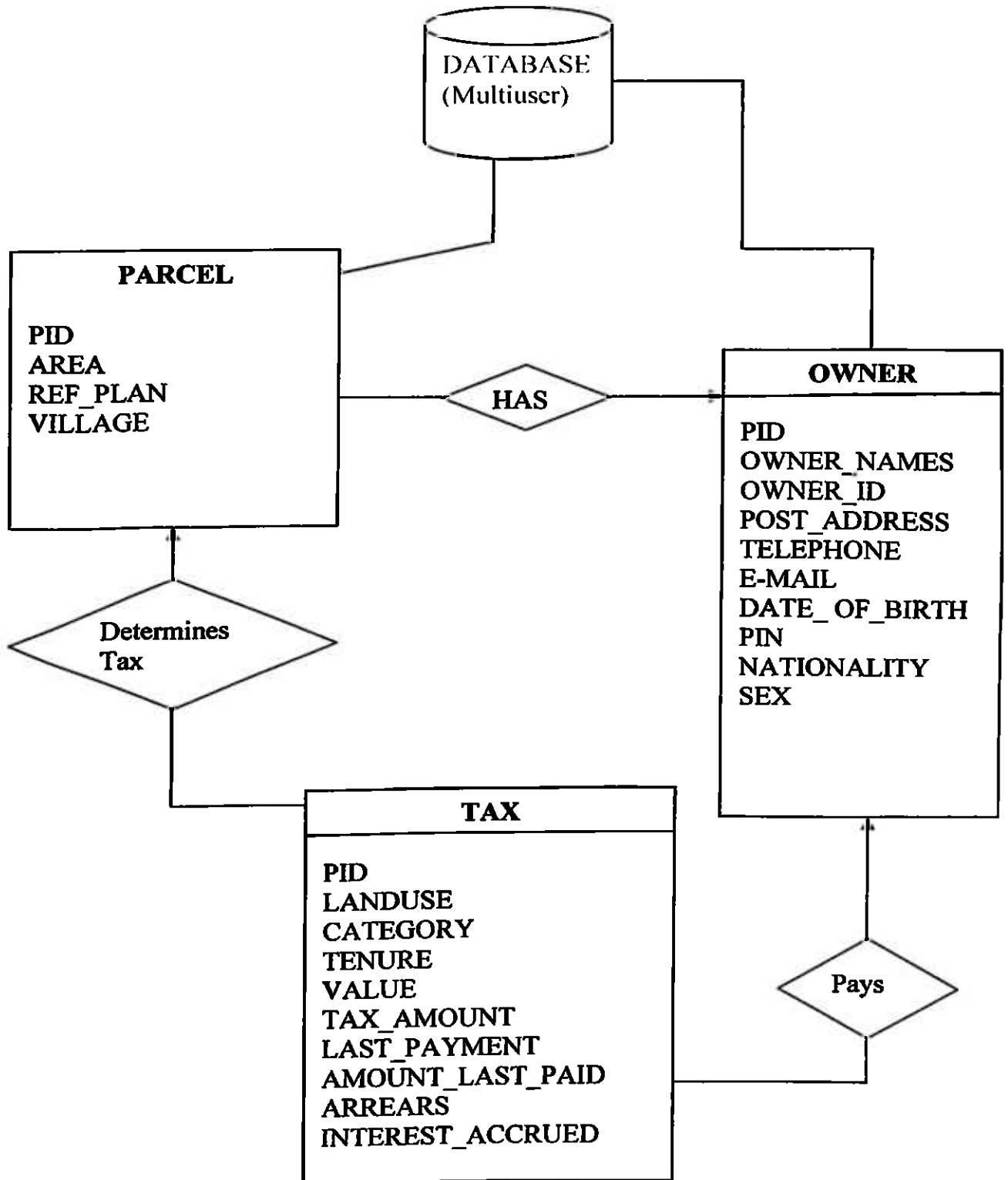


Figure 3.1: Entity - Relationship

Database Table

Owner

Field Name	Data Type	Allow Null	Length
LR No	String	No	
Land Use	Integer	Yes	15
Name	String	Yes	30
Address	String	Yes	40
ID/Passport No	String	Yes	50
KRA Pin	String	Yes	20
Date of Birth	Date	Yes	20
Nationality	String	Yes	10
Categories	Integer	Yes	20
Size	Double	Yes	20
Rateable Amolunt	Double	Yes	30
Site Value	Double	Yes	30
Status	Integer	Yes	40
Date of Last Payment	Date	Yes	20
Amount Paid	Double	Yes	15
Tenure System	Integer	Yes	30
Arrears	Double	Yes	10
Accrued Interest	Double	Yes	30

Subtypes of tenure system

Subtype Code	Subtype Description
1	Lease hold
2	Free hold

Subtype Code	Subtype Description
1	Developed
2	Undeveloped

Subtype Code	Subtype Description
1	Beach Plot
2	Beach Hotel
3	Commercial Plot
4	Residential Plot
5	Agricultural Plot

Subtype Code	Subtype Description
1	Commercial
2	Industrial
3	Institutional
4	Residential
5	Agricultural

Parcel Has Owner

Simple Feature Class

Field Name	Data Type	Allow Null	Length
ObjectID			
Shape			
LR No	String	No	30

Figure 3.2 Database Schema

3.3 Data collection

One of the most important elements of developing a GIS for Local Government is finding and utilizing the appropriate data. The format of the data used is critical to the overall database design and the success of the analyses performed by the system. The quality of the results produced from GIS analyses and applications ultimately resides in the quality of the data collected and used.

3.3.1 Spatial Data

The main spatial data required in this study was a digital parcel map identifying the location of all property units or “tax parcels” eligible for taxation. The registered properties formed the parcel units for the taxation as required in law.

The process involved collecting the cadastral plans of registered properties within a selected area of interest from Survey of Kenya headquarters. All the cadastral plans obtained from Survey of Kenya were in hard copy, and had to be converted into digital format. Approximately 100 cadastral plans covering the Central Business District (CBD), and beach properties were collected.

Digitization of the tax parcels was done using LISCAD version 8.0 and MICROSTATION version 8.0 Software. The digitization process created parcels as polygon features indicating the relative location, size and geometrical shape of each land parcel. This was the spatial data that was exported into the GIS environment.

A separate layer of the topographical map for the area was created with street names, buildings and other landmark features considered useful in locating the position of the tax parcels. Existing topographical maps of the area were scanned and digitized using the ESRI ArcView Software. The shoreline was digitized from high resolution satellite imagery of the year 2004.

3.3.2 Attribute Data

The attribute data needed in the study was the Council’s valuation roll. The valuation roll obtained from the Council contained information such as the parcel (property)

identification, owners name and postal address, size, cadastral reference map, land use, site value and tax amount.

The study considered adding extra fields such as the rateable owner's email address, telephone contacts, date of last payment, amount paid, and date of birth, gender and nationality of the property owner. The extra information was found to be useful in the administration of the property taxation and was to be collected gradually by the Council officers.

3.4 Database implementation

Within the framework of GIS, data are divided logically into two categories: geographical data and attribute data. The two datasets can be stored in two separate database systems, one for geographical data and one for attribute, or single database system for both categories. However, the relationships between the two categories of data must be preserved regardless of whether the division is physical or logical. In this project, a single database system was used to store the two categories of data.

A digital tax map was created from cadastral maps with additional tabular information such as PID (Parcel identification), REF_PLAN (source of cadastral information) and AREA (the parcel size in hectares) which was generated automatically by the software.

Attribute data from the valuation roll was organized in a schedule of two-dimensional tables, each of which contained records for one entity, and saved into the GIS environment. The relationship between the two categories of the datasets was linked through a primary key (PID), denoting the unit of property taxation.

Figure 3.3 shows the database implementation process.

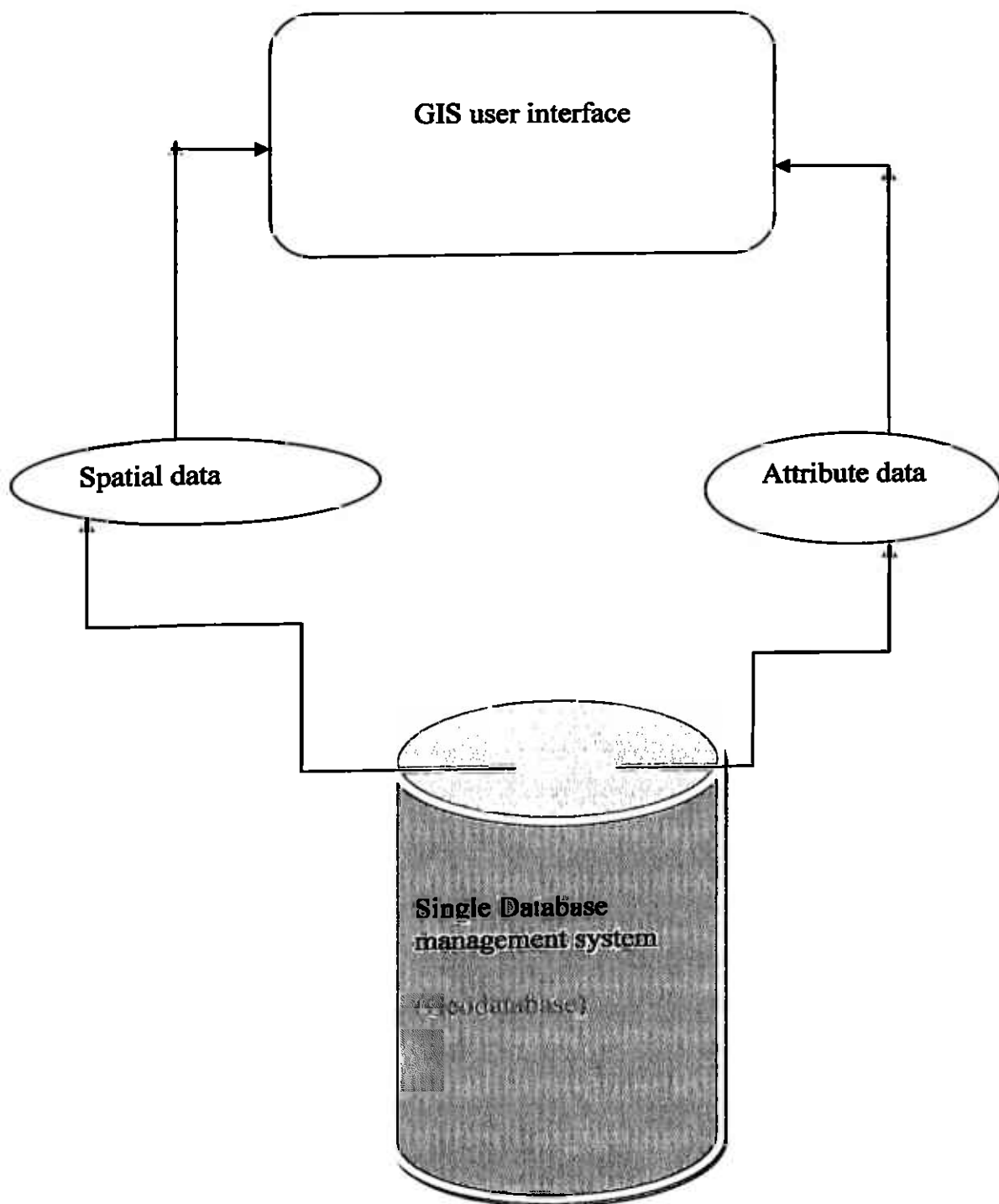


Figure 3.3: Single database

CHAPTER FOUR

RESULTS

4.1 Results

The main objective of the study was to demonstrate how GIS applications could be used as a tool for decision making in the local government on the area of revenue collection. In order to achieve the objective, land rates (property tax) collection in the Town Council of Kilifi was considered. The same concept could as well be applied to other sources of revenue collection that require positional data (spatial data) like managing collection of business permit fees. The analysis mainly involved the GIS functionality of displaying, browsing, query and overlay.

4.2 Discussion of results

Simple Display

This GIS function supports generation of maps or diagrams by computer. These are the maps and diagrams that were used to create the database.

Figure 4.1 shows the digital parcel map of the properties that were digitized to create the spatial data of Kilifi town, while figure 4 displays the attribute data.

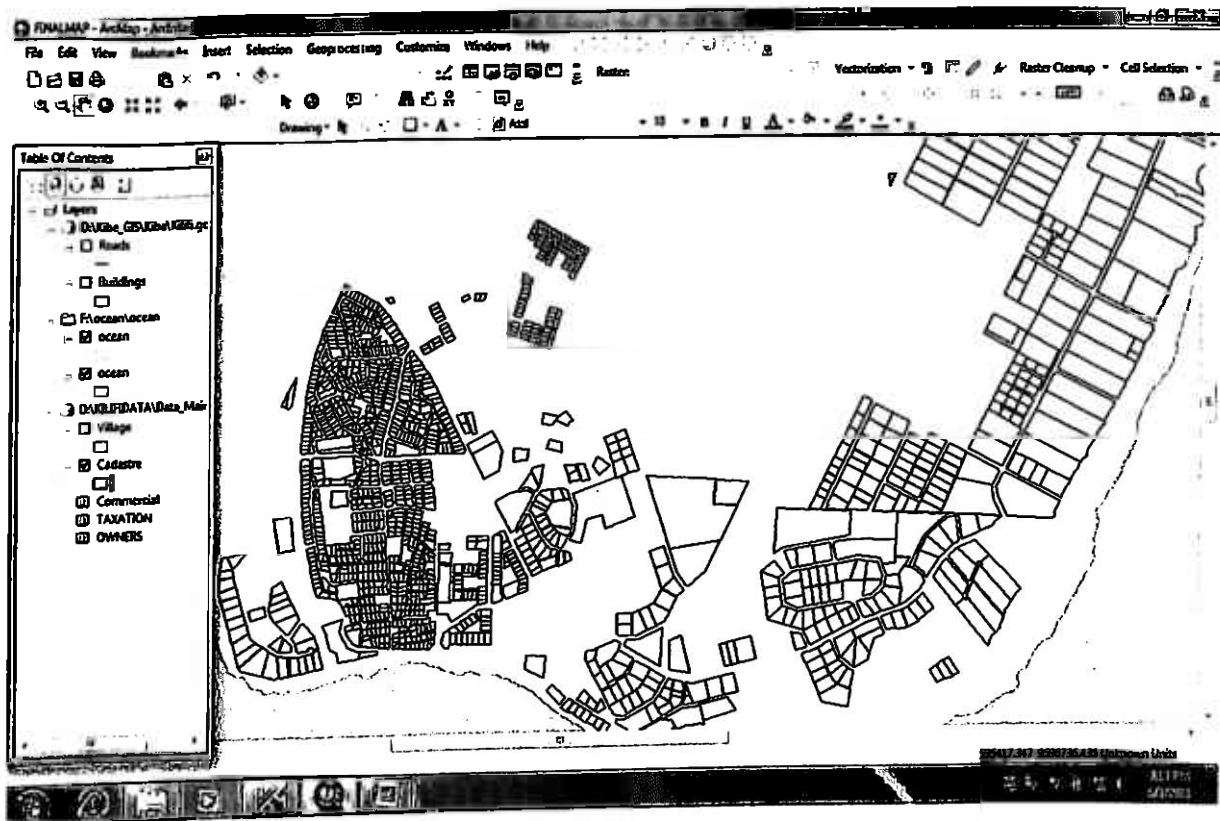


Figure 4.1: Digitized parcels

Figure 4.2 shows the digital Parcel map plus the Corresponding attribute table.

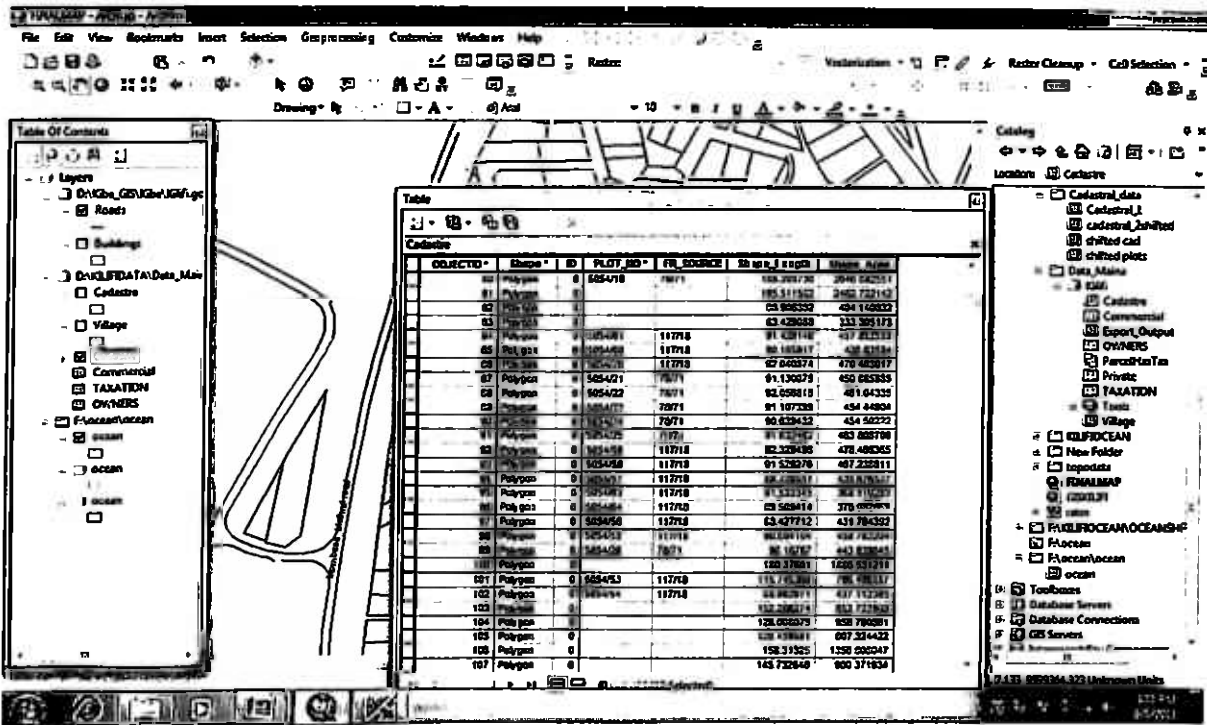


Figure 4.2: Parcels and attribute table

Figure 4.3 shows the topographical map with the streets and major roads within the town

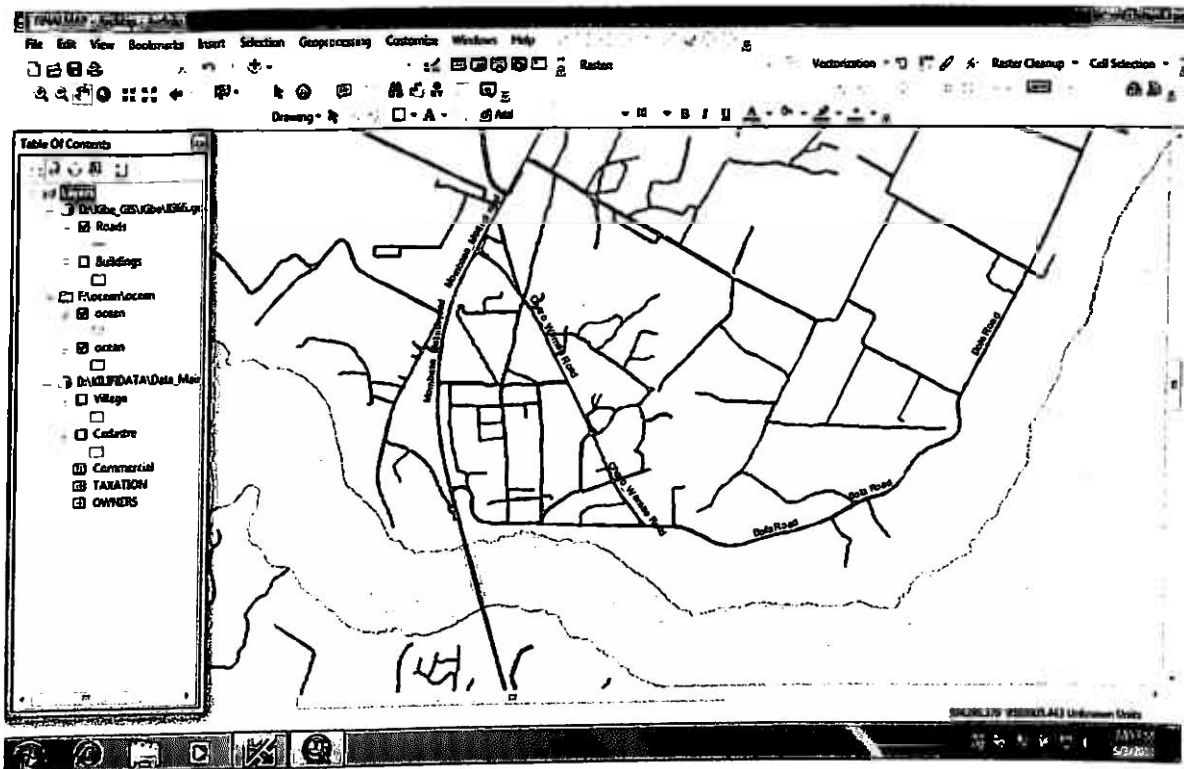


Figure 4.3: Main roads and streets

Map overlay

This is a GIS function that overlays the topographical map on the parcel map in order to assist in locating the properties. The topomaps show the relative position of features. Roads and streets have been shown on the map including the names of the major roads. Otherwise it is not easy to know the location of the parcels without the topographical map.

Figure 4.4 shows the parcel map layer super-imposed (overlay) on the topographical map layer

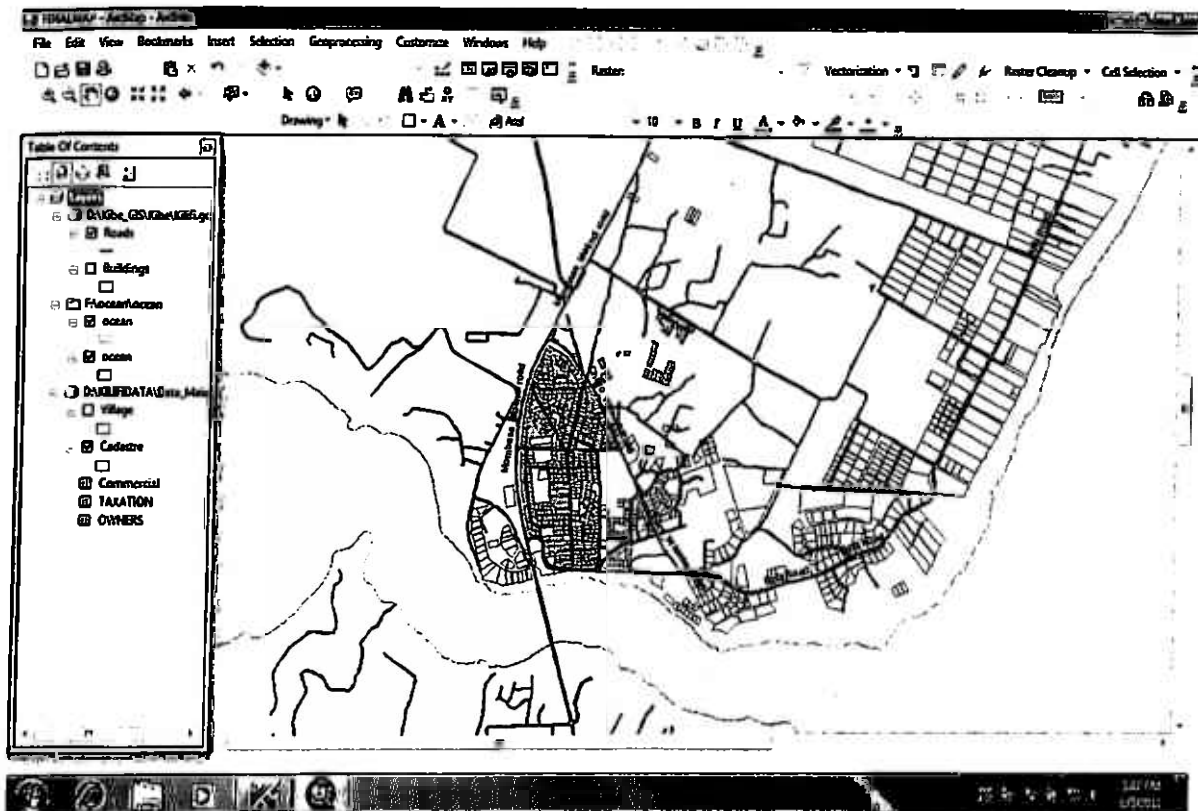


Figure 4.4: Overlaid map layers

Query and display

This function supported the posing of specific questions to the database in an interactive format.

A query was posed to the system to pick all the properties whose 'land- user' is RESEDENTIAL and display the results. The selection was done by defining the specific attribute from the attribute table.

Figure 4.5 Shows result of a query by a user to the question “what taxable properties are for residential use”

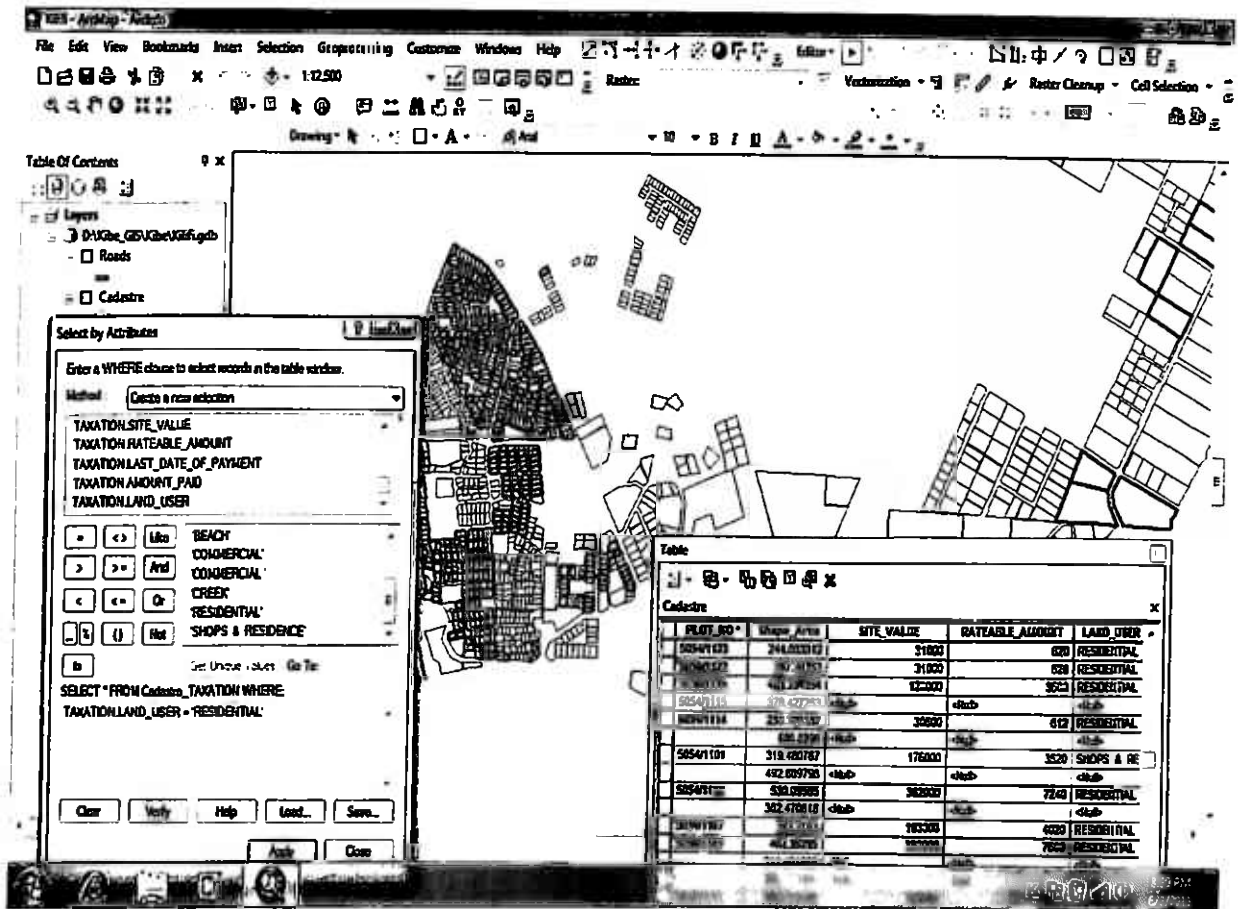


Figure 4.5; Highlighted properties are for residential use

Figure 4.6 shows result to the question “show properties that payments have been made from the year 2009 to date”

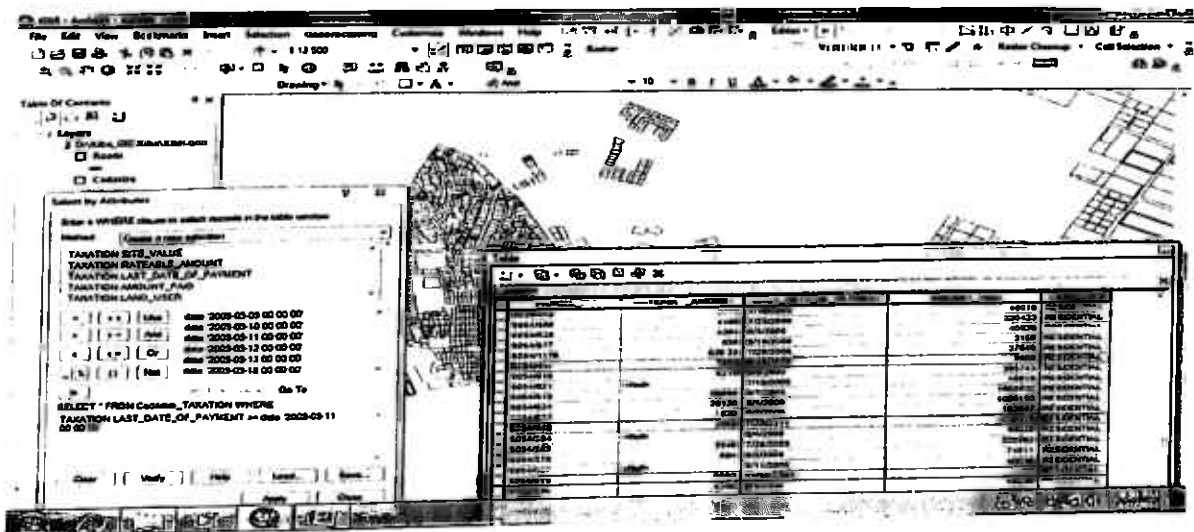


Figure 4.6: Tax compliant properties

Figure 4.7 shows result to the question “display a summary of all properties with tax amount greater or equal to five thousand shillings”

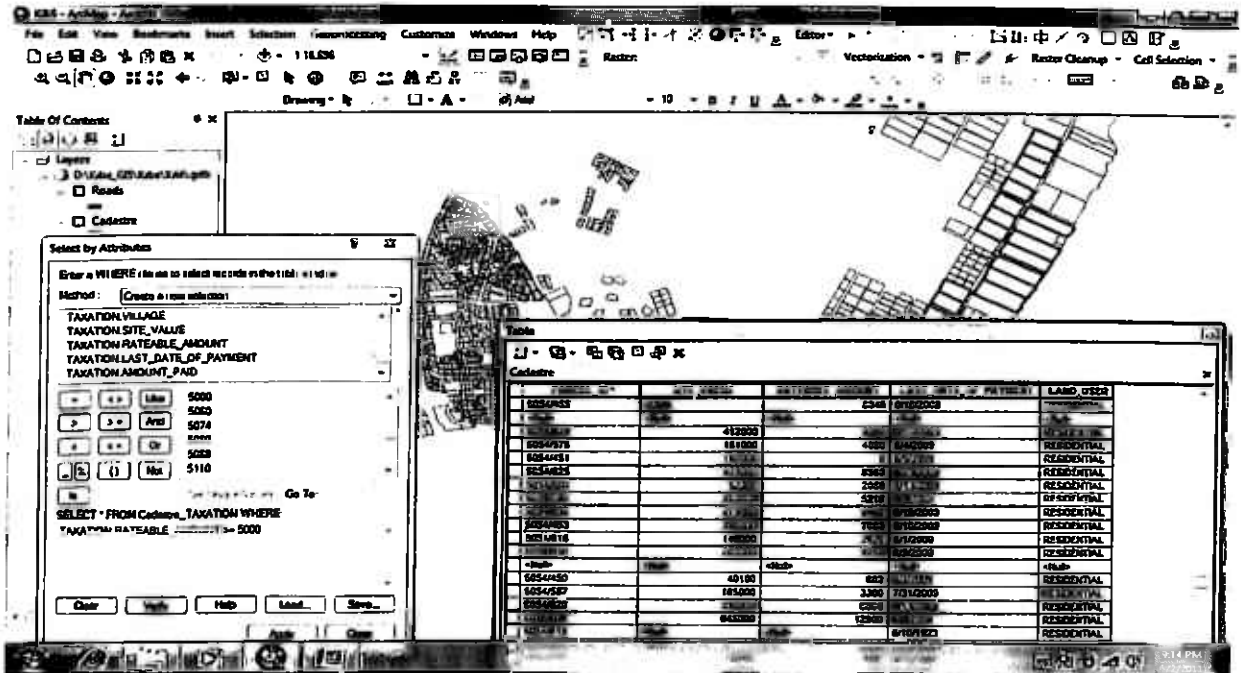
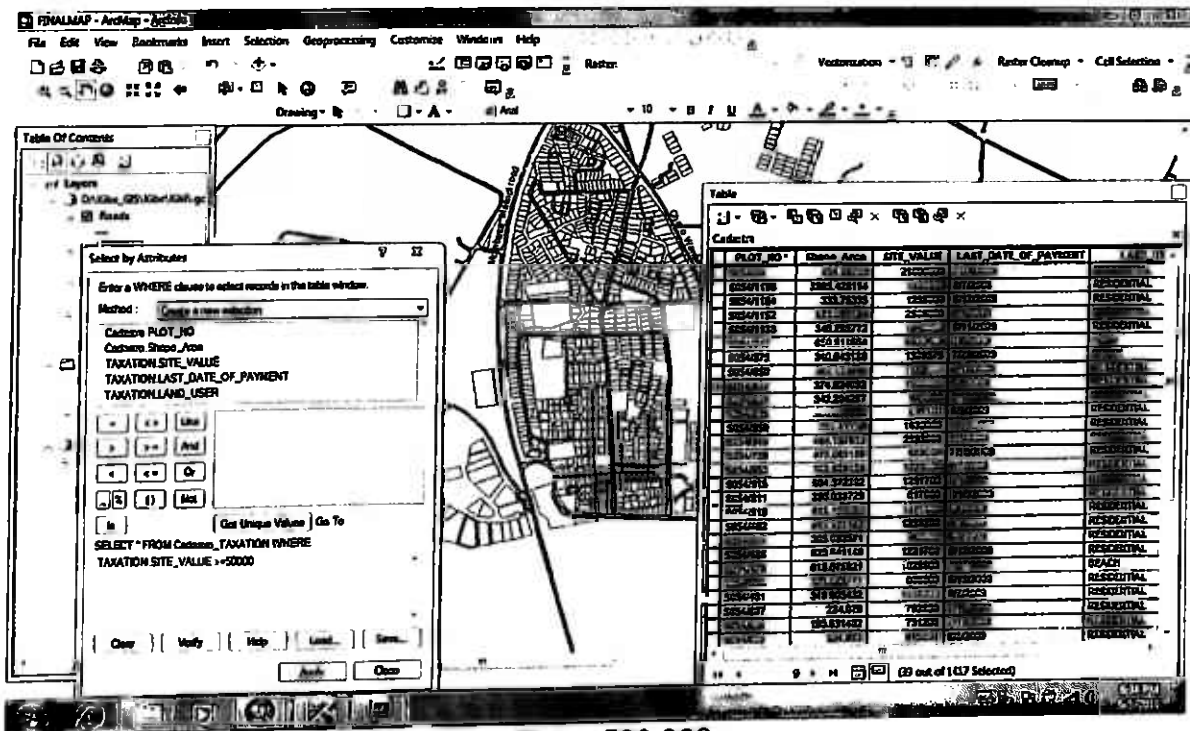


Figure 4.7: Tax amount greater or equal to Ksh. 5000

Figure 4.8 displays the results of a user who wanted to know the properties with site value equal or greater than Kshs. 500,000.



CHAPTER FIVE

CONCLUSIONS AND RECOMENDATIONS

5.1 Conclusions

From the findings of this study, it can be concluded that the manual system of managing property tax in local governments has proved to be ineffective and inefficient and thus the yield from revenue collection very low. A lot of setbacks are attached to the manual system of property tax administration, such as slowness, poor record keeping, omissions, discrepancies and data duplication. The manual system of handling data makes the processes of data up-dating and processing quite difficult, especially where the quantity of data to deal with is large and complex, as is often the case in the larger local authorities like Nairobi, Mombasa, Kisumu, Nakuru and Eldoret, which handle more than ten thousand properties.

The results of this study show that, it is impossible to manage property taxes effectively and efficiently without a rich reservoir of geographic information. The GIS as a tool is able to perform these tasks more efficiently. Some of the analytical tasks demonstrated in this study cannot be performed without a computer due to their size and complexity. In conclusion, the GIS will improve local government effectiveness by providing better information to administrators and policy makers.

Benefits from using a GIS in the Town Council of Kilifi falls into the two categories of efficiency and effectiveness in the revenue collection. Some of the benefits are;

- i. Preparing and prompt delivery of the demand notes to the property owners since it will be possible to locate the properties on the map.
- ii. The property tax office can use the system to maintain comprehensive up-to-date accurate property records for tax administration.
- iii. The Council can monitor changes in property ownership, addresses, property usage or subdivision.
- iv. Bill distributors, revenue collectors and enforcement officers can easily locate individual properties.

The system can assist in workload sharing among the workers and also identifying the particular areas where tax is not being collected effectively. By displaying the

property maps on the screen, the decision makers can single out the areas where revenue collection is low and investigate the causes.

5.2 Recommendations

The Geographical Information System may be used to accomplish several other tasks apart from enhancing revenue collection in a local government set-up such as, flow analysis in water and sewer, traffic analysis, infrastructure planning, etc. While not measurable in monetary form, the benefits from the application can be substantial.

5.2.1. Recommendations to the Town Council of Kilifi

The established GIS for the Council targeted the property taxation section in the treasurer's department only. The department also deals with collection of revenue from other sources which have geographical location such as business permits and development approval fees. The system should be upgraded to cover these other applications which will basically use the same spatial data, since developments and business are carried out within a property. These can be easily achieved by taking an inventory of all developed properties and the business being carried out within those parcel units.

5.2.2 Recommendations to the Ministry of Local Government

The Ministry of Local Government is mandated to oversee the operations of local authorities in Kenya by ensuring that they are providing quality services to the local residents commensurate with the taxes collected. It is also charged with responsibility of providing local authorities with technical back-up and capacity building in areas where it is lacking.

In establishing a GIS in a local government such as Town Council of Kilifi, it requires that a suitable environment be created to maintain such a system. Problems and needs of respective local authorities must be identified and solved. Some of the general problems that should be addressed are;

- i. *Level of Awareness:* the level of GIS awareness in the local authorities is poor and needs to be enhanced. The Ministry needs to create a better awareness of this growing tool in the management of public affairs in our local authorities where eighty percent of decisions made are based on geographical data.

- ii. ***Training:*** the Ministry should establish a regular training in GIS technology for local authorities' staffs.
- iii. ***Computer Literacy:*** GIS uses computers. The literacy levels of manpower in hardware and software usage should be critically enhanced if the system has to be implemented successfully.
- iv. ***Policy issues:*** establishment of GIS involves collection of data that is mainly held by different government departments. There should be institutional framework within the national government where such attribute data is shared with ease amongst the state institutions just like the spatial data through Kenya Spatial Data Infrastructure (KNSDI).

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