UNIVERSITY OF NAIROBI

DEVELOPMENT OF A COMPREHENSIVE WEB-BASED LAND INFORMATION SYSTEM FOR KISII MUNICIPALITY

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Master of Science in Geographic Information Systems

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Declaration

I, Bernard Ochori Ogechi, hereby declare that this project report is my original work. To the best of my knowledge, the work presented here has not been presented for a report in any other university.

Bernard Ochori Ogechi   Date 08-09-2021

This project has been submitted for examination with our approval as university supervisor(s)

B.M.Okumu   Date: **6TH SEPTEMBER, 2021**

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Abstract

The land management paradigm is centered on having a land administration system that is built in a manner that it is capable of supporting key LA functions namely; land tenure, value, use and land development. The Land Information System consists of cadastral maps, non-spatial, thematic land datasets and attributes of information contained in the cadastral registers and land related records. An ideal LIS is expected to be a replica of land information as it spatially exists on the ground vis-à-vis that which is captured and documented in the land administration systems.

Within the Kisii Municipality, there exist instances of parcel overlaps and mismatches between the cadastre and the actual ground parcel positions. This situation has led to loss of money due payments made over wrong properties shown and also led to the escalation of land disputes resulting in protracted litigations. The available LIS is also manual and manually accessed, spatial information about the land parcel i.e., the beacon coordinates, location, geometry, the coordinate reference systems (CRS), and the map in its entirety is left out.

This project therefore aims to provide an automated Land Information System that integrates both spatial and non-spatial attributes accessed through a web portal interface. Real-time checks on the position of the land parcel on the ground will also be provided for through an algorithm that converts parcel boundary coordinates into KML files capable of providing actual ground location through Google Earth satellite imagery. Coordinate inter-reference system conversions will also be catered for.

Survey plans (F/Rs) for Kisii Municipality Block II were obtained. Coordinates defining the parcels' beacon were plotted on QGIS working space, parcel polygons were created and thus provided a basis for inputting spatial and non-spatial attributes. The entries resulted in a LIS data base. An algorithm was created to link the LIS database to the web portal. The WEB Portal was developed using: Python, JavaScript, HTML and CSS. The HTML was used to define the content of web pages, CSS was used to specify the layout of web pages while Python and JavaScript were used to program the behaviour of web pages.

Searches on the web portal were executed to display both spatial and non-spatial attributes. Real-time identification of parcel ground location through Google Earth imagery was achieved as well as the coordinate conversion from one Coordinate Reference System to the other (Cassini Soldner, Arc 1960 UTM Zone 36S and WGS 84 geographic).

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List of Abbreviations

CSS – Cascading Style Sheet

CRS – Coordinate Reference System

DBMS – Database Management Systems

FIG – International Federation of Surveyors

F/R – Folio Register Number

GIS – Geographic Information System

HTML – Hyper Text Markup Language

LA – Land Administration

LAS – Land Administration System

LIMS – Land Information Management System

LIS – Land Information System

MoLPP – Ministry of Lands and Physical Planning

NLC – National Land Commission

NLIMS – National Land Information System

PID – Preliminary Index Diagram

QGIS – Quantum Geographic Information System

RIM – Registry Index Map

SoK – Survey of Kenya

UTM – Universal Transverse Mercator

CHAPTER 1: INTRODUCTION

1.1 Background

Land Management paradigm is a modern concept. Its core components include; land policy, information, infrastructure and administration which are fundamental in supporting sustainable development. Land administration remains a subset of Land management which can be described as "the processes of determining, recording and disseminating information about the ownership, value and use of land when implementing land management policies".

Land administration system is developed from cadastral maps and land records. The LAS aims at the preservation of security of land rights (I. Williamson et al., 2010). The universal idea of creating a National Land Information System (NLIS) is to establish infrastructure for the implementation of land policies and land management strategies tailored to buttress sustainable development.

A cadastre can be described as up-dated, parcel-based land information system that comprise of a record of interests to land for e.g. rights, responsibilities and restrictions. It also comprises of parcel geometric description connected to other land records providing a description of interests and control of those interests, encumbrances, value and improvements so far done on land parcels of interest (International Federation of Surveyors, FIG, 1995).

According to the modern land administration theory, the cadastre is acknowledged to be a central tool for government infrastructure and is pivotal in the implementation of the land management paradigm. A cadastral system includes both parcels and registered land rights which supports the functions of property valuation and taxation, it is also useful in the administrative functionality of the current and future use of land.

In the perspective of modern land administration theory, cadastral systems are seen to be a government multipurpose engine that merges and integrates land administrative functionality that includes land tenure, value, and use and land development for delivery of sustainable development. Ultimately, there is the anticipated, multi-purpose cadastral system that is expected to integrate the land administration functions at a higher level. To realize the multi-purpose cadastral system, redesigning and reengineering of land systems, policy and strategies are nonetheless necessary.

Efforts to create Land Information Systems in Kenya have seen the Ministry of Land and Physical Planning (MoLPP) develop a web-based NLIMS (National Land Information System) dubbed Ardhisasa. Ardhisasa is an online platform that allows Citizens, other stakeholders and interested parties to interact with land information held and processes undertaken by Government. It has been developed by the Lands and Physical Planning Ministry (MoLPP), the National Land Commission (NLC) and other stakeholders in Government. It allows the lodgment of applications for various services offered by the Ministry and the Commission. The applications are handled through the platform and responses presented through it.

The developed NLIMS (National Land Information System) at the Lands Ministry (MoLPP) headquarters, Nairobi is expected to be modeled out to the Counties of which Kisii County is one of them. At present, the Kisii cadastre is mainly manual and also manually accessed. The existing cadastral maps are stored in cabinets while land Registry transactions are recorded and contained in manual registers. Figure 1.1 shows the area of study.

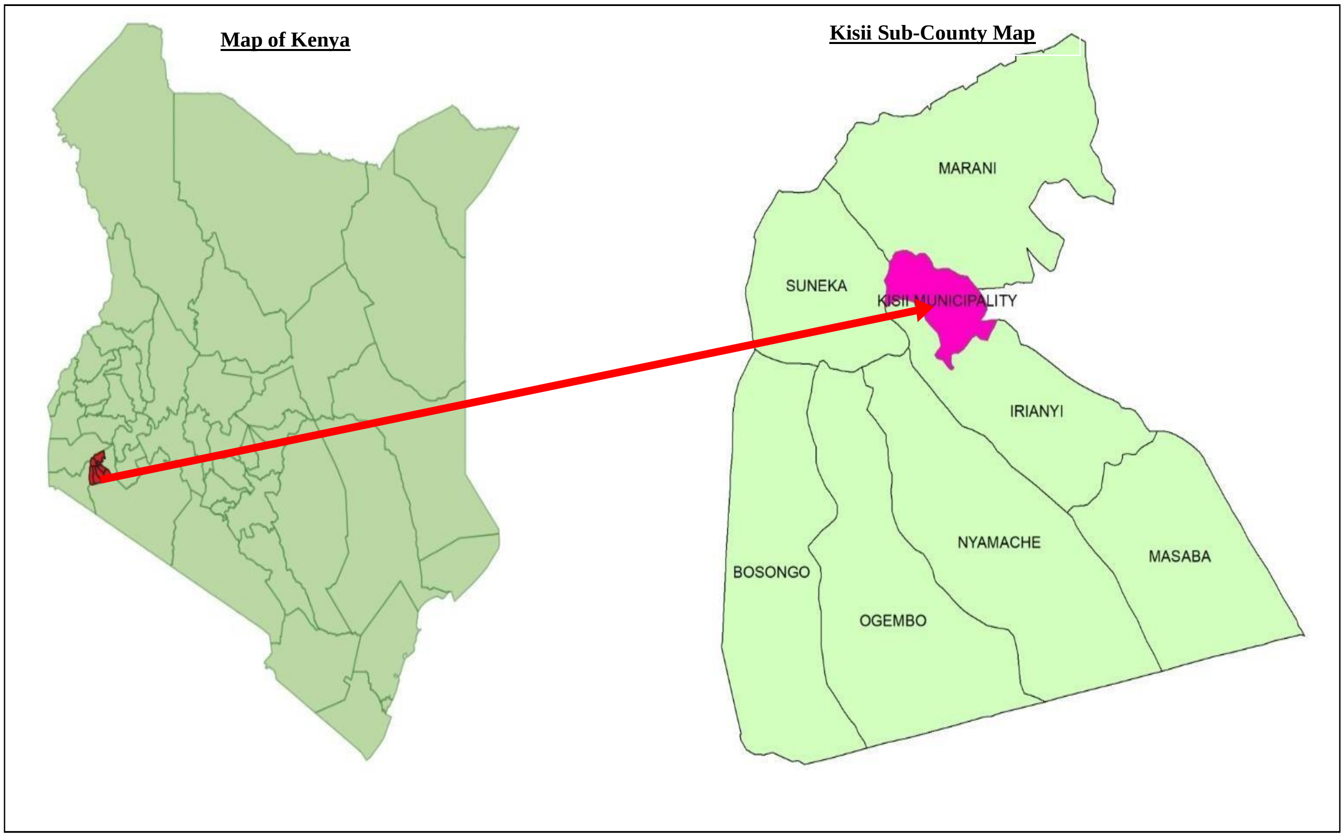


Figure 1. 1 Area of study

1.2 Problem Statement

A Land Information System provides an effective tool for the land resources' administrative, legal, and economic processes of decision-making. An ideal LIS is expected to be a replica of land information as it spatially exists on the ground vis-à-vis that which is captured and documented in the land administration systems.

Within the Kisii Municipality Blocks, there exist instances of land parcel overlaps and mismatches between the cadastre and the actual ground parcel positions. This situation has led to loss of money due to payments made over wrong properties as shown by prospective sellers and also led to the escalation of land disputes resulting in protracted litigations in the law courts.

The available LIS is also manual and manually accessed. Spatial information about the land parcel i.e., the beacon coordinates, location, geometry, the coordinate reference systems (CRS), and the cadastral map in its entirety is left out.

This project’s aim therefore was to provide an automated Land Information System that integrates both spatial and non-spatial attributes accessed through a web portal. Real-time checks on the position of the land parcel on the ground were also provided for through an algorithm that converts parcel boundary coordinates into KML files capable of providing actual ground location through Google Earth satellite imagery.

1.3 Objectives

The main objective

The study’s aim was to develop a comprehensive web-based Land Information System integrating spatial and non-spatial attributes.

Specific objectives

1) To create a digital cadastre for the Kisii Municipality
2) To create a web-based portal for the cadaster
3) To demonstrate parcel searches, locations and CRS conversion on the web portal

1.4 Justification for the Study

Government agencies; ministries and departments, citizens, organizations, professionals and businesses involved in land conveyancing and related services need real-time access to reliable and detailed land information. A land parcel remains the basic spatial unit upon which individuals and governments organize especially their economic activities which determine how a country’s land resource is understood, notwithstanding the land tenures that are formal legal or tenures that are informal social.

The nature of developments in the modern society dictates the type and quality of land information to be accessed real-time, this is also in support of Land Administrative functions of land tenure, value, use and development. Land administration systems have to spur confidence, trust and reliability in land markets through transfers and asset management.

The evidenced instances of land parcel overlaps and mismatches between the cadastre and the actual ground parcel positions, the present manual cadastre which is manually accessed and bearing no spatial land attributes to aid in real-time location of parcels and the prevalent land disputes, necessitates the development of an automated LIS to help in solving the problems of timely access to comprehensive land parcel information that is necessary in planning, land reform, project implementation and the ultimate land resource sustainable development.

1.5 Scope of the Project

The area of project study is the boundary limited to Kisii Municipality including Block II. The area is surveyed under fixed boundary regimes of which the area is mapped first in the survey plans (FRs) and finally the registry index map (RIM) is amended. To develop the envisaged comprehensive LIS, an estimated 107 land parcels were digitized.

CHAPTER 2: LITERATURE REVIEW

2.1 The Land Management Paradigm

The core component of land management paradigm (LMP) includes, land policy, information infrastructure and land administration. The said components combined are fundamental in the support of sustainable development. The concept brings forth the reason behind re-engineering agencies and processes also redesigning the policy deliverables to those which support integrated task and land information management (Lemmen et al., 2015).

The land management concept recognizes the processes and principles of managing land which are diverse across the world and within countries, and they are a reflection of the local judicial and cultural settings of a given country. The general philosophy of the paradigm is to have a land administration system build in such designs and systems that are capable of supporting the fundamental functions of LAS namely; land tenure, value, use and land development for sustainable development.

Land administration remains a subset of Land management and according to Williamson, (2010); Land Administration is defined as "the processes of determining, recording and disseminating information about the ownership, value and use of land when implementing land management policies".

As mentioned by Kamunyu, (2015) changes in technology, the introduction of computers recorded from 1990s, provided capacity to reorganize land information processing and accessing. Also nature of land developments in modern society dictates the quality and type of information required for the prevailing circumstances having changed drastically, thus the great need to redesign the LAS in order to put in place infrastructures and capable systems for executing the land management policies and strategies for sustainable development.

Some of the benefits associated with an effective LAS can be identified as; a trustworthy land ownership and tenure security system that spurs credit access, supporting reliable land markets through land transfers and management of assets. It also provides for access to land information aiding in administration function of decision making over land tenure, use, valuation and development. With an efficient LAS, land disputes are put at bay while safeguarding sustainable environmental use and creating a basis for good governance.

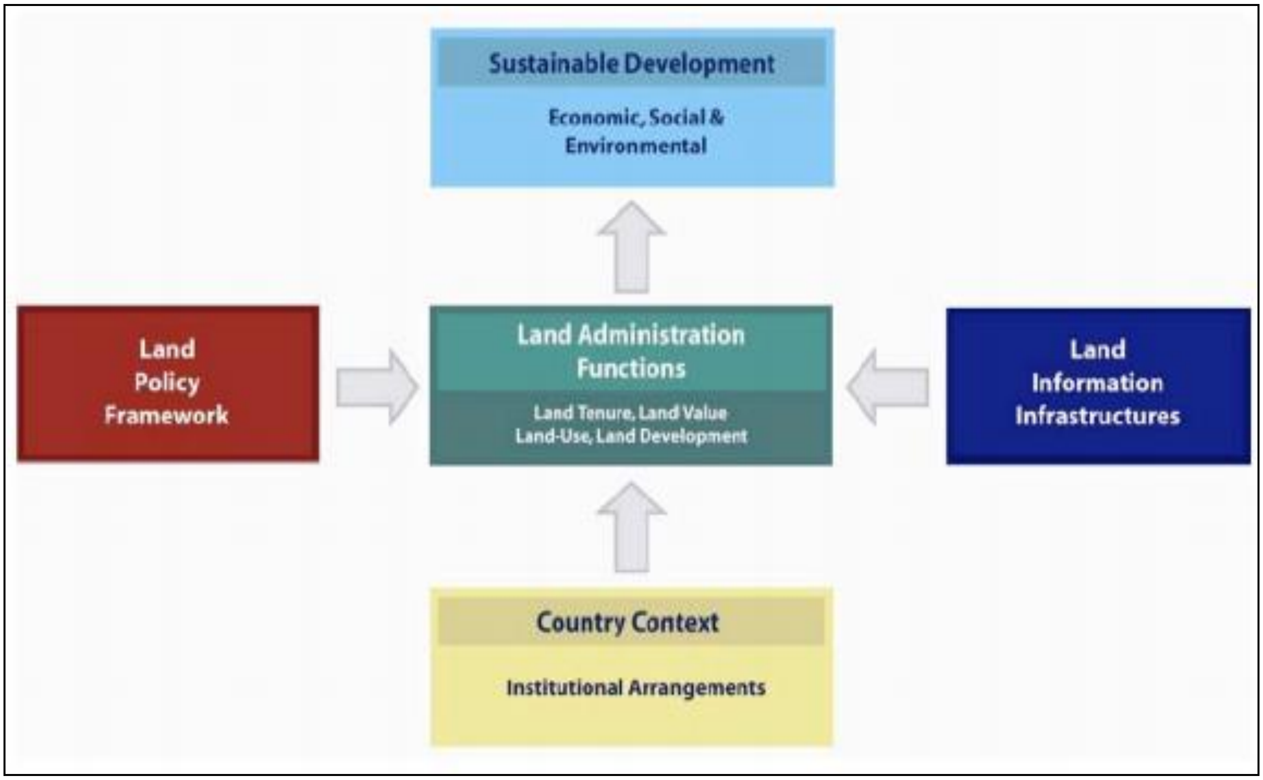


Figure 2. 1: Land management paradigm diagram showing the key components (Enemark, Williamson and Wallace, 2005)

With emerging global spatial technologies, there is growing trend towards the acquisition of uniform standards in the utilization of the cadastre and cadastral information by governments and actors in the business world. There are concerted efforts in the direction of developing refined land information system that support the establishment of multifunctional land information system.

Common spatial standards are being realized through SDI global, regional and national initiatives. The move towards the use of GPS to acquire positional data therefore spatial enablement continues to fuse and merge together the accuracies and reference frames within which land boundaries, demographic information, topographic, natural resource data and more other information linkable to the land resource can be defined within the parameters of spatial enablement technologies.

2.2 The Cadastral concept

2.2.1 Cadastre

According to the International Federation of Surveyors, (FIG, 1995) the definition of a Cadastre was given as an up-dated, parcel-based, land information system that comprises of records of land interest e.g. rights, responsibilities and restrictions. It also comprises of parcel geometric description connected to other land records providing a description of interests and control of those interests or ownership, encumbrances, value and improvements on land parcels of interest.

The basic elements that define an ideal cadastre include;

- A map capturing entire land parcels within a given jurisdiction,
- Land registers bearing information linkable to the parcels.
- Primary key or identifier linking all parcels to corresponding records in the register.
- The capacity for continuous updating (dynamism) of both cadastral maps and land registers.
- Reliable reference to information contained in both cadastral maps and land registers within a legal frame work.
- General public access to the cadastral and land register information.

The advancement of modern geo-spatial technologies provides opportunities to employ renewed approaches. According to I. P. Williamson & Wallace, (2007) in the context of developing spatial technologies, the definition of a cadastre is given as a map or maps containing land parcels, their arrangements captured in computer digital format. The cadastre often shows how the community puts its land resource into pieces of value with the roads interconnecting to the services. Figure 2.2 gives an illustration of the cadastral concept.

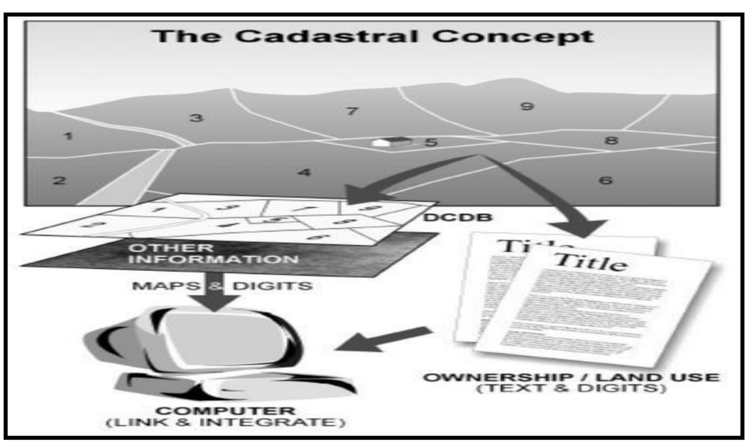


Figure 2. 2: Cadastral concept (Source, I. P. Williamson & Wallace, 2007)

Also referring to I. Williamson et al., (2010) a cadastre is meant to help in the land management functions of land value, use, tenure, and land development. Following this model, the cadastral system becomes the basis and fundamental key and technical engine in the delivery and putting in place the capacity of managing and controlling the land resource. The LAS supports land transactions of tenure and value, based on architecture of the local scale cadastre. Figure 2.3 depicts the significance of a cadastre.

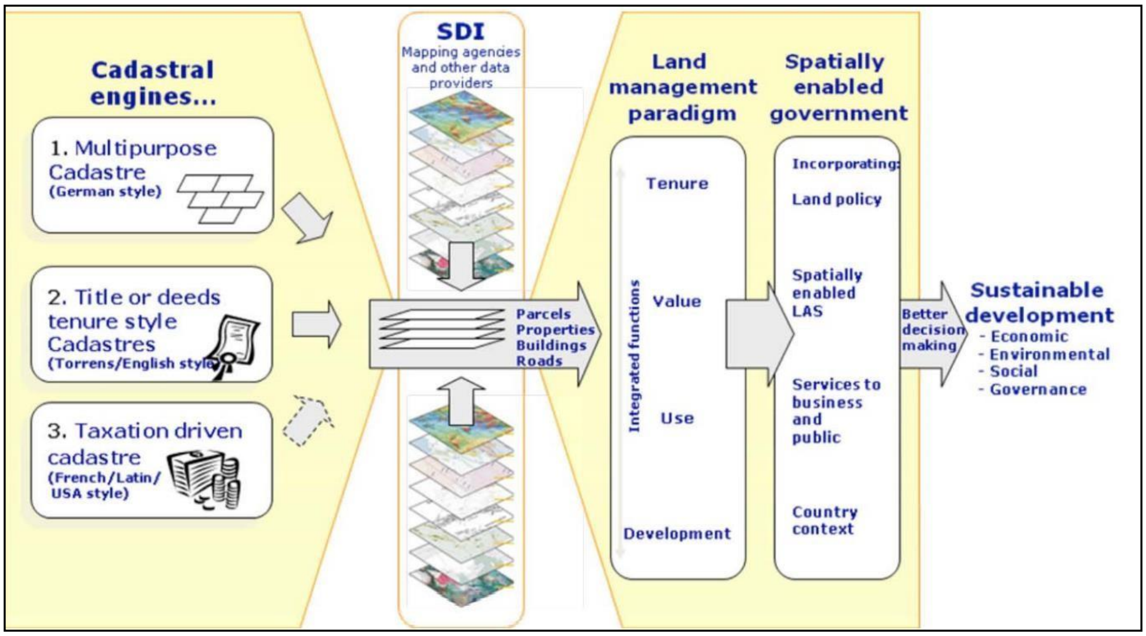


Figure 2. 3: The "Butterfly" diagram - Cadastre as an engine of LAS (Source, I. Williamson et al., 2010)

The LAS is created through digitizing the existing cadastral maps and plans, developing a mosaic of the intended area. New parcels are then generated by using accurate geo-spatial methods and computer software e.g., QGIS and Arc GIS. The cadastre remains the operational engine of the Land Information System. The contemporary cadastres are digital and are important and more adopted by the National to Regional governments since they contain spatial coordinates. Coordinates in a given framework and these allows computers to accurately identify where a feature, such as a street or a house, is on the globe. By adding geo-coded addresses, cadastres can show how parcels of land are arranged into properties and businesses (I. P. Williamson & Wallace, 2007).

A cadastral system can be linked to LAS whereby the system is a key component of a comprehensive land administration system and infrastructure which deals with the land processes of determination, taking records and dissemination of information about tenure, value and use of land in the implementation of land policies. Modern data processing provides two basic changes in the land records systems. First, it makes possible the storage and retrieval of records with a previously unknown efficiency. Second, the efficiencies achieved provide the impetus for significant change in the legal and administrative aspects of land records.

The key information layer of an integrated land information system (ILMS) is the cadastre, which entails the land parcel map and its linkage to the parcel indices. The ILMS is expected to be the cradle upon which contemporary governments' information systems will be based. The approach is to restructure the land administration system so that it is capable of supporting the needs of the modern society, governments and businesses in efficient service delivery within the confines of integrated systems. Sound land information systems provide a foundation for effective land management necessary to support social, economic and environment sustainability.

Pointing out parcels of land as captured in a cadastral system provides the fundamental infrastructure for operating related land systems in the domain of tenure, value and land use. Consequently, the focus on the traditional approaches to survey of land, mapping and registration of land has shifted focus from mainly being provider-driven to being user-driven. Nonetheless, the processes and tasks for each system present varying demands and requirements on the cadastral system. The efficiency of a cadastral is gauged on how it accommodates the aforementioned influences and delivers on the economic, social and environmental objectives.

2.2.2 Cadastre Development Approaches

Majorly the forces of colonialism and dominance of market economic theory have influenced the design of cadastral systems. The cadastral system approach by German and Torrens includes spatial cadastre contained within the national SDI. This approach is instrumental in providing tangible benefits of a cadastre to the countries that employs the approaches.

On the other hand, the Latin/ French approach only makes a remote connection between the land registers and cadastres, hence making the two functions to be separate and distinct. This approach often makes it difficult to merge the cadastre in an SDI and subsequently complications in supporting effective land administration systems.

Generally, the German and Torrens approaches through the concept of a complete and multipurpose cadastre have been adopted. For example, in the Switzerland, the cadastre is linked and supports LAS activities of land tenure, value, use, and development. Other functions in the Switzerland cadastre model for example, properties (buildings) are interlinked to insurance identifiers. The Torrens model has also being implemented in majority of advanced countries and it includes a completed spatial cadastre. As time went by, the Torrens system maintained the focus of developing a land registry which has the functions of supporting land tenure, title deeds and also a legal framework of conducting surveys and the subsequent cadastral mapping.

According to Siriba et al., (2011) most transactions and processes of land tenure occurs on land adjudication, apparently, there are sections of the land across the country that falls under adjudication not registered. The reason is attributable to the application of the two systems namely, the title and deeds systems.

Furthermore, the use of English and Torrens systems in Kenya in the land registration permits the application of both general and fixed boundary surveys in property mapping and identification. The said approach has presented challenges in the development of a consistent cadastre; however, this is a problem that an effective land administration system can solve.

2.3 Information Management

Information exists in many formats and from many sources, management of such information and its dissemination to the stakeholders with the prerequisite right for the information falls within the domain of information management. More than often, organizations have control over the processing, structuring and delivery of such information.

2.4 Information Management System (IMS)

The scope of information management system touches on collecting, processing, storing and dissemination of information within an enterprise. The basic elements of IMS includes; the people who make decisions, data or information that guides in making decision, and finally procedures that guide how the people interact with the data and tools that enable collection, analysis, storage and information dissemination.

In the contemporary society, all trends allude to information management system helping a great deal in decision making. Through the IMS, organization administration is therefore enabled to make crucial decisions guiding the operations of the organization at present and into the future. The significance of information technology is therefore central in the organization's quest for service delivery.

2.5 Land Information System (LIS)

A typical land information system links the cadastre and topographic data, it also links the built environment that is, legal and social rights to land, and with also the natural environment including environmental, topographical and issues to natural resources (I. Williamson et al., 2010).

The government services are expected to be best that as compared with the ones offered by the private sector in the criteria of accuracy, quality, time frames and user friendliness. The expectations of service delivery by today's governments are such that bureaucracy, delays, complicated procedures and excessive time-consuming are not acceptable. Owing to the said demands, information technology emerges as the strategic and efficient tool for solving the aforementioned problems.

A land information system is a computer-centred system that has the capacity to capture, manage and execute analysis of geo-referenced land data to provide land information for making decision in land management and administration. It is a convenient tool for the administrative, economic and legal decision-making processes. A LIS provides an infrastructure that addresses the processes of determination, recording and sharing information touching on land tenure, value and land use. The main focus of a land information system is the provision of detailed information of a land parcel as the basic unit.

According to I. Williamson et al., (2010) the discipline of land administration is depicted as not new. It has a specific focus on the security of land rights. The system evolved from the cadaster and registration sections. The global effort to develop a LIS was to put in place infrastructure key in the implementation of land strategies, policies and land management for sustainable development.

Land Information System is a derivative of the Land Administration concept. It involves the processes of recording, determining and sharing information about tenure, value and use of land and its related resources. In the context of executing land management policies which also includes determining land rights and associated attributes, the conducting of land surveys and describing the said attributes, documentation of their detailed account and providing other related information that supports land markets (Dawidowicz & Źróbek, 2017).

Land Information Systems is now applied in the management at local-level of land resources, it includes the description of ownership and the recording of specified characteristics of land parcels. The cadastral plan is one of the key products of cadastral survey. However, as technology evolve and simplicity made familiar, more effective and better services are expected. This has affected how information on cadastral survey is perceived (Bin Isa et al., 2015). A cadaster which is a component of land information system is based on geodetic controls and a cadastral map. A cadaster can consist of many layers e.g., a layer about soil, land use, buildings, zoning regulations that capture other attributes to land.

According to Badurek, (2009) the evolution of a LIS also focuses to capture accurately land ownership by including graphic display of a parcel, with the correct boundary measurements that correspond to the procured Title deed as a legal document.

The Netherlands' Cadastre, Land Registry and Mapping Agency (Kadaster), collects and records spatial and administrative data on property and the involved rights. This also goes for telecom networks, aircrafts and ships. In this regard, legal certainty is protected by Kadaster. National mapping and maintenance of the national reference coordinate system is also a responsibility of Kadaster. Furthermore, Kadaster is an advisory for national spatial data infrastructures and land-use issues (LandMark, 2020).

Land Information System for Local or Central Government Body of Land Record in India. The LIS is developed to be user friendly and highly customized; it is also a GIS based LIMS. The system was developed and intended to be used by the Local and central Government organization for Land Records. A LIS web portal interface for Local or Central Government Body of Land Record in India is depicted in figure 2.4

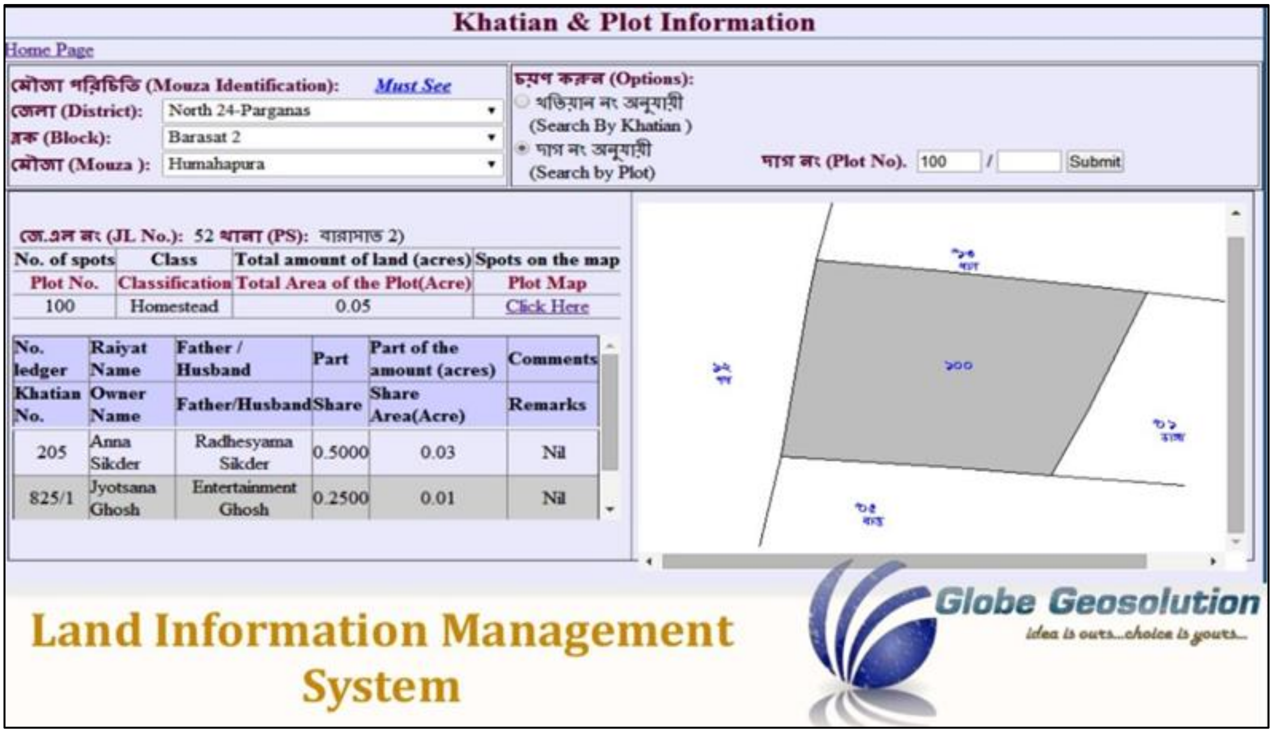


Figure 2. 4: Land Information System for Local or Central Government Body of Land Record in India (Source, LIMS – India)

A land information system provides infrastructure to develop and maintain spatial, geographic, legal and environmental information housed in a data base, the information contained is related to cadastral or real property in the country. It involves creating, analyzing and publishing data that is land-based for example, zoning regulations, parcel information, ownership, land use and general information about property (David Kuria, 2017).

According to David Kuria, key roles of an integrated LIS include:

- Developing procedures and a set of technical processes to enable the registration of interests and rights in real property.
- Computerizing the land procedures and real estate transactions.
- Creation of land parcel data applying standard editing tools for cadastral and the capability to generate reports with respect to a predefined template.

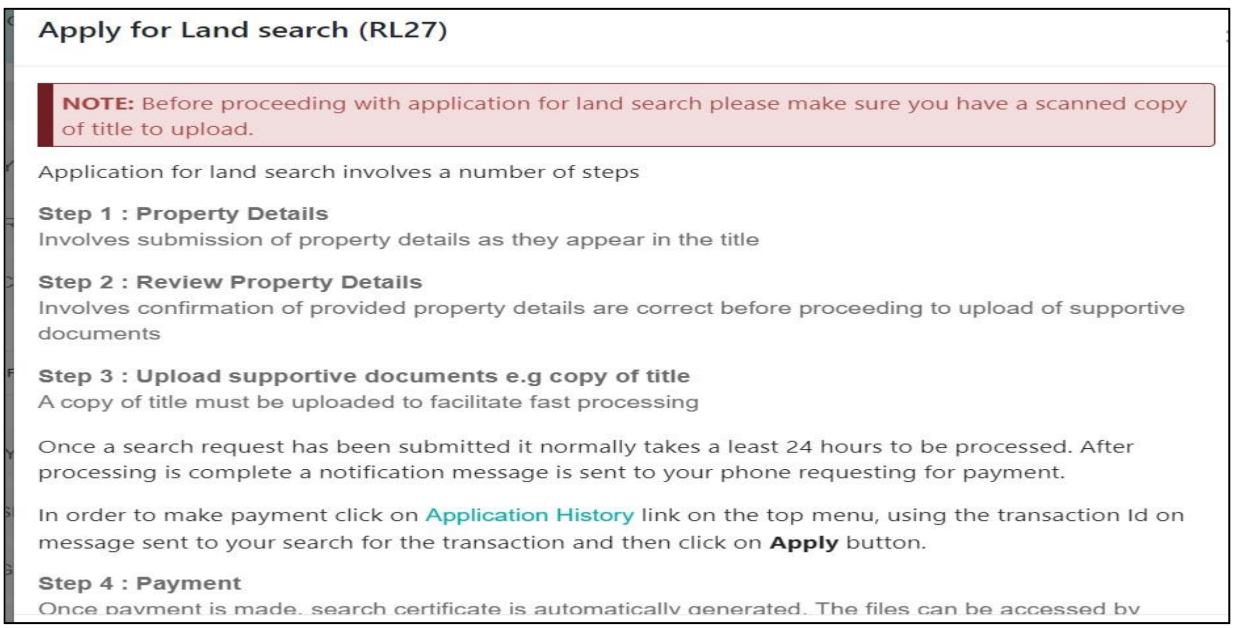
- A public service module that permits general set of technical processes and procedures for the registration of rights and interests in real property

- Provision of a public access module that allows enquiries by the general public.

In Kenya, the Lands Ministry’s LIS has evolved from the prototype in E-Citizen portal whereby in order for one to conduct searches the individual makes a request through an application and has to wait for at least 24hrs to get feedback. This means at the back-office things are just conducted manually before the feedback is scripted.

To apply for a land search the user would comply with the requirements as depicted in

Figure 2.5



Apply for Land search (RL27)

NOTE: Before proceeding with application for land search please make sure you have a scanned copy of title to upload.

Application for land search involves a number of steps

Step 1 : Property Details
Involves submission of property details as they appear in the title

Step 2 : Review Property Details
Involves confirmation of provided property details are correct before proceeding to upload of supportive documents

Step 3 : Upload supportive documents e.g copy of title
A copy of title must be uploaded to facilitate fast processing

Once a search request has been submitted it normally takes a least 24 hours to be processed. After processing is complete a notification message is sent to your phone requesting for payment.

In order to make payment click on Application History link on the top menu, using the transaction Id on message sent to your search for the transaction and then click on **Apply** button.

Step 4 : Payment
Once payment is made, search certificate is automatically generated. The files can be accessed by

Figure 2. 5: Application for Land Search Steps (Source, eCitizen)

As mentioned by Wayumba, (2013) for many years, the allocation of Trust Lands was controlled by the Local Authority, the local Provincial Administration and to some extent by the Central Government through the Commissioner of Lands. The process of acquiring land for development has been bureaucratic, slow and expensive. Since the promulgation of the new Constitution and subsequent implementation of the devolved government system, the setting apart procedure will now be carried out at the County level.

Currently in Kenya, the Ministry of Land and Physical Planning (MoLPP) has developed a web-based NLIMS (National Land Information System) dubbed Ardhisasa. Ardhisasa is an online platform that allows Citizens, other stakeholders and interested parties to interact with land information held and processes undertaken by Government. It was developed through the joint efforts by the Ministry of Lands and Physical Planning (MoLPP) and also the National Land Commission (NLC) and key stakeholders in Government.

The NLIMS provides an interface on which applications for various services offered by the Ministry and the Commission are lodged. The applications are handled through the platform and responses presented through it.

The applicant first of all registers their credentials in the system before they can log in for the land services. The web home page is shown in fig. 2.6

Figure 2. 6: Ardhisasa web home page (Source, NLIMS - Kenya)

Some of the land services to be accessed through the Ardhisasa LIS platform include;

1. Land Registration – Caution, charge, lease, registration of titles, replacement of title, restriction, search, stamp duty, transfer.
2. Land Administration – Pay land rent, Subdivision, extension of lease, change of user, consent, lease preparation, extension of user, renewal of lease.
3. Physical planning – Approval of part development plans, plan requisition, certificate of compliance.
4. Survey and Mapping – Subdivision, amalgamation, new grant, sectional property, extension of lease, change of use.
5. Valuation – Assets valuation, government leasing, government purchase, estate administration, arbitration.
6. Adjudication and settlement – Adjudication and settlement.
7. National Land Commission – Land Allocation

Some of the services offered on Ardhisasa website are shown in figure 2.7

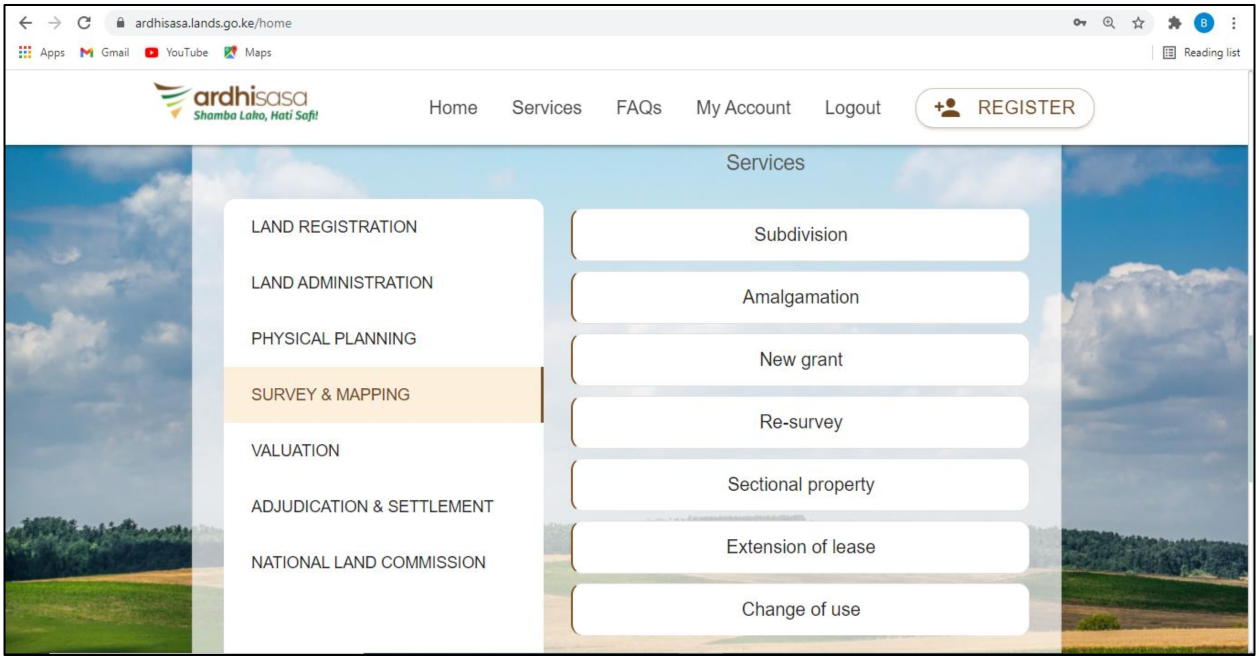


Figure 2. 7: Ardhisasa services page (Source, NLIMS - Kenya)

System development consists of three concatenated stages which include analysis, design and implementation. System scope and behaviour are system-specific whereas the scope of modelling information is usually enterprise-wide (Mwungu, 2020). The realization of Ardhisasa NLIMS is nonetheless a milestone achievement by the Kenya Ministry of Land and Physical Planning (MoLPP). Access to land information over web portal ensures land information decentralism and a great deal in saving time. The automation of land records helps reduce paper work and data storage space requirements.

To access the Ardhisasa NLIMS for services one however has to log in using the registered credentials (National ID number, ID serial number, copy of title/lease, passport) this is more of a verification process since the other parties who would be interested for example to conduct searches over the same parcel are procedurally excluded. This could put at bay a whole constituent of users for example land buyers who would want to verify the land ownership details before transacting.

The Ardhisasa NLIMS cadastre utilizes open street maps as the base maps, open street maps are more often exaggerated and done at small scale, overlays with the cadastral polygons would bear mismatches as to accurately show the parcel correct spatial locations other than just a general location depiction.

The spatial data to be contained on the NLIMS is mainly the data uploaded by surveyors in shape files in UTM as the stipulated coordinate reference system (CRS). This will occasion limitations to data interoperability since spatial data would exist in other data formats and different coordinate systems especially in Cassini Soldner which has been predominantly used in Kenya in fixed boundary areas.

The creation of a comprehensive Kisii Municipality LIS is an undertaking to provide spatial and non-spatial land parcel attributes on a web portal. The LIS will provide for the inclusion of spatial attributes of a land parcel that are of much interest to spatial data users. On querying the LIS over a given parcel, one would access the parcels' non-spatial attributes (proprietor name, adjudication section name, map sheet number, acreage, encumbrances etc.)

The spatial land parcel details will provide specific parcel position with respect to the surrounding; this would be displayed real time on Google Earth satellite imagery guiding the user to view the exact ground parcel position. The system will also cater for conversions from one coordinate system to the other (Cassini Soldner to UTM and vice versa).

CHAPTER 3: METHODOLOGY

3.1 Overview

This chapter covers the data and data types used for the study, it shows how the data was processed to pave way for results and analysis, it also indicates the methods employed to achieve the results. The flow diagram in Figure 3.1 presents a summary of the entire process.

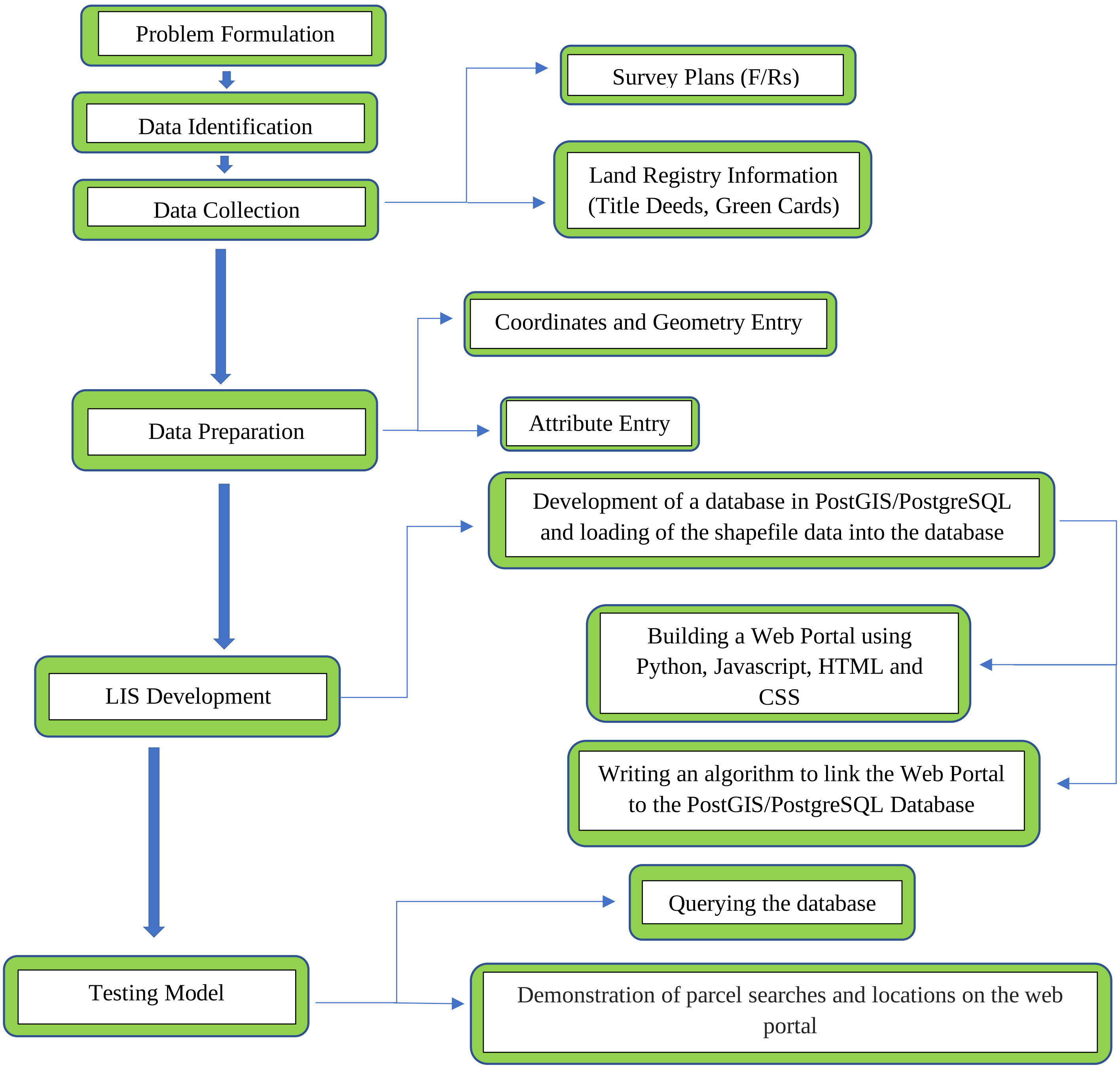


Figure 3. 1 Methodology Flow Diagram (source, Researcher)

3.2 Study Design

The Kisii Township Block II parcels were digitized to input spatial and non-spatial attributes, finally an algorithm was created to link the LIS database to a web portal to enable execution of data searches. Data searches depending on the user needs were executed to display both spatial and non-spatial attributes.

3.3 Location of the study area

The area of study is Kisii Municipality Block II within the Kisii County. The land tenure system within the area comprises of leasehold captured under fixed boundary, mapped in survey plans (FRs) and RIMs. Also, it has freehold interests mainly captured under general boundary areas mapped using Preliminary Index Diagrams (PIDs). The study utilized the fixed boundary to establish a comprehensive Land Information System incorporating both spatial and non-spatial attributes.

3.4 Rationale of selecting the study area

Some of the considerations to identification of the study area were encompassed in; the area being well known and within the researcher's working area. The availability of prerequisite data and the easiness of conducting ground validation also made it suitable and convenient.

3.5 Data Collection

The data required for the study was obtained from various points as indicated below:

The relevant survey plans (F/Rs) for Kisii Municipality were obtained from Survey of Kenya (Survey records section). The RIMs for Kisii Municipality/Block II were also obtained from Survey of Kenya (RIM section). Land registration details were obtained from the Kisii County Land Registry.

Details of some of the data used in this research is as listed below:

1. Survey plans (F/Rs) – 46/58, 73/8, 73/193, 86/185,115/5,134/94, 138/154, 140/107, 225/51, 394/20, 46/9, 111/95, 111/96, 113/61, 131/74, 428/48, 330/11, 246/108.

2. Land Titles, Green Cards for specified Number of Parcels.

3.6 Digitization

Digitization entailed plotting of parcel using the Coordinates Geometry (CoGo) plugin in a QGIS working space. Shape files (layers) were created for parcel boundaries and parcels (Polygons). All shape files were referenced in Arc_1960_UTM_zone_36S coordinate system.

This paved way for the creation of tables for attribute entry. The resultant parcel polygons are as shown in Figure 3.2

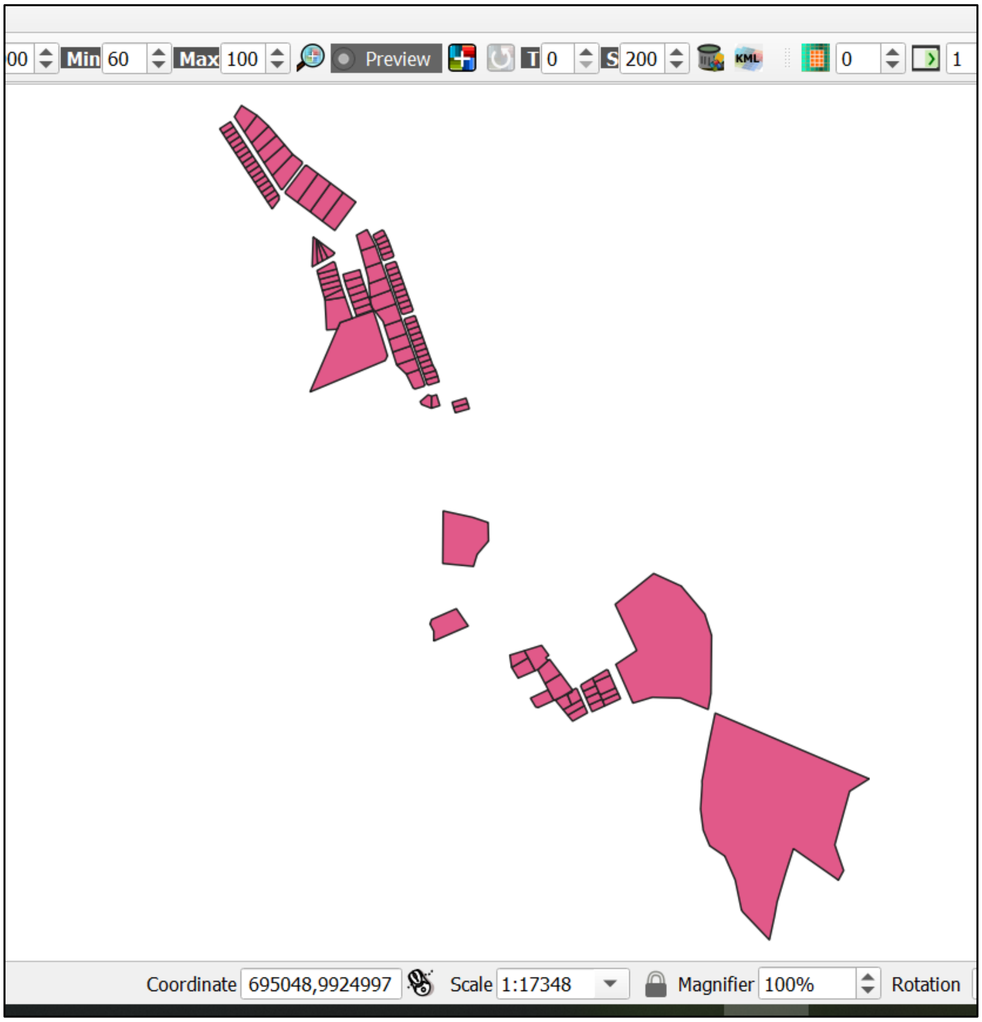


Figure 3. 2: Resulting Parcel Polygons (Source, Researcher)

3.6.1 Attribute Entry

In QGIS attribute table, fields were created capturing the targeted contents for a database. Some of the fields created included:

Proprietor name, Phone number, KRA Pin Number, Gender, Parcel Number, Acreage, Land value, Land tenure, Land use, Encumbrances etc.

Table 3.1 shows some of the data fields created and the captured data

Table 3. 1 Attributes of parcel polygon (Source, Researcher)

	Id	Fr_No	Parcel_No	Area_Ha	block_no	land_tenur	land_use	owner	gender	kra_pin	date_reg	registrar	c
1	567364	113_61	98	0.32876403100...	2	Leasehold	Commercial	Timothy Nyaran...	Male	A005969318K	19-10-82	Jenifer N. Kilonzo	Not Re
2	12364041	394_20	217	0.37795859500...	2	Leasehold	Commercial	Samuel Apoko ...	Male	A004279632Y	17-10-02	Jenifer N. Kilonzo	Not Re
3	12119507	394_20	216	0.20396034900...	2	Leasehold	Commercial	Ronald Morara ...	Male	A010047670Q	15-03-88	Kenneth Johnson	Not Re
4	12364015	394_20	204	0.21656914800...	2	Leasehold	Residential	Evans Mokoro	Male	A001420058S	17-03-93	Charles M. Wam...	Not Re
5	12608565	394_20	214	0.07999148000...	2	Leasehold	Residential	Godfrey O. Nya...	Male	A008917085R	07-08-85	Kenneth Johnson	Not Re
6	11630386	394_20	205	0.22175785300...	2	Leasehold	Residential	Henry Moracha	Male	A003520346J	17-03-93	Jenifer N. Kilonzo	Not Re
7	11385765	394_20	203	0.26386162200...	2	Leasehold	Commercial	Richard Bundi ...	Male	A005999718R	17-03-93	Jenifer N. Kilonzo	Not Re
8	24100011	131_74	109	0.37155966500...	2	Leasehold	Residential	Samwel Nyange...	Male	A007266711N	22-07-98	Kenneth Johnson	Not Re
9	11874867	394_20	215	0.37438885400...	2	Leasehold	Residential	Robert Nyamac...	Male	A003524346J	17-03-93	Jenifer N. Kilonzo	Not Re
10	27218266	394_20	220	0.37228968100...	2	Leasehold	Residential	Sammu Nyagak...	Male	A002098545W	20-04-09	Kenneth Johnson	Not Re
11	13586786	394_20	202	0.08430285400...	2	Leasehold	Residential	Cosmas Ombur...	Male	A007136112L	17-03-93	Charles M. Wam...	Not Re
12	11227254	394_20	221	0.09587306600...	2	Leasehold	Commercial	Charles Onchon...	Male	A005999718R	19-10-82	Jenifer N. Kilonzo	Not Re
13	5479257	394_20	219	0.08337278700...	2	Leasehold	Residential	Peter Nyaega O...	Male	A003461016W	29-09-04	Kenneth Johnson	Not Re
14	12608586	131_74	108	0.19465699100...	2	Leasehold	Residential	Samuel Angasa ...	Male	A005969318K	17-03-93	Jenifer N. Kilonzo	Not Re
15	12608524	394_20	218	0.05396787100...	2	Leasehold	Residential	Vincent Onyando	Male	A004279632Y	10-03-93	Jenifer N. Kilonzo	Not Re
16	13342249	131_74	107	0.08328408600...	2	Leasehold	Residential	Pius Abuki Bwo...	Male	A007186930S	19-10-82	Jenifer N. Kilonzo	Not Re
17	13097685	131_74	106	0.05367006800...	2	Leasehold	Commercial	Protus Aramba ...	Male	A004354865Z	17-03-93	Charles M. Wam...	Not Re
18	12853138	131_74	105	0.08369319500...	2	Leasehold	Commercial	Reuben Choi M...	Male	A007681187D	17-03-93	Charles M. Wam...	Not Re
19	12608524	131_74	104	0.05396787100...	2	Leasehold	Residential	Vincent Onyando	Male	A004279632Y	10-03-93	Jenifer N. Kilonzo	Not Re

Show All Features

3.7 Building the Database

3.7.1 External Model: User View Approach

The study looked at the various stakeholders in the land management sector in Kisii County and the information they would be interested in. The following model was generated as shown in Figure 3.3

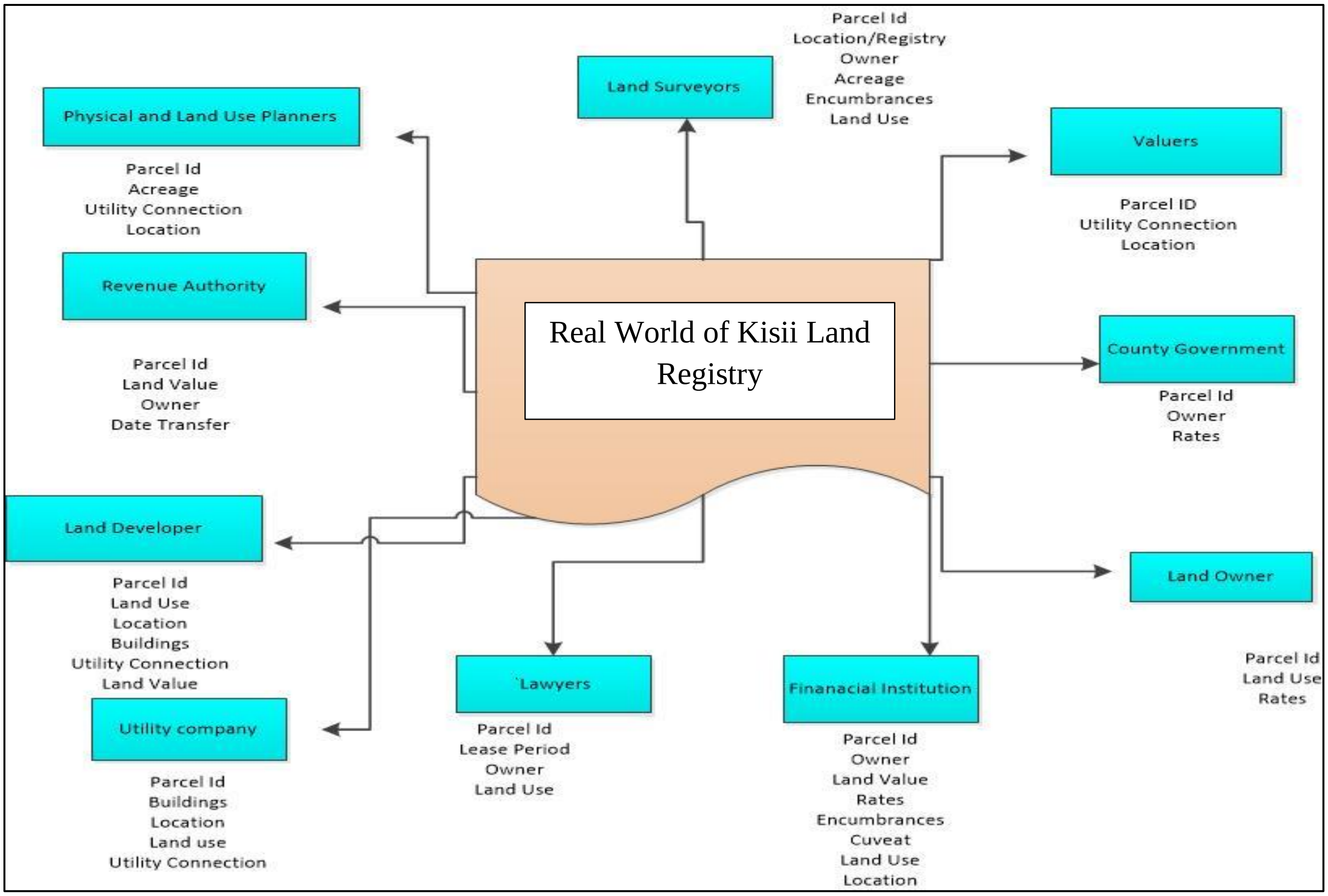


Figure 3. 3: External Model

3.7.2 Conceptual Model

The various entities and relationships in the land sector were modeled in the following E-R diagram as shown in Figure 3.4:

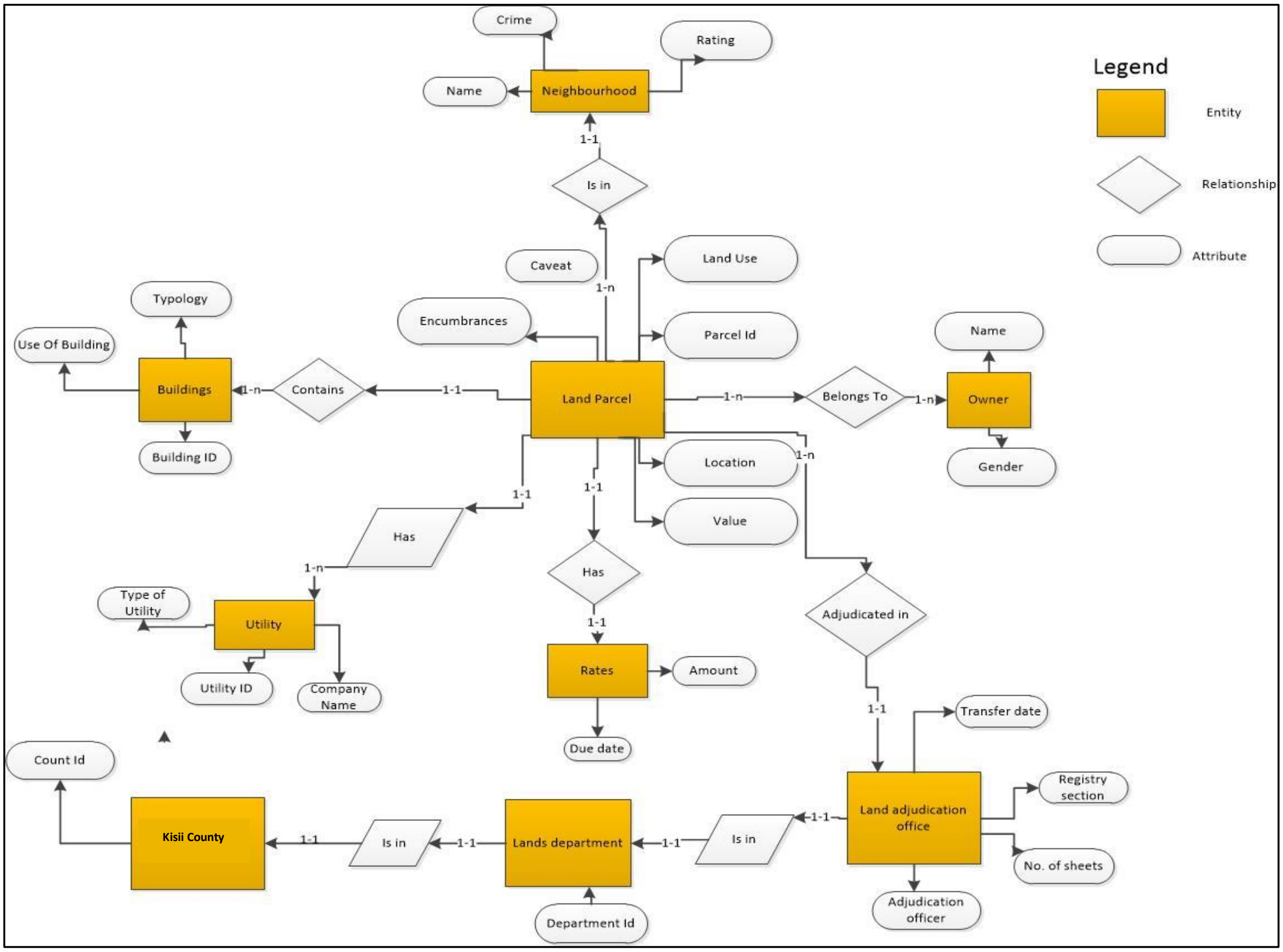


Figure 3. 4: Conceptual Model-ER Diagram

3.7.3 Logical Model

Schemas were generated from the E-R diagram. An example is shown in Table 3.2:

Table 3. 2: Kisii Block_II Schema

Relation 1:

Parcel No	Owner	Caveat	Acreage	Encumbrances	Land use

3.7.4 Physical Design

The schemas were normalized and populated.

3.7.5 Integrated GIS Database

The spatial data was merged with the non-spatial data to form an integrated database using PostGIS/PostgreSQL Database Management System.

3.8 Building of the WEB Portal

The LIS WEB Portal was developed in Flask Framework. Flask is a micro web framework written in Python. The LIS will be running on localhost.

The LIS WEB Portal was developed using: Python, JavaScript, HTML and CSS. The use of HTML was to define the content of web pages, CSS was used to specify the layout of web pages and the use of Python and JavaScript was to program the behaviour of web pages.

An algorithm was scripted in python to link the database to the web portal. This was to provide an interface of interaction between the various users and the Land Information System.

3.9 Data Presentation

The completed digitized Block II parcels results were presented in a multiplicity of formats to facilitate ease of analysis. One of the presentation formats was the visual display on the computer screen. A screen display of Block II land parcels is as shown in Figure 3.5

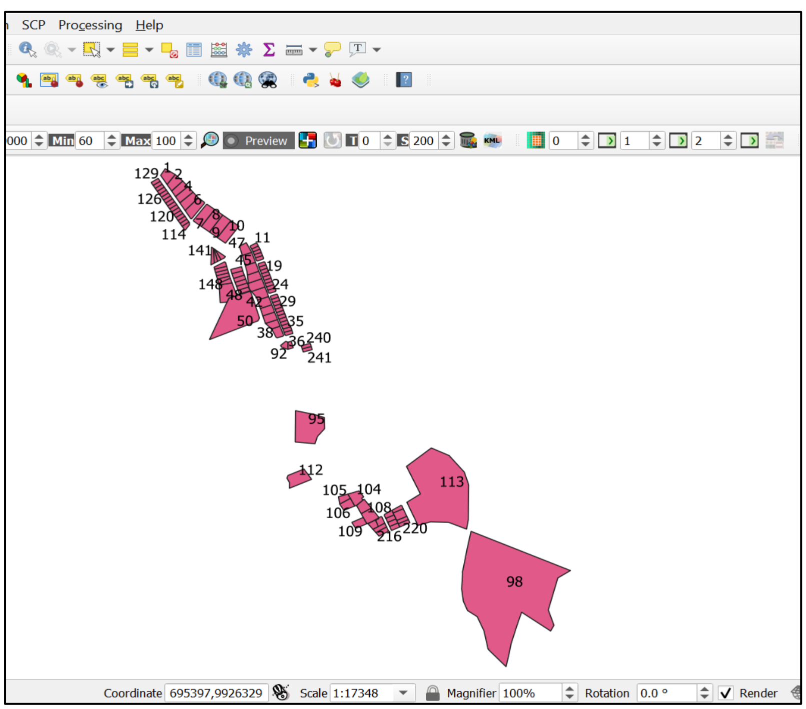


Figure 3. 5: Resulting Parcel Polygons (Source, Researcher)

3.10 Limitations of the study

- The covid-19 pandemic outbreak hindered physical interactions that created a disadvantage in making consultations that required practical demonstrations.
- Since the researcher could not collect information on the land owners, hypothetical names and associated details were used.

CHAPTER 4: RESULTS AND ANALYSIS

4.1 Results

The expected results of the study were a digital cadastre for the Kisii Municipality, a web-based portal for the cadastre and a demonstration of parcel searches and locations on the web portal.

4.1.1 Digitization

The result of the digitized parcels from various survey plans of Kisii Municiplity Block II is as shown in Figure 4.1

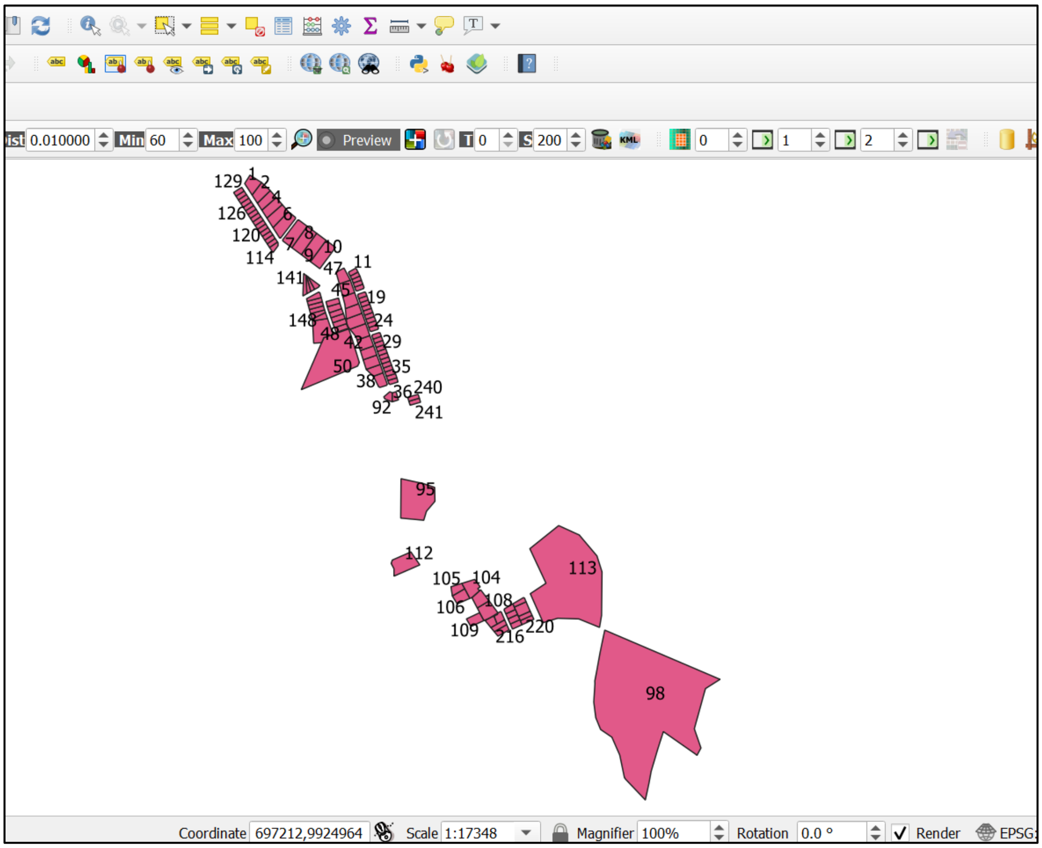


Figure 4. 1: Part of Kisii Block II RIM

4.1.2 Non-spatial attributes table

The result for the non-spatial attributes contained in the LIS database is as shown in Table 4.1:

Table 4. 1 Non-spatial attributes

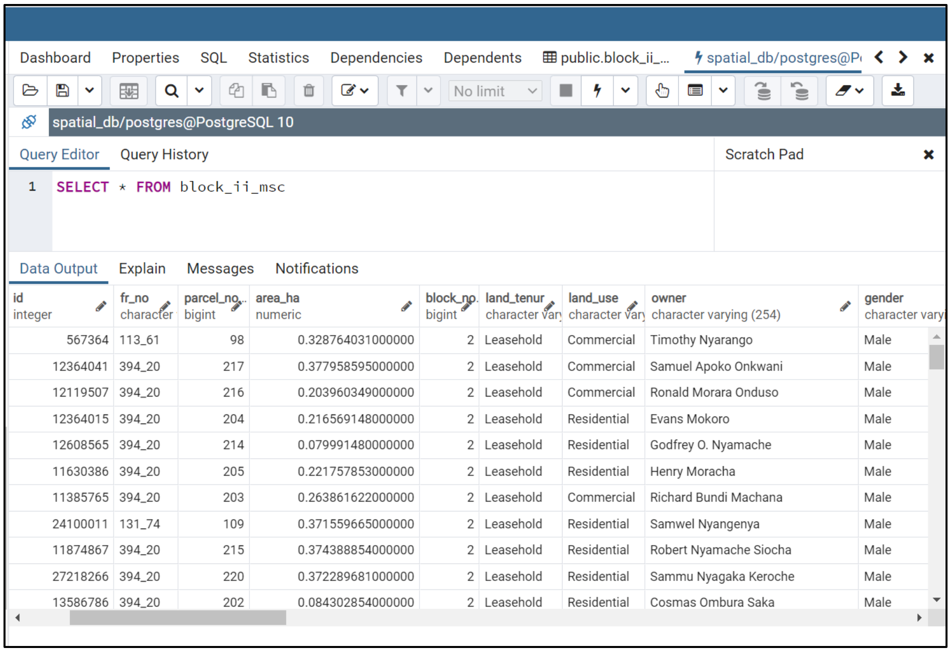
	Id	Fr_No	Parcel_No	Area_Ha	block_no	land_tenur	land_use	owner	gender	kra_pin	date_reg	registrar	c
1	510827	73_196	49	0.04634071100...	2	Leasehold	Residential	Kefah Onsongo ...	Male	A003461016W	14-03-93	Kenneth Johnson	Not Re:
2	512348	111_96	92	0.11636041100...	2	Leasehold	Residential	Isabella Nyabok...	Female	A004354865Z	17-03-93	Charles M. Wam...	Not Re:
3	532726	46_9	5	0.04921333100...	2	Leasehold	Commercial	Ceciliar Nyokabi...	Female	A003461016W	14-10-82	Kenneth Johnson	Not Re:
4	546726	46_58	28	0.05041666200...	2	Leasehold	Residential	Grace Kwambok...	Female	A004279632Y	17-03-93	Charles M. Wam...	Not Re:
5	567364	113_61	98	0.32876403100...	2	Leasehold	Commercial	Timothy Nyaran...	Male	A005969318K	19-10-82	Jenifer N. Kilonzo	Not Re:
6	1008904	46_58	45	0.07084736900...	2	Leasehold	Commercial	Dennis Onchan...	Male	A001228067V	19-10-82	Charles M. Wam...	Not Re:
7	1147064	46_58	43	0.04613326300...	2	Leasehold	Commercial	Kennedy Morac...	Male	A001234097S	17-03-93	Charles M. Wam...	Not Re:
8	1452595	46_58	11	0.43326324100...	2	Leasehold	Commercial	Haron Motume ...	Male	A004757097R	18-06-03	Jenifer N. Kilonzo	Restrict
9	1452788	46_58	44	0.19040080900...	2	Leasehold	Commercial	Henry Kubasu ...	Male	A005024716C	12-05-94	Kenneth Johnson	Not Re:
10	1643259	225_51	150	0.04605332400...	2	Leasehold	Commercial	Isaiah Mosota N...	Male	A001313147F	23-06-03	Charles M. Wam...	Not Re:
11	2141325	46_9	8	0.17756924000...	2	Leasehold	Residential	Henry Moracha	Male	A007186930S	17-03-93	Jenifer N. Kilonzo	Not Re:
12	2243608	140_107	127	0.04656007400...	2	Leasehold	Residential	Henry Ochori	Male	A004352216B	23-03-93	Charles M. Wam...	Restrict
13	2244250	46_58	17	0.09368007300...	2	Leasehold	Residential	Francis Aburi O...	Male	A000226681U	17-10-98	Kenneth Johnson	Not Re:
14	3450645	225_51	148	0.15935277000...	2	Leasehold	Residential	Kennedy Michir...	Male	A002746153B	17-10-08	Kenneth Johnson	Restrict
15	3450645	225_51	151	0.15935277000...	2	Leasehold	Residential	Kennedy Michir...	Male	A002746153B	17-10-08	Kenneth Johnson	Restrict
16	3881705	140_107	119	0.16767898800...	2	Leasehold	Commercial	Albert Moinde ...	Male	A001437959H	19-10-82	Charles M. Wam...	Not Re:
17	4069477	46_9	2	0.04661752000...	2	Leasehold	Commercial	Isaiah Onguti M...	Male	A001435432L	18-06-03	Charles M. Wam...	Not Re:
18	5320250	46_58	12	0.05896590100...	2	Leasehold	Commercial	Isaiah Mosoto	Male	A003533105F	17-03-93	Charles M. Wam...	Not Re:
19	5323380	46_58	15	0.06906582300...	2	Leasehold	Residential	Joash Nyaribo ...	Male	A011839487T	19-10-82	Charles M. Wam...	Not Re:

Show All Features

4.1.3 Querying the PostGIS/PostgreSQL Database

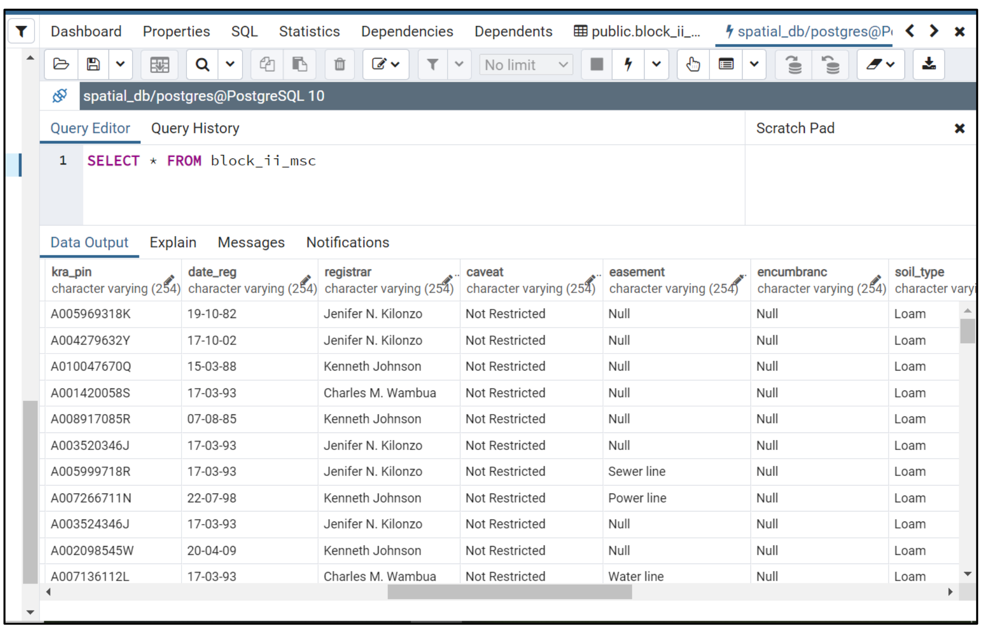
Querying the PostGIS/PostgreSQL database was mainly done to check for redundancies and ensuring the system runs devoid of errors.

For example, one conducting a search on all data in a database table in this case Block II, by keying in the command "SELECT * FROM block_ii_msc" the results displayed are as shown in Figures 4.2, 4.3 and 4.4:



id integer	fr_no character	parcel_no bigint	area_ha numeric	block_no bigint	land_tenur character vary	land_use character vary	owner character varying (254)	gender character vary
567364	113_61	98	0.328764031000000	2	Leasehold	Commercial	Timothy Nyarango	Male
12364041	394_20	217	0.377958595000000	2	Leasehold	Commercial	Samuel Apoko Onkwani	Male
12119507	394_20	216	0.203960349000000	2	Leasehold	Commercial	Ronald Morara Onduso	Male
12364015	394_20	204	0.216569148000000	2	Leasehold	Residential	Evans Mokoro	Male
12608565	394_20	214	0.079991480000000	2	Leasehold	Residential	Godfrey O. Nyamache	Male
11630386	394_20	205	0.221757853000000	2	Leasehold	Residential	Henry Moracha	Male
11385765	394_20	203	0.263861622000000	2	Leasehold	Commercial	Richard Bundi Machana	Male
24100011	131_74	109	0.371559665000000	2	Leasehold	Residential	Samwel Nyangenya	Male
11874867	394_20	215	0.374388854000000	2	Leasehold	Residential	Robert Nyamache Siocha	Male
27218266	394_20	220	0.372289681000000	2	Leasehold	Residential	Sammu Nyagaka Keroche	Male
13586786	394_20	202	0.084302854000000	2	Leasehold	Residential	Cosmas Ombura Saka	Male

Figure 4. 2: Queried result of database showing part of the contained fields: National ID, Block No, FR No, Parcel No, Area_Ha, Land Tenure, Land Use, Owner and Gender.



kra_pin character varying (254)	date_reg character varying (254)	registrar character varying (254)	caveat character varying (254)	easement character varying (254)	encumbranc character varying (254)	soil_type character vary
A005969318K	19-10-82	Jenifer N. Kilonzo	Not Restricted	Null	Null	Loam
A004279632Y	17-10-02	Jenifer N. Kilonzo	Not Restricted	Null	Null	Loam
A010047670Q	15-03-88	Kenneth Johnson	Not Restricted	Null	Null	Loam
A001420058S	17-03-93	Charles M. Wambua	Not Restricted	Null	Null	Loam
A008917085R	07-08-85	Kenneth Johnson	Not Restricted	Null	Null	Loam
A003520346J	17-03-93	Jenifer N. Kilonzo	Not Restricted	Null	Null	Loam
A005999718R	17-03-93	Jenifer N. Kilonzo	Not Restricted	Sewer line	Null	Loam
A007266711N	22-07-98	Kenneth Johnson	Not Restricted	Power line	Null	Loam
A003524346J	17-03-93	Jenifer N. Kilonzo	Not Restricted	Null	Null	Loam
A002098545W	20-04-09	Kenneth Johnson	Not Restricted	Null	Null	Loam
A007136112L	17-03-93	Charles M. Wambua	Not Restricted	Water line	Null	Loam

Figure 4. 3: Queried result of database showing more fields: KRA Pin, Date of Registration, Registrar, Caveat, Easement, Encumbrance and Soil Type.

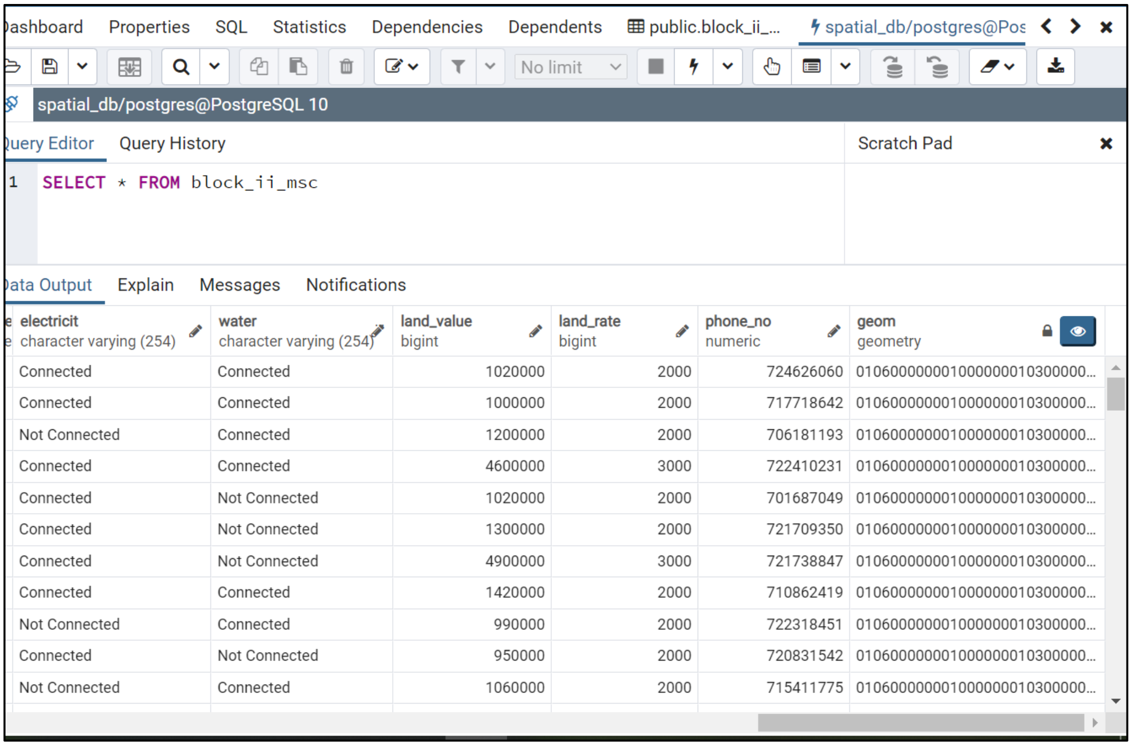


Figure 4. 4: Queried result of a database showing more fields: Electricity, Water, Land Value, Land Rate and Owner's Phone Number.

Conducting a query on all data in the database for Block II to display polygon geometry; by keying in the command "SELECT ST_ASText (geom) FROM block_ii_msc" the result displays beacon coordinates as shown in Figure 4.5. The type of geometry displayed was Multi polygon**.**

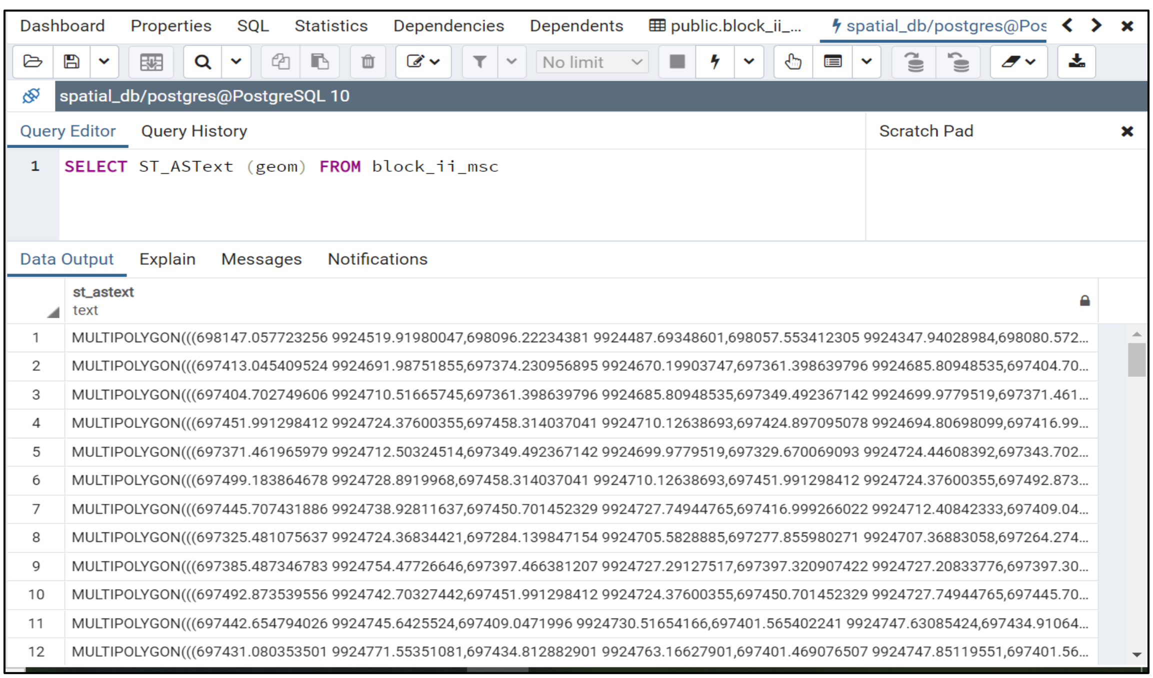


Figure 4. 5: Type of Geometry Query Result

Conducting a query on the database for Block II to display the attributes for example Parcel 98; by keying in the command "SELECT * FROM block_ii_msc WHERE parcel no = 98". The results displayed are as shown in Figure 4.6:

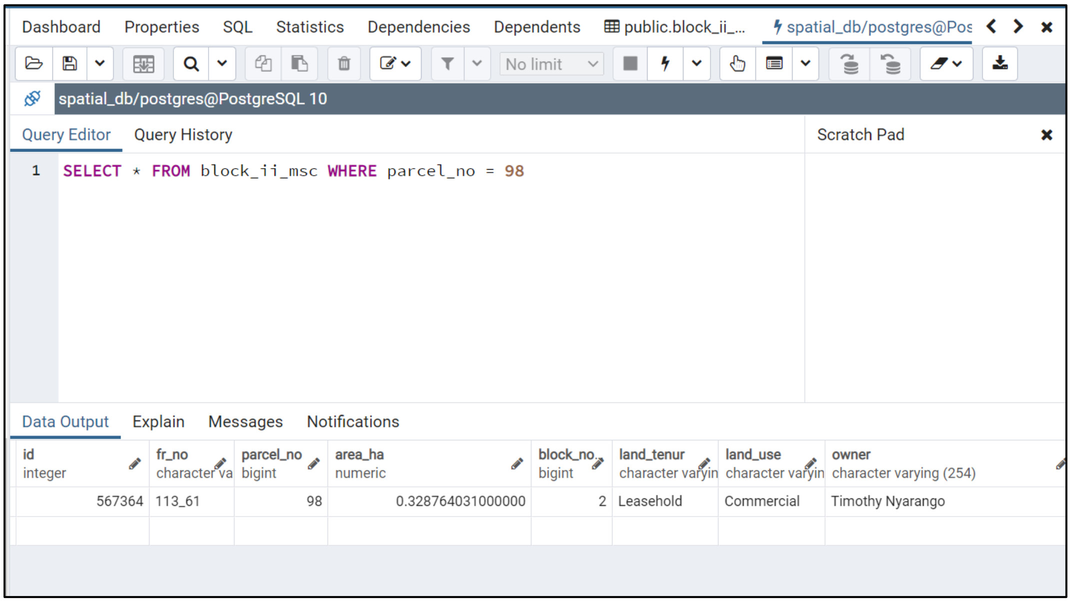


Figure 4. 6: A Query to Display Attributes for Parcel No. 98

4.1.4 Land Information System WEB Portal

The user accesses the Web portal by keying in personal credentials as captured in the database, this was achieved through the Log in screen interface as shown in Figure 4.7

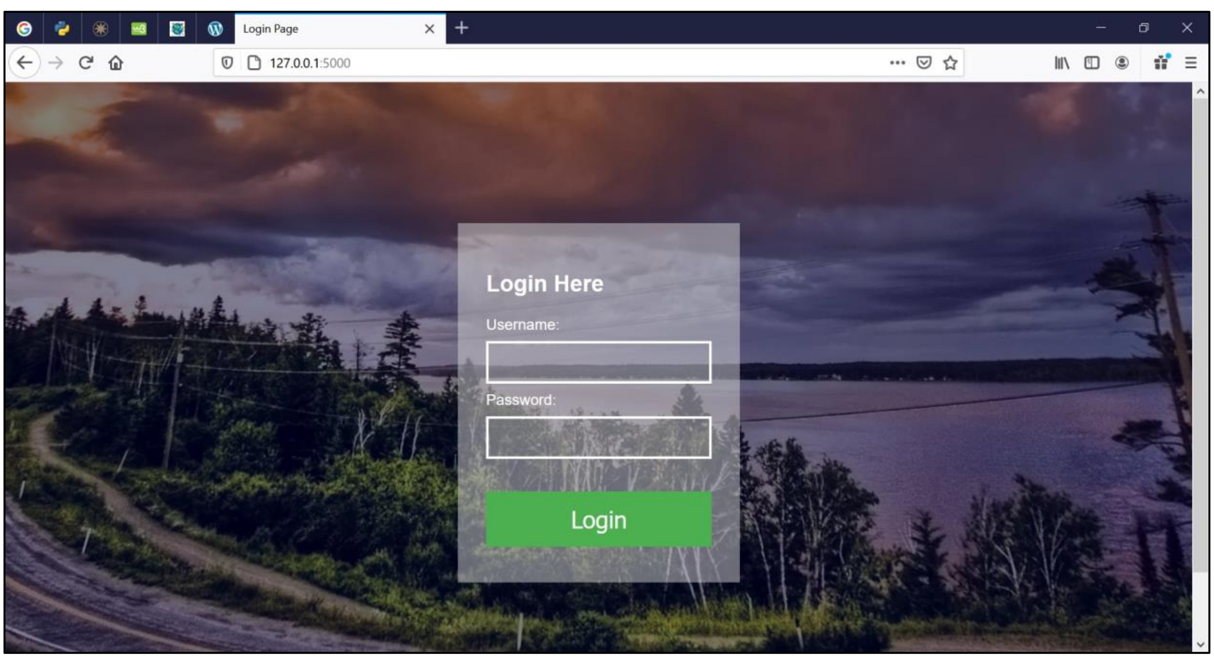


Figure 4. 7: Log in Screen Interface

The created LIS WEB Portal home page is as shown in Figure 4.8

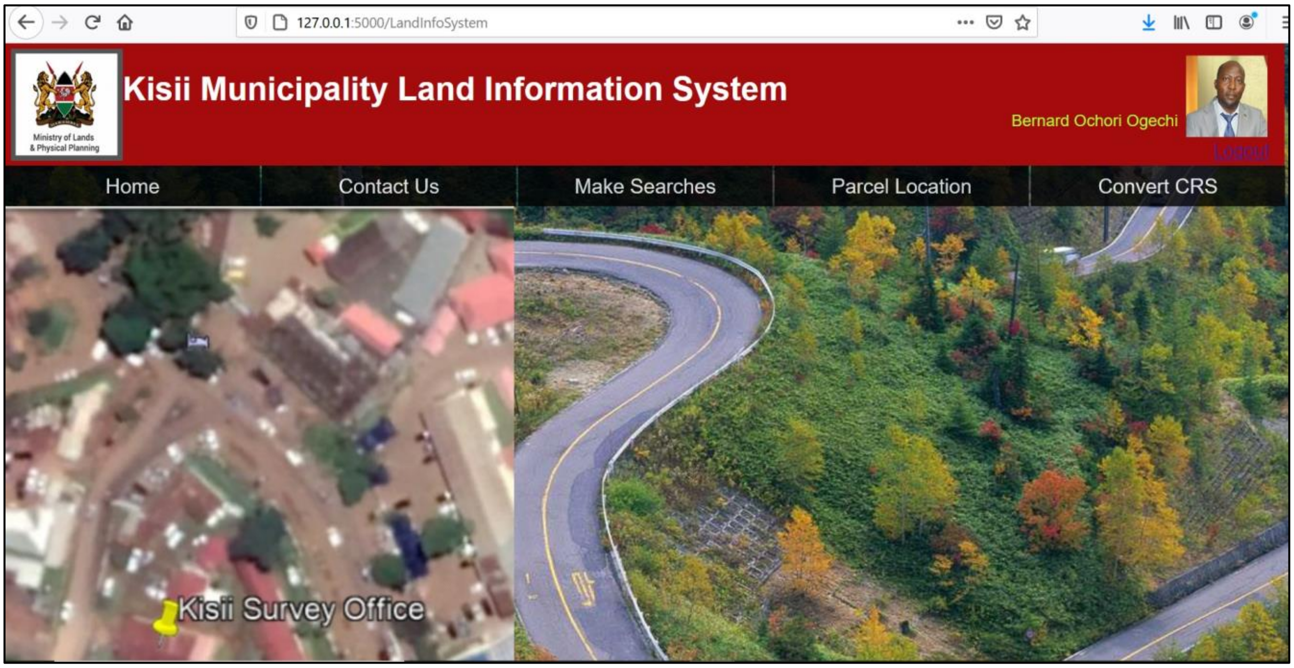


Figure 4. 8: The Interface of the LIS WEB Portal home page

4.1.5 Conducting Non-Spatial Searches on the LIS WEB Portal

On the WEB Portal the user accesses the relevant page that leads to conducting a search of interest based on the specified Block where the Parcel fall e.g. Block I, Block II or Block III as seen in Figure 4.9:

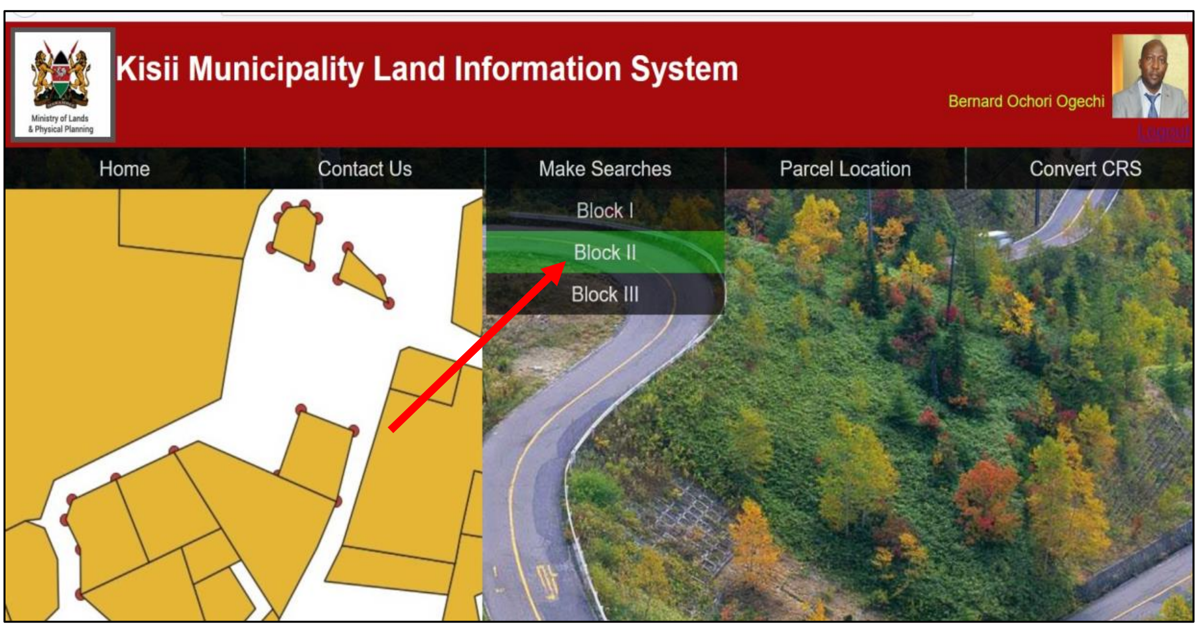


Figure 4. 9: The Interface of the LIS WEB Portal search page categories

On clicking on any Block of choice e.g., Block II, the user is directed to a page where he/she can conduct the land parcel searches of a specified parcel number as shown in Figure 4.10

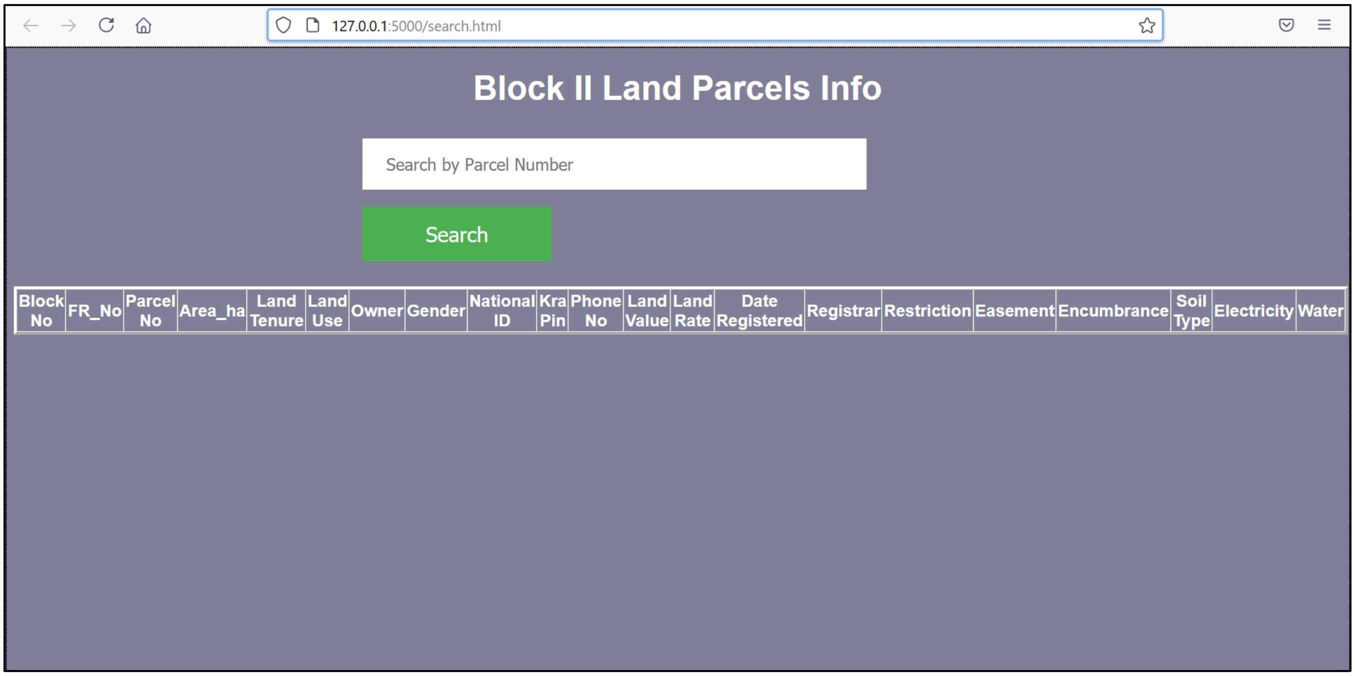


Figure 4. 10: LIS WEB Portal Land Parcel Data Search Page

The system fetches data directly from the developed PostGIS/PostgreSQL database. Parcel Number is the primary key so the user is expected to do data searches using a specific Parcel Number of interest e.g., a search on Parcel 98 of Block II, displays the results as seen in Figure 4.11:

Figure 4. 11: A Display of part of the Search Results for Block II Parcel No. 98

4.1.6 Conducting Spatial Searches on the LIS WEB Portal

Parcel search to find the location of the parcel of interest in real time was achieved through the created LIS WEB Portal. Parcel Location page has got the parcels in their respective blocks as depicted in Figure 4.12

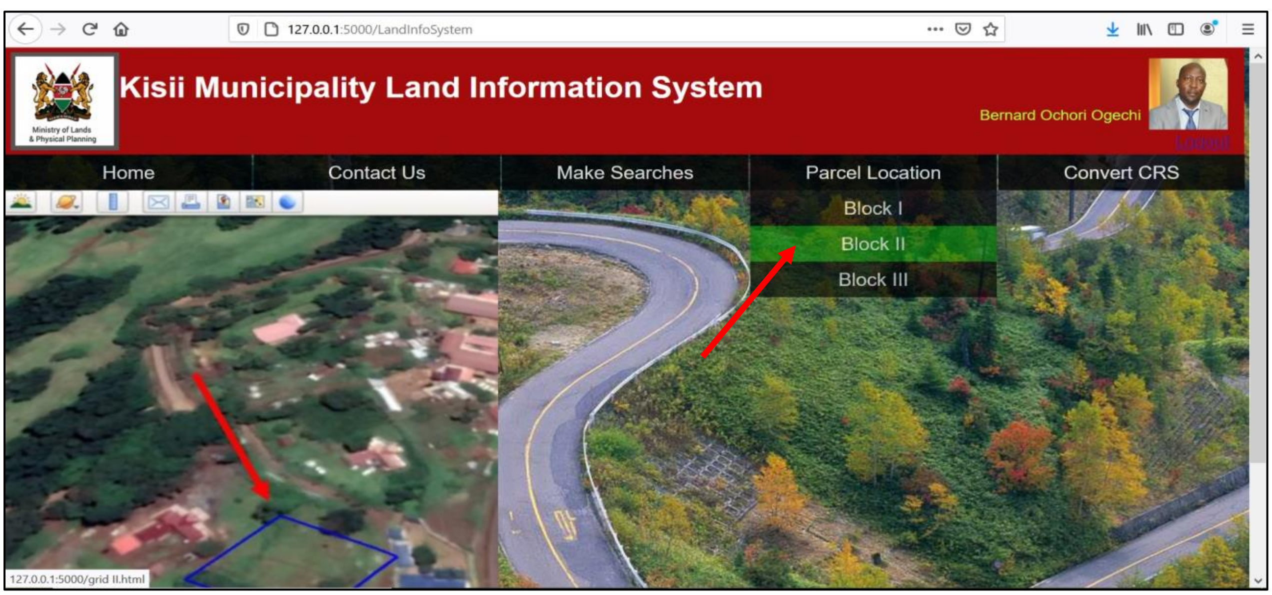


Figure 4. 12: Parcel Location Page Categories

On clicking the block of interest, the user is directed to a page containing parcels of the respective block. In doing so they are able to generate a kml file by clicking on their parcel of interest and the system loads it automatically as depicted in the Figure 4.13

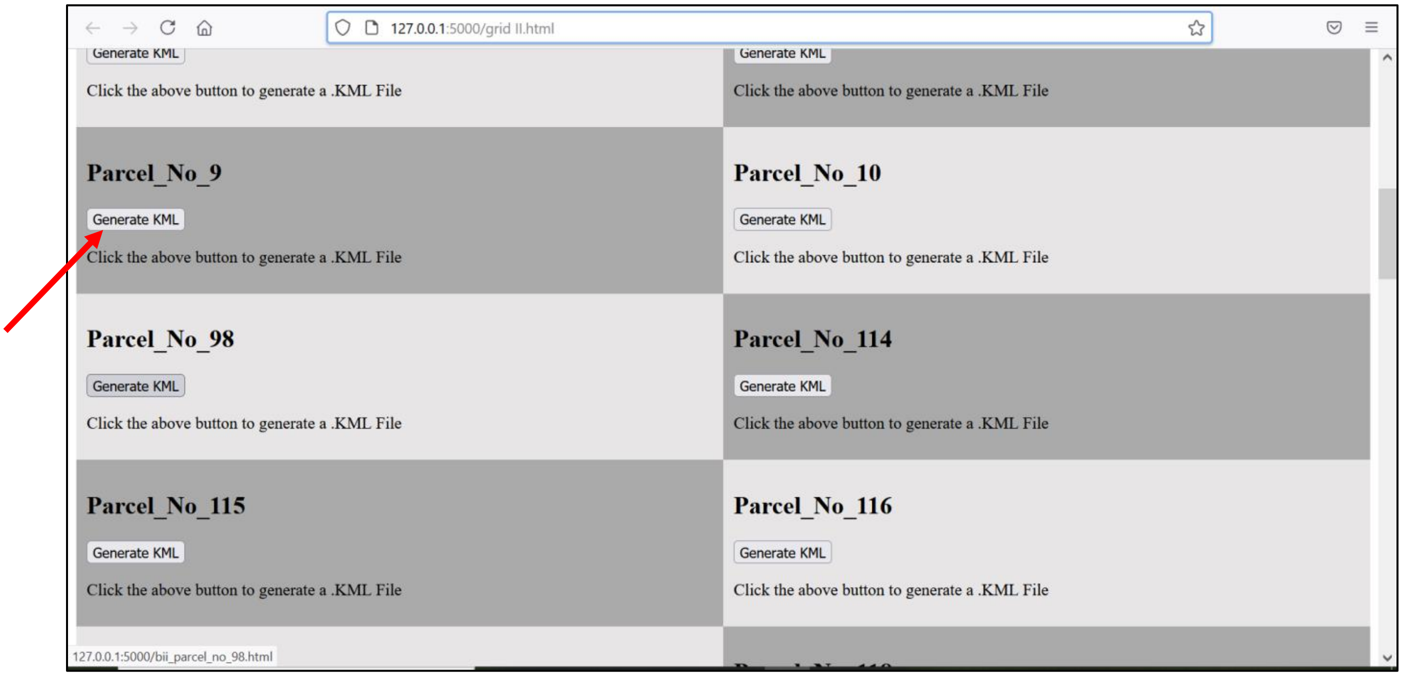


Figure 4. 13: KML Generation Grid

The generated KML file is loaded onto Google earth pro that casts the parcel on its respective spatial location. The loaded file is as shown in Figure 4.14

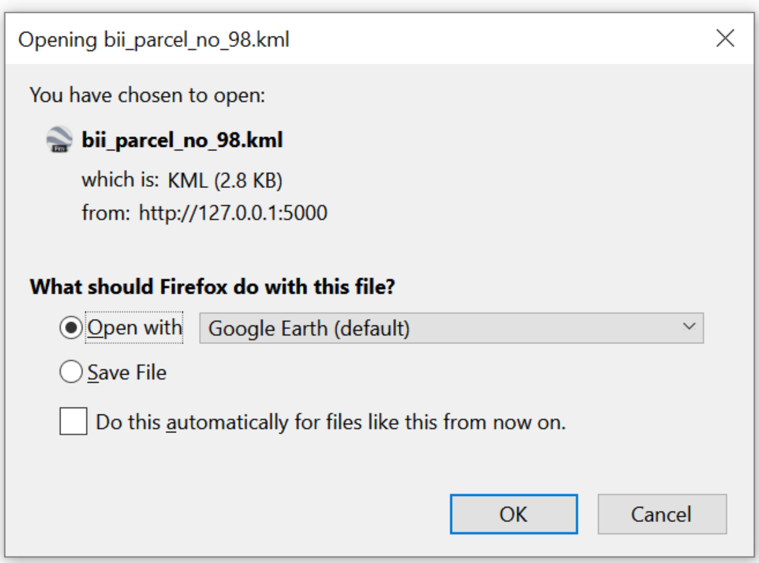


Figure 4. 14: A Wizard to enable the loading of the generated kml file on Google Earth Pro

Through Google Earth pro, the specified parcel is casted on its respective spatial position on the ground as shown in Figure 4.15:

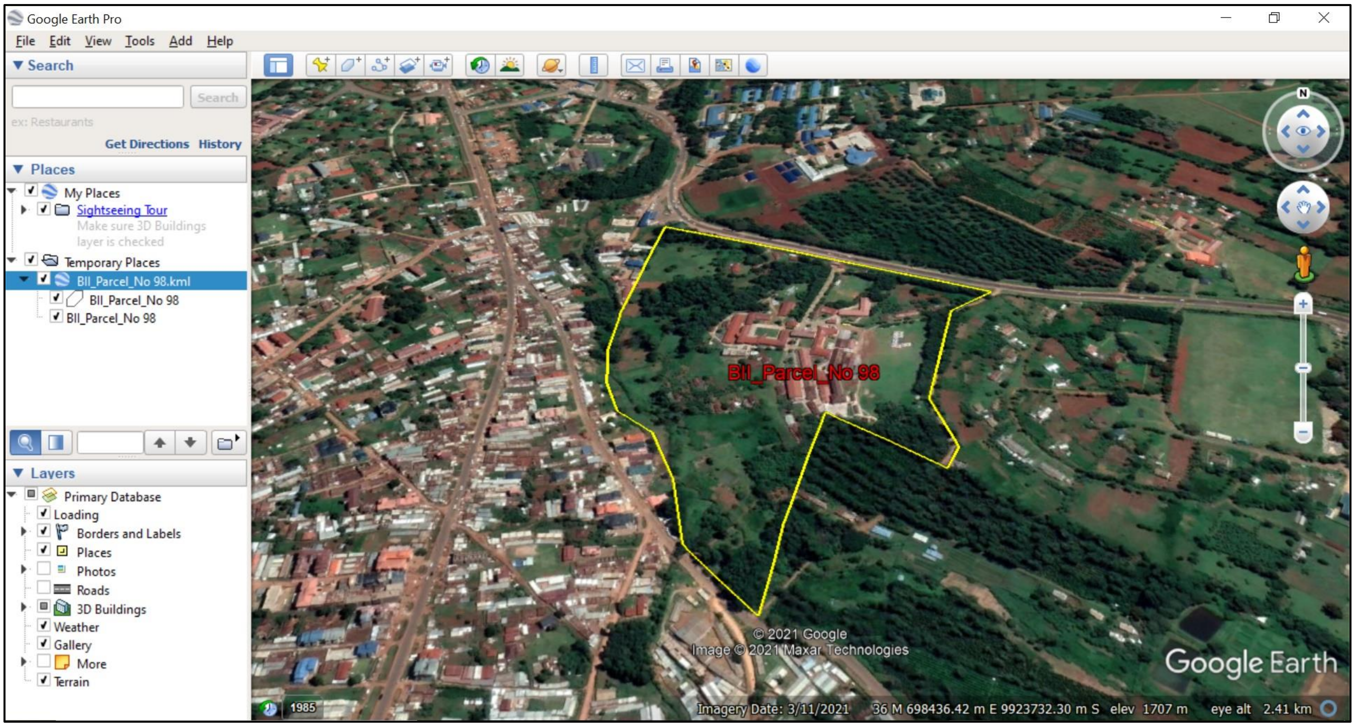


Figure 4. 15: Results of the loaded kml file on Google Earth Pro

4.1.7 Parcel Overlaps

The created LIS provides for the detection and display of parcels that overlap. This is crucial in highlighting possible land boundary disputes that needs to be solved before one transacts on specified parcels of land.

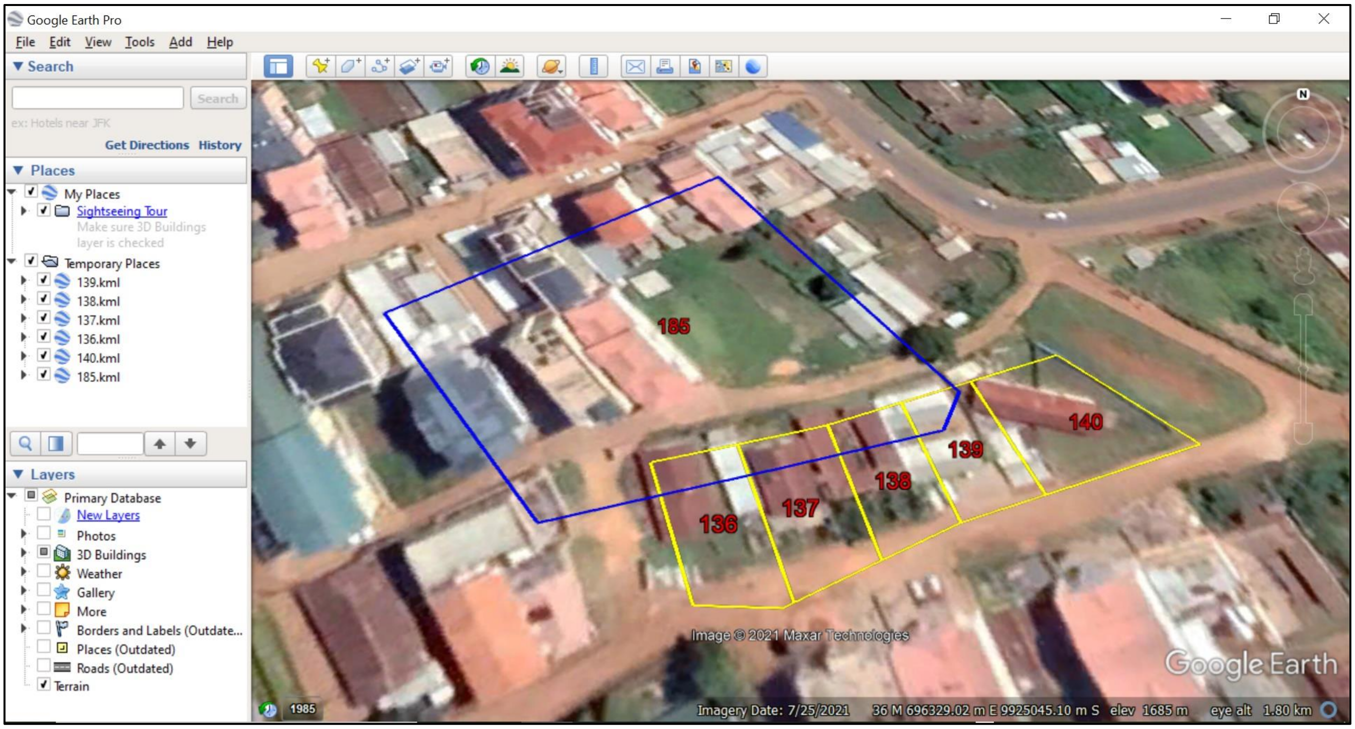


Figure 4. 16 Displaying Block I Parcel Overlaps

4.1.7 Coordinate Reference System Conversion

Conversion of Coordinate Reference System was also served well under the Convert CRS page as shown in the Figure 4.16

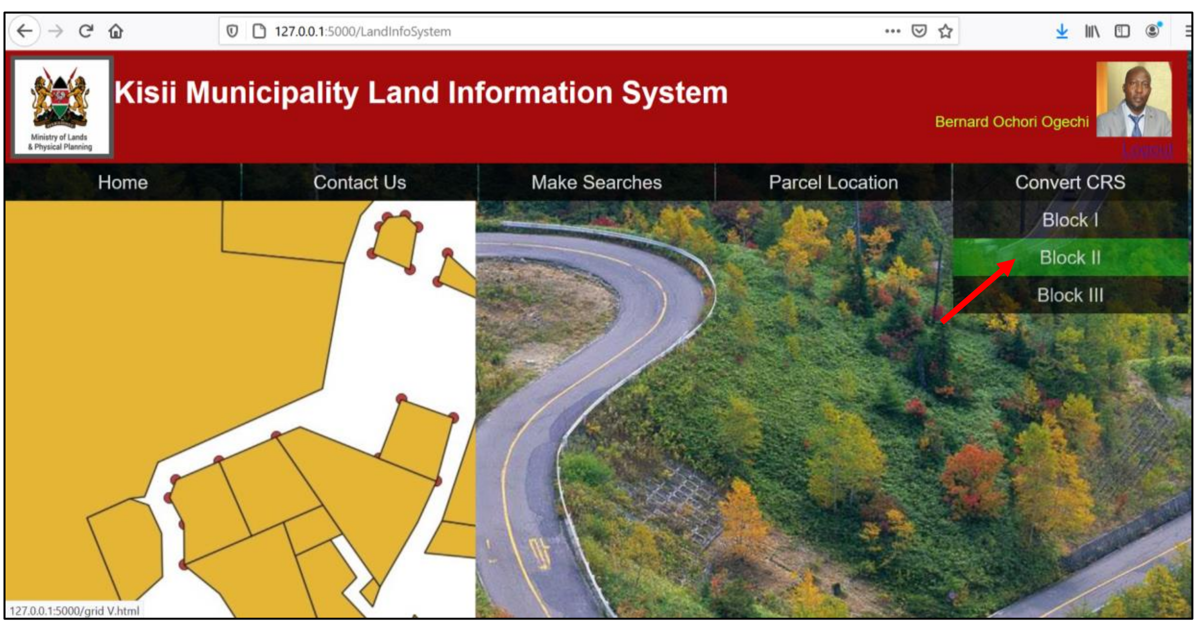


Figure 4. 17: CRS Conversion Page Categories

On clicking on the specific Block of interest the user is directed to the page as shown in Figure 4.17:

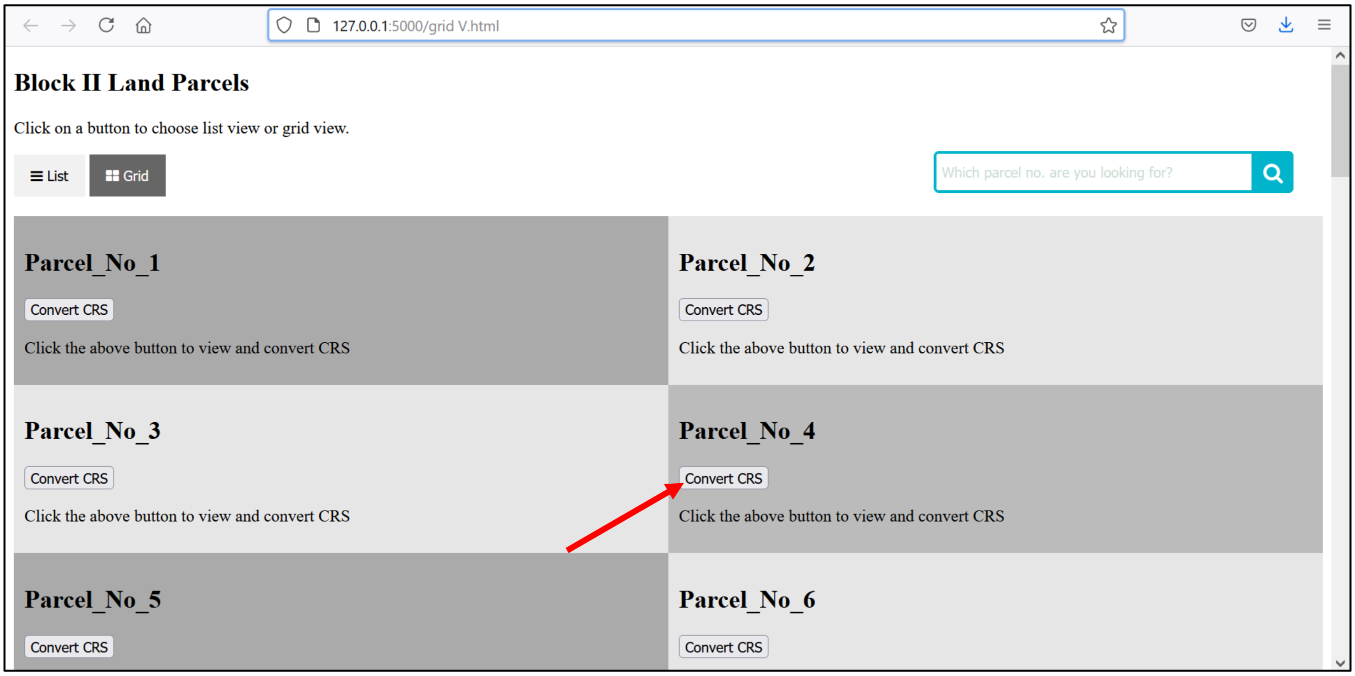
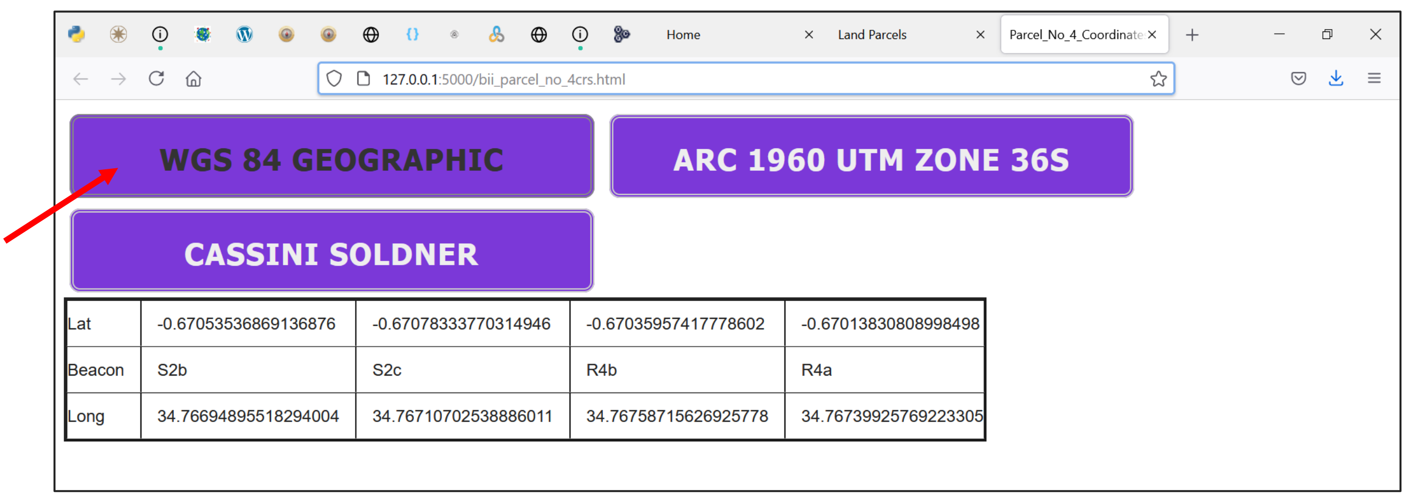


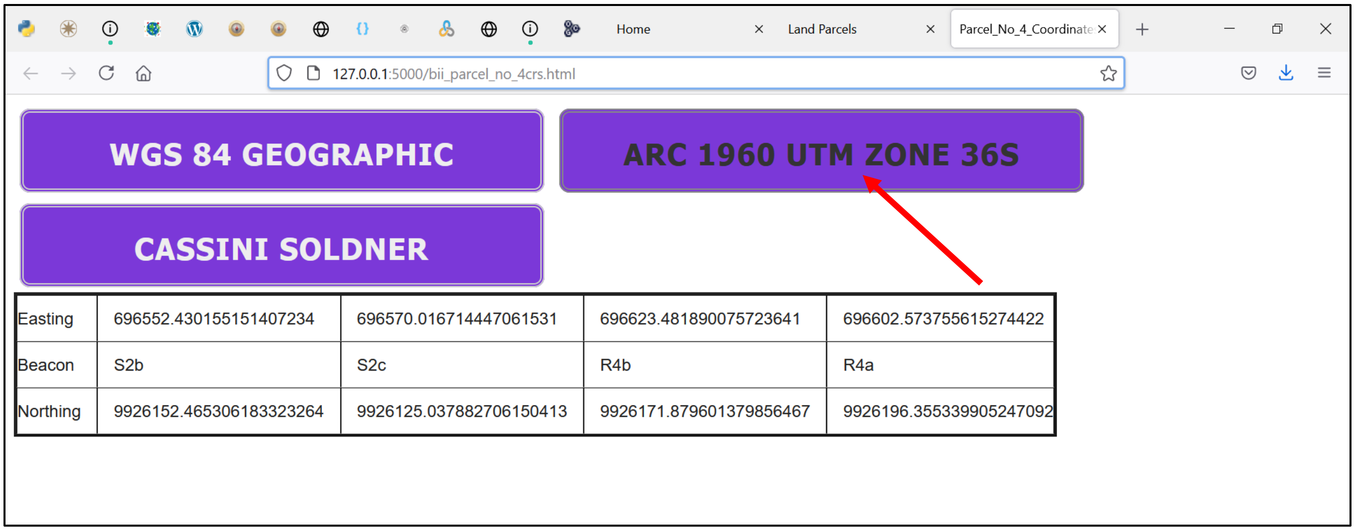
Figure 4. 18: Conversion of Land Parcels CRS Grid Page

Upon clicking on the parcel of interest in this case parcel number 4, the user is directed to select the coordinate reference system of their choice i.e., WGS84 Geographic, Cassini Soldner or UTM Arc 1960 – these being the commonly used Coordinate Reference Systems in Kenya. The user is in a position to view the outer boundary point coordinates of each parcel in any Coordinate Reference Systems of their choice. See Figures: 4.18, 4.19, and 4.20.



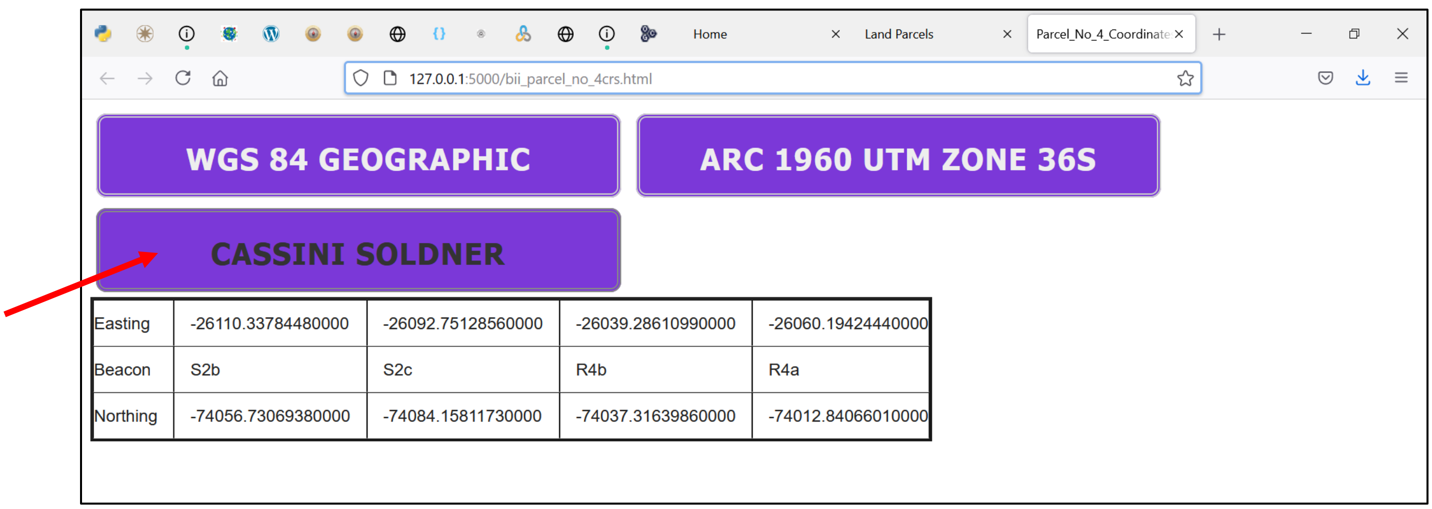
Lat	-0.67053536869136876	-0.67078333770314946	-0.67035957417778602	-0.67013830808998498
Beacon	S2b	S2c	R4b	R4a
Long	34.76694895518294004	34.76710702538886011	34.76758715626925778	34.76739925769223305

Figure 4. 19: Coordinate Points of the parcel in WGS 84 Geographic



Easting	696552.430155151407234	696570.016714447061531	696623.481890075723641	696602.573755615274422
Beacon	S2b	S2c	R4b	R4a
Northing	9926152.465306183323264	9926125.037882706150413	9926171.879601379856467	9926196.355339905247092

Figure 4. 20: Coordinate Points of the parcel in Arc 1960 UTM Zone 36S



Easting	-26110.33784480000	-26092.75128560000	-26039.28610990000	-26060.19424440000
Beacon	S2b	S2c	R4b	R4a
Northing	-74056.73069380000	-74084.15811730000	-74037.31639860000	-74012.84066010000

Figure 4. 21: Cassini Soldner Coordinates of the Parcel

CHAPTER 5: CONCLUSSION AND RECOMMENDATIONS

5.1 Conclusion

Through this study, the researcher was able to realize a Comprehensive Web-Based Land Information System for Kisii Municipality. The LIS provided capabilities to conduct land parcel searches obtaining both spatial and non-spatial attributes. Real-time identification of parcel ground location through Google Earth imagery was achieved as well as the Coordinate conversion from one Coordinate Reference System to the other (Cassini Soldner, Arc 1960 UTM Zone 36S and WGS 84 geographic).

The created LIS caters for a wide range of users spanning from the general users whose interest would be just to confirm the Parcel proprietor details (Name, National ID No, PIN etc.) to specialized users as in the case of Land Surveyors whose technical interest would involve acquisition of the Parcel’s coordinates and coordinate Reference System and Spatial location.

In the context of the overall study, the Comprehensive Web-Based Land Information System for Kisii Municipality will help solve problems of timely access to land parcel information, aid in adequate land planning, land reform, execution of works and generally help in fast and effective decision making on land administration at various developmental levels.

The capability of accessing real time ground position of the parcel of interest helps combat the land related malpractices which in many instances has seen Kenyans fall prey to land fraudsters and made to pay for wrong or non-existent land parcels.

5.2 Recommendations

This Research has demonstrated that a LIS for Kisii Municipality is a viable option worth undertaking; its presence will nonetheless improve service delivery.

It is recommended that the Comprehensive Web-Based Land Information System of Kisii Municipality be used as a model to be replicated in other land registries in Kenya.

The researcher also recommends that the Comprehensive Web-Based Land Information System be interfaced with the recently founded Huduma number's database to ensure a reduction to the bulkiness of documents required to effect land transactions and also for reducing time taken and bureaucracy involved in accessing government services.

Finally, with the developments in Information Technology supporting contemporary geospatial technologies, it is recommended that a research be conducted on the development of an Integrated Land Information System database on a Block chain System.

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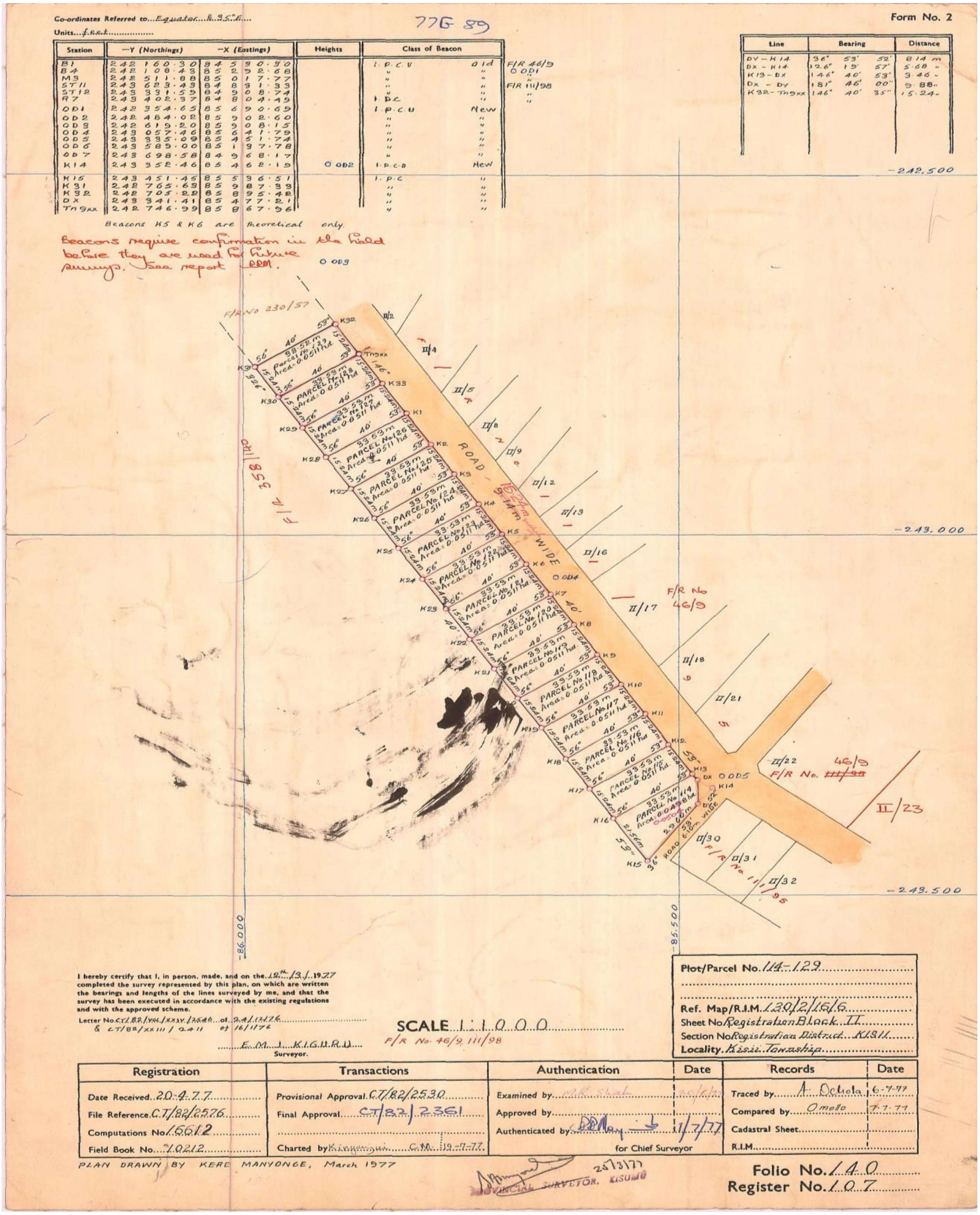
APPENDICES

Appendix 1



Appendix 2

REPUBLIC OF KENYA

THE REGISTERED LAND ACT

(Chapter 300)

Certificate of Lease

TITLE No. KISII MUNICIPALITY/BLOCK II/146

APPROXIMATE AREA 0.075HA

LESSOR GUSII COUNTY COUNCIL

RENT KSHS 980/=

TERM 99 YEARS FROM 1.5.1991

This is to certify that HENDRICUS OTENYO OSORO

ID/NO. 5818700 = = = =

= = = = =

OF BOX 80, KISII = = = =

is (are) now registered as the proprietor(s) of the leasehold interest above referred to, subject to the agreements and other matters contained in the registered lease, to the entries in the register relating to the lease and to such of the overriding interests set out in section 30 of the Registered Land Act as may for the time being subsist and affect the land comprised in the lease.

GIVEN under my hand and the seal of the KISII District Registry

this 9TH day of DECEMBER, 20 14

Land Registrar

(*To be completed only when the applicant has paid Sh.* 125).

At the date stated on the front hereof, the following entries appeared in the register relating to the land:—

EDITION: 1 OPENED: 13.2.2002	PART A—PROPERTY SECTION	
REGISTRATION SECTION KISII MUNICIPALITY/ BLOCK II	PARTICULARS OF LEASE LESSOR: GUSII COUNTY COUNCIL	NATURE OF TITLE
PARCEL NUMBER 146	LESSEE:MAKONE OMBESE	LEASEHOLD
APPROXIMATE AREA 0.075 HECTARES	RENT: KSHS 980/= TERM: 99 YRS FROM: 1.5.1991	
REGISTRY MAP SHEET No. 130/2/16/6	FOR APPURTENANCES *SEE* THE REGISTERED LEASE. N.B. WHERE THE LEASE IS OF A PART OF A PARCEL, THE PARCEL NUMBER REFERS TO THE NUMBER SHOWN ON THE FILED PLAN	

PART B—PROPRIETORSHIP SECTION

ENTRY NO.	DATE	NAME OF REGISTERED PROPRIETOR	ADDRESS AND DESCRIPTION OF REGISTERED PROPRIETOR	CONSIDERATIONS AND REMARKS	SIGNATURE OF REGISTRAR
		RESTRICTION: NO DISPOSITION BY THE PROPRIETOR SHALL BE REGISTERED WITHOUT THE WRITTEN CONSENT OF THE LESSOR (S. 48)			
5	8.12.14	HENDRICUS OTENYO OSORO			
6	9.12.14	CERTIFICATE OF LEASE		ISSUED	

PART C—ENCUMBRANCES SECTION

TRY NO.	DATE	NATURE OF ENCUMBRANCE	FURTHER PARTICULARS	SIGNATURE OF REGISTRAR

Land Registrar

REPUBLIC OF KENYA

THE REGISTERED LAND ACT
(Chapter 300)

Certificate of Lease