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FACULTY OF MINERAL RESOURCES TECHNOLOGY DEPARTMENT

OF GEOMATIC ENGINEERING

A THESIS REPORT ENTITLED

# DEVELOPMENT OF GEOSPATIAL LAND RECORDS MANAGEMENT SYSTEM-A CASE STUDY

BY

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SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN GEOMATIC ENGINEERING

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TARKWA, GHANA
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# DECLARATION

I Richard Yaw Asah, hereby declare that, apart from references cited, which have been duly acknowledged, this thesis is my personal work and it is being submitted as part of the requirement for the degree of Master of Science in Geomatic Engineering in the University of Mines and Technology (UMaT), Tarkwa. This thesis work has never been submitted either in part or whole for the award of any degree or examination in the University of Mines and Technology (UMaT), Tarkwa or any other University.

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(Candidate Signature)

…….day of ……, 2020

# ABSTRACT

Lands Commission (LC) cannot be mentioned without the tag of record manipulation, inefficiency and ineffectiveness. This is due to the manual nature at which duties are conducted at the records office under the Public and Vested Land Management Division, tasked to manage all records for the LC and retrieves or update when necessary. In order to achieve the vision and mission of the organisation, this research was sought to develop a Geospatial Land Records Management System for the LC, Tamale in QGIS environment where all land records such as Ledgers, Registers, Town Sheets, Maps and Layouts could be integrated through Georeferencing and Digitisation process. The system allows easy query of records by entering the site coordinates, generates search report, views layouts, views document in PDF and also allows the updating of records by just a click of a button instead of going through the old fashion method of combing through manual document before carrying out this same task. The system when adopted and implemented, would improve the work of the institution as speed, efficiency and security is assured.


KNOWLEDGE, TRUTH AND EXCELLENCE

# DEDICATION

To God be the glory for great things He has done. I dedicate this work to God Almighty for taking me to another step on the education ladder, to my mother and auntie, Mercy Yeboah and Dina Yeboah respectively, to my wife Abigail Asah Yeboah my sister Ama Boatemaa and my daughter Phyllis Asah Yeboah for their inspiration that keeps me going.

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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| C OF A | Certificate of Allocation |
| C OF APP | Certificate of Appropriation |
| C OF O | Certificate of Occupation |
| DXF | Drawing Exchange Format |
| FELIS | Federal Land Information System |
| FOI | Freedom of Information |
| GIS | Geographical Information System |
| GRASS | Geographic Resources Analysis Support |
| GELIS | Ghana Enterprise Land Information System |
| GNSS | Global Navigation Satellite System |
| GPS | Global Position System |
| ICT | Information Communication Technology |
| ISO | International Standard Organisation |
| IRMT | International Records Management Trust |
| LAP-I | Land Administration Project |
| LC | Lands Commission |
| LIMS | Land Information Management System |
| LI | Legislative Instrument |
| LIS | Land Information System |
| LRD | Land Registration Division |
| LVD | Land Valuation Division |
| NT | Notation |

| | |
|---|---|
| PDF | Portable Document Format |
| PVLMD | Public and Vested Land Management Division |
| QGIS | Quantum Geographical Information System |
| RTK | Real Time Kinematic |
| SLT | Systematic Land Title |
| SLT | Systematic Land Titling |
| SMD | Survey and Mapping Division |
| TCPD | Town and Country Planning Department |
| UPN | Unique Parcel Number |
| UDS | University for Development Studies |
| UMAT | University of Mines and Technology |

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# CHAPTER 1

## INTRODUCTION

### 1.1 Statement of the Problem

The Lands Commission (LC) was established by Articles 258 – 265 of the 1992 Constitution and was heightened by the Lands Commission Act 2008; Act 767 gave the legal basis for four land sector agencies to merge as Divisions. They are: The Land Valuation Division (LVD), Land Registration Division (LRD), Survey and Mapping Division (SMD) and the Public and Vested Land Management Division (PVLMD). The vision of the LC is to become the center of excellence for land services delivery, and the mission is to provide high quality, reliable and efficient services in geographic information, guaranteed tenure, property valuation, surveying and mapping through teamwork and modern technology to stakeholders (Anon., 2014).

However, in many developing countries like Ghana, government agencies are responsible for handling land administration but the process of keeping records are generally manual surrounded with conflicting and undependable data, suspicious manipulations of existing data by some recalcitrant staff and difficulty in retrieval of available information (Karikari, 2006).

The LC has a lot of flaws in its job delivery in terms of time and efficiency, which is in contrast to its vision and mission. For instance, there is poor attention and lack of innovations. The Commission's records department, also known as the "heart" and the "brain" of the LC in many cases works directly under the Public and Vested Land Management Division. The department is task to carry out duties such as keeping of land records, managing and updating all land transactions and providing reports on parcels of land.

Notwithstanding this, the department is still reliant on the age-old methods of creating and maintaining the land records. This system consists of manual surveys; cloth bound cadastral maps and non- uniform structures of record of rights. Currently, each region maintains this database as a hard copy register (Patil, 2014a). The method of keeping and retrieving the information makes it almost impossible for the LC to deliver its duties (Tagoe and Mantey, 2011).

Apiah (2013) also expressed that, the information management system currently operating in the country is mainly manual. Data and information are kept in the form of hard copy graphical maps, cadastral data and textual records. The linkage between these manual records is poor and there is difficulty in accessing data. Keeping records up-to-date in the land agencies is therefore a challenge. All these seriously constrain the operation of the land sector agencies. Furthermore, land records are deteriorating with use and this deterioration is compounded by the sub-standard conditions under which many of these records are stored, the extensive use to which they are subjected through retrieval and re-filing of the ageing manuscript documents. The records may also be at risk of disaster such as fire or flood as there is no backup system. A clear evidence of disaster occurred in 22nd day of March, 2012 where part of the LC head office records was burnt down.

According to Vinay *et al.*, *(*2003) data entry and verification of legacy data, regular updating of the records because of mutations, unstructured data, language issues, land records maintained on paper and cloth are in a very bad shape. Duplication on similar media is cumbersome and will result in similar problems of maintenance after a few years. Updating of boundaries or title information by manual process is highly time-consuming. All of these constitute a significant land records management problem.

When records are well managed, they serve as instruments of accountability and as authoritative and trusted sources of information. The potential benefits of Land records can be maximized when carefully managed. Recently, new know-hows for data collection and processing, together with increasing requirements of users, have directed attention to the need for enhanced land records management approaches. Such approaches are concerned with the effective grouping of resources in order to achieve a set of goals. These goals may include enhancements to the coverage, content, compatibility, and reliability of access to the information, and the likelihood of incorporating with other data. The ultimate aim is to meet the needs of users more efficiently, effectively and equitably (Patil, 2014b).

Hence this research seeks to develop: a land information system based on a written program where the various ledgers, registers, plans and maps can be integrated digitally to enable easy access to information. This is to boost the performance of the day to day activities of the records department and to increase their general output. The study area will be the

Airport Road Residential and Sagnarigu Dungu Kukuo West Extension Residential Areas in Tamale.

## 1.2 Objectives

The objectives of the research are:

i. To create a geo- database for the study Areas in Tamale; and
ii. To develop an application to enable easy update of records and generate search reports.

## 1.3 Methods Used

The methods used for the study include:

i. Site reconnaissance and data collection;
ii. Scanning of existing plans and records copy of documents;
iii. Geo-referencing and Digitization of existing maps, ledgers and registers; and
iv. Programming in QGIS

## 1.4 Facilities Used

The facilities to be used for the study include:

i. Library and Internet facility from UMaT and Tamale Lands Commission;
ii. AutoCAD version 2007 from LC;
iii. QGIS 3.6 software from the internet;
iv. Microsoft Excel version 2013 from LC;
v. Canon Cano scan lide 210 scanner from LC;
vi. Canon t3i camera from Big Joe Studios;
vii. Samples of approved cadastral plans from LC;
viii. Records copies of registered land documents; and
ix. Trimble dual frequency GPS receiver from LC.

## 1.5 Work Organization

This thesis has been structured into six chapters. Chapter 1 is the introductory chapter, which gives a brief outline of the research and it entails the statement of problem, the objectives, the expected outcome, the methods and the facilities used. Chapter 2 provides relevant information about the study area while Chapter 3 presents the literature review of the work. The materials and method used in carrying out the thesis are discussed in chapter

4. The results obtained and discussions of the results are presented in chapter 5. Conclusions drawn from the thesis and recommendations are outlined in chapter 6.

# CHAPTER 2

## RELEVANT INFORMATION ON STUDY AREA

### 2.1 Location and Size

The study area is within Sagnarigu District and the capital is located at Sagnarigu. It was one of the six (6) created districts in the Northern Region in early 2012. It was taken out of the Tamale Metropolis by Legislative Instrument (LI) 2066. The district was inaugurated on 24th June, 2012 with the aim to redirect developmental projects to the communities north and west of the Metropolis (currently Sagnarigu) which were comparatively less developed as compared to the urban areas in the Metropolis. The Sagnarigu District has 79 communities, comprising of 20 urban, 6 peri-urban, and 53 rural areas (Abu, 2015).

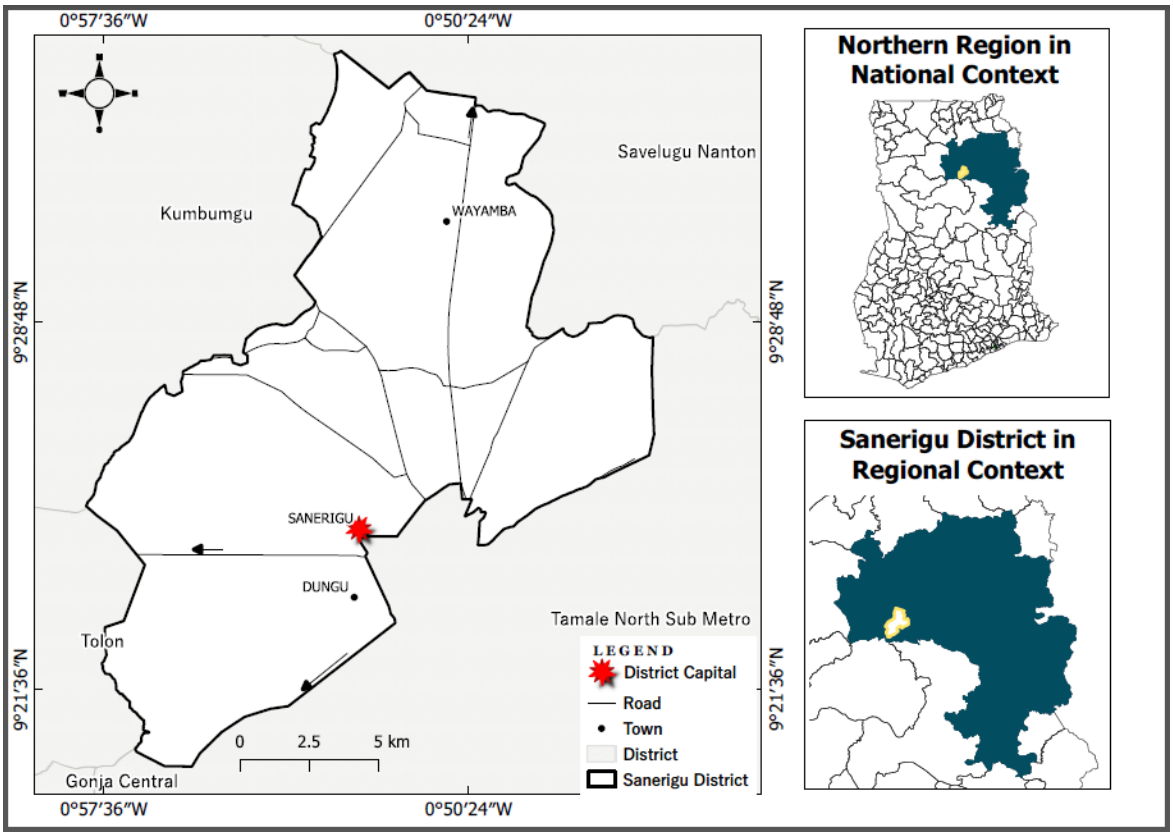



**Fig. 2.1 Map of Sagnarigu District**

The district covers a land surface area of 200.4 km² and bounded by the Savelugu - Nanton Municipality to the north, Tamale Metropolis to the south and east, Tolon District to the west and Kumbungu District to the north-west. Geographically, the district lies between latitudes 9º16' and 9º 34' North and longitudes 0º 36' and 0º 57' West. Fig 2.1 shows a map of the Sagnarigu District.

## 2.2 Climate

The Sagnarigu district, compared to other districts in the northern region, has a single rainy season, which generally extends from May to October, which is the agricultural season and the beginning of farming activities in the district. Average annual rainfall ranges from 600 mm to 1100 mm, with the peak generally occurring between July and August.

Daily temperatures vary from season to season. During the rainy season, there is high humidity with relatively less sunshine, strong windstorms and thunderstorms. Average daytime temperatures range from 28°C (December - mid-April) to around 38°C (April - June) while average nighttime temperatures range from 18°C (December) to 25°C (February, March). The dry season (November - March) is characterized by Harmattan dry winds; the Harmattan season presents two extreme weather conditions, the extremely dry and cold temperature of the early dawn and morning and the very hot afternoons (Anon., 2014b).

## 2.3 Drainage and Vegetation

The district has fewer water bodies in comparism to other districts; this is attributed to the high groundwater table. The only natural bodies of water are a few periodic streams which are normally flooded during the rainy season and dries up during the dry season. In addition, there are some dams and dug-outs such as Kpene and Kanvilli-Kpawumo. These sources provide alternative water for domestic, agricultural and animal use.

The district is in the wooded savannah region characterized by wooded savannah vegetation of varying sizes and densities. The main types of trees in the district are Dawadawa, Nim, Acacia, Mahogany and Baobab, among others (Anon., 2014c).

## 2.4 Traditional Structure, Ethnicity and Religion

There is a highly respected chieftaincy and the traditional institution structure in the district. The Sagnari-Naa is the chief of the Sagnarigu traditional area and was enskined by the Yaa Naa, who is the chief with the highest authority in the district. There are twelve (12) other sub-chiefs under the Sagnari- Naa to whom these chiefs owe allegiance.

The District has diverse ethnic groups of which Dagomba represent the highest percentage of its indigenes; other ethnic groups in the district are Gonja, Mamprusi, Akan, Dagaaba from the Northern Region and other parts of Ghana. In addition, there are other ethnic

groups from neighbour countries and from the West African Region such as Burkina Faso, Niger and Mali among others. Islam is the major and highly dominated religion in the district followed by Christianity and Traditional religions. The Dagomba's as dominant ethnic group in the district are predominantly Muslims while the rest of the ethnic groups from other regions of the country are largely Christians (Anon., 2014).

## 2.5 Economic Feature

Agriculture is the main economic activity of majority of the citizens in the district. They are largely engaged in both crop and animal farming. Hospitality is another form of industry that is gaining grounds as many hotels, restaurants and guest houses are springing up (Anon., 2014)

## 2.6 Transportation, Road Network and Utility

Tamale Airport is located approximately 14 kilometers from downtown Tamale and is within the boundaries of the Sagnarigu district. The airport is mainly used for scheduled international, national and currently regional flights between Tamale, Accra and other major cities in Ghana, Africa and the world. Recently, northern Islamic pilgrims were transported to Saudi Arabia via the Tamale airport.

Currently, taxi is the most convenient means of public transportation for easy access to the community and other nearby locations. However, motorbike and tricycle popularly known as "Yellow Yellow" are the most popular means of transportation for the local people in the district. Passage out of the district to the adjourning towns and districts is, however, mainly facilitated by the private mini-bus system, Yutong Long buses and the Metro Mass Transport System (Anon., 2014).

The district has fairly good roads. However, many are in a deplorable state, particularly those accessing rural communities and the newly developing areas. Most agricultural and peri-urban communities are linked to shopping centers by feeder roads. In the urban and Tamale-North parts of the district, the roads are coated with asphalt or bitumen.

The districts have basic public services, including electricity, water, roads, markets and communication services and are mainly available in urban areas of the district. However, these facilities are nonexistent or inadequate in rural areas (Anon., 2014).

## 2.7 Land Ownership Systems and Land Tenure Practices in the District

Basically, there are two (2) main land ownership system namely, State lands and Customary lands. State lands includes all lands acquired by colonial government and other government for the purpose of development and other public project in the district such as road, schools, hospitals, airports, markets etc. The district serves as a host to the University for Development Studies (UDS), School of Medicine and Health Sciences which was recently acquired by an executive instrument (EI) 2018 and many other public institutions.

The chiefs are the custodial lords of the land and have been given all powers as northern customs demand to hold and administer lands for and on behalf of the people. This makes about 90 percent of the land in the district a skin land. It is allocated to any person or persons, businesses or institutions by the chiefs with allocation letters after such areas are planned by the planning authorities, then the LC takes over till lease is finally granted.

However, apart from the UDS school site, the whole Dungu Kukuo West Extension Residential Area is skin land whiles the Airport Road Residential Area falls within state acquired area making it a state land.

# CHAPTER 3

## LITERATURE REVIEW

Several studies and researches have been conducted on geospatial land records management as well as digital land records which includes ( Bhatti *et al.*, 2013, Shukla, 2016 and ESRI, 2006). International standard organization defined records as an "Information created, received, and maintained as evidence and information by an organization or person, in pursuance of legal obligations or in transaction of business" (ISO, 2016). It forms a part of the transaction or provides proof. They are subsequently maintained and managed by or on behalf of those responsible for the transactions (Anon., 2000).

Records perform a major role in most human activities and they are important to many businesses and social interactions. Brosius (2003) explained that the origin of systems of archival record keeping were established over several millennia in Mesopotamia before expanding to Egypt, the Mycenaean world, and the Persian empire, continuing through the Hellenistic and Seleucid periods. Record keeping was thought critically in the administration of government offices such as in the British Civil Service in the nineteenth century (Moss, 2005), and in the Netherlands in the early twentieth century (Horsman, 2006). According to International Records Management Trust, (2000), it is a central activity of public administration. Without records there can be no rule of law and no accountability. Public servants must have information to carry out their work, and records represent a specific and critical source of information. Records provide a reliable, legally verifiable source of confirmation of decisions and actions.

Cox (2006) further stated that, the practice of keeping records started from the ancient word to modern times. The introduction of computers in the middle of the twentieth century affected the role of record keeping in reinforcing effective administration and business operations as organizations were beguiled by the impressive characteristics of digital technology, particularly in the creation, storage and retrieval of information along with apparently reliable security features. It is essential for establishments to have a reliable record keeping systems for their sustainability, particularly for censorship and retention policies, intelligence, security and intellectual property purposes.

In addition, the implementation of electronic government (e-government) systems in many countries across the world has resulted in the exponential growth of use of electronic records. Dominated by the digital environment by information and communication

technology (ICT) professionals, the records management community often finds it difficult to advocate for the adoption of an effective records management system across the organization in the context of an ICT strategy.

## 3.1 Types of Record

According to Unegbu and Adenike (2013), companies operate with four main types of records and are named according to their use. These are vital records (non-replaceable records), important records (those that can simply be transferred to an inactive record), useful records (day-to-day running records) and nonessential records (worthless records) Cage (2012), added that records could also be grouped according to their functions, in which case, records could be active or inactive.

## 3.2 Land Records

Adoye and Mensah (2017) elaborated that, Lands Commission has huge land related records which consist of huge volume of records comprising mainly of:

- Compilation of applicant's personal data for land
- Storage and retrieval of cadastral information
- Security and control of access to confidential land information management data, such as acquisition, assessments, allocations, valuations, consents, assignments and
- Registration of land related matters.

According to Azman (2009), in other parts of the world, land records are recorded by state offices and their names vary depending on the state that maintains them. For example, some call them Register of Deeds, Country Clerk, Auditor and others call them Recorder and so on. During this time, the type of document registered is linked and includes acts, privileges, dishes, surveys, mortgage documents, powers of attorney and easements. Information on the condition of a particular site must be obtained by written request with attached copy of the site map, in person or by a representative.

## 3.3 Land Ownership Types Recorded in Ghana

Land types in Ghana can be grouped under many categories, this basically depends on the historic background, mode of acquisition, ownership, mode of administration, who administers and the purpose for which it is granted. Land ownership in Ghana may fall under state land or customary land (skin, stool and family).

### 3.3.1 State Land

This type of land ownership has a colonial history which includes all the land which had to be acquired by the British colonial authorities, but was returned to the country during independence. These lands include airports and air strips, police and military facilities, railways and roads, hospitals and many others. These lands are vested in the President as a trustee and they are managed by the state through the Public and Vested Land Management Division of the Lands Commission. In total, state land accounts for about 18 percent of all land records in Ghana (Yeboah and Shaw 2013a).

Gyamera *et al*, (2018) further defined State land as land vested in the president on behalf and in trust for the citizens of Ghana. These lands are normally called government lands, as stipulated in the 1992 constitution of Ghana. These lands have been compulsorily acquired by the government for development and administrative purposes and are fully owned and managed by the state. Under the State Lands Act 1962 (Act 125), lands are acquired by declaration and publication of an instrument designating a parcel of land in accordance with the public interest. As in the case of the law and the policy of expropriation in many countries, the compulsory acquisition of land by the State should relate to projects benefiting the general public.

### 3.3.2 Customary Land (skin, stool and family)

Paaga (2013) defines customary land as "the set of rights in land that derive from customs or practices handed down from generation to generation". These lands comprise all lands which are owned by kingdoms, tribes, families and, in some cases, individuals. These lands are, regulated by the predominant customary tenure practices. Customary lands are usually owned collectively, the chiefs and or other designated leaders appointed by customs have the power to administer and manage such land. They are the easiest and most accessible source of land for development and constitute about 80 percent of the total land size in the country (Yeboah and Shaw, 2013).

Odame-larbi (2008) stated that customary lands represent all the different categories of rights and interests held in traditional systems. This includes stool land, skin land, clan land and family land. Ownership of these lands does not depend on government ownership or brute force. The rule governing these lands is publicly known but not primarily written (Bower, 1993). Ownership of this form involves discovery, conquest by war, uninterrupted

settlement for a long period of time, a gift from other families or clans or their overlords, or by purchase.

*Stool or Skin Lands*

Stool or skin lands like family lands, belongs to the community or to areas with stool or skin as a traditional emblem by their ancestors who initially settled there, making them the owners of the land. This settlement may have been the result of navigation for hunting or game, for fishing or fertile soil for agriculture, good drinking water or the escape from war. The land is administered according to the principle of customs and indigenous laws. They are directly managed by the stool occupant (in southern Ghana) or skin (in northern Ghana) or Tendana (landowners) and are normally used for the benefit of the stool, skin and the community in general (Lambrecht and Asare, 2015). The occupant of the stool or skin as a custodian of the land administers in trust and on behalf of his people. The chief uses the right attached to distribute a portion or a part of the said land to community members and developers who may be foreigners who express an interest in this land for a fee or a development project for the benefit of the community.

However, according to clause (3) of Article 267 of the 1992 constitution of Ghana, the lands commission must approve any disposition of such lands and must ensure its conformity to the approved development plan of the respective area. Freehold interest (lands given or convey to the buyer forever without any expiring period) is also not allowed but rather a lease term of 99 years for Ghanaians and a term not more than 50 years for non-Ghanaians.

*Family Land*

Historically, much of the skin and stool lands were distributed among families and allocated to different extended clans. These lands are now being categorized as family land (Lambrecht and Asare, 2015).

### 3.3.3 Vested Land

These are lands held under the 1962 Land Acquisition Act (Act 123) and entrusted to the state in trust for the actual owners (Anon., 2004). The acquisition of these lands by the government means that the beneficial interest and the legal estate have been transferred to the government. Paaga (2013) established that the lands acquired are subject to shared

ownership between the state and customary communities. The state manages them (holding the power to sell, rent and collect rents) as a trustee for the benefit of the customary community whose lands have been taken. Land rights are transferred to the state in accordance with the Land Administration Act of 1962 (Anon., 2019).

Karikari *et al*, (2002) also explained that under Act 123 of the Land Administration Act 1962, the executive instrument allowed the government to entrust stool and skin lands to the President of Ghana. It is shared property because the government manages and collects rents for customary landowners.

## 3.4 LC Records

The operation manual of the LC (2004), articulates that, the main objective of records management within the LC is to keep complete and accurate records of all land transactions in Ghana. As technology improves, the records section shall move into a digital format, involving the capture, storage, retrieval, analysis and dissemination of geographic information, using modern equipment and software (Geographic Information System (GIS)).

Information in the records room is mainly kept on plans, maps and ledgers/register. The present mainly manual system, aim at recording all transactions systematically in such a manner as to ensure easy retrieval of information and avoid conflicting recording of land transactions (Anon., 2004).

### 3.4.1 Types of Land Records

These are the various types of documents found in LC records

- correspondence (index) Files
- plans and maps
- file jacket containing completed land documents, court judgments and instruments
- records register
- layouts
- Index sheets
- geographical registers
- ledgers
- Topographic sheets

### 3.4.2 Process for Recording Deeds at LC Records

The LC operational manual, 2004 further describes specifically the work of the records office as plan examination**,** noting of proposal, plotting of completed documents, lapsing of document, revision and maintenance of records sheet and registers, land searches and provision of certified true copy of document.

*Plan Examination*

Land documents have spatial components that make reference to locations of the subject site. The spatial component is usually reduced to a plan, making reference to data in relation to a location of the earth's surface. Section 6 of the survey Act 1962, Act 127 and L.I 1444 of 1996 stipulate the requirements for the preparation of the plan. In examining the plan the following must be observed

- the plan is signed by a licensed surveyor and approved by the Director of Survey or his representative
- the grid value on the plan are examined to ensure conformity with survey requirements (i.e. at least two eastern with one northern and at appropriate interval and scale)

*Noting of Proposal*

This involves the temporal notation of land transaction that is still under processing. The site as contained in the plan is hatched in pencil on the records sheet and the file number or notation number (NT) is recorded, the Executive Secretary or the Regional Lands Officer shall authorize the deletion of any notation.

*Plotting of Completed Documents*

Permanent notation of a completed and approved document is recorded on the records sheet according to departmental color schemes. A land serial number or DEED number is given to the document and entered in the various registers namely; geographical, number and deed registers. The Executive Secretary or the Regional Lands Officer shall authorize the lapsing of plotted document.

*Lapsing of Document*

Where document is to be lapsed or expunged (where directed by the court) from the records, it shall be done on the sheet on which the document was originally plotted by striking a line

through the DEED number and further amending the entered records in respect to the parcel of land.

*Revision and Maintenance of Records Sheet and Registers*

Where an existing sheet is torn or made illegible and a new copy is procured, all information shall be transferred accurately unto the new sheet. Where a register becomes old or torn, the content shall be recopied into a new register or in certain case rebound.

*Land Searches*

It is the process of retrieving and disseminating information on a given parcel of land from records sheet and registers. The recorded transactions affecting the particular parcel of land is therefore disclosed upon request. Searches are usually requested as official search, permit searches (on request by town and country planning for the approval of a building permit) and records report/information, this is to know the state of the land at a particular period.

*Filling of Records Copy of Registered Documents*

A copy of land document after it has been completely registered is filed in records to enable easy access to information and further to assist in case of uncertainties by records staff and other officers.

## 3.5 Creating Land Records

Land records including maps, field sketches, ledgers and registers need to be kept up-to-date to provide land information in a timely manner (Ali *et al*, 2013). The daily activities in the records rooms like sketching, noting of proposals, plotting and filling leaves a lot of data to be store on daily basis. Resources such as ledgers, geographical registers, town sheets, layouts files, topographical maps, index sheet and registered leases are used. This resources need to be kept in safety with adequate maintenance to ease retrieval of data stored in them.

### 3.5.1 Land Instruments Recorded at LC Records

- Executive Instruments

  It is a statutory instrument other than legislative instruments or instruments of a judicial character. It is also the finishing point of a legal instrument such as a

contract or deed signed and sealed and delivered so that it becomes legally binding and enforceable (Anon., 2019).

- Certificate of Appropriation

  The act of selecting, devoting, or setting apart land for a particular use or purpose, as where land is appropriated for public buildings, military reservations, or other public uses (Anon., 2019).

- Certificates of Allocation

  These are already state lands acquire by government and further given portion, part or parcel to an institution, group or individual for any use.

- Certificate of Occupancy

  A Certificate of Occupancy, also known as the C of O is a document issued by the state or governments to landowners and property buyers as a legitimate proof of ownership. This document give details of what the land should be used for, thus residential, commercial or mixed development.

  Till now, the governors of the Gold Coast were mandated to issue the Certificate of Occupancy for lands acquired as state land or vested in the Governors (Anon., 2019).

- Certificate of Incorporation

  It includes all certificates, including the initial certificate filed, agreements of merger or consolidation, plans of reorganization or other instruments and recorded by the incorporators (Welch, 2019).

- Deeds

  Deeds are a group of documents that are used to legally prove the ownership of a property or piece of land. They include conveyances, mortgages, "indentures", and other documents. These documents were used to show the sale or transfer of property (House and Way, 2017).

Deed registration is the process of registering any instruments affecting Land per the Land Registry Act 1962, (Act 122). Apart from judges' certificate, the Law requires all instruments to be registered, and must contain a site plan or map having the description of the land (Sittie, 2006). The purpose of Land Registry Act was to record the document being used for the registration. Registration of Instrument has been in existence since 18th

century under the Land Registration Ordinance, 1883. The Land Registration Ordinance of 1883 was substituted by the Land Registration Ordinance of 1895 which has also been abolished by Land Registry Act 1962, (Act, 122), (Gyamera *et al*, 2018).

*Type of Deeds*

i. Deed of Conveyance
ii. Deed of Gift
iii. Deed of Trust
iv. Deed of Surrender
v. Leases
vi. Variation
vii. Assignment
viii. Sub-Leases
ix. Mortgages
x. Discharge
xi. Consent
xii. Declarations
xiii. Court Judgment
xiv. Affidavits

### 3.6 Nature of Land Records in Ghana

Land records are currently retained at local level in each region of Ghana. These records have problems of improper maintenance as they are kept on paper maps that with time keep defacing as shown in appendix C and D. Therefore, retrieval of the information may delay or may even be impossible.

Improper utterance in record of rights also leads to issue of safety and security of land record data. The records are only stored in the Regional records room and there are instances where the whole records are wiped out due to fire or floods as it happened at the LC head office in 2012 and recently in Takoradi. All the existing land records are mostly in manual form and only few data are currently being organized in digital format They can only be accessed by few due to distance and location of the LC offices (Ali *et al*., 2013).

The current assessment of the state of land information data in the regions and other parts of the country, point to a continuous dependence on old-fashioned data infrastructure that serves little or no purpose in the information age (Merem and Twumasi, 2008). Karikari (2006) further revealed that the four sector land agencies involved in Ghana's Land administrative project have technically been operating manually in an environment with undependable data, dubious manipulations of existing data by some recalcitrant staff and difficult retrieval of available information; suggesting the need to establish or develop computer-based land information systems and networks through re-engineering processes.

Seniwoliba *et al*, (2017) revealed that in an organization where paperwork is carelessly managed, the flow of records throughout the life cycle is delayed, chaotic or nonexistent. The information in these records are very difficult to retrieve and more expensive due to the recurrent duplication of paperwork. This poor management of the institution affects the efficiency and its operating cost.

### 3.7 Records Management

Records management is the task of ensuring that recorded information, both paper and electronic, is managed economically and efficiently. Records management controls the creation, maintenance, use and disposal of records so that the right records are provided to the right person at the right time (Anon., 2000). No business can exist without keeping records of its activities, and no office could function successfully if it had to rely solely on memory to track each transaction (Seniwoliba *et al*, 2017).

Managers often despise record management by providing the necessary resources and facilities until they need vital documents. Records management is also the practice of keeping the records of an institution or organization or body from their creation until they are final disposal of. This includes creation, classification, storage, securing and disposal (by destruction or, in some cases, preservation of the archives).

Management of records is not only collecting and keeping data but the knowledge of how these records are kept, stored, for how long they are to be stored and managed and who is to have access to them (Unegbu and Adenike, 2013).

In a complex institution like LC, activities recorded and documents must be kept due to the volume created daily. It makes it therefore virtually impossible to keep this information in

the brain. Records of past data are also heavily used for the daily operation of the institution and the exercise of its functions (Seniwoliba *et al*., 2017). Efficient records management system, allows easy access and retrieval of information. Resources, facilities and space must be managed effectively, efficiently and economically, as valuable documents are retained and unwanted ones disposed of (Anon, 2000).

## 3.8 Current Land Records Management System in Ghana

According to the introduction of the core principles of the World Bank (2000), institutions should act based on the reference to the past performance or future goals. Customer service, the quality performance of the tasks and measurable results are progressively more significant responsibilities, and all of these expectations depend on available and accessible to operational records. However, in many countries around the world, such as Ghana, record-keeping systems cannot cope with the growing unmanaged mass records. This situation is predominantly true in LC due to limited financial and administrative resources, recording and archive management training and professional development opportunities.

Records in the LC are classed in folders and files and cabinets which have been given meaningful, relevant and specific titles so that they can be easily retrieved.

These records are given names and notation marks that accurately reflect their content (Kite, 2006). Despite the introduction of Deeds, the records are still held in paper form, which is vulnerable to wear and tear and can get lost among other disadvantages of paper documents (Wayumba and Ayugi, 2017).

Just as it is done in America, in Ghana, records management varies depending on the purpose, setting and context of the services. In addition, there is still a need for staff to be trained in the legal and ethical requirements for record keeping and management. It is necessary to keep records under a little guide and confidentiality with proper security, maintenance and preservation (Seniwoliba *et al*., 2017).

### 3.8.1 Records Filling Systems

This is a planned way of categorizing and organizing records for storage and retrieval. If not done properly will create and increase unnecessary cost as lots of time and effort would be used in trying to serve applicants or providing the needed information. A proper filing system should be:

- Simple and user friendly – Create something that will be easily followed by staff.
- Transparent – It must make sense and meet the needs of your department.
- Follows Record Retention – This allows you to maintain accurate records as well as not store unnecessary records (Anon., 2019).

All files are given jacket or folders which are usually made with rigid Manila paper or cardboard. It is designed to be a little larger than the document it can hold to minimize damage and tearing. Meanwhile, documents like site plans larger than files are folded for adequate coverage or protection. The cover is pre-printed with design spaces for the file title, file number, index heading, associated file, file period, security marking, and other configured information needed depending on the use.

The vital requirement for filing must be met and must be filed as and when the documents are received. This then shows in order, the actions and decisions that have already been taken on the file (Anon., 2019).

*Filing Methods*

The importance of record-keeping and filing systems cannot be over-emphasized. A well planned system contributes significantly to the efficiency of the operation as well as to the image of the institutions. Whether the documents are stored on a computer or in a steel cabinet or shelves, they must be readily accessible (National Archives of Australia, 2003). Some of the questions one should ask are:

- What are the records?
- Where should they be filed?
- Who uses the records?
- How often are they used?
- How are they used?
- How are the records referenced?
- What is the size of each record?
- How many of each record are filed?
- Who else has copies of the same record?

Answers to these questions give clue as to how and where the records should be filed (Unegbu, 2013).

*Cabinet Filing*

The documents in records over time wear out due to their frequent use and exposure. The atmosphere around the storage room sometimes makes it humid and dry at an excessive high temperature, which also gradually weakens the record. For a long time before computers became predominant, cabinets were used to protect the situation, which also added advantages in terms of fire resistance and security. Documents in LC records are therefore locked at all times in their respective cabinets to ensure security as shown in the Fig 3.1 below and in Appendix E and F.

**Fig. 3.1 (a)**

**Fig. 3.1(b) Cabinet Filing System at LC, Tamale**

*Shelves Filing*

Shelf files are records stored on open shelves rather than in drawers or lockers. They come in a wide range of sizes. Documents stored on open shelves are easily accessible and can be easily replaced. Shelf filing is most suitable for filing and retrieving entire document, registers and ledgers and is ideal for numeric filing systems (Anon, 2019). Figure 3.2 is a typical LC filling system.

**Fig 3.2 Shelve Filing at Lands Commission, (Source: Karikari *et al*., 2002)**

*Box Filing*

Due to the congested nature of the LC files room, it has become necessary to keep some files and folders in labeled hard paper boxes to create space for new files. The situation has not only hidden the files, however retrieving same is very difficult since boxes on top needs to be brought down before one can get access to those below on daily basis. Fig 3.3 shows a box filing system at the Tamale LC.

**Fig. 3.3 Box Filing System at LC, Tamale**

3.8.2 Records Life Cycle

Unegbu and Adineke (2013) explained that some land records do not last forever. The life cycle theory of records is therefore necessary because it usually become less important over time. There is always a short period of high use of the records, followed by a longer period of low use. The records are only viewed occasionally during this second phase. Records or documents have a life cycle that resembles that of humans:

- It is born (creation phase)
- It lives (maintenance and use phase)
- It dies (disposition phase)

The sequence of capturing evidence, functions and events begin with creating or capturing documents over time and collecting additional information about the document. This can include context metadata with access to the content and its relationship to other data or

documents, the maintenance process and how to dispose. Records that are not required immediately are sent to the archives for research purposes. Fig 3.4 shows a model of the records life span given by (Read-Smith et al., 2002).

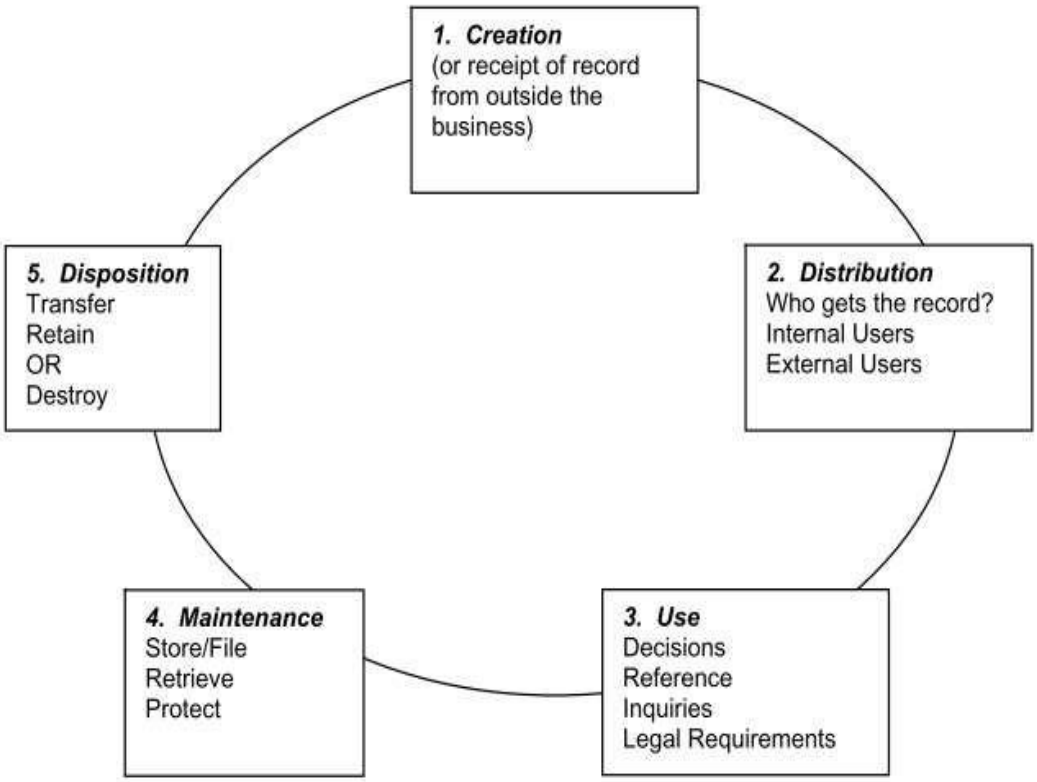



**Fig. 3.4 The Record Life Cycle (Source: Read-Smith *et al.*, 2002).**

The record lifecycle model has five phases: creation, distribution, use, maintenance and finally disposal. The first stage, which is the creation stage, includes records produced by organizations internally or received from external parties. The distribution stage is the second phase where the records are shared with the people responsible for their use. It uses forms the third phase where the records are used in decision-making, responding to queries, documentation references or to satisfy legal needs. Records needed for later use fall into three key steps known as storage, retrieval and protection. These also form the maintenance stage as the fourth phase. Records must be filed by preparing and placing them in the appropriate storage facility and are retrieved for use when necessary. It is also restored and protected when it is not fully used. At this level, appropriate equipment, environmental and human control is used to ensure safety, updating stored information, and purge or discard obsolete ones when unnecessary or replaced by more recent information.

The last stage in this model is the disposal stage. Once a predetermined period of time has elapsed, the records to be kept are transferred to less expensive storage sites within the

company or to an external record storage facility. At the end of the number of years indicated in the conservation calendar, the documents are eliminated, either by destruction, or by transfer to permanent storage. The facility, where records of an organization are kept because of their continuing or historical value, is the archive (Read-Smith *et al*., 2002).

*Records Disposal*

Records management is not possible without disposal. When records are properly disposed of it ensures long retention of needed information by institutions; and they are appropriately destroyed or transferred to achieve when no more needed.

These are some of the benefit of well managed disposal of records:

- The cost of storage incurred by using server space or office to maintained outdated records would no longer be necessary.
- It supports compliance with the 5th data protection principle if records contain personal information (in this regards, personal information must not be kept for too long a period by an organisation)
- It leaves few document making information search and retrieval so quick and easy.
- Responding to Freedom of Information (FOI) requests is more efficient (Anon., 2011).

Irresponsible disposal of records may result in data loss especially when burnt or dumped outside to the mercies of the whether as shown in Fig 3.5.

**Fig. 3.5(a) Records Dumped Outside the Office Building LC, Tamale**

**Fig. 3.5(b) Records Dumped Outside the Office Building LC, Tamale**

### 3.9 Land Records Revolution

Maintaining of land records on papers has been done since decades. Even if the system was very effective then and had been used for more than two hundred years, the complexity and insecurity make such manual records combine with the rising number of land owner's security suspicious. This system cannot contain the mounting volume of data associated with land and makes it, therefore, venerable for manipulation (Suri, *et al*., 1967).

With the globalization and geographical enlargement of human activities this twenty first century, it is more and more important to understand changes. These changes happen within the important spatial scope and ranges from as small as the person or surroundings to as big as the whole earth (Brenner, 1999).

We use space-time dimensions to better record spatial related changes (Goodchild, 1992). Human beings have been accumulating records of value of changes occurring since thousands of years or longer to appreciate, to protect and to improve our environment of life. Recently, records can be acquired by different technologies including our human eyes, contact and sense and more recently, satellites, telescopes, in situ detectors and sensor webs (Montgomery and Mundt, 2010). The advancements of sensing technologies have improved radically accuracy and spatiotemporal range of records. Collectively, we have amassed Exabyte of records as data and this datasets are increasing at a rate of petabytes daily (Yang *et al*., 2011).

Integrating these lands records into GIS format requires;

- ➢ Scanning and digitization of the land related records,
- ➢ Providing software facilities and creation of land records database for
- ➢ Compiling of personal data of land owners and applicants for Land
- ➢ Designing of a robust land records management system for analyzing land records (Adeoye and Mensah, 2017)

In the Korean republic the highest court has served analogue data to applicants till 2000 as a manager of the land registration system. The highest court has broken off years of strains to improve the quality of the service and to optimize the effectiveness of the work of the land registration digitization project to the digitization of the real estate registry. This project was promoted to overcome time and space that limits civil services and found standards and improvement of the efficiency of the land registration process. For the effective

management and a degree of service, the court has introduced publication and search by the title (Youngho, 2006).

Ceylan *et al,* (2015) further revealed that, with the technological developments, the paper and pencil cadastre will be abolished. Computers are now used in every field including land registration processes.

Data, confidentiality and respect for the requirements of sovereignty to grow must be applied to a growing list of sources of information. At the same time, it was expensive and inefficient to keep everything simple. A role-specific comprehensive records management is important because each meets the legal and operational requirements, but it needs a new approach to accomplish this objective (Ludlow, 2018).

Traditional records management system is a total setback for Government or anyone else. Government organizations and agencies are insufficient and ineffective in their nature of traditional records management practices in this digital age because:

- Digital and more mobile citizens drive the technological transformation of government by asking for new levels of reciprocal action based on information and for service.
- More information is being produced by more processes and it is often sitting isolated in silos and repositories.
- The native knowledgeable workers are even not willing to adopt the classification which requires labor-intensive and filling directives.

Osskó (2014) strongly argued that there is a very strong need for the development of information technology and computerization of cadaster and land registration institutions. It has become clear that records management as a singular, end goal is no longer satisfactory to meet these requirements. Public service agencies require a new method of managing, accessing, and sharing information. With the advancement of modern technology, the manual system is more or less becoming obsolete and therefore there is the need for the LC to speed up its technological revolution to ease and speed up its job delivery (Ludlow, 2018).

## 3.10 GIS Based Land Records Interventions

Effort to create fast, effective, efficient and modern land record management services have resulted in many developed interventions by Governments and institutions. Many of such initiatives are on a working basis whiles others are still locked up on computers. Kakari *et al*., (2002) expressed that there are numerous attempts made to apply GIS in land records management, of which several of them have had little implications for the lands sector, but there has been no attempt to address the specific issue of using GIS to support the administration of land in the country. Below are some known interventions.

### 3.10.1 The Ghana Enterprise Land Information System (GELIS)

The reliable information on land is essential to support the administration of efficient land management; however, if the system must support the analysis of data efficiently and decision-making, it is also important to achieve this information quickly and, to link up different groups of data in the computer system.

Fact to envisage quick access and ease of extraction of data is best fulfilling by developing a computer information system containing both graphical (spatial) and link textual (the attribute) data. Under the Land Administration Project I (LAP- I), Land Information System (LIS), with five sub - systems using the same structure of database, was developed for Divisions of LC as a basic system which allowed the users to enter and to treat data which were newly produced of the Systematic Land Titling (SLT) campaign, based partly on the existent manual files and the maps. The LIS Sub-systems were intended to allow every land Sector Agency during every day business, to treat electronically its own (unique and non-redundant) data in a permissible format for LIS and using its unique (and separated from other Divisions) parcel number (UPN). These subsystems were developed, however, based on the old processes of doing business with use of paper folders and documents in their processing of business. In reality these subsystems were not used operationally (Deane *et al*., 2017).

### 3.10.2 Federal Land Information Systems (FELIS)

FELIS is the computerization of the records of land in the Ministry of Federal Housing and Urban Development by using GIS. FELIS Gives cherished improvements to land and the registration of property to Abuja which has given rise to the following benefits:

- Urban development by using GIS.
- The speed of response promoted improvement land security
- Reduction in the modification of land documents
- Perfection in the security of land
- Physical restructuring and refurbishing of land documents
- Allows safer property registration
- Reformation of Land Administration processes
- Impartation in the improvement of the organisation
- Improved income
- Ability to have considerable projected income generation and the cash flow associated to land properties.

FELIS offers first class tool for innovative planning and management of lands in general. The application of FELIS has improved the economy of the country (Adoye and Mensah, 2017).

### 3.10.3 Land Information Management Systems (LIMS)

A LIMS is a computerized system for land ownership records that usually consist of precise, up-to-date and reliable plans of the land and its accompanied attributes developed to bring sustainable development in Africa. A well-functioning LIMS can be responsible for multiple profits to a society, some of which include:

- Improving land ownership,
- Enabling land to be used as assurance for credit,
- Increasing land markets,
- Improving land taxation,
- Decreasing land disputes and facilitating rural land reforms among others.

These gains, can results in sustainable development when put together, which is described as the skill to meet current needs without compromising the future generations ability to meet their own needs (Wayumba and Ayugi, 2017).

## 3.11 Electronic Records

Records in machine readable format are usually termed as electronic records. They may be a combination of documents, databases, images, graphics, data, text, video, e-mail,

spreadsheets, internet content, and so on that are created, maintained, amended or transferred in digital form by a computer or related system, (Coetzer, 2012). On the other side of paper records, an electronic records management system centers on intangible digital files. Electronic records are more accessible and easy to dispense (Alzamora, 2018).

In some occasions this is just a matter of giving electronic access to existing information. In others, electronic services, such as land searches or submission of tax returns, are being provided on-line. Electronic government has the potential to transcend constraints imposed by distance and increase the speed of service delivery (Anon., 2000).

### 3.12 Geospatial Land Records

Geospatial information is defined by ISO as "information in relation to occurrences implicitly or explicitly associated with a location relative to the Earth." (Charvat *et al*., 2013). It is agreed by some researchers that geospatial data may represent the biggest data challenge of all if the positional constituents in the data are extensively used in storage, retrieval, analysis, processing, visualization and knowledge discovery (geospatial data) The Data systems require certain type of technologies, techniques and algorithms for management, analytics and distribution. Using geospatial data offers exceptional opportunities for providing enhanced, more adaptive, more clever and economical services in government, private and science and research divisions. In summary, managing geospatial data has several advantages in the storage, processing, analysis, visualization and publication areas (Amirian *et al.,* 2014).

Rapid expansion in information technology in the last decade has created a distinctive opportunity for the development of such a tool in the form of multi-purpose land resources information systems (LIS), which can be used to generate quick and efficient varieties of information according to the needs of different users. The LIS comprises a computerized database, models, decision-support tools and a user interface to simplify its task (Sombroek and Antoine, 1994). In a nut shell, geospatial land records management together with an entrenched land policy, play a unified role in improving land access and productivity of land use as well as securing land tenure (Shukla, 2016).

## 3.13 Challenges in Managing Lands Records

The world of records management is swiftly changing. The days of paper only records are past and the ability to review each document and catalog it appropriately for predicting the future, records managers would have many challenges over the next one to three years. This may include:

*The Volume of Information*

Ninety percent of the total data in the world since the beginning of humanity has been generated within just the last two years. This pace brings to mind the rate at which information is generated. By 2020 about 50 times of the earlier mentioned data would be generated 2.5 billion gigabytes of data is created every day. This is equivalent to creating enough data to fill 10 million Blue-Ray disks. Analytically, if they are stacked on top of each other, the height of four Eiffel Towers would be reached.

*Records Are Everywhere*

Records in the last 10 or 20 years were just physical documents and few electronics and were largely obtained from on-premise document management systems, file shares, and other physical locations. This has changed evolutionally forcing the definition of records to also change over the years.

Some of the leading contributors to this has been the booming of cloud solutions that have presented new software, new formats, and new sources into establishments. These have drastically enlarged the rate of acceptance like we have never seen before. We have migrated from a world where constantly using the same tools was significant into a world where people are permitted to use the tools that best allow them to get their job done. In actual fact, from now on, we almost need to accept that everything is a record and records are everywhere.

*International and Local Compliance*

The cumulative complication around compliance requirements is also creating a big challenge to record managers and to suppliers of record management solutions. Companies are no longer only affected by local laws and regulations any longer. They need to consider international laws and regulations too. This is requiring companies to adopt much difficult record keeping and information sharing processes (Woodward, 2018).

### 3.14 Benefits of Digitisation / Geospatial Land Record Management System

Geospatial land records as other records interventions earlier indicated have lots of benefits running from the records itself through its managers, facilities and the end users. Land ownership and titling, collateral and mortgages, land taxations and reforms are some of such benefits.

Onuiri *et al*., (2015) stated that, there are numerous benefits associated with records management system. One of which is the use of a central database. This database is fundamental for all actions in the system and can be easily updated and used to ease all the system's processes. This storage process is more efficient than a paper based file system. Human errors have also been taken into consideration, which is made in the recording and filing process avertable in a database system. The advantages are as follows:

- ➢ It makes provision for easy amendments of errors made.
- ➢ Reduced time consumption
- ➢ Reduced manpower with paperless record
- ➢ Reduce cost
- ➢ Operational Efficiency
- ➢ Provides fully integrated paperless recording and filing capabilities, enabling significantly improved customer service while also improving the efficiencies in the office and reducing the manual processing associated with paper documents (Anon., 2014).

Anon. (2014) further submitted that records and information are the lifeblood of any institution. They are the basis on which decisions are made, services provided and policies developed and communicated. It supports an institution's business and discharge of its functions, promotes business efficiency and underpins service delivery by ensuring that authoritative information about past activities can be retrieved, used and relied upon in current business. It supports compliance with other policies which requires records and information to be kept, employment legislation and health and safety policy. It improves accountability, enabling compliance with policies and other rules and requirements to be demonstrated to those with a right to audit or otherwise investigate the institution and its actions. It enables protection of the rights and interests of the institution, its staff and its stakeholders. It increases efficiency and cost-effectiveness by ensuring that records are

disposed of when no longer needed. This enables more effective use of resources, for example space within buildings and information systems, and saves staff time searching for information that may not be available (Anon., 2000).

# CHAPTER 4

## MATERIALS AND METHODS

### 4.1 Materials

The research materials used are data, software and equipment.

#### 4.1.1 Data

The data used for the research consist of digital spatial datasets, boundary map of Sagnarigu District, primary data from site, data from Survey and Mapping Division, town sheets and layout from Lands Commission and Town and Country Planning Department. Also copies of registered land documents were also used as shown in Table 4.1.

**Table 4.1 Data Source Table**

| Data | Type | Source |
|---|---|---|
| Boundary map of the study area at a scale of 1:2500 | Secondary | Tamale metro, Town and Country Planning |
| Site coordinate | Primary | Airport road residential area, Tamale |
| Town sheets at a scale of 1:2500 | Secondary | Lands Commission, Tamale |
| Layout of the study area | Secondary | Town and Country Planning, Tamale |
| Site coordinates | Secondary | Survey and Mapping Division, Tamale |
| Copy of registered land document | Secondary | Lands Commission, Tamale |

#### 4.1.2 Software Used

The under listed software were operationally very useful for this project

- MS Excel
- AutoCAD version 2007
- QGIS software 3.6

#### 4.1.3 Equipment Used

The following devices were used in capturing data for the research

- Trimble GPS dual frequency receivers

- Canon canoscan lide 250 scanner
- Canon t3i camera

## 4.2 Methods Employed

Fig. 4.2 is the summary of the method and procedures used for the study

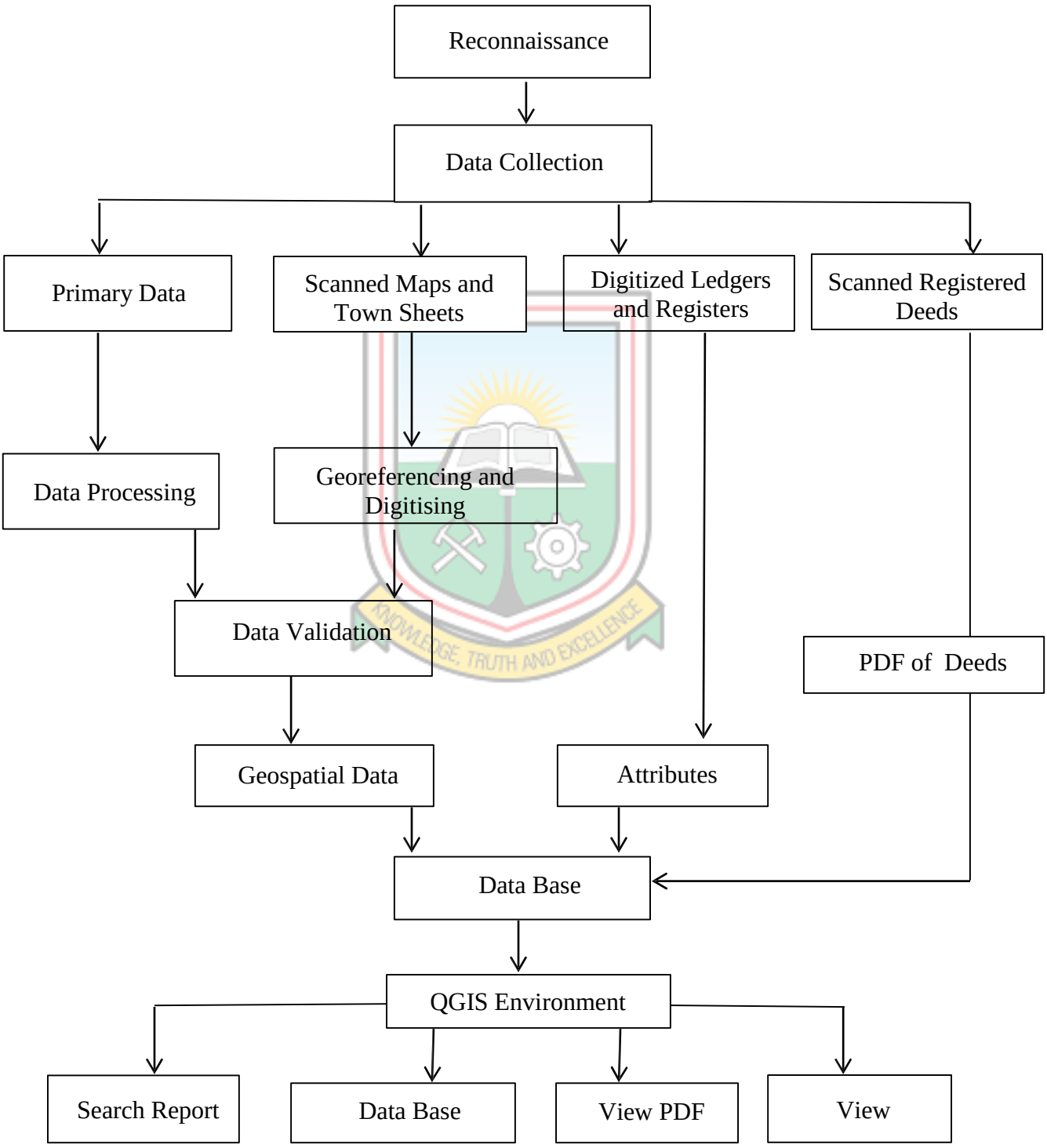



**Fig. 4.1 Flowchart of the Methodology**

### 4.2.1 Reconnaissance Survey

Familiarity to the study area was done to ascertain the extent of work in terms of pillaring and demarcation of the plots and in conformity with the layout provided by the Town and Country Planning Department and other data received from Survey and Mapping Division of the Lands Commission. It also helped in the choice of equipment to be used for the data capture which will enable further preparation of the site for the field work. Fig 4.2 shows the researcher relating the layout of the area to some ground control points.

**Fig 4.2 Site Reconnaissance to Relate the Layout to the Ground Pillars**

### 4.2.2 Data Capturing

Primary and secondary data were used to achieve the objective of the research.

*Primary Data*

Trimble dual frequency GPS receiver was used to obtain coordinate of some pillared site on ground within the georeferenced map of the study area in order to validate the georeferenced work. It was also used to survey some site to validate the maps. Table 4.2 shows samples of primary data captured.

**Table 4.2 Primary Data (Site A)**

| BEACON INDEX | | |
|---|---|---|
| Beacon | Co-ordinates | |
| | X( Easterns )/Feet | Y( Northerns )/Feet |
| SGN/B117/2017/1 | 175 5103.38 | 955 094.71 |
| SGN/B117/2017/2 | 175 5206.41 | 955 110.76 |
| SGN/B117/2017/3 | 175 5190.42 | 955 220.62 |
| SGN/B117/2017/4 | 175 5087.56 | 955 204.04 |

**Table 4.3 Data for Setting out (Site B)**

| BEACON INDEX | | |
|---|---|---|
| Beacon | Co-ordinates | |
| | X( Easterns )/Feet | Y( Northerns )/Feet |
| SGN/1 | 175 6917.60 | 955 428.91 |
| SGN/2 | 175 6905.95 | 955 532.65 |
| SGN/3 | 175 6802.84 | 955 518.76 |
| SGN/4 | 175 6813.74 | 955 417.70 |

*Secondary Data*

These are data extracted from the georeferenced maps and town sheets for validation and for carrying out the whole task to achieve the objectives of the research. Figs 4.3, 4.4, 4.5 and 4.6 show image of the secondary data sources.

### 4.2.3 Georeferencing and Digitization

The process of Georeferencing and digitizing of the planning schemes were done to orient the schemes to the same ground position. The layout was then digitized with the town sheet in the AutoCAD environment as DWG and later converted to DXF to enable the data be manipulated in the QGIS environment to achieve the research objectives.

### 4.2.4 Data Validation

Two methods were used to check data accuracy; ground truthing, and setting out of some selected parcels of land within the study area and the outlier detection text. The ground truthing was done by picking some pillared site at random, plotted onto the digitized map as shown in Appendix A1 and A2 to check it accuracy and whether it falls in line with

same plot. Coordinates from some marked out positions were also set out on site to identify how the ground and the spatial map positions are related.

**Table 4.4 Data for Ground Truthing (Site A)**

| BEACON INDEX | | |
|---|---|---|
| Beacon | Co-ordinates | |
| | X( Easterns )/Feet | Y( Northerns )/Feet |
| SGN/B117/2017/1 | 175 5103.38 | 955 094.71 |
| SGN/B117/2017/2 | 175 5206.41 | 955 110.76 |
| SGN/B117/2017/3 | 175 5190.42 | 955 220.62 |
| SGN/B117/2017/4 | 175 5087.56 | 955 204.04 |

**Fig. 4.3 Sample Town Sheets and Layout before Georeferencing and Digitising**

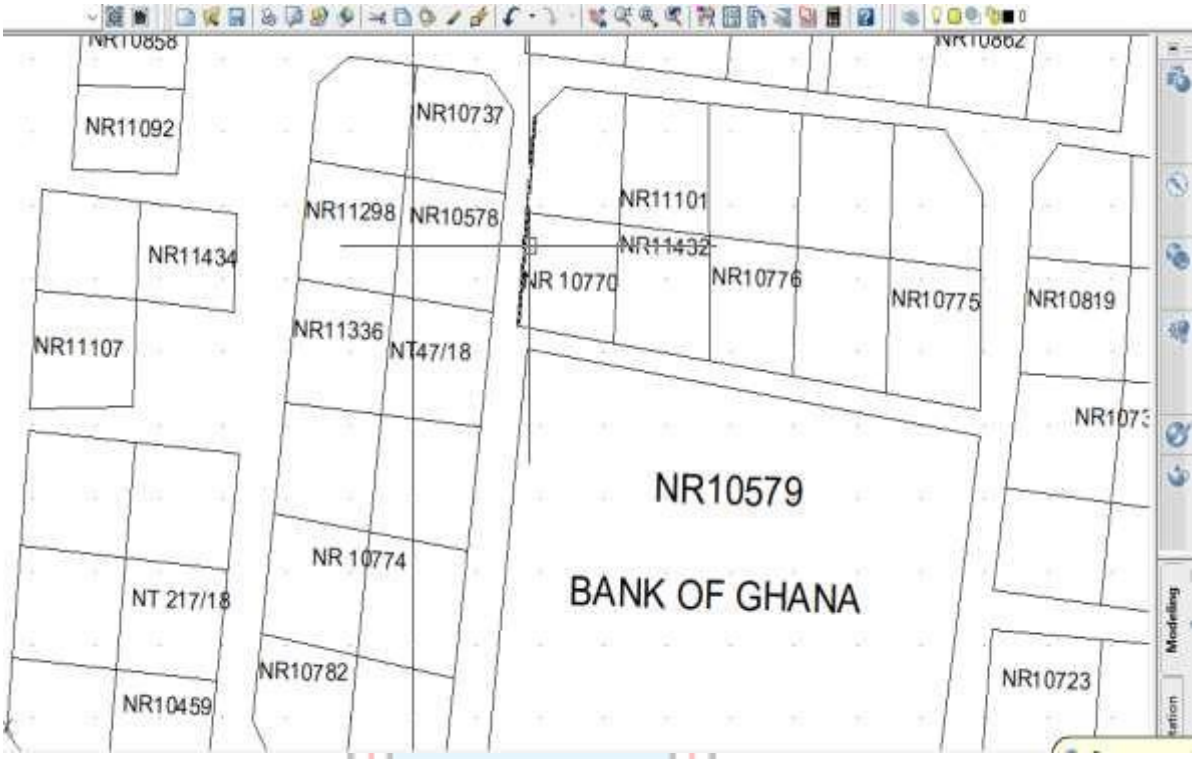



**Fig.4.4 Digitize Town Sheet in AutoCAD**

4.2.5 Exporting of data from AutoCAD to QGIS

Drawing Exchange Format (DXF) files of parcels together with their corresponding noted proposal numbers and (or) deed numbers were obtained using AutoCAD and were exported to QGIS environment for further manipulation and analysis. Fig 4.5 Shows exported data from AutoCAD to QGIS.

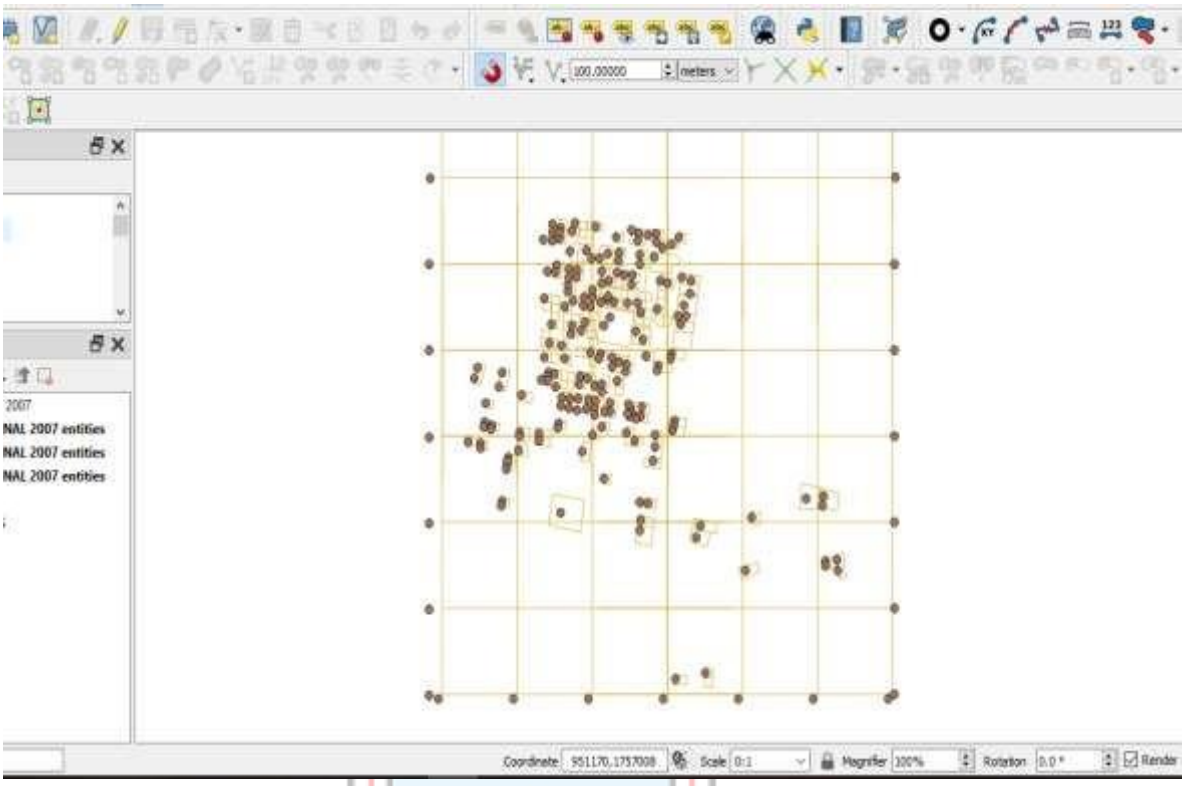



**Fig 4.5 Exporting of Data from AutoCAD to QGIS**

### 4.2.6 Data Cleaning

The parcels which are to be derived from the DXF files needed to be checked for geometry errors (which included snapping errors, invalid geometries and lines containing dangles). The GRASS toolkit in QGIS, which has embedded algorithms that allows the removal of the earlier stated errors by allowing for a “threshold value” within which to snap lines, removed dangles, etc., was used to correct all these errors.

Figs 4.6- 4.9 shows the processes employed in cleaning the data and removing errors from the DXF file.

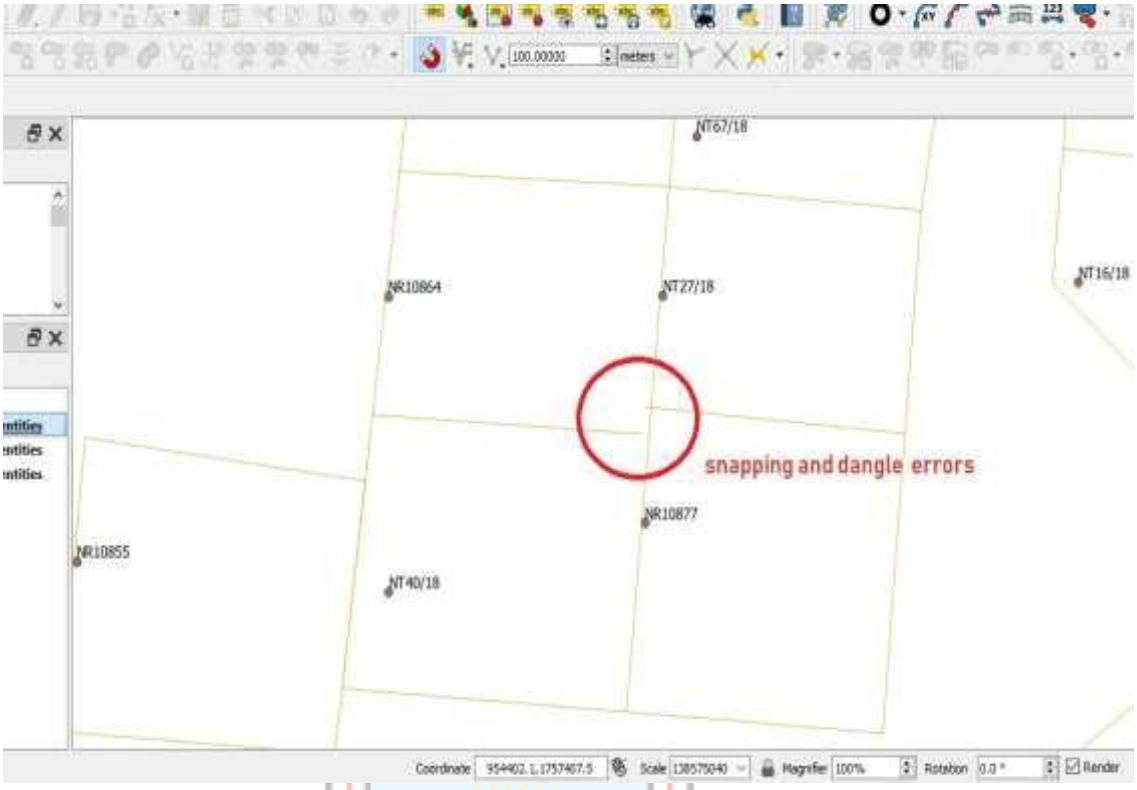



**Fig 4.6 Using V. Clean in GRASS**

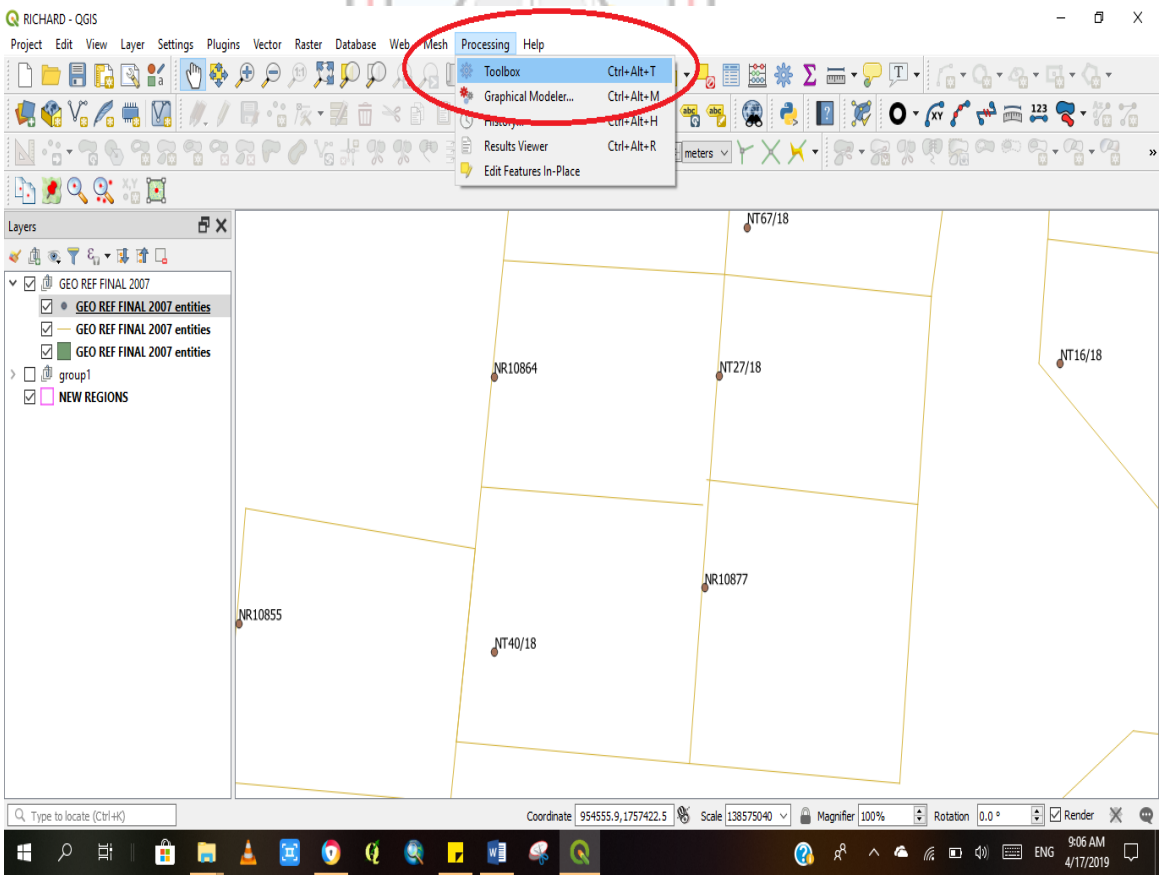



**Fig 4.7 Command to Clean Imported Data from AutoCAD**

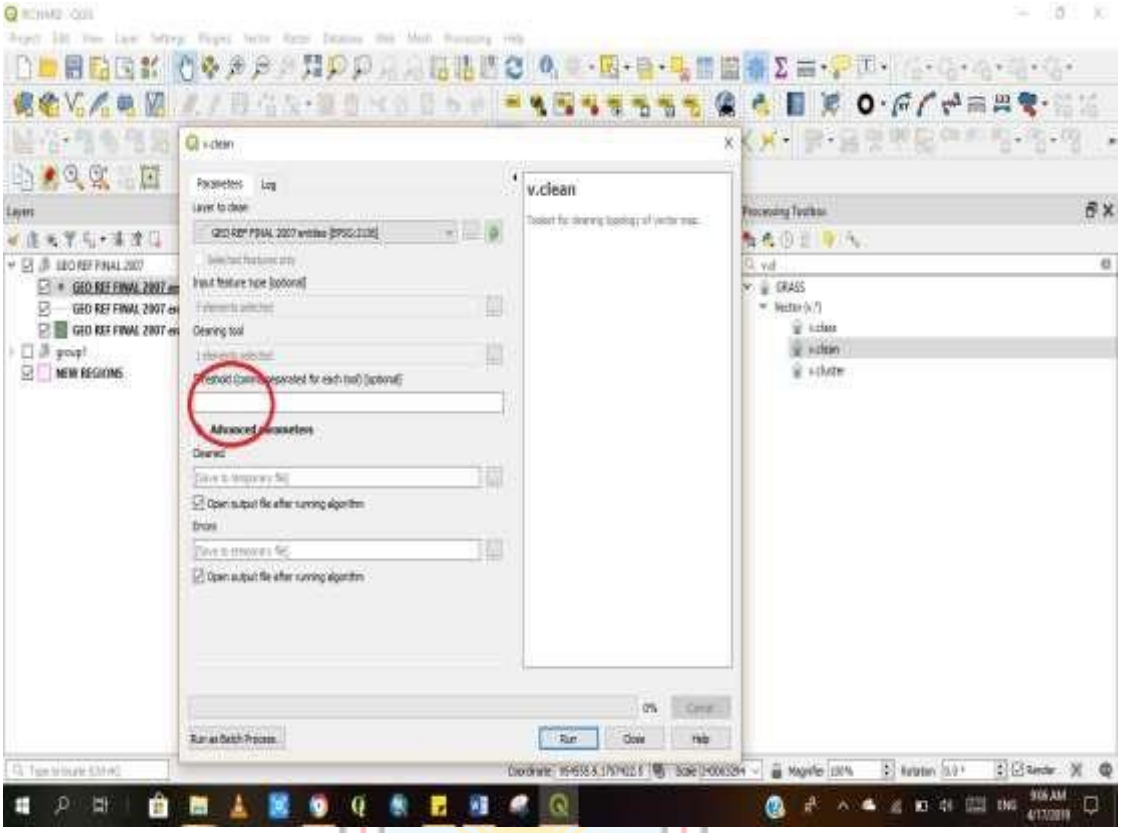



**Fig. 4.8 Command to Remove Errors**

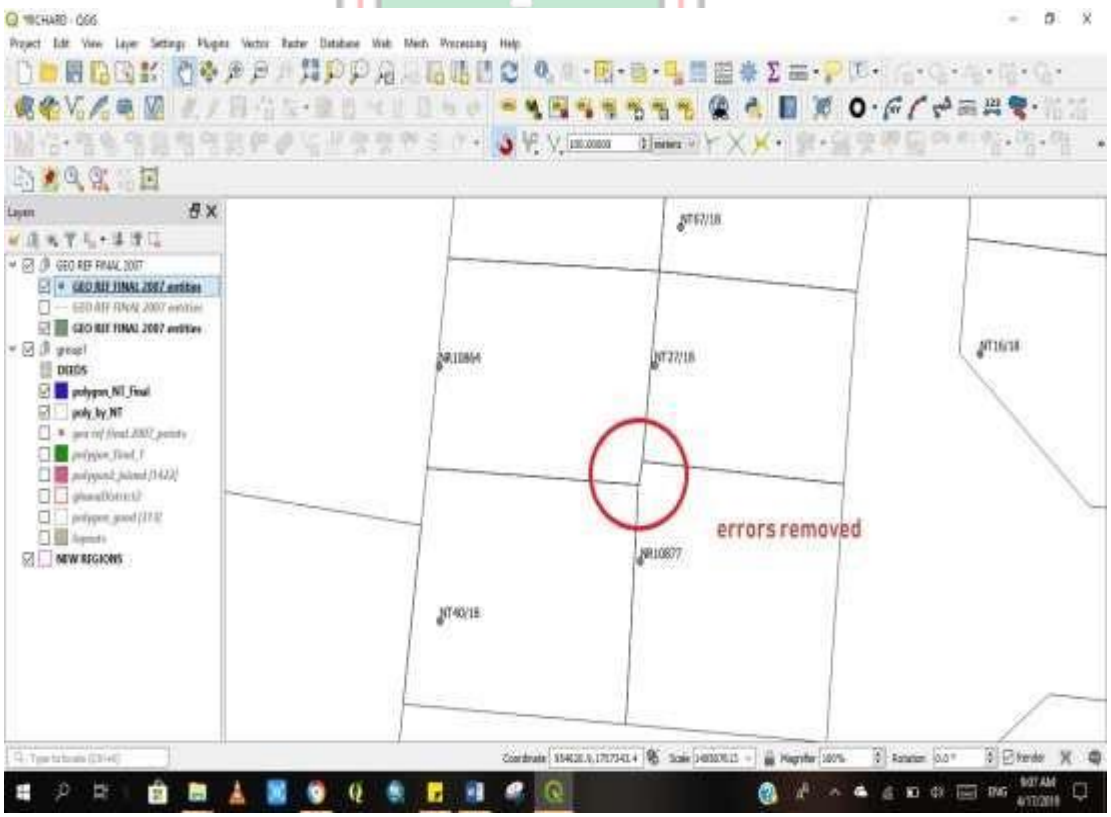



**Fig. 4.9 Errors Removed**

### 4.2.7 Performing the Spatial Join

Next step was to perform a spatial join of the points (from the DXF file) to the "cleaned" parcel polygons and this function is located under vector – data management tools join vector by attributes. Figs 4.10-4.12 shows the spatial joint process that adds attributes to their respective polygons.

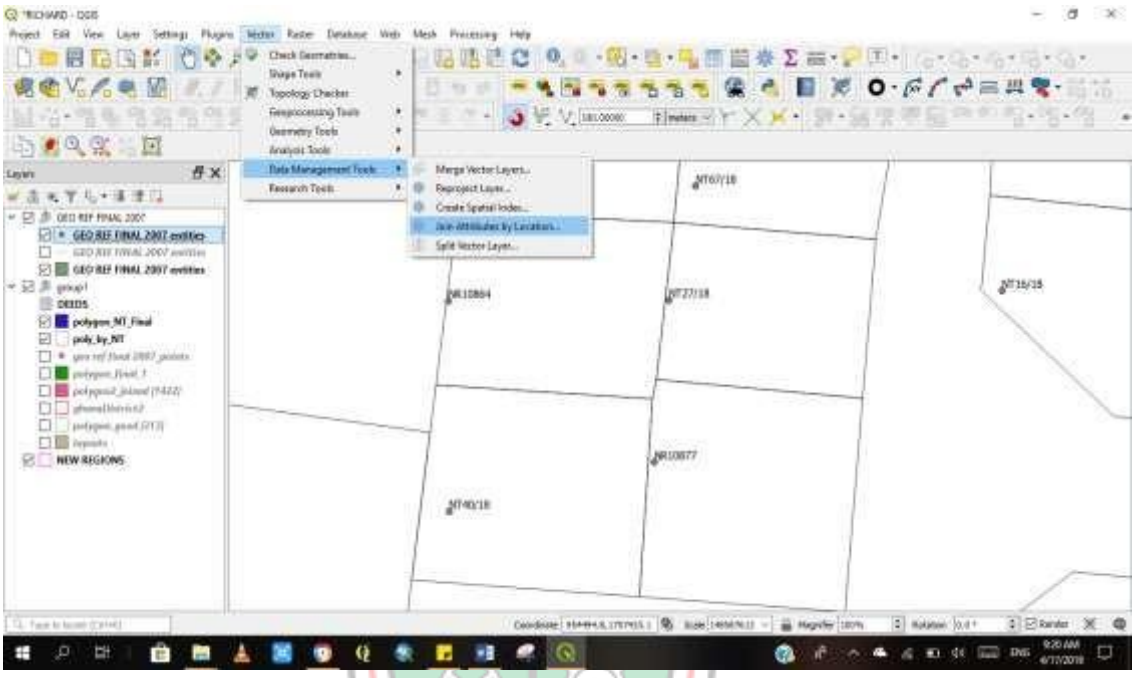


**Fig. 4.10 Performing the Spatial Join**

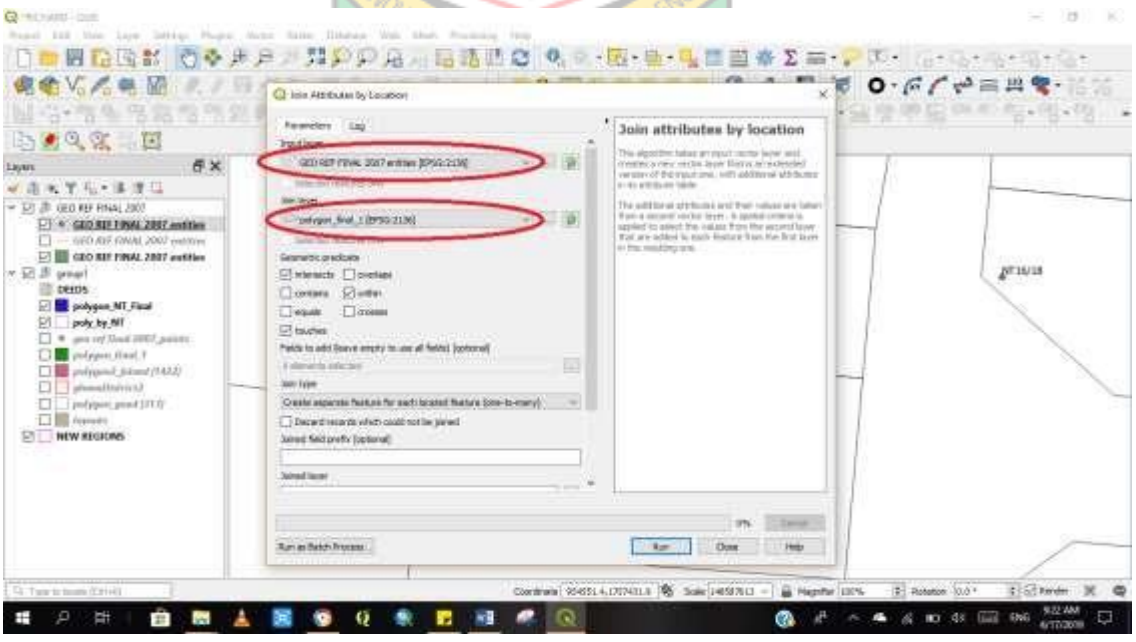



**Fig. 4.11 Spatial Join Command**

After performing the spatial join (thus, the polygon now has “Deed No.” as attribute),

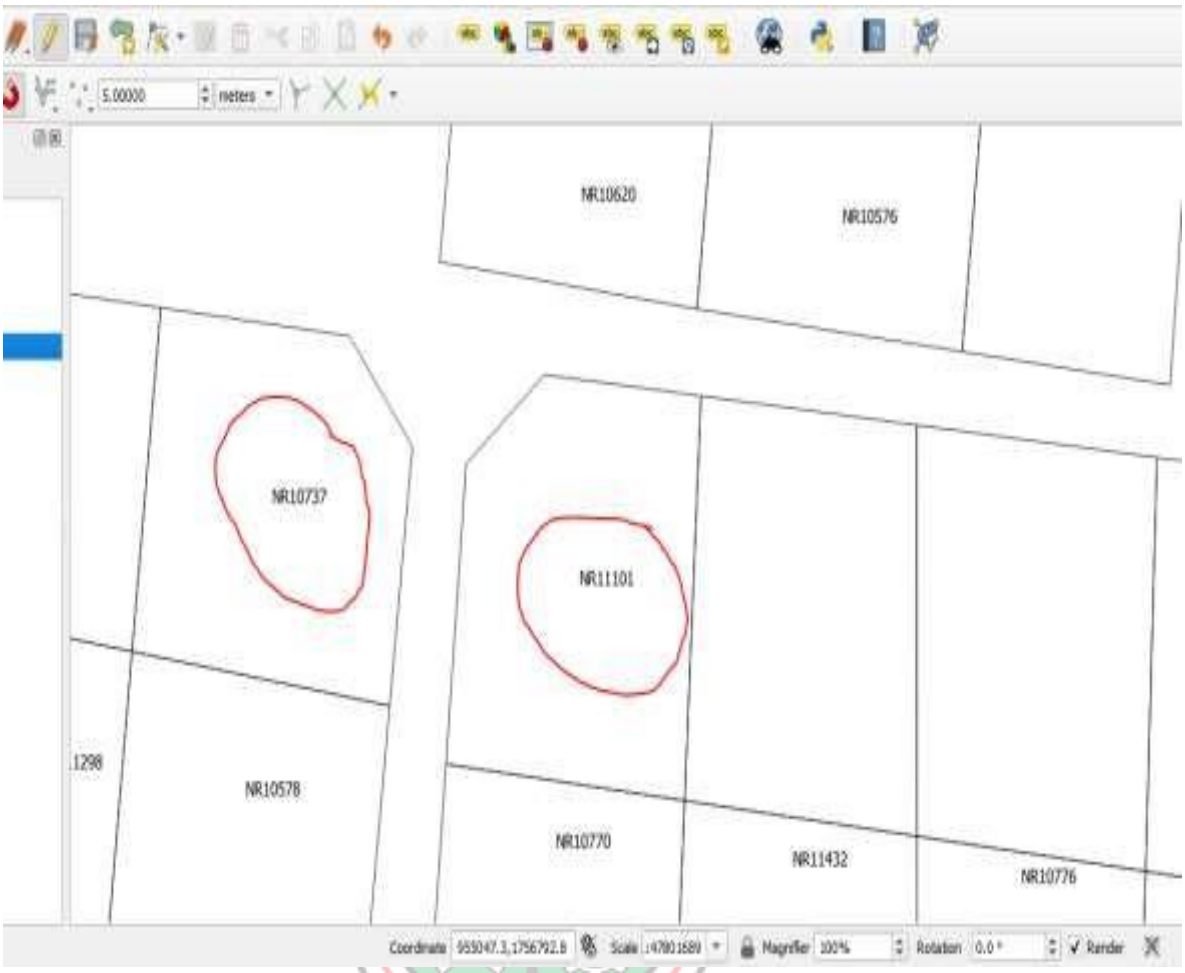
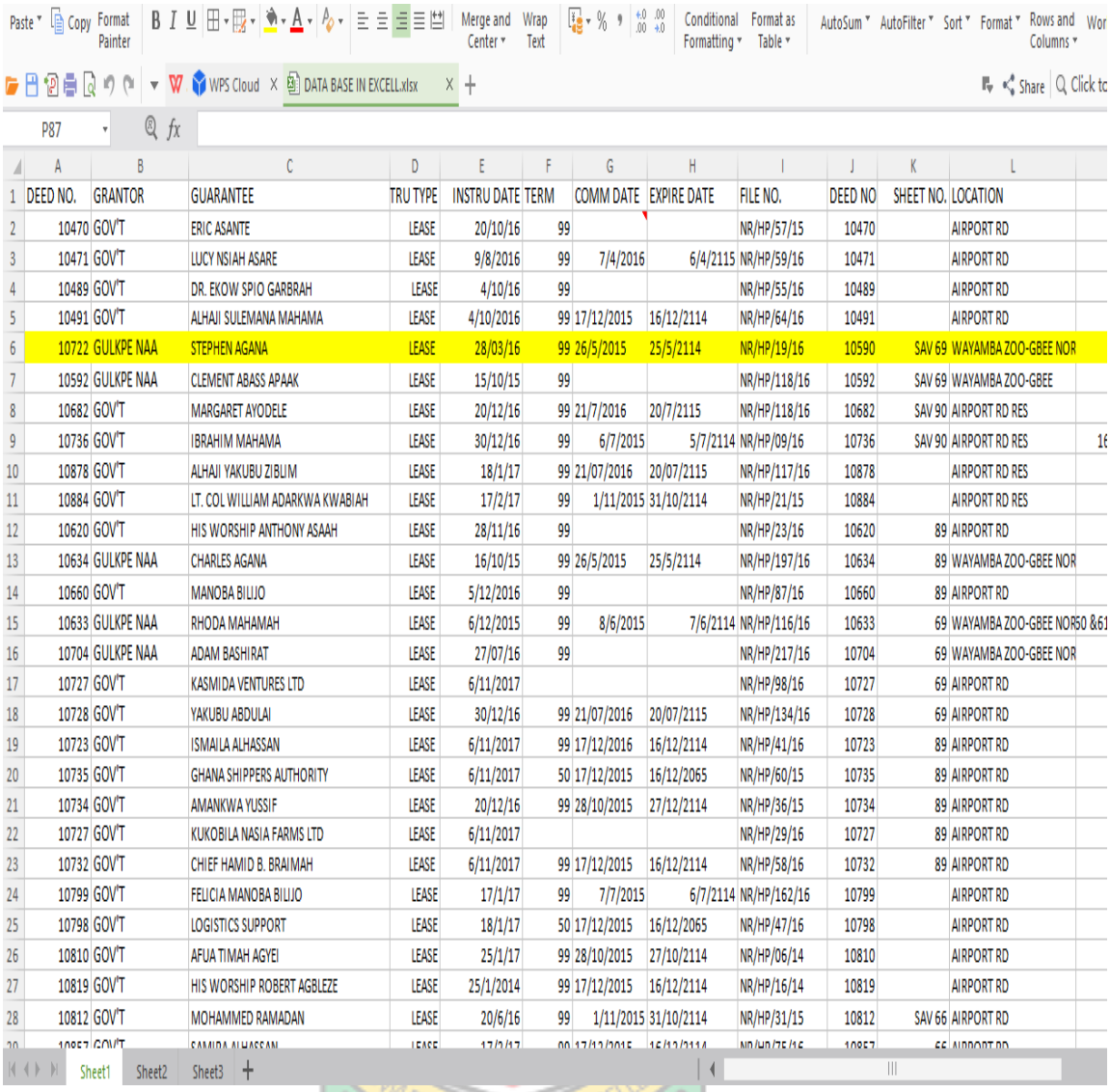



**Fig. 4.12 Polygons now have their Related Attributes**

**Fig. 4.13 Ledgers and Registers as Source of Attributes Data**

*Source of attribute data*

Attribute data of the parcels were compiled in spreadsheet (Microsoft Excel). These contained information such as Deed number, Grantor, Lease Term, etc. Fig 4.13 shows geographic registers and ledgers from which the attribute data was acquired.



| DEED NO. | GRANTOR | GUARANTEE | TRU TYPE | INSTRU DATE | TERM | COMM DATE | EXPIRE DATE | FILE NO. | DEED NO | SHEET NO. | LOCATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10470 | GOV'T | ERIC ASANTE | LEASE | 20/10/16 | 99 | | | NR/HP/57/15 | 10470 | | AIRPORT RD |
| 10471 | GOV'T | LUCY NSIAH ASARE | LEASE | 9/8/2016 | 99 | 7/4/2016 | 6/4/2115 | NR/HP/59/16 | 10471 | | AIRPORT RD |
| 10489 | GOV'T | DR. EKOW SPIO GARBRAH | LEASE | 4/10/16 | 99 | | | NR/HP/55/16 | 10489 | | AIRPORT RD |
| 10491 | GOV'T | ALHAJI SULEMANA MAHAMA | LEASE | 4/10/2016 | 99 | 17/12/2015 | 16/12/2114 | NR/HP/64/16 | 10491 | | AIRPORT RD |
| 10722 | GULKPE NAA | STEPHEN AGANA | LEASE | 28/03/16 | 99 | 26/5/2015 | 25/5/2114 | NR/HP/19/16 | 10590 | SAV 69 | WAYAMBA ZOO-GBEE NOR |
| 10592 | GULKPE NAA | CLEMENT ABASS APAAK | LEASE | 15/10/15 | 99 | | | NR/HP/118/16 | 10592 | SAV 69 | WAYAMBA ZOO-GBEE |
| 10682 | GOV'T | MARGARET AYODELE | LEASE | 20/12/16 | 99 | 21/7/2016 | 20/7/2115 | NR/HP/118/16 | 10682 | SAV 90 | AIRPORT RD RES |
| 10736 | GOV'T | IBRAHIM MAHAMA | LEASE | 30/12/16 | 99 | 6/7/2015 | 5/7/2114 | NR/HP/09/16 | 10736 | SAV 90 | AIRPORT RD RES |
| 10878 | GOV'T | ALHAJI YAKUBU ZIBLIM | LEASE | 18/1/17 | 99 | 21/07/2016 | 20/07/2115 | NR/HP/117/16 | 10878 | | AIRPORT RD RES |
| 10884 | GOV'T | LT. COL WILLIAM ADARKWA KWABIAH | LEASE | 17/2/17 | 99 | 1/11/2015 | 31/10/2114 | NR/HP/21/15 | 10884 | | AIRPORT RD RES |
| 10620 | GOV'T | HIS WORSHIP ANTHONY ASAAH | LEASE | 28/11/16 | 99 | | | NR/HP/23/16 | 10620 | 89 | AIRPORT RD |
| 10634 | GULKPE NAA | CHARLES AGANA | LEASE | 16/10/15 | 99 | 26/5/2015 | 25/5/2114 | NR/HP/197/16 | 10634 | 89 | WAYAMBA ZOO-GBEE NOR |
| 10660 | GOV'T | MANOBA BILIJO | LEASE | 5/12/2016 | 99 | | | NR/HP/87/16 | 10660 | 89 | AIRPORT RD |
| 10633 | GULKPE NAA | RHODA MAHAMAH | LEASE | 6/12/2015 | 99 | 8/6/2015 | 7/6/2114 | NR/HP/116/16 | 10633 | 69 | WAYAMBA ZOO-GBEE NOR |
| 10704 | GULKPE NAA | ADAM BASHIRAT | LEASE | 27/07/16 | 99 | | | NR/HP/217/16 | 10704 | 69 | WAYAMBA ZOO-GBEE NOR |
| 10727 | GOV'T | KASMIDA VENTURES LTD | LEASE | 6/11/2017 | | | | NR/HP/98/16 | 10727 | 69 | AIRPORT RD |
| 10728 | GOV'T | YAKUBU ABDULAI | LEASE | 30/12/16 | 99 | 21/07/2016 | 20/07/2115 | NR/HP/134/16 | 10728 | 69 | AIRPORT RD |
| 10723 | GOV'T | ISMAILA ALHASSAN | LEASE | 6/11/2017 | 99 | 17/12/2016 | 16/12/2114 | NR/HP/41/16 | 10723 | 89 | AIRPORT RD |
| 10735 | GOV'T | GHANA SHIPPERS AUTHORITY | LEASE | 6/11/2017 | 50 | 17/12/2015 | 16/12/2065 | NR/HP/60/15 | 10735 | 89 | AIRPORT RD |
| 10734 | GOV'T | AMANKWA YUSSIF | LEASE | 20/12/16 | 99 | 28/10/2015 | 27/12/2114 | NR/HP/36/15 | 10734 | 89 | AIRPORT RD |
| 10727 | GOV'T | KUKOBILA NASIA FARMS LTD | LEASE | 6/11/2017 | | | | NR/HP/29/16 | 10727 | 89 | AIRPORT RD |
| 10732 | GOV'T | CHIEF HAMID B. BRAIMAH | LEASE | 6/11/2017 | 99 | 17/12/2015 | 16/12/2114 | NR/HP/58/16 | 10732 | 89 | AIRPORT RD |
| 10799 | GOV'T | FELICIA MANOBA BILIJO | LEASE | 17/1/17 | 99 | 7/7/2015 | 6/7/2114 | NR/HP/162/16 | 10799 | | AIRPORT RD |
| 10798 | GOV'T | LOGISTICS SUPPORT | LEASE | 18/1/17 | 50 | 17/12/2015 | 16/12/2065 | NR/HP/47/16 | 10798 | | AIRPORT RD |
| 10810 | GOV'T | AFUA TIMAH AGYEI | LEASE | 25/1/17 | 99 | 28/10/2015 | 27/10/2114 | NR/HP/06/14 | 10810 | | AIRPORT RD |
| 10819 | GOV'T | HIS WORSHIP ROBERT AGBLEZE | LEASE | 25/1/2014 | 99 | 17/12/2015 | 16/12/2114 | NR/HP/16/14 | 10819 | | AIRPORT RD |
| 10812 | GOV'T | MOHAMMED RAMADAN | LEASE | 20/6/16 | 99 | 1/11/2015 | 31/10/2114 | NR/HP/31/15 | 10812 | SAV 66 | AIRPORT RD |

**Fig. 4.14 Excel Sheet Containing Attributes**

### 4.2.8 Attribute Join

After performing the spatial join (thus, the polygon now has "Deed No." as attribute), there is the need to attach the data from the excel spreadsheet to the polygons. Hence, an attribute join is needed to be performed so that the polygon would have the other needed attributes. This is done by right-clicking on the excel file (already loaded into QGIS) – properties – joins. Figs 4.14 above shows excel sheet containing attributes and Fig 4.15 also shows command to attach all related attributes to their respective parcels.

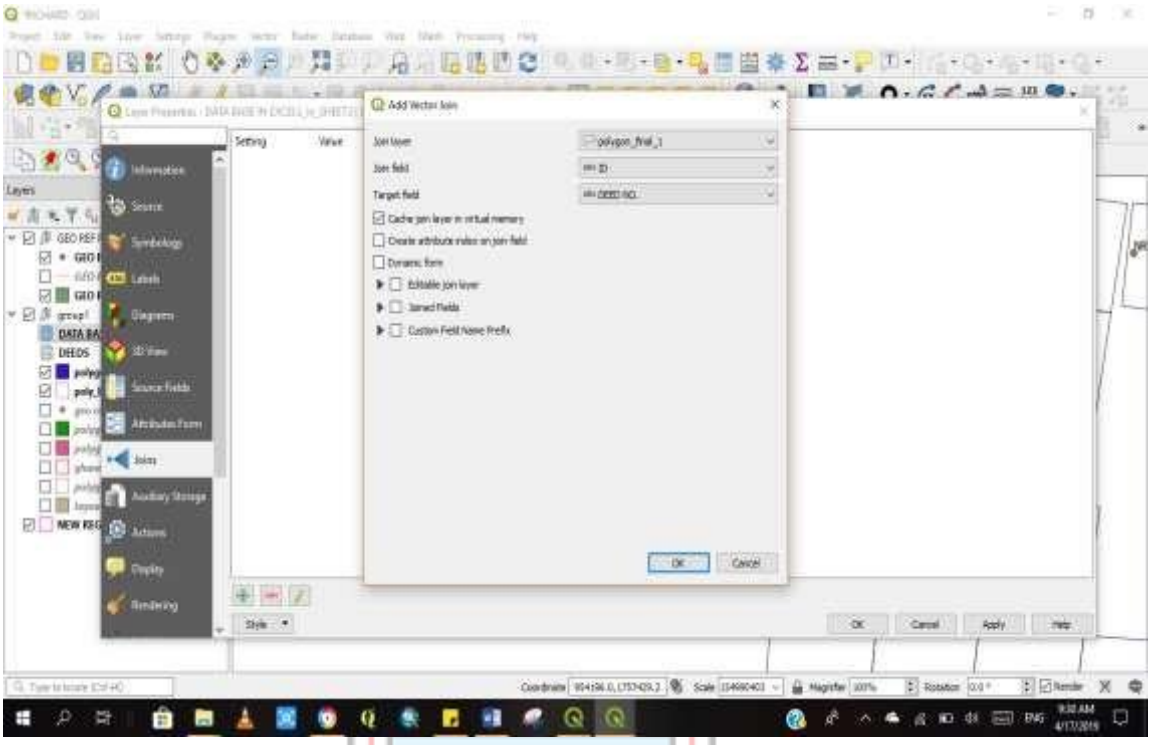



**Fig. 4.15 Command to Attach all Related Attribute to their Respective Parcels**

Finally, the polygons now have all the attributes from the excel spreadsheet. A simple click on the polygon now reveals the entire details of the selected polygon.

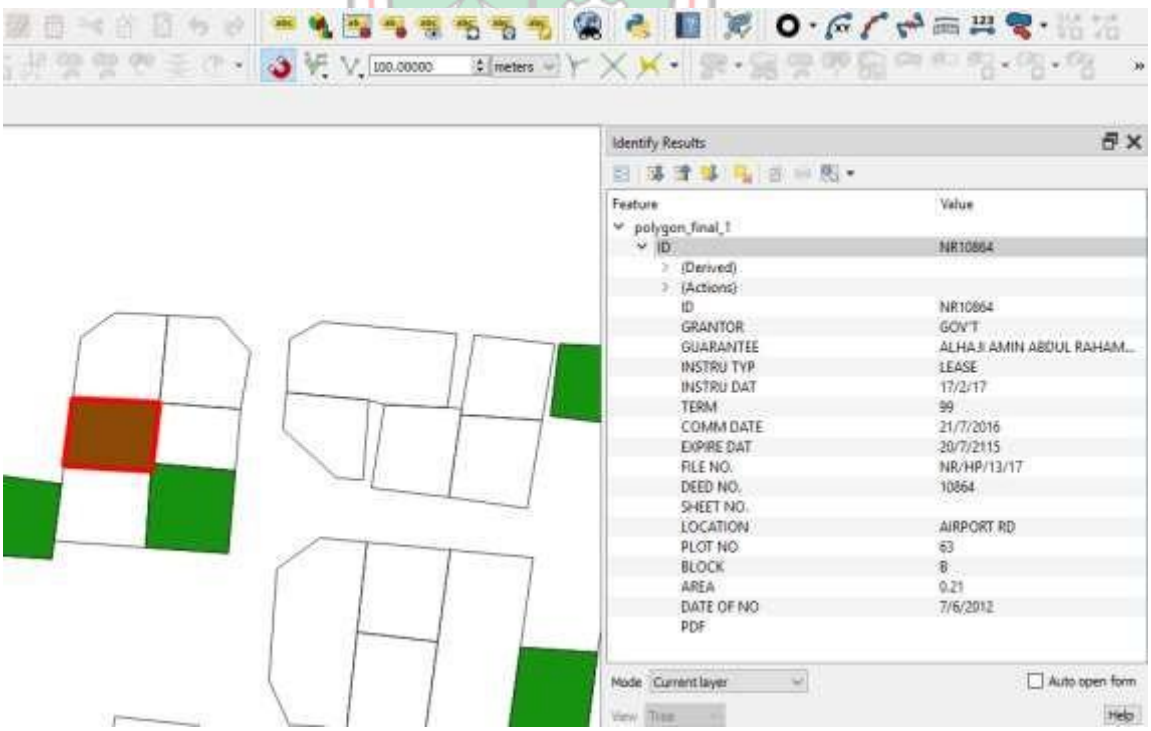



**Fig. 4.16 Polygons Showing all Added Attributes**

### 4.2.9 Attach PDF of Registered Deeds to Attribute Table

QGIS allows for different file formats to be attached to features within the map window (canvas). A new column named "PDF" is created in the attribute table and the file location of the PDF is copied into their corresponding columns.

Eg. "C:/Richard/documents/NR10777. PDF" is linked to column with deed no, 10777 and so on as shown in Fig 4.17.

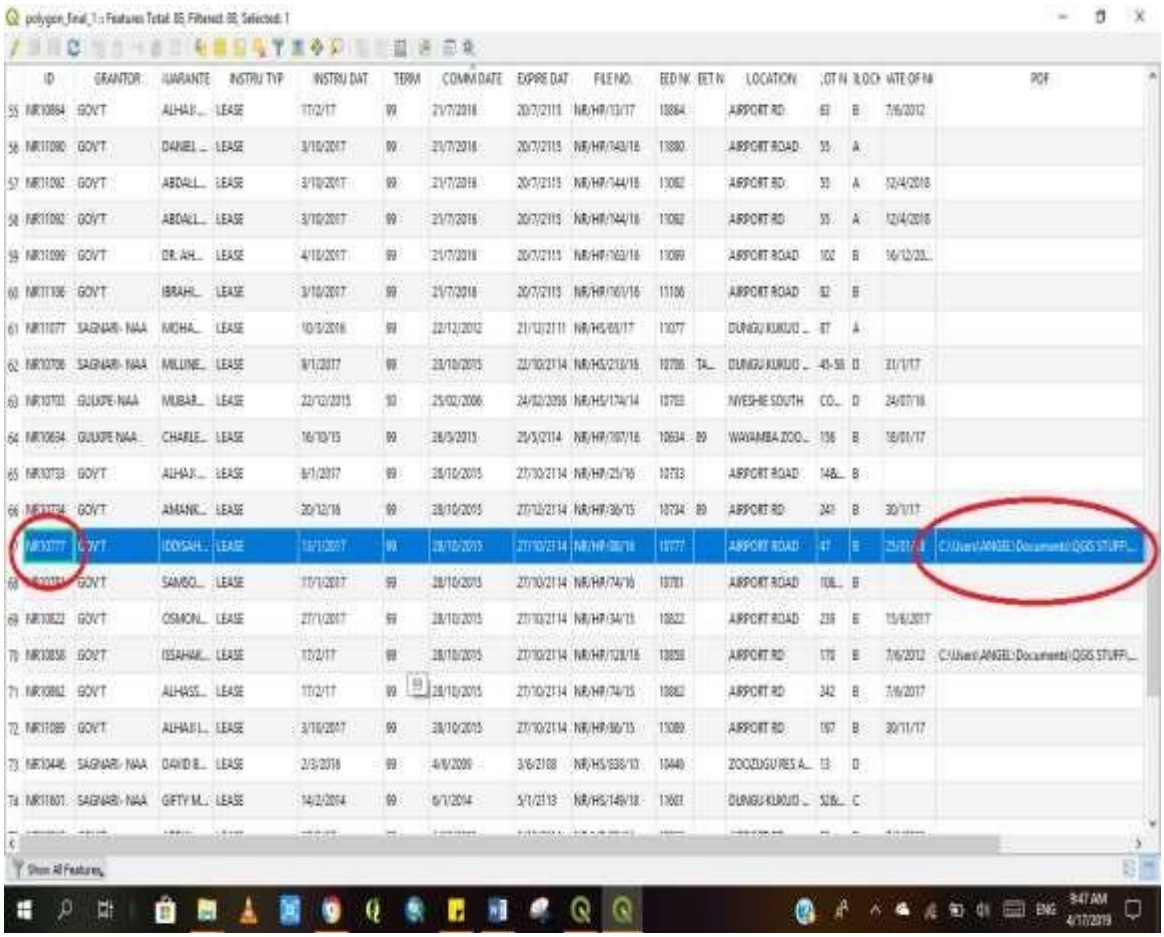


**Fig. 4.17 PDF Attached to the Attribute Table**

### 4.2.10 Command to Open PDF at a Click of a Polygon or Land Parcel

Now the PDF of registered deeds pops open when the parcels containing their corresponding PDF's are clicked on by the "action" icon on the menu bar. This enable easy access to a copy of any registered land document for verification and any other official use as shown in. Fig. 4.19.

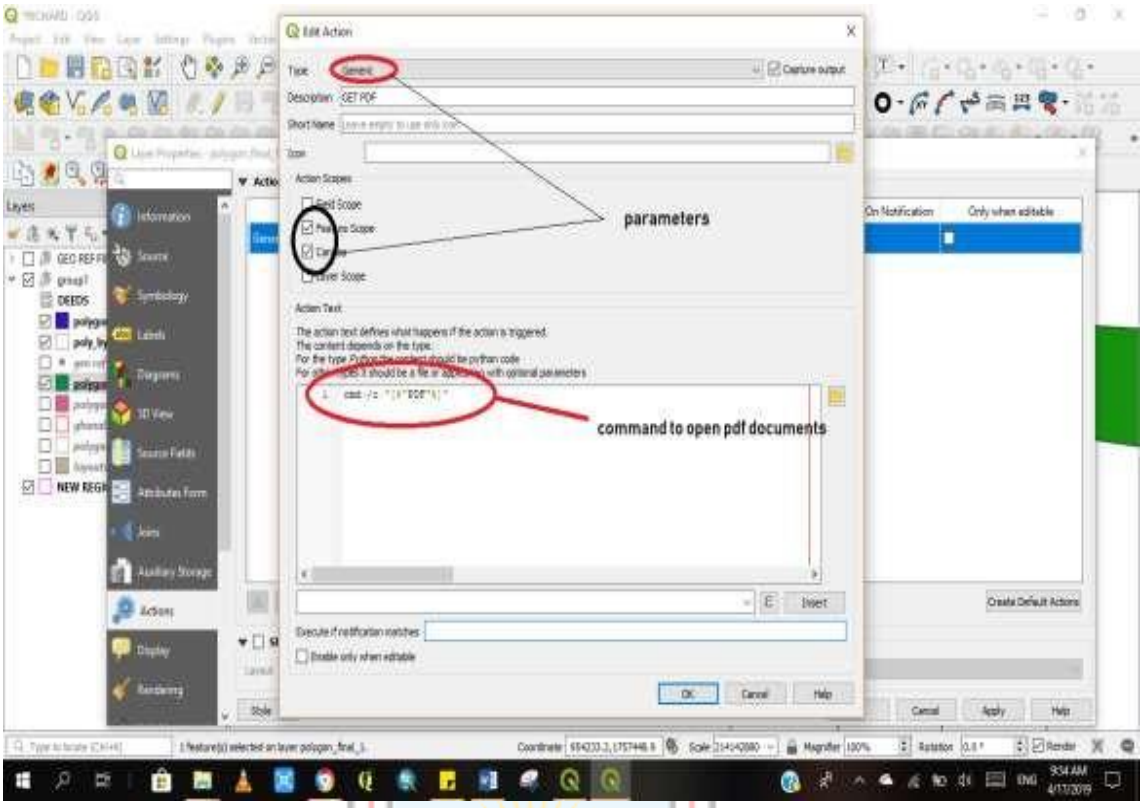



**Fig. 4.18 Command to Open PDF**

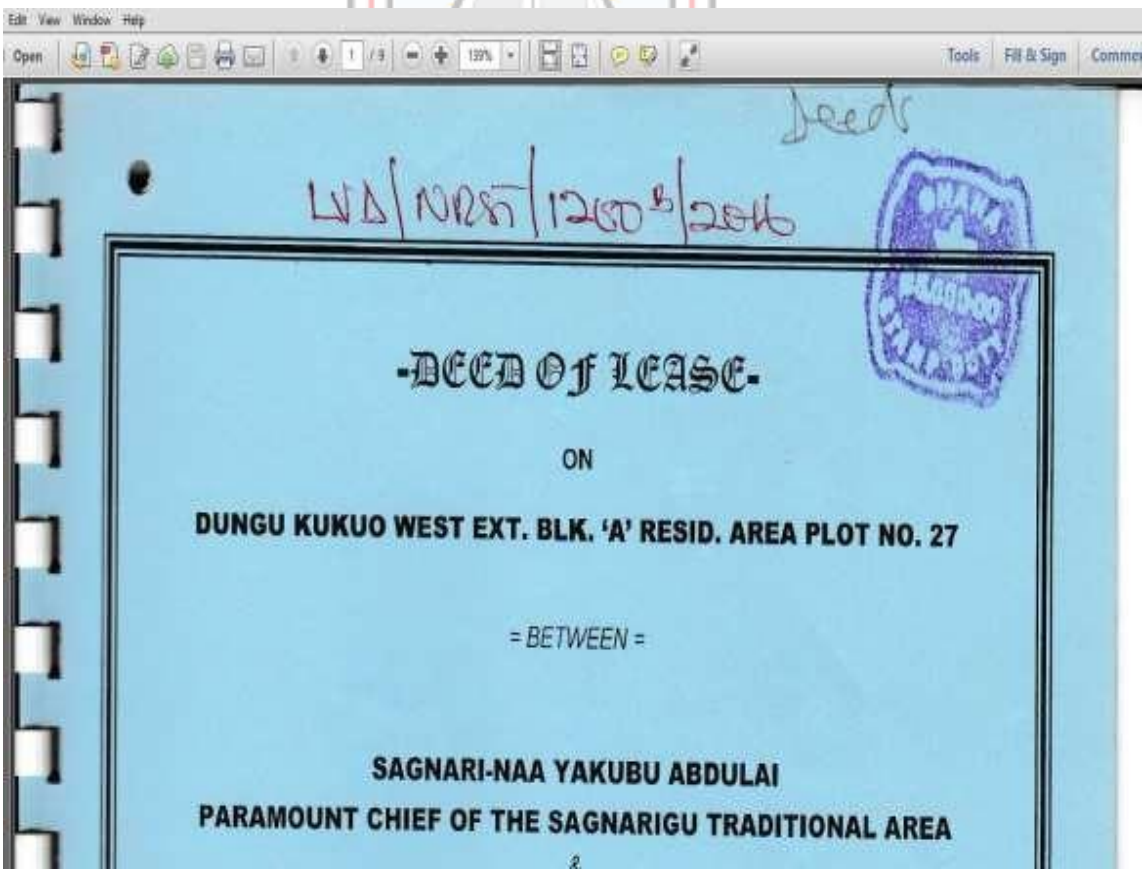



**Fig. 4.19 PDF of the Related Parcel Pops-up**

### 4.2.11 Searching by Coordinates

The system allows for searching by typing the coordinates of points using a plugin called zoom to latitude/longitude with this icon . The typed coordinates can be saved as point layer and can be further connected to form another parcel or polygon in terms of making updates or adding a new parcel. Fig. 20 shows the position of the coordinate highlighted in blue with a red curser.

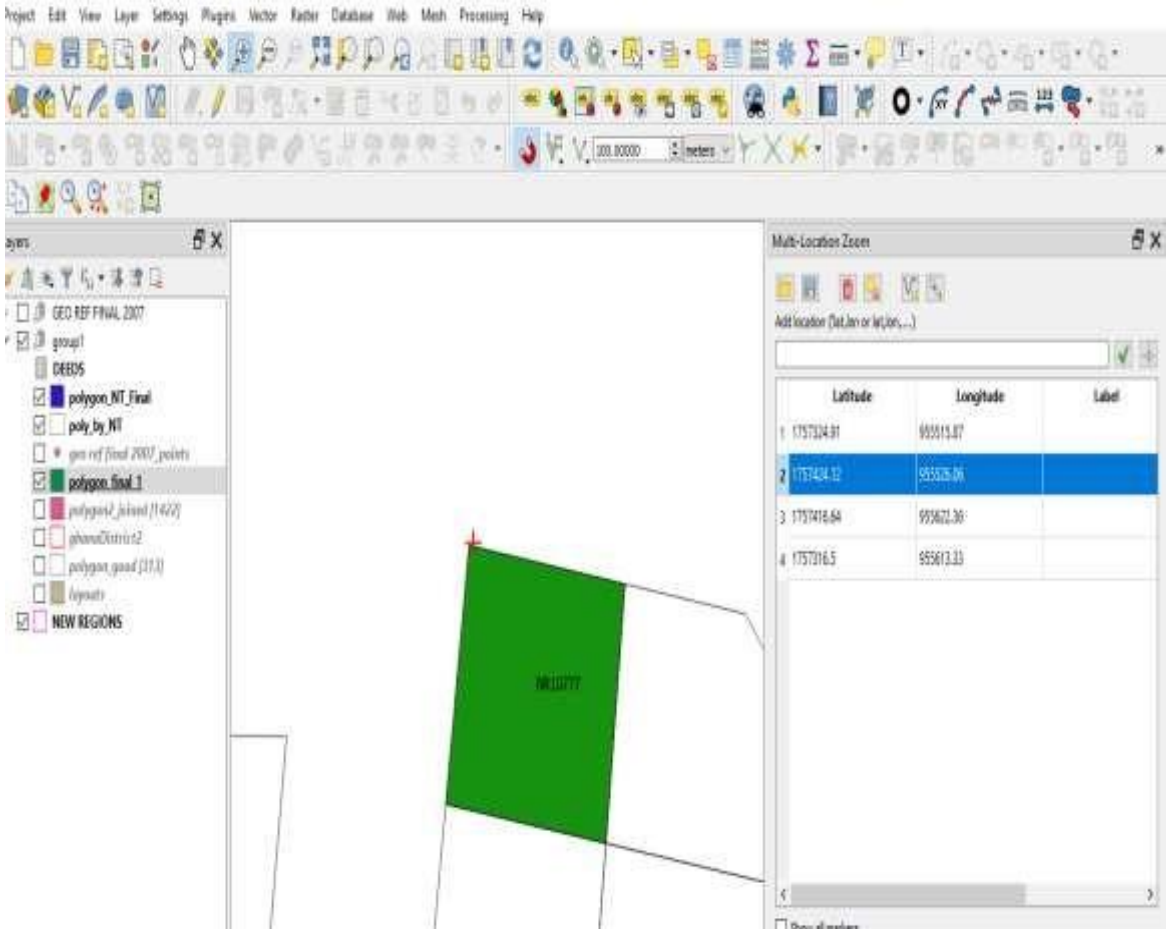


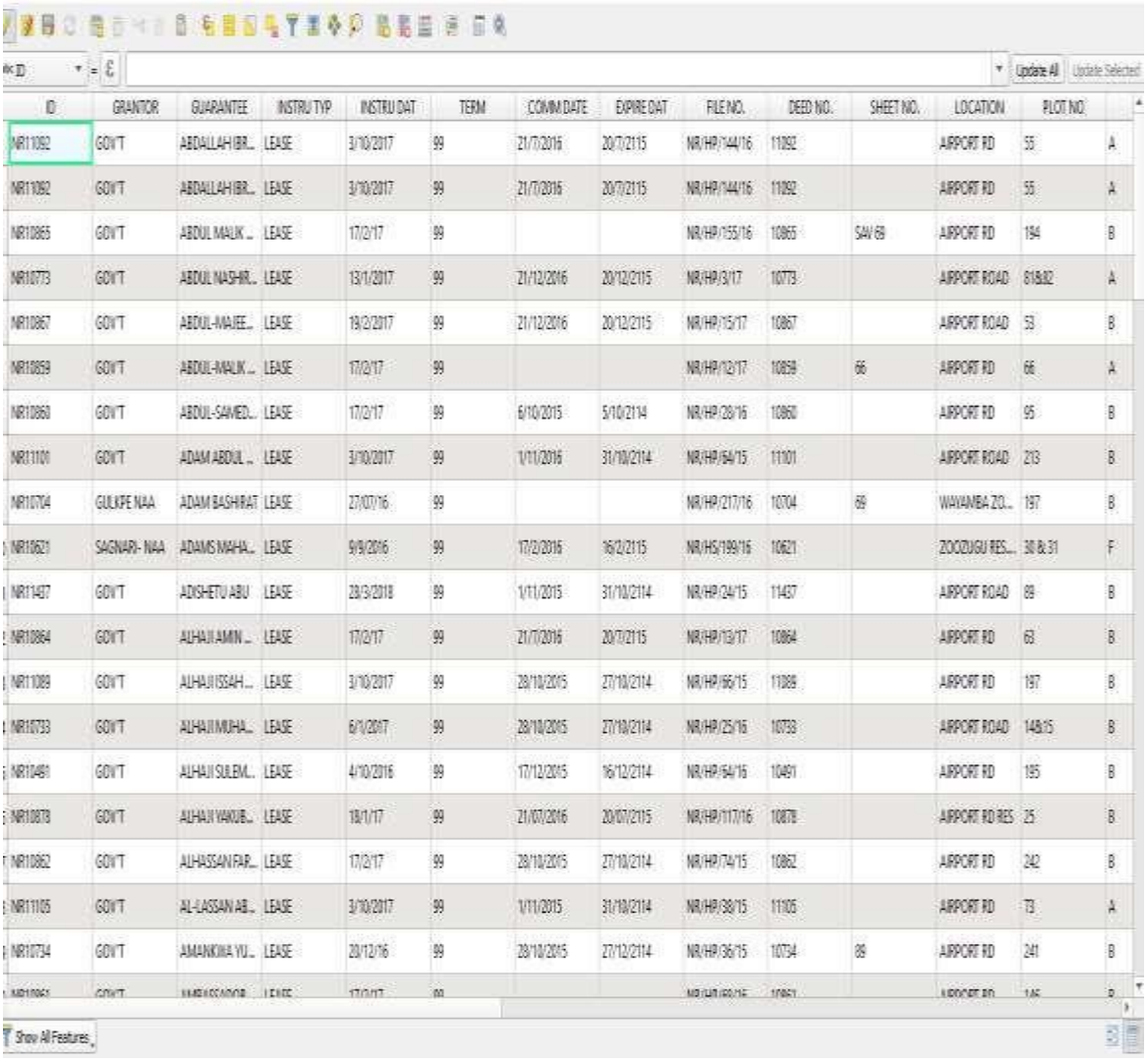

**Fig. 4.20 Searching Parcel by Entering Coordinate**

# CHAPTER 5

## RESULTS AND DISCUSSIONS

### 5.1 Geodatabase

A database is created as an attribute from digitized ledgers and registers in MS excel and further call into the QGIS environment as shown in Fig 5.1, this enables the user to view the records of a particular plot or parcel of land at a glance.



| ID | GRANTOR | GUARANTEE | INSTRU TYP | INSTRU DAT | TERM | COMM DATE | EXPIRE DAT | FILE NO. | DEED NO. | SHEET NO. | LOCATION | PLOT NO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NR11092 | GOVT | ABDALLAH IBR... | LEASE | 3/10/2017 | 99 | 21/7/2016 | 20/7/2115 | NR/HP/144/16 | 11092 | | AIRPORT RD | 55 | A |
| NR11092 | GOVT | ABDALLAH IBR... | LEASE | 3/10/2017 | 99 | 21/7/2016 | 20/7/2115 | NR/HP/144/16 | 11092 | | AIRPORT RD | 55 | A |
| NR10865 | GOVT | ABDUL MALIK ... | LEASE | 17/2/17 | 99 | | | NR/HP/155/16 | 10865 | SAV 69 | AIRPORT RD | 194 | B |
| NR10773 | GOVT | ABDUL NASHIR... | LEASE | 13/1/2017 | 99 | 21/12/2016 | 20/12/2115 | NR/HP/3/17 | 10773 | | AIRPORT ROAD | 81&82 | A |
| NR10867 | GOVT | ABDUL-MAJEE... | LEASE | 19/2/2017 | 99 | 21/12/2016 | 20/12/2115 | NR/HP/15/17 | 10867 | | AIRPORT ROAD | 53 | B |
| NR10859 | GOVT | ABDUL-MALIK ... | LEASE | 17/2/17 | 99 | | | NR/HP/12/17 | 10859 | 66 | AIRPORT RD | 66 | A |
| NR10860 | GOVT | ABDUL-SAMED... | LEASE | 17/2/17 | 99 | 6/10/2015 | 5/10/2114 | NR/HP/28/16 | 10860 | | AIRPORT RD | 95 | B |
| NR11101 | GOVT | ADAM ABDUL ... | LEASE | 3/10/2017 | 99 | 1/11/2016 | 31/10/2114 | NR/HP/64/15 | 11101 | | AIRPORT ROAD | 213 | B |
| NR10704 | GULKPE NAA | ADAM BASHIRAT | LEASE | 27/07/16 | 99 | | | NR/HP/217/16 | 10704 | 69 | WAWAMBA ZO... | 197 | B |
| NR10621 | SAGNARI- NAA | ADAMS MAHA... | LEASE | 9/9/2016 | 99 | 17/2/2016 | 16/2/2115 | NR/HS/189/16 | 10621 | | ZOOZUGU RES... | 30 & 31 | F |
| NR11437 | GOVT | ADISHETU ABU | LEASE | 28/3/2018 | 99 | 1/11/2015 | 31/10/2114 | NR/HP/24/15 | 11437 | | AIRPORT ROAD | 89 | B |
| NR10864 | GOVT | ALHAJI AMIN ... | LEASE | 17/2/17 | 99 | 21/7/2016 | 20/7/2115 | NR/HP/13/17 | 10864 | | AIRPORT RD | 63 | B |
| NR11089 | GOVT | ALHAJI ISSAH... | LEASE | 3/10/2017 | 99 | 28/10/2015 | 27/10/2114 | NR/HP/66/15 | 11089 | | AIRPORT RD | 197 | B |
| NR10733 | GOVT | ALHAJI MUHA... | LEASE | 6/1/2017 | 99 | 28/10/2015 | 27/10/2114 | NR/HP/25/16 | 10733 | | AIRPORT ROAD | 14B/15 | B |
| NR10491 | GOVT | ALHAJI SULEM... | LEASE | 4/10/2016 | 99 | 17/12/2015 | 16/12/2114 | NR/HP/64/16 | 10491 | | AIRPORT RD | 195 | B |
| NR10878 | GOVT | ALHAJI YAKUB... | LEASE | 18/1/17 | 99 | 21/07/2016 | 20/07/2115 | NR/HP/117/16 | 10878 | | AIRPORT RD RES | 25 | B |
| NR10862 | GOVT | ALHASSAN FAR... | LEASE | 17/2/17 | 99 | 28/10/2015 | 27/10/2114 | NR/HP/74/15 | 10862 | | AIRPORT RD | 242 | B |
| NR11105 | GOVT | AL-LASSAN AB... | LEASE | 3/10/2017 | 99 | 1/11/2015 | 31/10/2114 | NR/HP/38/15 | 11105 | | AIRPORT RD | 73 | A |
| NR10734 | GOVT | AMANKWA YU... | LEASE | 28/12/16 | 99 | 28/10/2015 | 27/12/2114 | NR/HP/36/15 | 10734 | 88 | AIRPORT RD | 241 | B |

**Fig 5.1 Developed Attribute Database in QGIS**

### 5.2 Spatial Map

The georeferenced maps, thus town sheets after going through the digitizing process in AutoCAD, converted to DXF and taken through the cleaning process becomes the Spatial Map as shown in Fig 5.2.

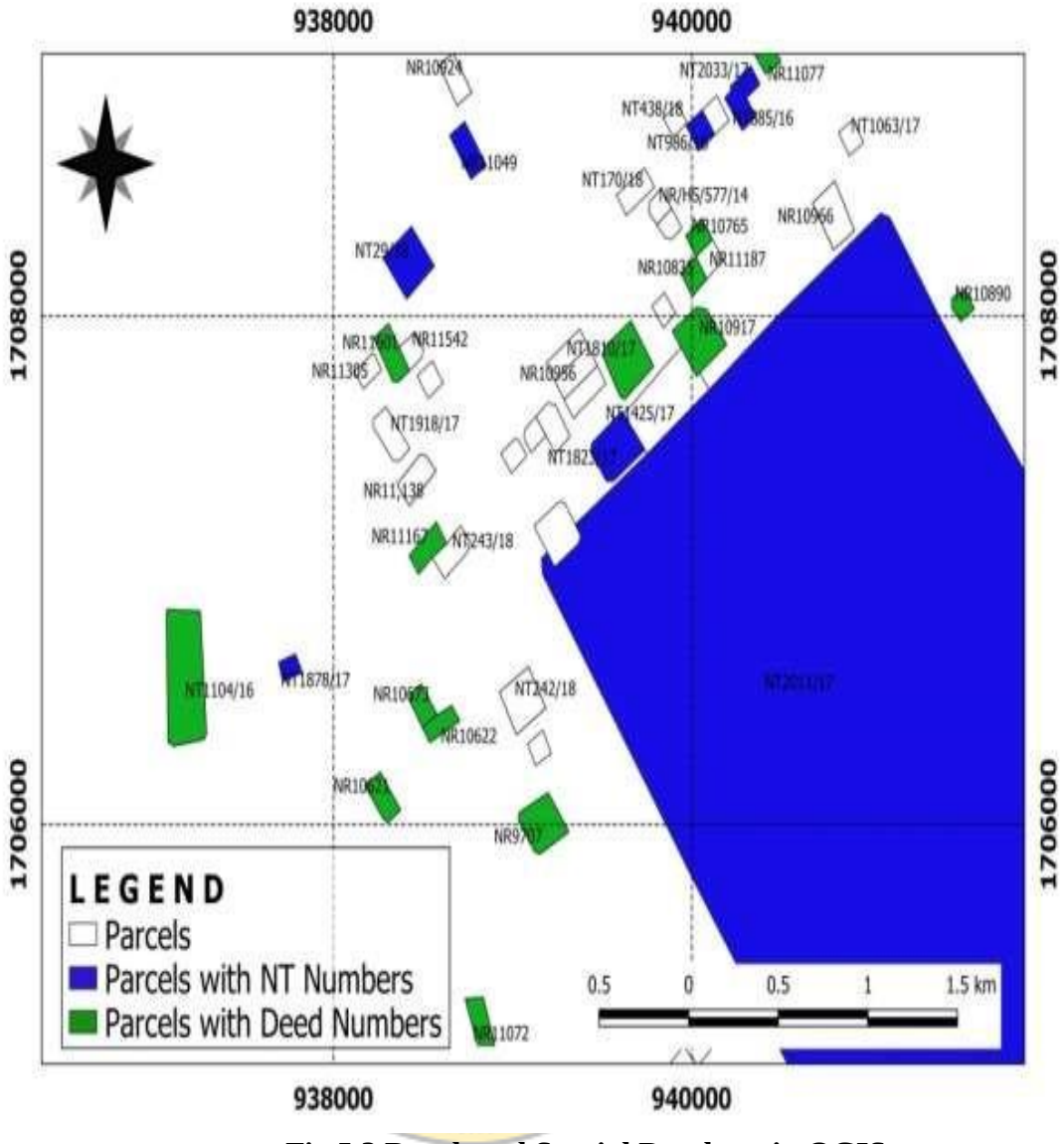



**Fig 5.2 Developed Spatial Database in QGIS**

## 5.3 Coordinate Entry and Generation of Search Report

The spatial map enable coordinate from site plans to be entered into an interface for the point to show at the exact position on the map as the ground situation may be. Fig 5.3 clearly shows coordinate entered and a point displayed on the map showing the exact position of the coordinate (red mark) as in relation to the ground situation. Land parcels as shown in a polygon are linked to the database in Fig 5.1 therefore making it possible to generate a search report at the click on the identify feature icon and on any parcel (eg. red highlighted parcel) as indicated in Fig. 5.4. Parcels shaded green are registered with DEED numbers while those in blue shade represent a noted proposal site with the N T numbers.

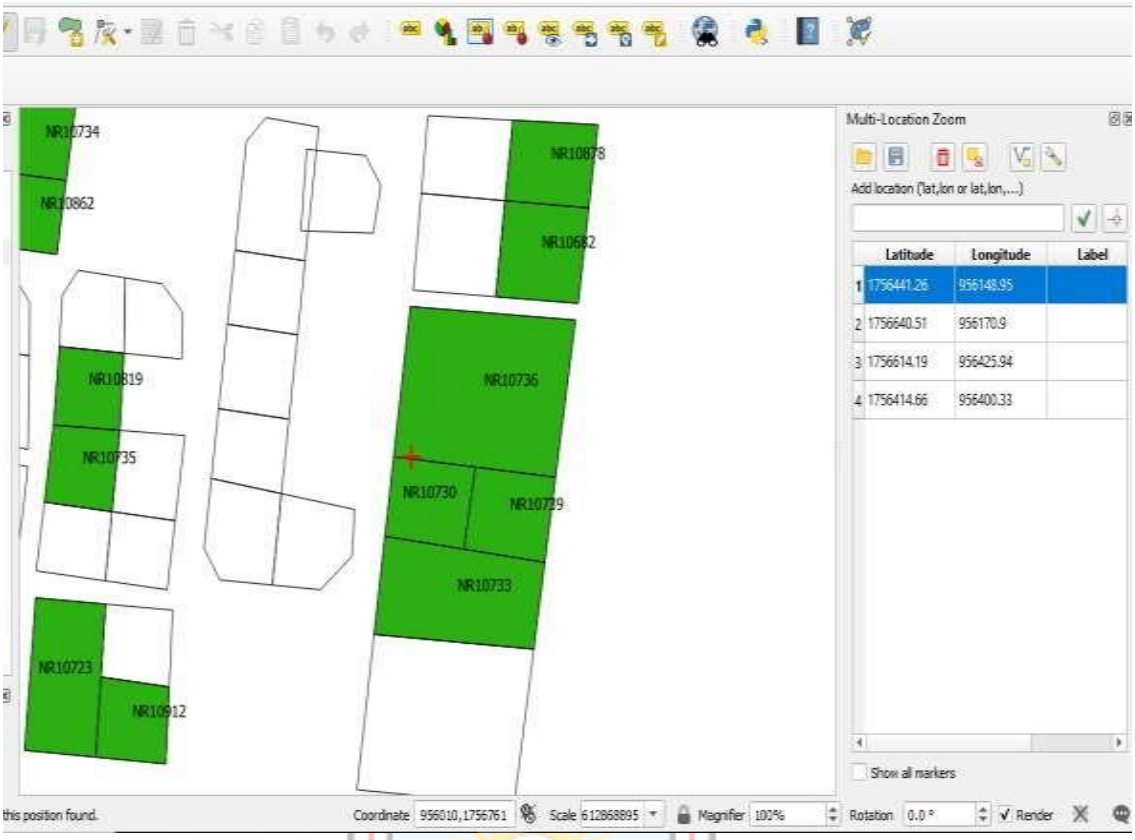



**Fig 5.3 Coordinate Entry**

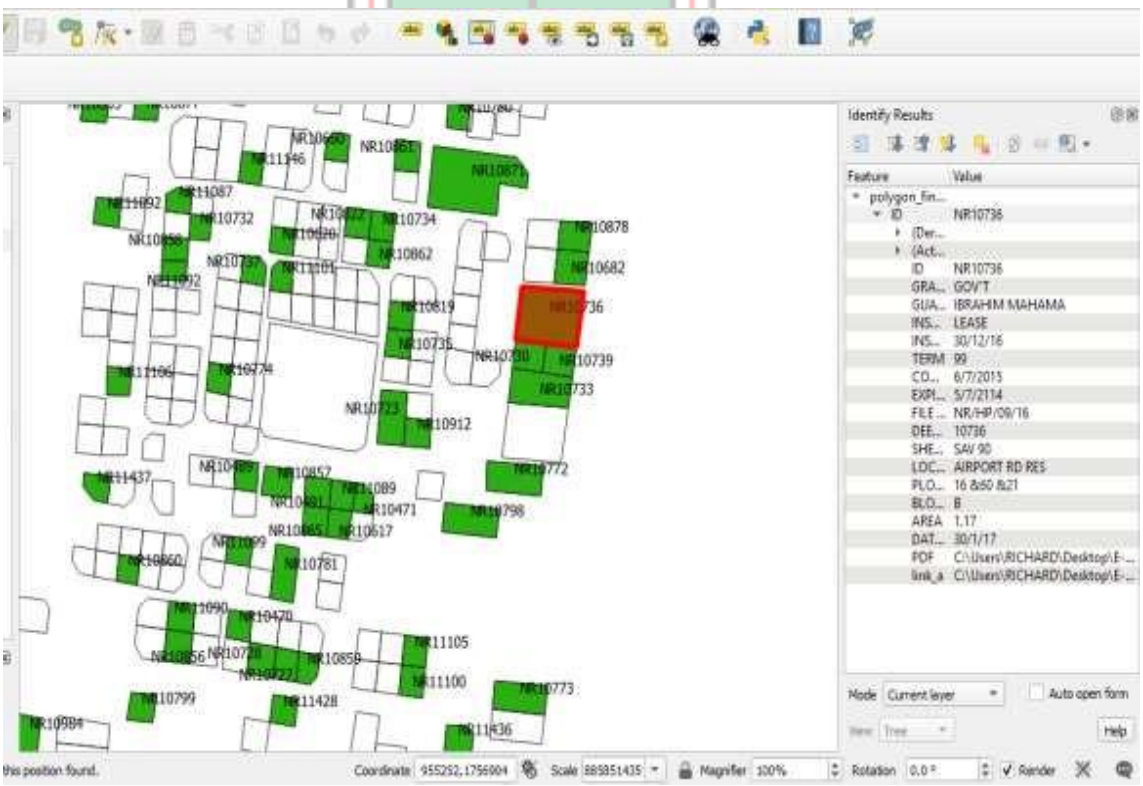



**Fig 5.4 Search Report Display**

## 5.4 View PDF

Fig 5.5 shows a pop-up of PDF of respective lease. The PDF pops-up after the run feature icon is clicked and further clicking on any of the registered parcels or polygons. The PDF allows for further verification in respect to the Deed Number, Lessor, Lessee, Date of the Agreement, Commencement and Expiration Dates, Acreage of the plot, Lease period and parties involved in the transaction and their signatures before the search report is finally printed.

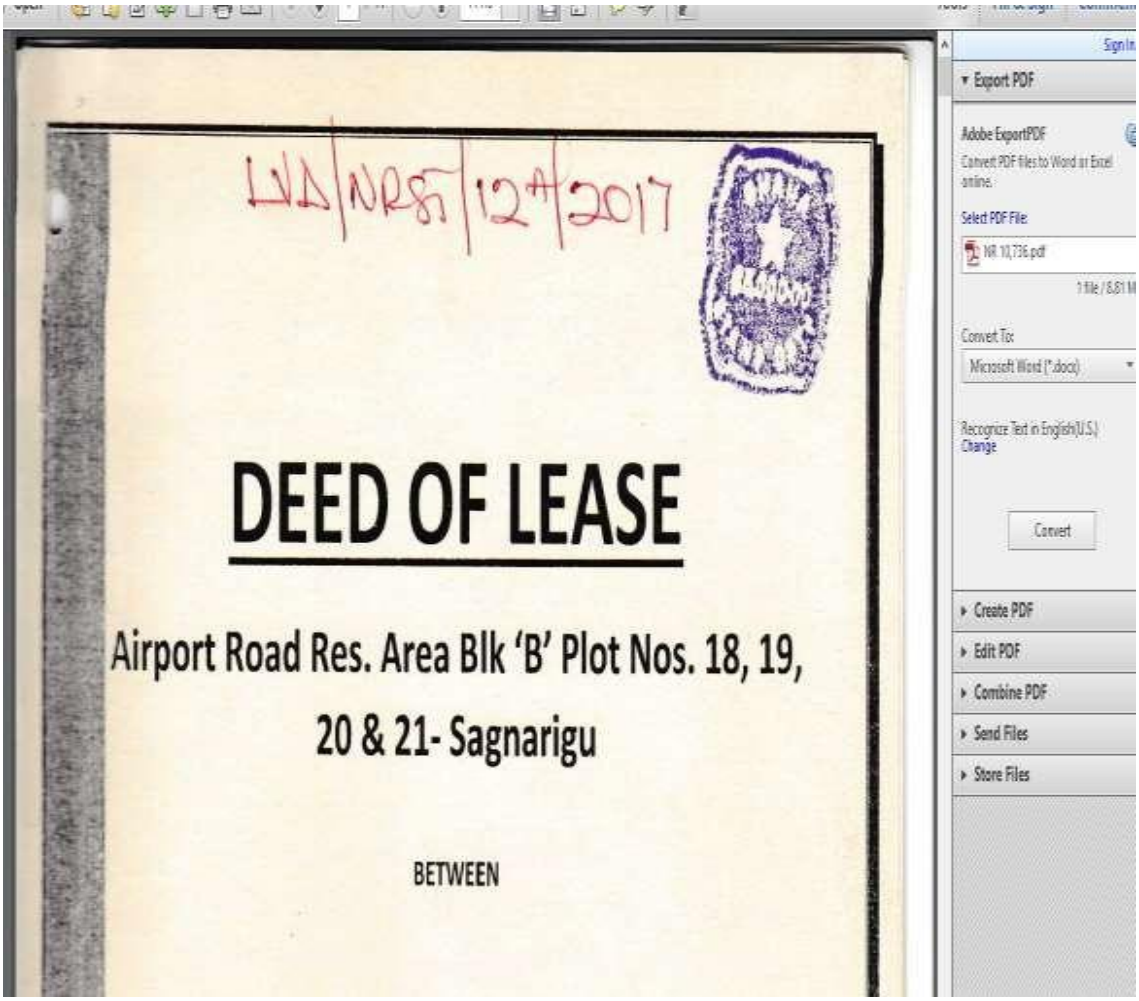



**Fig 5.5 PDF Pop-up**

## 5.5 View Layout

As shown in Fig 5.6, the digitized layout can also be viewed when necessary to ascertain the shape, size and even the adjoining plot of a particular site for further analyses when required.

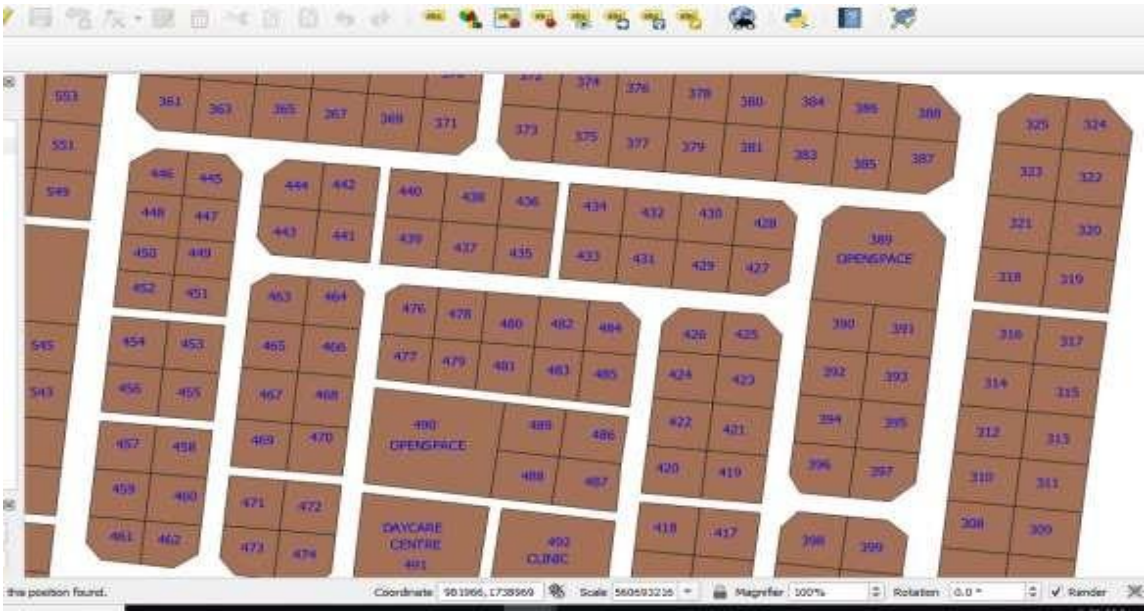



**Fig. 5.6 Layout View**

## 5.6 Updating Records

Finally, the map and the attribute can be updated by adding further parcels (polygon) and information (attributes) as and when a new document gets to records for proposal noting or plotting. Its respective attribute can also be edited or updated. All programming codes are shown in Appendix K. Fig 5.7 shows how new parcels can be added using their respective coordinates. Fig 5.8 displays an interface where attributes of any new added parcels are entered.

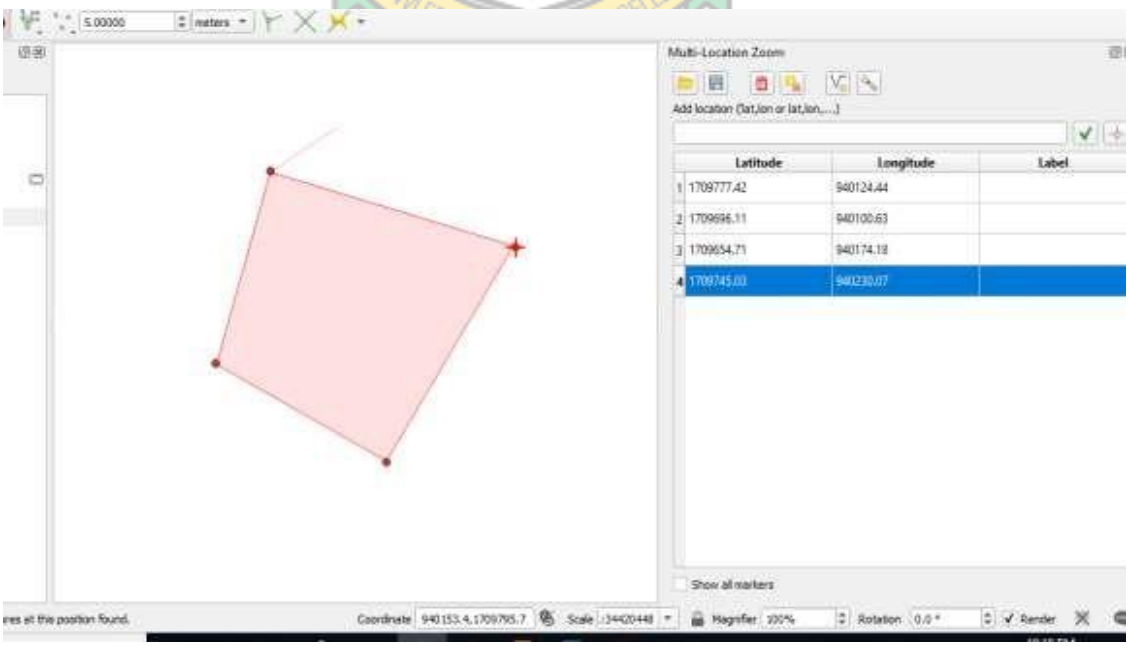



**Fig. 5.7 Updating Records by Coordinate**

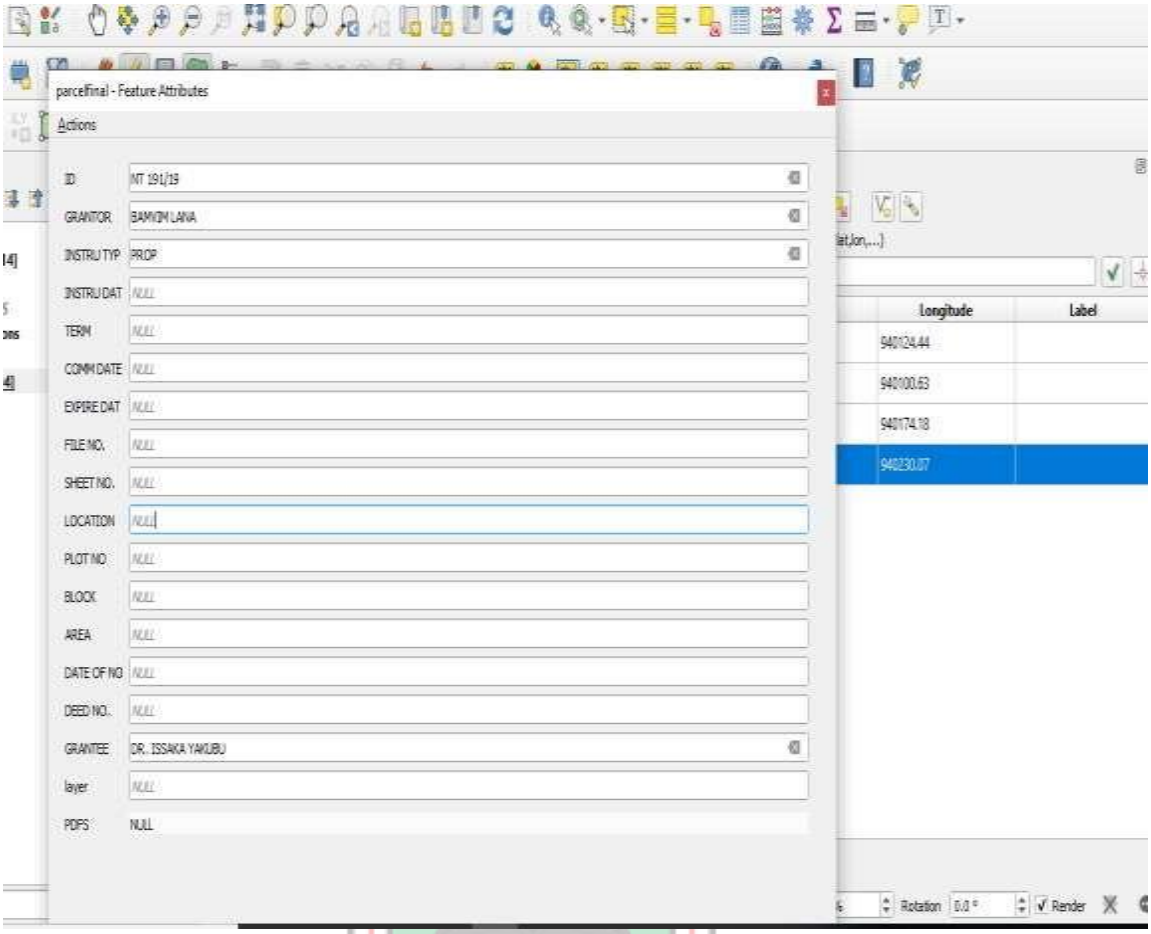



**Fig. 5.8 Entering Record Details (Attribute)**

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# CHAPTER 6

## CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Conclusions

These are the conclusions drawn at the end of the research:

i) A geodatabase was created from LC records of the study areas in Tamale. This could simplify the number of documents and eases difficulties that records staff go through in their daily duties.

ii) A QGIS based programme is developed to link all data and document in records, thus enabling search report be generated at a click of a button.

iii) The process of manually making entries on all maps, ledgers, and registers before a parcel can be updated is outdated now since the system enables easy update by just clicking a button and making few entries.

### 6.2 Recommendations

i) The age old long method of using papers, books and folders to keep land record is past, for the LC to become the center of excellence in land service delivery as its vision, modern method of keeping records in a digitized environment is required. It is therefore recommended that this work be adopted and further expanded to all regions by the LC to attract good appraisal from the public.

ii) Almost all Government initiatives to digitize the work of the LC fails, lots of scanning of town sheets and documents has been done with the same intension but none is successful. It is therefore recommended that all aspect of land data be digitized to enable trust and reliability in the Government land agencies. This would facilitate accelerated growth and development of the country since no development is attainable without land.

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# APPENDICES

## Appendix A: Primary Data (Site B)

| BEACON INDEX | | |
|---|---|---|
| Beacon | co-ordinates | |
| | X( Easterns )/Feet | Y( Northerns ) Feet |
| SGN/1 | 171 0806.51 | 939 571.40 |
| SGN/2 | 171 0695.62 | 939 652.30 |
| SGN/3 | 171 0630.44 | 939 572.86 |
| SGN/4 | 171 0741.65 | 939 492.60 |

## Appendix B: Data for Setting out (Site D)

| BEACON INDEX | | |
|---|---|---|
| Beacon | co-ordinates | |
| | X( Easterns ) / Feet | Y( Northerns ) / Feet |
| SGN/1 | 175 5784.25 | 953 795.70 |
| SGN/2 | 175 5764.29 | 953 898.93 |
| SGN/3 | 175 5518.50 | 953 847.23 |
| SGN/4 | 175 5543.76 | 953 741.15 |

## Data for Setting out (Site E)

| BEACON INDEX | | |
|---|---|---|
| Beacon | co-ordinates | |
| | X( Easterns ) / Feet | Y( Northerns ) / Feet |
| SGN/1 | 175 5217.15 | 956 036.32 |
| SGN/2 | 175 5199.92 | 956 253.41 |
| SGN/3 | 175 5094.16 | 956 240.61 |
| SGN/4 | 175 5115.52 | 956 026.37 |

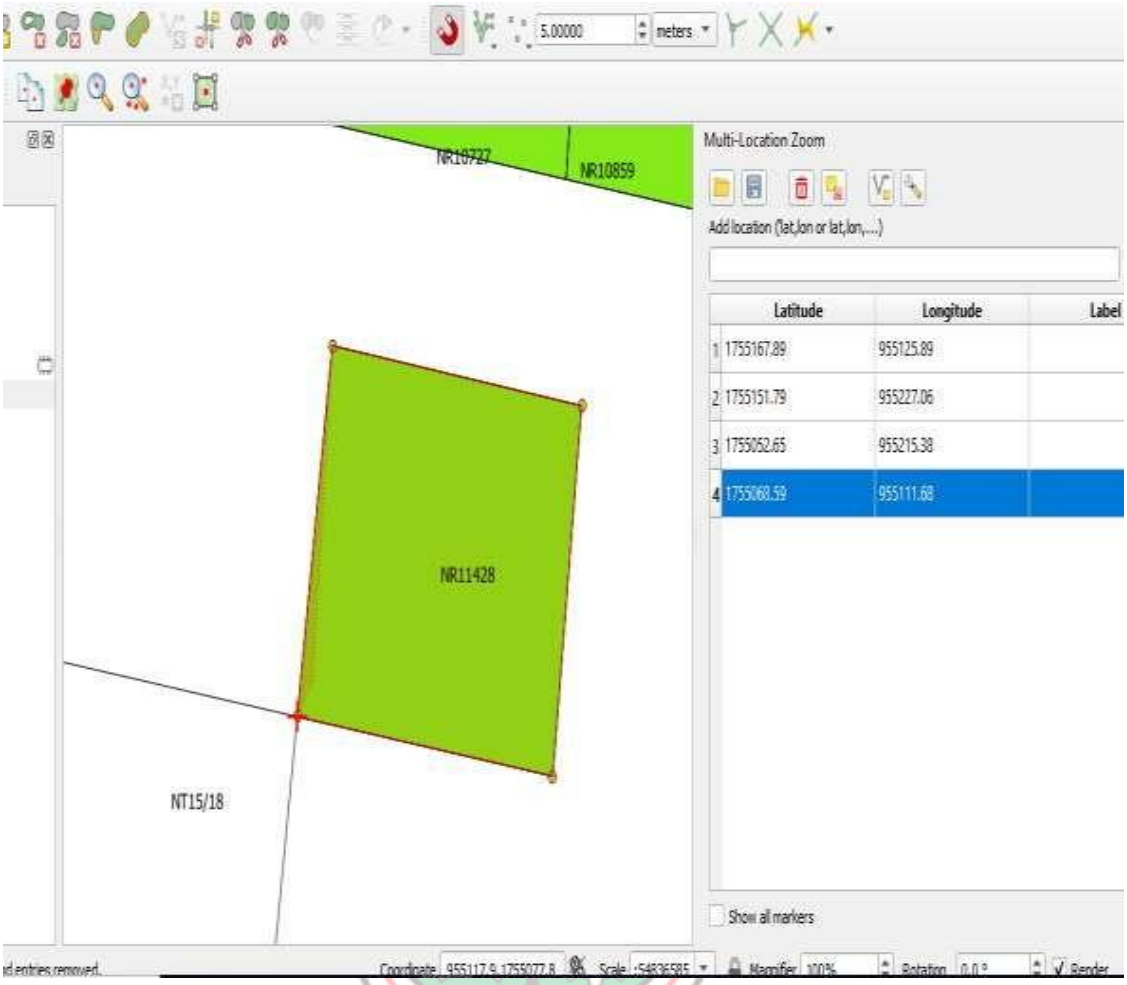
## Data for Setting out (Site F)

| BEACON INDEX | | |
|---|---|---|
| Beacon | co-ordinates | |
| | X( Easterns ) / Feet | Y( Northerns ) / Feet |
| SGN/1 | 170 8231.47 | 940 022.96 |
| SGN/2 | 170 8144.45 | 940 083.86 |
| SGN/3 | 170 8077.25 | 940 002.72 |
| SGN/4 | 170 8169.89 | 939 937.62 |

## Appendix C: Data for Ground Truthing (Site B)

| BEACON INDEX | | |
|---|---|---|
| Beacon | co-ordinates | |
| | X( Easterns ) / Feet | Y( Northerns ) / Feet |
| SGN/1 | 171 0806.51 | 939 571.40 |
| SGN/2 | 171 0695.62 | 939 652.30 |
| SGN/3 | 171 0630.44 | 939 572.86 |
| SGN/4 | 171 0741.65 | 939 492.60 |

## Appendix D: Overlay of Primary Data on Map for Validation

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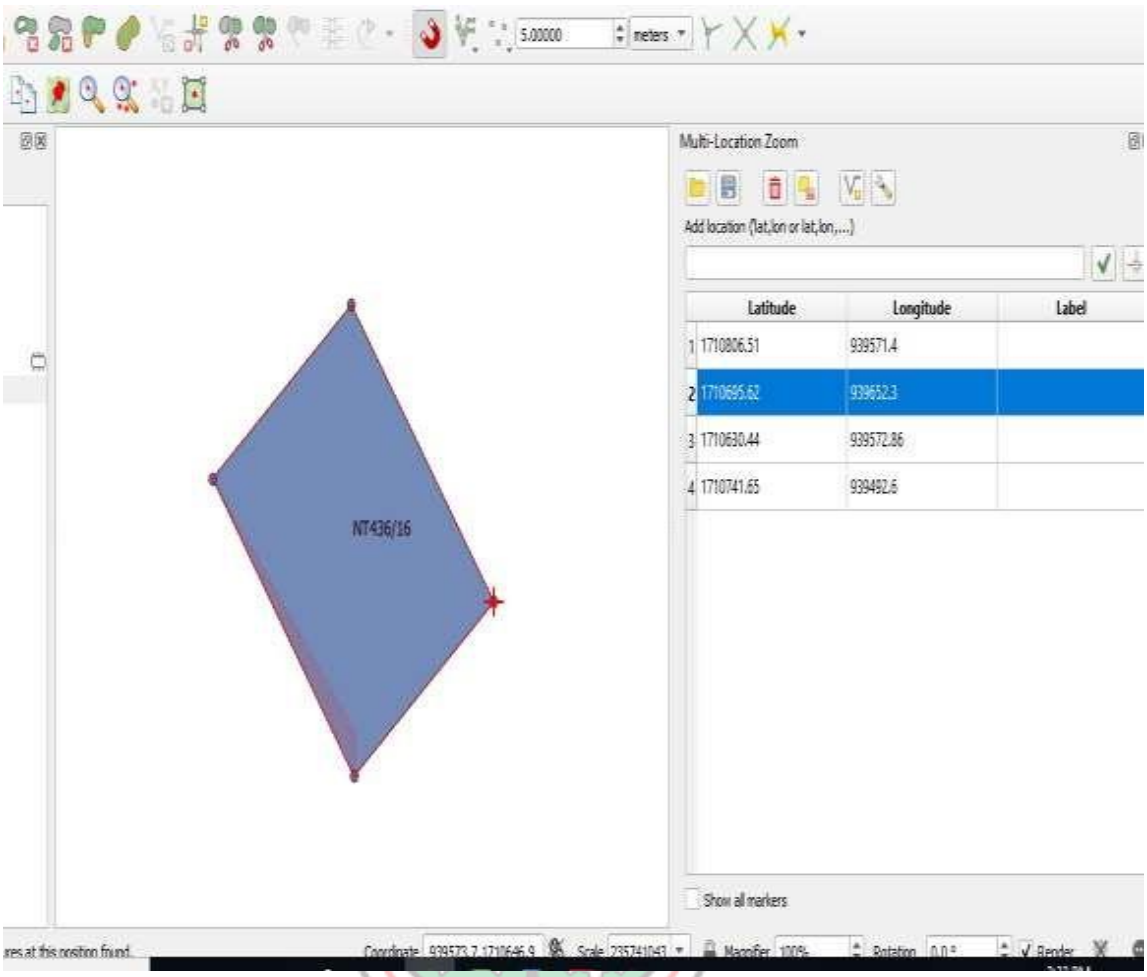
## Appendix D1: Overlay of Primary Data on Map for Validation

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## Appendix E: State of Some LC Layouts in Tamale Records

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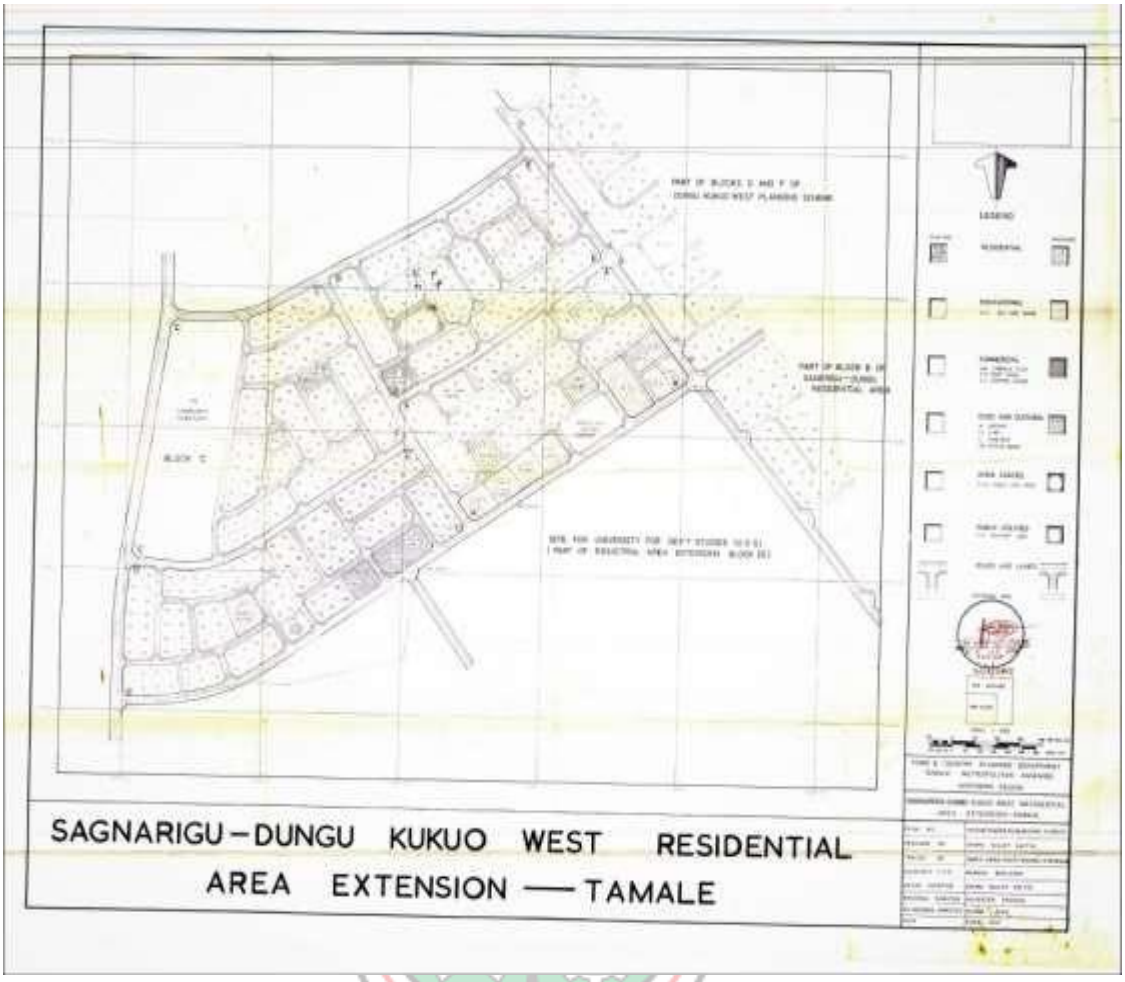
## Appendix F: State of Some LC Town Sheet in Tamale Records

## Appendix G: State of Some LC Layouts in Tamale Records

## Appendix H: Cabinet Filing of DEEDS

## Appendix I: Cabinet Filing of DEEDS

## Appendix J: Layout of Dungu Kukuo West Residential Area Extension

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## Appendix K: Code for the Programme Developed

### Script for Zoom to Coordinates

```
Python
__init__ file script
def classFactory(iface):
    from .latLonTools import
    LatLonTools return
    LatLonTools(iface)
import
os
import
re
from qgis.PyQt.uic import
loadUiType from qgis.PyQt.QtGui
import QIcon
from qgis.PyQt.QtWidgets import QDockWidget
from qgis.PyQt.QtCore import pyqtSignal,
QTextCodec from qgis.gui import QgsVertexMarker
from qgis.core import Qgis, QgsJsonUtils,
QgsWkbTypes from .LatLon import LatLon
from .util import *
#import
traceback from .
import mgrs
from . import
olc


FORM_CLASS, _ = loadUiType(os.path.join(
    os.path.dirname(__file__), 'ui/zoomToLatLon.ui'))
class ZoomToLatLon(QDockWidget, FORM_CLASS):
  def __init__(self, lltools, iface, parent):
      super(ZoomToLatLon, self).__init
      (parent) self.setupUi(self)
```

```
    self.canvas = iface.mapCanvas() self.marker = None
    self.zoomToolButton.setIcon(QIcon(':/images/themes/default/mActionZoomIn.svg
    '))
    self.clearToolButton.setIcon(QIcon(':/images/themes/default/mIconClearText.svg')
    ) self.zoomToolButton.clicked.connect(self.zoomToPressed)
    self.clearToolButton.clicked.connect(self.removeMarker)


    self.lltools = lltools
   self.settings = lltools.settingsDialog self.iface = iface
   self.coordTxt.returnPressed.connect(self.zoomToPressed)
   self.canvas.destinationCrsChanged.connect(self.crsChange
   d) self.configure()
 def showEvent(self,
         e):
   self.configure()
def closeEvent(self,
   event):
   self.removeMarker()
   event.accept()
         def
 crsChanged(self):
   if self.isVisible():
      self.configure()
 def is_number(self,
         s):
   try: float(s)
      return
      True
   except ValueError:
      return False
def
configure(self):
   self.coordTxt.setText("")
   if self.settings.zoomToProjIsMGRS():
```

```
        # This is an MGRS coordinate
        self.label.setText("Enter MGRS
        Coordinate")
    elif self.settings.zoomToProjIsPlusCodes():
        self.label.setText("Enter Plus Codes")
    elif self.settings.zoomToProjIsWgs84():
        if self.settings.zoomToCoordOrder == 0:
            self.label.setText("Enter 'Latitude, Longitude'")
        else:
            self.label.setText("Enter 'Longitude, Latitude'")
    elif self.settings.zoomToProjIsProjectCRS():
        crsID = self.canvas.mapSettings().destinationCrs().authid()

        if self.settings.zoomToCoordOrder == 0:
            self.label.setText("Enter {} Y,X".format(crsID))
        else:
            self.label.setText("Enter {} X,Y".format(crsID))
       else: # Default to custom
                    CRS
        crsID = self.settings.zoomToCustomCrsId()
        if self.settings.zoomToCoordOrder == 0:
            self.label.setText("Enter {} Y,X".format(crsID))
        else:
            self.label.setText("Enter {} X,Y".format(crsID))
                def
zoomToPressed(self):
    try:
        text = self.coordTxt.text().strip()
        if text[0] == '{': # This may be a GeoJSON point
            codec = QTextCodec.codecForName("UTF-8")
            fields = QgsJsonUtils.stringToFields(text,
            codec)
            fet = QgsJsonUtils.stringToFeatureList(text, fields, codec)
            if (len(fet) == 0) or not fet[0].isValid():
                raise ValueError('Invalid Coordinates')
```

```
    geom = fet[0].geometry()
    if geom.isEmpty() or (geom.wkbType() != QgsWkbTypes.Point):
        raise ValueError('Invalid GeoJSON Geometry')
    pt = geom.asPoint()
    lat = pt.y()
    lon = pt.x()
    srcCrs = epsg4326
elif self.settings.zoomToProjIsWgs84():
    if re.search(r'POINT\(', text) == None:
        lat, lon = LatLon.parseDMSString(text, self.settings.zoomToCoordOrder)
    else:
        m = re.findall(r'POINT\(\s*([+-]?\d*\.?\d*)\s+([+-]?\d*\.?\d*)', text)
        if len(m) != 1:
                raise ValueError('Invalid
                    Coordinates')

          lon = float(m[0][0])
        lat = float(m[0][1])
    srcCrs = epsg4326
elif self.settings.zoomToProjIsPlusCodes() and olc.isValid(text):
    # This looks like a Plus Codes
    coordinate coord = olc.decode(text)
    srcCrs = epsg4326
    lat = coord.latitudeCenter
    lon =
    coord.longitudeCenter
elif self.settings.zoomToProjIsMGRS():
    # This is an MGRS coordinate
    text = re.sub(r'\s+', '', str(text)) # Remove all white
    space lat, lon = mgrs.toWgs(text)
    srcCrs = epsg4326
else: # Is either the project or custom CRS
    if re.search(r'POINT\(', text) == None:
        coords = re.split(r'[\s,;:]+', text, 1)
        if len(coords) < 2:
```

```
                raise ValueError('Invalid Coordinates')
            if self.settings.zoomToCoordOrder == self.settings.OrderYX:
                lat = float(coords[0])
                lon = float(coords[1])
            else:
                lon = float(coords[0])
                lat = float(coords[1])
        else:
            m = re.findall(r'POINT\(\s*([+-]?\d*\.?\d*)\s+([+-]?\d*\.?\d*)', text)
            if len(m) != 1:
                raise ValueError('Invalid Coordinates')
            lon = float(m[0][0])
            lat = float(m[0][1])
        if self.settings.zoomToProjIsProjectCRS():
            srcCrs = self.canvas.mapSettings().destinationCrs()
        else:

            srcCrs = self.settings.zoomToCustomCRS()

        pt = self.lltools.zoomTo(srcCrs, lat, lon)
        if self.settings.persistentMarker:
            if self.marker is None:
                self.marker =
            QgsVertexMarker(self.canvas)
            self.marker.setCenter(pt)
            self.marker.setIconSize(18)
            self.marker.setPenWidth(2)
            self.marker.setIconType(QgsVertexMarker.ICON_CROSS)
        elif self.marker is not None:
            self.removeMarker();
    except:
        #traceback.print_exc()
        self.iface.messageBar().pushMessage("", "Invalid
Coordinate" , level=Qgis.Warning, duration=2)
```

```
            return
    def removeMarker(self):
        if self.marker is not None:
            self.canvas.scene().removeItem(self.mark
            er) self.marker = None
            self.coordTxt.clear()
```

**Icons**

**Zoom to Coordinates Dialog (xml coded)**

```
<?xml version="1.0" encoding="UTF-8"?>
<ui version="4.0">
 <class>ZoomToLatLonDockWidgetBase</class>
 <widget class="QDockWidget" name="ZoomToLatLonDockWidgetBase">
 <property name="geometry">
  <rect>
   <x>0</x>
   <y>0</y>
   <width>312</width>
   <height>101</height>
  </rect>
 </property>
 <property name="sizePolicy">
  <sizepolicy hsizetype="Preferred" vsizetype="Fixed">
   <horstretch>0</horstretch>
   <verstretch>0</verstretch>
  </sizepolicy>
 </property>
 <property name="windowTitle">
  <string>Zoom to Lat Lon</string>
 </property>
```

```
<widget class="QWidget" name="dockWidgetContents">
 <property name="sizePolicy">
  <sizepolicy hsizetype="Preferred" vsizetype="Fixed">
   <horstretch>0</horstretch>
   <verstretch>0</verstretch>
  </sizepolicy>
 </property>
 <layout class="QVBoxLayout" name="verticalLayout">
  <item>
   <layout class="QHBoxLayout" name="horizontalLayout">
    <property name="spacing">
     <number>5</number>
    </property>
    <item>
     <widget class="QLabel" name="label">
            <property
           name="text">
      <string>Enter Latitude, Longitude</string>


     </property>
     </widget>
    </item>
    <item>
     <widget class="QToolButton" name="zoomToolButton">
      <property name="toolTip">
       <string>Zoom To</string>
      </property>
      <property name="text">
       <string>...</string>
      </property>
     </widget>
    </item>
    <item>
     <widget class="QToolButton" name="clearToolButton">
      <property name="toolTip">
```

```
        <string>Clear Marker</string>
       </property>
       <property name="text">
        <string>...</string>
       </property>
      </widget>
     </item>
    </layout>
    </ite
     m>
    <ite
     m>
    <widget class="QLineEdit" name="coordTxt"/>
    </ite
     m>
   </layou
      t>
  </widge
      t>
 </widge
      t>
 <resources
       />
 <connections
        />
</ui>
```

**V.clean Tool (Python Coded)**

```
import
os
import
wx
import wx.lib.scrolledpanel as scrolled
from core.gcmd import RunCommand,
GError from core import globalvar
```

```
from core.utils import _
from gui_core.gselect import Select
from core.settings import
UserSettings from grass.script import
core as grass class
VectorCleaningFrame(wx.Frame):
    def __init__(
            self, parent, id=wx.ID_ANY,
        title=_('Set up vector cleaning
        tools'),
            style=wx.DEFAULT_FRAME_STYLE | wx.RESIZE_BORDER,
        **kwargs): """
        Dialog for interactively defining vector cleaning tools
        """
        wx.Frame.__init__(self, parent, id, title, style=style, **kwargs)
        self.parent = parent  #
        GMFrame if self.parent:
            self.log = self.parent.GetLogWindow()
        else:
            self.log = None
        # grass
        command
        self.cmd =
        'v.clean'
        # statusbar
        self.CreateStatusBa
        r()
        # icon
        self.SetIco
        n(
            wx.Icon(
                os.path.joi
                    n(
```

```
            globalvar.ICONDIR,
            'grass.ico'),
        wx.BITMAP_TYPE_ICO
        ))
self.panel = wx.Panel(parent=self, id=wx.ID_ANY)
# input map to
clean self.inmap =
"
# cleaned output
map self.outmap =
" self.ftype = "
# cleaning tools
self.toolslines = {}
self.tool_desc_list =
[
    _('break lines/boundaries'),
    _('remove duplicates'),
    _('remove dangles'),
    _('change boundary dangles to lines'),
    _('remove bridges'),
    _('change bridges to lines'),
    _('snap lines/boundaries'),
    _('remove duplicate area centroids'),
    _('break polygons'),
    _('prune lines/boundaries'),
    _('remove small areas'),
    _('remove lines/boundaries of zero length'),
    _('remove small angles at nodes')
]
self.tool_list =
          [
    'break',
    'rmdupl',
    'rmdangle',
```

```
    'chdangle',
    'rmbridge',
    'chbridge',
    'snap',
    'rmdac',
    'bpol',
    'prune',
    'rmarea',
    'rmline',
    'rmsa'
]
self.ftype = [
    'point',
    'line',
    'boundary',
    'centroid',
    'area',
    'face']

self.n_ftypes =
len(self.ftype)
self.tools_string = ''
self.thresh_string = ''
self.ftype_string = ''
self.SetStatusText(_("Set up vector cleaning tools"))
self.elem = 'vector'
self.ctlabel = _('Choose cleaning tools and set thresholds')
# top controls
self.inmaplabel = wx.StaticText(parent=self.panel,
                                id=wx.ID_ANY, label=_('Select input vector
                                map:'))
self.selectionInput = Select(parent=self.panel,
                             id=wx.ID_ANY,
```

```
                    size=globalvar.DIALOG_GSELECT_SIZE
                    , type='vector')
self.ftype_check = {}
ftypeBox = wx.StaticBox(parent=self.panel,
                id=wx.ID_ANY, label=_(' Feature type: '))
self.ftypeSizer = wx.StaticBoxSizer(ftypeBox, wx.HORIZONTAL)
self.outmaplabel = wx.StaticText(parent=self.panel,
                        id=wx.ID_ANY, label=_('Select output vector
                        map:'))

self.selectionOutput = Select(parent=self.panel, id=wx.ID_ANY,
                        size=globalvar.DIALOG_GSELECT_SIZE,
                        mapsets=[grass.gisenv()['MAPSET'], ],
                        fullyQualified=False,
                    type='vector')

self.overwrite = wx.CheckBox(
   parent=self.panel, id=wx.ID_ANY,
   label=_('Allow output files to overwrite existing files'))
self.overwrite.SetValu
   e( UserSettings.Get(
      group='cmd',
      key='overwrite',
      subkey='enabled'
      ))
# cleaning tools
self.ct_label = wx.StaticText(parent=self.panel,
                        id=wx.ID_ANY, label=self.ctlabel)
self.ct_panel = self._toolsPanel()
# buttons to manage cleaning tools
self.btn_add = wx.Button(parent=self.panel, id=wx.ID_ADD)
self.btn_remove = wx.Button(parent=self.panel,
id=wx.ID_REMOVE) self.btn_moveup =
```

```
wx.Button(parent=self.panel, id=wx.ID_UP) self.btn_movedown =
wx.Button(parent=self.panel, id=wx.ID_DOWN)
# add one tool as
default self.AddTool()
self.selected = -1
# Buttons
self.btn_close = wx.Button(parent=self.panel, id=wx.ID_CLOSE)
self.btn_run =
    wx.Button(
    parent=self.panel,
    id=wx.ID_ANY,
    label=_("&Run"))
self.btn_run.SetDefault()
self.btn_clipboard = wx.Button(parent=self.panel, id=wx.ID_COPY)

self.btn_clipboard.SetToolTipString(
    _("Copy the current command string to the clipboard (Ctrl+C)"))
self.btn_help = wx.Button(parent=self.panel, id=wx.ID_HELP)
# bindings
self.btn_close.Bind(wx.EVT_BUTTON, self.OnClose)
self.btn_run.Bind(wx.EVT_BUTTON, self.OnCleaningRun)
self.btn_clipboard.Bind(wx.EVT_BUTTON, self.OnCopy)
self.btn_help.Bind(wx.EVT_BUTTON, self.OnHelp)
self.btn_add.Bind(wx.EVT_BUTTON, self.OnAddTool)
self.btn_remove.Bind(wx.EVT_BUTTON, self.OnClearTool)
self.btn_moveup.Bind(wx.EVT_BUTTON, self.OnMoveToolUp)
self.btn_movedown.Bind(wx.EVT_BUTTON,
self.OnMoveToolDown)
# layout self._layout()
self.SetMinSize(self.GetBestSize(
)) self.CentreOnScreen()
    def
_layout(self):
sizer = wx.BoxSizer(wx.VERTICAL)
```

```
#
# input output
#
inSizer = wx.GridBagSizer(hgap=5, vgap=5)
inSizer.Add(
    item=self.inmaplabe
    l, pos=(
        0
        ,
        0
        ),
    flag=wx.ALIGN_CENTER_VERTICAL | wx.ALL |
    wx.EXPAND, border=1)
inSizer.Add(
    item=self.selectionInpu
    t, pos=(
        1
        ,
        0
        ),
```

```
    flag=wx.ALIGN_CENTER_VERTICAL | wx.ALL |
    wx.EXPAND, border=1)

self.ftype_check = [
    wx.CheckBox(parent=self.panel, id=wx.ID_ANY, label=_('point')),
    wx.CheckBox(parent=self.panel, id=wx.ID_ANY, label=_('line')),
    wx.CheckBox(parent=self.panel, id=wx.ID_ANY,
    label=_('boundary')), wx.CheckBox(parent=self.panel,
    id=wx.ID_ANY, label=_('centroid')),
    wx.CheckBox(parent=self.panel, id=wx.ID_ANY, label=_('area')),
    wx.CheckBox(parent=self.panel, id=wx.ID_ANY, label=_('face'))
]
typeoptSizer = wx.BoxSizer(wx.HORIZONTAL)
for num in range(0, self.n_ftypes):
    type_box = self.ftype_check[num]
    if self.ftype[num] in ('point', 'line', 'area'):
        type_box.SetValue(True)
    typeoptSizer.Add(item=type_box, flag=wx.ALIGN_LEFT, border=1)
self.ftypeSizer.Add(item=typeoptSizer,
                    flag=wx.ALIGN_CENTER_VERTICAL | wx.ALL,
                    border=2)
outSizer = wx.GridBagSizer(hgap=5, vgap=5)
outSizer.Add(
    item=self.outmaplabe
    l, pos=(
        0,
        0),
    flag=wx.ALIGN_CENTER_VERTICAL | wx.ALL |
    wx.EXPAND, border=1)
outSizer.Add(
    item=self.selectionOutpu
    t, pos=(
        1,
        0),
```

```
    flag=wx.ALIGN_CENTER_VERTICAL | wx.ALL |
    wx.EXPAND, border=1)

    replaceSizer = wx.BoxSizer(wx.HORIZONTAL)
replaceSizer.Add(item=self.overwrite,
                 proportion=1, flag=wx.ALL |
                 wx.EXPAND, border=1)
outSizer.Add(item=replaceSizer, pos=(2, 0),
             flag=wx.ALL | wx.EXPAND, border=1)
#
# tools selection
#
bodySizer = wx.GridBagSizer(hgap=5, vgap=5)
bodySizer.Add(item=self.ct_label, pos=(0, 0), span=(1,
              2), flag=wx.ALL, border=5)
bodySizer.Add(item=self.ct_panel, pos=(1, 0), span=(1, 2))
manageBoxSizer = wx.GridBagSizer(hgap=10, vgap=1)
# start with row 1 for nicer
layout manageBoxSizer.Add(
    item=self.btn_add, pos=(1, 0),
    border=2, flag=wx.ALL | wx.EXPAND)
manageBoxSizer.Add(
    item=self.btn_remove, pos=(2, 0),
    border=2, flag=wx.ALL |
    wx.EXPAND)
manageBoxSizer.Add(
    item=self.btn_moveup, pos=(3, 0),
    border=2, flag=wx.ALL |
    wx.EXPAND)
manageBoxSizer.Add(
    item=self.btn_movedown, pos=(4, 0),
    border=2, flag=wx.ALL |
    wx.EXPAND)
```

```
bodySizer.Add(item=manageBoxSizer, pos=(1, 2),
              flag=wx.EXPAND | wx.LEFT | wx.RIGHT,
              border=5)
bodySizer.AddGrowableCol(2)
#
# standard buttons
#
btnSizer = wx.BoxSizer(wx.HORIZONTAL)
btnSizer.Add(self.btn_close,

flag=wx.LEFT | wx.RIGHT, border=5)
btnSizer.Add(self.btn_run,
             flag=wx.LEFT | wx.RIGHT, border=5)
btnSizer.Add(self.btn_clipboard,
             flag=wx.LEFT | wx.RIGHT, border=5)
btnSizer.Add(self.btn_help,
             flag=wx.LEFT | wx.RIGHT, border=5)
#
# put it all together
#
sizer.Add(item=inSizer, proportion=0,
          flag=wx.ALL | wx.EXPAND,
          border=5)
sizer.Add(item=self.ftypeSizer,
          proportion=0, flag=wx.ALL |
          wx.EXPAND, border=5)
sizer.Add(item=outSizer, proportion=0,
          flag=wx.ALL | wx.EXPAND,
          border=5)
sizer.Add(item=wx.StaticLine(parent=self, id=wx.ID_ANY,
                             style=wx.LI_HORIZONTAL),
                             proportion=0,
          flag=wx.EXPAND | wx.ALL, border=5)
```

```
    sizer.Add(item=bodySizer, proportion=1,
              flag=wx.ALL | wx.EXPAND,
              border=5)
    sizer.Add(item=wx.StaticLine(parent=self, id=wx.ID_ANY,
                                 style=wx.LI_HORIZONTAL),
                                 proportion=0,
              flag=wx.EXPAND | wx.ALL, border=5)
    sizer.Add(item=btnSizer, proportion=0,
              flag=wx.ALL | wx.ALIGN_RIGHT,
    border=5) self.panel.SetAutoLayout(True)
    self.panel.SetSizer(sizer)
    sizer.Fit(self.panel)
    self.Layout()
def _toolsPanel(self):
    ct_panel = scrolled.ScrolledPanel(parent=self.panel,
                                      id=wx.ID_ANY, size=(500, 240),
                                      style=wx.SUNKEN_BORDER)


                                      self.ct_sizer = wx.GridBagSizer(vgap=2, hgap=4)
                                      ct_panel.SetSizer(self.ct_sizer) ct_panel.SetAutoLayout(True)
    return ct_panel
def OnAddTool(self, event):
    """Add tool button
    pressed""" self.AddTool()
          def
  AddTool(self):
    snum = len(self.toolslines.keys())
    num = snum + 1
    # tool
    tool_cbox = wx.ComboBox(parent=self.ct_panel, id=1000 +
                            num, size=(300, -1), choices=self.tool_desc_list,
                            style=wx.CB_DROPDOWN |
                            wx.CB_READONLY | wx.TE_PROCESS_ENTER)
    self.Bind(wx.EVT_COMBOBOX, self.OnSetTool, tool_cbox)
    # threshold
```

```
txt_ctrl = wx.TextCtrl(
    parent=self.ct_panel, id=2000 + num, value='0.00', size=(100, -
    1), style=wx.TE_NOHIDESEL)
self.Bind(wx.EVT_TEXT, self.OnThreshValue, txt_ctrl)

# select with tool
number select =
wx.CheckBox(
    parent=self.ct_pane
    l, id=num,
    label=str(num) +
    '.')
select.SetValue(False)
self.Bind(wx.EVT_CHECKBOX, self.OnSelect, select)

# start with row 1 and col 1 for nicer
layout self.ct_sizer.Add(item=select,
pos=(num, 1),
                         flag=wx.ALIGN_CENTER |
                              wx.RIGHT)
self.ct_sizer.Add(item=tool_cbox, pos=(num, 2),


flag=wx.ALIGN_CENTER | wx.RIGHT, border=5)
self.ct_sizer.Add(item=txt_ctrl, pos=(num, 3),
                  flag=wx.ALIGN_CENTER | wx.RIGHT,
                  border=5)

self.toolslines[num] = {'tool_desc': '',
                        'tool':
                          '',
                        'thresh':
'0.00'}
self.ct_panel.Layout()
```

```
    self.ct_panel.SetupScrolling
    ()
def OnClearTool(self, event):
    """Remove tool button
    pressed""" id = self.selected

    if id > 0:
        self.FindWindowById(id +
        1000).SetValue('')
        self.toolslines[id]['tool_desc'] = ''
        self.toolslines[id]['tool'] = ''
        self.SetStatusText(
            _("%s. cleaning tool removed, will be ignored") %
            id)
    else:
        self.SetStatusText(_("Please select a cleaning tool to remove"))
def OnMoveToolUp(self, event):
    """Move up tool button
    pressed""" id = self.selected

    if id > 1:
        id_up = id - 1
        this_toolline = self.toolslines[id] up_toolline
        = self.toolslines[id_up]
        self.FindWindowById(id_up).SetValue(Tru
        e) self.FindWindowById(
            id_up +
            1000).SetValue(
```

```
            this_toolline['tool_desc'])
        self.FindWindowById(id_up +
        2000).SetValue(this_toolline['thresh']) self.toolslines[id_up] =
        this_toolline self.FindWindowById(id).SetValue(False)
        self.FindWindowById(id +
        1000).SetValue(up_toolline['tool_desc']) self.FindWindowById(id
        + 2000).SetValue(up_toolline['thresh']) self.toolslines[id] =
        up_toolline
        self.selected = id_up
        self.SetStatusText(_("%s. cleaning tool moved up") % id)
    elif id == 1:
        self.SetStatusText(_("1. cleaning tool cannot be moved up "))
    elif id == -1:
        self.SetStatusText(_("Please select a cleaning tool to move up"))
def OnMoveToolDown(self, event):
    """Move down tool button
    pressed""" id = self.selected
    snum = len(self.toolslines.keys())
    if id > 0 and id < snum:
        id_down = id + 1
        this_toolline = self.toolslines[id]
        down_toolline = self.toolslines[id_down]
        self.FindWindowById(id_down).SetValue(Tru
        e) self.FindWindowById(
            id_down +
            1000).SetValue(
            this_toolline['tool_desc'])
        self.FindWindowById(
            id_down +
            2000).SetValue(
            this_toolline['thresh'])
        self.toolslines[id_down] = this_toolline

        self.FindWindowById(id).SetValue(False)
```

```
        self.FindWindowById(id + 1000).SetValue(down_toolline['tool_desc'])

        self.FindWindowById(id + 2000).SetValue(down_toolline['thresh'])
        self.toolslines[id] =
        down_toolline self.selected =
        id_down
        self.SetStatusText(_("%s. cleaning tool moved down") % id)
    elif id == snum:
        self.SetStatusText(_("Last cleaning tool cannot be moved down "))
    elif id == -1:
        self.SetStatusText(_("Please select a cleaning tool to move down"))

def OnSetTool(self,
    event): """Tool was
    defined""" id =
    event.GetId() tool_no
    = id - 1000
    num = self.FindWindowById(id).GetCurrentSelection()
    self.toolslines[tool_no]['tool_desc'] =
    self.tool_desc_list[num] self.toolslines[tool_no]['tool'] =
    self.tool_list[num]

    self.SetStatusText(
        str(tool_no) +
        '. ' +
        _("cleaning tool: '%s'")
        % (self.tool_list[num]))
def OnThreshValue(self, event):
    """Threshold value was
    entered""" id = event.GetId()
    num = id - 2000
    self.toolslines[num]['thresh'] = self.FindWindowById(id).GetValue()
```

```
    self.SetStatusText(
      _("Threshold for %(num)s. tool '%(tool)s': %(thresh)s") % {
        'num': num,
        'tool': self.toolslines[num]['tool'],
        'thresh': self.toolslines[num]['thresh']})


        def OnSelect(self, event): """Tool was selected""" id = event.GetId()

    if self.selected > -1 and self.selected != id:
      win =
      self.FindWindowById(self.selected)
      win.SetValue(False)
    if self.selected != id:
      self.selected =
    id else:
      self.selected = -1


def         OnDone(self,
    event): """Command
    done"""
    self.SetStatusText('')

def OnCleaningRun(self, event):
    """Builds options and runs
    v.clean """
    self.GetCmdStrings()


    err = list()
    for p, name in ((self.inmap, _('Name of input vector
                map')), (self.outmap, _('Name for output vector
                map')), (self.tools_string, _('Tools')),
                (self.thresh_string, _('Threshold'))):
      if not p:
        err.append(_("'%s' not defined") % name)
```

KNOWLEDGE, TRUTH AND EXCELLENCE

```
if err:
    GError(_("Some parameters not defined. Operation
            " "canceled.\n\n%s") % '\n'.join(err),
           parent=self)
    return

    self.SetStatusText(_("Executing selected cleaning operations..."))
snum = len(self.toolslines.keys())

if self.log:
    cmd = [self.cmd,
           'input=%s' % self.inmap,
           'output=%s' % self.outmap,
           'tool=%s' % self.tools_string,
           'thres=%s' % self.thresh_string]
    if self.ftype_string:
        cmd.append('type=%s' % self.ftype_string)
    if self.overwrite.IsChecked():
        cmd.append('--overwrite')

    self.log.RunCmd(cmd, onDone=self.OnDone)
    self.parent.Raise()
else:
    if self.overwrite.IsChecked():
        overwrite =
    True else:
        overwrite = False
    RunCommand(self.cmd,
               input=self.inmap,
               output=self.outmap,
               type=self.ftype_string,
               tool=self.tools_string,
               thresh=self.thresh_strin
               g, overwrite=overwrite)
```

```
    def OnClose(self,
            event):
        self.Destroy()
    def OnHelp(self, event):
        """Show GRASS manual
        page"""
        RunCommand('g.manual',
                quiet=True,

                parent=self, entry=self.cmd)
    def OnCopy(self, event):
        """Copy the command"""
        cmddata =
        wx.TextDataObject()
        # get tool and thresh strings
        self.GetCmdStrings()
        cmdstring = '%s' %
        (self.cmd)
        # list -> string
        cmdstring += ' input=%s output=%s type=%s tool=%s thres=%s' % (
            self.inmap, self.outmap, self.ftype_string, self.tools_string, self.thresh_string)
        if self.overwrite.IsChecked():
            cmdstring += ' --overwrite'

        cmddata.SetText(cmdstring)
        if wx.TheClipboard.Open():
            wx.TheClipboard.SetData(cmddat
            a) wx.TheClipboard.Close()
            self.SetStatusText(
                _("Vector cleaning command copied to clipboard"))
    def
        GetCmdStrings(self)
        : self.tools_string = ''
```

```
        self.thresh_string = ''
        self.ftype_string = ''
        # feature
        types first =
        1
        for num in range(0, self.n_ftypes - 1):
            if self.ftype_check[num].IsChecked():
                if first:
                    self.ftype_string = '%s' % self.ftype[num]
                    first =
                0 else:
                    self.ftype_string += ',%s' % self.ftype[num]

                    # cleaning tools first = 1
        snum = len(self.toolslines.keys())
        for num in range(1, snum + 1):
                            if
            self.toolslines[num]['tool']:
                        if
                    first:
                        self.tools_string = '%s' % self.toolslines[num]['tool']
                        self.thresh_string = '%s' %
                        self.toolslines[num]['thresh'] first = 0
                    else:
                        self.tools_string += ',%s' % self.toolslines[num]['tool']
                        self.thresh_string += ',%s' % self.toolslines[
                            num]['thres
                                h']


        self.inmap = self.selectionInput.GetValue()
        self.outmap = self.selectionOutput.GetValue()
if __name__ == '__main__':
    app = wx.App()
    frame = VectorCleaningFrame(parent=None)
    frame.Show()
```

app.MainLoop()

**Linking PDFs to Polygons((Python Coded)**

from os import startfilefrom os.path import abspath, dirname,

join proj = QgsProject.instance()

urfile = str(proj.fileName())

path = join(abspath(dirname(urfile)), "HyperlinksTest", "[% PDF %]")

startfile(path)

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