International Journal of Innovative Research and Review ISSN: 2347 – 4424 (Online)
An Online International Journal Available at http://www.cibtech.org/jirr.htm
2016 Vol. 4 (3) July-September, pp.55-65/Govindu et al.
Research Article

DEVELOPMENT OF A GIS-BASED LAND REGISTRY SYSTEM

***Vanum Govindu[1], Kidu Gebremedhin[2] and Desta Luel Tsegay[3]**
[1]Department of GEOS for Natural Resource Management, Institute of Geo-Information and Earth Observation Sciences, Mekelle University, Ethiopia
[2]Woreda Coordinator, Ukaid, Land Investment for Transformation (LIFT) Program, Mekelle, Ethiopia
[3]Abbiyi Addi College of Teachers Education and Educational Leadership, Department of Computer Science, Temben-Abbiyi Addi, Ethiopia
**Author for Correspondence*

ABSTRACT
Rural land management is a challenging task to many developing countries, due to limited financial and technological resources. This is a serious problem too in Ethiopia in general, and in Seharti Samre in particular. Seharti Samre suffers from the lack of advanced techniques that help and support land registration using GIS technology. The currently-used-system for land registration in the Seharti Samre is extremely traditional, takes long processing time and not able to meet the increasing demand. Conflicts among data on maps and on ground are frequently faced and decisions relating to these problems cannot easily be made. Such an out of date system leads to difficulties in tracking and updating land owners and identifying the actual current owners. This study was conducted to assess the existing land registration techniques in Seharti Samre and to exploit the use of Geographic Information Systems (GIS) based land registration techniques. Methods included on the one hand the use of PostgreSQL to create a geospatial database that will store land holding details in a database format for textual data; and on the other hand the use of the Open Geospatial Consortium (OGC) standard's Web Map Service (WMS) for easy registration, management and user friendly interface. A prototype of the system has been developed and tested; and its relevance was validated by users in Seharti Samre. The study showed that with the use GIS technologies, rural land registration can be significantly improved.

Keywords: *Land Registration System, Web-Based GIS, Seharti Samre, Ethiopia*

INTRODUCTION
Land is a fundamental factor for agriculture production and is thus directly linked to food security. Land is one of the main sources of collateral, used to obtain credit from established financial institutions and is the major asset in any economy and can often account for between half to three-quarters of national wealth (Bell, 2009). In any country, reform of land management is a major investment of capital and human resources and requires strong and consistent leadership in order to achieve effective, sustainable outcomes.

Various land management initiatives to reform the land management systems in Indian reserves have been introduced by the federal government since 1973, when Aboriginal rights were first recognized legally in Canada (Rakai and Nichols, 2002). Good land administration creates accurate, accessible, interoperable, timely, secure, and complete information about land and property in an affordable and efficient way that promotes confidence between the public, its commercial enterprises, and government.

The need to record and manage lands forced us to create a system to order, control, and manage land parcels and its information, that system was Land Registration System. Very similar topic is cadastres, which defined as an official record of information about land parcels, including details of their bounds, tenure, usage, and value (McLaughlin and Nichols, 1989; Sagashya, 2012).

Land registration is a process of official recording of rights in land through deeds on the properties. It means that there is an official record (the land register) of rights on land or of deeds concerning changes in the legal situation of defined units of land. It gives an answer to the question "who" and "how". Land registration always refers to a legal and official registration, so you can know who owns a certain property (Zevenbergen, 2004; Hailu, 2006).

GIS incorporates all types of land and geographic information to enable land administration professionals to make informed decisions. Leveraging geodatabase technology, open standards, cloud computing, extensive worldwide data and high-resolution imagery, global map libraries, and mobile technology, GIS provides the essential infrastructure backbone for successful land management systems (McLaughlin and Nichols, 1989).

The three outlined perspectives of GIS (mapping, database populating and spatial analysis), which can support Aboriginal land management: 1) Using the GIS mapping function, the external boundaries of Aboriginal title can be delineated 2) Using the spatial database function, the GIS can be used to store and manage both spatial and textual information pertaining to Aboriginal title. Many land claim applications lodged with the federal court highlight the need for appropriate database facilities and 3) The GIS spatial analysis functions can be used to analyze land tenure information and determine "gaps" and "overlaps" of Aboriginal title claims (Maguire and Dangermond, 1991).

The main problems encountered in Seharti samre rural land management office is administering the land out of the rules, regulations and proclamations, and lack of modern and systematic land information and documentation. This is fundamentally due to that there is no centrally maintained database that provides integrated information accesses services for decision makers or land developers. Some data collected by different governmental organizations for the same area are collected in disorganized fashion with possibly different projection and this makes full information gathering impossible others are in textual form.

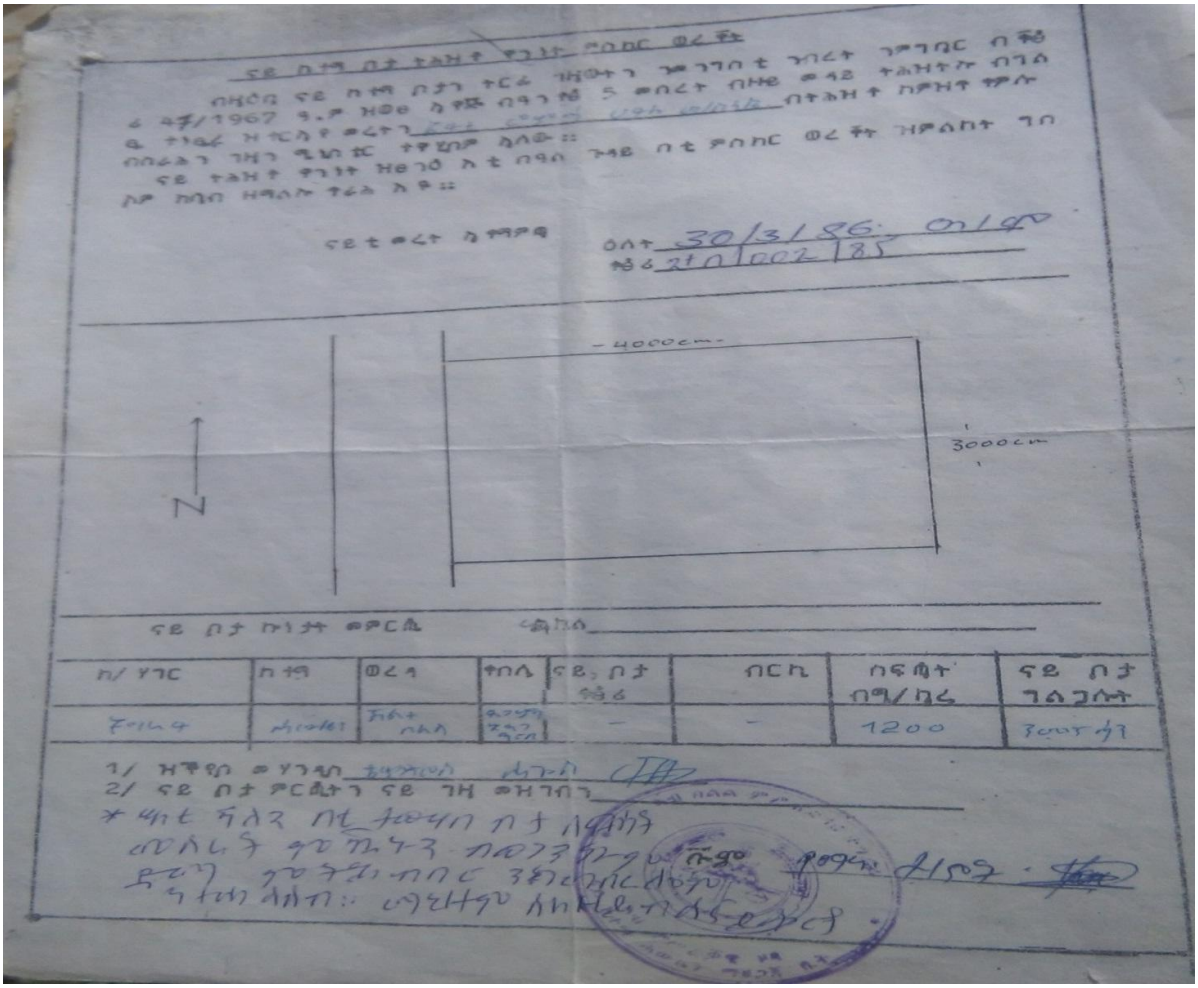

Figure 1: Existing Land Registration Technique in Seharti Samre (From Land Administration Office

Information like land use type, metrological data, soil type topology and geological data, water sources (rivers and lakes), roads and water prospects with similar geographic projection. Information gathering from large area by field trips is costly. Investors and land developers spend a lot of money for field trips to undergo preliminary information gathering. Such an out of date system leads to difficulties in tracking and updating land owners and identifying the actual current owners and there is no gender equality in ownership. The sectors are faced low productivity and investment.

Therefore, GIS based land registration technique maintains the official records pertaining to land parcel details, their exact location, shape, size, land use, land fertility and ownership which facilitates taxation and investment by providing full information in centralized way in Woreda Seharti Samre.

System Development

The system was developed based on the waterfall methodology consisting of the following phases:

- Planning Phase
- Requirement Analysis Phase
- Physical and Logical Design Phase
- Implementation and Testing Phase
- Usage and Maintenance Phase

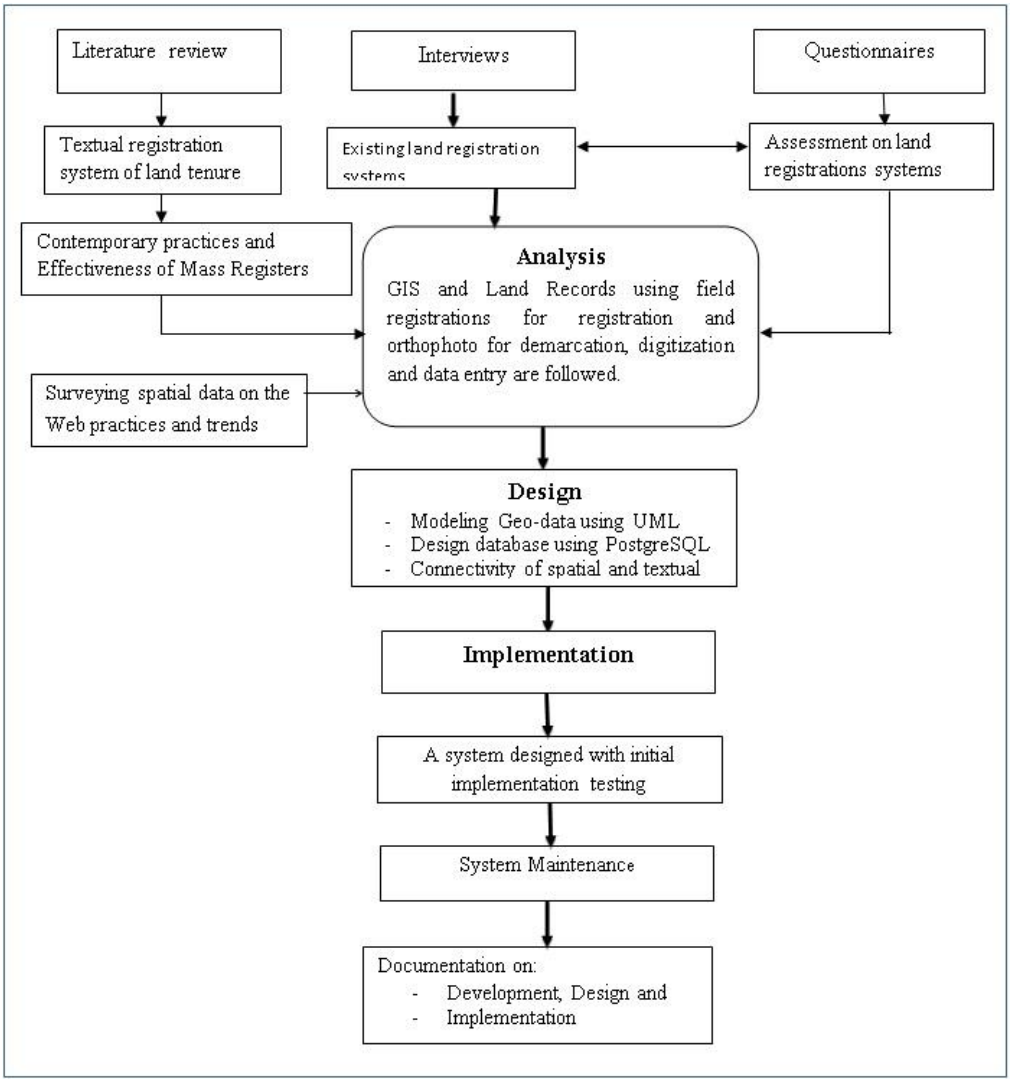

Figure 2: Flow Chart of Research Methodology

Table 1: Brief Explanation of each Phase for GIS Based Land Registration Techniques

R. No	Phases	Activities
1	Requirement Analysis	– Literature review on GIS and Land Registration – Data collection was performed in Sehart Samre Office of Land administration and protection – Field survey in Seharti Samre to identify the existing land registrations system – Determines the needs and requirements for the new system – Interview to identify needs and requirements – Documentation to support the other method used
2	Conceptual Design and Physical Design	– Evaluate various design options – Design enumerating and description – Evaluate each design option. – Design Use case, Activity and Class diagrams – A spatial database is designed and populated
3	System Implementation	– Review detailed – Connectivity of spatial and textual data – Coding (programming) – Using and Testing of the system
4	Usage and Testing	– Presentation to the office of Sehati Samre
5	Maintenance and Documentations	– Fix problems and prototype applications. – Give explanations for the lack of clarity on design, – Simple guidelines about the design and implementation that have been made

RESULTS AND DISCUSSION

Data Handling Mechanism in Land Administration and Protection Office

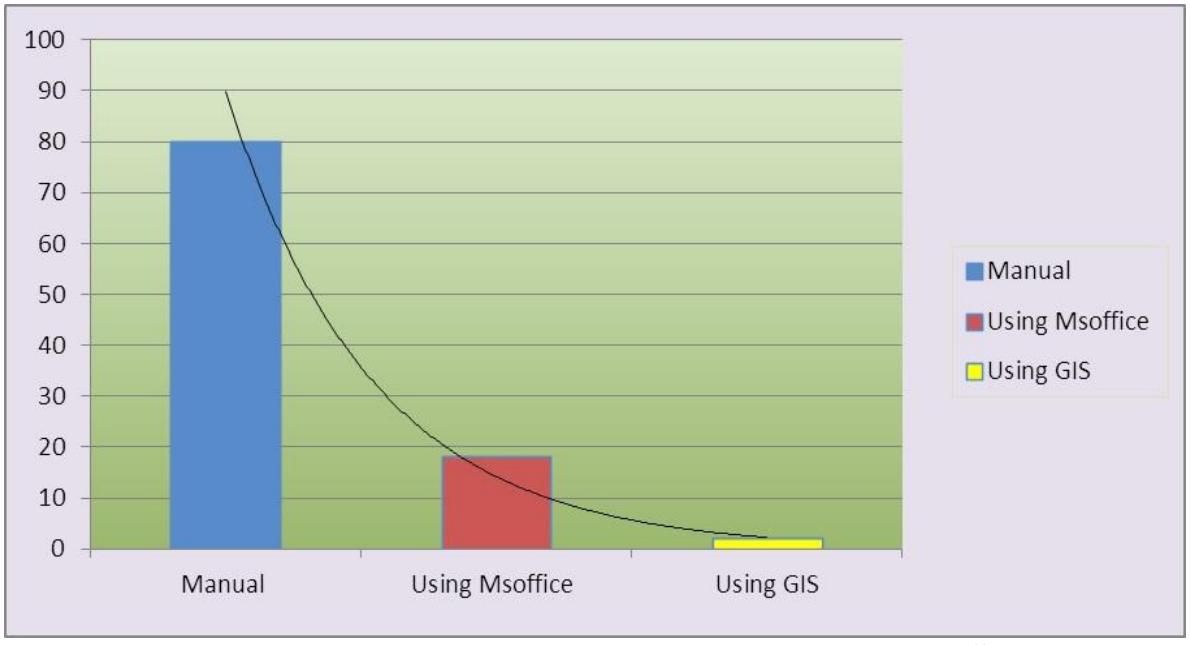

Figure 3: Data Handling Mechanism in Land Administration Office

This shows that the land administration and protection office has a very limited use of database systems. As such, there is no efficiently managed data or information of land in the office because there is poor data management system for data handling, for that case, our investigation shows that data and information are scattered in different sections; as such there is data redundancy, inconsistency, integrity problems, and backup and recovery problems.

Therefore, the office of land administration office as a whole has problem to search, extract and update specific information of land (low land registration and transaction techniques). Major activities that GIS based land registration technique support the management and planning.

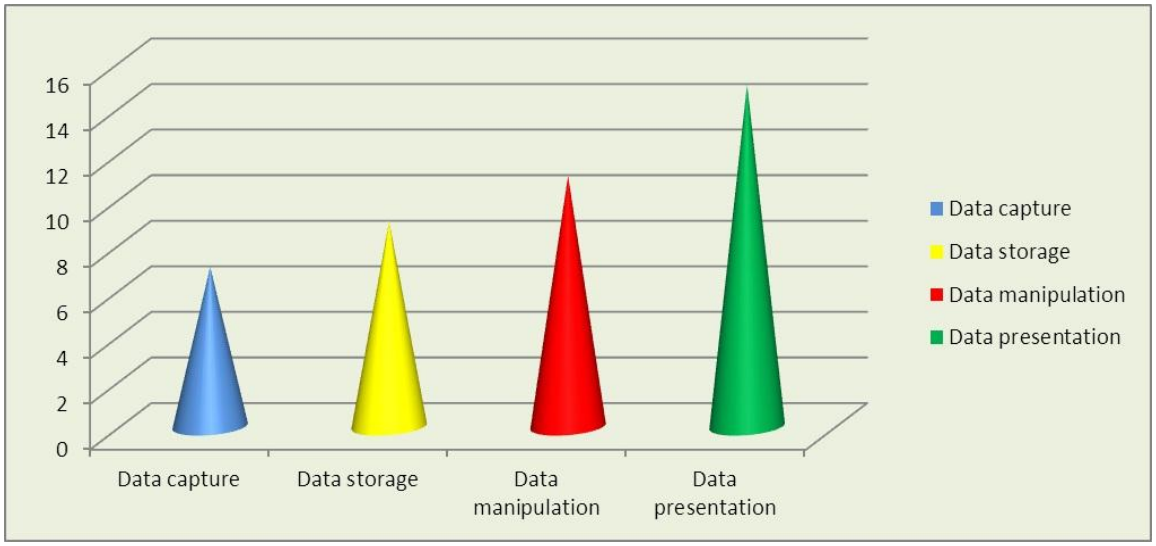

Figure 4: GIS Functional Components for Land Registration and Mapping

Majority of the respondent responded the activities that can be supported by utilizing GIS based land registration are data collection (referrers adjudication), data storage, data manipulation or analysis and data presentation (production of spatial information). The extent of a Geographic Information System based land registration technique facilitates the activities of land administration system.

Figure 5: Extent of GIS Based Land Registration Technique in Facilitating the Management Function of Land

This indicates that almost all respondents of the office believed that Geographic Information System and systematic registration of land can facilitate land management functions very greatly. They have confidence in that; GIS tool can support land management activities and allow access of spatial analysis anywhere at any time with Internet connection easily.

Prototype for Land Registration System

Figure 6: Security and System Setting

User Interface is used to enter to the main window. This system was built using Mass Register, Java, Python, PHP, HTML programming languages with two languages in English and Tigrigna (local language); in order to be used by the land data administrators and this can be accessed at http://10.10.10.51:8080/Massreg/Indes.html. All users of the system must be properly authenticated and authorized before using the application. User information is stored in the database. The passwords encrypted before being stored.

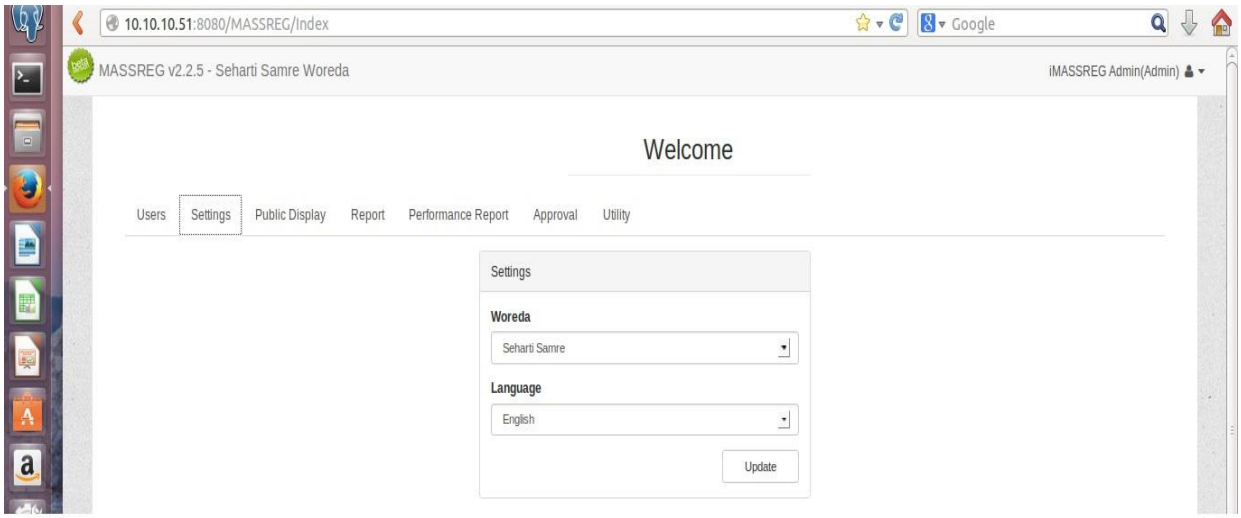

Figure 7: Administrator- System Setting

The administrator is also responsible for setting up the Sehrti Samre Woreda and the language to be used by the new system. To change system setting click the setting tab found in the administrator page and select the Woreda for the region and the preferred language used in the region from the drop down list and click the Update button to save the setting. The Administrator manages all user credentials, to create new users and assign them to various roles and has the responsibility for setting up the Woreda and the preferred language to be used by the system.

Figure 8: Registering Users

To manage users the administrator has to login into the system using administrator credential, then to add new user click on the add button on the left bottom of the page and a popup window appears showing user registration form. Once the required information is entered click the Add button to save the user, and then it will be added to Users page showing all the list of available registered operator's details. The administrator is allowed to view, edit delete and change password by clicking the appropriate link in the user's page.

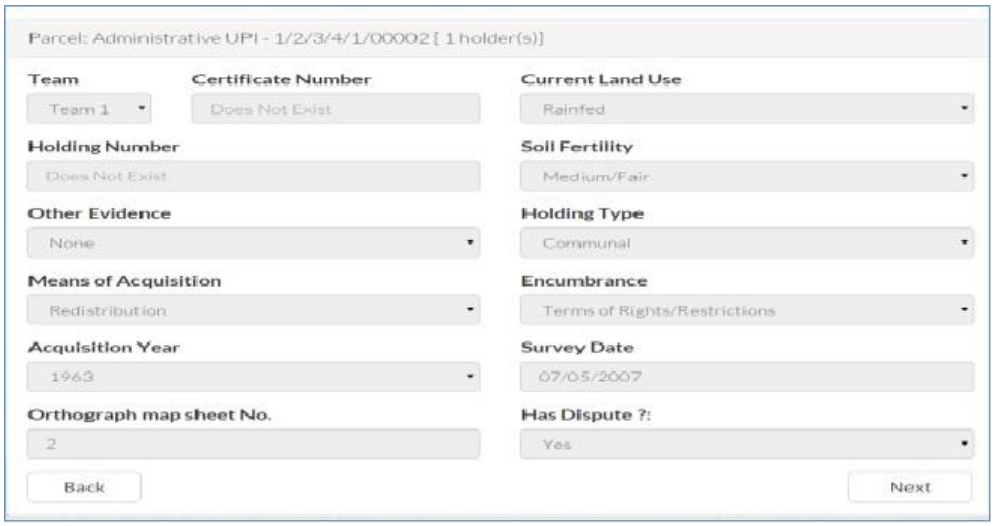

Figure 9: Displaying Parcel Information Details

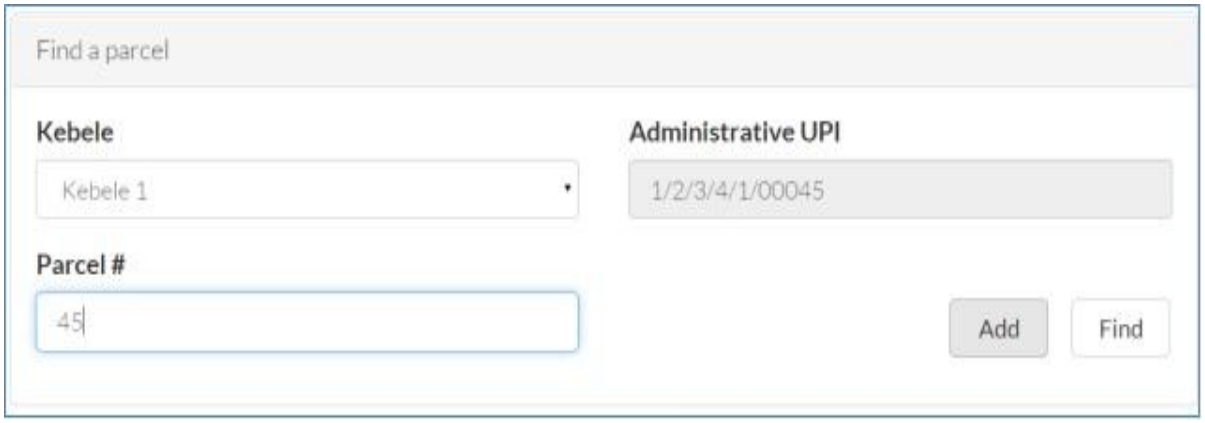

Figure 10: Searching a Parcel from the Database

A parcel is identified by specifying its UPN – Unique Parcel Number or UPI – Unique Parcel Identifier. The UPN is constructed from its location information by putting together the regional, zonal, woreda and Kebelle codes and finally adding the parcel number. The parcel number is only unique in the Kebelle where it is located.

Operators are not burdened with entering the UPI into the system in order to locate a parcel. They must, instead, specify the kebelle from context sensitive drop-downs and then entering the parcel number in the selected kebelle.

The system will then automatically construct the UPI and use it to locate the parcel on the database, and present the information on the screen.

Demarcated, Scanned, Geo-Referenced, Digitized and Extracted Map Sheets from Field Surveying to Back Office Work

Having connected the spatial database and textual database, the new system Web GIS for land registration system, has the capability of producing individual land owner certificates with its detail information holder names, addresses… as well as detail information of land registrations (land use, soil fertility, area, holder type…).

In addition, the new system capable of (1) Keeping land records and files related to land registry, (2) hold records of transactions and restrictions on the land, parcel, (3) Produce registration and ownership certificates in accordance with the restrictions listed in records, (4) Conduct the mortgage transactions and the acquisitions of lands, (5) Record Registration applications for transactions, standardization and collecting properties etc.

Conclusion

The purpose of this study basically focused on land registration system in Seharti Samre, Ethiopia. In addition, the study attempts to suggest new method that creates automated land registration system. Depending on the data and outputs of the study, it draws the following results: In Tigray, Seharti Samre, there is no database system to hand data and information of land registrations efficiently. Considering the rapid growth of expansion in Seharti Samre, GIS is the only valuable tool for handling spatial data for the effective upgrading and formalization of Land Registration System. This study shows that the current Land Registration System is a traditional and mainly paper based procedure. This traditional Land Registration System is in a critical need to be adapted with new technology. One of the most critical findings of this study is that the automated system will effectively manage the continuously increasing demand on Land Registration System offices. The automated Land Registration System will save time and efforts for both PLA employees and the clients. Utilizing GIS technology; this study provided a tool to produce high quality and accurate digital maps. The produced digital maps were connected to a database for the Mass Register lands of Seharti Samre. This study revealed the need for developing PLA"s technicians and employees" capacities on more advanced GIS and technological based Land Registration System.

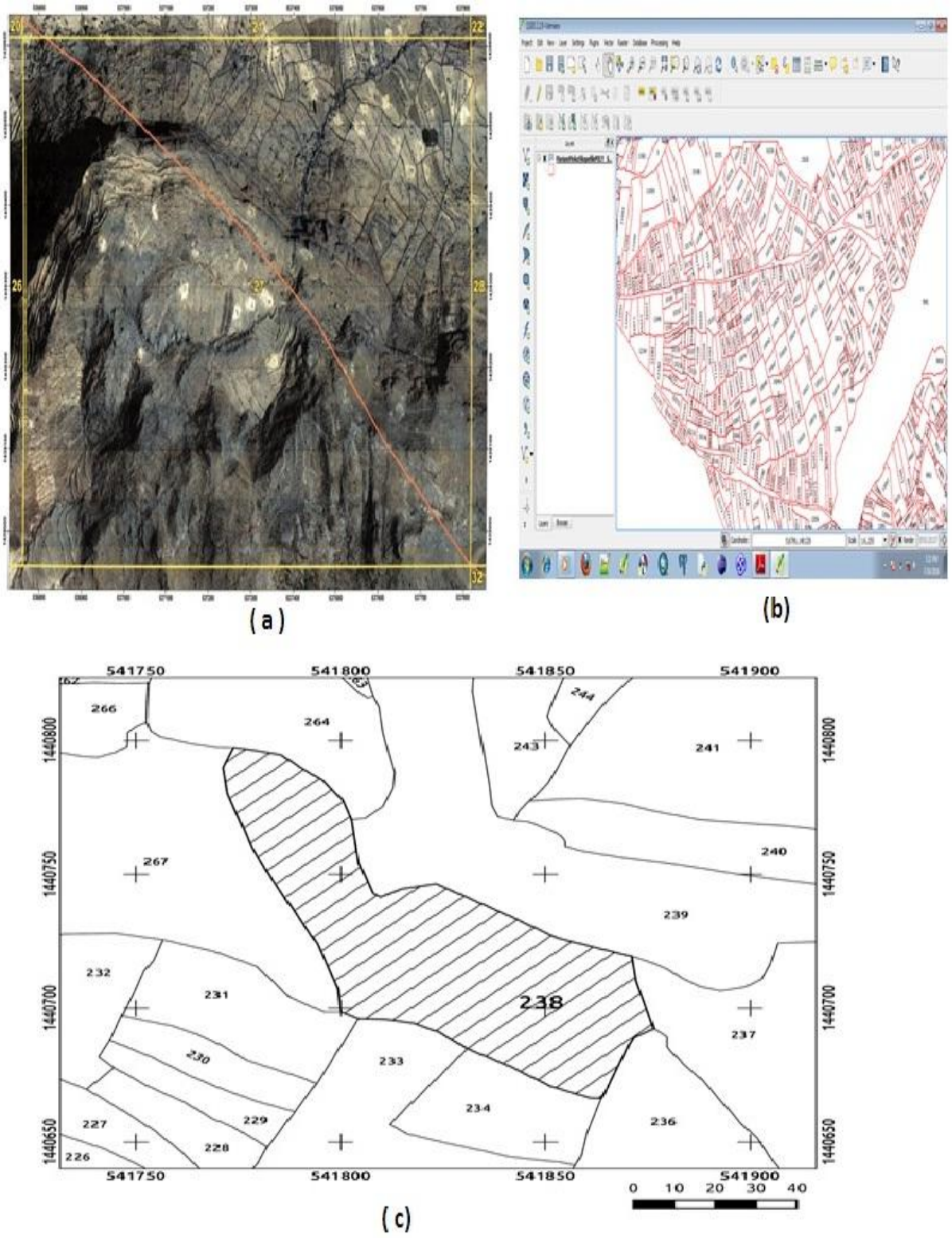

Figure 11: Processes of Map Sheets to Get a Final Certificate
(a): Demarcating Field Maps at Field at Kebele in Seharti Samre
(b): Scanning, Georeferencing and Digitization Maps at Office
(c): Extraction of each Parcel by its Unique Parcel Identification Number

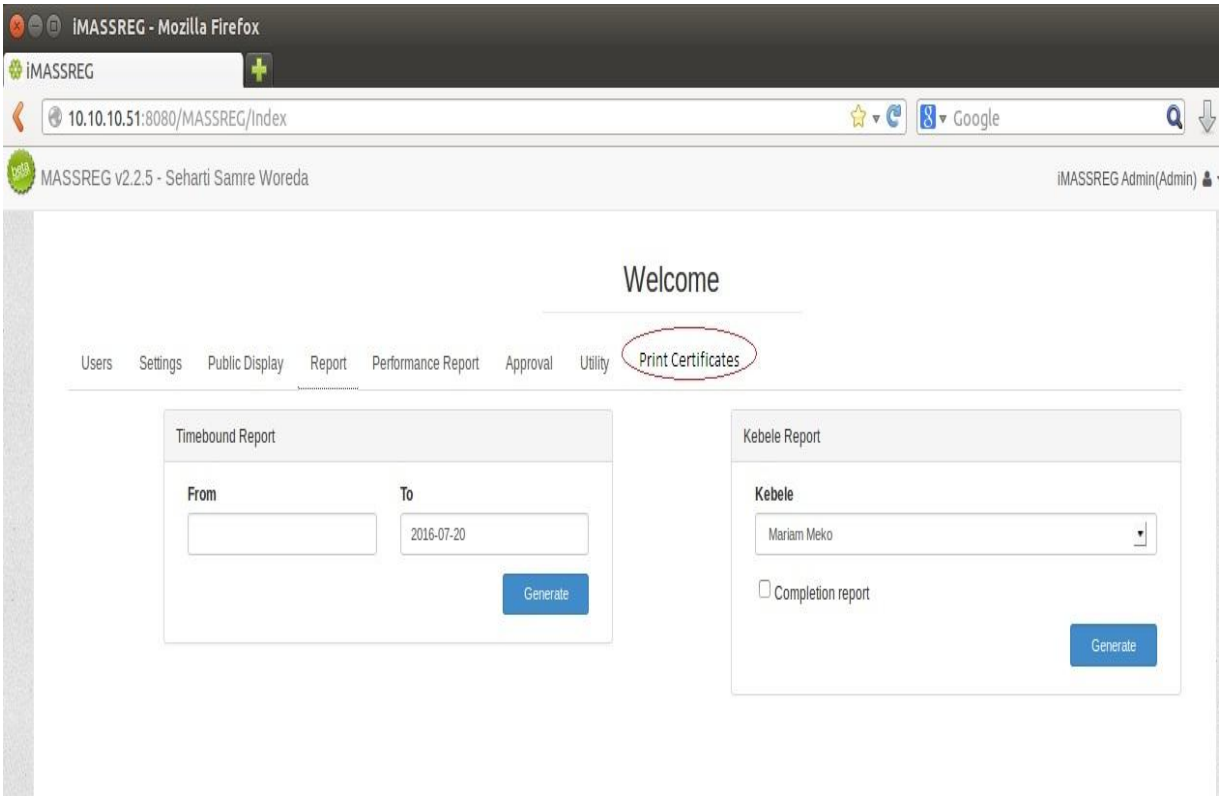

Figure 12: Web GIS for Land Registration, Mapping and Certificate Printing

Recommendations

The research has the following recommendations:

- Using the results of this research as a base for future work will require more enhancements and adding more functionality into the web GIS prototype for better transactions.
- Doing further studies on the Land Registration System so as to make fast, reliable and timely decision makings. Web-GIS components and services that offer improved levels of interoperability and efficiency.
- Computerized digital mapping system must be employed as the essential components Land Registration System provision. The considerable points are:

(1) Improve the incomes of the rural poor farmers and enhance economic growth, through modernized land certification distribution for land owners,
(2) Improved rural land administration (RLAS)
(3) Improve cross-cutting policy reviews in line with international good practice and human rights obligations,
(4) Development of the rural land sector to enhance productivity poor farmers and investment.

REFERENCES

Bell KC (2009). Trends in Land Administration and Management with Particular Reference to World Bank Support for Projects in the East Asia Region. *7th FIG Regional Conference* 19-22, Hanoi, Vietnam: International Federation of Surveyors.

Eid MI (2013). Development of a GIS-based Land Registry System for Gaza Strip, (Rimal, Gaza, Palestine).

Hailu Z (2006). Experience on Parcel Identification System for Rural Land Administration. *Standardization of Rural Land Registration and Cadastral Surveying Methodologies Conference/ Proceedings of a National Conference, Ethiopia.*

Maguire D and Dangermond J (1991). The functionality of GIS, *Geographical Information Systems*, editions D. Maguire, M. Goodchild, D. Rhind, (Longman Group, London, UK).
McLaughlin J and Nichols S (1989). Resource Management: The Land Administration and Cadastral Systems Component. *Surveying and Mapping* **2** 77-86.
Rakai M and Nichols S (2002). International Comparisons of Aboriginal Land Tenure Systems, interim Report for the Confederacy of Mainland Mi'kmaq. Department of Geodesy and Geomatics, University of New Brunswick.
Sagashya ED (2012). *Building Land Administration in Rwanda through Systematic Land Registration,* (Geospatial World Forum, Amsterdam, Netherland).
Zevenbergen J (2004). A Systems Approach to Land Registration and Cadastre. *Nordic Journal of Surveying and Real Estate Research* **1**.