

# Development of an Open Source Land Records System for Urban Centres in Ethiopia

Gertrude PIEPER, The Netherlands and Markus HAKALIN, Finland

**Key words:** Cadastre, Land Records, Open Source Software, Low Cost Technology, Ethiopia

## SUMMARY

As is the case in many other African countries, the land records in Ethiopia are mostly kept in paper format, and the information is generally unorganised, duplicated or outdated. The Ministry of Urban Development and Housing (MUDHo) has been planning for the development of a national urban real property registration and information system (URPRIS) for some time, and recognises the need to organise and digitalise existing land records. During the recently completed Integrated Urban Land Holding File Management System (IULHFMS) project, a first step was taken towards this reorganisation, and a land holding file management system was developed using open source software tools. The paper records and their metadata were digitalised and linked to the digital parcel map through unique parcel numbers. The scanned documents can be quickly accessed through the image viewer, giving instant digital access to land records that were previously hard to find. The system became operational in April 2016 and is now used in Bahir Dar, Mekele and Dire Dawa to manage land records and serve land administration staff as well as landholders with the information they need.

## SUMMARY in Amharic / ማጠቃለያ

በኢትዮጵያ ላሉ የከተማ ማእከላት በአጥን ሰርሰ (ሶፍትዌር) የመሬት ሪከርድ ስርአት የማልማት ስራ

እንደሌሎች በርካታ የአፍሪካ አገራት በኢትዮጵያ ያለው የመሬት ይዘታ ሪከርድ አያያዝ በአመዛኙ በወረቀት ቅጽ ላይ የሰፈሩ መረጃዎችን መሰረት ያደረገ ሲሆን ባጠቃላይ አሁን ያለው የመሬት ይዘታ መረጃ በቅጡ ያልተደራጀ፤ ድግግሞሽ የበዛበትና ጊዜ ያለፈበት ነው። ከቅርብ ጊዜ ወዲህ አንድ ወጥ የሆነ ሀገራዊ የከተማ እሴት ምዝገባና መረጃ ስርአት ለማልማት፤ እንዲሁም በስራ ላይ ያለውን የመሬት ይዘታ ምዝገባ በአዲስ መልክ ለማደራጀትና ዲጂታላይዝ ለማድረግ የከተማ ልማትና ቤቶች ማረጋገጫ እቅድ ይዞ በመንቀሳቀስ ላይ ይገኛል። አጥን ሰርሰ የሆኑ የሶፍትዌር መሳሪያዎችን በመጠቀም በቅርቡ የተጠናቀቀው የተቀናጀ የከተማ መሬት ይዘታ ማህደር አስተዳደር ስርአት ፕሮጀክት የመጀመሪያ እርምጃ የመሬት ይዘታ ሰነዶችን መልሶ ማደራጀትና ዲጂታል የመሬት ይዘታ ማህደር አስተዳደር ስርአት በማልማት ስራ ላይ ነበር ትኩረት ያደረገው። በዚህም መሰረት የመሬት ይዘታ ሰነዶችንና ተያያዥ የሆኑ ሜታዳታዎችን ዲጂታላይዝ በማድረግ፤ በቁራሽ መሬት መለያ ልዩ ቁጥሮች አማካኝነት የዲጂታል ቁራሽ መሬት ማፖችን ማገናኘት ተችሏል። ቀደም ሲል ለአጠቃቀም አስቸጋሪ የነበረውን የመሬት ይዘታ ሪከርድ አያያዝ አሰራር በማስቀረት፤ ስካን ተደርገው በመረጃ ቋት የተቀመጡ ዶኩመንቶችን በምስል ማሳያ ቴክኖሎጂ በመጠቀም ፈጣን የሆነ ዲጂታል መረጃ መስጠት ተችሏል። በዚህም መሰረት አዲሱ የአሰራር ስርአት እንደ አውሮፓዊያን አቆጣጠር ከአፕሪል 2016 ጀምሮ ስራ ላይ በመዋሉ የባህርዳር፤ መቐሌና ድሬዳዋ ከተሞችን የመሬት ይዘታን ሪከርዶችን በዘመናዊ ዲጂታል ስርአት ማስተዳደር ከመቻሉም በላይ አገልግሎቱ የመሬት አስተዳደር ስራተኞችም ሆኑ የመሬት ይዘታ ባለቤቶች የሚፈልጉትን መረጃ ማግኘት የሚያስችላቸው ነው።

---

Development of an Open Source Land Records System for Urban Centers in Ethiopia (8730)  
Gertrude Pieper and Markus Hakalin (Finland)

# **Development of an Open Source Land Records System for Urban Centres in Ethiopia**

**Gertrude PIEPER, The Netherlands and Markus HAKALIN, Finland**

## **1. BACKGROUND**

The development of digital land records systems, and in fact, all digital cadastre related systems, is never a mere IT task. In each country the context and culture of land registration is different and each set of traditions brings unique challenges. Where land registration has been predominantly paper-based, preconditions must be met before the digitalisation and system development can reasonably start. The Integrated Urban Land Holding File Management System (IULHFMS) project had to tackle a fair amount of challenges to complete what it had set out to do.

The project goal as described by the Ministry of Urban Development and Housing (MUDHo) was “to pave a way for fast, credible strata and completing of adjunction, legal and fiscal cadastre development process and create a system that helps the land right originator institute to manage its filing and process in an efficient way” (MUDHo, 2015a). The government of Ethiopia had been planning for the development of a national urban real property registration and information system (URPRIS) for some time, but an efficient land registration system could only be implemented when the existing situation had been clarified and the paper records had been digitised. With the IULHFMS project, the MUDHo was hoping to find a methodology for the re-organisation and digitalisation of paper records that could be implemented in all urban centres in Ethiopia.

The scope of the work included system requirement analysis and designing, files reorganisation, data capturing encoding and map overlapping with verification of ground reality analysis. Meanwhile, a system for entering and storing land records data had to be designed, tested, and deployed.

The project was awarded to FM-International Oy FINNMAP in consortium with AFRICOM Technologies, an Ethiopian IT company. The focus was on three major cities in Ethiopia: Bahir Dar, Mekele and Dire Dawa. The expectation was that once a system had been developed for these three cities, other urban centres would be able to implement the same methodology independently.

## **2. LAND RECORDS IN BAHIR DAR, MEKELE AND DAWA**

The IULHFMS project started in July 2015 with a requirement analysis, followed by a design phase. Through meetings with the city mayors, land office directors, archive staff, and with some of the landholders in Bahir Dar, Mekele and Dire Dawa, it became clear that some of the identified issues were common in all three cities, but there were some differences as well.

The land records are organised in files and ordered by file number. When there is a change or a transfer, an entry is usually, but not consistently, recorded in a registry book. The registry book entries also contain a file number, but this number does not always match with the number of the

---

Development of an Open Source Land Records System for Urban Centers in Ethiopia (8730)  
Gertrude Pieper and Markus Hakalin (Finland)

FIG Working Week 2017

Surveying the world of tomorrow - From digitalisation to augmented reality

Helsinki, Finland, May 29–June 2, 2017

related file, as the numbering system may have been revised multiple times. Some of these registry books in the city archives were so old that they had become unreadable and were falling apart.



*Landholders waiting at Fasilo Land Office, Bahir Dar*

In Bahir Dar, the land offices relied on landholders to remember their file number. They would need this number when registering a sale or inheritance, or another change in tenure. Without the file number, it could take days, or weeks, to find the file. The offices did keep lists of names, addresses and file numbers, but these lists appeared to be outdated and unreliable. Sometimes, the files could not be found at all, in which case registration could not take place and landholders had to be sent away.

The situation made it difficult for land offices to answer basic questions such as: How many landholdings are residential and how many are commercial? How many title deeds have been issued this year? Which landholders have paid their annual land tax and which ones have not? Or even: how many landholder files are there in the city? The files did not contain addresses or contact information, and it became clear that extensive field work would be needed in Bahir Dar to match landholders and parcels with their landholding files.

Mekele is a much larger city than Bahir Dar, and the number of landholder files in Mekele is almost three times as high. There was an ongoing initiative to assign a street numbering system and unique parcel numbers, but it had been put on hold because the federal government was about to introduce a standard for unique parcel numbers in Ethiopia, which differed from the numbering system introduced in Mekele. There had also been an effort to organise the files and record metadata of the landholding documents in a digital system developed by the University of Mekele. It had been installed in all sub-city offices in Mekele in 2012. However, the city lacked the needed budget for hardware and software, computers broke down and most land offices had gone back to processing the registrations manually.

---

Development of an Open Source Land Records System for Urban Centers in Ethiopia (8730)  
Gertrude Pieper and Markus Hakalin (Finland)

FIG Working Week 2017

Surveying the world of tomorrow - From digitalisation to augmented reality

Helsinki, Finland, May 29–June 2, 2017

In Dire Dawa, the organisation of the land records appeared to be in a better state than in Bahir Dar and Mekele. A local IT company had developed a digital cadastre system that was actively used to serve landholders and register transactions over the parcels. But also here, there were problems matching parcels and files. The files were organised by city block numbers according to an old map of the city, but this map was lost and with it, the knowledge of what block number represented which part of the city. As in Bahir Dar, extensive field work would be needed also in Dire Dawa to match landholders and parcels with the related file documents.

### **3. DESIGNING AND DEVELOPING THE SYSTEM**

The development of the IULHFMS system started early on in the project with the preparation of the datamodel as a PostgreSQL table structure. The datamodel was initially based on ELADM, the Ethiopian adaptation of the Land Administration Domain Model (LADM) ISO 19152:2012 Standard (Lemmen et al, 2015). The IULHFMS was thought of as a base for the future national URPRIS system in Ethiopia, but during the requirement analysis phase it became clear that the IULHFMS was not planned to be developed into a full cadastre system, but rather to form a reference database with metadata of existing paper records, and it would continue to be used in parallel to the URPRIS system.

The system would hold data from the paper files as well as from the old registry books. The paper files had to be scanned, after which metadata was to be captured in the database. For this purpose, data entry forms were developed which would let the users enter the metadata easily, without much training.

The landholders data was found to be highly redundant, and in many cases, inconsistent. This was expected, as one of the goals of the project was to identify files where landholder names do not match with the names as recorded in the Registry Book. Also, the names on building permits and land acquisition documents could be different from the names on title certificates. The data had to be captured in such a way that it could be analysed and compared, and this required a certain redundancy in the datamodel.

During inspection of the archive files, the types of documents that occurred in the files were considered. A list of eight document types was proposed to MUDHo and it was agreed that these were the documents that needed to be scanned and for which metadata had to be recorded into the system:

- Title deeds and certificates
- Agreements
- Injunctions (suspension and cancellation)
- Mortgage documents
- Means of Acquisition documents
- Receipts
- Building permits
- Compensation and valuation documents

As the core function of the system would be to provide access and management of scanned documents, the datamodel and custom forms were designed to cover these eight document categories. An image viewer was developed that lets users quickly browse through the scanned documents of a selected parcel record and display the document image next to its recorded metadata.

### **3.1 Unique parcel numbers**

To organise the file documents into digital records, it was important to uniquely identify parcels. The MUDHo had just approved the parcel numbering as suggested in ELADM (MUDHo, 2015b). This 14-digit number was a composition of administrative level codes: region code (2 digits), city/town code (3 digits), woreda code (2 digits), neighbourhood code (2 digits), city block code (2 digits) and parcel code (3 digits). For condominium units, an extra 6 digits is added to indicate condominium number (2 digits), floor number (2 digits) and unit number (2 digits).

To assign the parcel numbers, the digital parcel map was updated. City boundaries and woreda limits were already known, but neighbourhood and block boundaries were created in the process. In an effort to match parcels and landholders with the archive files, field work was undertaken in Bahir Dar, in Dire Dawa and in parts of Mekele, starting in December 2015. During this field work, all parcels in the selected areas were visited systematically to obtain the landholders name and the file number. If a landholder was found, the location was marked on the parcel map and a unique parcel number was assigned.

### **3.2 Open source software tools**

The choice to use open source software for IULHFMS was a conscious one. The use of open source software for mission-critical applications has been growing steadily over the past decade and also for cadastre systems, open source database and geospatial software projects like PostgreSQL, PostGIS and GeoServer have become acceptable alternatives to proprietary products (Stuedler et al. 2010). Although the use of and experience with open source software is still very limited in Ethiopia, it is growing, and data-driven projects like IULHFMS and URPRIS could provide a stimulus for local ICT companies in acquiring and developing the needed capacity to maintain open source based systems. The IULHFMS project did not have a software budget, and the land offices in the three cities did not have software licenses either, or the means to purchase them. The expectation was that the IULHFMS system would be rolled out to many more cities in Ethiopia, and if it were based on proprietary software, the cost and limitations of proprietary software licenses could become a major obstacle to its installation throughout the country. Moreover, the national URPRIS system that was under preparation by the MUDHo was being designed to run on PostgreSQL, and using a common database backend would facilitate the linking and integration of the systems. For the system to be financially sustainable, scalable and practical, it had to be built on open source software.

### **3.3 The IULHFMS system, up and running**

---

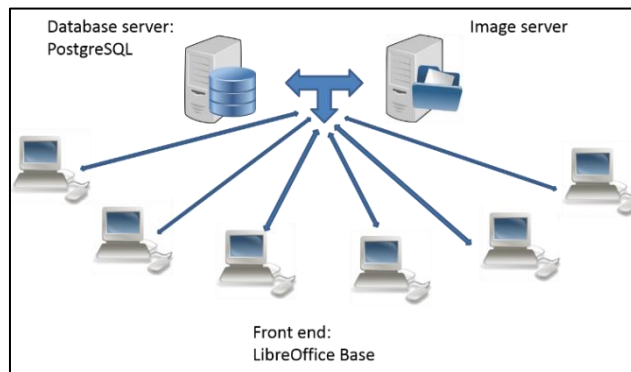
Development of an Open Source Land Records System for Urban Centers in Ethiopia (8730)  
Gertrude Pieper and Markus Hakalin (Finland)

FIG Working Week 2017

Surveying the world of tomorrow - From digitalisation to augmented reality  
Helsinki, Finland, May 29–June 2, 2017

The development phase ran from October 2015 through the first months of 2016. Testing took place in Bahir Dar city administration office in March 2016 and in April 2016, it became operational.

The system uses PostgreSQL as a data store, and an image server to hold the scanned file



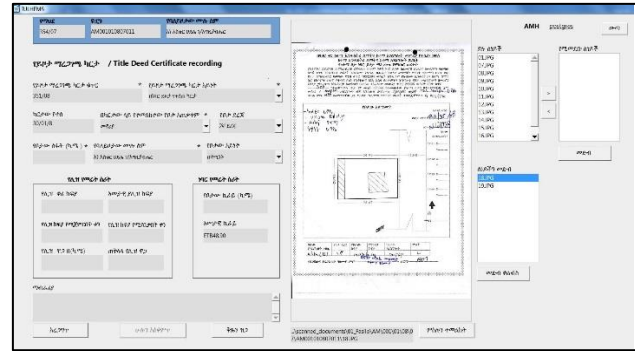
*Components of IULHFMS*

documents. The front end is built on LibreOffice Base and connects to the PostgreSQL database as well as the image server.

The core function of the resulting IULHFMS system is to support digitisation of property files and provide access and management of scanned documents including; title deeds or certificates, agreements, suspension and cancellation documents, acquisition documents, receipts, building permits, and compensation and valuation documents. Information on parcels such as area, land use, land grade and street address is captured and organised by Unique Parcel Identification Numbers (UPIN). Search functions through either the UPIN or the name of the landholder allow users to quickly find the records and access document images and metadata.

The system supports both Ethiopian and Gregorian calendars. The dates that are entered as metadata are all entered (and displayed) in their Ethiopian format, but kept as Gregorian dates in the PostgreSQL database. The interface was initially developed in English, and support for Amharic and Tigrinya was added as required by MUDHo. The interface languages are managed through lookup table entries and translated labels in the custom forms. More interface languages can be added in the future, if needed.

Database roles were defined for different kinds of users (supervisors, data entry staff, backup) and each user created his or her username and password. The security is managed by PostgreSQL through user authentication processes, database file protection and the restriction of server access through client connections. The user interface is designed in such a way that users do not have direct access to data tables for adding, and updating or removing records; they can only interact with the data through the data entry forms. A generic PostgreSQL trigger function is used to capture changes to the data. For each modification, the trigger registers the user who made the change, and a timestamp.



*Left: data encoding in ICT Park, Addis Ababa. Right: the IULHFMS system includes an image viewer that lets users quickly browse through the scanned documents of a selected parcel record and display the document image next to its recorded metadata.*

Data capture from the scanned land holding file documents took place at the data capture centre in ICT Park Addis Ababa. Each data entry operator used a PC with LibreOffice installed along with the custom forms and image viewer components, while the database server hosted the PostgreSQL database used to store the captured land holding data. The database connections were steady and the data capturing went smoothly. Even when data was being accessed and edited simultaneously from over 50 client PCs, the system did not experience performance problems.

In October 2016, the IULHFMS system with the encoded data was installed and officially handed over to the city administration offices of Bahir Dar, Mekele and Dire Dawa. It is now a fully operating File Management System, enabling quick and transparent archive service for the landholders.

#### **4. OUTLOOK AND CONCLUSIONS**

The IULHFMS system was developed within a relatively short time and considered successful. The system provides access and management of scanned documents including title deed certificates, agreements, suspension and cancellation documents, acquisition documents, receipts, building permits, compensation and valuation documents. Information on parcels such as area, land use, land grade and street address is captured and organised by Unique Parcel Identification Numbers (UPIN). Land records can be searched and accessed through either UPIN or landholder name. The system includes an image viewer to quickly access and view the scanned document images.

A review of existing land systems in Ethiopia was conducted by Land Equity International on behalf of the World Bank in July 2016 in which the IULHFMS was considered among a number of other computerized systems. The review assessed the systems for their potential in supporting the systematic adjudication in selected urban centres in Ethiopia, as the planned URPRIS is unlikely to be operational before the end of 2017. The IULHFMS system received the highest ranking and the review concluded that extending the IULHFMS would be the best option for addressing the gap in providing support for systematic adjudication (LEI, 2016).

Although the IULHFMS system is now in active use in Bahir Dar, Mekele and Dire Dawa, this does not mean that the process of reorganisation has been completely finalised in these three cities. Even

---

Development of an Open Source Land Records System for Urban Centers in Ethiopia (8730)  
Gertrude Pieper and Markus Hakalin (Finland)

after extensive fieldwork there were still files for which a location could not be identified, and there were parcels for which no landholder could be found. Systematic adjudication is an important next step, but the IULHFMS system has helped to provide the basic tools for reorganisation and digitalisation of the land records. It also forms an efficient IT-system for archive file maintenance, providing a better customer service experience through reduced waiting times.

## REFERENCES

FINNMAP, AFRICOM Technologies (2016) IULHFMS File Analysis Report, October 2016

FINNMAP, AFRICOM Technologies (2016) IULHFMS Final report, October 2016.

Lemmen, C., et al., (2015), The Land Administration Domain Model, Land Use Policy, 2015

LEI (2016) Review of the Legal Cadastre of the Government of Ethiopia – ICT Report, 11 July 2016

MUDHo (2015a) IULHFMS Terms of reference, 20 February, 2015

MUDHo (2015b) Ethiopian Land Administration Domain Model (ELADM) No.-02/2015, Jan 2015

Stuedler, D., Törhönen, M-P. and Pieper, G. (2010), FLOSS in Cadastre and Land Registration – Opportunities and Risks, published jointly by FAO and FIG, April 2010

## CONTACTS

Gertrude Pieper  
FM-International Oy FINNMAP  
Malminkaari 5  
FI-00700 Helsinki, Finland  
Phone: +358 406314446  
Email: gertrude.pieper@finnmap.com

Markus Hakalin  
FM-International Oy FINNMAP  
Malminkaari 5  
FI-00700 Helsinki, Finland  
Phone: +358 405028230  
Email: markus.hakalin@finnmap.com