Second United Nations World Geospatial Information Congress

Theme: **"Geo-Enabling the Global Village: No one should be left behind"**

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TP10E - Effective Multi-stakeholder Partnerships

Digitization of Land Records - Do open source software solutions suffice?

Flow

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1. Definitions

- "Land Record" includes rights such as the
  - Record of Rights,
  - Tenancy and Crop Inspection Register,
  - Mutation Register,
  - Disputed Cases Register,
  - Registers containing geological information of the land,
  - and economic information related to irrigation and crops.

- Land Records are known by various terms in different states in India for eg. Bhulekh, Khata, Patta, Chitta, Adangal, Pahani.

- "Digitization" is the process of converting information into a digital (i.e. computer-readable) format.
  - In modern practice, the digitized data is in the form of binary numbers, which facilitates processing by computers

- "Open-source software" is computer software that is released under a license in which the copyright holder grants users the rights to use, and distribute the software and its source code to anyone and for any purpose; Examples include:
  - Python [https://www.python.org/]
  - LibreOffice [https://www.libreoffice.org/]
  - R [https://cran.r-project.org/]

2. Introduction

•Land records must be “registered”; This registration refers to a system whereby ownership and land-related rights are recorded by a government entity.

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•These records provide evidence of title, facilitate transactions, and prevent fraud.

•Outdated land registry systems introduce delays in verification, slows down transactions, and lead to misappropriation

• A World Bank study informs us that 70 percent of the world’s population lacks access to land titles (as of 2018)

• The status of land records and rights:
    - •For citizens, can affect their access to economic opportunities.
    - • For governments, land records are essential to collect taxes, provide services, and establish territorial authority

3. The Re-Survey Project in Andhra Pradesh

•The Survey, Settlements, and Land Records Department [SSLR], Government of Andhra Pradesh recently launched a program to create a single window dispersal system for the agricultural lands. The SSLR requested the Andhra Pradesh Space Applications Center [APSAC] for GIS services

•Under this, the survey of the Land Parcels(LP) would be carried out using unmanned aerial vehicles (UAV), and the resulting images will be verified with ground-truthing of LP boundaries, followed by the generation of Ortho-Rectified Images (ORI).

•After suitable corrections, an unique LP number(ID) is allotted to each land parcel, and a **LP map will be issued to the landowner,** with secure digital markers like quick response code.

•The above process involves raster and vector data analysis, and geodatabase integration.

•This "Resurvey" of LP is being conducted in the state after about 100 years, and will cover 17461 villages spread over 1.26 lakh square kilometers.

3. The Re-Survey Project in Andhra Pradesh

•The generation of LPM from the Very High Resolution Images from the UAV and integrating the attributes of each land parcel is the key activity.

•The key steps are:

1. Collection of ORI images through the UAV survey by SSLR
2. Creation of the Geo-database by APSAC
3. Extraction of Land Parcel (LP) from ORI by SSLR
4. Quality Checking of each LP by APSAC
5. Necessary corrections of QC LP by SSLR
6. Preparation of Map Layout by APSAC
7. Map Print of each LP to SSLR for field verification by APSAC
8. On-field verification, correction and resurvey of doubtful LP by SSLR
9. Correction and updation of verified LP by SSLR
10. Final validation and Quality Check (QC) by APSAC
11. Final approval of QA LP for assigning Unique Identification Number by SSLR
12. Layout and LPM printing by APSAC

4. Software Artifacts

•Would a free and open source Geographical Information Systems software (like QGIS at https://www.qgis.org/en/site/) suffice for this project?

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•Analysis shows that:

- •On average, a village may have between 300 to 10,000 land parcels depending on the population size;
- •The drone image files for a single village, on average, are between 4 gigabytes (GB) to 6 GB;
- •The ORI of a village would be between 10 megabytes (MB) to 300 MB.
- •QGIS can be used for a limited purpose of digitization of land parcels using ORI data (that is, converting the ORI to vector data)
- • The proprietary software [Ex. ArcGIS pro(2.8.3), (costing Rs. 9,00,000 per standard license) with Reviewer extension (Rs.2,90,000 per unit)] is efficient for:
  - •ORI image caching,
  - •Geo-database creation,
  - •Quality checking involving vector algebra, raster and vector data analysis, and
  - • Topology analysis of LP superimposed over ORI data.
- •A comparative analysis is shown in Table 1

4. Software Artifacts …

Table 1 - The Land Records Re-Survey Project - Comparison of functionalities between ARCGIS and QGIS			
#	Description	ARCGIS	QGIS
1	Installation packages	Provide complete packages for installation	To implement a complete open source GIS solution requires the installation of separate packages from different organizations and code bases. Linking them together is often difficult. QGIS is not an integrated system.
2	Editing tools	Available	Editing and adding featurelayers is not very intuitive. Changing colors of added point or line features is a complicated process
3	Topology	Tools are available	Limited tools are available
4	Spatial Join	Inbuilt functionality of table and spatial jointools available	Customisation required
5	Cartographic tools	In-built cartographic tools available	Cartographic tools are lacking - harder to produce high quality traditional "paper maps"
6	Query by Attribute	Available	Customization required
7	Geoprocessing	time efficient	More time is required (3x for the re-survey project)
8	Publishing maps	Available	Customization required
9	Raster fileformats	Directly supports rasterfile formats	Support limited raster fileformats
10	Vector Data Size	Handle huge vectordata	Difficult to handle more than 1GB
11	Product support	Available	No single point support contact for support.
12	Security	Granular level and fine- grained security. OS,Database, Application, and object level security is supported.	Limited security features

5. Proposition

1. We argue that complex geospatial analysis involving land records can be undertaken using a mix of open-source freely available software (like QGIS) and proprietary software to reduce costs.
2. Using licensed proprietary software entirely for geospatial analysis can result in escalating costs due to license and renewal.
3. An understanding of the gamut of geospatial software available would inform the applicability and constraints of open-source free software, which can be used to a limited extent to reduce costs.
4. Proprietary software shall be used where considerations of time, quality and security of geospatial services are paramount.

Conclusion

•In applying Information Technology (IT) to land records for digitization, the Government of Andhra Pradesh is moving towards the adoption of the Land Administration Domain Model (LADM),•which is a global land administration standard.

•The LADM was formally published as an international standard (the ISO 19152) on December 1, 2012 :

- •supported by the Food and Agriculture Organization of the United Nations (FAO), and
- •the United Nations Human Settlements Program (UN-Habitat);
- •LADM encourages IT adoption for land management, and thus supports the Sustainable Development Goal 9 (Industry, Innovation, and Infrastructure).

End of session

Thanks