FELA-based geospatial knowledge infrastructure

**Brandon TOURTELOTTE (USA), Katie PICKETT (USA),
& Kees DE ZEEUW (The Netherlands)**

KEY WORDS

FELA, Geospatial Knowledge Infrastructure, GKI, land administration, GIS, Cadastre, ICT, geospatial, geographic information systems, land information systems, developing countries

SUMMARY

We live in an era where it can feel like an overwhelming task to address climate change, conflicts, population density, and increasing poverty and inequality. Good land administration and tenure security is a basic requirement for governments and societies to address these challenges.

The nine strategic pathways of the UN-GGIM's Framework for Effective Land Administration (FELA) provide guidance for the design and evaluation of Land Administration Systems. To develop a Fit-for-Purpose Land Administration System, the legal, institutional, and geospatial framework should be developed in parallel and in balance. While great developments have taken place in this regard, to make the next steps in nationwide implementations, there is a need for a strong Geospatial Knowledge Infrastructure on Land Administration.

The key findings of the GKI Geospatial Readiness report include the need for (1) trusted and authoritative foundation data (such as Cadastre), and (2) technology architecture to make this data available for use. We envision a Geospatial Knowledge Infrastructure on Land Administration implemented through the Framework for Effective Land Administration. Such a Geospatial Knowledge Infrastructure on Land Administration will be capable of addressing these two key needs, and this is the main purpose of this paper, and we will give some consideration to the community building needed for this infrastructure in various aspects.

International, national, and local networks are considered as well as the interlinkage between those networks. A Geospatial Knowledge Infrastructure on Land Administration is much more than creating a community of practice with networks and events. The capturing of expertise in tools and software is part of it, as well as the introduction of scalable, secure, locally contextualized solutions. Geospatial technology can help us address both of the Geospatial Knowledge Infrastructure findings mentioned above. Innovation and capacity building for land administration practices should become a collaborative responsibility with public-private partnerships and a flow from and between high-, middle-, and low-income countries through networks, tools, and expertise. The Framework for Effective Land

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Administration gives us an excellent framework to understand the elements of a Geospatial Knowledge Infrastructure on Land Administration.

1. INTRODUCTION

Our global community clearly faces challenges that can seem daunting and for which it is hard to know where to begin, such as climate change and global poverty. Effective land administration plays a key role in enabling society to mount effective responses to those same challenges. We should consider the advances that have been made in our field regarding implementation of fully functioning Land Administration Systems (LASs) at the national-level, or so-called "production level systems". Then we must review and understand what is still needed to make further gains, or take next steps, in effectively implementing production-level LASs. What elements are missing or not yet fully formed?

Internationally established and agreed upon evaluation, recordation, and tenure security standards should be supported by scalable technical solutions for the development of transparent, trustworthy, secure, and inclusive LASs. The Framework for Effective Land Administration (FELA), Fit-for-Purpose (FFP) approach, Land Administration Domain Model (LADM), and Continuum of Land Rights are international standards and frameworks which geospatial technology can implement and adopt. Geospatial technology provides the technical tools that local and national communities and governments need for alignment with FELA, FFP, LADM, and the Continuum of Land Rights while implementing LASs (Tourtelotte, 2022).

Implementation of international standards and frameworks can be realized by scalable technical solutions from local- to national-level contexts through a formal Geospatial Knowledge Infrastructure on Land Administration (GKI LA). A GKI LA provides a knowledge sharing space for local, national, regional, and international land administration professionals. Good land administration practices, including successful technical operationalization, should be shared through these multi-level GKI LA networks and communities of practice. Continual knowledge sharing and contribution at events and through communities of practice will expedite and leverage the successful implementation of land administration system development.

2. EXISTING GUIDANCE AND APPROACHES

2.1. The UN GGIM Framework for Effective Land Administration

Land administration, in general, relates people to land and informs on the 'how', 'what', 'who', 'when', and 'where' of land tenure, land use, land value, and land development. Land administration systems are the basis for recording the complex range of rights, restrictions, and responsibilities related to people, policies, and places. Hence FELA recommends effective land administration to be FFP, appropriate and adequate, interoperable and sustainable, flexible and inclusive, and able to accelerate efforts to document, record, and recognize people-to-land relationships in all its forms.

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Effective land administration can ensure better access to and security of land and property rights for people, mitigate issues relating to land as a root cause triggering resource conflict, and ultimately to leave no one behind in terms of development, the overarching principle of the 2030 Agenda for Sustainable Development. FELA does not seek to be prescriptive, rather intending to be a reference framework or a common basis for use in all countries, states, or regional contexts in the development, reform, renewal, strengthening, and or modernization of land administration and management systems (EGLAM - UNGGIM, 2020).

The nine strategic pathways of the UN-GGIM Framework for Effective Land Administration (EG-LAM, 2020) provide guidance for the design and evaluation of LASs.

2.2. Existing approaches and the use of standards

Where FELA is providing global guidance on the development of Land Information Systems (LISs), the use of proven approaches and standards is promoted in the implementation of such systems. The FFP approach, LADM, and Continuum of Land Rights provide effective and far-reaching evaluation, capturing, and representative methodologies and tools for positive land administration.

The FFP approach (FIG/World Bank, 2014; UN-Habitat/GLTN/Kadaster, 2016) argues for cost-effective, time-efficient, transparent, scalable and participatory land administration, including Participatory Surveying, Volunteered Land Administration, and Crowdsourcing. The principle of the FFP approach is that the spatial, legal, and institutional frameworks for land administration are in balance in such a way that tenure security can be established and maintained in a timely and affordable way, always aiming at the local, regional, or national needs. Many examples of the implementation are available and documented (de Zeeuw et al., 2019).

The LADM is a global standard (ISO:19152), describing people-to-land relationships. The standard is widely used (Lemmen et al., 2015) and is in the process of updating to a revised six-part ISO standard (Lemmen et al., 2020). The Continuum of Land Rights provides an inclusive understanding of tenure allowing for the growth and change of tenure types and in turn LISs. As nations, their land laws, and populations evolve, LISs must also to continually provide good land governance.

It is clear that a very usable set of guidance documents, frameworks, approaches and standards is available at the global level. Now it comes to implementation at the national and local level. What is hampering our efforts or limiting our progress? How do we operationalize these tools to implement them at the national level, and thereby put all this great work into action? It is our belief that there is a need for a strong GKI LA to make the next step in country implementations.

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3. WHO CAN CONTRIBUTE TO THIS KNOWLEDGE INFRASTRUCTURE?

Local, national, and international networks are a vital part of the creation, building, and maintenance of a GKI LA. A tertiary overview of alternate formations, integrations, and network making are provided but a comprehensive detailing cannot be entirely captured in this paper. Local networks can represent indigenous peoples and communities such as civil society organizations, providing foundational understanding of land-to-people relationships for sub-national and national networks. National networks can represent the whole of a country's people and institutions while considering the socio-political history and transformation of all local and multi-level community networks over time. Intenational networks can represent public and private entities such as non-profit organizations, non-governmental organizations international working groups, technology firms, and intergovernmental organizations allowing for cross-border knowledge sharing and proliferation.

Multi-modal knowledge sharing relationships exist between local, national, and international communities. Their interlinkages proliferate the growth and capacity building of a GKI LA. Organized events and communities of practice provide the space for these multi-level relationship networks to contribute to good land governance practices and examples of such spaces are outlined in the next section.

4. THE COMPONENTS OF A FELA BASED KNOWLEDGE INFRASTRUCTURE

In our view, the main components of a GKI LA would include a) communities of practice; b) conferences and events; c) training and capacity building opportunities; d) geospatial software tools for maintaining authoritative data; and e) geospatial software tools for disseminating that same authoritative data.

The land administration domain is fortunate to have a number of international conferences and other events throughout the year. Examples include International Federation of Surveyors, Geospatial World Forum, the World Bank Land & Poverty Conference (WB L&P), various UN GGIM events, the Organization of American States' Summit of Cadastre and Registry Conference, and the Esri User Conference. Of note, the WB L&P Conference has not taken place in the past few years, which is unfortunate. These events and their sub-communities of practice help to contribute to the knowledge sharing that is instrumental to the functioning of a GKI LA. Such sharing typically comes in the form of presentations, papers, and discussion about ongoing land administration projects globally and is successful due to the continued commitment of land administration domain professionals to good land governance.

Last year's Esri User Conference, for example, saw increased presentations by and participation of national land agencies. The National Government Executive Forum, a sub-group of User Conference participants, provided the space for these national land agencies to contribute and learn about their ongoing, scalable land administration implementations. With innovation, capacity building, and knowledge sharing for land administration practices should

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become a collaborative responsibility with public-private partnerships and a flow from and between high-, middle-, and low-income countries through existing and emerging networks, tools, and expertise.

More active and available communities of practice are needed to create and expand a GKI LA. Communities of practice are defined as user groups that meet regularly around shared topics of interest and groups that form around certain regions of the world. There are communities of practice available to land administration professionals, although much more needs to be done here in terms of learning and knowledge sharing. A successful GKI LA would be defined by a robust set of communities of practice organized on the guidelines of:

1. Region (Sub-Saharan Africa, Caribbean, Pacific Islands, etc.).
2. Topic (registries, tenure security, parcel management, Spatial Data Infrastructure, etc.).
3. Other aspects of expertise (formal training courses and certifications, etc.).

The good news is that several such communities of practice have begun meeting or are newly forming. The User Community for Geospatial Authorities (UCG) is one such example. The Young Surveyors Network is an excellent community that is well established and well known. Other multi-national and regional communities are beginning to form such as the Caribbean Land Agencies community intending to gather annually. These are positive first steps toward a GKI LA.

As communities of practice become more prevalent, the key will be those activities which convey expertise to others. Here we're referring to training activities and capacity development. These would be accessed through communities of practice but also by countless individuals who want to pursue careers in the Land domain. Examples include:

- Formal training courses, virtual or in person.
- Massive open online courses.
- Training academies.
- Online, geospatially enabled sites to access free self-paced learning on not only land administration concepts but specific geospatial tools like desktop and web Geographic Information System clients.
- How-to guides and tutorials in implementation of standards and frameworks.

The private sector also has a large role to play in providing expertise. We at Esri offer many training courses and workshops throughout the year and online at no cost. We facilitate several communities of practice such as the UCG mentioned above. Our staff collectively have many years of experience gained from working in the land administration space and are always eager to share our expertise with others. We also use geospatial technology itself as a means of delivering training to support the GKI LA.

5. GEOSPATIAL SOFTWARE TOOLS AS PART OF GKI LA

A GKI LA is much more than creating a community of practice with networks and events. It is important to recognize that geospatial knowledge is transmitted and made available to all through specific geospatial software tools. Geospatial software in the land administration domain, particularly those that persist over many years, represent a tremendous level of accumulated expertise. Most of these tools are developed over many years and are an iterative process with customer feedback and improvement, most of which happens in the developed countries. In turn, those refined and improved tools can benefit developing countries when they adopt the same software.

One example would be the ArcGIS Parcel Fabric. This solution for parcel management has been in use and continual development for over 10 years. It has been deployed mainly in the US, Canada, and Australia. Yet in recent years the same technology, with all its improvements and enhancements, has been put into use in the Middle East, Caribbean, and Africa. Now land agencies in those countries are employing the same accumulated knowledge as those countries where Parcel Fabric was originally developed. Very different contexts are drawn together into the same GKI LA.

Registry systems have also been continuously refined and improved based on software development cycles largely in high- and middle-income countries. These systems increasingly include geospatial capabilities for Cadastre workflows. Many of these software vendors now have customers benefiting from the same technology in high- and low-income countries, such as North America and the Middle East.

Perhaps the ultimate example of this would be configurable geospatial platforms implemented at enterprise scale. Such systems, once implemented for one context, can be applied to administrative divisions in a similar context. For instance, a technical system deployed in Senegal can also be deployed in other nations with similar property laws. A technical system deployed for a municipal Cadastre in Puebla, Mexico could, for example, be deployed to all other municipal Cadastres within Mexico.

The scalability of a geospatial platform to operate a Cadastre at a national level is also a key concept. The ability of an implemented technical system to transition from a small pilot project into a full national system has proven to be the most challenging for many LASs particularly in low- and middle-income countries. The know-how required to overcome this is a key element of the sought-after GKI LA. This entails recognizing what technologies enable these sorts of scalable systems, while also being cyber-secure and fully supported over time. The other portion of accumulated expertise lies in identifying best practices for exactly how to scale up the same platform used in a pilot project into a nationwide system. This type of expertise can be compiled as project documentation and also shared in workshops in communities of practice.

Geospatial technology can help us address both of the GKI findings mentioned above, which are stated as two key needed elements. For the first need, robust and proven geospatial tools

support the collection, storage, and maintenance of trusted and authoritative, foundational data. These proven tools are currently operating on a national scale on an ongoing basis. Typical foundational and authoritative layers managed with such systems include cadastre, official statistics, maritime, aviation, and topographic maps. The software components to create and maintain such data include desktop, server, web, and mobile components. The use of a centralized enterprise spatial database is essential to the deployment of such technology. This provides users with one foundational system of record avoiding data duplication and a siloed approach.

The second need, and a core functionality for a modern, configurable geospatial platform, is an IT infrastructure to ensure this data can be made available to the public. Online, destination hub sites are the most common and are populated with foundational data layers served up as web services. Usability for the consumers of these authoritative data sources is key; such hub sites do a lot more than simply offer users the ability to download files. The data can be consumed into web maps and various apps, regardless of which software or vendor the user has is currently operating with. Well-designed and informed geospatial architecture facilitates secure end-user environments, increasing trust in private and public access and dissemination of land administration data.

6. GEOSPATIAL KNOWLEDGE INFRASTRUCTURE ON LAND ADMINISTRATION THROUGH THE FRAMEWORK FOR EFFECTIVE LAND ADMINISTRATION

We therefore envision a GKI LA implemented through the FELA, which provides an excellent structure for guiding its development. Requirements of FELA which are particularly relevant for our topic include:

- Strengthens partnerships and supports collaboration.
- Facilitates capacity development and knowledge transfer and exchange.
- Advocates for effective land administration.
- Data maintained, secure, and not duplicated.
- Upgradable systems and approaches.
- Considers internationally agreed standards.
- Affordable with sustainable business models.

The *Overview of the Goals, Requirements, and Pathways of FELA* table ((EGLAM - UNGGIM, 2020:16) has been amended with five GKI LA actions to reflect our vision:

1. Promotion through public-private partnerships, communities of practice, and international conferences.
2. Enablement through geospatial tools.
3. Increase scalability of geospatial tools through implementation of nationwide LASs from pilot projects.
4. Support international standards of domain models, metadata, encodings, cataloging, and security with a modern, configurable geospatial platform.

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5. Ensure participation of middle- and low-income countries through grant programs.

GKI LA Action	FELA Goals	FELA Requirements	FELA Pathways
Promotion through public-private partnerships, communities of practice, and international conferences	Cooperation, partnerships, and participation leveraged	Strengthens partnerships and supports collaboration	Partnerships
	Capacity, capability, knowledge transfer, and exchange attained	Facilitates capacity development and knowledge transfer and exchange	Capacity and Education
	National engagement and communication enhanced	Advocates for effective land administration	Advocacy and Awareness
Enablement through geospatial tools	Reliable data and service quality attained	Data maintained, secure, and not duplicated	Data
Increase scalability of geospatial tools through implementation of nationwide LASs from pilot projects	Responsible and innovation oriented	Upgradable systems and approaches	Innovation
Support international standards of domain models, metadata, encodings, cataloging, and security with a modern, configurable geospatial platform	Interoperability and integration supported	Considers internationally agreed standards	Standards
Ensure participation of low-income countries through grant programs	Affordable investments and economic return assured	Affordable with sustainable business models	Financial

Supporting affordable, sustainable business models, Esri is focused on ensuring the GKI LA includes low-income countries by offering its geospatial tools via a special grant program called the Land Administration Modernization Program (LAMP). This program has already enabled 19 middle- and low-income countries to access affordable geospatial technology for land administration. The technology included enables agencies to address both of the needs

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from the GKI reports key findings; maintaining authoritative data and making it usable to the public in their own mapping applications.

6. CONCLUSION

Participation and support of events and the expansion of regional communities of practice is vital, including those supported by both professional organizations and the private sector. The need for numerous and sustained training and capacity-building opportunities, many of which take place in, or are formed within, those same conferences and events, should be considered. The importance of geospatial software tools, as they represent an opportunity for accumulated knowledge to benefit all land agencies, whether in Canada, Senegal, Australia, or Cambodia, are extremely important and will continue to play a leading role in fomenting the global GKI LA. Grant programs such as LAMP will facilitate access to geospatial tools so that more nations can participate in efforts around GKI LA.

The creation, promotion, and growth of a GKI LA is essential to make additional progress in implementing effective land administration at the national level. That, in turn, will enable nations to reap the benefits and rewards of land administration as they confront enormous global challenges. This is what is at stake as we discuss the need for and components of a true GKI LA and the five GKI LA actions.

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BIOGRAPHICAL NOTES

Brandon Tourtelotte is the Business Development Director for Land Administration, on the Geospatial Authorities team at Esri. Effective and modernized Land Administration is a must for citizen's ability to ensure they have legal rights to land, but it also serves as the basis for strong and just economic growth. The Geospatial Authorities team at Esri works every day with a global network of Distributors and Business Partners to help Cadastral Agencies leverage GIS to make this happen. He also focuses on how Cadastral Agencies can benefit from an integrated approach Geospatial Infrastructure. Brandon is an active member of Commission 7 and its FELA working group. He has 21 years of experience in the Geospatial industry, and is based in Minneapolis, MN. He holds a B.S. in Geography from the University of Minnesota.
btourtelotte@esri.com

Katie Pickett is a Land Administration and Global Development Consultant and Project Manager in the Professional Services, Geospatial Authorities Department at Esri. She is an experienced and award-winning geospatial professional who focuses on international development, humanitarian, and land administration initiatives. She has a Bachelor of Arts in International Studies, Africana Studies from the University of New Orleans and Masters in Geographic Information Systems focused on spatial statistics of violence in the Great Rift Valley from the University of Central Arkansas. Katie has supported and built geospatial capacity for national governments, large-scale international non-governmental organizations, the United States government, and social change enterprises for more than a decade. She has presented and led trainings around the

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globe on geospatial technology implementation solutions and strategies for social good projects in the Global South.
kpickett@esri.com

Kees de Zeeuw is a Principal Consultant at Esri inc. Since 2022 he has been the Practice Lead on Land Administration in the Geospatial Authorities department of Professional Services. He holds an MSc degree in land and water management (1989). After long term assignments in Rwanda and Bolivia he has been working more than 10 years in environmental and geo-information sciences at Wageningen University and Research Centre in The Netherlands. At Cadastre, Land Registry and Mapping Agency in The Netherlands (2007 – 2022), he has been for 12 years the director of Kadaster International. His expertise is on Land administration and NSDI. He made contributions to Fit for Purpose, LADM, IGIF and FELA.
kdezeeuw@esri.com

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