From Standards to Solutions: Kadaster International's Role in Implementing LADM for Sustainable Land Administration in Latin America

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Key words: LADM, Fit For Purpose Land Administration, Latin America, Colombia, Brazil, Kadaster International

SUMMARY

Kadaster International, the international department of the Netherlands' Cadastre, Land Registry and Mapping Agency, plays a pivotal role in advancing sustainable land governance worldwide. Kadaster International supports governments and communities in building inclusive, interoperable, and fit-for-purpose land administration systems. In Latin America, the organization has been instrumental in supporting land tenure formalization, capacity building, and the deployment of innovative geospatial technologies. A cornerstone of its approach is the Land Administration Domain Model (LADM – ISO 19152), a global ISO-certified standard that enables the integration of legal, spatial, and administrative land data across institutions. Complementing this is the Fit-for-Purpose Land Administration (FFP-LA) methodology, which emphasizes affordability, flexibility, and participatory mapping to accelerate land tenure formalization. This paper presents key use cases from Colombia and Brazil, where LADM and FFP-LA are applied to address complex land governance challenges. In Colombia, the adoption of LADM—locally adapted as LADM_COL—is central to the country's post-conflict land policy following the 2016 Peace Accords. Led by the Colombian Institute Agustín Codazzi (IGAC), LADM_COL aims to create an interoperable, multipurpose cadastre covering 70% of the national territory by 2026. Kadaster International supports this effort through projects such as Land in Peace, LAND-at-Scale, and Booster, which combine LADM with FFP-LA principles to simplify data collection, integrate local knowledge, and promote community participation. These initiatives address key challenges such as institutional fragmentation, the recognition of informal rights, and the modernization of cadastral infrastructure. In Brazil, Kadaster International and ITC facilitated a high-level training with three federal ministries—Economics (Receita Federal), Agricultural Development (MDA/INCRA), and Data Processing (SERPRO)—to explore how LADM can unify Brazil's fragmented cadastral systems. The workshop resulted in a jointly developed roadmap for an integrated cadastre, demonstrating how LADM serves as a common language between land administration and IT professionals. This collaboration continues with plans to engage additional ministries and stakeholders. Further south, in Mato Grosso, Kadaster supported smallholder land regularization through a pilot project in São Joaquim. In partnership with INCRA, local registries, and academic institutions (UNICAMP and Wageningen University), the project applies LADM and FFP-LA tools to streamline land titling processes. A trial in Tangará da Serra uses GPS-based mapping

and administrative adverse possession to address overlapping claims and reduce procedural barriers. In the Amazon's Tapajós region, Kadaster works with indigenous communities to protect ancestral lands from illegal encroachment and deforestation. Using FFP-LA and participatory mapping, communities and key stakeholders at federal and state level will be trained to document landholders and generate spatial data that authorities can use to enforce indigenous land rights. This initiative exemplifies how inclusive land administration can empower vulnerable groups and support environmental stewardship. Together, these examples illustrate how LADM and Fit-for-Purpose approaches can be adapted to diverse legal and institutional contexts, contributing to tenure security, institutional coordination, and sustainable development. By strengthening land information systems and promoting inclusive governance, Kadaster International's work supports broader societal goals, including the Sustainable Development Goals (SDGs)—particularly those related to poverty reduction, gender equality, climate action, and peacebuilding.

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1. INTRODUCTION

Kadaster International, the international department of the Netherlands' Cadastre, Land Registry and Mapping Agency, plays a pivotal role in advancing sustainable land governance worldwide. Kadaster International supports governments in building inclusive, interoperable, and fit-for-purpose land administration systems and helps communities to increase their tenure security. In Latin America, the organisation has been instrumental in supporting land tenure formalisation, capacity building, and the deployment of innovative geospatial technologies.
A cornerstone of its approach is the Land Administration Domain Model (LADM – ISO 19152), a global ISO-certified standard that enables the integration of legal, spatial, and administrative land data across institutions. This is complemented by the Fit-for-Purpose Land Administration (FFP-LA) methodology, which emphasises affordability, flexibility, and participatory mapping to accelerate land tenure formalisation.
This paper presents key use cases from Colombia and Brazil, where LADM and FFP-LA are being applied to address complex land governance challenges.

1.1 Kadaster International

The Netherlands' Cadastre, Land Registry and Mapping Agency (in short Kadaster) collects and registers administrative and spatial data on property and the rights involved since 1832. Doing so, Kadaster protects legal certainty. Kadaster is also responsible for national mapping and maintenance of the national reference coordinate system. Furthermore, it is an advisory body for land-use issues and national spatial data infrastructures.
Kadaster carries out international activities. In collaboration with national partners around the world, including governmental organisations and universities, Kadaster International further develops knowledge and skills in land administration and geospatial data management. In addition, Kadaster International actively participates in international umbrella organisations.

1.2 FELA, LADM & FFP-LA

1.2.1 Framework for Effective Land Administration

The Framework for Effective Land Administration (FELA) is a United Nations–endorsed strategic guide developed by UN-GGIM (United Nations Committee of Experts on Global

Geospatial Information Management) (UNGGIM, 2020). It offers Member States a policy and operational reference to develop, modernise, or strengthen their land administration systems in alignment with the sustainable development goals. FELA operationalises the broader Integrated Geospatial Information Framework (IGIF) for the land sector.
FELA emphasises the recognition of all forms of land tenure, including customary and indigenous rights, and seeks to ensure that no community is left behind. The framework is designed as a living document, intended to evolve alongside societal, technological, and environmental changes. It outlines a vision of securing people-to-land relationships in all their forms for the well-being of people, planet, prosperity, partnerships and peace. Its mission is to provide leadership, coordination, and internationally recognised standards, while fostering innovation and partnerships to achieve effective land administration.
Implementation is organised around nine strategic pathways covering I: governance, institutions, accountability, II: policy and legal, III: financial, IV: data, V: innovation, VI: standards, VII: partnerships, VIII: capacity and education, IX: advocacy and awareness. These pathways help countries translate policy into action. FELA encourages a step-by-step approach that delivers early benefits while building towards long-term sustainability.
Since its endorsement in 2020, FELA has gained traction globally, with regional initiatives in Europe, Africa, Asia, and the Americas. Expert group meetings, workshops, and collaborative projects are helping nations share experiences, adapt the framework to their contexts, and address common challenges.

1.2.2 Land Administration Domain Model

The Land Administration Domain Model (LADM), formalised as ISO 19152, is a global conceptual standard for managing information on people-to-land relationships (FIG, 2025). Since its first edition in 2012 (Lemmen, 2012), LADM has aimed to harmonise land administration across diverse stakeholders, facilitating seamless information exchange between entities responsible for land tenure, valuation, and spatial planning. This coordination ensures data is up-to-date, complete, and interoperable—supporting both public and private use and enabling future-ready information infrastructures.
In 2019, ISO/TC 211 initiated a multi-part revision of LADM, dividing it into five distinct standards:

- Generic conceptual model
- Land registration
- Marine georegulation
- Valuation information
- Spatial plan information

LADM's global uptake is reflected in over fifty country profiles, with around ten implemented in land information systems.

1.2.3 Fit for Purpose Land Administration

Sustainable development demands effective land administration and effective land administration supports sustainable development. This is realised through integrated geospatial

information management supporting land policy, land tenure, land value, land use, and land development (UNGGIM, 2020). In many contexts, a simple indication of properties and boundaries is often sufficient to meet basic land administration needs, particularly in less developed countries. In this vein, the World Bank and the International Federation of Surveyors (FIG) developed the 'Fit for purpose' approach (FIG, 2014). The idea behind 'Fit for purpose' is that land administration systems should be designed to meet the needs of people and the environment. It also should identify the way land is occupied and used within a relatively short time and at relatively low costs.

Flexible and pragmatic approach

In general, establishing and operationalising conventional land administration systems is complex, cost and time consuming. 'Fit for purpose' refers to an inclusive, flexible and pragmatic approach that means that land administration systems are simple at the start and can be improved over time whenever necessary or relevant. It is a dynamic process: purposes evolve, thus administrations as well.

1.3 Alignment with Other Global Frameworks

FELA, the only adopted UN framework for Land Administration and management, guides countries in developing effective, integrated, and sustainable land administration systems. It references the VGGTs, and it supports standards such as the ISO standard LADM and approaches such as FFP-LA for the implementation of effective land administration.

LADM and FFP-LA stand out as mutually reinforcing tools that align with broader international guidelines such as the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests (VGGTs), published by the FAO in 2012.

LADM enables interoperability across systems and supports the inclusion of both formal and informal tenure types, aligning closely with the VGGT's emphasis on recognizing diverse tenure arrangements (FAO, 2012). LADM also underpins several GLTN tools, including the Social Tenure Domain Model (STDM), which extends its capabilities to pro-poor and gender-sensitive contexts. By offering a standardized data structure, LADM facilitates transparent and accessible land information systems that are critical for good governance.

The FFP-LA approach is highly compatible with the VGGT's call for inclusive and equitable tenure security. FFP-LA operationalises many of GLTN's tools and principles, enabling governments and communities to secure land rights incrementally while building capacity and trust. Its emphasis on participatory mapping and community engagement ensures that land administration systems are responsive to local needs and realities.

Guided through FELA, LADM and FFP-LA, countries are enabled to design and implement land administration systems that are not only technically sound but also socially just and institutionally resilient.

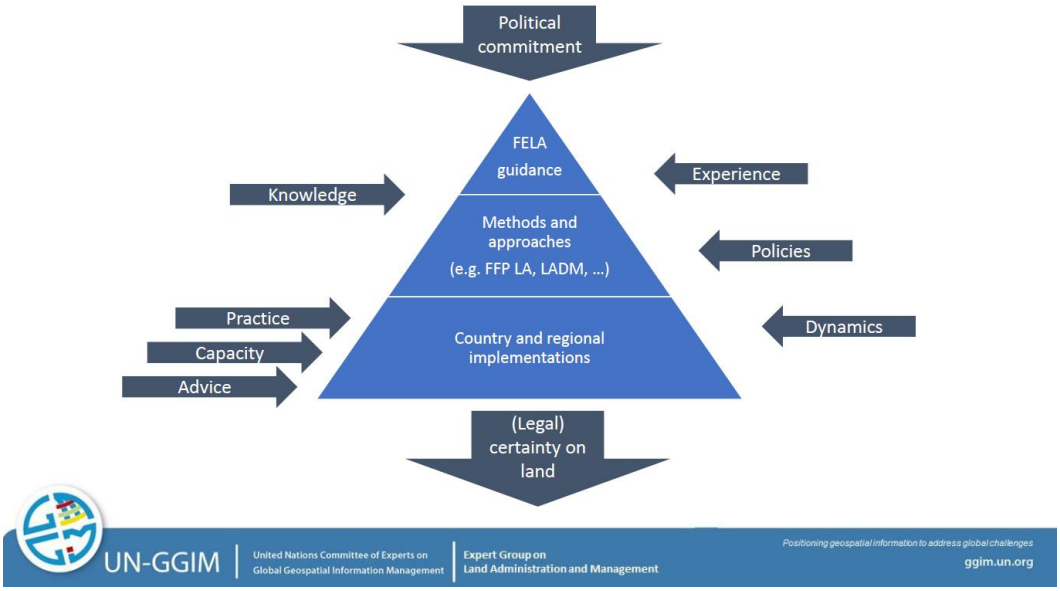

Figure 1. UNGGIM, Expert Group on Land Administration Management (De Zeeuw, 2022)

2. USE CASE COLOMBIA

In the post-conflict period, the Colombian government has promoted public policies aimed at fulfilling the Peace Agreements signed in 2016. Initially, these policies were based on the development plans of each presidential term, with particular emphasis on the 2014–2018 period, during which the importance of a multipurpose cadastre was highlighted. This cadastre was linked to the Comprehensive Rural Reform —Point 1 of the Peace Agreement— and aligned with international standards (IGAC, 2018).

Within this framework, the Geographic Institute Agustín Codazzi (IGAC), as the highest cadastral authority in the country, with the participation and endorsement of the Superintendence of Notary and Registry (SNR), the National Planning Department (DNP), and Swiss international cooperation, promoted the adoption and piloting of the LADM ISO 19152:2012 standard. This standard became mandatory for all entities related to land administration in Colombia and was formally implemented on May 30, 2018, with the adoption of LADM-COL (IGAC, 2018).

Subsequently, in the 2018–2022 Development Plan, the Multipurpose Cadastre (MC) was consolidated as a public service, with the goal of ensuring that cadastral information was accessible, reliable, and permanent, while fostering efficient land management and legal security of property rights (Congreso de la República de Colombia, 2019).

Although progress was made in adopting the international LADM standard, the path toward effective implementation has been shaped by multiple goals, approaches, challenges, and priorities set at the political level. For example, in the most recent National Development Plan 2022–2026, the government aimed to achieve 70% cadastral updating nationwide. However, by January 2025, only 39.1% coverage had been reported (IGAC, 2024).

It is worth noting that the MC has been financed with public funds and public debt, given its nature as a public service. This represents a challenge for 2025, as the government faces

budgetary constraints and fiscal issues that could hinder the achievement of the targets set for 2026. This situation makes it necessary to adjust strategies and explore alternative sources of financing (Rodríguez-Correa, 2025).
A key aspect of land administration in Colombia is the division of responsibilities between land administration institutions. For example, the IGAC or cadastral managers are responsible for cadastre, appraisals, and cartography. The Land National Agency (ANT) is responsible for formalisation in rural areas and the SNR for registering parcels. It is important to note that the cadastre provides information but does not guarantee land rights.
Given this context, the role of Kadaster International becomes especially relevant, as it promotes participatory and integrated approaches in Colombia. These FFP-LA approaches help reduce operational costs, strengthen cadastral maintenance, and increase operational efficiency, while ensuring quality and trust in cadastral processes.

2.1 LADM in Colombia

In Colombia, the LADM has developed through three levels. The first level is the adoption of the ISO 19152 standard, resulting in the LADM-COL Core Model, which provides the ontological and semantic foundation for interoperability among different entities managing diverse territorial objects, such as properties (cadastre and registry), environmental zoning (Ministry of Environment), and land-use planning (municipalities). Together, these objects form the Territorial Administration System (SAT), enabling coordinated territorial management across sectors (IGAC, 2025).
The second level, the Extended Models, elaborates on specific aspects of land administration while remaining aligned with the Core Model. For example, the Cadastre–Registry Extended Model V4.1 standardizes property information and supports unified management by IGAC, the national geographic and cadastral institute) and authorized cadastre managers, under the supervision of IGAC and the SNR, the national property registry authority). This addressed the previous lack of standardized methods for information exchange and reporting (IGAC, n.d.).
The third level, the Application Models, is flexible and can be adapted to specific technical needs, such as field data collection, while conforming to the Extended Model and LADM-COL. IGAC has developed Application Models aligned with the Cadastre–Registry Extended Model, and specific models have been designed for indigenous communities to strengthen their territorial management according to cultural practices (IGAC, n.d.).
Although LADM development is reflected in national regulations, some aspects remain underdeveloped. Cadastre and registry models have been tested since 2018, but models for other territorial objects related to environmental and land-use planning have only seen limited pilots. Therefore, true interoperability across all SAT actors has not yet been achieved.
The implementation of the LADM-COL models faces significant challenges, as evidenced in the various projects developed by Kadaster in Colombia and recently confirmed in the Booster project, through the analysis document on land optimization in the country. This study included multiple interviews with members of different institutions, aimed at gathering their perspectives on the implementation of key aspects in certain policies.

- **Technical capacity:** insufficient numbers of professionals with expertise in spatial databases, GIS, and the specific software required for implementation.

- **Model complexity:** the models cover numerous variables and intricate relationships, which complicates adoption and increases the likelihood of errors during data integration.
- **Resistance to change:** some cadastral managers continue to rely on legacy models, slowing the adoption of standardized approaches.
- **Predominant fiscal use of data:** while LADM can serve multiple purposes, its information is still primarily used for fiscal objectives. Differences in institutional missions sometimes result in the same territory being surveyed or processed multiple times.
- **Limited local capacity:** territorial offices often lack the resources, equipment, and trained personnel to capture and manage geospatial data efficiently.
- **Low sustainability projection:** although substantial efforts have updated the cadastre using LADM, there are no clear strategies or mechanisms to ensure medium- and long-term maintenance, leading to risks of data obsolescence.
- **High implementation costs:** overall expenses have risen, partly due to outsourcing operations to private companies, as well as the complexity of training personnel and integrating multiple systems. The Multipurpose Cadastre in Colombia has been mainly financed through international loans (World Bank, IDB), complemented by national government funds, local resources, and international cooperation.

2.2 Projects Kadaster International in Colombia

Since 2018, Kadaster has provided support to the Colombian Government by promoting methodologies for land administration procedures that are efficient, participatory and transparent. These methodologies are based on the FFP-LA approach. Kadaster has further developed and implemented this approach, adapting it to the reality of Colombia's rural post-conflict areas in collaboration with key actors in the Colombian land administration. These include the National Land Agency (ANT), the IGAC, the Superintendence of Notaries and Registries (SNR), the National Department of Planning (DNP), academic institutions such as the University of Twente (the Netherlands) and the Distrital University (Colombia), and private entities including Esri, Departmental Government, municipalities and indigenous organizations.

Kadaster International's projects in Colombia have demonstrated that the multipurpose cadastre can be implemented through innovative approaches that promote participatory methodologies and strengthen community empowerment, generating inputs that facilitate and accelerate the formalization of land tenure. The following activities were carried out by Kadaster International to implement the FFP-LA approach.

1. Worked out recommendations to the establishment of working agreements with institutions such as SNR, IGAC, and ANT.
2. Implemented preliminary technical and legal studies.
3. Engaged with communities to discuss and clarify the objectives of the project, as well as the extent of its scope, to ensure the effective and efficient execution of the proposed work.

4. Designed a training programme to capacitate indigenous and farmer grassroots surveyors in the management of a user-friendly application and the use of Global Navigation Satellite System (GNSS) antennas.
5. Validated the results by the community which represents a pivotal stage in the process.
6. Integrated data into institutional systems

Through research, pilot initiatives, and continuous social engagement, institutions have increasingly recognized the value of participatory approaches, promoted inter-institutional interoperability to improve citizen services, and simplified procedures that have traditionally been complex and costly. The collaborative activities within the FFP-LA frameworks have further emphasized the need to optimize resources, reduce costs, simplify the application of the LADM model, and recognize topographic data collected by farmers and Indigenous communities as quality, relevant, and useful information in property formalization processes.

2.2.1 Land in Peace (2018-2023)

The objective of this project was to facilitate the formalisation and registration of land ownership in post-conflict rural areas through the implementation of an FFP methodology. The programme was implemented in various communities across Colombia, including those in Sumapaz, Huila, Meta, Antioquia, Vichada, and Magdalena, in partnership with multiple entities.
Key achievements:

- Research on legal and procedural obstacles to the implementation of Fit-for-Purpose in the Colombian territorial administration and identification of possible solutions and recommendations. In addition, presentation to the Fifth Committee of the Colombian House of Representatives.
- Inter-institutional cooperation
- Capacity building through the design of courses for the training of basic surveyors by SENA (National Learning Service), and inclusion of the “Fit for Purpose” approach in the Cadastral Engineering curriculum of the District University.
- Impact Study examines the importance of a land property title in terms of investment, valuation, legal security, sustainable management and the perception of security. This investigation reveals that changes are evident in some, but not necessarily all, aspects.

During the development of this project, initial steps were taken towards an application version of the LADM model, known as LADM_FFP, which was adapted to the country's context and is an application model aligned with the Cadastre–Registry of LADM_COL. This was achieved through understanding the work and needs of Colombian organisations to agree on a model that could be adapted for field surveys and used as data input for cadastral and formalisation processes.
The implementation of LADM_COL has gone through different versions across its various levels: core model, extended models, and application models. These have been designed for land administration professionals —such as surveyors, lawyers, and geographers— to capture, process, and manage the data, under very strict compliance rules.
In contrast, the LADM_FFP model partially aligns with these institutional standards, since it is not intended for data capture to be carried out exclusively by professionals, but also by

community members, who are likewise involved in parts of the processing, validation, and management. Moreover, the LADM_FFP model cannot be as strict, as this would contradict the FFP approach itself, which prioritizes efficiency and simplicity fit for purpose, over complex models that are difficult to manage.

2.2.2 LAND at Scale (2021- June 2025)

The main objective of the LAND-at-Scale programme, which is financed by RVO (the Netherlands Enterprise Agency), is to strengthen essential land governance components for men, women and young people with the potential to contribute to structural, just, sustainable and inclusive change. This is being implemented in countries such as: Colombia, Uganda, Mozambique, Mali, Burkina Faso, Rwanda, Burundi, Somalia, Chad, Iraq, Palestine and Egypt (RVO, 2025).
The 'LAND-at-scale' project in Colombia aimed to support land administration processes of indigenous and Afro-Colombian communities in a fair, efficient and effective manner. The aim of the integrated approach is to improve land governance for the communities so that they invest in sustainable income generating activities in those areas as well as the protection of natural resources (Kadaster, 2025).
The project was implemented by Kadaster and the Dutch NGOs ICCO- Conexión and Tropenbos Colombia, who have experience in economic empowerment and sustainable environmental practices, respectively. The project team worked with the indigenous communities of: The Arhuaco community in the Sierra Nevada de Santa Marta; the Makaguaje and Coreguaje communities in Solano, Caquetá; and an Afro-Colombian community in Los Riscales, Nuquí.
In this project, the Kadaster Team adapted the LADM_FFP to meet the new needs and world view of indigenous peoples. For example, the team developed ways to capture and manage sacred places and areas for expanding reserves. This aspect was relevant at a national level because the National Plan included the integration of ethnic aspects into cadastral activities led by IGAC.
In Solano, Caquetá, communities trained by Kadaster in the use of user-friendly applications and GNSS were able to measure the expansion of their reserve by approximately 22,000 hectares, as well as a new reserve of 5,000 hectares, using an FFP-LA approach. Meanwhile, in the Sierra Nevada de Santa Marta and with Kadaster's support through the Booster project, indigenous communities are continuing to record information of their lands and sacred sites.

2.2.3 Booster (2025- present)

The Booster project, is intended as a booster follow up project of the LAND at Scale project and aims to compile the insights gained from the previous two projects, consolidate the associated lessons and best practices, and test and promote the legal application in order to implement the FFP-LA approach nationwide. The project has two main pillars: strengthening indigenous governance and developing a land administration sandbox.

In the context of indigenous territorial governance, Kadaster has supported the Arahuaco community, an indigenous community in the Sierra Nevada de Santa Marta, by providing

training and technical support to help them consolidate and administer their own Geographic Information System. This involved developing a model based on LADM_COL and LADM_FFP to adapt to the community's needs and incorporate their objectives regarding territorial expansion.
Currently, the Arahuacos population are the only users of this system. In the future, it will be possible to integrate the GIS with a SIG-I, an initiative by National Commission for Indigenous Territories (CNTI) and IGAC, which groups together different indigenous sources of information. This information is also a starting point for expanding the reserve with ANT in the future, and other projects, such as carbon credits, reforestation and environmental initiatives.
The sandbox aims to create a legal and technical laboratory to test ways of simplifying internal procedures in the ANT, which the Agency can then adapt to become more efficient and simple. Firstly, Kadaster researched the current legal situation and internal procedures and developed new technologies. In a second phase, the objective is to test the recommendations from the first phase and, ultimately, to incorporate the lessons learned into the ANT.
In the context of the sandbox, Kadaster is analysing the model developed by the ANT in 2025, with the objective of facilitating the collection of information in the field by grassroots surveyors and automating the process of data entry using secondary sources. Upon completion of the study, a new model will be proposed, incorporating an expanded version of the work field and office, and generating software developments.

2.3 Challenges & Lesson Learned

Below the main challenges and lessons learned are described:

- Institutional fragmentation: Objectives and procedures across institutions are often misaligned, information is not effectively shared, and full interoperability has yet to be achieved.
- Legal and bureaucratic barriers: Regulatory constraints hinder institutional action, reinforcing slow and costly processes.
- Data quality and technical capacity: Limited availability of experienced professionals affects the quality and reliability of data, sometimes generating unrealistic expectations and controversial processes in local communities.
- Community engagement and trust-building: While social engagement has advanced, communities are not fully empowered as active participants, limiting trust and ownership in the process.

Addressing these challenges is essential to ensure that FFP-LA approaches translate into sustainable, inclusive, and effective land administration that responds to the needs of both institutions and communities.

3. USE CASE BRAZIL

3.1 LADM in Brazil

Despite recurrent efforts to modernize cadastral systems and optimize land use monitoring tools in Brazil, the current Land Administration System (SAT) is very fragmented and not LADM compliant, In Brazil, different institutions have various operational systems for different purposes, such as land use/occupation, environmental monitoring, formal rights, possessions, etc. without proper integration of systems or data.

The most compromising aspect of it is the lack of a unified and integrated land cadastre that comprises geoinformation of the parcels and associated rights/responsibilities to be used as a 'baseline' for all the information related to that parcel of the territory. This limitation has been explored by different authors (see Reydon et al, 2017, Purificação, N. R. S., 2020; Carneiro, et. al., 2010 for more details). However, despite these limitations, it is also worth to note the incremental advances contributing to building a more effective land cadastre and other land administration tools that improve the current situation.

One of the most important steps towards an effective SAT in Brazil is related to the Law 10.267/2001 - the "Cadastral Law" - that enabled the current SIGEF system (*Sistema de Gestão Fundiária*), which is the closest system to a *strictu senso* Cadaster, that collects information of rights and the spatial extent of properties in a single system, integrated between the national agency responsible for the rural land cadastre (INCRA) and the Registry Offices. The system was first developed in 2010 to support another Public Policy of land regularization in the Amazon region, called Terra Legal (2009 to 2019), where georeferenced parcels, surveyed by professionals, could have their information checked and validated in the Registry Offices to guarantee that there was no overlapping land claim.

There are many other land information systems, such as the literal cadastre of land use and possessions SNCR, the environmental cadastre CAR, the Cadastre of Federal properties SPU-net, the cadastres and systems from the Federal Revenue, among others. But they lack a basic framework of concepts and vocabulary to describe the essential elements to allow for and enable the integration of data or information. In this regard, the LADM could provide a reference for these actors and systems to communicate with each other. If an LADM approach were to be implemented in Brazil, as seen in Colombia, a shared conceptual foundation is necessary to allow integration and to define a common 'baseline' or basic-cadastre to be used as reference for the other information systems. However, this would require inter-organisational discussions and agreements.

On this regard, it is important to note a recent 'movement' towards the different land data systems in Brazil as a joint effort between different ministries (MGI, MMA, MDA, and AGU)[1] to promote a Planning Committee to develop a "Plan for Data Integration and Improvement of Federal Environmental and Territorial Management Systems" (Pesquisa, 2025). This was a result of responding to the Federal Supreme Court Order (Conjur, 2025) that demanded the

1 **MGI**: Ministério da Gestão e da Inovação em Serviços Públicos = Ministry of Management and Innovation in Public Services. **MMA**: Ministério do Meio Ambiente e Mudança do Clima = Ministry of Environment and Climate Change. **MDA**: Ministério do Desenvolvimento Agrário e Agricultura Familiar = Ministry of Agrarian Development and Family Farming. **AGU**: Advocacia-Geral da União = Attorney General of the Union

Brazilian State to integrate the Environmental Cadastre (CAR) with the other existing land data systems to create a more efficient enforcement mechanism towards illegal deforestation. Opportunistically, this will lead to a broader LAS modernisation, including a LADM-based model and Cadastre elements, which is being developed by INCRA's technical staff that participated in the High-Level training promoted by Kadaster in 2023.
Even though that is still too soon to understand the real impact of this momentum towards the integration of different land data systems, it is a very promising proposal, and due to the Judicial Order, it has additional 'pressure' and significance to provide a reasonable response to it. Nevertheless, to have the participation in the modernization of the land cadastre component of the Plan, those who participated in the LADM high-level training promoted by KI, also give a sense of optimism towards an effective LAS for Brazil in the near future, something that can be pointed out as a result/consequence of KI's efforts in the country.

3.2 **Projects Kadaster International in Brazil**

3.2.1 High Level Training

In 2023, Kadaster was responsible for conducting a High-Level Training for key staff, from key institutions that are relevant for the LAS in Brazil, on LADM and how this ISO standard can help the country's sustainable development. For that end, the project proposed to: a) conduct key-informant interviews, (b) use LADM as a platform for inter-institutional discussions, (c) organise a workshop on LADM as a tool for institutional collaboration, and (d) facilitate focus group discussions to validate the outputs of the workshop.
To provide further context, early2023, Kadaster was part of a Trade Mission led by the Embassy of the Kingdom of the Netherlands (The Dutch Embassy). Under the scope, the 'Land Governance Agenda' and seeking to support the development of a Brazilian Land Administration System (SAT), meetings and events were organised between representatives of Kadaster, Instituto Governança de Terras (IGT), University of Twente (Faculty ITC), and key public institutions.
After that, in June 2023, a workshop for capacity building on LADM was prepared by Kadaster and the University of Twente. Key institutions dealing with the Brazilian land administration system were invited including technical staff from Instituto Nacional de Colonização e Reforma Agraria (INCRA), Receita Federal do Brasil (RFB), Ministerio do Desenvolvimento Agrário (MDA), and Serviço Federal de Processamento de Dados (SERPRO), being the last one a publicly owned company focused on the development and implementation of IT solutions for public services.
At last, the results and conclusions developed at the Workshop were further validated at the 9th International Seminar on Land Governance and Economic Development (SIGTDE), which was held at the Faculty of Cartographic Engineering at the Federal University of Pernambuco (UFPE), under the supervision of Profa., Dra. Andrea Carneiro, a Brazilian expert on LADM.

3.2.2 Applying Fit for Purpose Land Administration in Mato Grosso (2018)

Kadaster and a team of local consultants/specialists developed a Pilot case to test a FFP-LA based methodology to upscale land regularization in Brazil, in Tangará da Serra, Mato Grosso,

from 2017 to 2018. At the time, its main goal was to provide a test case for the successful implementation of the FFP-LA approach in a municipality in Mato Grosso as a model for country-wide implementation.
This intervention, along with the Pilot results, proved that using cheaper/user-friendly technology made it possible to optimize and speed up land rights regularization processes in cases where there was no conflict between neighbours or overlapping claims. The institutional arrangements made it possible to conclude all steps and procedures in a record time - around three months - with all the technical requirements and the necessary documents, ensuring the participation and consent of all people being regularized.
To do that, all the relevant direct stakeholders were invited to participate and observe the FFP-LA approach and its final results, as an attempt to highlight the bottlenecks and promote the changes needed in the current setting. The 'consortium' of institutions included representatives from the local Registry Office, the Registry Office's Association (ANOREG and IRIB), the National Institute for Agrarian Reform and Colonization (INCRA), the State Land institute of Mato Grosso (INTERMAT), a local lawyer and an engineer that followed the process and provided the signatures necessaries for processing the documents alongside the respective public institutions. These were all the 'mandatory' professionals that needed to be involved, considering the existing legal framework for the "Administrative Adverse Possession", the legal instrument applied to regularize the plots within the community. Additionally, the professionals involved (registry officers, lawyers, and engineers) agreed to not charge, or as little as possible, for their services, resulting in an 'optimal scenario' where the plot owners would have their deeds registered free of charge (or almost free).
After the land regularization process was submitted for approval, legal complications arose due to a claim that the land already had a private deed, making state verification unnecessary. The State Attorney's Office (PGE) disagreed and involved the Public Ministry, triggering an external audit of the Registry Office. Although the audit confirmed the Registry's reliability in 2021, the delay caused significant changes—owners had sold, moved, or inherited plots—requiring the process to restart. These changes increased costs, and the Registry Office, which had previously covered expenses, declined to do so again.
After this turmoil, the research team went back to Tangará da Serra in November 2023, 5 years after the initial FFP-LA intervention, seeking to: 1) assess the impact of the project 2) verify the possibility of replication and/or scalability of FFP-LA solutions for Brazil considering the lessons learned from the project developed, and 3) report the limitations and bottlenecks that prevented the registries and deeds to be concluded.
By conducting in-person interviews and surveys focused on the plots (and their holders) that participated in the 2018 FFP-LA activity, a questionnaire was developed and applied in the field in November 2023 in Tangará da Serra, together with recurrent visits to the community at São Joaquim do Boche. From the 48 plots that had participated in the 2018 process, the research team was able to find and conduct 28 valid interviews.
From that experience, it became clear that, institutional bottlenecks can drastically impact the development of regularizations in Brazil, there are ways to optimize this process using technology but the current regulations do not allow or enable these opportunities, and there is a limit to the cooperation from the Land Registry Offices with the land regularization process. This bureaucratic nature of this service did not allow exceptions or alternatives, as it was later

seen in the audit process, where the Registry's official had to justify why they were willing to reduce the costs, as it is not regular to do so.
Regularization processes are very time-sensitive, and delays can generate significant costs. The assessment was able to measure that from 2018 to 2023, almost one-third of the original participants had sold their plots. This, in turn, means that to complete the regularization, these plot owners would have to restart the process and pay the fees for the initial documentation all over, including the declaration over boundaries from the neighbouring plot owners.
Besides that, constant/periodic feedback for the people under regularization is an important component that must be addressed. Even though the plot owners did not receive the titles, they recognize the effort of a novel approach to regularization. Nevertheless, one of the main issues reported is related to the fact that there was no feedback whatsoever for them about why the process got delayed or about the next steps they should take, affecting their trust in the process.
Conflicting signals about willingness to sell plots after regularization warrant further exploration. When asked, 36 of 41 respondents said they do not intend to sell after receiving the title. While this suggests a desire to stay, it contrasts with the 27% who sold their plots over five years. Nearly 80% reported improved perceptions of tenure security, despite the process not being finalized. They attributed this mainly to having their boundaries mapped with neighbour acceptance. Other findings, beyond the questionnaire, help characterize the community and their sense of land security. Informal land rights pose a major economic barrier, limiting access to agricultural credit—even smallholder lines. This is often cited as a reason for leaving plots (usually leasing, sometimes selling). Some interviewees also expressed fear of taking any credit, worried that banks or the government might seize their land if they default.
At last, this experience showed that the survey of the plots with the FFP-LA approach, incorporating all members of the community, gathering neighbours at the fences for mapping, was an important action that helped people feel more secure about their lands. Even though they had no fear of eviction prior to this experience and afterwards, it was important to them to precisely know the size of their properties and exactly who their neighbours are, with the well-defined boundaries and sizes of their plots. This added further security and confidence to them, even without a formal deed in hand.
Besides that, in relation to the impossibility of completing the process and the reasons for it, the absence of stakeholders relevant to the judicial component of the processing documents highlighted the importance to consider all phases in future experiences. Including those related to after the technical components are concluded, gathering the responsible agents for the analysis and approval of each process into the initiative/pilot is crucial. Otherwise, there will be very little chance that an innovative approach can be accepted by the responsible institutions.

3.2.3 Applying Fit for Purpose Land Administration in Apajós (2025)

The project titled "Capacity Building for the Identification and Clarification of Non-Indigenous Landholders' Rights inside the Indigenous Land (TI)", aims to support the Indigenous communities in the Lower Tapajós region of Brazil in protecting their territory, culture, and the Amazon rainforest. Although the Brazilian state has officially recognized indigenous territory through a Declaratory Ordinance in 2016, there are still non-Indigenous landholders occupying parts of the land. These occupants include both legitimate landholders who were present before the demarcation and invaders who arrived afterward. However, the Indigenous communities as

well as technical staff from FUNAI lack the tools and capacity to precisely identify and map these areas. To address this gap, the project proposes to capacitate the local communities and FUNAI local agents with an easy-to-use FFP-LA recordation and mapping tool that allows to identify and map the possessions of non-Indigenous landholders and clarify their legal status. This initiative will build capacity within the indigenous community to map and analyse data of these landholders, thereby improving legal clarity, reducing deforestation, and preserving biodiversity.
The project is a collaboration between Kadaster (the Dutch land registry agency), IGT in Brazil, the Netherlands Embassy in Brazil, Indigenous organizations such as CITA, SURARA, and CIMB, and governmental institutions including FUNAI, which will assist in community engagement and training.

3.3 Challenges & Lessons Learned

Below, the main challenges and lessons learned are described:

- **Institutional fragmentation and fragility**: The dispersed land agenda in Brazil, fragmented into multiple institutions with (often) competing responsibilities, makes it difficult for data integration and a joint policy towards integration. A great deal of effort was made in that sense, but there is still much to be advanced. Part of the challenge is exacerbated by underfunded institutions and a lack of civil servants, compounded by institutional instability, including the creation or dismantling of key Ministries (such as the Ministry of Agrarian Development or the Ministry of Indigenous Populations), which can disappear with a change in government.
- **Political instability**: As seen in recent changes of government (especially from 2016 onwards), the sustainability and human rights agenda may receive a strong (or not) political backing. Without strong political enforcement, it will be really difficult to achieve SDG goals and international environmental commitments. Even harder is to maintain long-term strategic agendas, such as the modernization of a national Cadastre or a LAS. There is a strong lobby from those who benefit from the current situation (of fragmented, non-transparent data), forcing other institutions and sectors of society (such as the Judicial court) to intervene and add pressure for strategic action to continue or advance properly.
- **Working with IPLC's complexity**: Working with indigenous communities and other traditional groups will always add complexity, as they require a lot of time and clear communication due to cultural differences. The already mentioned institutional limitations add complexity to it, as often different 'timings' from the parts involved may compromise the advances of the necessary actions within an expected time frame. Kadaster's project, which was presented, showed this very clearly: that despite LADM and FFP-LA approaches being able to support upscaling of land data collection and data integration, sometimes the institutional complexity/fragmentation and the necessary time to work with traditional groups can prevent those advances from happening.

Understanding these challenges is the first step towards finding solutions related to an FF-PLA implementation in countries such as Brazil. In order to reach a sustainable management of the territory and recognize land rights for the most socially vulnerable groups, it will require

strategies to overcome these challenges and effective responses from the involved institutions/stakeholders.

4. SUSTAINABILITY & FUTURE DIRECTIONS

Modernising land administration systems is essential for achieving long-term sustainability, transparency, and inclusivity. Standards such as the Land Administration Domain Model (LADM) and solution-oriented approaches such as FFP-LA that support this goal. LADM provides a robust conceptual foundation for integrating diverse land information systems, which is particularly important in countries such as Brazil, which have extensive legacy data and fragmented institutional arrangements. Without such standards, achieving data interoperability and integration remains a huge challenge. FFP-LA complements this by offering a pragmatic, cost-effective approach to land administration that can be adapted to different countries and gradually expanded, as has been demonstrated in Colombia. Its success is evidenced by numerous international benchmarks and best practices. However, technical solutions alone are insufficient. Policy and strategic support, such as that provided by FELA, is vital for guiding national-level advocacy, prioritising interventions and assessing progress. Equally important are securing political will and institutional buy-in, which are foundational for implementing and ensuring the sustainability of reforms.

4.1 Scaling & Institutionalising

4.1.1 Colombia

In the Colombian context, the implementation of national agreements, the multipurpose cadastre public policy, and the adoption of the LADM-COL model have been subject to different political interpretations, as each government tends to prioritize short- or medium-term measurable goals. This creates long-term uncertainty and poses barriers to scaling up implementation and institutionalization. These challenges, however, can be mitigated through the role of peasant, indigenous, Afro-descendant, and other community organizations, which tend to be more stable over time. This was evident in the LAND-at-scale Colombia project, where indigenous organizations identified the need to manage their own systems and data to safeguard their territories.

Therefore, it is essential to move forward along two complementary lines:

1. Scaling up the adoption of LADM-COL through community organizations across the national territory, applying approaches such as Fit-for-Purpose Land Administration (FFP-LA). This would ensure cost-effective updating and maintenance of LADM-COL models, while also generating key inputs to strengthen land administration systems.
2. Establishing long-term, cross-cutting national agreements that enable institutions to:
    - Accept FFP-LA approaches as the first level of reference to guarantee national coverage of the multipurpose cadastre through LADM-COL, as a fundamental input for securing land tenure.
    - Institutional Agreements: Formalize inter-agency roles and data-sharing protocols to ensure continuity and reduce duplication.

- Decentralized Capacity: Invest in local offices and train community-based surveyors to sustain cadastral updates.

The impact of scaling through community organizations and institutionalizing the processes developed with them has made significant progress with Indigenous communities. In 2025, a law was enacted granting Indigenous organizations the possibility to manage the cadastre of their territories, and a special LADM-based application model was proposed. However, these organizations represent only a portion of the country and do not encompass the diversity of actors present across the territory. Moreover, the implementation of this new law remains unclear, particularly regarding the availability of resources and whether indigenous organizations have the capacities to meet the extensive regulatory requirements.

4.1.2 Brazil

For the case of Brazil, it is important to highlight that international standards should be perceived as the foundation for interoperability and a safeguard towards responsible Land Administration. The historical process of institutional development and the creation of different land cadastres, each with disjointed functions/responsibilities, now exposes the difficulties in data integration. Furthermore, the fragility of the land administration system results in compromises of institutional enforcement and traditional land rights recognition. KI's interventions and projects demonstrate that importance of standards and frameworks to help reverse this scenario, considering the momentum towards LAS modernization in the country, by designing it considering its foundation over consolidated knowledge on how a National Cadastre can be optimized with an LADM-based framework.

It is also very promising to see the efforts (led by MGI) on the Land Data integration and the modernisation of the LAS in Brazil. Although it is still important to find ways to guarantee continuity of such efforts and that the plans continue in the long term, especially after new political cycles of elections that might drastically change the scope and preferred actions in a different direction. Political backing is essential to pursue structural changes as proposed for the LAS in Brazil, especially considering the costs (financial and political) to develop and maintain cadastres and land administration tools/platforms whose benefits are not fully clear to a fair share of society. During the High-level training, one mentioned that investing in LAS and Cadastres was (politically) similar to investing in sewage/sanitation improvement, as, even though it's critically essential to the whole society, those benefits are 'hidden underground' and often cause distress during its maintenance, making it difficult to capitalize on votes or support from it.

All that said, it is important that the necessary changes come from inside, and not from external interference, either from the current national plans for development, institutional demand or pressure, or by the awareness from the public agencies' staff that there are standards and frameworks that can be used to tailor a domestic solution, considering all cultural-institutional specificities a country has. Considering the structural nature of a LAS and the number of institutions involved, it is important to consider a phased implementation plan with clear milestones and commitments under this strategy, as an attempt to safeguard progress in case of a political shift or turmoil. At last, successful FFP-LA pilots and/or experiences can help understand the potentialities of change and help the necessary local stakeholder engagement to

endorse this strategy in the long run, as arguments towards the development of internal solutions based on international standards.

4.2 Recommendations for policy & practice

4.2.1 Colombia

The implementation of the multipurpose cadastre and the LADM-COL model in Colombia faces challenges such as institutional fragmentation, high costs, legal barriers, and lack of sustainability.

- Inclusive policies are needed to integrate ethnic and cultural dimensions. The 2025 law allowing Indigenous organizations to manage the cadastre is a step forward, though questions remain about resources and implementation. The 2022-2026 National Development Plan also supports the indigenous GIS through the National Commission for Indigenous Territories (CNTI).
- Public-private partnerships can provide technical capacity but must operate under clear public oversight to ensure efficiency and trust.
- It is essential to scale up the adoption of LADM-COL through community organizations, applying the Fit-for-Purpose Land Administration (FFP-LA) approach for cost-effective and sustainable processes.
- Long-term national agreements are required to define interagency roles, promote interoperability, and strengthen local capacity through the training of community-based surveyors.
- Overcoming bureaucratic barriers, improving data quality through technical training, and strengthening community participation are key to building trust and ownership.
- Ensuring long-term sustainability mechanisms is fundamental to prevent data obsolescence and consolidate a robust, reliable, and inclusive land administration system.
- Academia should play a stronger role in practical research. This should lead to the creation of initiatives using FFLA and FELA approaches and the training of professionals with intercultural and ethnic knowledge.

4.2.2 Brazil

- Data Integration: Use LADM as a backbone for harmonizing environmental, fiscal, and cadastral systems.
- Legal Reform: Simplify regularization procedures and clarify roles of registry offices and land institutes.
- ‘Institutionalize’ or legally consider the strength of self-declaratory mapping and FFP-LA approaches towards understanding different land rights within a LADM framework.

5. CONCLUSION

Together, these examples illustrate how LADM and FFP-LA approaches can be adapted to diverse legal and institutional contexts, contributing to tenure security, institutional coordination, and sustainable development. By strengthening land information systems and promoting inclusive governance, Kadaster International's work supports broader societal goals, including the Sustainable Development Goals (SDGs) particularly those related to poverty reduction, gender equality, climate action, and peacebuilding.

In Colombia, the adoption of LADM-COL and the implementation of multipurpose cadastres have laid the groundwork for more transparent and interoperable land systems. Despite constraints and institutional fragmentation, projects like Land in Peace and LAND-at-Scale demonstrate that combining tenure formalization with community engagement and environmental stewardship yields transformative results.

Brazil's experience highlights the importance of institutional coordination and legal reform. Pilot projects and high-level training have shown the opportunities and challenges of FFP-LA and LADM. Scaling these efforts requires increased advocacy, stronger political commitment and integration across highly fragmented systems.

The use cases in Colombia and Brazil exemplifies how global standards like LADM and methodologies such as Fit-for-Purpose Land Administration can be locally adapted to address complex land governance challenges. These interventions, with the support of Kadaster, have not only advanced technical integration but also fostered inclusive, participatory approaches that empower communities and promote sustainable development.

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BIOGRAPHICAL NOTES

Paula Dijkstra, as the Director of Kadaster International, oversees the coordination of the organization's global initiatives and international cooperation projects. Kadaster International offers consultancy services to governments worldwide in land administration, geo-information services, e-governance, and SDI implementation.Joining the international department in 2011, Paula brings extensive experience to her role. Her academic background includes a Master's degree in Social Geography, complemented by specialized training in GIS, cadastral data acquisition, and 3D modelling. Currently, Paula serves as the chair of the FIG task force dedicated to advancing the Sustainable Development Goals. Also, she is appointed as co-chair of the UNGGIM Expert Group on Land Administration Management.

Claudia Lindner works as a Land Administration Advisor at Kadaster International engaging in several international projects and providing advisory work focusing on FFP-LA, innovative technologies and digitalisation in land administration. She is currently working on projects in Chad, Sierra Leone and Brazil. A geographer by training, Claudia received her PhD in land administration from the ITC at the University of Twente in 2021. For the 2023–2026 term, she is acting as co-chair of FIG Working Groups 7.6 and 8.4, 'Digital Transformation for Integrated Land Management'.

Jonathan Montoya works as the Local Project Manager of the Booster project in Colombia, where he leads initiatives that integrate innovation into land formalization processes. His first engagement with the Fit-For-Purpose Land Administration (FFP-LA) approach dates back to 2018, when he participated in Kadaster's initial pilots in Colombia as a student of Cadastral and Geodesy Engineering. Since then, he has taken on leadership roles in various land formalization projects, combining technical expertise with a strong commitment to innovation. Jonathan recently obtained a Master's degree in Data Science, complementing his professional background with advanced analytical and technological skills. With a research-oriented mindset and a critical perspective on Colombia's traditional land administration systems, he advocates for more efficient, inclusive, and sustainable land governance.

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