

Environmental information as a fundamental axis of the Rights, Restrictions and Responsibilities of the Land Administration System in Colombia

Ana Milena PRADA, Rosa Angelica LADINO and Andrés GUARIN, Colombia

Key words: LADM, LAS, Land, Environmental management, Resource use, Water use, Protected areas.

SUMMARY

The information management of the environmental sector has a high relevance and strategic importance in implementing different public policies, such as the Multipurpose Cadastre CM and the Land Administration System LAS. In this sense and according to what is stated in the document CONPES 3958 of 2019, one of the primary bets in implementing this new Cadastre is the Interoperability between information systems. Therefore, Interoperability is taken as a fundamental basis for adopting the international standard defined in ISO 19152: 2012, which speaks of a Land Administration Domain Model LADM.

On the other hand, CONPES 4007 of 2020 states that weak governance of the SAT leads to adverse environmental impacts such as deforestation and the growth of the agricultural frontier over areas of ecological importance and facilitates illegal activities related to soil or subsoil exploitation, which, in turn, degrades the environment. However, the conceptualization and implementation of a territorial administration system in the country create a tremendous challenge for the institutions that will be part of this model. This situation makes standardized data necessary to structure all the fundamental elements in a sequential and articulated manner for a correct harmonization of the territorial dimensions and for these to be reflected in the EWS.

The Land Administration Domain Model adopted by the country for the implementation of the LAS described in ISO 19152:2012 describes the importance of the semantic and ontological standardization of territorial objects and scopes in the adoption of the same by each country; this is why the Colombian Profile LADM_COL has been created and formalized; this is an adaptation of the standard to the normative and organizational characteristics of the national context, in this sense, and seeking to ensure the implementation of this model progressively and harmoniously among the different entities, a model-driven approach.

In this land administration system, environmental information will be of great importance in a country like Colombia, where its biodiversity characteristics, marine ecosystems, and the plurality of ecosystems provide transversal elements in territorial management, where, given the national and international regulations, they are highly protected territories and where the administration and maintenance of the environmental surroundings must be a priority.

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1. INTRODUCTION

Colombia is a multiethnic, multicultural, and biodiverse country of continental and maritime territory, the latter present in the Pacific Ocean and the Caribbean Sea (Constitution, 1991) Art. 101. It is comprised of 5 (five) natural regions, crossed by three mountain ranges, and shares biomes with other countries, as is the case of the biogeographic Choco, the moorlands, and the Amazon biome, and has 91 major types of ecosystems and about 8,000 smaller ecosystems.

The territory has an ethnic diversity represented by 115 indigenous and Black, Afro-descendant, Raizal, and Palenquero communities. Under this reality, the ILO Convention 169 was ratified by Law 21 of 1991, which seeks the protection and recognition of the rights and autonomy of Indigenous Peoples (Constitution, 1991) Art. 7 y 8 and the recognition of Black, Afro-descendant, Raizal and Palenquero communities through Law 70 of 1993.

Since the 1940s, the National Government has been making efforts in favor of conservation and has issued legislation in that sense; in 1942, it created the Biological Reserve of La Macarena (Ley 52, 1948) with approximately 1,300,000 hectares. In 1959 the Forest Reserves and National Forests were defined (ley 2, 1959), and in 1974 the Natural Resources Code (ley 2811, 1974) was issued. It legislates on each resource, water, soil, air, forest, and exceptional management areas, and addresses the objective and purpose of the National Natural Parks (ley 2811, 1974) mentioned in Law 2 of 1959, where the need to create this system was already present.

Subsequently, in the 1992 Rio Convention, the countries committed themselves to create Ministries of Environment and adopted the definition of sustainable development. This set the basis for the creation of the National Environmental System-SINA, the guarantor of the ecological function of property through Law 99 of 1993 and the National System of Protected Areas; this same law mentions that the country's development must be sustainable and in its article 3 adopts the concept of sustainable development. In the same sense, Article 7 of this law defines the environmental management of the territory. It emphasizes the function of the State to "regulate and guide the process of design and planning of the use of the territory and the renewable natural resources of the Nation, in order to guarantee their adequate exploitation and sustainable development." Furthermore, Colombia ratified the Convention on Biological Diversity through Law 165 of 1994 and approved the "United Nations Framework Convention on Climate Change," signed in New York on May 9, 1992, through Law 164 of 1994. Today, in compliance with international commitments on biodiversity and climate change, Colombia has made progress in creating a multi-scale, multi-stakeholder system of protected areas with

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public and private governance. As a result, as of December 2022, 1552 protected areas have been declared in Colombia, occupying 23.84% of the total national maritime and terrestrial territory.

Colombia is currently in a post-conflict context, made possible by the Peace Agreement signed in 2016. Therefore, after signing the agreements, we speak of post-conflict or post-agreements in Colombia, a situation that does not imply the absence of conflicts, but rather that the conflicts that may be generated will be resolved without resorting to violence means; hence the need for to understand conflicts from a socioeconomic, environmental and territorial perspective. In this context, the Cadastre becomes a fundamental instrument to support a more transparent land market, defend property rights, guarantee the flow of financial resources to improve agricultural productivity, and support environmental sustainability by identifying areas susceptible to being protected.

2. ENVIRONMENTAL INFORMATION AS A BASIS FOR LAND-USE PLANNING AND MANAGEMENT

Currently, Colombia is making a conceptual shift towards a comprehensive rural reform, total peace, and water management, which generates the need to consider "an updated multipurpose cadastre that supports the social management of rural property, the recognition of peasant communities and ethnic groups that inhabit and make use of areas of special environmental importance." (PND 2022-2026) On the other hand, following the Law 1454 of 2011, known as the Organic Law of Territorial Planning, protected areas, including the areas of the National Natural Parks System, are established as matters of national interest, as well as the competencies and instruments for departmental territorial planning and the creation of territorial associative schemes.

One of the main obstacles municipalities face in formulating and revising their planning instruments (POT) is incorporating protected areas Disaster Risk Management and Climate Change as environmental determinants, primarily because of inconsistency in the basic geographic information used. For example, 62 % of the municipalities do not incorporate the cartography required by Law 388 of 1997 and its regulatory decrees in their POT, 21 % of the municipalities do not have georeferenced information, and 97 % do not take into account threat and risk studies (MVCT, 2018). Therefore, the survey of cadastral information provided by the Multipurpose Cadastre will allow territorial entities to identify and diagnose the support information for their territorial planning to support the definition of uses for rural, urban, and expansion land, specifying the current land use and its tenure, vocation and possible land use conflicts present in the territory.

In this sense, (Paredes, 2022) identifies three objectives for the incorporation of biodiversity and protected areas in land use planning, as follows:

1. "Contribute to comprehensive territorial planning by recognizing and complying with environmental determinants in the land use plan following the regulations established by environmental authorities;
2. Harmonize municipal or district development plans, programs, and projects with the provisions established in the protected areas' management plans;
3. Formulation and joint and coordinated management with environmental authorities of programs, projects, and strategies for conservation, restoration and/or sustainable use that combat deforestation, climate change, and loss of diversity in compliance with environmental regulations and contribute to compliance with sentences and commitments regarding biodiversity and improvement of the population's quality of life".

Similarly, the research "Integration of protected areas into land use planning, a necessity for the achievement of human wellbeing in Colombia" identifies three causes for the weak inclusion of biodiversity and protected areas in land use planning:

- Confusion, proliferation, and disarticulation of planning processes and instruments applied to the same territory.
- The disintegrated vision of the territory
- The low-priority positioning and articulation of biodiversity in the processes of land use planning and formulation of sectoral public policies (Paredes, 2012)

2.1 Environmental Information and Territorial-Environmental Planning

Protection of the environment on public, collective, private lands, and lands where people hold private interests, embodies both a challenge and an opportunity for any government. The challenge is understanding and integrating diverse rights, including "property rights, collective rights, access rights, harvesting rights, management rights, exclusion rights, and alienation rights" (Sandberg 2007). On the other hand, conflict, land, and property meet at every point in the conflict cycle, as experienced in many countries. In this sense, approaching land-use planning from the environmental dimension and with a systemic perspective involves a paradigm shift.

It implies that the municipality, district, or department not only identifies the socio-ecosystemic configuration of its territory through the collection of reliable information but also identifies the various stakeholders' knowledge of the environmental values present to analyze the dynamics and interactions between the environment and society. The territory's analysis should consider, for example, the characteristics of the conflict and how it determines many economic, social, and political dynamics and what role or incidence the biophysical and environmental setting has on it.

Concerning land-use planning processes, at least four types of conflicts have been identified; Intersectoral, each sector plans individually and competes for space and resources. Claiming of ethnic-territorial rights, who seek recognition of their concept of territory and typologies of

territoriality guided by the principles of traditional knowledge, ancestry, and their effective participation in land-use planning instruments developed by territorial entities. Socio-environmental is an occupation of protected areas or strategic ecosystems, conservation, and intergenerational ecosystem services. Impacts of illegal economies (illicit crops, mining, hunting, deforestation, and pollution).

2.2 Environmental information and Cadastre

An example of these conflicts is the lack of secure land ownership rights and the absence or weak presence of the State, which has legitimized the processes of degradation and loss of forest ecosystems, in some cases closely related to the territorial control exercised by various armed actors. On the other hand, the structural problem of inequality has exacerbated the conditions of the vulnerability of ethnic and peasant communities, for whom the processes of formalization of rural property are a necessary condition to contribute to the stabilization of the expansion of the agricultural frontier and to secure areas of particular environmental importance. In this sense, cadastral information is necessary for environmental and forest governance as a guarantor of the social and ecological function of property, aimed at protecting the rights of the population and the environment, as well as an instrument that favors the administration and appropriate use of the land managing conflicts arising from the multiple visions of territorial development.

In line with the above, the National Policy for the Consolidation of the National System of Protected Areas SINAP (CONPES 4050 of 2021) reinforces the need for cadastral information by specifying that the scarce information on Cadastre within protected areas, together with the budgetary and management weaknesses of the Environmental Authorities have limited the timely solution of problems related to use, occupation, and tenure affecting biodiversity. Likewise, the document specifies that being an occupant of a protected area without having clarity about the status in terms of ownership limits the development of the inhabitants' life projects, as they cannot demand rights of use or access to resources or benefits that would bring them wellbeing, taking into account the limitations of the protected areas they occupy.

The national policy for protected areas supports local communities that live and develop their productive activities within the public protected areas without formal land titles due to the limitations on ownership that apply to some management categories, in addition to the weaknesses in the processes of land formalization. This problem is evident in over 50% of the country's rural properties. For this reason, the management of areas of particular environmental importance AEIAs implies recognizing that these zones have been occupied and transformed to varying degrees; therefore, there is a rural population that exercises informal land tenure together with agricultural and livestock uses, aspects that could be clarified through the information gathered by the Cadastre with a multipurpose approach.

In this sense, it is clear for the environmental authorities that the implementation of multipurpose Cadastre in Areas of Special Environmental Interest (AEIAs) affected by deforestation will make it possible to have updated and complete information on the physical,

legal, and economic conditions with environmental approach, in such a way that it becomes a fundamental tool for planning and decision making. It is necessary to specify that the current Cadastre has incorporated in its implementation the issue of interoperability with the so-called "non-parcel layers," which is a gateway for the citizen to visualize property information regarding their Rights, Restrictions, and responsibilities - RRR.

Likewise, the Integral Strategy for the Control of Deforestation and Forest Management includes an important cadastral component that begins with cadastral and registry information interoperability. Hence, it was necessary to adopt the Land Administration Domain Model (LADM) standard for cadastral and registry information interoperability. Fundamentally, this new Cadastre contains modifications aimed not only at modernizing the Cadastre but also at promoting the proper administration of the territory under the principles of reliability and completeness of the information, as well as the consistency of the cadastral information with the registry bases and with the common denominator of the interoperability of the information with other official data sources that generate rights, duties, and responsibilities over the land.

3. RIGHTS, RESTRICTIONS, AND RESPONSIBILITIES OF THE ENVIRONMENTAL SECTOR SAT

3.1 Territory Administration System SAT

Land administration is the appropriate instrument for implementing national land policies. It performs several functions, including supporting the establishment of the land market, land use organization, setting land taxes, and managing State and environmental strategic ecosystems. The goal of land administration processes is to support the implementation of land policies using the aspects of land management. According to Wehrmann (2005), transferring good governance criteria to post-conflict land policy and management would likely provide a reasonable basis for sustainable and low-conflict development. Therefore, the establishment of such a framework is of crucial importance, especially in situations of post-conflict countries.

Moreover, it is essential to recognize that the multipurpose Cadastre with non-parcel layers is only the engine of a Land Administration System. For example, FAO states that "sustainable systems require that institutions that interact with citizens who are their beneficiaries do so in ways that build their trust, particularly by managing disputes and handling points of tension related to land ownership, use and availability (FAO, 2007)". Focusing on governance allows us to illustrate the complexity of organizing policies, institutions, processes, and information to administer the territory and ensure environmental and social justice.

In this sense, land administration projects are distinct from land reform projects, although the boundary between the two is blurred in many practical situations. However, many land administration activities are carried out as part of projects to improve national or regional government administration and social-territorial justice. It is critical then to remember that "the discipline of land administration does not provide an analysis of when and to whom to

redistribute land and resources. Rather, it defines the appropriate administrative institutions and processes to implement these policy decisions.

3.2 Domain Model for the Administration of the Territory in Colombia LADM_COL

The domain model for the administration of the territory adopted by the country for the implementation of the SAT contemplated in ISO 19152:2012, describes the importance of the semantic and ontological standardization of territorial objects and the scopes in the adoption of the same by each country, which is why the Colombian Profile LADM_COL has been created and formalized, which is an adaptation of the standard to the normative and organizational characteristics of the national context, in this sense and seeking to ensure the implementation of this model in a progressive and harmonious manner among the different entities, a model-driven approach is implemented, the core model, which is governed by the Colombian spatial data infrastructure, extended models, which are the models that describe the semantics of each territorial object, and application models, which are models that respond to particular needs, processes or tools that do not necessarily conform to the core model, but which must respect the semantics defined by the entities in relation to the TOs.

In this sense, good territorial administration is based on correctly managing territorial information. The foundation of information management is the administration of territorial objects. Examples of territorial objects include a property, a national natural park, an environmental protection area, and a cultural or cultural or archaeological heritage zone, among others.

The ISO 19152:2012 LADM (Land Administration Domain Model) standard proposes a common data model through semantic standardization of territorial information to facilitate the governance and exchange of information between the systems that manage it. It also defines the possible relationships between territorial objects and their rights, restrictions, and responsibilities.

For this reason, the Ministry of Environment and Sustainable Development - MADS, as part of the implementation of a multipurpose cadastre in the country and aware of the great responsibility it has regarding the availability of environmental sector information in the EWS, has proposed a plan for the adoption and implementation of the LADM_COL model for the availability of information by the sector's entities.

3.2.1. Colombian Profile of the LADM_COL model

The national government and the entities linked to the CM and SAT project have been adopting the LADM_COL model, a national profile of the ISO 19252:2012 standard. This standard focuses on the semantic domain of the interoperability model defined by the MINTIC, i.e., it allows us to define the semantics that describes each territorial object.

Modeling the sector's territorial objects is a first step in the search for interoperability, but by itself, it is not enough to have a significant impact on public policies, nor does it guarantee data interoperability; the sector must take advantage of these initiatives in order to meet the main trends in geospatial information management, such as:

- Data quality
- Permanent updating of information
- Sharing mechanisms
- Availability of information

Adopting ISO 19152:2012 by a country implies the generation of a national profile which response to the adaptation of the LADM standard following the regulations in force and applicable in that country. In the case of Colombia, the LADM-COL Profile has been generated in response to the specific needs of the territory.

The main adaptations of the LADM standard to the LADM-COL Profile are:

- Adaptation of prefixes of the main classes of the model. Example: LA_BAUnit to COL_BasicAdministrativeUnit
- Definition of particular classes for the Colombian context. Example: COL_Spatial_Source
- Some cyclic relationships are suppressed. Example: LA_SpatialUnit
- Design and inclusion of modeling definitions for the territorial objects to be included in the model ecosystem. Example: COL_UnidadAdministrativaBasicaType in COL_UnidadAdministrativaBasica

In this sense, the adoption of the LADM standard also seeks to guarantee, among other things, the integration and interoperability of the Cadastre with other systems involved in land administration, fulfilling the objective of a multi-property cadastre, as well as aligning the institutions with the principle of legal independence (Stuedler, 1998).

On the other hand, the adoption of LADM as a standard seeks, among others, to improve the access of citizens and the entities themselves to information through appropriate information technologies based on standards that allow the integration of information from public entities (CONPES, 2016).

3.2.2. Colombian Profile of the LADM COL model

The implementation of LADM in Colombia, which does not consist of a single data model, but in the definition of an ecosystem of data models that expands under the territory information management as shown in Figure 1, three levels of abstraction have been defined for the modeling, as presented in (SwissTierras, 2021)

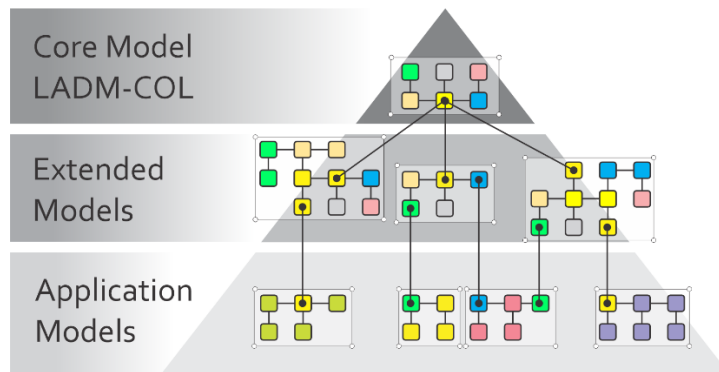


Figure 1. LADM-COL models and their hierarchies. Source. SwissTierras Colombia

Core Data Model

The core model is the basis for the semantic description of territorial objects. Under this premise, this model is the central axis from which the territorial objects that will be part of the territorial administration and inventoried and registered in the Colombian Spatial Data Infrastructure (ICDE) must be described.

Extended Data Model

Extended models must maintain semantic and structural conformity with what is established by the core model. This type of data model is developed to have authentic records (physical and/or logical) of territorial objects that, at the national level, should be the only source of official and true information (single official record). These models must describe the information of a territorial object according to:

- a) the specific applicable legislation;
- b) the needs of information governing body;
- c) the obligations of the person responsible for collecting and maintaining the specific information;

Consequently, the authority responsible for a given territorial object defines the corresponding extended model. For example, the extended data model of the Forest Reserve must be defined by the national authority in charge of its management, the MADS. In this sense, a record generated and managed in the extended model is official and authentic. This allows the information users to know the information the data model will make available for consultation.

Application Data Models

The implementation scheme of the model-driven approach for land administration in Colombia is complemented with application models, which respond to the particular needs of processes and/or systems and are directly related to the respective extended model. Therefore, the application models use the semantics defined by the extended models, and although the structures and definitions made in these models must be respected, it must be kept in mind that in their construction, they are free to implement new classes or attributes depending on each need.

It is essential to specify that to manage the collection, updating, processing, and exchange of information, a specific application data model must be defined and used, ensuring that different extended data models that define the semantics and relationships of these territorial objects can be fed from this model. The responsibility for the definition and use of application data models lies with each entity that manages and uses the information.

3.3 Territorial Objects of the Environment Sector

It is important to note that the Ministry of Environment is not directly responsible for cadastral updating since this is led by the Agustín Codazzi Geographic Institute (IGAC). However, for a cadastre to be multipurpose, the environmental sector must have interoperable information on the Territorial Objects, information with the legal support that generates Rights, Restrictions, and Responsibilities over the territory. For this, it is necessary to implement information exchange standards within the Multipurpose Cadastre public policy framework to improve the information governance mechanisms of the Colombian Environmental Information System.

In the development of the extended LADM models of the environment sector, particular emphasis will be placed on the territorial objects associated with environmental determinants, which are of four types: natural environment, transformed environment, risk management and climate change, and rural land occupation densities: These typologies are characterized (MinAmbiente, 2020) among others by being identified in regulations issued by the environmental authorities (Ministry of Environment and Sustainable Development, Colombian National Natural Parks, regional environmental authorities, sustainable development environmental authorities and urban environmental authorities.), have their own legal life (they derive obligations, responsibilities, and rights), are rules of higher hierarchy, constitute different levels of restriction on land use and generate management plans and management instruments.

1	NATIONAL SYSTEM OF PROTECTED AREAS OF SINAP (Legal basis Decree 2372 of 2010 compiled Decree 1076 of 2015)	Those of the National Natural Park System
		Protective Forest Reserves
		Regional Natural Parks
		Integrated Management Districts
		Soil Conservation Districts
		Recreation Areas
		Civil Society Nature Reserves
2	AREAS OF SPECIAL IMPORTANCE ECOSYSTEM AND ECOSYSTEMS STRATEGIC Legal basis (Decree 3600 of 2007 compiled Decree 1077 of 2015) - - (Decree 2372 of 2010 compiled Decree 1076 of 2015)	Páramos
		Water sources
		Aquifer Recharge Zones
		Water courses
		Wetlands
		Swamps
		Lakes
		Lagoons
Swamps		

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		Mangroves
		Tropical Dry Forest
		Natural Forests
		Protected Forest Areas
3	COMPLEMENTARY STRATEGIES CONSERVATION	2nd Law Forest Reserve
		Ramsar Wetlands
		DMI Macarena North and South Macarena - Ariari Guayabero
4	DERIVED FROM INSTRUMENTS OF PLANNING	POMCA
		POMIUAC
		POF
5	DERIVED FROM THE EEP	Core Areas
		Areas for connectivity
		Areas for sustainable use

Table 1. Environmental determinants of the natural environment, source: MinAmbiente 2020

4. EXTENDED PROTECTED AREAS, DATA MODEL

The National System of Protected Areas (SINAP) was created to implement the country's commitments to the Convention on Biological Diversity, ratified by Law 165 of 1994. The SINAP is defined as the set of private, community, and public protected areas at the local, regional, and national management levels, the social and institutional actors, governance arrangements, and management instruments that, in coordination with each other, are necessary for their conservation. SINAP, together with other strategies, contributes to fulfilling the country's conservation objectives.

Protected areas are defined as "A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature and its ecosystem services and associated cultural values." Protected areas are declared and designated under specific criteria framed by conservation objectives, which are particular to each protected area and follow SINAP's conservation objectives. The management category of protected areas is "the unit of classification or generic denomination assigned to protected areas taking into account their specific characteristics, to achieve specific conservation objectives under the same management guidelines, restrictions, and permitted uses."

Following the provisions of Art. 2.2.2.2.1.2.1 of Decree 1076 of 2015, the categories of protected areas that make up the National System of Protected Areas may be public or private. In the case of public protected areas, reference is made only to the nature of the entity responsible for their declaration:

- Public protected areas:
 - Those of the National Natural Park System (National Park, Natural Reserve, Unique Natural Area, Flora Sanctuary, Fauna Sanctuary and Parkway) Decree Law 2811 of 1974.
 - Protective Forest Reserves

- Regional Natural Parks
- Integrated Management Districts
- Soil Conservation Districts
- Recreation Areas
- Private protected areas:
 - Civil Society Nature Reserves

According to the Constitutional Court in Ruling C-189 of 2006, it stated: "The National Natural Parks System becomes a limit to the exercise of the right to the private property since the areas reserved and declared for such purpose include not only state-owned land but also private property. In these cases, the owners of the properties affected by such encumbrance must fully comply with the activities permitted in such areas according to the type of ecological protection intended to be carried out. Thus, for example, when a park is declared a "flora sanctuary," only conservation, recovery, control, research, and education activities may be carried out."

It is essential to highlight the legal recognition of nature as a subject of rights to address socio-environmental conflicts, many of which are associated with the rights, restrictions, and responsibilities of those who administer, occupy, or use protected areas. This highlights the need for standardized information that allows for timely decision-making and avoids the need to reach judicial instances for example, sentences, **Atrato River**, its basin and tributaries as a subject of rights recognized in the Tutela Ruling T 622 of 2016. **The Colombian Amazon**, recognized as a subject of rights in Ruling STC 4360 of April 2018. Within this biome are comprised 17 protected areas of the Colombian National Natural Parks System. **Via Salamanca Island Park**, STC 3872 of 2020. **Los Nevados National Natural Park**, a protected area declared subject of Rights in the Tutela sentence No. STL 10716 of 2020., that, through sentences, attempt to resolve situations that should be identified and addressed in less time and impacts on ecosystems by the different institutions and communities related to protected areas.

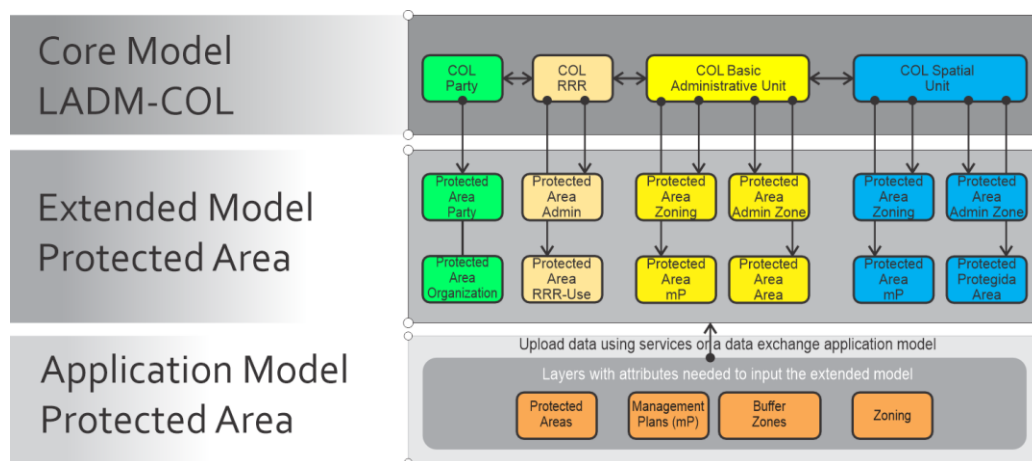


Figure 2. Ecosystem of LADM_COL models of the protected area territorial object and its hierarchies. Source. SwissTierras Colombia

5. CONCLUSIONS

Although environmental protection is a subject that generates much positive sentiment globally, it involves significant debate due to the restrictions it places on human activities. They stimulate resistance when either the economic productivity of land or the established way of life is disturbed. This is especially relevant in a country like Colombia, where the presence and strength of various legal and traditional rights are diverse. Moreover, Colombia is vastly dependent on its natural resources, which play an essential role in social and economic goods and services in its national economy.

For example, the institution of national parks has facilitated the task of preventing loss of biodiversity and wildlife destruction caused by development and land conversion. However, because of the level of enforcement, right holders, particularly in developing countries, are susceptible to establishing such areas. As a result, they lose their access to natural resources, resulting most of the time in forced livelihood changes and are exposed to forced displacement. In this sense, it is essential to improve knowledge bases about the diverse range of rights held in national and environmental interest areas while also promoting the inclusion of the right holders in participatory decision-making processes. In this respect, throughout this paper, we have identified the crucial role that cadastres can play in understanding and administering the relationships between people and land.

However, while such collaborative approaches are promoted, it is still generally not clear to what extent existing rights, interests, and uses over land determine the performance of environmental policy implementations. Prescribed environmental measures and the stakeholders involved often focus merely on environmental implications and underestimate the importance of other critical variables: the underlying role of land rights, the establishment of quantifiable indicators regarding community and individual rights, as well as the implementation of instruments designed to deal with those rights are often neglected. Therefore, it is necessary to improve understanding of the relationship between land rights, land uses, and environmental measures—potentially using alternative analysis tools relating to land, not merely the Cadastre. Thus, land administration is not land reform but an essential precondition for the success of land reforms". (Williamson, 2019)

Consequently, there exists no unique formula for selecting suitable approaches to reach the multifunctional goals that environmental protection seeks. The context, including landscape, land tenures, and governance arrangements, constitute some factors that will lead to selecting a particular strategy. However, whatever conservation approach is taken, rights holders and those disturbed by the establishment of the protected areas should be informed and considered. Sensitivity to specific conservation goals, local context, and continuous monitoring are crucial issues.

Finally, taking as a frame of reference the objectives set out by (Paredes, 2022) the commitments of the court rulings that have granted rights to nature, the progress in sectoral

articulation, and the availability of information on the territorial objects prioritized by the environment sector will provide the necessary elements to trigger informed and transparent decision-making processes that lead to conflict prevention and management, harmonization between planning instruments, effective citizen participation, and progress in digital government; all of this on the road to territorial peace and respect for human rights. In this sense, in post-conflict contexts, the aim of state building is building effective systems and institutions of government; establishment of trust and mutual accountability; the notion of rights and obligations by citizens; and a political agenda aiming at the development of an inclusive state in support of an equitable economic, political, environmental and social order.

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BIOGRAPHICAL NOTES

Ana M. Prada Uribe is an Architect with a master's degree in Public and Urban Policy and an emphasis on data analysis. Her work has focused on using information systems and analysis for community and land development policies through a spatial and environmental justice lens. In addition, she has designed, developed, and managed projects using open data and technology to generate local information through collaboration and sustainable relationships between institutions and local communities for disaster management and other challenges such as sustainable development, urban planning, and climate change, among others. She is currently a consultant for the Ministry of Environment and sustainable development on implementing the environmental cadaster and developing the data infrastructure's governance framework for environmental planning and forestry management.

Rosa A. Ladino Parra is a Cadastral Engineer and Geodesist, specialist in Natural Resources Management and Master in Geography. She has worked as a coordinator and analyst of geographic projects with emphasis on protected areas, experience in advising and accompanying territorial and regional entities in the development of their Territorial Development activities, In the definition of the strategy of land use, occupation and management, the design and adoption of instruments and the definition of projects and programs that concretize these purposes, in order to optimize the use of natural and human resources for the improvement of the living conditions of the population. Design of tools to support planning and land management processes at the national, regional and local levels. local level

Andrés P. Guarín López is a cadastral engineer and geodesist with a master's degree in information sciences and communications. During his professional occupation, he has been the

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technical leader in implementing several technology projects, from analysis, design, and development to the implementation stage. In addition, he participated in the drafting of the conceptual design of the new multipurpose Cadaster of Colombia, participated in the conceptualization and definition of the national Profile of the ISO 19152:2012 LADM standard, and currently works for the National Land Agency as a consultant to support the implementation of the Integrated Land System and its compliance with the LADM_COL model in the framework of the public policy for land administration.

CONTACTS

Ana Milena Prada Uribe
Ministerio de Ambiente y Desarrollo Sostenible
Cl. 37 #8-40,
Bogotá
Colombia
Phone. +57 3002119341
Email: amprada@minambiente.gov.co
Web site: <http://minambiente.gov.co>

Rosa Angelica Ladino
Parques Nacionales Naturales de Colombia
Calle 74 No. 11 – 81
Bogotá D.C.
COLOMBIA
Phone: + 57 319 227 70 64
Email: rosa.ladino@parquesnacionales.gov.co
Web Site: <https://parquesnacionales.gov.co>

Andres Guarin
SwissTierras Colombia
Av el Dorado No. 69 - 63, Oficina 406
Bogotá D.C.
COLOMBIA
Phone: + 57 301 489 42 75
E-mail: andresguarinlo@gmail.com
Website: <https://www.swisstierrascolombia.com>

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