The Economic and Social Justification for Cadastral Reform: The Latin American experience

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ABSTRACT

As a contribution to policy formulation concerning cadastral infrastructures for sustainable development in the developing world, this paper focuses on three aspects arising out of the Latin American experience: (i) the current cadastral situation in the region and mainstream trends; (ii) the case of Colombia, the largest and oldest national multipurpose cadastre in Latin America, and (iii) a reference to lessons learned from two recent experiences, linking the role of cadastre databases to the phases of immediate attention, planning, and recovery after large-scale natural disasters occur in developing economies.

Keywords and phrases: *sustainable development, cadastral reform, land titling*

1. The Outlook for Cadastre in Latin America

Cadastral organizations exist in most Latin American nations. They have been operating for decades, under a variety of schemes, in most cases having been developed and still being used for fiscal purposes. While urban cadastres are, generally, managed in a decentralized manner, rural cadastres are linked to central organizations that are part of the national government. In many countries in the region, there are also thematic cadastres (mining, agriculture, etc.) that are directly related to planning processes and the administration of natural resources.

a. The Need for Cadastral Reform

As we near the end of this century, it is clear that this situation is starting to change. Most countries have defined the need for cadastral reform and modernization. In spite of the relevance of fiscal applications in these reforms, sustainable development is also at the core of many of them. Countries like Peru, Paraguay, Bolivia, and Ecuador, where until recently, cadastral limitations were all too evident, today are incorporating modern digital systems to be used by local land authorities, with different and broader purposes in terms of data usage and data access for development (Table 1).

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Table 1
Cadastres in South America: Relevant Features

Country*	National Authority	Urban Cadastre [1]	Rural Cadastre [1]	Thematic Cadastres	On-going Reform [2]	Digital Technology Applied
Argentina	No	State	State	No	Partial	Medium
Bolivia	Yes	Local	National	Yes	Yes	Medium
Chile	Yes	National	National	Yes	No	Low
Colombia	Yes	National	National	No	Yes	High
Paraguay	Yes	Local	National	No	Yes	Medium
Peru	Yes	Local	National	Yes	Partial	Low
Uruguay	Yes	National	National	No	Partial	Medium
Venezuela	No	Local	Local	Yes	No	None

[1] Level of responsibility
[2] Cadastral reform: Process by which modern technology, institutional developments, digital databases and remote sensing information are efficiently combined to improve the quantity and quality of cadastre services.
* Not including Brasil

The main reasons behind this change are related to the trend of economic and social reform in Latin American societies, including the need for administrative reform. Especially meaningful are those activities linked to urban and agrarian reforms where graphic and descriptive lot information is needed to support policy formulation, decision-making, infrastructure development, and to registry/cadastre institutional linkages and land management.

Thus, the role of multilaterally and bilaterally financed development projects, designed to solve large-scale problems due to urbanization, is highly relevant. Of particular relevance are those related to management of the problem of illegally occupied state-owned lands or those aimed at the promotion of community development through better territorial or environmental administration, including land title granting programs, where the owners have limited recognition of their property rights.

b. Information Technology, Data Infrastructures and Cadastre

In terms of the relevant standards for cadastral information, at present, the situation in Latin America shows few signs of improvement. Most nations in the region do not have properly structured nor referenced cadastre information. There are, nonetheless, a few important exceptions. Colombia, for example, follows the standards developed by the USGS/FGDC, since data content is quite similar. Also, this issue is just starting to be

studied within the context of sub-regional markets, i.e., the Caribbean initiative for spatial data infrastructure or the Andean Pact in South America, where building seamless parcel data will influence the development of land transactions and real estate markets in border areas.

Today, the use of cadastral information is still quite limited with respect to policy formulation and decision-making. In every country in the region there is a multiplicity of data, existing as part of old archives, and coexisting with modern databases, which are poorly structured, poorly documented and not referenced to any spatial data infrastructures.

However, the main problem facing the Region is the sustainability of these cadastral reform processes, including resources, technology acquisition, institutional development and a sufficient budget to maintain adequate data production and cadastre conservation. In the developing world, there is a severe lack of long-term policy and continuity. As mentioned above, these reforms are essentially maintained by foreign funding. There is no guarantee about how, once these funds are exhausted, the programs will be able to continue since no government resources are applied to this purpose. In Colombia, after investment in technology, there has been little budget left over for data production.

c. The Role of Multilateral Cooperation in Data Infrastructure Development

The United Nations should be, from the perspective of the developing world, at the center of the development agenda as it pertains to cadastral reform, data infrastructure policy formation, and the sustainability of this process.

Inspired by the UN/FIG works leading to the Bogor Declaration for Cadastral Reform, the UN Regional Cartographic Conference for the Americas (New York, 1997) approved a resolution on the role of the cadastre in spatial data infrastructures. In that declaration, the cadastral vision and the need for re-engineering cadastral systems were closely linked to other resolutions proposing: (i) the creation of a Permanent Committee on GIS Infrastructure for the Americas, (ii) a special working group to determine the future role of the UNRCCs and (iii) for the discussion of problems and solutions regarding the integration of digital cadastral mapping and databases in broader national spatial data infrastructures.

In addition, the World Bank, the Inter-American Development Bank, and aid and development programs under bilateral cooperation agreements, must play a key role in cadastral reform. More specifically, these entities should pay additional attention to the sustainability of these reforms and the renewed character and capacity of cadastral information in terms of development and policy formulation in transitional nations.

2. The Case of Colombia: Multipurpose Urban/Rural National Cadastre

Cadastral activities began in Colombia early this century. Since 1940, by law, the national cadastre is the responsibility of the Agustin Codazzi, the Geographic Institute of Colombia (IGAC).

The Agustin Codazzi Institute is responsible for mapping, cadastre, agrology, geography, and remote sensing activities in Colombia. The IGAC conducts geographic activities at the national and international level, with priority placed on Latin America and the Caribbean region. It was founded in 1935 as a military organization and in 1955, evolved into a civilian entity, which is unusual in South America. The Institute has up-to-date digital facilities and well-equipped laboratories. Since 1965, it has possessed a GIS and remote sensing training center (CIAF), at which 4,500 students from the region have received training.

a. The Need for ICDE, the Colombian Spatial Data Infrastructure

The Institute is a member of the main international geographic organizations, including FIG, and carries out progressive initiatives in the region, such as the Global Spatial Data Infrastructure (GSDI). In Latin America, the IGAC stands out as a key organization for institutional development, technological change, and competitiveness, with a focus on the promotion of territorial development.

Recent production of digital cadastral mapping at large scales for urban areas (1:2000) is significant and the availability of information for other urban applications is increasing rapidly. Still, there is limited capacity to absorb all this data adequately, although there is a growing awareness that cadastral information is important, if it can be made accessible to most users. Data production problems such as: enormous diversification, high costs, lack of standards, quality problems, and poor documentation, are now leading to the development of the ICDE, the Colombian Spatial Data Infrastructure, which is in its initial stages. Expected results include the definition and accomplishment of the following:

* Geographic metadata standards
* Quality standards for geographic standards
* Standards related to basic geographic object cataloguing
* Standards on terminology
* Standards for cadastral information

To accomplish these objectives with respect to the Cadastre database is not an easy task in Colombia nor elsewhere in the Region. Colombia, despite the IT era, has yet to adopt an official national policy concerning the use of geoinformation and the ways in which it will be used to promote wealth and development. In a period of fiscal crisis, there are enormous problems affecting data maintenance and hardware and software updates. The IGAC is facing data needs and SDI challenges at a time when its investment budget has been reduced drastically to the lowest point in 25 years.

b. The Colombian National Cadastre

Originally, the Colombian cadastre focused on mere fiscal applications, or property taxes, in the form of information used at the local level by municipal authorities to collect their main source of income. Later, in the 1970s, as part of accelerated

urbanization processes in Latin America, the cadastre evolved in Colombia as a multipurpose source of information, based on additional lot data collected with different categories, used mainly for territorial and natural resources planning.

The process, however, was greatly affected by technological limitations that began to be overcome in the 1990s when GIS tools, satellite imagery applications (for rural areas where vast landholdings are common), digital processing and the whole array of information technology was incorporated to produce an integrated, national data model called the SIGAC, thereby affecting parcel data formation, updating and mutation.

Data production in Colombia under the aegis of the IGAC is centralized in terms of guidelines. Information is collected in a semi-private fashion via 21 Department[*] level offices. Municipalities are increasing their share in terms of financing. Information is maintained through 46 delegate cadastral offices, which are in charge of mutation processes over areas made up by 5000 lots or more. A good number of these delegate offices are already connected to the IGAC information network. Bogota, Medellin, and Cali (with an aggregate of 11 million inhabitants and being the three largest cities in the country), together with Antioquia Department, for political reasons, maintain independently managed cadastres under the general and technical supervision of the IGAC. There are about 10 million cadastral lots in Colombia, 70% of which are directly under the IGAC's responsibility.

Unfortunately, resources are not available to keep the cadastral system up-to-date and this is leading to controversy, not in terms of justifying the national cadastre but rather, by opening the discussion of the possibility of increased decentralization. This could put at risk the coherence of cadastral information in times of ICDE/SDI development (Table 2).

Despite this difficulty, the IGAC is trying hard to introduce additional technical modernization to the Colombian Cadastre. Internally, the IGAC is in the process of consolidating the cadastral database by (i) increasing data quality, (ii) improving data precision (position), and (iii) improving parcel information by updating and providing user data-access. Also, the IGAC is designing applications to convert IGAC/GIS into an expert system to:

- Produce automatic valuations
- Provide dynamic conservation of cadastral information
- Automatically produce map certificates and cadastral charts
- Provide digital parcel archives
- Automatically produce thematic applications and charts
- Produce any type of alphanumeric reports
- Apply historical database options to capture geometric and alphanumeric information related to parcel information
- Use orthophotos in rural cadastral activities

[*] The term, Department, in Colombia refers to a geopolitical level, similar to State in the United States.

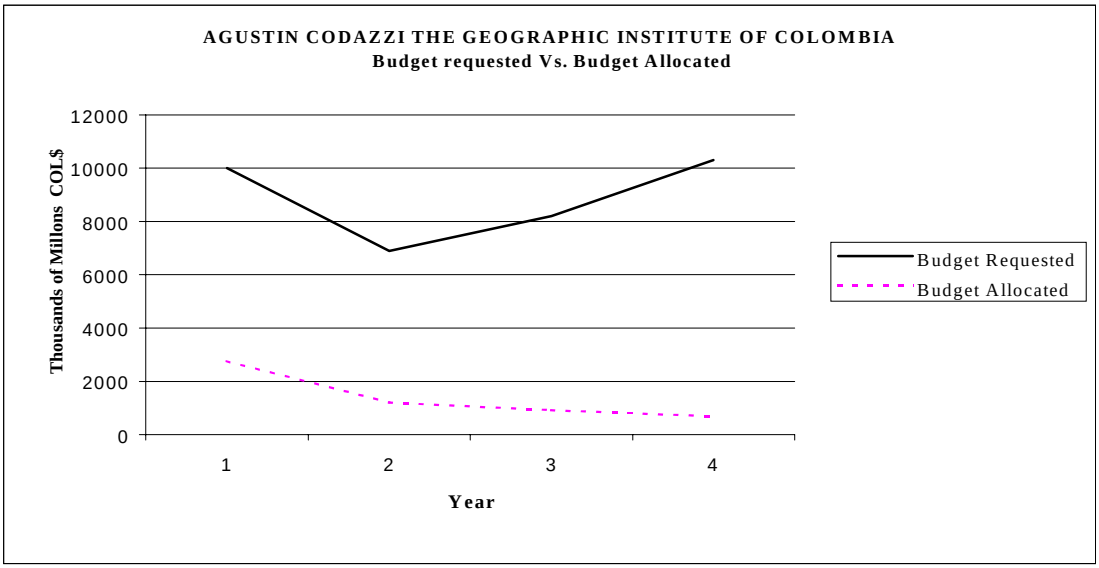
- Apply GPS technology to rural/urban data capture
- Use digital photogrammetry and digital cadastral mapping technology to capture urban information, especially in the large cities.

Table 2
The Colombian Cadastre: Allocated National /Local Funds, and Cadastre Production

Year	National Budget ratio*	Municipal Budget ratio*	Total Budget ratio	Updated Lots**	Lots Maintained**
1995	27.65	8.58	36.23	1,198	787
1996	17.75	14.71	32.46	501	939
1997	11.22	24.15	35.37	1,387	785
1998	6.58	17.01	23.59	504	771

* Requested/approved funds
** Thousands of Parcels

Figure 1
Colombian Cadastre
1995-1998 Budget requested vs. Budget allocated



Externally, in terms of user-oriented requirements, the IGAC is improving service to (i) provide digital, updated cadastral information for municipalities and other local level clients/users; (ii) deliver updated information periodically; (iii) efficiently advise clients/users on the appropriate use of cadastral information; (iv) gradually set up a clearinghouse system and (v) electronically link registry and cadastre databases. All these developments will be attained within the concept of the Colombian spatial data infrastructure, the ICDE.

3. Agenda 21: Natural Disasters and the use of Cadastral Information

Two natural disasters of great magnitude have occurred in Colombia over the last twenty years: the eruption of the Nevado del Ruiz volcano that destroyed the town of Armero (Tolima Department) and the earthquake that struck the coffee growing region, destroying more than 40,000 homes.

In both cases, the information stored in the Cadastral Office database played an important role in defining the following points, among others:

- Who are the landowners?
- Who only owns buildings?
- What is the value of the land?
- What are the building features?
- How is the land used?
- What land is located in the risk zone?

When the Armero tragedy occurred in 1985, the Colombian Cadastral Office was in the process of digitally converting the attributes (the land registry ledgers), but graphic information was left on paper. After the eruption, Cadastral maps were used to provide the information needed to identify landowners and land holders in general, since the town, containing approximately 10,000 urban properties, had been completely destroyed. The owners' names and real estate appraisals were required to provide aid to the inhabitants through housing relocation and economic subsidies. In addition, information on property located within the risk zone was provided by INGEOMINAS[1].

To further this process, the following data was extracted: the owner's name, national identity document number, property address, property use, and appraisal. This information was manually cross-referenced with the cadastral map, which contained the graphic portion of the land registry, to determine whether the applicant was, indeed, the owner or the owner's next-of-kin. This tragedy had resulted in more than 20,000 dead and their survivors had the right to receive an economic subsidy and new housing if they were able to prove that they lived on a piece of land wiped out by mthe landslide.

While the lots affected by the volcanic eruption and their respective owners were being identified, the properties located in the volcanic influence zone were also identified, in order to avoid new, potential tragedies. The Geological Institute drew up the map (on paper), classifying the zones according to the level of risk (red–orange–yellow) and the Cadastral Office indicated which lots were located in which zones.

The procedure was carried out and all the information on paper was manually superimposed, thus producing a new map. Next, a list was drawn up in which each plot of land was classified according to risk level. The national government defined the

[1] INGEOMINAS is the Colombian Research Institute on Geociences, Mining, and Chemistry

usage for each zone, based on its features, and further defined the type of public investment to be made in each case.

Although the information was on paper, the Cadastral Office activities did produce the expected results both for landowners and government entities, in terms of obtaining the information needed to carry out their specific processes. During this event, the land information system (although analogous) fulfilled its main purpose of serving as an information source to aid the decision-making process.

On January 25, 1999, an earthquake struck the Colombian coffee-growing region located near the Andes Mountains, which is a model of Colombian development. The affected area contains 350,000 parcels, of which 90,000 suffered damage ranging from light damage to complete destruction. These parcels are located in 28 municipalities, of which Armenia, La Tebaida and Pereira were the most affected.

In 1999, thanks to the fact that the Land Information System (LIS) implemented at the Colombian Cadastral Office had undergone a modernization process, the main Colombian cities had a land information system that included, for the urban areas, land registries and topographical information and for the rural areas, this same data plus soil information. Despite the enormity of the tragedy and the extension of the affected area, the coffee growing region had updated information available (from the last six years), most of it in digital format.

Unlike the case of Armero, the main task in this disaster was to attend to reconstruction of urban centers and housing relocation. This meant that the cadastral information had to respond to various needs. The day after the tragedy, a new aerial photograph of the town of Armenia (the most affected municipality) was taken by the IGAC and then digitally processed, thus enabling identification of the parcel blocks where buildings had totally caved in. This allowed an initial count of the most seriously affected property.

The town of Armenia was the central axis of the destruction and therefore, the main focus for reconstruction. There was damage in several neighborhoods to buildings of differing heights and various uses. This required carrying out intensive fieldwork to enable classification according to the degree of damage.

The parcels that were totally damaged (where the buildings had disappeared) were quickly identified and updated in the Land Information System. This was done, in most cases, by selecting the whole block and erasing all attributes describing the destroyed building at the level of the building on the property lot. By logically linking the tables, the lot level information was updated to eliminate the building value from the total lot value.

Identification of minor or slight damage was the most detailed process since in some cases, the building was only partially affected and this made it difficult to detect the damage. Upon completion of the total census of the lots, the Land Information System was completely updated in terms of the physical aspects of the land and buildings, since this data is entered in the system on a daily basis.

At that point, cross-referencing was carried out between the Land Information System and the information kept in the Notary Public's Office and Registry Office, to update any possible changes to the property. The process was agile, since the identifier assigned to each lot by both entities is kept at the LIS. With the cross-referencing of this information, the owners of the affected property could all be identified.

The data regarding persons, who own only the building but not the land, is stored and kept in the LIS. Depending on how well the LIS is maintained, these persons may or may not appear in the list of affected people. However, in the case of the coffee-growing region, the updating and maintenance processes at the Cadastral Office ensured that data for both owners and land was current. The maps showing the zones affected and classified according to the degree of damage, the uses of each lot, and whether or not they were located in geologically active zones, were generated automatically by feeding the SIG with certain external data.

The maintenance of data stored at the Cadastral Office and its level of detail resulted in it being the most important information used to carry out the reconstruction process during the initial stage, when it was necessary to identify the degree of damage to owners and land and to write up a detailed description of the damage suffered to each building.

Conclusion

This paper, in addition to examining cadastral reform and modernization, also takes a critical look at the experience in Latin America and in particular, Colombia's current situation, in terms of the need for cadastral sustainability in emerging economies. Special efforts must be made to raise awareness at the highest levels of government. A practical example can be observed in the role cadastral information plays in the prevention, attention, and recovery of areas impacted by natural disasters in developed or underdeveloped regions, located in urban and rural centers in transitional nations.