Analysis of the Multipurpose Cadastre use for Risk and Disaster Management in Colombia.

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Key words: Cadastre, Land Administration, Risk, Disaster Management, Spatial Data Infrastructure.

SUMMARY

Currently, in Colombia, cadastre is a field with a very limited range of development. It is outdated in 63.9% of the 15'768,188 identified properties in the country and has not yet been implemented in 28.5% of Colombian territory (IGAC, 2015). Moreover, is inefficient in the field of mapping and data gathering, which doesn't have an optimal standardized process that gathers the necessary tools, in order to avoid inadequate and redundant activities that can lead to a higher cost of public policy implementation. For this reason, the Colombian government has proposed a new design for a multipurpose cadastre system within the peace process framework, with the objective being to improve information on property to prioritize public investment and guarantee property rights and regulation.

In accordance with the previous arguments, the objective of this paper is to analyze the use of this new cadastre system in risk management and indicate the importance of the integration of these two tools to identify, analyze, evaluate and treat the possible risks. The way in which the integration of land administration information processes and risk management is considered essential for the achievement of effective practices and agile response to hazard events in developing countries will be studied. Also, the role and function of the multipurpose cadastre will be evaluated and the way in which it could support risk management through technical aspects and institutional changes.

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1. INTRODUCTION

Today in Colombia, the cadastre system is significantly underdeveloped. It is outdated for 63.9% of the 15,768,188 identified properties in the country, and it has not yet been implemented for 28.5% of Colombian territory (IGAC, 2015). Additionally, mapping and data gathering are inefficient; there is no optimal standardized process used in order to avoid inadequate and redundant activities that can lead to higher public policy implementation costs. Historically, Colombian cadastre has been used mainly as a tool for property tax collection, but even for this function it is still not well developed as the quality of parcel-evaluation differs throughout the country. In addition, it is not used as a planning tool for environmental, territorial, agricultural, infrastructure and property rights protection policies as many of these functions use their own reference maps.

Considering these limitations, the Colombian government has proposed a new design for a multipurpose cadastre system as part of the peace process framework. The main purpose of this new design is to prioritize public investment and guarantee property rights and regulations. The design and implementation are defined in the national policy document named CONPES 3859. However, in this document, the importance of the cadastre in risk and disaster management is not mentioned.

All countries have to deal with land management in terms of tenure, value, use and development. That is why it is vital to develop a cadastre, which allows to be the support for the prevention and management of disasters, so the objective of the paper is to analyze how the multipurpose cadastre is a fundamental tool to integrate the land administration with the risk management. Likewise, the existing theory will be examined, which will make it possible to clarify the concepts, it will show the importance of collaboration of entities to develop a solid information system and cases will be shown where having had a cadastre and an adequate land administration system would have been fundamental to avoid tragedies.

It is crucial now, in Colombia, to implement a policy that meets the needs of the country and that can correct the flaws and inconsistencies that have arisen around the cadastre, land administration and disaster management. This investigation has been carried out with the aim of giving some relevant conclusion in the process of transformation of a fiscal cadastre to a multipurpose cadastre, considering the importance of the cadastre as a basic input for risk management, an issue that can be defined as the relationship between a growing population and its use of land, and the prescient necessity for sustainable development.

2. CONTEXT

Currently, in most countries, cadastre and risk management work within separate institutions with no shared purpose, resulting in a lack of coordination and interactivity between them. Similarly, the advances in each institution are different one from each other, causing delays in processing and exchanging information. Furthermore, the lack of communication between public and private agencies, and the absence of data sources that allow for finding information in real time are making it difficult to have easy access to all the information available, which is important to consider when making decisions that can influence government and society development. When we make decisions it is important to have as much information available as possible, in order to have a complete view of the situation. In many countries, information is spread over a variety of organizations, which can generate confusion, delays, and higher costs. As a result, it is important to take a holistic approach between cadastre, land administration, and spatial data infrastructure, one that integrates the varying information and uses it to improve risk management.

2.1 Conpes 3859 Multipurpose Cadastre In Colombia

Law 1753 of 2015, National Development Plan 2014-2018, Article 104, orders the implementation of a multipurpose cadastre that accounts for the economic, social, and environmental functions of property. It also orders the implementation of a National Land Administration System that takes cadastral information and the registration of property through established standards into account. For this reason, and due to the multiple failures in the Colombian cadastre as well as the new cadastral requirements for the new peace framework in the country, CONPES 3859 was created.

In Colombia, Law 19 of 1958, created CONPES (National Council of Economic and Social Policy), which is a government advisory organ for economic and social development cases in the country. It is the highest national planning authority, it studies and recommends general policies to be implemented, and coordinates delegate authorities.

CONPES 3859 is the policy that sets out the adoption and implementation of a multipurpose cadastre, the objective of which is to "Implement a complete, up to date and reliable multipurpose cadastral system that is consistent with the real estate registration system and integrated with other information systems. It should improve the guarantee of property rights, contribute to fiscal strengthening, and strengthen strategic planning and land management." The document CONPES 3859 is endorsed by the President of the Republic of Colombia and all his ministries; it has the support of the National Planning Department, the Agustín Codazzi Geographic Institute, the Superintendency of Notaries and Registry, the National Land Agency, and the Department of National Statistics.

The CONPES 3859 seeks to develop different plans of action, which can be summarized as follows:

Table 1. Summary CONPES 3859

Economic ●Creation of observatories for the real estate market and the normative adaptation and optimization of territory appraisal procedures. ●The implementation of a financing plan, the multipurpose cadastre will cost COP $2.61 billion, approximately US$870 million, for an eight-year period, cost that will be approximately 63% financed by the municipalities, 16% by the departments, 18% by the national government, and 3% by international cooperation.	**Physical** ● A national cartography plan will be implemented, which will generate a new basic cartography. ● The geodesic network will be re-densified and consolidated. ● A new National Registry of property recognizers will be created. ● International standards will be adopted, such as ISO 19152:2012 LADM.
Legal ●The registration-cadastre statute will be issued. ●An integrating norm will be created, one that allows for unification and updating. ●Technological interrelation will be generated between cadastre and registry. ●Boundaries conflicts of will be resolved.	**Institutional** ● The cadastre institution will be strengthened. ● There will be third party participation (private, public, academic sectors), which will be in charge of formation, updating, and planning activities. ● A National Land Administration System will be created. ● It is proposed that the adscription of the cadastre entity is handed over to either the planning sector or the financial sector. ● The technological platforms will be adjusted.

2.2 **Risk management**

The world has lately seen an increase on efforts towards reducing disaster losses and damages as part of a global initiative on reducing disaster risk. However, factors such as population growth in hazard exposed areas, rapid urbanization, environmental degradation among others, have developed on an increased global risk (CRED, EM-DAT, & UNISDR, 2016). Different strategies forming part of this effort agree on the need to improve and widen the collection practices to better understand how to reduce disaster losses and damages. The decision making process, together with the socio cultural aspects of the community are the key aspects shaping the resilience and vulnerability of a community; therefore, it is important to pay more attention on such aspects during the aftermath and prevention of a disaster.

Currently, the effects of climate change have been the subject of arduous studies, catastrophic events such as floods, earthquakes, hurricanes, tsunamis, are increasing their intensity and frequency of occurrence, due to both climate change, population growth, excessive exploitation of human resources and agricultural production systems, among others. In

Colombia, 86% of the population is exposed to a high and medium seismic threat, 28% to a high flood potential and 31% to a high and medium threat by landslides. (OSSO-EAFIT Corporation, 2011). Likewise, on average 4,650 homes are lost per year and 25,911 are affected by natural phenomena and anthropogenic events.[1]

Unfortunately, despite of the inclusion of land use and urban planning as a mean to strengthen disaster risk governance to manage disaster risk in the Sendai Framework for Disaster Risk Reduction (UNISDR, 2015), risk management has not yet been fully considered in the land administration system of many countries. Such is the case of Colombia and its more than 100 million USD investment on risk mitigation and vulnerability reduction, where none went (2015-2016) to restructuring land administration systems for non-structural risk mitigation as land use planning or cadastre improvement.

3. **METHODOLOGY**

An analysis of the document CONPES 3859 MULTIPURPOSE CADASTRE IN COLOMBIA was carried out to identify whether the importance of the cadastre as an input for the management of emergencies and disasters is shown within the policy. Likewise, the national disaster risk management policy was analyzed to observe the characteristics, advances or possible shortcomings that are presented in the National Disaster Risk Management System. In this context, two cases were studied where the cadastre would have been a fundamental tool to reduce risk and avoid disaster.

On the other hand, the model developed in the thesis "Using Land Administration for land risk management" (Katie Potts, 2013), which points out the importance of the integration of these two processes to identify, analyze, evaluate and treat the possible risks, avoiding leaving the community vulnerable, was taken as a basis. This model was used to identify recommendations that must be taken into account to take advantage of the new multipurpose cadastre as an essential component for territorial planning and the National Disaster Risk Management System.

[1] Análisis de la gestión del riesgo de desastres en Colombia: un aporte para la construcción de políticas públicas –Bogotá, Colombia: Banco Mundial, 2012.

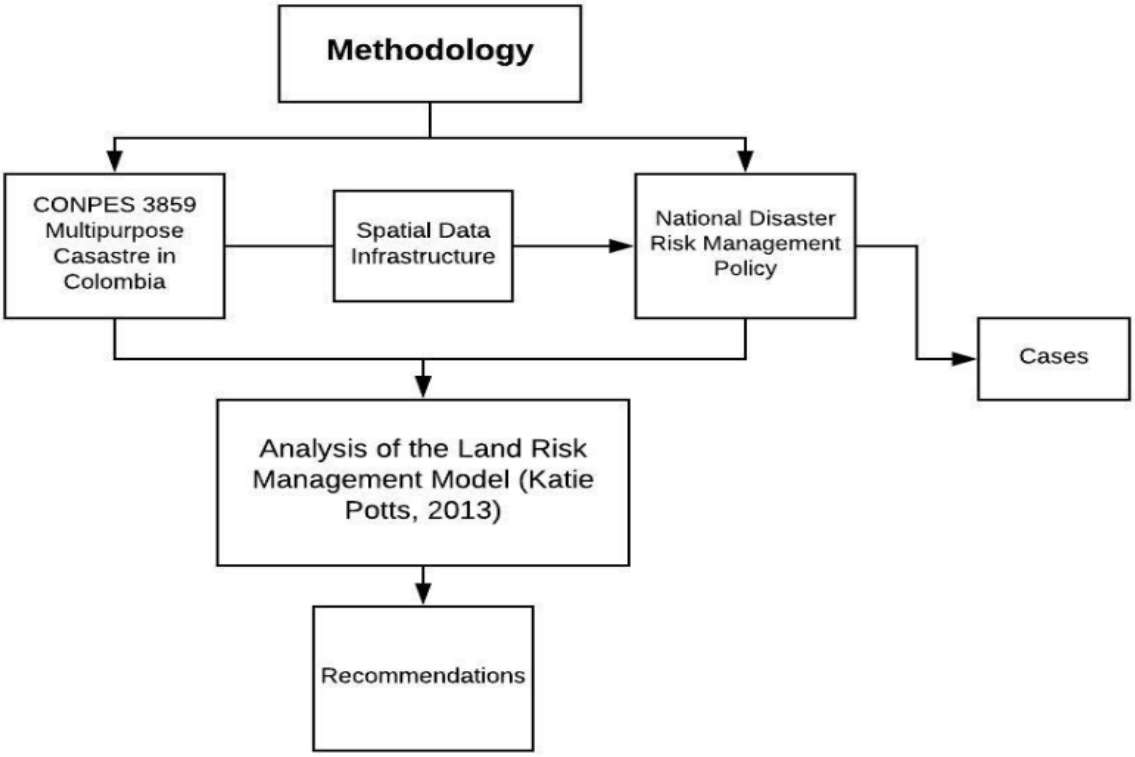

Diagram 1. Summary of the Methodology

The Land Risk Management Model developed by Katty Potts in 2013, considers 3 general aspects: Context, Land Risk Management Process and Social Outcomes. In this context, it allows analyzing the situation of the country, the institutions involved, the existing risk levels and the different stakeholders. The Land Risk Management Process consists of five main elements: the risk management process, infrastructure´s information, land administration data, users and stakeholder relationships, and data and exchange maintenance. At this stage, the fundamental relationship with land management and the importance of cadastral data to make decisions and generate risk mitigation alternatives and a more resilient community is evident. Finally, the social results allow the community to have access to the information and that the authorities have useful and up-to-date information for decision-making, generating an awareness in the owner of the risks they have and the information of their property can generate efficient mitigation alternatives that allow losses and damages to be lower when facing a disaster event.

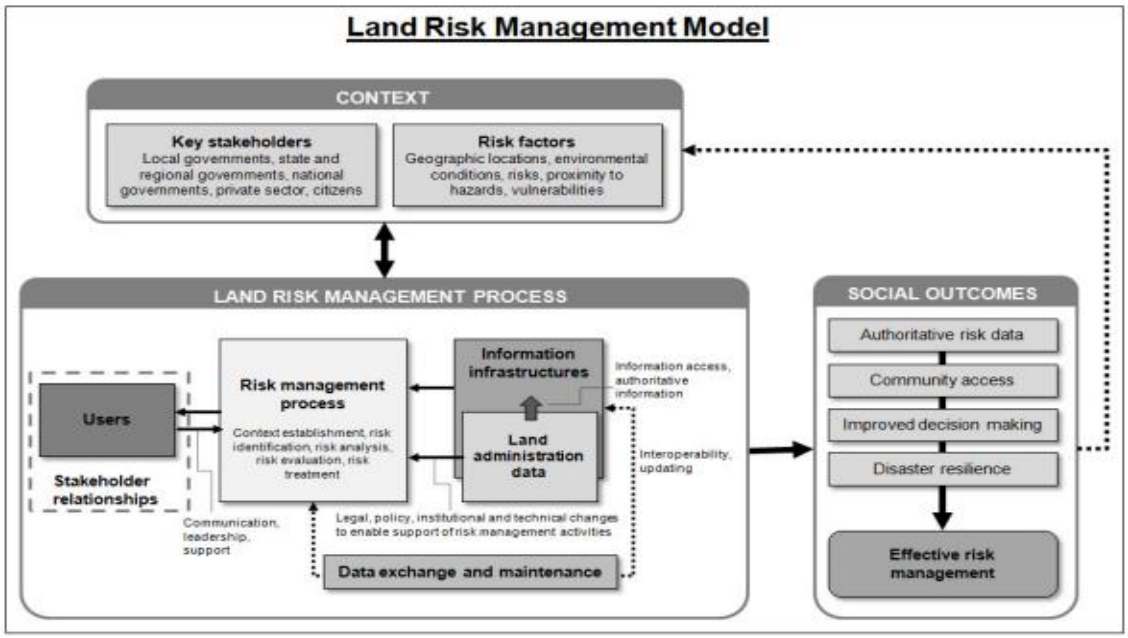

Diagram 2. Land Risk Management Model. Source: Thesis Potts K.

Finally, when analyzing this method and the Colombian context, it will be shown how the cadastre being the basis for the generation of security in land tenure will impact the ability of citizens to respond and recover from a disaster. In addition, recommendations will be generated that allow the multipurpose cadastre to be an essential input for disaster risk management and take advantage of the new generation of land data to design more up-to-date policies in accordance with the needs of the country.

4. ANALYSIS

The multipurpose cadastre is a tool that provides large amounts of information on the characteristics of a territory. The information that describes the nature and location of a particular threat could be used to help those interested in implementing effective management of easily accessible practices to manage the risk and improve the response of communities to an eventuality. Bearing in mind that the majority of risks are related to land, it will be easier to understand potential risks to which communities are exposed and in this way they could be the first to take an initiative to prevent or respond to a risk event.

It is important to have clarity in the concepts and see their relationship, so in the following diagram is possible to see the relationship between the most important components to generate a spatial enable society.

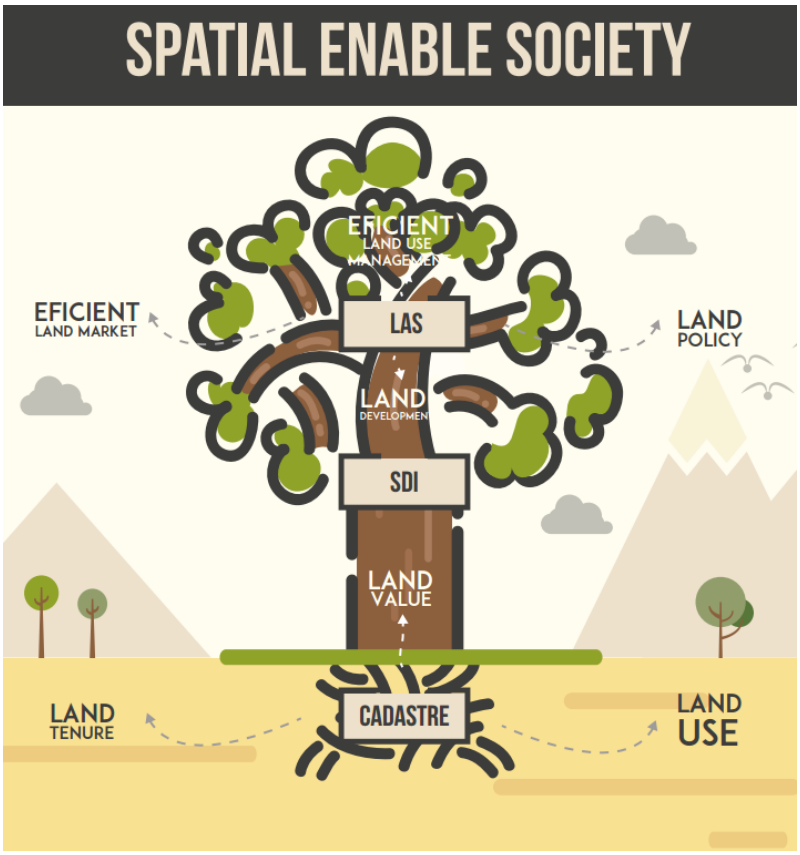

Diagram 3. Tree Spatial Enable Society

In the roots, as the basis and foundation of the tree for growth is the cadastre, which is closely linked with tenure and land use. Following is Land Value, which is an economic factor, derived from the form of use and land tenure. The spatial data infrastructure represents the trunk, giving the tree the shape and strength, generating support for the connection between the cadastre with land administration systems. Inside the trunk there is a network of tubes that carries water and nutrients essential for the support of the entire tree. In the same way, SDI connects large volumes and varieties of necessary data, permits the network of spatial web services, integrating all the information between the cadastre and LAS. In addition, LAS is located on the crown of the tree, connected with land policy, efficient land use management and land market, which all need cadastre and SDI to be performed. Therefore, we will have the essential information to generate an efficient risk management system that allows us to identify, analyze, evaluate and treat risk, allowing us to identify the exposure and vulnerability of communities. All of these components result in this basic formula to integrate wide varieties of information and permit a spatial enable society, in which the relationship between man and land is the only reason for this tree to continue growing and not be cut off.

The holistic approach between Cadastre, SDI, LAS and Risk Management is founded in the relationship between land and people, along with the way in which this relationship has advanced throughout the years and their eternal search for correct and optimal resource

management. It is important to highlight an additional component in this relationship, which is technology. Technology is a central component of our dynamic world, and therefore it becomes an important part of this relationship between land and the people who use it.

Diagram 4. Global perspective of the holistic approach between Cadastre, SDI, LAS and Disaster Risk Management.

It is necessary to realize that the consequences of a disaster and risk event have social, economic and environmental implications. So it is necessary to have clear rights, responsibilities and duties to ensure security of land access and land tenure for the vulnerable communities. Land administration assists prior to a disaster through promoting the importance of land tenure systems to mitigate the impact and facilitate disaster management and resettlement, and secondly, after the event, by supporting a tenure-aware resettlement and reconstruction process (FAO, 2014).

In Colombia, cadastre, Land administration and Disaster Risk management work within separate institutions with no shared purpose, resulting in a lack of coordination and interactivity between them. Similarly, the advances in each institution are different one from each other, causing delays in processing and exchanging information. Furthermore, the lack of communication between public and private agencies, and the absence of data sources that allow for finding information in real time are making it difficult to have easy access to all the information available, which is important to consider when making decisions that can influence government and society development. As a result, is necessary to integrate the varying information and uses it to improve resource management and build resilience communities. Building resilience in communities involves recognizing, recording and recognizing legitimate property rights to land that exist prior to a disaster, which will lay a solid basis for reconstruction, physical planning, compensation and economic growth (FAO/FIG, 2011).

In CONPES 3859, regarding risk and disaster management, the topic is mentioned in the relationship between the multipurpose cadastre's goals with the Sustainable Development Goals (SDG) section. Nonetheless, the participation of the National Unit for Risk and Disaster Management (UNGRD)[2] was not taken into account. This unit could contribute in the reformulation of the multipurpose cadastre by establishing a cadastre with the capacity to form a resilient country, in which not only natural risks are dealt with but also physical, chemical, and biological ones. For instance, the cadastre could provide data pertaining to prevalent construction materials, building heights, property conservation states, evidence of proximity to bodies of water, location of pipeline network, etc. Also, according to CONPES, a Cadastre-registry Committee will be created, however, the participation of institutions responsible for risk management is not taken into account, nor an action plan so that the information resulting from the multipurpose cadastre is used to generate mitigation and response policies to disasters.

In Colombia's National Plan for Risk and disaster management, one of the projects for the 2015-2025 period is to strengthen cartographic information related to the cadastre. This shows the importance and the connection of the cadastre as an input to develop risk management strategies and policies in the country. In countries like Australia and New Zealand, the public services network is thoroughly identified. Similarly, schools, universities, hospitals, fire departments, police stations, public buildings, parks, and constructions that need to be identified during an emergency can be easily located. In Poland, in November 2015 the K-GESUT plan was implemented; its main objective is to compile a unified and updated database of the geodetic public services network. This is available at geoportal.gov.pl.

On the other hand, the Colombian Spatial Data Infrastructure (ICDE by its initial in Spanish) is not being considered as a fundamental connection tool; this tool, if updated and strengthened, will allow information to be shared with the interested entities and new opportunities will arise because of this sharing of information, which could reduce cost and allow for the implementation of new technologies that enable new services in transport, infrastructure, economy, government and a higher quality of life, giving way to the development of smart cities.

[2] Unidad Nacional para la Gestión del Riesgo de Desastres (UNGRD)

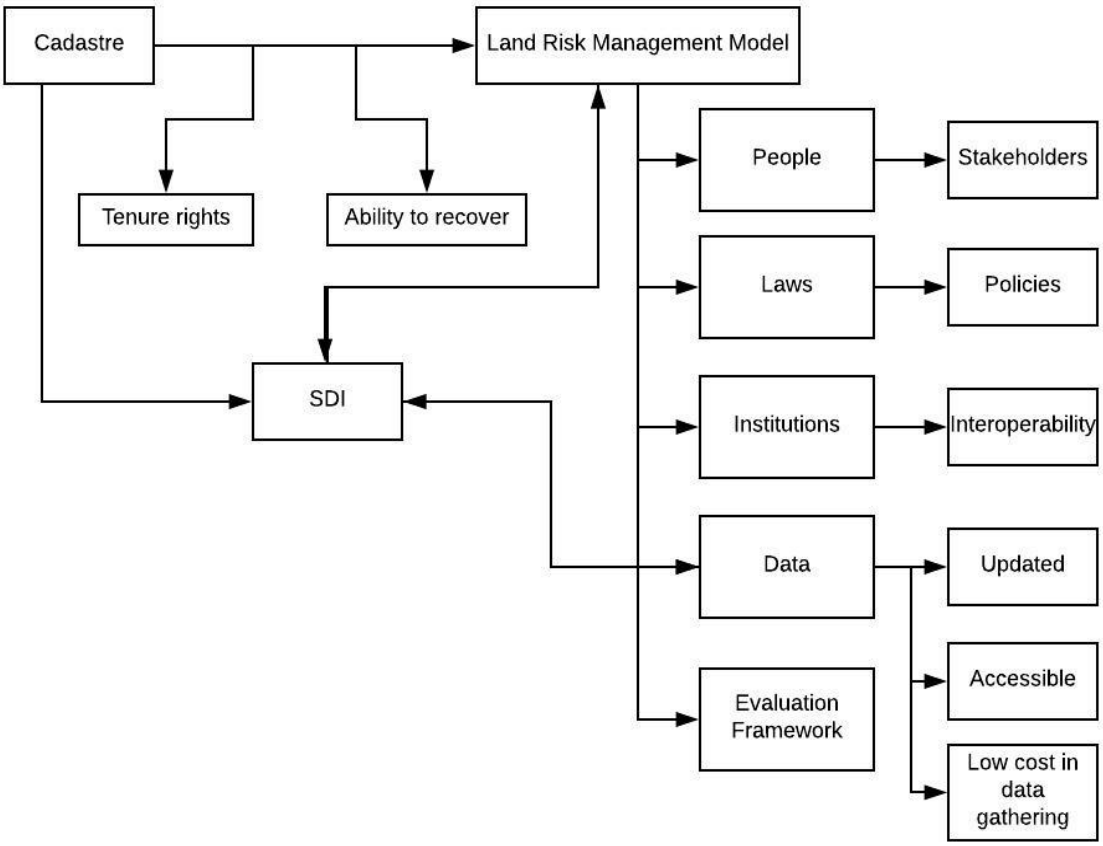

Diagram 5. Basic components Land Risk Management Model

Moreover, is important to apply a clear evaluation framework, that provides for the possibility of change, and for meeting the country's varying requirements over the years as land matters are always dynamic and subject to change. If an evaluation framework is not taken into account, in a few years the data may be outdated and useless. Kaplan and Norton (1996) suggested that "You can't improve what you can't measure and if you cannot measure it, you cannot manage it".

4.1 **Cases**

4.1.1 The Forest reserve adjoin to Bogotá

Bogotá has the Protective Forest Reserve (RFPBOB), which has 14,150 hectares; it's one of the biggest forest reserves next to an urban area. It is part of the orographic system and the districts main ecological structure. Through here, the regional connection of Bogota with the national parks of Chingaza and Sumapaz is made. Moreover, many hydric sources are born in this territory where a great variety of environments coexist. Nowadays, more than 10,000 forest fires occur every year in the world (NOAA), which in average represents 1% of a country's GDP in expenses. In Colombia more than 60,000 hectares are burnt each year and only in the RFPBOB, around 2500 hectares in the last 15 years, fires of which more or less 90% have been

generated by humans. This is why having a perfect identification of the territory, is a key to generate a prompt response to the emergency. If it is clear the characteristics of the land, its use, proximity to fire stations, available natural resources, it is possible to identify immediately the best way to respond to the emergency. Likewise, allows optimizing resources and decisions facing forest fire control and help to reinforce the elaboration of prevention plans and survival guides.

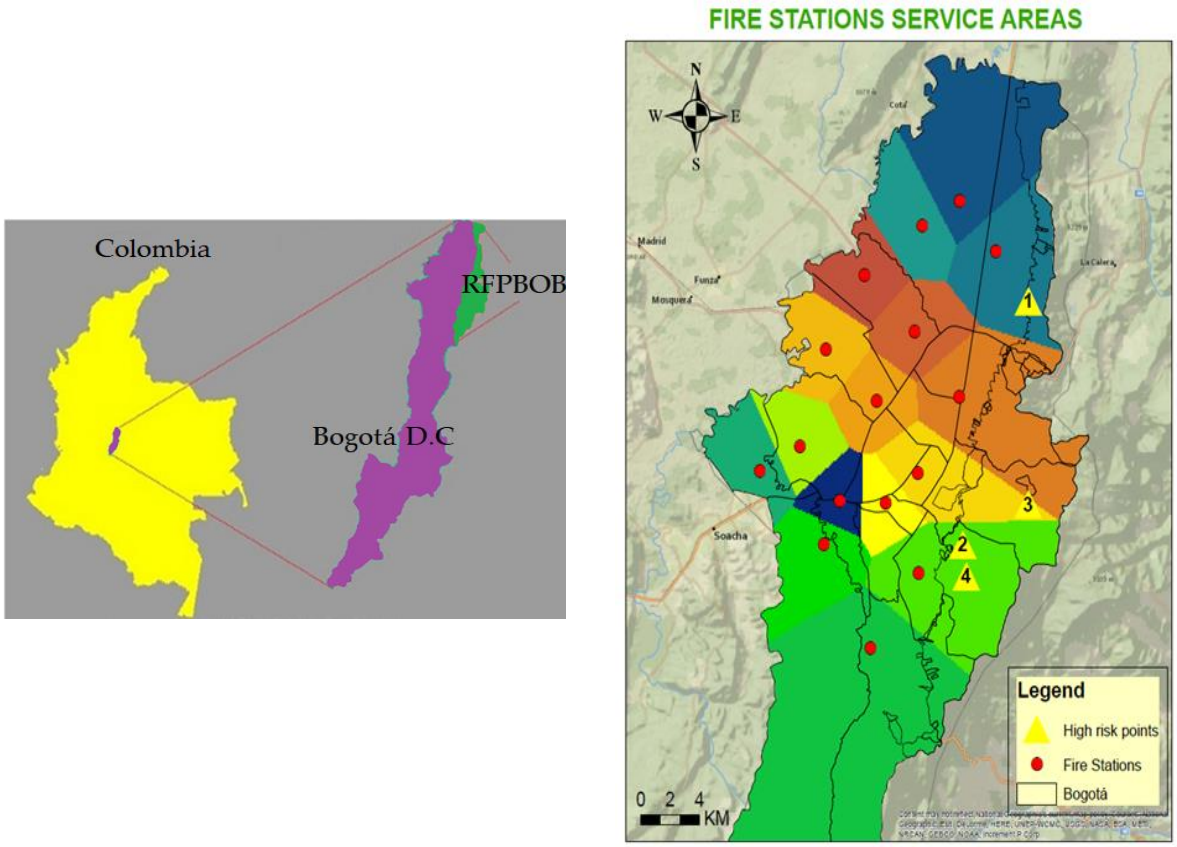

Diagram 6. Map RFPBOB and Fire Stations Service Areas

4.1.2 Mocoa

Located in the Northwestern part of the Colombian amazon region in the south of the country, Mocoa is a city with an approximate area of 1.263 km2, corresponding to 0.11% of Colombia's territory and 0.26% of the Amazon region. Mocoa has characterized itself for having received people from the region, most of whom are victims of forced displacement caused by the armed conflict and the strong drug production.

For almost 400 years, Mocoa was a town with no considerable growth, but from the beginning of the XX century its urban limits started to progressively grow. But this growth boosted the creation of informal settlements in high slope areas and river rounds.

From 1998 to 2005 Mocoa saw the entry of almost 13.000 people, forcing it into an abnormal land use change, where the periphery of the city became the new home of most of this newcomers whose socio-economic situation was less than favorable (Sánchez Steiner, 2006).

The new settlements saw the construction of wooden houses (29%), unstable houses (18%) and masonry houses (53%), where a 46% of the newcomers shared their house with 2, 3 or more families, leading to the densification and overcrowding of these areas. Moreover, in this settlements approximately an 86% of the population had no land tenure at all (Sánchez Steiner, 2006). The Diagram 7 illustrates the allocation of the 2000-2004 new-settlements considering their grow by 2016.

Diagram 7. Informal settlements in Mocoa allocated in 2000-2004 considering their growth until 2017, before the 2017 mudslides. *Aerial photography from Corpoamazonía (2017).*

Fast-forward to April 1st 2017 to the devastating mudslides that took nearly 300 lives and many economic and social losses in Mocoa, the mainly affected areas, as can be seen in the Diagram 8, were some of those informal settlements established more than a decade before, particularly the northwestern one was completely devastated.

Diagram 8. Informal settlements in Mocoa allocated in 2000-2004 considering their growth until 2017, after the 2017 mudslides. *Aerial photography from Corpoamazonía (2017).*

5. RECOMMENDATIONS

The multipurpose cadastre should be a basic input for the development of disaster risk management policies. It is from the cadastre that the necessary characteristics are identified to determine the different types of risk to which a community is exposed. In Colombia, an interrelation between the cadastral entities and the National Disaster Risk Management Unit (UNGRD by its initials in Spanish) is necessary, which allows the full recognition of the rights, duties and responsibilities of the land, which will contribute to the protection of property rights and will generate security of tenure. This will give an important tool to Colombians to obtain a better capacity to recover from a disaster, having fully identified the territory and its necessities.

Likewise, it is recommended to establish a mechanism that facilitates and favors the purchase of land by the State in risk areas, so that they are not used by vulnerable populations seeking a place to settle. In this way, adequate planning of the territory will be supported and possible risks will be avoided.

On the other hand, it is necessary to strengthen the infrastructure of spatial data so that it is an interoperable platform that allows citizen participation, the periodic update of information and that is easily accessible for the entire population. New opportunities will arise because of this sharing of information, which could reduce cost and allow for the implementation of new technologies that enable new services in transport, infrastructure, economy, government and a

higher quality of life, giving way to the development of smart cities, 3D land property management and urban analytics.

The committee of the multipurpose cadastre will perform technical secretariat functions. It would be ideal if it carry out the evaluation processes and delegate the corresponding corrections and recommendations to the institution in charge. Besides, it is a fundamental tool to make informed decisions and observe strengths, weaknesses, threats, and opportunities.

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BIOGRAPHICAL NOTES

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Ricardo Camacho is a civil and environmental engineer from Universidad de los Andes in Bogotá, Colombia. He has a Master of Science in Civil Engineering for Risk Mitigation from Politecnico di Milano (2016). Currently Mr. Camacho works as Instructor Professor at Universidad de los Andes Civil and Environmental Engineering Department where he leads the Geomatics area and course. His research focuses on land use planning and remote sensing for disaster risk reduction.

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