

# **DEPENDENT ASPECTS OF BRAZILIAN ENVIRONMENTAL LAWS AND NATIONAL TOPOGRAPHIC MAPPING SERIES**

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**ABSTRACT** – This paper presents a discussion concerning some issues between the level of detail and modern scientific approach of the environmental laws and topographic mapping laws, regulations and accomplishments in Brazil that do not allow the Brazilian authorities to enforce environmental laws accurately and effectively. The objective of this paper is to study and analyze the dependence of topographic maps and the effective application of the Brazilian environmental legislation. The application of these environmental laws requires spatial information such as Park and Public Forest limits, Conservation Units (UC) boundaries, location of ecological corridors, and Permanent Preservation Areas – APP limits which must be depicted in official maps. In order to achieve the intended objective we studied the history of the legislation for topographic mapping in Brazil. In a second moment we analyzed the demands for spatial information for the environmental laws compliance and enforcement. The production of the official cartography in Brazil is a Federal Constitution obligation. Consequently, the Brazilian Federal Government complies with the federal legislation about the responsibility for providing society with cartographic services. However there is a critical difference between the cartographic legislation objectives for the country and the results achieved of the mapping services along the Brazilian History. The percentage of the country area mapped at every scale of the topographic map series today are: 81% (1:250,000), 75% (1:100,000), 14% (1:50,000) and 1% (1:25,000). This situation is the main cause of the poor quality of the results of any kind of work that demands for data information from topographic maps of regions where there are not maps at suitable scales. An important consequence for the application of environmental legislation is the absence of maps at medium and large scales and the age of the existing maps, some of them printed 40 or 30 years ago. The national topographic mapping should provide different scales, accurate and revised map series in order to support the organizations responsible for enforcing laws. Although topographic mapping is an expensive activity for the Brazilian society it is essential for any plan or action that aims environmental protection and conservation.

**Key words** – national topographic mapping, environmental laws, permanent preservation areas

## **1 - INTRODUCTION**

The legal environmental protection has become a key task for modern world development. Countries with great natural resources like Brazil invest time and money in regulation projects that have impacts on nature. According to Mittermeier et al. (1992), Brazil has one of the highest biodiversity rates in the world: about 10% of known organisms and 30% of tropical forests can be found inside the country. National topographic mapping should be a reliable data source for the calculation of perimeter, area and length on earth surface, and for the definition of accurate positioning of natural and artificial features. These aspects are directly related to several issues on Brazilian environmental laws, such as the location of permanent preservation areas and native forests suppression; which are essential for application and calculation of penalties fees from environmental crimes law. This reveals a highly dependent relationship between the enforcement of environmental laws and the availability of complete and updated topographic map series.

## **2 – BRAZILIAN TOPOGRAPHIC MAPPING POLICIES**

The National Cartographic System, short SCN, “is not able to supply the map user needs in Brazil, either public or private sectors of the society, to incorporate new technology developments and to improve the quality of the cartographic products”. This is a declaration of the National Commission for Cartography, short CONCAR. CONCAR is responsible for proposing and implementing the Brazilian Federal Government Policies for topographic mapping and for maintenance of the National Cartographic System. Today the percentage of the country area mapped at every scale of the topographic map series are: 81% (1:250,000), 75% (1:100,000), 14% (1:50,000) e 1% (1:25,000) (CONCAR, 2008). It has become common, in the cartographic community, to use the term “cartographic holes” (in Portuguese, “vazios cartográficos”) to refer to the absence of maps in some regions. These “cartographic holes” and the lack of a programme for map revision make the accomplishment of several spatial analysis tasks difficult or even impossible. The problem can be even more critical when the spatial analysis is to be performed for the Amazonian or international boundaries regions.

Topographic mapping is expensive but essentially important for the infrastructure and development of any country. We can learn from the history of some national mapping services that the developed countries have been investing in topographic mapping services (ORDNANCE SURVEY, 2008) (USGS, 2009). In Brazil the first topographic map was printed in 1899 (FARRAN & CINTRA, 2003), around 20 years after the beginning of an official topographic mapping in United States or 98 years after the publishing of the first Ordnance Survey map. The first edition of the “Chart of Brazil at 1:1,000,000” was printed in 1922, and it was the first series of maps that covered the whole country (ARCHELA & ARCHELA, 2008).

The Brazilian cartographic legislation is organized by the National Cartographic System, which is managed by CONCAR. According to Article VII of the Decree-Law # 243 of 1967 “the National Topographic Mapping is intended to represent the national territory through a series of adjacent, homogeneous and updated quadrangle maps (...)”. An example of an activity that demands for basic topographic mapping is the definition and use of a National Spatial Data Infrastructure – NSDI. The decree number 6666 approved in November, 27<sup>th</sup> 2008 defined the NSDI for Brazil. According to this decree the NSDI goal is “to provide high quality of generating, storing, retrieving, sharing, publishing and using geospatial data from federal, state or municipal levels of public administration in order to promote the country development and the production of maps based on rules and standards approved by the National Cartographic Commission”. A NSDI provides a base source for the utilization, evaluation and searching of spatial data by means of a minimum set of patterns of practice, protocols and specification. However, the spatial data interoperability is possible only if a complete and accurate topographic base map is produced and available for all citizens.

### **3 – BRAZILIAN ENVIRONMENTAL LEGISLATION**

According to United Nations Environment Programme, the Brazilian environmental legislation has been considered one of the most modern of the world. The environmental laws in Brazil are established in the Federal Constitution, Criminal and Civil Codes and there is also specific and supplementary legislation at federal, state and municipal levels. The result is a collection of acts and decrees that take into consideration the environment as a basic right of human being. The basis of the Brazilian environmental laws is established in the 1988 Federal Constitution, Article 225, which states: “All have the right to an ecologically balanced environment which is an asset of common use and essential to a healthy quality of life, and both the Government and the community shall have the duty to defend and preserve it for present and future generations.”

There are several government obligations that ensure the effectiveness of preserving and restoring the essential ecological processes and providing for the ecological treatment of species and ecosystems; preserving the diversity and integrity of the genetic patrimony of the country and controlling entities engaged in research and manipulation of genetic material; defining, in all units of the Federation, territorial spaces and their components which are to receive special protection, with any alterations and suppressions being allowed only by means of law, and any use which may harm the integrity of the attributes which justify their protection being forbidden; demanding in the manner prescribed by law, a prior environmental impact study for the installation of works and activities which may potentially cause significant degradation of the environment.

The environment protection is also ruled by the normative acts. Among them the most important is the act 6938/1981 which establishes the Brazilian National Policy for Environment. The policy for environment comprises goals and proceedings, formulation

and implementation mechanisms for protection and use of the nature resources. This act creates the Environment National Council (CONAMA), a government agency subordinated to the Ministry of the Environment, Water Resources and Legal Amazonian Region (MMA) and the Environment National System (SISNAMA), which represents the integration of activities of the three spheres of government - federal, states and municipalities. The Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) is the federal agency in charge for the implementation of this policy. Other important environment-related acts are:

- Act 4771/1965: establishes the forest code;
- Act 4118/1962: provides for the nuclear power national policy;
- Act 9985/2000: establishes SNUC – the National System of Nature Conservation Areas;
- Act 9433/1997: provides for the water resources national policy;
- Act 11284/2006: provides for public forests management;
- Act 11428/2006: provides for use and protection of Atlantic Forest Biome;
- Act 9605/1998: the environmental crimes law.

Some of these legal mechanisms and their relationship with geographic features can be listed (TABLE 1) in order to show the necessary use of topographic maps. In this paper, we focus on the Forest Code and the Environmental Crimes Law, which are some environmental laws under direct influence of topographic mapping products.

### **3.1. Act 4.771/1965 – The Brazilian Forest Code**

According to Wainer (1995) "the evolution of environmental legislation in Brazil dates back to the Portuguese rich legislation on the matter, as we were a Portuguese colony until the beginning of XIX century. [...] Those rules aimed at protecting the Brazilian riches which supplied the mother country, especially wood, used to foster the commercial navy." As Brazil became an independent country, it began to work in its own collection of regulations, including the use of its natural resources.

The first Brazilian Forest Code was established in 1934, based on the need of setting limits on what seemed, according to Ahrens (2003), "a plundering of forest resources". The government had to intercede, withdrawing from the land owners the unrestricted right of destroy forests and other vegetation forms. Thirty one years later, the new Forest Code was established, reflecting a policy of state intervention on private land ownership. It was conceived in order to protect soils and water as well as to provide stability in the timber market. It is argued that only with act 6938/1981 that natural forests became an environmental legal asset with an intrinsic value irrespective of all possible benefits they may produce: an "existence-based value", instead of simply a "use-based value" (AHRENS, 2003).

Act		Issues concerning to topographic mapping
Act 4118/1962	Nuclear Power National Policy	Location of mines and deposits - of the interested substance for production of atomic energy - which are national reserves, essential for country security, and held by the Union as imprescriptible and inalienable goods.
Act 4771/1965	Forest Code	The 'Rural Property' legal concept; Definition of Permanent Preservation Areas (related to slope, top of hills, width of water bodies); Definition of Legal Reserve; Suppression of Native Forests; Limits of Parks and Public Forests, which must be depicted in official maps.
Act. 9985/2000	SNUC – the National System of Nature Conservation Areas	Definition of boundaries of Conservation Units (UCs), damp areas and ecological corridors; Definition of Conservation Units Mosaics; Calculation of financial compensation for traditional populations living within UCs areas; survey of areas without legal registration intended for nature conservation; SNUC areas must be depicted in official maps.
Act 7661/1988	National Coastal Management Plan	Definition for Ecological-Economic Coastal Zoning - ZEEC, which guides the territorial planning process; and sets the high tide line, the coastline and the sea waterfront.
Act 6938/1981	National Policy for Environment	Potentially polluting activities control and zoning; Control of threatened or degraded areas; Tax collecting for survey and licensing activities accordingly to the land use and area size.
Act 9433/1997	Water Resources National Policy	Definition for Watershed; Calculation of river basin areas; Class definitions for water bodies.
Act 9605/1998	Environmental Crimes Law	Penalties for deforestation, economic exploitation or degradation of native or planted forest area.
Act 6766/1979	Urban Areas Management Law	Definition of Urban Areas and Urban Expansion; Definition of waterflood areas, slope above 30% and ecological preservation areas.

TABLE 1 - Brazilian environmental law issues concerning to topographic mapping

Forty four years later, Brazil cannot be proud of the practical results of the code: the decade of 1980 and 1990 had expressive deforestation rates – about 17.500 hectares per year, being Atlantic Forest the most impaired biome (ZAÚ, 1998). Rural producers argue that Forest Code prevent the country to have better results in rural industry. Ecologists argue that the code has not been applied, with few investments in monitoring and surveillance. There are several points of disagreement (BLEY JUNIOR et al., 2004) and an important discussion is about how to decrease these rates. But there are not studies pointing out the relationship between these problems and the absence of topographic mapping in Brazil.

The object of the Brazilian Forest Code is native forests and other natural forms of vegetation, excluding anthropic – associated, influenced by human activities – plantation areas, even of forest species. The Forest Code defines two classes of protected areas in particular rural properties: APP – Permanent Preservation Areas; and

Legal Reserves. The APP are protected areas “covered or not by native vegetation, with the environmental function of preserving water resources, landscape, geological stability, biodiversity, gene flow of fauna and flora, protecting the soil and ensuring the welfare of human populations”. No human intervention is allowed into these areas and the ecosystem must be recovered if not found in a primary stage. The Legal Reserves are reserved areas where vegetation cannot be suppressed, but only managed under principles of sustainable forest management. These areas are calculated based into the total area of the rural property, accordingly to the biome which they are located in.

Brazil has six different major biome types: *Amazon forest*, *Atlantic forest*, *Caatinga*, *Cerrado*, *Pantanal* and *Pampa*; and, as cited above, legal reserves areas depend on the biome which the rural land is located in, ranging from 80% of demanded reserve area in the *Amazon Forest* to 20% in *Pantanal*. For example, act 11428/2006 defines that the Atlantic Forest biome consists of some classes of vegetation, which are depicted on IBGE 1:5,000,000 map and these areas are under differential use, management and legal regime. In this map scale, areas smaller than 625km<sup>2</sup> – about 2 times the area of Italy – cannot be accurately located. A 500 km<sup>2</sup> property land owner located nearby *Amazon Forest* and *Pantanal* biome borders can legally prove, using an official cartographic product, that he can suppress 400km<sup>2</sup> of native vegetation instead of 100km<sup>2</sup>.

### 3.2 Permanent Preservation Areas and Topographic Mapping

The act 4771/1965 establishes the APP as the most important legal instrument against predatory deforestation, particularly around areas between lands and streams. APP is delimited along the riparian zones and also in high slope areas, top of mountains and hills and highly altitude areas. In case of stream areas, the APP consists in the riparian zone calculated accordingly to the width of the stream (TABLE 2). The protected riparian zone can be calculated by buffer operations in spatial analysis, using spatial features extracted from topographic maps. In 1:100,000 scale maps, a stream represented by a 1mm width line corresponds to a surface width of 100 meters. Between 1 and 100 meters there are 3 classes of APP, varying widths from 30 to 100 meters. Therefore, APP features minimum ranges are about 10 meters, so 1:10,000 scale maps are more adequate to calculate these areas. The Brazilian *Amazon Forest* biome, which is located around the Amazon basin, the largest drainage basin in the world, is covered only by 1:250,000 and 1:100,000 sheets published in 1980’s.

<i>Stream width range (in meters)</i>	<i>Minimum riparian zone width (in meters)</i>
10 or less	30
10 to 50	50
50 to 200	100
200 to 600	200
600 or high	500
Source of river or stream	50

TABLE 2 - The width of Permanent Preservation Areas adjacent to stream region.

### **3.3 - 9605/1998 – The environmental crimes law**

Brazilian environmental crimes law was approved in March, 1998 and is considered to be one of the most modern and comprehensive legal text about environmental crime (UNEP, 2006). It is based on a broader sense of culpability, which establishes culpability not only for the person who actually breaks a law, but notably, also for any person in a position of authority, person who knew about the illegal activity and failed to stop it or inform the appropriate authorities; and the Assignment of Penalties which outlines criteria that should be considered for an environmental law violation.

The environmental crimes law - Section II contains a list of actions that are considered to be crimes against flora or plant life. Law violators are subject to the prescribed penalty, which varies according to the crime, and aggravating and mitigating circumstances. For example, the penalty is to be increased if any fact causes the decrease of natural waters, soil erosion or modification of climatic regime. Another important section is on crimes against environmental administration which generally includes violations committed by civil servants that harm the environment in some way. A good example of this kind of crime is an environmental license of deforestation issued by a public department to a rural business that is located in a region of primary *Atlantic Forest* – according to article 38-A, cited below:

**Art. 38-A Destroy or damage primary or secondary vegetation, advanced or medium regeneration stage, at Atlantic Forest biome, or use it violating protection rules**

Penalty – 1 to 3 years detention, or fine, or both cumulatively.

Penalty provided in this article can be easily disrupted if the criminal proof that the damaged vegetation was not included in *Atlantic Forest* biome. This is possible if there is only 1:100,000 topographic maps of the region. In those maps the location of the perimeter of the area is not accurate, and it can vary around 1 km along the borders of biome area.

Some of the articles of the environmental crimes law (such as article 50-A) provide penalties that are proportional to degraded area or accordingly to aggravating circumstances, like damaging sources of streams or rivers permanently. Those areas could not be represented in medium scales such 1:25,000 or 1:50,000 with enough accuracy.

### **4. CONCLUSIONS**

Brazil is the fifth largest country in the world and the largest of the South hemisphere with around 8 million square kilometers. Due to its continental extension the country has relevant biomes for the world. Those biomes demand for conservation programmes and strategies for sustainable development. These actions depend on a topographic

mapping at a suitable scale. Topographic cartography is an expensive activity however it is essential for any plan or action that aims environmental protection and conservation.

In Brazil the production of topographic maps started later than other countries and the lack of government investments made the consequent problems even worse. This situation made the private business and local government users to produce their own maps in order to carry on some specific projects. As a consequence there is not an official collection of large and medium scale maps. Then, engineering projects as the construction of a hydro-power plant, highway roads, airports, dams demand for a map production for those particular cases.

Furthermore, those kind of engineering projects need to be licensed by the environmental legislation, which demands for different licenses for every step of the project, since the activity installation until the operation itself. The Brazilian Ministry of Environment together with IBAMA and state environment agencies are responsible for the environment licenses and they have, as an example, to be aware of all activities that may cause environment impacts and to take the necessary action to minimize and compensate the environment damage. This responsibility requires studying and analyzing the characteristics of the impacted area. Therefore, a basic topographic cartography at a suitable scale can bring benefits to the quality of results of the environment license process. Besides the environment protection licenses the Brazilian environment legislation encompasses a set of aspects related to geographic data and they should be considered when the government authorities make decisions about budget for mapping the country. The analysis of the environmental legislation allows us to establish its dependence of the existence of an official topographic mapping at a suitable and accurate scale.

## 5. REFERENCES

Ahrens, S. 2003. O “novo” código florestal brasileiro: conceitos jurídicos fundamentais. In: *VIII Congresso Florestal Brasileiro*, São Paulo, Brazil. Sociedade Brasileira de Engenheiros Florestais. 1 CD-ROM

Archela, R. S.; Archela, E. 2008. Síntese Cronológica da Cartografia no Brasil. *Portal da Cartografia*. Londrina, v.1 (1), pp. 93-110. Available at: <http://www2.uel.br/projeto/cartografia/v1/6edison.pdf> [Accessed in: 26 June 2008].

Bley Junior, C., de Bastos, E. F., Simoni, F., Brun, M. R., Loch, C. 2004. Código Florestal Brasileiro: Considerações sobre o artigo segundo e dezesseis. *COBRAC 2004 - Congresso Brasileiro de Cadastro Técnico Multifinalitário*. UFSC – Florianópolis.

CONCAR/IBGE - Legislação cartográfica nota introdutória. Available at: <http://www.concar.ibge.gov.br/indexdca0.html?q=node/21> [Accessed in: 26 June 2008]



Farran, N. L., Cintra, J. P. 2003. O primeiro mapeamento sistemático do Brasil: significado e construção. In: *Anais do XXI Congresso Brasileiro de Cartografia*, Belo Horizonte – MG. Available at: [http://www.cartografia.org.br/xxi\\_cbc/160-C32.pdf](http://www.cartografia.org.br/xxi_cbc/160-C32.pdf) [Accessed in: 26 June 2008].

IBGE – Instituto Brasileiro de Geografia e Estatística. Área Territorial Oficial Brasileira. Available at: <http://www.ibge.gov.br/home/geociencias/areaterritorial/principal.shtm>. [Accessed in: 26 June 2008] (a).

IBGE – Instituto Brasileiro de Geografia e Estatística. Mapa Índice Digital. Available at: [http://www.ibge.gov.br/home/geociencias/default\\_prod.shtm#TOPO](http://www.ibge.gov.br/home/geociencias/default_prod.shtm#TOPO) [Accessed in: 26 June 2008] (b).

IBGE – Instituto Brasileiro de Geografia e Estatística. Censo demográfico 2000. *Dados recuperados e visualizados através do SIDRA – Sistema IBGE de Recuperação Automática*. Available at: <http://www.sidra.ibge.gov.br>. [Accessed in: 26 June 2008]

Mittermeir, R. A.; Werner, T.; Aires, J. M. & Fonseca, G. A. B. 1992. O país da megadiversidade. *Ciência Hoje*, 14(81): pp 20-27..

Nebert, D. (ed.). *Developing Spatial Data Infrastructures: The SDI Cookbook*. Version 2.0, Global Spatial Data Infrastructure, Technical Committee. Available at: [www.gsdi.org/gsdicookbookindex.asp](http://www.gsdi.org/gsdicookbookindex.asp) [Accessed in: 26 June 2008]

Ordnance Survey. A brief History of Ordnance Survey. Available at: <http://www.ordnancesurvey.co.uk/oswebsite/aboutus/history/index.html> [Accessed in: 03 January 2008]

UNEP - United Nations Environment Program. 2006. *Manual on Compliance with and Enforcement of Multilateral Environmental Agreements*. UNEP. ISBN: 92-807-2703-6

USGS. USGS Topographic Maps. Available at: <http://topomaps.usgs.gov/index.html> [Accessed in: 02 January 2009]

Wainer, A. H. 1995. *Legislação Ambiental Brasileira: subsídios para a história do direito ambiental*, Rio de Janeiro: Forense, pp 158-169.

Zau, A. S. 1998. Fragmentação da mata atlântica: aspectos teóricos. *Floresta e Ambiente*. 5(1). pp160-170.