

## **Pedological Survey and Aspects Regarding the Use and Occupation of the River Itacolomi Hydrographical Sub-Basin in Ceará**

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### **Abstract**

*This work seeks to conduct a survey about the principal types of soils, as well as to identify different forms of use and occupation of the river Itacolomi hydrographical sub-basin. The area under consideration, what is part of the river Coreaú hydrographical sub-basin, covers a territorial extension of about 1065 km<sup>2</sup> and is inserted into the municipalities of Tianguá, Viçosa do Ceará, Granja and Meruoca. The methodology is based upon the general system theory, which is grounded in systems analysis. Furthermore, geo-mapping charts suited to that sub-basin were drawn up along with the conduction of field and bibliographical surveys. From this point of view, it must be stressed that such sub-basin has unique levels of environmental degradation due to the presence of partially unspoiled areas that present humid segments besides totally debased areas. In this manner, it is realized that the process of use and occupation of that sub-basin is tied to the extensive stockbreeding, subsistence farming, deforestation and fires, which plays a significant role in the intensification in erosive processes and loss of soils.*

**Keywords:** Hydric Resources; Degradation; Subsistence Farming.

### **1. Introduction**

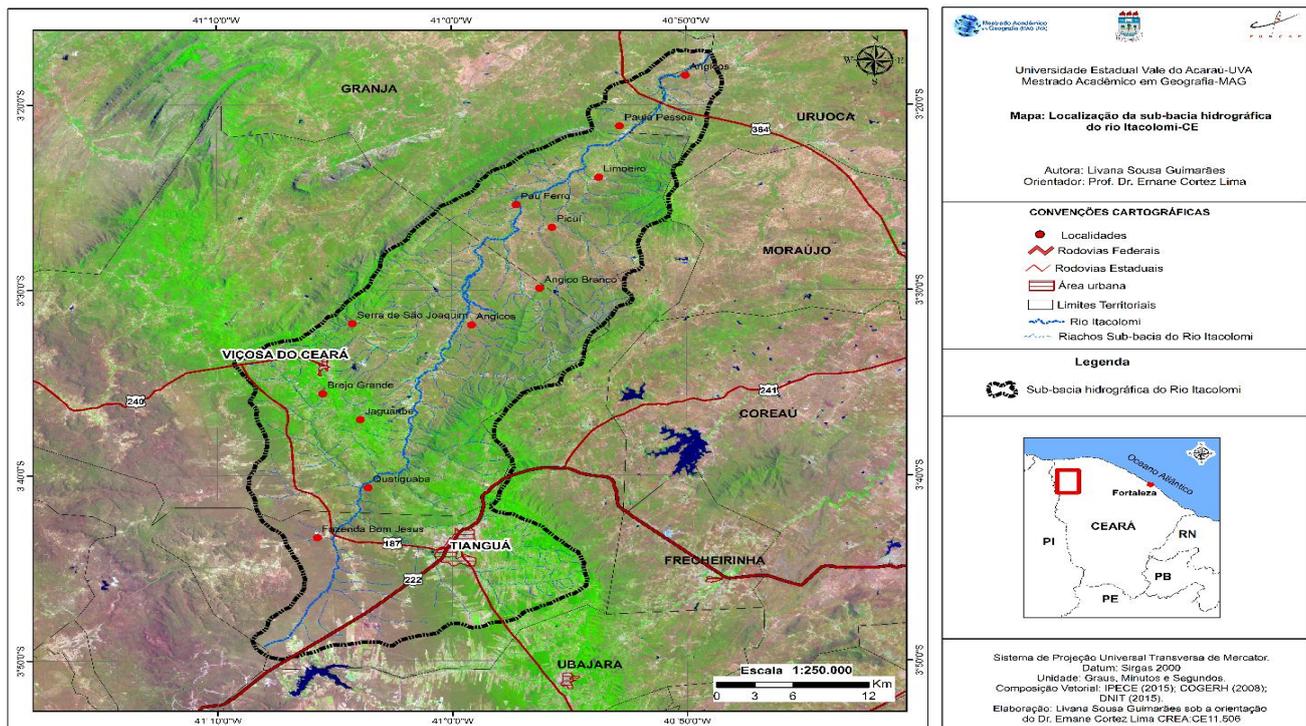
The Brazilian semi-arid region has specific characteristics that differentiate itself from other regions since it has been presenting irregularity in precipitation level over the years besides high temperatures, the presence of shallow soils, acaatinga prevailing vegetation and the possession of intermittent rivers (AB'SÁBER, 1999). In this respect, the conduction of studies toward the recognition of that area is extremely essential, in particular, those that are related to hydrographical sub-basins.

In this sense, studies incorporated in hydrographical sub-basins are had as alternatives to ensure better living conditions with more suitable techniques concerning the use and occupation of soils. This way, Rodrigues (2016), stresses that those hydrographical sub-basins which are had as territorial units make possible an integrated analysis of natural, social and economic elements. In addition to it, Rodrigues and Lima (2015, p.61) highlight that "hydrographical sub-basins became an essential spatial analysis unit".

Therefore, a soil survey and an analysis of its use and occupation were carried out, taking into consideration the Itacolomi river hydrographical sub-basin. In this light, it was sought to conduct a diagnosis of the soil types and the impacts which this area has undergone.

The Itacolomi river hydrographical sub-basin is located in the Northwest region of Ceará and, according to SUDENE/DGS, its cartographical points are SA.24-Y-C-V (Viçosa do Ceará), SA.24-Y-C-III (Granja), SA.24-Y-C-VI (Frecheirinha) and SA.24-Y-C-II (Chaval), what corresponds to an extension of about 1065 km<sup>2</sup> and composes the Coreaú river hydrographical sub-basin system. The object of analysis drains part of the municipalities of Tianguá, Viçosa do Ceará, Granja and Uruoca.

In this context, the Itacolomi river hydrographical sub-basin displays a unique dynamism originated from the junction of physical and environmental elements that make it up.



**Figure 1:** Itacolomi river hydrographical sub-basin location map. (Guimarães 2018)

Having its springs in Ibiapaba plateau, which is formed by sedimentary rocks, it flows into the Coreáú river hydrographical sub-basin, what is an attribution of the sertaneja depression or pediplain, and provides a significant landscape diversity represented in its vegetation, soil and hydric resources formation as well as in its geological and geomorphological aspects. The Itacolomi river has some creeks in its network which ranges between the 1<sup>st</sup> and 5<sup>th</sup> order in accordance with the Stralher fluvial hierarchy (1952). (Observe figure 1)

## 2. Development

### 2.1. Methodological procedures

The methodological theoretical conception, what has guided this research, refers to the employment of system analysis, which is grounded in the Ludwig von Bertalanffy's general system theory (1975), turned to the landscape analysis once that area has a great territorial extension and unique forms of use and occupation along its hydrographical system.

As regards the cartographical conventions used to draw up the location and soils maps, vectorial records were adjusted to the sub-basin. Rivers and creeks data were made available by the *Companhia de Gestão de Recursos Hídricos* (COGERH) (Hydric Resources Management Company), the municipalities boundaries, towns and highways were provided by the *Instituto Brasileiro de Geografia e Estatísticas* (IBGE) (Geography and Statistics Brazilian Institute), the *Instituto de Pesquisa e Estratégia Econômica do Ceará* (IPECE) (Institute of Surveys and Economical Strategy of Ceará) and the *Empresa Brasileira de Pesquisa Agropecuária* (EMBRAPA) (Brazilian Company for Stockbreeding Research).

In order to demarcate the Itacolomi river sub-basin polygon, geoprocessing techniques were used through the automatic demarcation technique using SRTM (Shuttle Radar Topography Mission) radar images, a device which was provided by EMBRAPA and whose working is given by satellite monitoring in GeoTIFF format.

As stated by Rodrigues (2016, p. 42), firstly the drainage is removed with the aid of tools so the flux direction can be recognized, "the flux gathered in each cell, the longest flux trajectory and the numerical order to each segment". After that, a drainage bitmap shapefile is generated soon after a drainage shaping and, lastly, the sub-basin is demarcated from a collection point. Having these steps been carried out, the bitmap shapefile is converted into a polygon vector shapefile.

For the recognition of soils present in that area, the *Sistema Brasileiro de Classificação de Solos* (SIBCS) (Brazilian System for Soils Classification) was used, which was produced by EMBRAPA (2013) and facilitated the production of a map of the analyzed area.

## 2.2. Results and discussion

The results were obtained from the approached methodology, which was based on the study of natural elements from the Itacolomi river hydrographical sub-basin. This way, a natural elements characterization – like geology, geomorphology, climate, vegetation – was conducted, in particular in soils from that sub-basin area. Such characterization and analysis were possible only after a geo-mapping survey of that area.

As regards the soil types that correspond to the Itacolomi river hydrographical sub-basin area, they were identified not only through the *Sistema Brasileiro de Classificação de Solos* (SIBCS), but also through a morphological investigation conducted during fieldworks.

The Planossols present in the northern part of that sub-basin are characterized by presenting A and E horizons with a medium or clayey texture and also a sandy texture over a Bt horizon. They are typical soils for slightly wavy and plane reliefs, which are commonly, found occupying the lowest parts of Pediplains and Floodplains in semi-arid regions. It was found the presence of Planossols, which are characteristics for slightly wavy and plane reliefs and typical of semi-arid regions that occupy the lowest parts of Pediplains and Floodplains (Pereira e Silva, 2007).

Litholic Neossols are characterized by their weak pedological evolution, shallow sandy texture, A horizon followed by the C or over the rock – R, stoniness in their surfaces, in which are frequently found linked to rocky outcrops and present in Pediplains. Furthermore, they present strong limitations regarding their use in agriculture once they are susceptible to erosion, stoniness and rockiness.

Fluvic Neossols are deep soils that are originated from the Holocene fluvial sedimentation and present A and C horizons. Once they are considered as soils of high agricultural potentiality and with high natural fertility, they are largely used with irrigation systems and are made up of non-consolidated clayey, silty and sandy sediments, which is a characteristic for alluvial plains.

The Red-Yellow Latossols are had as the oldest soils in Ceará and are in general constituted of sandstone materials from the Cretaceous epoch and also of sand-clayey sediments of the *Formação Barreiras* (Tableland or Plateau, Barrier Formation) from the Miocene and Pleistocene epochs. They have colors ranging between red and yellow, are deep and quite weathered and are found in sedimentary areas like in the Ibiapaba plateau. In addition, they present A, B and C horizons, which are slightly different and have almost uniform clay levels.

The Red-Yellow Argissols are featured by their great deepness, A, Bt and C horizons, medium clayey texture, having the B horizon higher levels of clay in comparison to the A horizon, what implies in a notorious difference between both textures. They are originated from different types of materials, from sand-clayey sediments of *Formação Barreiras* (Miocene and Pleistocene) to alterations in different kinds of crystalline rocks (Precambrian).

Therefore, the soil map (figure 2) below is presented as a way to deliver a better comprehension of the types of soils which make up that sub-basin. Adapted data from EMBRAPA (2013) was in order to produce this map.

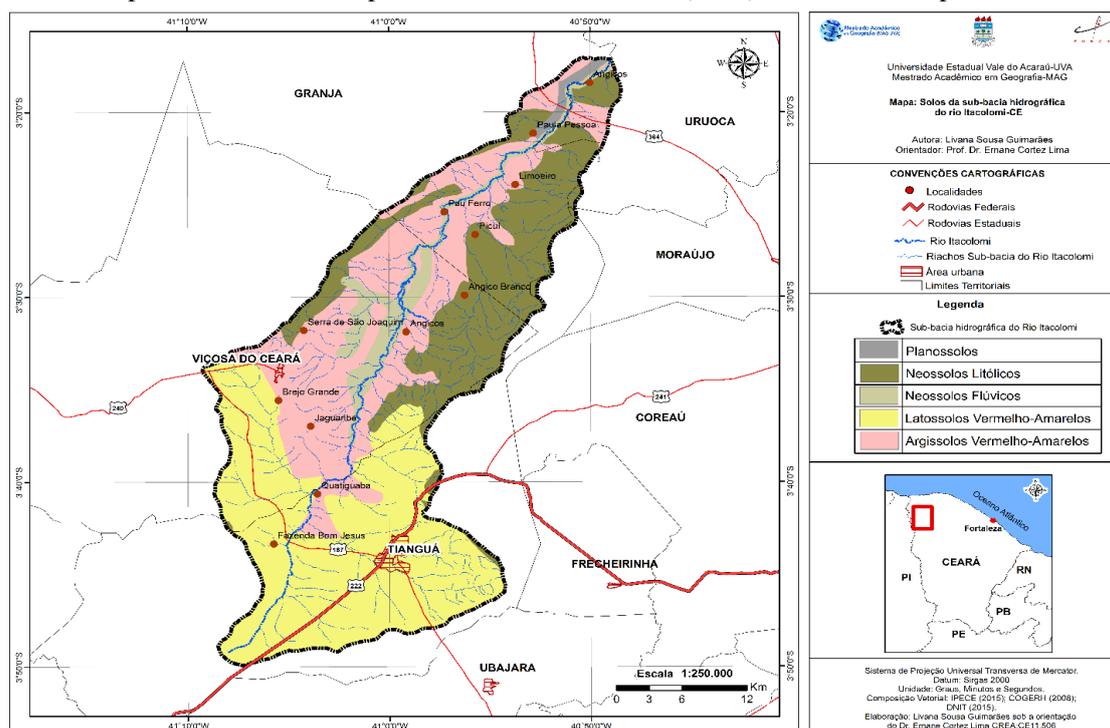


Figure 2: Itacolomi river hydrographical sub-basin soil map. (Guimarães 2018)

From this view, it must be highlighted that the Itacolomi river hydrographical sub-basin presents, in pedological terms, a diversified soil patchwork in which they have dominant characteristics besides limitations regarding their use since they are not related to differentiated reliefs. Thus, these soils are handled accordingly to their fertility and used mainly for subsistence farming in the planting of corn, beans, banana and vegetables, which are grown close to hydric resources since the predominant soils in this kind of area are Fluvic Neosols and they possess a medium or high natural fertility. (Observe table 1)

**Table 1:** Characteristics of soils present in the Itacolomi river hydrographical sub-basin (Guimarães 2018).

Type of Soil	Morphological Unit	Dominant Characteristics	Limitation in their Use	Agricultural Use
	(Solodic Planosols) Typical of slightly wavy or plane reliefs in semi-arid regions.	They are badly drained soils and usually have a high level of clay.	Susceptible to erosion.	Grassland for extensive stockbreeding, planting of legumes and subsistence farming.
	(Litholic Neosols) Pediplain.	Shallow soils with sandy texture usually related to a rocky outcrop.	Used only for agriculture, susceptible to erosion, low permeability.	Short-cycle crops; Planting of corn and bean.
	(Fluvic Neosols) Alluvial Plain (low-declivity plane relief).	Deep soils, high agricultural potential, high natural fertility.	Susceptible to floods and erosion.	Short-cycle crop of corn and bean, vegetal and mineral extraction.
	(Red-Yellow Latosols) Ibiapaba plateau.	Deep soils located in sedimentary areas.	Low natural fertility.	Cultivation of banana, bean and corn.
	(Red-Yellow Argisols) Ibiapaba plateau.	Deep soils, clayey texture, low natural fertility.	Strongly susceptible to erosion, desiccated relief.	Subsistence farming, corn and bean.

### 3. Aspects of the use and occupation in the itacolomi river hydrographical sub-basin

In Zanella's view (2007), natural resources in Ceará have been suffering lots of changes due to a continued expansion of productive activities performed by anthropic actions. It is also stated that one of the principal problems concerning the hydric resources degradation is tied to the pollution caused by domestic and industrial sewage, which are dumped into waterways without being previously treated. Thus, studying hydrographical basins becomes meaningful since they deliver a more systematic knowledge that can be employed in environmental plans of these areas.

For Nascimento (2010), the environmental degradation process is a result more of socioeconomic and cultural interventions than environmental factors in their own dynamism. Furthermore, the non-observance of policies regarding territorial management and conservationist practices of use and occupation of lands are liable to generate environmental deterioration problems once they jeopardize the soil production capacity and, consequently, its environmental quality.

After the fieldwork, it was verified that the use and occupation in that sub-basin resulted from the existence of two important urban centers in the region, namely Tianguá and Viçosa do Ceará, in addition to towns situated close to creeks making up the area. In this manner, it was noticed that the area is used for stockbreeding, which causes compression on the soil and the removal of the ground cover. (Figure 3)



**Figure 3:** Areas used for stockbreeding (Guimarães 2018)

In this regard, in the Lajes creek, which is close to Sierra Dom Simão, the ciliary forest is partially preserved with the existence of *carnaúba* (*Coperniciaprunifera*), *oiticica* (*Licaniarigida*) and *mofumbo* (*Combretumleprosum*). There is considerable gravel transportation with a 20 – 30 cm of diameter at the bottom of the creek bed, what means a more effective flow of it.

In the Itacolomi river hydrographical sub-basin, it is possible to go over the use of it in subsistence farming practices with the use of quite rudimentary techniques such as vegetation removal soon after burning and, after that, the place is used to grow corn, bean and cassava. Another problem worthy of mentioning is the indiscriminate deforestation, which in accordance with Souza (2000), compromise seriously the soil production capacity. For Pereira and Silva (2005), fires constitute one of the main offending agents for the soil. (Figure 4)



**Figure 4:** A cornfield in the area. (Guimarães 2018)

The Frecheirinha creek is also notorious due to the total disfigurement of its ciliary forest in reason of a road that was built removing its whole vegetation, however, it is possible to see close to the creek a sugarcane plantation. (Figure 5)



**Figure 5:** Frecheirinha creek. (Guimarães 2018)

It is noteworthy that the principal forms of use and occupation in that sub-basin are tied to an extensive stockbreeding, subsistence farming, deforestation and fires, which plays a considerable role in the intensification of erosive processes.

#### 4. Final considerations

The Itacolomi river hydrographical sub-basin is had as an important hydrographical system in the northwestern region of Ceará, which has been suffering environmental degradation processes related to the indiscriminate use of natural resources due to anthropic activities.

The intense use of natural resources by men can lead to serious impacts in the environment. Therefore, as a result of such acute exploitation of natural resources, it extremely essential to study hydrographical sub-basins. Such resources are limited and, for this reason, it is necessary to propose measures to ease or reduce the impacts caused by anthropic actions that result in a disfiguration of landscapes.

In this view, the Itacolomi river hydrographical sub-basin has a rich landscape diversity, but along the years it has been suffering changes caused by anthropic actions such as the vegetation removal to subsistence farming and the use of those areas for stockbreeding, what makes necessary a reassessment of the environmental potentialities to a proper handling of this environment.

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