

Soil Management in the Wet Solid Mass of Uruburetama, Ceará, Brazil

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Abstract

The process of land use and occupation in environments of residual masses in the semi-arid region has generated changes in the landscape. This fact is attested in the Uruburetama massif, located in the northern region of the State of Ceará, fruit of a degradational agricultural cultivation of the soil in its steep slopes. This area comprises a territorial dimension of 973.43 km² and for analytical purposes of such degradation, it was decided to establish the top sequence model and to select in the massif two areas: quadrant I, in the municipality of Itapajé, and quadrant II, in the municipality of Uruburetama. Having said that, we aim to analyze the landscape alteration considering the land use and occupation process in the referred massif. During the research, physical and chemical analyzes of soil samples were performed, based on the EMBRAPA (2006) methodology. In quadrant I (top with soil under Atlantic forest, soil under banana cultivation and valley with soil under fallow in 12.47 km³) and in quadrant II (top with soil under banana tree, in the slope with soil under banana tree cultivation in the valley with soil under banana cultivation in 12.47 km²). The spatiality of the red-yellow argisol was verified. It was identified the decharacterization of the landscape in the two quadrants, and the need to consider the parceling and the curves of levels as an adequate management of the reality of the local relief.

Palavras-chave: Agricultural cultivation; toposequence; installment.

1. Introduction

Featuring a territorial extension of 148,887,633 km², the state of Ceará is constituted for 184 municipalities IBGE in 2017, being under the dominion of the semi-arid climate. In this context the spatial changes of the landscape in the residual mass of Uruburetama by agricultural activities results in the process of soil degradation.

Considered an exception environment, the residual mass of Uruburetama stands out for presenting differentiated vegetation between caatinga and remnants of Atlantic forest (wet forest). It has an altitude that reaches up to 1,060 meters and a rainfall above the surface of the country.

Such an environment, for Lima (2004, p. 97), reports that "the human occupation in areas of residual masses in the State of Ceará happens over many years. The search for areas that offer more favorable conditions for survival is undoubtedly the primary cause of this occupation. This context is common in the Uruburetama massif and similar to the interior of the state of Ceará.

Among the characteristics that favor the cultivation of temporary and permanent crops in such environments, there are in Uruburetama the soils Red-Yellow Argisols, Luvisols, LitholicNeosols and Planosols, which are superimposed on pluviometric precipitations varying from 800 to 1,500 mm / year. However, there are problems with farming, associated with a marked slope in its geomorphological features, with crests, steep slopes and V-valleys, which causes erosion and sedimentation to be recurrent problems. In the landscape, changes are observed that compromise the environment due to deforestation and improper land use practices.

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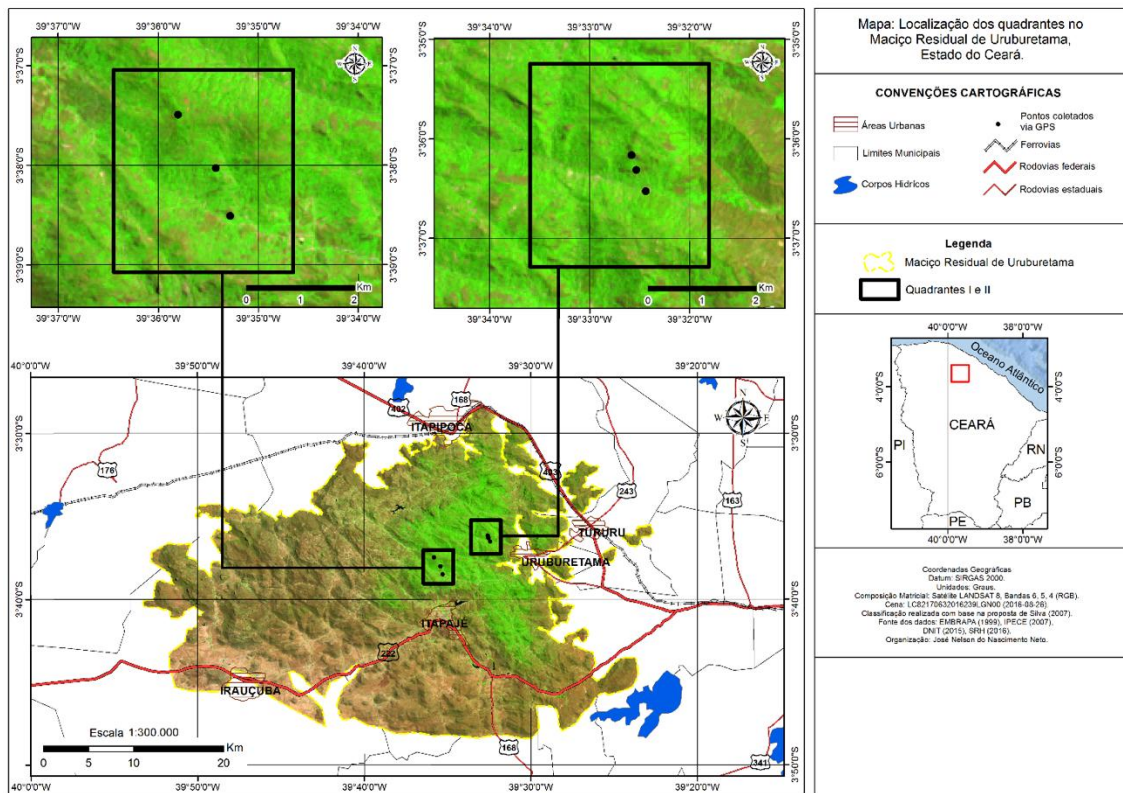
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These concerns are discussed in Schneider, Giasson and Klamt (2007, p.43), arguing that "superficial changes in terrain resulting from inadequate soil management result in compaction, reduced water infiltration, increased water runoff and loss of soil with formation of furrows and / or gullies [...] ". Thus, it is important to analyze the physical-chemical characteristics of a soil type in function of different forms of use in the Uruburetama massif. The purpose of this study is to analyze the alteration of the landscape from the use and occupation of the soil of the referred massif. The light of the integrated analysis of the landscape, based on the systemic theory, which leads us to the understanding of the Geosystem proposed by Bertrand (1968), contributes to the understanding of the understanding of the agricultural potentialities and respectively reading of the process of use and occupation of the soil in Uruburetama.

2. Characterization of the uruburetama mass

The residual mass of Uruburetama constitutes a morphological feature classified in brejo of altitudes along the Brazilian northeastern semi-arid. According to Ab'saber (2003), the marshes are true green islands along the dry Northeast. The geomorphological structure of Uruburetama is due to the endogenous and exogenous processes. They result in a landscape grouping defined by Oliveira and Carrasco (2003) as a geomorphological feature in the context of the backlands, having an altitude with a maximum of 1,080 meters and considerable extension in relation to the inselbergs. Still about the Uruburetama mass (Figure 1), it classifies into domains of the ancient shields and masses belonging to the pre-Cambrian era, still forming part of this classification the domain of the sertaneja depression and the inselbergs according to Magalhães e Silva (2012).

Figure 01: Map of the quadrants location of the residual mass of Uruburetama.



Source: NASCIMENTO NETO, José Nelson (2017).

A spatial range, the Uruburetama massif involves 4 municipalities (Table 01), as specialized in the following table:

Table 01: Participation of municipalities in the Uruburetama residual mass (CE).

Municípios	Total em Km²	Participação no Maciço
Itapajé	430,56	65%
Itapipoca	1.614,15	11%
Irauçuba	1.461,25	9%
Uruburetama	97,07	15%
Total	973,43	100%

Source: IBGE and IPECE (2017), adapted by NASCIMENTO NETO, José Nelson (2016).

OPERATIONAL TECHNICAL AND METHODOLOGICAL SURVEY

The theoretical basis used was the Bertrand (1968) geosystem, because it allowed to understand the nature of the Uruburetama residual mass and the units of geofácies. For this, it was possible to make use of the landscape in the elements of nature, investigation, where the forms of the land cultivation were analyzed to subsidize the interpretation of soil fertility. Based on the criterion of selection of the areas to be investigated, we adopted the representativeness of soil use and the predominant characteristics, from which we selected two areas for experimental purposes in Itapajé and Uruburetama. These being identified the types of uses and the physical and chemical characteristics of the soil.

In relation to the environmental conditions of the landscape, the selection of the two areas of slopes for soil analysis in the interpretation of the landscape is adequate, given the difficulty of working with large areas. In the application of the Geosystem was made use of the image LANDSAT 8, of August 26, 2016, in order to understand the geomorphological structure. The maps presented here were made using the Geographic Information Systems (GIS) platform, ArcGIS, on the responsibility of the geographer Lucas Pereira Soares, CREA (CE326919). The technical work base makes use of the scale 1: 300,000 for the area of the massif and 1: 50,000 for the area of studies, quadrant I and quadrant II. Thus, we chose to produce the cartographic documentation of the following products: location of the research area with the quadrants and map of soil types. The profiles elaborated corresponded to quadrant I and quadrant II, interconnecting the points collected in the field. Profile 1 corresponds to quadrant I, connecting Points 1, 2 and 3; and profile 2 corresponds to quadrant II, connecting Points 4, 5 and 6. Each point is represented in the profile and they served as the basis for interpretation of the landscape.

3. Selection of areas and collections of Soil Samples

The structural ordering of the research comprises two moments - the first with the definition and the location of the research and the second with the technical execution of soil samples collection in loco. The research area comprises the residual mass of Uruburetama, with 973.43 km², a morphological environment in the interior of the state of Ceará, with favorable environmental conditions for the agricultural cultivation of the soil in the northeastern semi-arid region. It was then chosen to divide, punctuate and locate two experimental areas, called quadrants I and quadrant II, with a territorial dimension of 12.47 km² each.

The choice for the two research areas was due to the representativeness of the areas in relation to the spatial dimension and due to the empirical knowledge of the massive. In the I quadrant, there is the area planted with remnants of humid forest on top, banana plantation on the slope and fallow soil in the valley; and, in quadrant II, the area with plantation of banana tree at the top, followed by the slope and by the valley. Then a comparison is made between the two study areas in relation to the forms of land use, so that the alteration of the current landscape represents the contextualization of the socio environmental dynamics existing in the two areas of the study of the residual mass of Uruburetama. After the definition and location of the experiment area, the second moment was taken, with the soil sampling (sampling) in the experimental areas. The purpose of the collection is to analyze the physical and chemical characteristics of the soil. The Red-Yellow Argisol was identified in quadrants I and II, comparing their characteristics in function of the use. Thus, the technical operation of the soil sample collection took place through the following instruments: bucket for sample mixing, spatula for collection, tape measure for definition and determination of depths, transparent bags numbered to add soil samples, log book of field "Manual of Description and Collection of Soil in Field of Lemos (1996)", camera, GPS and notes sheets.

Due to the operational technical conditions it was not possible to open trenches for morphological characterization of soil profiles, however, it was decided to use mini-trenches following the model of top sequence for collection and samples of the superficial layers of the soil in a unit of slope in the quadrant I, with 12.47 km², and another one in unit of slope in the quadrant II, with 12.47 km², so that the agricultural and environmental spatialization were represented in the units of slopes of each area. The depth determinations are from 0 cm - 5 cm, 5 cm - 10 cm, 10 cm - 15 cm, 15 cm - 20 cm, 20 cm - 25 cm, 25 cm - 30 cm, so that the detail scale is standardized in 5 cm of difference. It was then decided to establish the determination of 0 cm - 30 cm of depth for each collection point, in order to observe soil fertility.

The top sequence is represented as the following: quadrant I, unit of geofácies, top with soil under wet forest, slope with soil under banana tree and valley with soil under fallow in approximately 5 years. The representation in the quadrant II is given by units of landscape in geofáceis. They are top areas with soil under cultivation of the banana tree, slope with soil under banana cultivation and valley with soil under banana cultivation. After collecting the soil samples, they were directed to the laboratory. It was decided to analyze the physical and chemical characteristics of the soil, with the purpose of generating specific information from two study areas where they subsidize soil fertility information. The analytical determinations of physical characteristics (coarse sand, fine sand, silt and clay, textural classification and density) and chemical determinations (pH, MO, P, K, Ca, Mg, Na, Al, H + Al, SB, CTC, V, PST, m, CE) follow the Manual of Chemical Analysis of Soils, Plants and Fertilizers of EMBRAPA (1999).

4. Results and discussions

For the characterization and analysis of the physical and chemical attributes of the soils, it had been chosen the interpretation of Mello et al. (1983, p. 14), when he mentions that fertile soil is that which contains, in sufficient and balanced quantities, all the essential nutrients in assimilable forms. It must be reasonably free of toxic materials and possess satisfactory physical and chemical properties. All fertile soils are potentially productive. For this reason, the soil fertility chemical characteristics (pH, Phosphorus, Potassium, Calcium, Magnesium and Aluminum), according to (Table 02), are considered. In relation to the fertility criteria considered by the laboratories of the State of Ceará.

For this, we consider the chemical characteristics of soil fertility (pH, phosphorus, potassium, calcium, magnesium and Aluminum) according to (Table 02). Regarding fertility criteria considered by the State of Ceará laboratories.

Table 02: Results of classification levels used by the Lab of Ceara..

Determination	unity	ranking			
		Low	Medium	High	
Aluminum - AL KCL 1M	mmml / dm ³	0 - 5	6 - 10	> 10	
Calcium - Ca KCL 1M	mmml / dm ³	0-15	16-40	> 40	
Magnesium - Mg KCL 1M	mmml / dm ³	0 - 5,	6 - 10	> 10	
Potassium - K Mechlich I	mmm / dm ³	0to 1.15	1.18 to 2.30	> 2.33	
Phosphorus - P I Mechlich	mg / dm ³	0-10	11 - 20	> 21	
Organicmatter	g / kg	0-15	16 - 30	> 30	
pH in water (1: 2.5)					
Acidity		neutrality		Alkalinity	
High	Average	Low	Low	Average	High
<5.0	5.1 to 5.9	6.0 to 6.9	7.0	7.1-7.9	> 7.9

Source: UFC 1993.

From the point of view of physical characteristics of the soil, Ferreira (2010, p. 12) points out, in relation to the soil structure refers to the arrangement of their particles. The same authors, citing Marshall (1962), states that the arrangement of soil particles and pore space between them includes the size, shape and arrangement of the aggregates formed when primary particles are grouped in separable units. " Soil structure affects the permeability of their material, so to Troeh and Thompson (2010, p. 73), the Soil structural unit aggregate is called, natural groups of primary particles (sand, silt, clay and organic materials) that occur and persist in the soil. " Soils which have frank texture class consists of the balance relation in the soil fractions (sand, silt and clay), allowing good root and pedogenetic process development, considering the aspects of aeration caused by good porosity of these soils, favoring subsistence crops on site research.

Physical characteristics indicate textural variation at depths of 0 to 30 cm in relation to collection points according to (Tables 3:05), such variation may be related to the use forms, as well as by erosion and by the geo-environmental characteristics such as steepness of the terrain. In quadrant I, the area of top, where it is ground under trace of forest, the physical characteristics correspond to texture rating of frank to the depths from 0 to 30 cm (see Table 03), where it is observed that the environmental conditions plant and largest wetland coverage favoring a better balance of the mineral constituents of the soil.

In the shed area under cultivation conditions of banana texture class is the predominant clay sandy loam depths of 0 to 5 cm, Franco clay from 5 to 20 cm and clay 20 to 30 cm (see Table 03). The various types and conditions of use may indicate the textural variation, since in the region the historical context evidence sugarcane cultivation in the 1980s and Coffee in 1990. For Valley area, where the conditions of use is fallow, textural classification is open in the depths 0-20 cm and loamy franc between 20 and 30 cm. In the second area of study, Quadrant II, was noted for environments that use conditions are similar to the points collected with the cultivation of banana, however, the physical characteristic differs depending on erosion.

Thus, the top area, there was a sandy loam rating depths of 0 to 15 cm, followed by sandy loam clay between 15 and 30 cm. In the shed area textural classification corresponds to blunt determination sandy clay at depths from 0 to 30 cm (see Table 05), such condition may be associated plantains where the surface presents discovery regarding the handling and preparation the land for planting. In the valley variation in texture class, along the depths of 0 to 30 cm, ranging from Fr sandy clay, open and clay franc (Table 05), such condition can be matched by the proximity of the access route (carriageway road), where the texture of that environment certainly was altered by their proximity.

Considering the physical and chemical aspect of the soil, it is important to analyze the information of (Tables 03, 04, 05 and 06).

Table 03: Soils Physical characteristics under different types of cultivation in quadrant I

Depth	Coarsesand	Sand Slim	silt	Clay	Silt / clay	ranking textural	Density	
 g / kg g / cm				
Soil Particles								
Top area								
Soil under Atlantic Forest								
00-05 cm	294	212	347	147	2.36	France	2.67	0.94
05-10 cm	437	17	366	180	2.03	France	2.78	0.96
10 - 15 cm	268	184	364	184	1.98	France	2.53	1.00
15 - 20 cm	300	163	343	194	1.77	France	2.90	0.98
20 - 25 cm	292	148	347	213	1.63	France	2.99	1.04
25 - 30 cm	273	150	363	214	1.70	France	2.99	0.97
Strand area								
Soil under cultivation of banana leaves								
00-05 cm	380	131	254	255	1.00	Fro. Arg. sandy	1.27	2.61
05-10 cm	306	145	257	292	0.88	Franco clay	1.22	2.61
10 - 15 cm	293	153	227	327	0.69	Franco clay	1.18	2.62
15 - 20 cm	224	151	240	385	0.62	Franco clay	1.16	2.65
20 - 25 cm	201	98	228	473	0.48	Clay	1.15	2.64
25 - 30 cm	171	79	180	570	0.32	Clay	1.14	2.61
Valley Area								
Soil under fallow								
00-05 cm	295	172	328	205	1.60	France	1.26	2.63
05-10 cm	291	164	311	234	1.33	France	1.23	2.67
10 - 15 cm	314	145	317	224	1.42	France	1.21	2.63
15 - 20 cm	310	143	298	249	1.20	France	1.18	2.69
20 - 25 cm	285	135	298	282	1.00	Franco clay	1.17	2.68
25 - 30 cm	179	168	330	323	1.02	Franco clay	1.14	2.66

Source: IFCE and UFC, 2017.

Table 04: Chemical characteristics of soils under different types of cultivation in quadrant I

Depth	pH	MO	P	K	Here	mg	At	al	H + Al	s	CTC	V	PST	m	EC
..... g / kg mg / kg cmolc / kg cmolc / kg % dS / m															
Top area															
Soil under Atlantic Forest															
00-05 cm	4.2	125.16	0	0.18	6.00	11.50	0.26	4.60	11.40	17.94	131.94	14	0	72	0.34
05-10 cm	4.3	83.79	0	0.13	2.50	17.00	0.17	3.80	10.70	19,80	126.80	16	0	66	0.29
10 - 15 cm	4.3	65.17	0	0.10	2.50	15.00	0.17	3.15	8.15	17.77	99.27	18	0	64	0.28
15 - 20 cm	4.5	45.51	0	0.05	2.00	15.50	0.22	3.10	7.90	17.77	96.77	18	0	64	0.20
20 - 25 cm	4.5	35.17	0	0.05	3.00	22.00	0.17	3.15	5.90	25.22	84.22	30	0	56	0.22
25 - 30 cm	4.5	201.71	0	0.03	2.00	15.50	0.17	3.00	5.05	17,70	68.20	26	0	63	0.17
Strand area															
Soil under banana cultivation															
00-05 cm	6.0	29.79	2	0.45	4.20	3.10	0.10	0.35	3.63	7.85	11.48	69	1	4	0.16
05-10 cm	5.8	26.38	1	0.43	3.50	2.40	0.09	0.25	3.47	6.42	9.89	65	1	4	0.14
10 - 15 cm	5.6	23.17	1	0.39	3.00	1.50	0.10	0.20	3.47	4.99	8.46	59	1	4	0.12
15 - 20 cm	5.5	20.79	1	0.39	2.70	1.20	0.11	0.25	3.47	4.40	7.87	56	1	5	0.08
20 - 25 cm	4.8	17.58	1	0.29	2.00	1.10	0.12	0.70	4.62	3.51	8.13	43	1	17	0.08
25 - 30 cm	4.6	17.38	1	0.21	1.30	1.20	0.12	1.35	5.78	2.83	8.61	33	1	32	0.07
Valley Area															
Soil under fallow															
00-05 cm	5.7	21.62	16	0.11	4.20	3.40	0.14	0.15	4.29	23.85	28.14	64	1	2	0.07
05-10 cm	5.6	17.27	15	0.09	3.90	3.00	0.15	0.30	4.29	22.14	26.43	62	1	4	0.06
10 - 15 cm	5.5	16.03	18	0.08	3.90	3.60	0.16	0.25	4.13	25.74	29.87	65	1	3	0.05
15 - 20 cm	5.8	14.48	16	0.09	4.00	3.10	0.18	0.25	4.13	23.37	27,50	64	2	3	0.05
20 - 25 cm	5.6	13.76	19	0.08	3.80	3.10	0.18	0.30	3.63	26.16	29.79	67	2	4	0.05
25 - 30 cm	5.5	12.72	18	0.07	4.00	3.70	0.19	0.45	3.80	25.96	29.76	68	2	5	0.05

Source: IFCE and UFC, 2017.

Table 05: Physical characteristics of soils under different types of cultivation in quadrant II

Depth	Coarsesand	Sand Slim	silt	Clay	Silt / clay	ranking textural	Density	Soil Particles
..... g / kg g / cm								
Top area								
Soil under cultivation of banana leaves								
00-05 cm	496	149	177	178	0.99	sandyloam	1.45	2.62
05-10 cm	415	192	192	201	0.96	sandyloam	1.44	2.64
10 - 15 cm	408	185	210	197	1.07	sandyloam	1.45	2.61
15 - 20 cm	391	198	204	207	0.99	Franco arg. sandy	1.41	2.50
20 - 25 cm	371	213	210	206	1.02	Franco arg. sandy	1.45	2.56
25 - 30 cm	368	229	196	207	0.95	Franco arg. sandy	1.25	2.60
Strand area								
Soil under cultivation of banana leaves								
00-05 cm	431	173	198	198	1.00	Franco arg. sandy	1.45	2.65
05-10 cm	456	160	144	240	0.60	Franco arg. sandy	1.44	2.69
10 - 15 cm	385	172	203	240	0.85	Franco arg. sandy	1.42	2.67
15 - 20 cm	395	169	148	288	0.51	Franco arg. sandy	1.35	2.67
20 - 25 cm	318	177	186	319	0.58	Franco arg. sandy	1.31	2.93
25 - 30 cm	331	156	267	246	1.09	Franco arg. sandy	1.29	2.73
Valley Area								
Soil under cultivation of banana leaves								
00-05 cm	316	205	219	260	0.84	Franco arg. sandy	1.34	2.65
05-10 cm	255	206	289	250	1.16	France	1.32	2.69
10 - 15 cm	324	178		219	1.27	France	1.40	2.65
			279					
15 - 20 cm	297	193	231	279	0.83	Franco arg. sandy	1.30	2.69
20 - 25 cm	267	186	207	340	0.61	clayey Franco	1.24	2.65
25 - 30 cm	238	200	354	208	1.70	France	1.35	2.67

Source: UFC, 2017.

Table 06: Chemical characteristics of soils under different types of cultivation in quadrant II

Depth	pH	MO	P	K	Here	mg	At	al	H + Al	s	CTC	V	PST	m	EC
... g / kg mg / kg cmolc / kg cmolc / kg % dS / m															
Top area															
Soil under banana cultivation															
00-05 cm	5.4	28.34	9	0.21	4.00	2.60	0.04	0.10	4.95	6.85	11.80	58	1	1	0.26
05-10 cm	5.1	22.86	6	0.23	4.30	3.40	0.08	0.15	4.95	8.01	12.96	62	1	2	0.22
10 - 15 cm	4.9	20.89	6	0.22	4.20	2.60	0.05	0.10	5.45	7.07	12.52	57	1	1	0.21
15 - 20 cm	4.9	18.31	6	0.35	3.80	3.40	0.04	0.25	5.45	7.59	13.04	58	1	3	0.17
20 - 25 cm	5.0	22.45	6	1.13	3.60	3.40	0.04	0.20	4.95	8.17	13.12	63	1	2	0.24
25 - 30 cm	5.1	17.27	11	1.15	4.20	4.00	0.03	0.10	4.29	9.38	13.67	69	1	1	0.18
Strand area															
Soil under banana cultivation															
00-05 cm	5.5	25.34	23	0.31	2.80	1.70	0.06	0.10	3.47	4.87	8.34	59	1	2	0.17
05-10 cm	5.2	24,00	21	0.42	7.00	3.80	0.10	0.10	4.29	11.32	15.61	75	1	1	0.14
10 - 15 cm	4.9	15.83	17	0.09	3.20	2.40	0.04	0.20	4.29	5.73	10.02	57	1	3	0.11
15 - 20 cm	4.8	15.41	16	0.17	5.90	3.30	0.06	0.25	4.79	9.43	14.22	66	1	3	0.07
20 - 25 cm	4.6	11.59	13	1.80	1.80	2.00	0.28	0.30	4.29	5.88	10.17	58	3	5	0.06
25 - 30 cm	4.5	09.00	7	0.23	4.30	3.70	0.08	0.45	4.46	8.31	12.77	65	1	5	0.08
Valley Area															
Soil under banana cultivation															
00-05 cm	5.9	18.31	4	0.14	2.00	1.80	0.05	0.05	2.15	3.99	6.14	66	1	1	0.17
05-10 cm	5.6	15.83	4	0.29	5.20	3.80	0.05	0.05	2.31	9.34	11.65	79	1	1	0.12
10 - 15 cm	5.8	15,10	6	0.26	4.80	1.90	0.05	0.05	1.98	7.01	8.99	78	1	1	0.15
15 - 20 cm	5.8	12,10	3	0.28	3.80	2.20	0.05	0.05	2.15	6.33	8.48	74	1	1	0.13
20 - 25 cm	5.5	09.62	4	0.28	3.50	1.50	0.06	0.10	2.15	5.34	7.49	71	1	2	0.09
25 - 30 cm	5.3	11.38	5	0.35	3.20	1.80	0.09	0.10	2.64	5.44	8.08	67	1	2	0.12

Source: UFC, 2017.

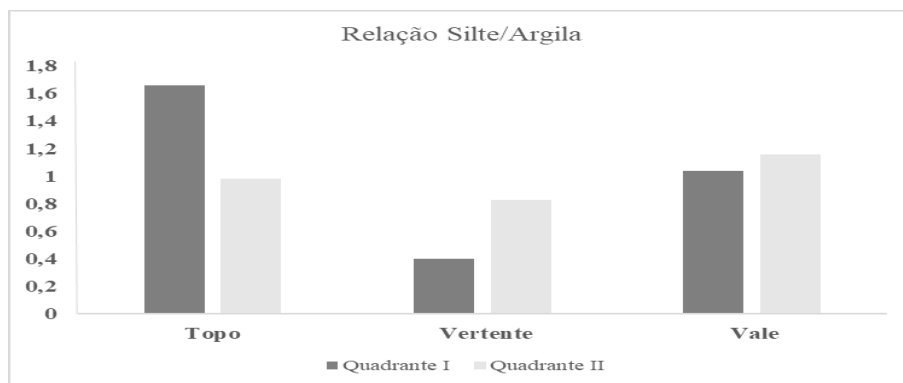
Considering the (Tables 3:05) on the physical characteristics of the soils in two areas topossequence quadrant I and II studies, the following are registered:

Physical Attributes

The soils of the geofácies did not present significant differences in relation to the clay content, except for the soils of the areas of slope of the quadrants I and II, that presented, respectively, 570 and 246 g / kg in the depth of 25 cm, suggesting presence of the horizon B in the soil of quadrant I.

According to Barbosa (2008), the silt / clay ratio can be considered as indicative of soil degree of weathering. The author compared soils at the same altitudinal level and degree of slope in the wet and dry slopes of the Baturité Massif, and found that this relationship was lower in the humid slope, concluding that the soils are more weathered than those located on the dry slope. In the same way, it was observed that the soils of the quadrant I (wetter area) had inferior values in the silt / clay relation when compared to the soils of the quadrant II, except for the top (Figure 02).

Figure 2: Average of the silt / clay ratio in the depths of 20cm - 25cm, 25cm - 30cm of the studied areas soils

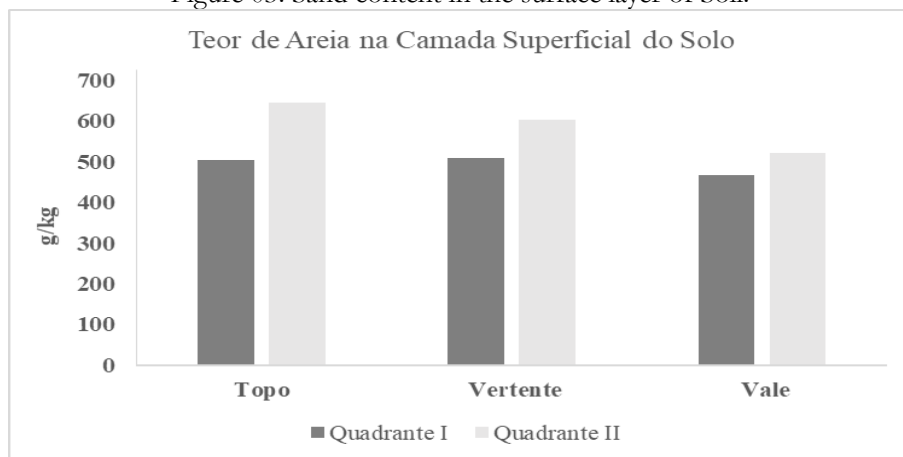


Source: BIRTH NETO, José Nelson (2017).

This lower silt / clay ratio at the top of quadrant II may be associated with laminar erosion of the finer particles in the soil, probably favored by exposure in the soil preparation process for banana cultivation. According to Barbosa (2016), studying the physical attributes of soils in the region of the Middle Jaguaribe, found higher levels of the coarse fraction (coarse sand + fine sand) in uncovered soils when compared with soils with vegetation cover and suggested that this accumulation of the sand fraction in the surface is due to the erosive process of the finer fractions that constitute the soils.

In this work, it can be added that this process of residual accumulation of the sand fraction in the II quadrant in relation to the quadrant I (Figure 03) is also favored by the greater slope of the terrain in the II quadrant, which allows a greater erosive potential.

Figure 03: Sand content in the surface layer of Soil.



Source: BIRTH NETO, José Nelson (2017).

4.1. Chemical Attributes

The results of the chemical analyzes of quadrants I and II are shown in Tables 04 and 06.

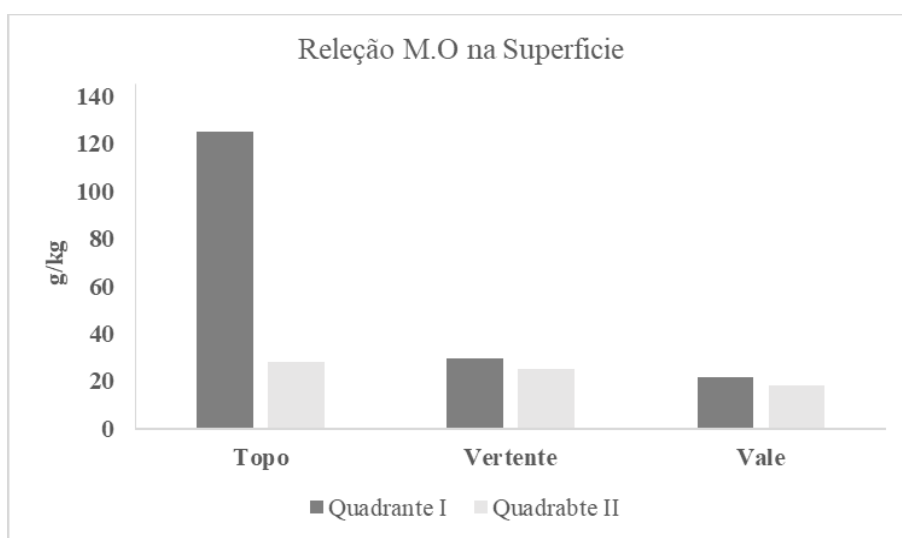
The soils presented average acidity, with pH ranging from 5.1 to 5.9 in the samples collected in quadrants I and II, except for the soil of the top area of quadrant I where the pH ranged from 4.2 to 4.5 of the surface to the depth of 30cm. Indicating soil with high acidity which presupposes a greater leaching process when compared with other soils.

For Barbosa (2008), it verified different degrees of soil leaching in the Baturité Massif, analyzing the pH, sum of exchangeable bases (S) and exchangeable Al content, and noticed that more weathered soils had lower pH and S due to removal of the cations by the leaching process and a higher concentration of exchangeable Al, as we observed in the soil of the top area of quadrant I. In soils with banana cultivation was found low content of exchangeable bases, probably removed from the system by the crop itself and by erosive processes.

However, due to the geoenvironmental conditions favoring greater soil protection, higher concentrations of these cations (Ca, Mg, Na, K) are observed even in the wetter conditions. The organic matter content (M.O) in the soil beds ranged from 29.79 to 18.31 g / kg, with the exception of soil in the top area of quadrant I, which had 125.16 g / kg of M.O. This is due to the presence of a remnant of Atlantic Forest vegetation that favors a constant addition of material for decomposition. It is also observed that in both topossequences the content of M.O decreases from the top to the valley (Figure 04), which presupposes that the erosive processes act in the removal of this organic material together with the finer mineral particles of the soil. It is worth emphasizing the influence of the cultivation on the dynamics of the organic matter in the two quadrants.

The saturation by base (V%) indicates eutrophic soils in both topossequences, except for the soil of the top area of the quadrant I that presented base saturation of less than 50%. This dystrophic condition must be associated to the higher degree of leaching of this soil.

Figure 04: MO ratio on the surface of the massive Uruburetama - CE.



Source: BIRTH NETO, José Nelson (2017).

The chemical analyzes indicated a variation of pH, MO, P and K, throughout each use condition (Tables 04 and 06), thus, the Uruburetama Mountains present a context of use and occupation that is influenced by environmental conditions, erosion, and slope in the chemical properties of soils.

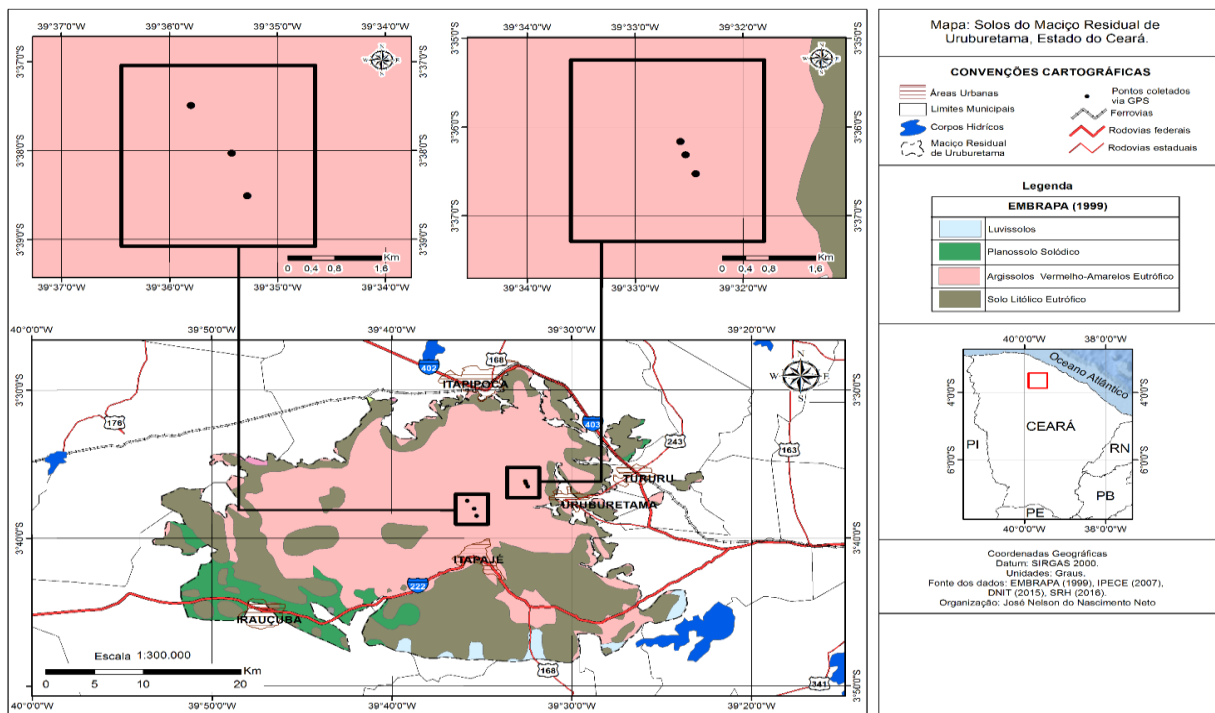
In the Topo area, it observed in the depths 0 to 30 cm that there was alteration of pH of 4.2 to 4.5, corresponds to acid soils. In relation to M.O this varied from 35.17 g / kg to 201.73 g / kg corresponding to soils with high concentration, in the P the determination was 0 for the depths of 0 to 30 cm. Such context is associated with the closed forest environment favoring more acid soils associated with low phosphorous contents. In the Strand area, the pH was 6.0 to 4.6 along the depths of 0 to 30 cm, so are high to low acidity soils. For M.O the variation was from 29.79 to 17.38 at depths from 0 to 30 cm, a fact that is influenced by the low presence of M. O on the surface, since the area is under banana cultivation. For the P the variation was 2 to 1 along the depths.

In the Vale area, the pH ranged from 5.7 to 5.5 along the depths of 0 cm to 30 cm, soils of medium acidity. In relation to M.O the variation was from 29.79 to 17.38 at depths from 0 to 30 cm, which corresponds to M.O decreasing in the lower layers. The P presents a variation of 15 to 19 classified as medium content, probably related to the fallow environment. In the second quadrant study area, the chemical contents presented in Table 6 indicate for pH, pH ranging from 5.4 to 4.9, which characterizes soils with high to medium acidity, OM ranging from 28.34 to 17.27 along the depths of 0 to 30 cm very high and P between 11 to 6 considered low to medium content, the relation of banana cultivation and the presence of forest remnants may influence the chemical variation.

In relation to the Vertente, the chemical determinations of pH ranged from 5.5 to 4.5 along the depths 0 to 30 cm, are soils of high to medium acidity. In M.O it presents contents of 25.34 to 09.00 can be considered as high content and the P ranged from 23 to 7 along the depths of 0 to 30 cm classifying in high. The context that allowed the chemical changes is due to environments where the current crop is the banana tree, where erosion can interfere with soil properties. In the Vale (Table 06), the pH ranged from 5.9 to 5.3, classified as medium acidity. For the OM, the variation was from 18.31 to 9.62 classifying at very high, which is certainly influenced by the conditions of the environment where the use of the soil with the cultivation of the banana tree for the P was from 6 to 3, ranking in low.

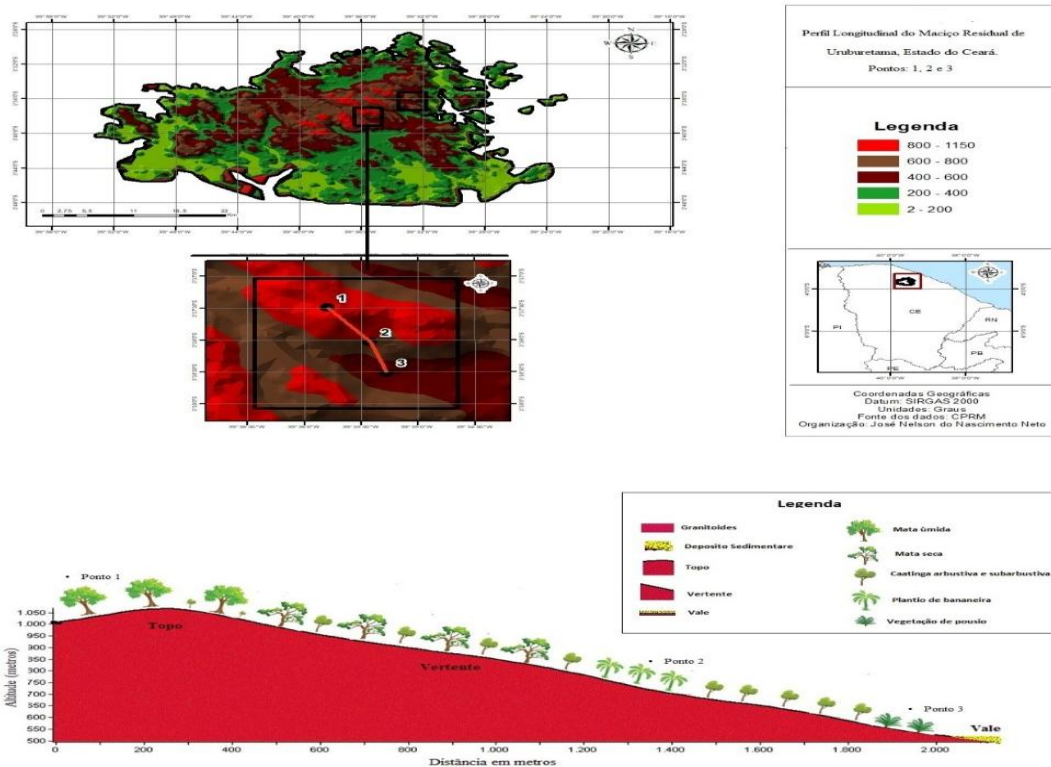
From the base (Figure 05) that shows the spatiality of the selected points for soil collection, we can observe that in the map the soils are located in Argissolos, however, since no morphological description of the soil was made, we chose to highlight only the physical and chemical properties of soils not identifying their classification, thus, the dynamics of the slopes in topossequence in the (Figure 06) allow us specific information of the area.

Figure 05: Soil map of the residual mass of Uruburetama, State of Ceara.



SOURCE: BIRTH NETO, José Nelson (2018).

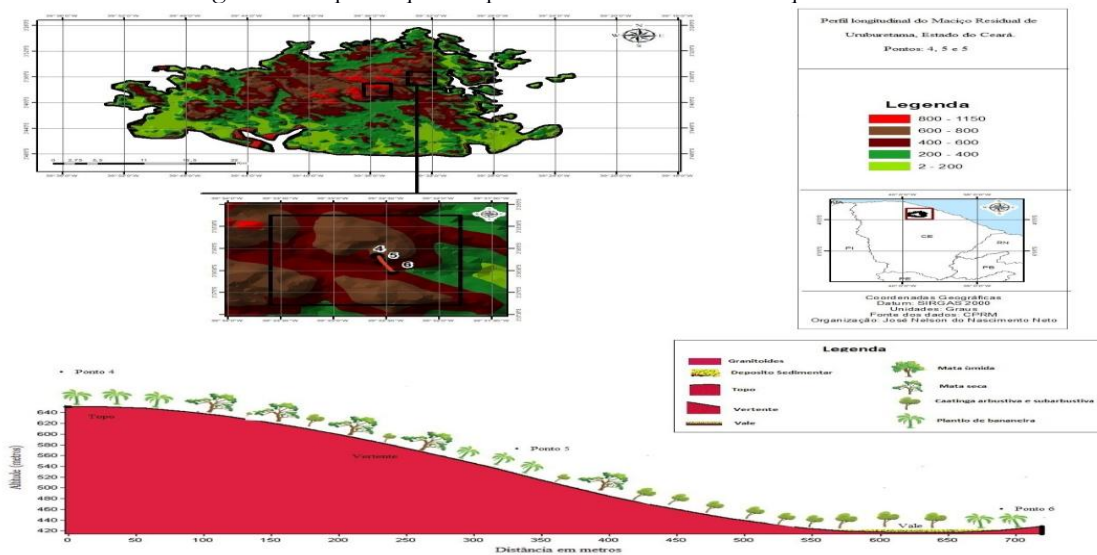
Figure 06: topossequence profile of soil collected in Quadrant I.



Source: BIRTH NETO, José Nelson (2018).

When we consider the landscape and correlate it with the environment, the altitude immediately denounces that the form of planting on the hill below is inadequate, which for these conditions the appropriate management are the forms of level curves and parceling of the land, being an area of an intense process of soil erosion, causing rocky outcrops that end up aggravating the environmental condition and agricultural production. For the second area of study, the (Figure 07) below is shown.

Figure 07: topossequence profile of soil collected in quadrant II.



Source: BIRTH NETO, José Nelson (2018).

Thus, when considering the two study areas and the physical and chemical characteristics of the soil, it is important to highlight the importance of adapting the soil management to the parceling and the level curves in order to adapt it to the topographic characteristics of the terrain and, respectively, the process of land use and occupation, besides providing the communities with survival conditions in these places, end up respecting the proper management of these environments, once the landscape ends up denouncing the quality of the environment.

5. Final considerations

The main contribution of this research is to investigate the process of degradation of the residual mass of Uruburetama resulting from a series of factors related to deforestation, agricultural cultivation in steep areas and to rainfall erosion. In this way, the direction in relation to the spatial organization of the landscape comprises a reflection of the cultivation of the earth from investigations of the physical and chemical characteristics of the soil.

In the study of the soils, in quadrant I, we observed more intemperate soils in the top and valley areas, with physical and chemical attributes that suggest a good environmental quality for the pedological development. Already in the second quadrant, less weathered soils were observed compared to the I-quadrant toposequence.

Due to the geoenvironmental conditions, mainly the less humidity and the greater slope, favoring the agents of the erosive processes, intensified by the agricultural activities. Thus, it is also possible to consider toposequence as an instrument of adequate soil management, from the two areas (quadrant I and II) it would be more accessible and practical to establish the parceling and the land level curves as an environmental planning tool aiming an appropriate adjustment to maintain the quality of the environment.

In this way, we perceive that the types of crops developed along the slopes end up influencing the alteration of the landscape, since they cause the degradation of the slopes and the alteration in the morphosculture of the relief forms with the loss of soil and the exposure of the rocks that appear from the top of the slope to the base.

On the final sieve, we emphasize the importance of considering the information on an integrated perspective where, the environmental degradation results from a series of factors, that need to be analyzed on the vision of the management and the techniques of adequate planting of the soil considering the topographic characteristics of the areas where the agricultural cultivation is located in the Uruburetama Mountains.

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