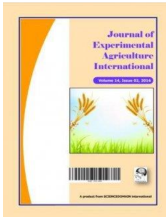

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Physical and Conservational Diagnoses of the Hydrographic Micro-Bacy of Rio Farinha

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The process of degradation of the environmental system of the Farinha river basin is due to soil inadequacy and natural factors.
Aims: The present work had as objective to evaluate the degree of deterioration of the environmental system of the hydrographic basin of the river Farinha the geo - referenced information are related to the physical characterization of the micro-basin based on the physical conservationist diagnosis of the Geographic Information Systems - GIS.
Methodology: The hydrographic basin of the Farinha River, located in the Center-West region of Paraíba, includes an area of 8.0915,8 ha. Images of the Landsat 8 satellite, OLI sensor in bands 3, 4 and 5 were applied, are classified as a visual and supervised process. With this, the software QGIS 2.18.17 generated vector data and the IDRISI Selva V.17, was used as a means to process

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the raster data. Under these conditions, the Digital Terrain Model (DTM) of the SRTM project was included for plans related to the polygonal delimitation of the micro-basin, characterizing a drainage network, compartmentalization and mean slope.
Results: The natural vegetation of the Caatinga presents as open tree shrub and closed arboreal, with the predominance of open vegetation, representing 48037 ha (59.4%). Concerning conflict analysis for land use, it was observed that compartment 1 was the only one that did not present such events. Compartment 2 resulted in a higher percentage of conflicts with 24.1%, however, areas with 4.2% have agricultural divergences, the 19.9% are due to livestock and mining activities. In relation to compartment 3 the area 6.3% is used for agriculture.
Conclusion: The physical-conservationist diagnosis of the micro-basin of the river Farinha presents an incorrect management, for this, a suitable study must be done to reduce the degradation of the area. Consequently, public policies are designed to interconnect communities living in these areas with their physical environment in a sustainable way.

Keywords: Environmental degradation; Caatinga; geotechnology; semiarid.

1. INTRODUCTION

The hydrographic basins are units of environmental analysis in which they can be considered the most adequate in the geographic space, the adoption of systemic studies are constructed by the environmental, social and economic aspects, thus, its morphology is totally integrated in the natural and social actions of the environment [1].

The relationships among these different components form scenarios with marked and dynamic peculiarities, with direct participation of society [2]. Thus, the interaction of biotic and abiotic factors such as soil, water, vegetation, and fauna, responds to natural (weathering, landscape modeling) and anthropogenic interference through the use and exploitation of the environment, interfering with the ecosystem as a whole [3].

Currently the socioeconomic system and the environment have interests that diverge explicitly, mainly due to the lack of planning in the occupation of these natural spaces. In this way the knowledge of the areas of use, allows the correct direction and management to be adopted, as well as helps in the identification of the possible effects of the anthropic actions. Correct land planning must be constantly carried out, especially in areas of permanent preservation (APP) so that problems with degradation are minimized [4].

In the Brazilian semi-arid region, the river basins are degraded due to economic interests, resulting in intensive grazing, the withdrawal of native vegetation as a source of energy, extraction of riparian forest and traditional agriculture, standardizing a set of natural characteristics of the region. It is worth noting that, intense rains, as well as extreme droughts, contribute directly to soil degradation [5].

For the identification and mapping of these areas, the use of geotechnology is an indispensable tool in the management of water resources, since it allows to evaluate the areas of the watersheds to be studied in relation to surrounding vegetation, land occupation, as well as organize and manipulate vector data and matrices within a database [6].

This set of tools (geotechnologies) is fundamental in the identification of land use and coverage and in the implementation of measures of environmental re-adaptation, since, combined with the analysis of physical parameters, it is possible to generate information plans for vegetation mapping and potential conflicts when confronted with land use [7,8].

The development of these plans ("Layers") will be based on remote sensing products. Fernandes [9] states that the products derived from this technology allow the extraction of topographic information such as delimitation of perimeters, drainage, slope, areas, among other physical characteristics of the river basins in a fast and efficient way, having significant relevance in environmental planning.

The aim of this work was to evaluate the degree of degradation of the environmental system of the Farinha river basin, using geo - referenced information regarding the physical characterization of the micro-basin and the physical conservation of the watershed using the Geographic Information Systems - GIS.

2. MATERIALS AND METHODS

2.1 Geography of the Study Area

The hydrographic basin of the Farinha river, located in the Center-West region of Paraíba, includes an area of 8.0915,8 ha. Located at the following geographical coordinates: 07º01'39" at 07º16'50" south latitude and 36º43'41" at 37º16'28" longitude west of Greenwich (Fig. 1.).

The municipalities that integrate the micro-basin are the following: Passagem, its area is integrally inserted in the micro-basin and the municipalities of Areia de Baraúnas, Assunção, Cacimbas, Junco do Seridó, Patos, Quixaba, Salgadinho, Santa Luzia, São Mamede, Taperoá and Teixeira part of the hydrographic basin set [10].

According to the classification of Koppen [11], the climate of the micro-basin is classified as Bsh, hot and dry, with two well defined seasons, the rainy season extends from January to April and the dry season from May to December, the average annual rainfall is around 700 mm.

The vegetation in the micro-basin is of the Caatinga type, with presence of medium to small woody species, usually endowed with spines. These species exhibit the deciduous mechanism that lose leaves in the dry season.

According to SUDEMA [12], the open Arboreal Arboreal Caatinga (CAAA), is found in most of the micro-basin, is characterized by a high degree of degradation, due to the incorrect use of the soil, becoming the sparse vegetation, with few trees and average height of 3 m, with predominance of herbaceous and cactaceous. In the sites of the watershed, slopes of hills and mountains are presented, in which there is a lower degradation, classifying the Closed Arboreal Shrub Caatinga (CAAF), with presence of arboreal individuals of average height of 5 m.

In the Farinha river basin, the diversity of soil units is verified. According to the mapping carried out on the soils, there is an exploratory level made by Embrapa [13], with the predominance of Orotic Crumoic Luvisols, planing areas, in the other regions, Eutrophic Littoral Neosol, Neolithic Regolithic Dystrophic and to a lesser extent Cambisols, Soil types are characteristic of a hyperoxerophophic Caatinga.

2.2 Material Used

The cartographic data used in this study were the SUDENE digital topographic charts of 1972, Patos (SB.24-ZDI) and Juazeirinho (SB.24-ZD-II) squares in the 1: 100,000 scale and UTM / SAD69.

The image used was the satellite in digital format Landsat 8 OLI; bands 3, 4 and 5, referring to orbit 215 and point 065, and passage of August 25, 2017; IDRISI Selva V. Software 17.0 "SIG" (Clark University, 2012) and QGis 2.18.17.

For the topographic analysis of the micro-basin the Digital Terrain Model (DTM) of the SRTM (Shuttle Radar Topography Misson) project is composed of 4 scenes of which are: 07s_37w, 07s_38w, 08s_37w and 08s_38w of September 14, 2014 and resolution of 30 m.

The Software used consisted of IDRISI Selva V. 17.0 "SIG" (Clark University, 2012) and QGis 2.18.17.

2.3 SRTM Data Processing

The SRTM obtained through the Earth Explore site, in GeoTIFF format, with the reference system in the WGS 84 Datum and 30m resolution. The process with the following routines was applied: raster> micelle> mosaic, to join the scenes; raster> projections> redesign, in which it modifies the coordinate reference system for the Datum SIRGAS 2000 - UTM - 24S.

For the filling of the areas without data in raster map the algorithm "r.fillnulls" with spline interpolation was used.

2.4 Generation of the Vegetation Cover Map and Current Use

The map generation of land use and land cover was based on hybrid classification (visual / supervised). For the visual method, the first step was the processing of the images of satellite Landsat8 orbit 215 and point 065, the images were of August 25, 2017. The stage consisted in the mosaic> reprojection for Datum SIRGAS 2000, Zone 24Sul> Colored composition RGB in bands 3, 4 and 5.

The second stage consisted of the vector representation of each identified theme, rasterizing on a mask previously generated with definition of the polygon of the basin.

From the overlapping of the two classifications, a hybrid image was generated with which the land use and cover map was created with the following typologies: Open Arboreal Shrub Caatinga (CAAA) - with predominance of grasses, tree and sparse trees and Closed Arboreal Arboreal Caatinga (CAAF) with the presence of shrubs and trees with height varying from 6 to 8 m, pasture area, agriculture, Urbana area, Corpos D'água and mining area. Then, the area values of each category of land use were calculated [14].

2.5 Automatic Generation of the Traverse, Subdivision and Drainage Map of the Watershed of the River Farinha

The delimitation of the macrobacia emphasizes the acquisition of the hydrological properties in the QGIS GIS, in which the complement of GRASS "r.watershed" stands out. This module derives from maps of flow accumulation, drainage direction, drainage location and micro-basin boundary.

In this respect, the flow direction map and the drainage network are organized with a "Thershold = 5000" (Threshold), naming the "Single Flow Direction" algorithm, with implantation in the algorithm "r.water.outlet" for demarcation of the micro-basin, beginning to be considered exuberant at coordinates UTM 691187920 w, 9221582.966 s, previously chosen on the "Stream" map. For the composition of the drainage network map and flow direction, the "r.stream" modules are produced for the following resolutions: (1) hierarchization of the drainage network by the algorithm "r.stream.ordere" (2) of the micro-basin, number and length of rivers with each order and drainage density, using the algorithm "r.water.outlet" [15].

The division into compartments, to denominate each subdivision of the micro-basin, was realized employing the Digital Terrain model (DTM) of the SRTM (Shuttle Radar Topography Misson) project.

2.6 Generation of the Mean Slope Map

Slope is a significant physical feature, since it is related both to the flow velocity and to the vulnerability of the region. The slope of the micro-basin is based on the DTM in the IDRISI SIG environment, observing the following routine: GIS Analysis> Surface Analysis> Topographic Variables> SLOPE. With support in this plane the average slope per stratum is extracted, according to the following routine: Gis Analysis> Database Query> Extract> Average.

For the declivity parameter, classes of interpretation of the obtained values were established, following the methodology of EMBRAPA [15].

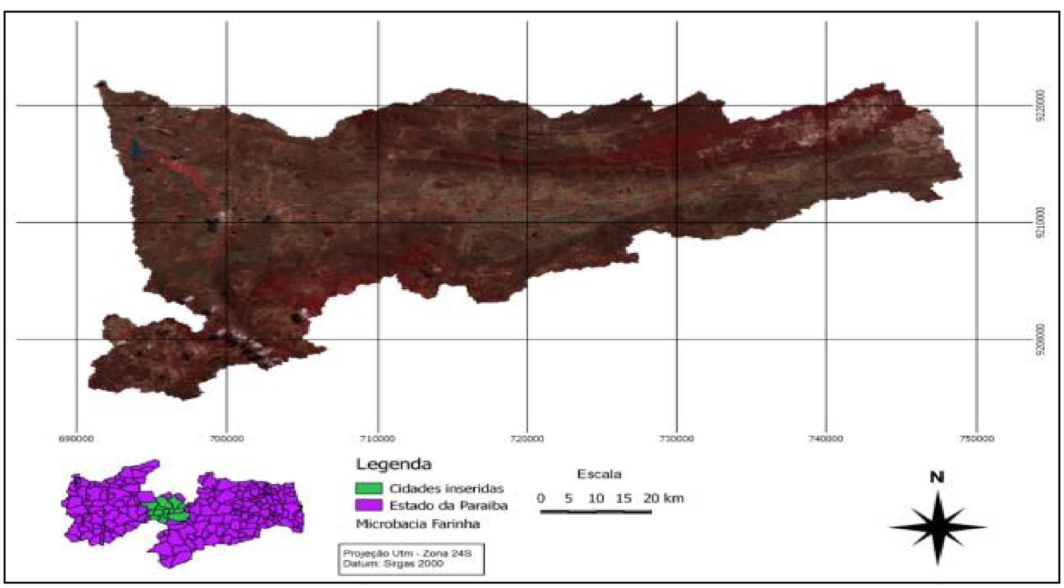

Fig. 1. Map of the location of the hydrographic basin of the Farinha-PB river

Table 1. Classes of slop, according to EMBRAPA (1979)

Declivity (%)	Relief
0-2	Plan
2-5	Soft wavy
5-10	Wavy
10-20	Wavy strongly
20-45	Mountainous
>45	Strongly hilly

2.7 Physical-Conservationist Diagnostic (CFD)

The physical conservationist diagnosis was developed according to the methodology proposed by Rocha [16], adapting to the region of the river basin of the river, using the Roughness Coefficient that directs the potential use of the earth in relation to its characteristics (Ruggdeness Number - RN) classified the land use into four classes, described below:

A - Land suitable for agriculture
B - Land suitable for pasture
C - Land suitable for pasture / afforestation
D - Land with aptitude for afforestation

The Roughness Coefficient is given by the following expression:

$$RN = D \times H$$

In which:

RN = roughness coefficient (dimensionless).
D =drainage density of the compartment evaluated, in km / ha.
H = average slope of the compartment evaluated, in%.

Next, there is verification of each RN value, for the calculation of the amplitude between the largest and smallest value, given by the formula:

A = higher RN value - lower RN value

With the value of "A", the value of the intervals (I) for the classes was calculated using the following formula:

$$I = A/4$$

The denominator 4 is the number of fitness classes, defined by alphabet letters (A, B, C, B).

2.8 Micro-Basin Degradation

To determine the degradation of the microbasin per compartment throughout the study area, the procedure suggested by Rocha [16] was adopted:

- Conflicts - For the enclosure distributed in class A, it is specified the sum of the agricultural areas and areas with burn practices, however, the slope is greater than 10%. If the slope is less than 10%, the conflicts are recognized by the burned areas. For compartments in classes B and C, it refers to the sum of agricultural areas, burned areas and possible mapped associations. In relation to compartment D, it is equivalent to the sum of the agricultural areas, pastures, fires and possible associations present.
- N - Refers to the percentage of areas occupied by forest cover, expressed total area of the compartment in question.
- A Forests - Microcatchments with a mean slope of less than 15% must have a minimum of 25% afforestation. Areas with a mean slope, equal to or greater than 15%, there is a management plan with a minimum of 50% forest cover. The area proposed for afforestation on lands whose average slope of less than 15% corresponds to the difference of 25% in the percentage of remaining forest cover in the compartment. The land, whose average slope is equal to or greater than 15%, applies the same intervention, and the difference to the percentage of existing forest cover is set at 50%.
- Excess (+) and Availability (-) in Agriculture - Excess (+) and Availability (-) in agriculture, for class A compartment, refers to the difference of its total area to the sum of the forest cover, areas buildings, agricultural areas, fires, water bodies and areas to be planted. For compartments contained in classes B, C, and D, assign the sum of the areas with agricultural cultivation.
- Area to be worked for the correct management of the micro-basin - for class

A compartments is the sum of the areas of conflict, and areas with agricultural excess or availability. For compartments included in Classes B, C and D, it is the sum of the areas to be planted, as well as areas of excess or availability in agricultural cultivation.

- Degraded area - sum of conflict areas and areas proposed for afforestation. % of degradation - percentage of degraded area in each compartment and the average in each micro-basin.

After the classes were vectorized, the calculations were carried out to determine the percentages of each one and defined the areas in conflicts of use in each compartment. Finally, the degree of degradation of the micro-basin was determined using Rocha's methodology [16] for subsequent recovery and environmental conservation measures.

3. RESULTS AND DISCUSSION

3.1 Natural Plant Cover

It is observed that in Fig. 2 the predominant vegetation was of the open-season shrub caatinga type with 48037 ha (59.4%) of the study area. On the other hand, there were 13828 ha (17%). These high rates of open tree shrub caatinga can be justified by the edaphoclimatic characteristics of the region, and the inadequacy of the use and management of the microbasin studied.

The closed arboreal shrub caatinga occurs in places of difficult access in a lesser proportion and in points where the topographic characteristics show marked slopes, hindering the anthropic action in these areas.

In the area of the micro-basin, inadequate agricultural practices occur along the rivers' channel with 4.4%, extensive cattle raising with 18.30%, with predominance of bovine and caprine cattle raising, urbanization with 0.44% and 'kaolin' mining areas with 0.07%, evidencing the inadequacy of land ownership, considering the environmental liabilities executed by practices in restricted areas with superlatively in the areas destined for permanent preservation.

The high index of areas for pasture can be justified by the practice of animal husbandry, mainly cattle and goats, which are widespread in the region due to their economic value in regional trade.

In a study carried out in the same area, Santos [17] identified the percentage of cover corresponding to 46% of the micro-basin with open tree shrub caatinga and 24% of the closed shrub caatinga, and a reduction in biomass of the open shrub caatinga the estimation of loss of 820 ha per year, indicating a possible deforestation process for the expansion of livestock production in the region, evidenced by the increase of anthropized areas.

A similar result is observed by Mendonça et al. [18], in a study developed in the Jatobá hydrographic basin, Patos-PB, identified that the area of the shrub Caatinga closed with 23.2%, and the woody shrub Caatinga open by 29.7%, already agriculture and livestock production by 41.4% and water bodies by 5.7%.

3.2 Map of Compartmentation and Drainage of the Watershed

The map shown in Fig. 3 represents the three compartments and drainage of the watershed. The compartment 1 presents an area of 12045.93 ha, the compartment 2 with 55536.58 ha and the compartment 3 with 13333.34 ha. The sum of the length of the drainage is estimated at 652,195 km.

According to Rocha [19] for the characterization and potential use of the land, Table 2 shows the aptitude of 68.63% for forest preservation. This fact can be justified by the mean slope of more than 16% and the low average drainage.

This fact can be justified by the mean slope of more than 16% and the low average drainage. In relation to compartment 3 the aptitude is identified with pasture / afforestation, however, it obtained a slope of more than 10%, which indicates that conservation practices are necessary for pasture use in the area, since they are areas susceptible to erosion, which consequently they lead to the silting of rivers, increasing the degradation of the micro-basin. Already compartment 1 aptitude is described for agriculture with 14.88%, the characteristics of flat areas near riverbanks show favorable conditions to agricultural practices.

In a similar study carried out in the Talhado-PB micro-basin, Silva et al. [20] is equivalent compartment with capacity for forest preservation 62.7% and slope of 13.63%.

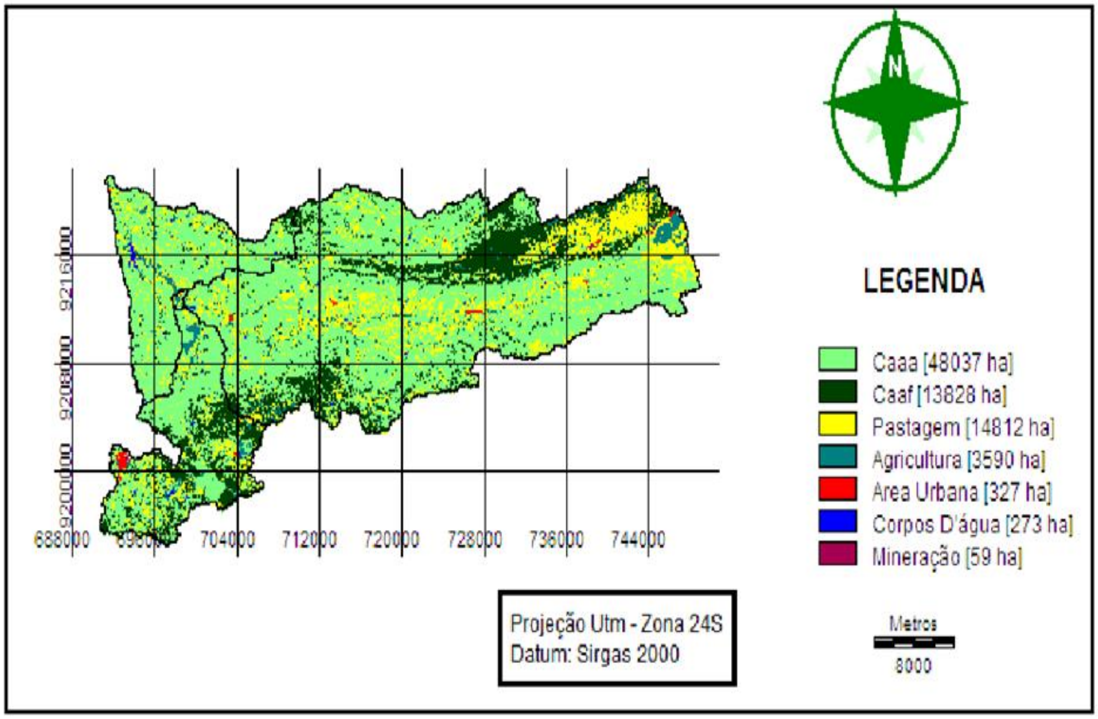

Fig. 2. Use and occupation map of the river basin of Farinha river

It is observed that classes 1 and 2 are in an area near the urban perimeter, which are developed agricultural activities and livestock, relating to a total of 37.98% of the area. In relation to class 5 that is located in the range of 20-45% resembles the restriction areas for anthropic activities, since they are tops, hills, mountains and mountains.

It is observed that approximately 50% of the study areas are distributed with slopes lower than 10%, that is, they are areas favorable to agricultural activities, as they present higher rates of infiltration and lower rates of erosion.

However, class 6 with slopes greater than 45% corresponds to permanent preservation areas such as the slopes. In the area of the micro-basin are represented by incelbergs and high hills around the Borborema Plateau.

The soils of these areas because they are steep, are highly susceptible to erosion, which requires greater protection. This way, the conservation of the areas avoids the drag of sediments that provoke the silting of dams and rivers in areas closer [21].

Medeiros [14] in a study elaborated in the Espinharas River Subbasin, observed that the slope of 0-3% represents 11.7% of the area, while the slope of 20-45% was 13.9%. mountainous and heavily mountainous areas with declivity greater than 45% indicated a total of 3.9%.

For Soares et al. [22], the determination of slope in Watersheds is important because it becomes essential to determine the environmental planning that reduces anthropic interventions and guarantees the environmental balance.

The absence of vegetation in an area with a steep slope causes a higher flow velocity and, consequently, a lower amount of water contained in the soil, thus causing sedimentation of rivers and reservoirs exposing the basin to the phenomenon of degradation.

3.3 Physical-Conservationist Application

According to Rocha (1991), the coefficient (Rn) (Rn), the parameters of amplitude of variation and the range of the roughness coefficient for the micro-basin of the Farinha river were calculated, whose values of the amplitude A = 13.54 and the interval between classes is (I) = 3.38 The value of the roughness coefficient (Rn), identified for the soil classification in the watershed was 3.38.

It allowed for the specification for Agricultural use, it is notorious that it is based on the values of class A, according to the classification of Rocha and Kurtz [23], that are of 1,09 - 10,63 (Table 3).

A similar result was observed by Campos et al. [24], in the Bauru-SP watershed, with aroughness coefficient value of 4.68, indicating the Bauru river basin with capacity for agricultural use (Class A).

Barros et al. [25], in a work in the yellow water stream watershed, Itaberá-SP, found the roughness coefficient of 13.36 classifying the soil as class B, which favors only pasture.

In table 4, for the roughness coefficient (RN) classes, we determined: A (with areas suitable for agriculture and urban expansion potential), class D (It is classified as unsuitable for agriculture and livestock use, allowing application only for afforestation) and C (indicates forests and limitations in pasture use).

The compartment 2, classified as class D, is classified as a permanent protection area, because it is an area with marked slope for anthropic activities and is strictly prohibited, in compliance with Brazilian environmental legislation, areas preserved with sensitive signs of erosion, native vegetation is still (2.33%) and pasture (11.36%), thus constituting a conflict of use.

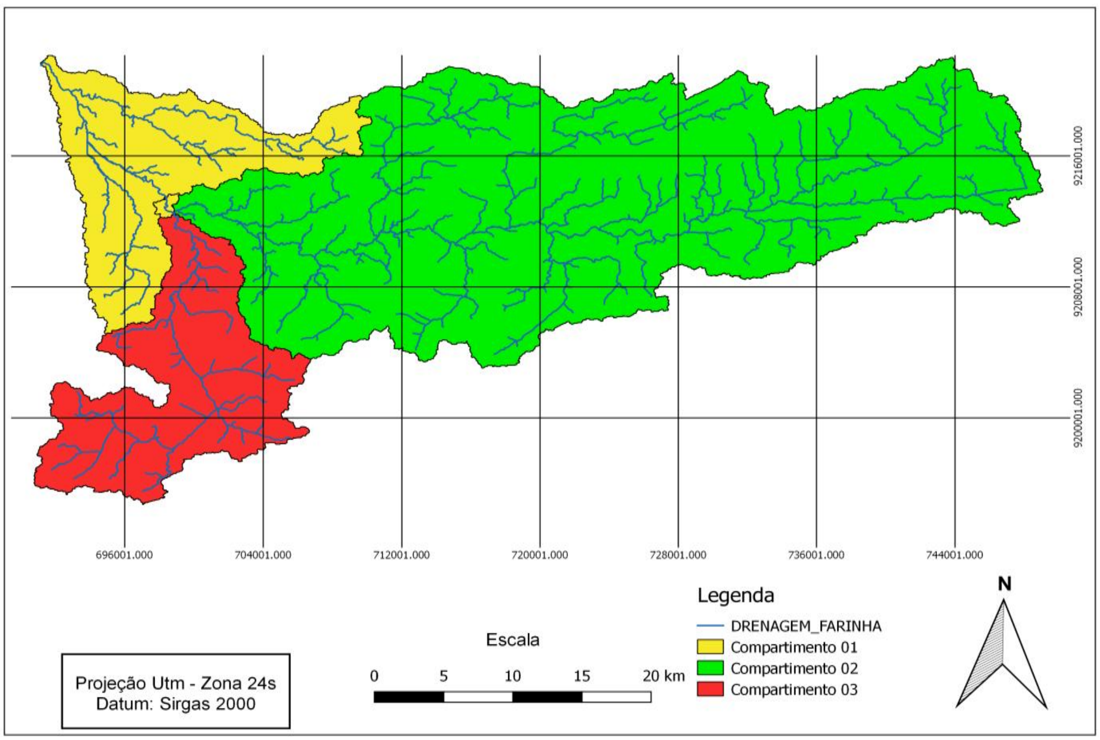

Fig. 3. Map of compartmentalization and drainage of the river basin of Farinha-PB

Table 2. Land use suitability, per compartment, of the river basin Farinha river - PB

[1]*Classes of RN	[2] Study areas	Basic Table - Physical-Conservationist Diagnosis - Rio Farinha - PB				
		[3] $\sum$(RCT) (km)	[4] Compartment area (ha)	[5] Average declivity (%)	[6] Density of drainage (km/ha)	[7] RN $x10^2$
A	1	97,43	12045,93	0.284940	0,0170	0,48
D	2	451,014	55536,58	16.118392	0,0087	14,02
C	3	103,751	13333,34	13.079647	0,007781	10,17
Total	-	652,195	80915,85	-	-	-

According to the map of mean slope, (Fig. 4.) the percentage of areas of the following classes are: class 1: 0-2% (11,10%), class 2: 2-5% (26,88%) , class 3: 5-10% (18.55%), class 4: 10-20% (18.65%), class 5: 20-45% (18.31%), and class 6: , 5%).

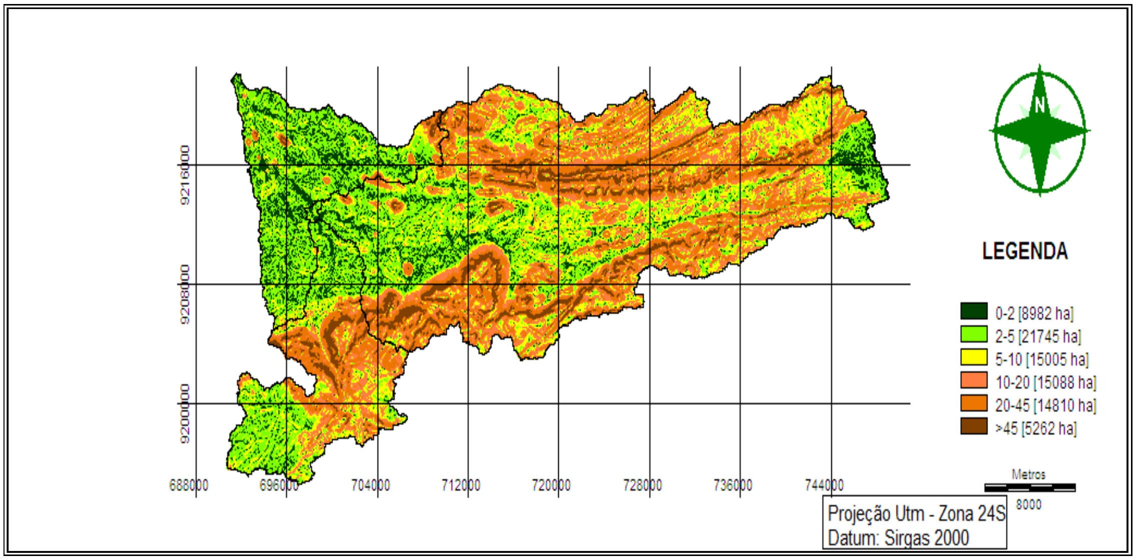

Fig. 4. Slope map of the river Farinha micro-basin

Table 3. Classes of roughness coefficient, of the river basin of Farinha-PB

Classes	Domain range (RN value)	Use	Found values
A	+ 3,38 0,48.......................3,86	Agriculture A	1 RN
B	+ 3,38 3,87.........................7,25	Pasture B	-
C	+ 3,38 7,26........................10,64	Grazing/Forestry C	1 RN
D	+ 3,38 10,65........................14,02	Florestamento D	1 RN

Table 4. Land use, by study compartment, in the Farinha – PB river basin

Classes of RN [8]	Compartments [9]	Use of the Land (ha)							
		N (ha)		∑ N [12]	2 [13]	3 [14]	4a [15]	4b [16]	5 [17]
		1ª [10]	1b [11]						
A	01	491.31	9085.95	9577.26	1875.87	474.03	20.97	106.74	
D	02	9787.50	32120.10	41907.60	11076.39	2279.88	132.2	84.42	59.04
C	03	3549.69	6830.64	10380.33	1860.30	836.46	173.52	81.63	-
Total		13828,5	48036,69	6186,19	14812,56	3590,37	326,7	272,79	59,04

The categories are natural vegetation and the current use of the compartments: 1 - Forests / natural vegetation (n), 1a - CAAF (Closed shrub caatinga) 1b - CAAA (open shrub caatinga), 2 - Pastures. 3 - Agricultural crops. 4 - Constructed areas: 4a Urbanization, 4b Water Corp, 5 - Mining area

These inadequate activities in these areas are related to the lack of inspection by environmental agencies, as well as by the increasing demand for new areas for agricultural and livestock activities, since they are practices that accelerate soil degradation.

Similar results were observed by Silva et al. [20] in the Talhado Paraíba watershed, in which compartments 1 and 2 with class D, shows the capacity for utilization of afforestation in agriculture (7.62%) and pasture (6.34%).

In compartments 1 (A) with potential for agriculture and urban expansion, it covers flat and slightly undulating areas, only 2.19% of the area is used for agriculture, the pasture area corresponds to 8.7%, in which the compartment predominates over that of agriculture, generating opposition in use. There is a marked highlight of areas of the open shrub caatinga (42%).

This predominance of open shrub caatinga vegetation is related to the abandonment of the lands after the cotton cycle in the 80's, that is, the vegetation is in a slow recovery due to the intense use of the soil.

In a study in the Upper Paraíba River Basin, in Cariri Paraíba, Dornellas et al. [26] found that the cerrado shrub caatinga and the rarefied or open Caatinga together obtained 72%, but the high rate of deforestation (24%) reveals the presence of small crops (2.1%).

For compartment 3, which is in class C, the areas have moderate to marked slopes, the predominant presence of open tree caatinga (28%), and grazing areas (7.85%). In this case, the most suitable for this type of area is the forest preservation, the pasture can be cultivated together with appropriate cultural practices to avoid soil degradation mainly by erosion.

In the sum of the three compartments the pasture areas in the micro-basin is 27.91%. The practice of animal husbandry in the semi-arid region is very widespread with extensive livestock farming, and semi-intensive for milk production. It is also worth noting the goat and sheep flocks [27].

It is observed in Table 5, the specific characteristics for each compartment, through the RN suggests the potentiality and limiting factors of each area. The compartment 1 is characterized by Class A RN, its area is 12045.9 ha, in this compartment there was no conflict, since its class includes all soil types. In this compartment the cover with natural vegetation of 79% was examined, being satisfactory, since the minimum recommended for area with slope is less than 15% is 25%.

However, compartment 1 presents around 1875.87 ha (15.57%), available for agricultural practices and should be managed to better exploit its potential, in this area there are no indicators of degradation. In order to exploit these new areas, measures are needed to promote agricultural production without a high degree of degradation, abandonment and afterwards the area does not become pasture.

In compartment 3 their lands fall into class C, which are suitable for reforestation and pasture. It has an area of 13333,34 ha, with a natural vegetation cover of 77.8%, above the minimum requirement of 25%, it is an extremely satisfactory situation with regard to forest reserves. It should be noted that in this compartment it presents a conflict area of 6.3% used for agriculture, making it urgent to suppress agricultural crops for the correct management of the micro-basin.

As for compartment 2 their lands were distributed in class D, they have strong physical limitations only suitable for afforestation. This compartment has an area of 55536.58 ha, and 79% contains natural vegetation cover. However, 24.1% of this area has conflict, 4.2% presents agricultural practices and the 19.9% are due to conflicts with areas of livestock and mining activities, which is characterized by a situation of marked degradation in the use of the soil in this compartment

Only compartment 1 did not show any degradation, the others showed deterioration indices, in relation to conflict rates. The average degradation of the watershed was 17.61% of the area. According to Rocha [16], the limit value for physical conservation degradation is below 10%, reveals that the micro-basin of the Farinha River presents a high degree of degradation due to anthropic activities performed incorrectly.

According to Westman [28], the conditions of natural vegetation cover, densification of the drainage network and slope are determining factors for the distribution of land in the classes of land use and slope.

The comparison with the study carried out in the Brazilian semi-arid region is worth the degradation found by Baracuhy et al. [29] studied the watershed of the Paus Brancos stream in Campina Grande - PB. In their research Baracuhy reported the high degradation of the Paus Brancos creek micro-basin, related to the small vegetation cover (10%) of the area with the mentioned description.

Mendonça [30], in a study carried out in the hydrological micro-basin of Riacho Una, Sapé-PB, noticed an average degradation of the micro-basin of 37.2%, due to the low percentage of vegetation cover due to the excess of agriculture, and temporary crops.

However, in order to reduce the degradation of the micro-basin, it is necessary to increase the environmental, socioeconomic and vegetal diagnoses, in the case of the Farinha river basin, families need the natural resources for survival, the socioeconomic conditions are limited, for this, the public policies should promote the connection of the community as the physical environment in a sustainable way.

Complementary studies should be carried out in this micro-basin, aiming to establish measures for the prevention, conservation and recovery of degraded areas, as well as to identify existing forms of human interventions, promoting subsidies for the environmental planning of the Farinha river basin.

Table 5. Physical degradation of the hydrographic micro-basin of Farinha river, PB

Classes RN [16]	Compartments [18]	Área of Microbac. (ha) [17]	Conflicts		N	A forests		Excess (+) and availability (-) In agriculture		Area to be worked for the correct management of the watershed		Areadeteriorated by Micro-basin	% of deterioration per micro-basin
			USO (ha) [20]	(%) [21]	(%) [31]	(ha) [32]	(%) [22]	(ha) [23]	(%) [24]	(ha) [25]	(%) [26]	(ha) [27]	Prioridades [28]
A	01	12045,93	**-**	-	79	-	-	-1875,87	15,57	1875,87	15,57		
D	02	55536,58	13415,31	24,15	75,45	-	-	+2338,92	4,21	2338,92		13415,31	24,15
C	03	13333,34	836,46	6,27	77,85	-	-	+836.46	6,27	836.46	6,27	836,46	6,27
Total		80915,85	14251,77			-	-			5051,25		14251,77	
Microbacy Average Degrad													**17,61**

4. CONCLUSION

The application of geotechnologies provides fast and efficient environments in the georeferenced environmental analysis of micro-basins, fundamental for the integrated development of the physical-conservationist diagnosis, achieving extremely satisfactory results and reducing costs.

In the analysis of conflicts of land use, it was analyzed that compartment 1 was the only one that did not present such events. In compartment 2 resulted in a higher percentage of degradation, due to conflicts with agricultural areas, pasture and mining. In compartment 3, their lands presented conflicts with agricultural areas, indicated only for pasture and forests.

The average degradation of the microbasin was 17.61%, indicating a high degree of degradation due to agricultural and livestock activities carried out incorrectly without any type of sustainable management.

The physical-conservationist diagnosis, it is concluded that the micro-basin of the Farinha River presents incorrect management of its lands, being necessary of more studies so that I can reduce the degradation and to implement the public policies in the community interacting like the physical means in a sustainable way.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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