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# Morphodynamics and erosion risk in the upper course of the Curimataú River (PB): an analysis based on soil loss monitoring techniques

## *Morfodinâmica e risco de erosão no alto curso do Rio Curimataú (PB): uma análise a partir de técnicas de monitoramento da perda de solo*

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**Abstract:** The work aimed to estimate soil loss data in the upper reaches of the Curimataú River Basin using experimental stations with erosion pins. These stations consist of measuring the loss of soil from the lowering of the soil in relation to the exposure of the surface pin. 2 monitoring stations were installed in sample sub-basins of the basin under study with similar geoenvironmental characteristics. Station 01 presented the use and land cover of areas uncovered by agricultural activities, while station 02 presented the use and cover of wooded steppe savannah in the initial stage of recovery. After 1 year of monitoring, it was possible to analyze that the station that had the most soil loss was station 1, presenting 1.6 t/ha/year, while station 02 totaled 1.1 t/ha/year. Thus, given the same geoenvironmental scenarios between the two sub-basins, the greatest susceptibility to soil loss occurred in station 01, which presented its cover characterized as bare soil and agricultural practices, this type of land use and cover in the basin represents 905 km$^2$ of a total area of 2,021 km2, raising a worrying scenario in soil degradation for the Curimataú River basin.

**Keywords:** Soil loss; Curimataú River; Station.

**Resumo:** O trabalho objetivou estimar os dados de perda de solo no alto curso da Bacia Hidrográfica do Rio Curimataú, estado da `Paeaíba, utilizando as estações experimentais com pinos erosivos. Essas estações consistem na medição da perda de solo a partir do rebaixamento do solo em relação a exposição do pino da superfície. Foram instaladas 2 estações de monitoramento em sub-bacias amostrais da bacia em estudo com características geoambientais semelhantes. A estação 01 apresentou o uso e cobertura da terra de áreas descobertas com uso de atividades agrícolas, já a estação 02 apresentou o uso e cobertura de savana estépica arborizada em estagio inicial de recuperação. Após 1 ano de monitoramento foi possível analisar que a estação que mais obteve perda de solo foi a estação 1, apresentando 1,6 t/ha/ano, enquanto a estação 02 totalizou 1,1 t/ha/ano. Dessa maneira, diante de cenários geoambientais semelhantes entre as duas sub-bacias, a maior suscetibilidade a perda de solo ocorreu na estação 01, que apresentou sua cobertura caracterizada como solo desnudo e práticas agrícolas, esse tipo de uso e cobertura da terra na bacia representa 905 Km$^2$ de uma área total de 2.021 Km$^2$, levantando um cénario preocupante na degradação de solos para a bacia do Rio Curimataú.

**Palavras-chave:** Perda de solo; Rio Curimataú; Estação.

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## 1. Introduction

Water erosion is a very active geomorphological agent in the semi-arid region, as pointed out by Xavier (2020),Medeiros (2021), Xavier (2021), Silva et al. (2021) and Silva (2023). Susceptibility to erosion in the semi-arid region has a natural character in different scenarios, as pointed out by Santos and Santos (2021). The "triggers", as Girão and Santos (2020) call them, which correspond to the low intensity of rainfall and its concentration in certain months of the year, susceptible soils, the deforestation of the caatinga vegetation due to land use practices in a incorrect results in favoring the occurrence of erosion in this environment. In this way, the seminar also demonstrates vulnerability to soil loss, as stated by Souza, Souza and Sousa (2021), Sousa and Paula (2019), Sobrinho and Barbosa (2022) and Queiroz (2022).

The loss of soil due to water erosion in the semiarid region of the Northeast, based on comparisons between experimental plots of land use, has gained concern in the environmental scenario, causing several environmental degradations and, as a consequence, a decrease in soil fertility. In Brazil, several studies have found considerable amounts of soil loss, being more intense in poorly managed agricultural soils (Cantalice et al., 2016; Baldassarini and Nunes, 2019; Rabelo and Araújo, 2019).

Soil loss caused by water erosion in semi-arid environments in the Brazilian Northeast has been measured based on studies such as those by Dornellas (2017, 2021). Monitoring soil subsidence from erosive pins is a technique that is currently rarely used to estimate soil loss. Most researchers prefer to use mathematical and environmental GIS models to produce soil loss estimates, however, in relation to empirical monitoring of soil loss in linear erosion, in Brazil the methodologies were presented in Guerra (1995), Baccaro (1999) and, from the 21st century onwards, one of the main published works was that of Guerra (2005), presenting the monitoring of gullies using the pile method and the monitoring of laminar erosion using the erosion pin method. Guerra and Cunha (1995) presented this technique based on their studies on erosion, Antoneli (2004) used the soil lowering technique measured by erosion pins in his study and obtained promising results, in the studies of Baldassarini and Nunes (2019) the technique was also applied and obtained positive results. Therefore, this methodology was used in the present research in order to estimate, from field experiments, soil loss in tons per hectare in experimental plots.

The stations were used in the studies by Baldassarani and Nunes (2018) and consist of an adaptation of the observation stations for rainfall morphodynamic processes presented by Casseti (1991), with the monitoring of erosion pins instead of water and soil collectors. This type of technique allows you to extend the reading and visiting periods of the stations. This aspect was important for the decision to use the technique because, in addition to enabling this interval of visits to the stations, they are also low cost and resistant to different socio-environmental scenarios, due to their low maintenance, and can therefore be installed in the semi-arid region.

The records allow identifying soil erosion through the exposure of the pins, as well as deposition when they are covered, indicating the spatial variation of erosion or deposition throughout the plots. This type of measurement helps to identify the types of erosion, linear and laminar, in addition to the loss in ton per hectare (Cunha and Guerra, 2002; Guerra, 2005; Lawler, 1978; Hatum, 2009).

Some authors have been using the Universal Soil Loss Equation to carry out this type of measurement in the semi-arid region, considering that it uses erodibility and erosivity factors based on GIS environment files, presenting good estimation results. However, understanding the physical dynamics of the area is extremely important for observing the processes that are visualized in the landscape. Therefore, it was decided to install these stations in order to extract more accurate data. There is a lack of studies with experimental stations in semi-arid areas of Paraíba, and, specifically in the Curimataú River Hydrographic Basin (BHRC), studies of this nature were non-existent. Therefore, this research can contribute to environmental preservation policies in the face of degradation that different land uses can generate in the environment.

## 2. Methodology

It was decided to choose two locations for installing the experimental stations on properties located in rural areas, each within a sub-basin. Studies such as those by Xavier (2021) use micro or sub-basins to analyze dynamics and connectivity in the production of sediments related to soil loss. Santos (2010), in studies on erosion in the semi-arid region of Rio Grande do Norte, also used the delimitation of sub-basins to analyze soil loss and erosion susceptibility. Santos (2012), in studies on erosion in municipalities in the interior of Ceará, also used sub-basins to install experimental plots to quantify soil loss in the area. Therefore, the present research chose two sub-basins to install the experimental stations for soil loss due to erosion in the upper reaches of the BHRC.

The sub-basins where the experimental stations were installed are the Lagoa de Onça sub-basin and the Filgueiras sub-basin, both located in the municipality of Cacimba de Dentro - PB. The natural characteristics of the two are grouped in table 1. Both have granite as the most common type of rock, which, according to the CPRM (2016) classification, is in the group of igneous/metamorphic rocks.

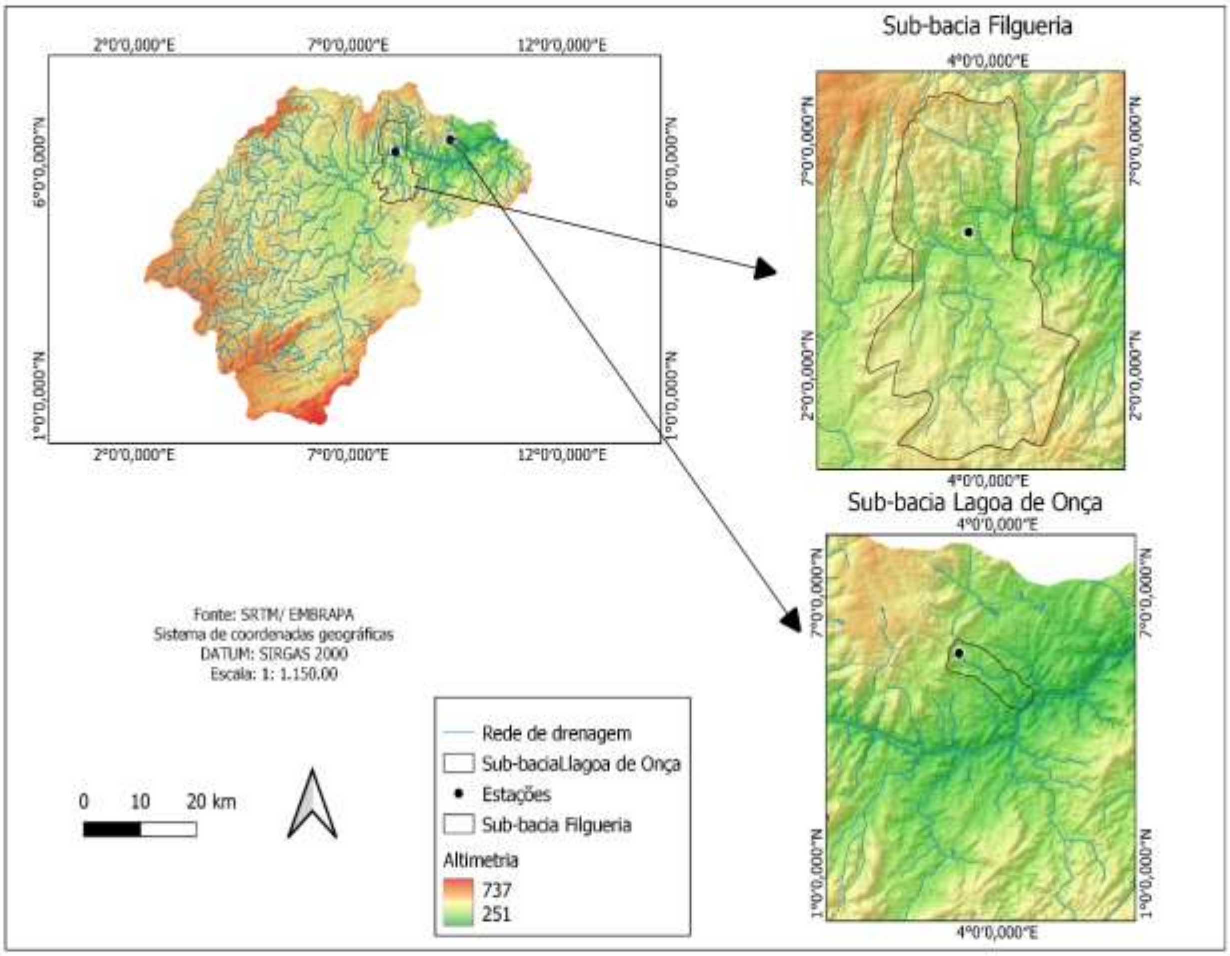



*Figure 1 – Location map of the sub-basins.*
*Source: Research data, (2023).*

To estimate soil loss at specific points, two experimental soil loss stations were installed, containing erosion pins, located in a sub-basin in the upper reaches of the BHRC. The choice of sub-basins to analyze a sample reality is present in studies such as those by Xavier (2021). These stations adapted to the research reality due to their low cost and ease of maintenance.

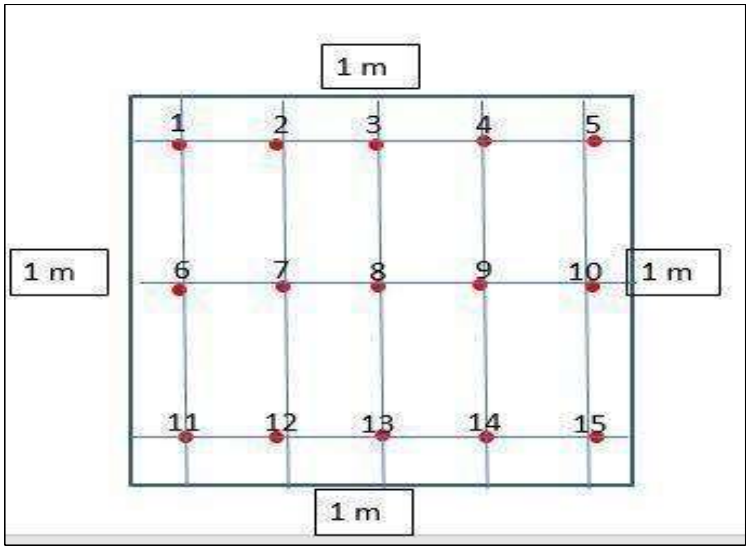



*Figure 2 – Distribution of pins at stations.*
*Source: Research data (2022).*

The experimental plots consist of an adaptation of the observation stations for rainfall morphodynamic processes by Casseti (1983), which are also present in the studies by Baldassarini and Nunes (2018). Monitoring consists of measuring the exposure of the pins in relation to the ground at considerable intervals of time, to identify the rate of lowering between the pin and the ground. There were a total of 15 pegs at each station, distributed as shown in figure 2. The pegs were made using wood as the primary material; measurements were taken and each pin was cut to a size corresponding to 30 centimeters, so that only 10 centimeters are exposed above ground level. Centimeters and millimeters were marked on each pin, to assist in measuring soil lowering. It is worth noting that after the end of the annual monitoring, the pins began to show damage caused by exposure to sun and rain. Therefore, it is advisable that for a longer useful period, the pins are made using iron rebar.

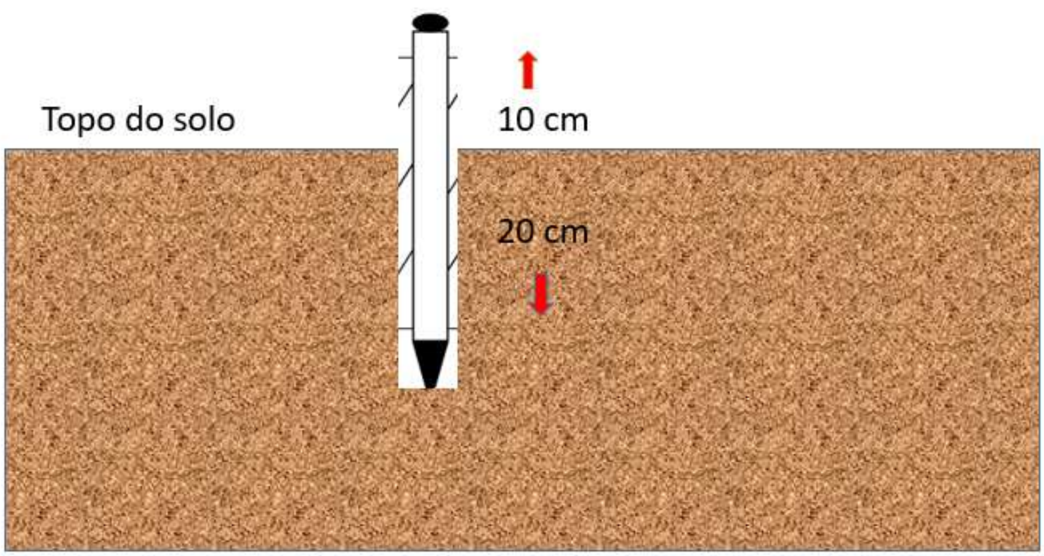



*Figure 3 – Erosive pin in profile.*
*Source: Research data (2022).*

Two stations were allocated throughout the basin, chosen for their similar slope and vegetation cover. Station number 01 was installed in an area used for agriculture, station number 02 was installed in an area of bushy caatinga. Both were fenced to prevent any damage caused by animals or people.

*Figure 4 – Pins in the process of being installed at station 01.*
*Source: Research data (2022).*

*Figure 5 – Station 01 after installation.*
*Source: Ana Célia, (2022).*

Data were collected from February 2022 to February 2023, to be able to measure soil loss in a seasonal cycle. Soil loss was determined by the change in the soil surface (Bertoni; and Lombardi Neto, 2014), based on the following expression:

P = h * A * Ds.

On what:

P = Soil loss (t/ha)

h = average change in ground surface level

A = plot area (m2)

Ds = soil density (t/m3)

In addition, monthly rainfall data from the river basin were collected, made available by the Executive Water Management Agency of the state of Paraíba (AESA), with the aim of comparing precipitation volumes and the monthly drawdown rate, identifying periods with greater rainfall rates and their correlation with erosion processes. To estimate soil density, an undisturbed Neosol Litholic soil sample was taken for analysis in the laboratory.

## 3. Results and discussion

### 3.1 Geoenvironmental aspects of station installation locations

The geoenvironmental aspects of the locations where the stations were placed will be briefly addressed, just to characterize the scenario as shown in table 1. Therefore, Baldassarani and Nunes (2018) argue that it is important that the stations are installed on the same or similar slopes so that , therefore, the speed of sediment transport provided by the slope is also similar. It is worth mentioning that the length of the ramp at station 01 is greater than that at station 02, but both were installed on a slope that, according to Embrapa (2018), is 20% to 45%.

*Table 01 – Geoenvironmental characteristics of the locations where the stations were installed.*

| | **Geologia** | **Declividade** | **Solo** | **Uso e cobertura da terra** |
|---|---|---|---|---|
| Station 01 | Lithotype: Granite and Biotite, Quartz are the main ones. Metamorphic igneous rocks. | 20% to 45%. Convex slope of a valley. | Litholic Neosol | Temporary agriculture + uncovered areas + Wooded Steppe Savanna. |
| Station 02 | Lithotype: Granite and Biotite, Quartz are the main ones. Metamorphic igneous rocks. | 20% to 45%. Convex slope of a valley. | Litholic Neosol | Wooded steppe savanna recovering an area intended for agriculture. |

*Source: Adapted from CPRM (2016) and EMBRAPA (2018).*

In the hydrographic context of the area, the Lagoa de Onça sub-basin encompasses a 1st order tributary that flows directly into the main river, the Curimataú River. The Filgueiras sub-basin already directly covers the main river, very close to station 02, installed in the sub-basin's drainage network. It also has 1st and 2nd order tributaries. Station 01 is installed approximately 300 meters from the tributary of the sub-basin and station 02 is installed approximately 500 meters from the Curimataú River. The predominant soil in the two sub-basins is Neosol Litólico, according to Embrapa (2018) (figure 6).

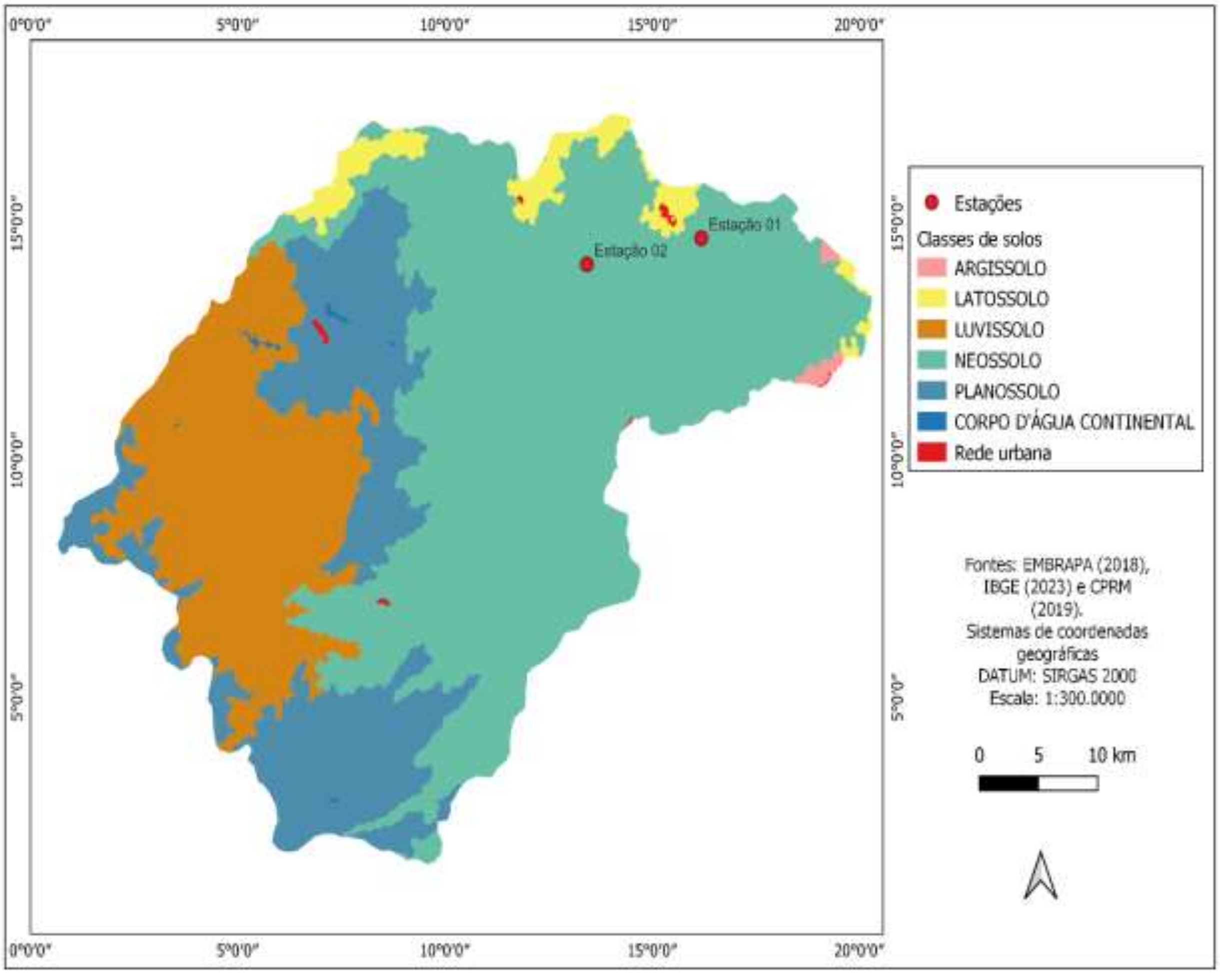



*Figure 6 – Soil map with location of stations.*

*Source: IBGE (2018). The predominant neosols in the study area are litholics.*

This type of soil is present in a large part of the river basin. According to Embrapa (2018), Neossolos are made up of mineral material or organic material less than 20 cm thick, without any type of B horizon and even A horizon, whose pedogenetic material is found directly above the matrix rock. Litholic Neosols, according to Santos and Santos (2021), are classified as soils with very high susceptibility to erosion. Since, as a whole, they are shallow, have high stoniness and direct contact with the parent rock in many cases, occur in rugged terrain, these factors limit root growth, the use of machines and increase the risk of erosion.

The study aimed to compare two areas, the first having exposed soil, subjected to temporary agricultural cycles and, locally, as sectors with steppe savannah in the initial stage of recovery. Land use and coverage in the vicinity of station 01 consists of types of temporary agriculture, with corn and beans planting (figure 7). During the station installation period, these crops were absent, with the presence of completely exposed soil. The land use in the second season is the wooded steppe savanna in the initial growth process, that is, and also constitutes an area that was used for temporary agriculture. However, in the year the station was established, it was no longer used for agriculture, allowing the vegetation regeneration process to begin.

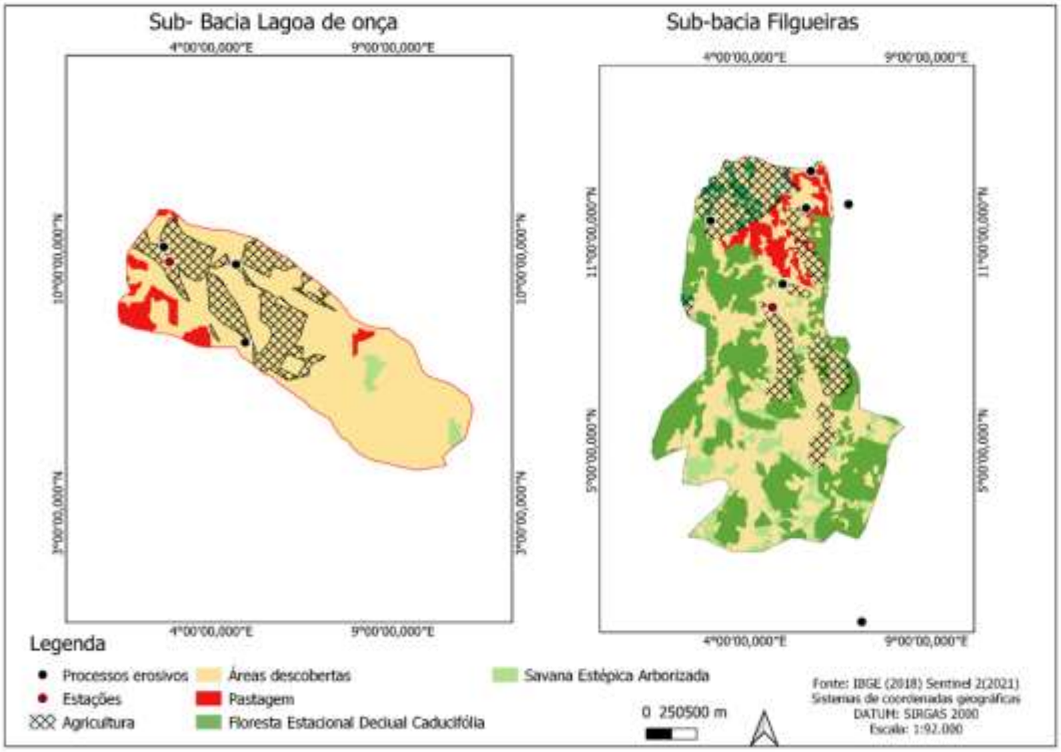



*Figure 7 – Map of land use and coverage in the sub-basins.*
*Source: Research data, (2023).*

### 3.2 Soil loss monitoring results

The rainfall regime during the monitoring period presented the following rainfall volumes in millimeters measured by AESA (Table 02). The area presents typical semiarid rainfall dynamics, where rainfall is concentrated in the months of March to July and the dry period from August to February. The graph shows the monthly averages in the municipality of Cacimba de Dentro, where the stations are installed.

*Table 02 – Monthly averages for the year under monitoring.*

| Ano | Mês | Volume pluviométrico mensal |
|---|---|---|
| 2022 | Fevereiro | 9,8 mm |
| 2022 | Março | 122,7 mm |
| 2022 | Abril | 66,4 mm |
| 2022 | Maio | 175 mm |
| 2022 | Junho | 145,6 mm |
| 2022 | Julho | 196,1mm |
| 2022 | Agosto | 57,4 mm |
| 2022 | Setembro | 22,0 mm |
| 2022 | Outubro | 7,0 mm |
| 2022 | Novembro | 24,5 mm |
| 2022 | Dezembro | 37,4 mm |
| 2023 | Janeiro | 30,4 mm |
| 2023 | Fevereiro | 25,1 mm |

*Source: EASA (2023).*

*Graph 1 – Rainfall in millimeters for the municipality of Cacimba de Dentro.*


*Source: EASA (2023).*

The monitoring was carried out in a year considered very rainy, so that, in July, the municipality of Cacimba de Dentro, where the two stations are located, recorded around 169 mm monthly. This intense rainfall regime results in an increase in erosivity in the area, considering that the intensity in relation to time of rainfall events was quite considerable.

The soil lowering data collected during monthly visits to each station are expressed in tables 03 and 04, so that the monthly lowering of each pin at the station was calculated, so that, in the end, the annual value of each pin was estimated. , and thus, an average total annual loss for each station was obtained. For each value gained, in the form of deposition on the pin, a plus sign (+) was assigned, and for each millimeter lowered, a (–) sign was assigned.

*Table 03 – Soil drawdown data for station 01, Lagoa de Onça sub-basin.*

| Mês | Fev 2022 | Mar 2022 | Abri 2022 | Mai 2022 | Jun 2022 | Jul 2022 | Ago 2022 | Set 2022 | Out 2022 | Nov 2022 | Dez 2022 | Jan 2023 | Fev 2023 | Média do pino |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pino | | | | | | | | | | | | | | |
| **P1** | 0 | -0,2 | -0,3 | -0,2 | -0,3 | 0 | -0,1 | -0,1 | 0 | -0,1 | 0 | 0 | 0 | **-1,3** |
| **P2** | 0 | -0,1 | -0,1 | -0,3 | -0,3 | -0,2 | -0,,2 | 0 | -0,1 | 0 | 0 | 0 | -0,1 | **-1,4** |
| **P3** | -0,1 | 0 | 0 | -0,2 | -0,2 | -0,4 | -0,2 | -0,1 | 0 | 0 | 0 | 0 | 0 | **-1,2** |
| **P4** | 0 | -0,1 | -0,1 | -0,3 | -0,3 | -0,5 | 0 | -0,1 | 0 | -0,1 | 0 | 0 | 0 | **-1,5** |
| **P5** | -0,1 | 0 | 0 | -0,4 | -0,3 | -0,2 | -0,5 | -0,3 | 0,2 | 0 | 0 | 0 | -0,1 | **-2,1** |
| **P6** | 0 | -0,1 | 0 | -0,4 | -0,5 | +0,5 | -0,2 | 0 | 0 | -0,1 | 0 | 0 | 0 | **-1,9** |
| **P7** | 0 | 0 | 0 | -0,5 | -0,1 | 0,3 | +0,3 | +0,2 | 0 | 0 | 0 | 0 | 0 | **-1,3** |
| **P8** | 0 | 0 | +1,0 | -1,3 | -0,5 | -02 | 0 | 0 | 0 | -0,1 | 0 | 0 | 0 | **-1,1** |
| **P9** | 0 | -0,1 | -0,2 | -0,2 | 0 | -0,4 | -0,1 | 0 | 0 | -0,1 | 0 | 0 | 0 | **-1,1** |
| **P10** | -0,1 | 0 | 0 | -0,4 | -0,5 | +0,2 | +0,2 | 0 | 0 | +0,5 | 0 | 0 | -0,1 | **-0,2** |
| **P11** | 0 | 0 | +1,0 | -1,5 | -0,5 | -0,1 | 0 | +0,1 | 0 | -0,2 | 0 | 0 | 0 | **-1,2** |
| **P12** | 0 | -0,1 | -0,1 | -0,4 | 0 | -0,1 | 0 | +0,2 | 0 | +0,2 | 0 | 0 | -0,1 | **-0,4** |
| **P13** | 0 | -0,1 | +0,1 | -0,3 | -0,2 | -0,5 | 0,5 | 0,2 | 0 | -0,1 | 0 | 0 | 0 | **-1,8** |
| **P14** | 0 | -0,1 | 0 | -0-3 | -0,4 | -0,2 | -0,2 | -0,1 | 0 | -0,2 | 0 | 0 | 0 | **-1,5** |
| **P15** | -0,1 | -0,1 | -0,3 | 0 | -0,3 | -0,1 | +0,1 | 0 | 0 | +0,2 | 0 | +0,1 | -0,2 | **-0,5** |
| | | | | | | | | | | | | | | **Total: -1,2 cm** |

*Source: Research data, (2022/2023).*

*Table 04 – Soil drawdown data for station 02, Filgueira sub-basinFonte: Dados da pesquisa, (2022/2023).*

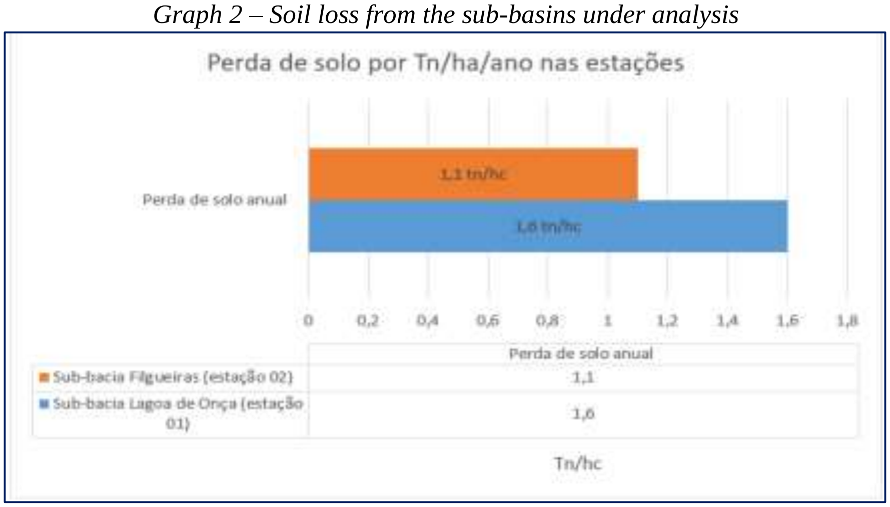
| Mês | Fev 2022 | Mar 2022 | Abri 2022 | Mai 2022 | Jun 2022 | Jul 2022 | Ago 2022 | Set 2022 | Out 2022 | Nov 2022 | Dez 2022 | Jan 2023 | Fev 2023 | Média do pino |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pino | | | | | | | | | | | | | | |
| **P1** | 0 | -0,2 | -0,3 | -0,2 | -0,3 | 0 | -0,1 | 0 | -0,1 | 0 | 0 | 0 | -0,1 | **-1,4 cm** |
| **P2** | 0 | -0,1 | -0,1 | -0,3 | -0,3 | -0,2 | -0,1 | -0,1 | 0 | 0 | 0 | 0 | -0,1 | **-1,4 cm** |
| **P3** | -0,1 | 0 | 0 | -0,2 | -0,2 | -0,4 | -0,2 | -0,1 | 0 | 0 | 0 | +1,5 | 0 | **-0,3 cm** |
| **P4** | 0 | -0,1 | -0,1 | -0,3 | -0,3 | -0,5 | 0 | -0,1 | +0,2 | 0 | -0,1 | +1,0 | 0 | **-0,5 cm** |
| **P5** | -0,1 | -0,1 | 0 | -0,4 | -0,3 | -0,2 | +1,0 | +0,3 | 0 | 0 | 0 | -0,8 | 0 | **-0,4 cm** |
| **P6** | 0 | -0,1 | 0 | -0,4 | -1,5 | +0,5 | +0,5 | -0,2 | +0,2 | 0 | 0 | -0,1 | -0,1 | **-1,3 cm** |
| **P7** | 0 | 0 | 0 | -0,5 | -1,0 | -0,3 | +0,3 | +0,5 | 0 | 0 | 0 | -0,1 | 0 | **-0,6 cm** |
| **P8** | 0 | 0 | +0,1 | -0,3 | -0,5 | -0,2 | 0 | 0 | 0 | 0 | -0,1 | -0,2 | +0,3 | **-0,7 cm** |
| **P9** | 0 | -0,1 | -0,2 | -0,2 | 0 | -0,4 | -0,1 | 0 | 0 | +0,5 | 0 | -0,1 | -0,1 | **-0,8 cm** |
| **P10** | -0,1 | -0,1 | 0 | -0,4 | -0,5 | +0,2 | +0,3 | +0,5 | 0 | 0 | 0 | -0,1 | 0 | **+0,3 cm** |
| **P11** | 0 | 0 | +0,1 | -0,5 | -0,5 | -0,1 | 0 | +0,1 | +0,1 | 0 | 0 | -0,1 | -0,1 | **-0,4 cm** |
| **P12** | 0 | -0,1 | -0,1 | -0,3 | -0,1 | 0 | 0 | +0,2 | 0 | 0 | 0 | 0 | -0,1 | **-0,4 cm** |
| **P13** | 0 | -0,1 | 0 | -0,3 | -0,2 | -0,5 | -0,5 | -0,3 | 0 | 0 | 0 | 0 | -0,1 | **-2,2 cm** |
| **P14** | 0 | -0,1 | 0 | -0,3 | -0,4 | -0,2 | -0,2 | -0,1 | -0,1 | 0 | 0 | -0,1 | -0,1 | **-1,6 cm** |
| **P15** | -0,1 | -0,2 | -0,3 | -0,1 | -0,3 | -0,1 | -0,1 | 0 | -0,3 | 0 | 0 | 0 | 0 | **-1,4 cm** |
| | | | | | | | | | | | | | | **Total: -0,8 cm** |

*Source: Research data, (2022/2023).*

This erosion pin technique shows consistent results when compared to other studies that used the same technique. Moraes et al. (2016) obtained results of soil loss between 0.1 and 0.3 t/ha/year in areas of rugged relief with high slopes and the presence of Quartzarene Neosols in the state of São Paulo. In the work of Marinheski (2011), in his experiments in pastures with little slope and Litholic Neosols and Cambisols, values between 0.2 and 0.4 t/ha/year were obtained. Finally, Baldassarini and Nunes (2018) estimated results between 0.5 and 1.5 t/ha/year. When analyzing the data provided, taking into account geomorphological and pedological factors similar to those of the study area, it is notable that the results presented in the research are higher, this indicates that land uses and covers can strongly influence the process of soil loss. as well as climatic factors characteristic of the semi-arid region, such as torrential rains with a high power of disintegration and sediment transport. It is worth noting that studies applying this methodology in the semi-arid region of Paraíba, precisely in eastern Curimataú, were not found, this being one of the first studies to use this technique in this area.

The station with the highest soil loss was in the Lagoa de Onça sub-basin, with 1.6 t/ha/year. The Filgueira sub-basin presented 1.1 t/ha/year of soil loss as shown in graph 2.

*Graph 2 – Soil loss from the sub-basins under analysis*




*Source: Research data, (2023).*

Given the soil loss data presented above, it is notable that the Lagoa de Onça sub-basin, which had agricultural land use and coverage and exposed soil, suffered greater soil loss when compared to the Filgueiras sub-basin. This indicates that agricultural areas that result in exposed soil for a large part of the year, due to the regime of removing vegetation for plowing the land, have greater soil loss in the upper reaches of the BHRC in the year in question. Given this perspective, the high susceptibility to erosion and soil loss in areas with exposed soil is worrying, with a large participation of agriculture in this process. The uncovered areas represent 905 square kilometers in the upper course of the BHRC, which has a total area of 2,021 square kilometers, that is, this type of coverage is very present in the area's landscape and is very susceptible to soil loss, as shown in station 01.

Another important factor to be analyzed after comparing the results between the two seasons, is the protective effect on the soil that the vegetation cover of the Filgueiras sub-basin exerted; the area was covered by steppic savanna vegetation recovering after deforestation practices. Therefore, when comparing the Filgueira sub-basin with Lagoa de Onça, it is clear that there was a reduction in soil loss between them, proving that the caatinga vegetation in the initial recovery stage provides a certain level of protection for the soil against water erosion. Taking into account that all other physical aspects such as lithology, pedology and slope are similar in both seasons, it is notable that the reduction in loss occurred in collaboration with the different types of land use and cover between them.

*Figure 8 – Steppic savanna in its initial stage.*
*Source: Research data, (2023).*


*Figure 9 – Area of exposed soil after plowing the land near station 01.*
*Source: Research data, (2023).*

Studies such as those by Silva et al. (2019) point out that areas destined for agriculture, called by the authors Terra Arada (TA), tend to present 7 times more soil loss, when compared to a caatinga cover in the process of regeneration. Consequently, with the increase in these factors, the production of sediment generated by soil loss becomes increasingly accelerated. According to Ferreira and Araújo (2014), in the upper portions of a river basin, there is greater erosion and sediment transport naturally, as is the case in the upper reaches of the BHRC, however, inappropriate land use and cover practices can accelerate these natural processes. Therefore, it is clear that the use and coverage of the basin's land strongly contributes to the intensification of the basin's erosion processes. These are areas of agricultural activities with an estimated loss of 1.6 tons/hc/year.

It is worth noting that these were the first quantitative data from the research and the objective is to install new stations for more data collection in the semi-arid environment of Curimataú Paraibano.

## 4. Final considerations

Given the comparison between the two sub-basins and the similar geoenvironmental scenarios between them, station 01 presented the greatest susceptibility to soil loss, considering the influence of land cover characterized as bare soil and agricultural practices, warning of a worrying scenario in soil degradation in the Curimataú River basin.

The sampling also reveals the importance of vegetation for the recovery of degraded areas, through data obtained at station 02, reinforcing the presence of vegetation as the main factor for protecting soil against erosion processes in the semi-arid region.

Given these results, there is a clear concern about soil loss in the upper reaches of the Curimataú River basin, as areas with exposed soil represent 905 km2 of a total area of 2.2021 km2 in the upper reaches. Therefore, it is necessary to raise awareness in society for the development and application of conservation practices in land use and coverage so that the site does not suffer from soil degradation in the near future.

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