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Transport Phenomena on The Landscape: Lateral Connectivity And Fluvial Sediment Transport

Fenômenos de Transporte na Paisagem: Conectividade Lateral e Transporte de sedimento Fluvial

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Abstract: Fluvial sediment transport as bedload and suspended sediment is linked to rainfall-runoff and water erosion on watershed hillslopes. Therefore, the connectivity between the sediment transport phenomenon in watershed hillslopes and sediment transport rates in rivers may link issues such as lateral flow to resistance to the water surface, generating impedance/resistance to lateral sediment transport on hillslopes. This research was conducted to determine the suspended sediment transport from hillslopes from three Brazilian watersheds and address their curve number values to address this idea. The lateral sediment transport constituted by suspended sediment being detached and transported on the hillslopes was a linear adjustment to the watershed CN values. Additionally, the linear relationships among the amount of suspended sediment added to the bedload, and shear stress were successfully applied here to achieve soil erodibility at the watershed scale.

Keywords: lateral sediment connectivity; landscape; watershed critical shear stress; watershed erodibility; curve number; suspended sediment transport on hillslopes.

Resumo: O transporte fluvial de sedimentos na forma de carga de fundo e sedimento suspenso está ligado à precipitação-escoamento gerando erosão hídrica em encostas de bacias hidrográficas. Portanto, a conectividade entre o fenômeno de transporte de sedimentos em encostas de bacias hidrográficas e as taxas de transporte de sedimentos em rios pode ligar questões como o fluxo lateral à resistência ao livre escoamento superficial, gerando impedância/resistência ao transporte lateral de sedimentos em encostas. Esta pesquisa foi conduzida para determinar o transporte de sedimentos em suspensão de encostas de três bacias hidrográficas brasileiras e abordar seus valores de curva número para expressar esse transporte. O transporte lateral de sedimentos constituído por sedimentos em suspensão sendo desagregados e transportados nas encostas foi expresso por meio de um ajuste linear aos valores de CN da bacia hidrográfica. Além disso, as relações lineares entre a quantidade de sedimento em suspensão adicionada à carga de fundo e a tensão de cisalhamento foram aplicadas com sucesso aqui para alcançar a erodibilidade do solo na escala da bacia hidrográfica.

Palavras-chave: conectividade lateral de sedimentos; paisagem; tensão de cisalhamento crítica da bacia hidrográfica; erodibilidade da bacia hidrográfica; número de curvas; transporte de sedimentos em suspensão em encostas.

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1. Introdution

The fluvial sediment transported as bedload and suspended sediment is linked to rainfall runoff, resulting in water erosion on watershed hillslopes. Initially, all sediment is detached and transported due to all water erosion types or sediment sources: interrill erosion, rill erosion, ravines, and gully erosion, which are jointly known as gross erosion. However, only a fraction of the gross erosion reaches the main watershed channel, the river. A significant part of the detached sediment is deposited on hillslopes or in the watershed drainage system; there is no free impediment to flow, and the flow transports sediment. How do we represent this resistance to sediment-laden flow? How can resistance to flow and transport on hillslopes be linked to fluvial sediment transport?

The term 'connectivity' is currently applied in hydrological and landscape formation processes; Bracken and Croke (2007) address hydrological and sedimentological connectivity. The connectivity concept includes lateral connectivity (channel width), longitudinal connectivity (material transfer into the channel), and vertical connectivity (subsurface and surface interactions). Connectivity is often classified as structural or functional, with structural connectivity describing the spatial landscape pattern and functional connectivity correlating the spatial landscape pattern with the transfer process in the watershed (BRACKEN; CROKE, 2007; SOUZA; HOOKE, 2021; TURNBULL *et al*. 2008). Therefore, it is possible to link the channel connectivity for the width landscape to sediment transport on hillslopes and to bedload and suspend sediment via river flow.

Sediment connectivity measures how sediment fluxes move through a landscape, linking hillslopes and drainage systems. Consequently, the index of connectivity (IC) represents the connection between various parts of a watershed (CAVALLI et *al*. 2013, CREMA; CAVALLI, 2008). Cisllagui and Bischetti (2019), using the concept of connectivity to mountainous-forest hillslopes in unstable areas under landslide conditions, reported that sediment connectivity results from water erosion processes, resulting in sediment redistribution and, consequently, landscape formation.

On the other hand, the CN value of the SCS runoff CN method (JAIN; SINGH, 2019) was developed as an index representing the combination of a hydrologic soil group and land use and treatment class to estimate the potential runoff from a watershed, representing the lateral water transport on the landscape. The runoff curve number is a function of the following factors: hydrologic soil group, land use, soil-cover complex, and antecedent moisture conditions. Therefore, this approach results in exciting parameters, as the soil–cover complex impedes lateral water movement in a watershed.

Souza and Hooke (2021) investigated the effects of biomass seasonal variation and antecedent soil moisture on hydrological connectivity in semiarid Brazil and reported findings linking these effects to runoff and water erosion at the watershed scale. They also reported that higher rainfall events coincided with dry summer events in semiarid Brazil, when semiarid watersheds presented very high hydrological connectivity, indicating that hydrological connectivity is correlated with high seasonal biomass variation and antecedent humidity variability. Furthermore, they reported that hydrological and sedimentological connectivity are linked to semiarid variability in rainfall, water discharge, and seasonal vegetation density when structural connectivity is represented by seasonal soil cover promoted by vegetation and its effect on functional connectivity in water discharge from the semiarid environments.

These findings, Souza and Hooke (2021), agree with and reinforce the hydrologic soil group, land use, soil-cover complex, and antecedent moisture condition factors of the Runoff Curve Number, specifically the soil-cover complex and the three antecedent moisture conditions considered in this method.

The connection between transport phenomena on watershed hillslopes and sediment transport rates may be related to issues such as lateral flow resistance, water surface impedance to lateral sediment transport on hillslopes, and sources of bedload and suspended sediment delivered to the drainage system. This laterally transported sediment can have or cannot have a relationship with the shear stress in the principal channel. Landscape connectivity is functional and inspires natural resource management, environmental degradation, and environmental management.

Usually, soil erodibility is obtained for a specific soil class, i.e., the natural resistance to water erosion, Wischmeier and Smith (1978) in concentrated and nonconcentrated hydraulic flow, when this soil parameter expresses the natural resistance to soil erosion or its reciprocal, which is the natural susceptibility to soil erosion processes. In the water erosion prediction project, the WEPP model is based on physical processes (ELLIOT et al. 1999, FLANAGAN; NEARING, 1995). When the concentrated overland flow in channels generates shear stress that surpasses the critical shear stress of the soil, it leads to soil detachment. By employing linear regression between the applied shear stress and soil detachment rates, it is possible to determine soil erodibility and the critical shear stress for each soil class. In this modeling, the critical shear stress (τ_{cr}) is the linear intercept with the X abscissa, and the soil erodibility is represented by the angular coefficient of the regression fit between the shear stress (τ) and the instantaneous soil detachment rate. Therefore, determining the erodibility of all soils in a watershed is always challenging, but a statistical approach can be used to determine natural soil resistance to surface flow. This statistical approach permits the erodibility of all watershed soils working together against the flow shear stress in the river flow, which indicates watershed erodibility.

These relationships between water and sediment transport on agricultural hillslopes and hydrologic parameters, such as hydrologic soil groups and number curves, are used to determine lateral connectivity to determine the resistance of natural soil to flow shear stress, which means that watershed erodibility, including the effects of all soils from the watershed, is a welcome tool for sustainable environmental management and can be adopted by governmental agencies that work with natural resources, such as soil, water, forest, and land use, for animal and crop production. Determining watershed erodibility aids sustainable environmental management and supports hydrology and soil science, simplifying government decisions on environmental policies.

The objectives of this study were to investigate the lateral connectivity of the water surface and sediment discharge of three Brazilian watersheds through hydrologic parameters, such as hydrologic soil groups and number curve values with soil cover promoted by vegetation and crops in the form of a soil–vegetation complex, which generates impedance to laterally suspended sediment transport, as well as to sand transport on hillslopes that reach the drainage system and, finally, the primary watershed channel. Another objective is to determine the soil erodibility at the watershed scale of the three Brazilian watersheds because of the possibility of adding the suspended sediment flux from hillslopes to the bedload to the main channel and fitting all the sediment from these watersheds to shear stress in their respective rivers via linear regression.

2. Methodology

2.1 Watershed Studies

Three Brazilian watersheds were selected for this sediment transport research: the semiarid Cachoeira watershed (SILVA FILHO et al. 2019) with less developed soils and two coastal Brazilian watersheds with more developed soils, the Beberibe watershed (MORAES et al. 2024) and the Capibaribe watershed (CANTALICE et al. 2015), to express the degree of resistance and development of the soils.

The Cachoeira watershed (Figure 1) has an area of 68.98 km^2 and a concentration time of 4.22 hours; it is a small watershed located in Tabira city, Pernambuco State, Brazil, at 7°32′12″ south latitude and 37°29′18″ west longitude. The Cachoeira watershed has a relief with strong to gentle hillslopes; its main channel has a slope of 0.0041 m m^{-1}. The climate type is BSwh according to the Köeppen classification, which features 800 $mm.year^{-1}$ of average annual rainfall and 27 °C. The typical vegetation is the arboreal and semiarboreal shrub, known in Brazil as hyper xerophilic Caatinga, which grows under Entisols Fluvents and Entisols Lithic Orthents.

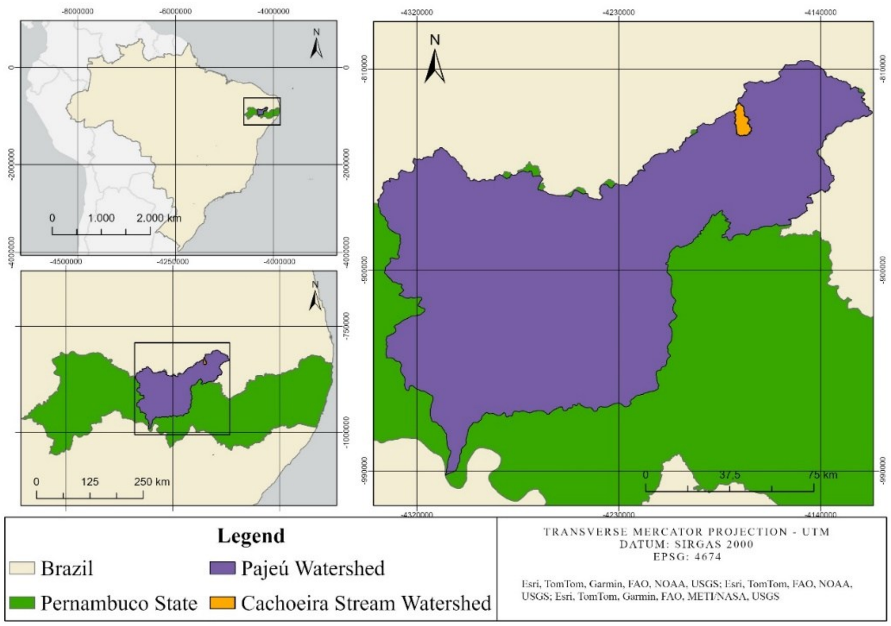

Figure 1. Cachoeira location map.

The Beberibe watershed from the Brazilian coast is under 1800 mm.year^{-1} of precipitation (Figure 2), as reported by Moraes *et al*. (2024), is a small watershed for an area equal to 81 km^2, with 10 hours of concentration time located at latitude 7°40'56" and 8° 38'00" W, longitude 34° 49' 00" and 35°15'52" W. Half of its area is urban, and the other half is Atlantic Forest, with a stepped relief and a channel slope of 0.00391 m.m^{-1}. The soils are predominantly developed Oxisols and Ultisols (Figure 2).

Capibaribe is a large watershed (Figure 3), with an area of 7557 km^2 and 30 hours of concentration time (CANTALICE et al. 2015), beginning still in the semiarid area and ending on the east coast, located at latitude 7° 41” e 8° 18” S e longitude 34° 51” e 36° e 42’’ W. The semiarid region receives 550 mm of rainfall annually, whereas the east coast receives an average of 1800 mm per year. In the semiarid portion, the vegetation is an arboreal and semiarboreal shrub; in the east coast part, there are sugarcane plantations. The soils in the Capibaribe watershed include less developed types in the semiarid region, such as Inceptisoils, Aridisoils, and Alfisols. At the same time, in the coastal part, there are Ultisols and Oxisols, which are more developed soils due to greater rainfall. The terrain is stepped into the semiarid region, whereas the coastal area is gentle. The main channel has a slope of 0.0079 m.m^{-1}.

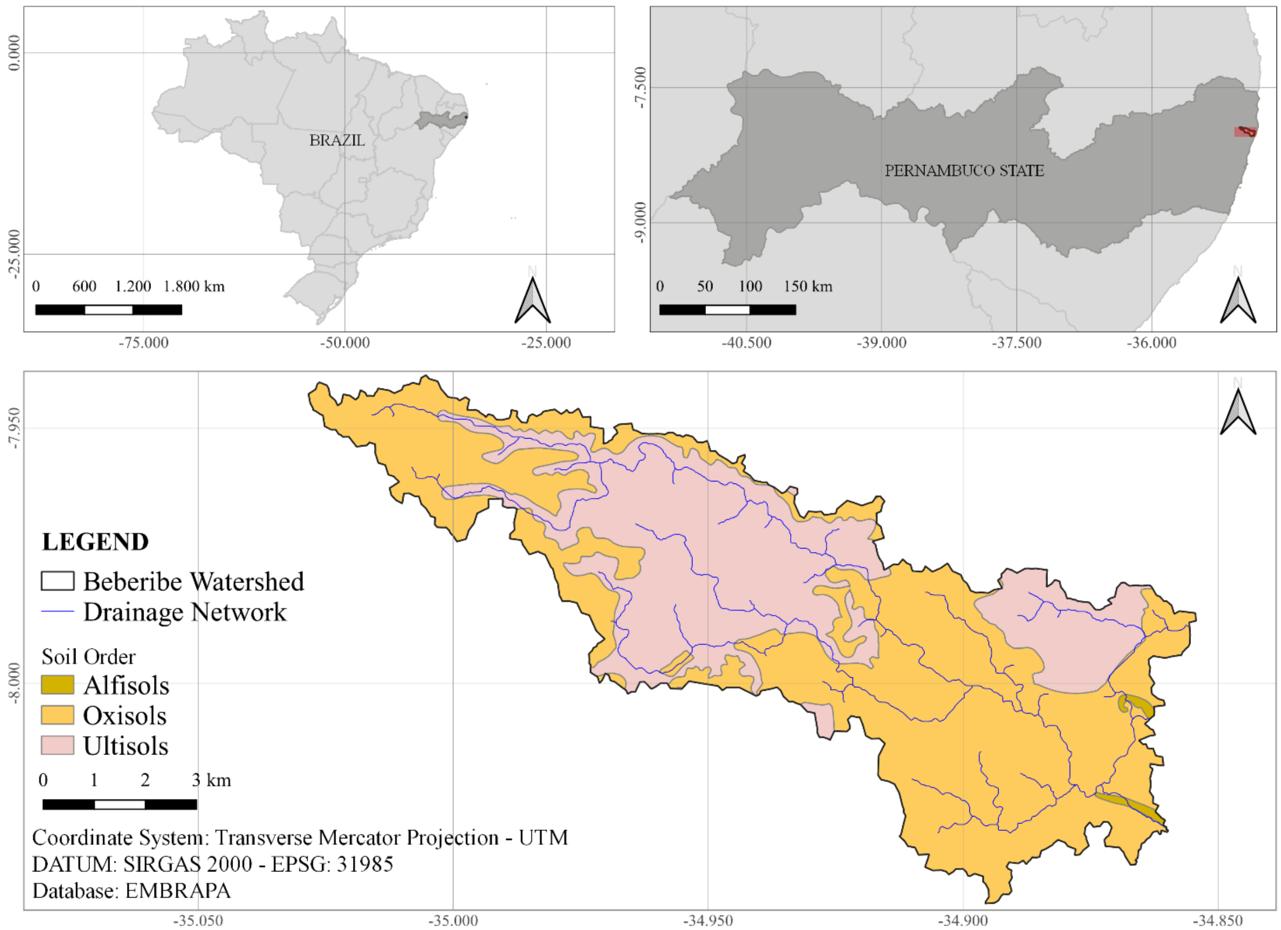

Figure 2. Beberibe watershed soil's map.

The hydrologic soil group and curve number value (*CN*) concepts of the SCS curve number method, as described in (Jain and Sing. 2019), were considered here. This method calculates the potential runoff captured in a watershed as follows:

$$Q = \frac{(P-I_a)^2}{P-I_a+S} \quad (1)$$

where Q = the potential runoff (mm), P = the total rainfall (mm), and I_a = the initial water abstraction given as $I_a = \lambda S$, in which λ = the initial abstraction coefficient assumed as 0.2, and S = the maximum potential water retention by watershed soils (mm) given as:

$$S = \frac{25400}{CN} - 254 \quad (2)$$

where the *CN* parameter expresses the interaction between the hydrologic soil group and land use, i.e., the soil-cover complex. This SCS land cover complex includes three parameters: land–soil use, use practices, and hydrologic conditions. The soil conservation service curve number method considers 15 different uses to identify the curve number values. After that, the curve number value is considered in three antecedent soil moisture conditions representing the low, average, and high watershed flow conditions during the year (JAIN; SING, 2019).

The geodatabases from all watersheds were Aster and Landsat images obtained from the Brazilian Research Institutions IBGE, DNIT, MapBiomas and ZAPE-Embrapa.

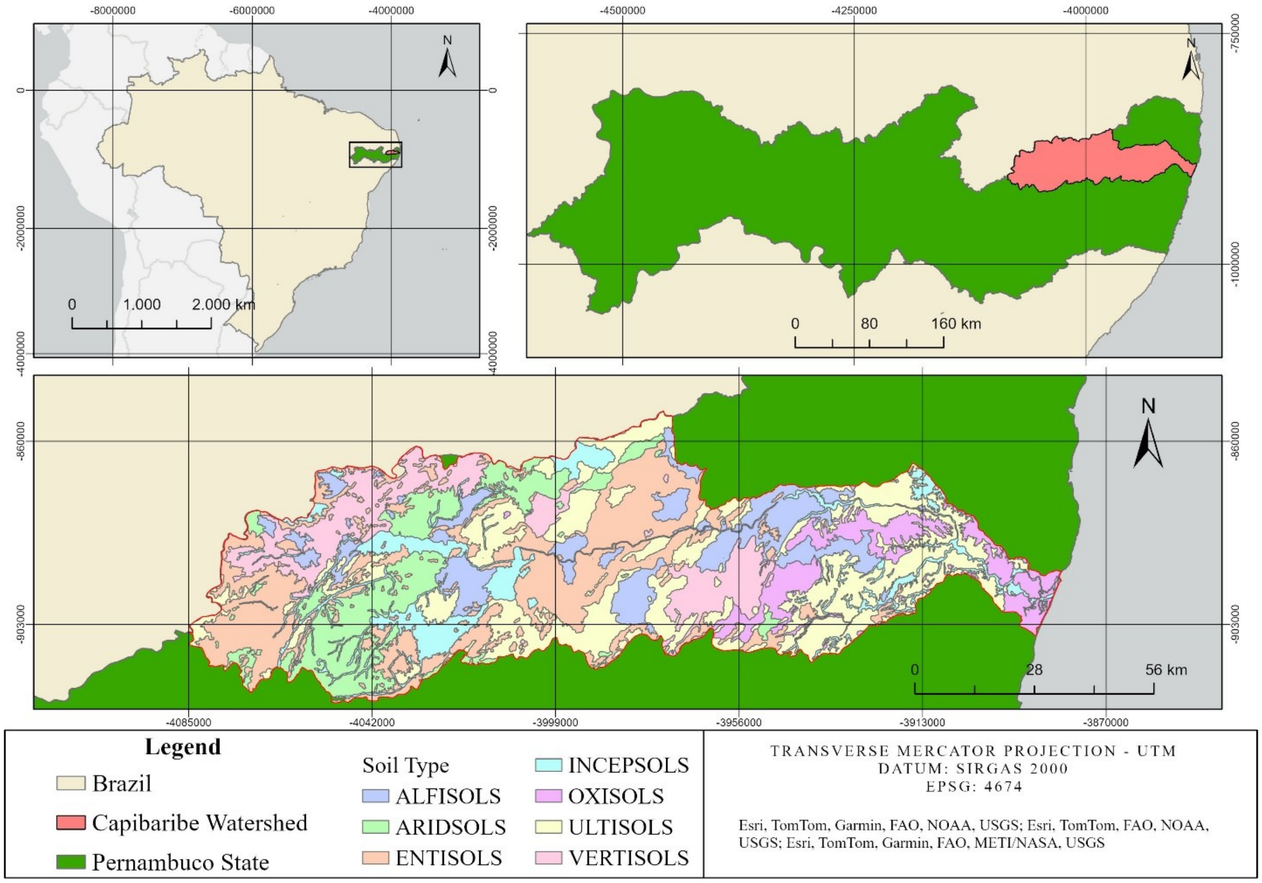

Figure 3. Capibaribe watershed location map and soil map.

2.2. Suspended sediment and bedload determination

The suspended sediment was determined following the equal-width-increment (EWI) method of Edwards and Glisson (1978) and Gray (2015) when the sediment samples and water discharge data were taken from the principal channel of the studied watersheds. The cross sections were divided into ten vertical lines of equal width when the DH-48 or DH-49 sampler was used to collect the suspended sediment. An electromagnetic current meter was used to determine the flow velocity in each vertical line. Following Horowitz (2003), the suspended sediment rates were calculated for each vertical velocity according to the product of the suspended sediment concentration (*Css*) obtained under evaporation by the corresponding water flow (*Q*):

$$Q_{SS} = 0.0864 \sum(C_{SS_i} . Q) \quad (3)$$

where Q_{ss} is the suspended sediment rate (t day^{-1}), 0.0864 is a constant for unit adjustment, C_{ss} is the suspended sediment concentration in the vertical segment (mg L^{-1}), and Q is the water flow from each vertical segment (m^3 s^{-1}); however, here, the Q_{ss} values are also expressed in kg m^{-2} s^{-1}.

The bedload rates were obtained for only the Beberibe and Capibaribe watersheds, following Gray (2005) below:

$$Q_{Bed} = \sum_i^n \frac{m}{w \cdot t} \quad (4)$$

where Q_{Bed} is the bedload sediment rate (g s^{-1} m^{-1}), m is the bedload collected and weighed dry mass, w is the width of the nozzle sampler, 0.076 m, and t is the sample time, which is equal to 60 s. The values of the bedload sediment fluxes are expressed in kg m^{-2} s^{-1}.

3. Results and discussion

3.1. Lateral connectivity - suspended sediment rates from the hillslopes and number curve values relationships

Figure 4 presents the sediment graph for the Capibaribe, Beberibe, and Cachoeira watersheds during the sampling events. The Capibaribe River presents a multimodal sediment graph. The first events are linked to the semiarid watershed portion as peaks in sequence, and after sediment, the graph follows a wave pulse following the flow behavior. This wave pulse behavior is probably correlated with rivers under dams since the Capibaribe watershed has five dams along its longitudinal axis. The suspended sediment concentration varies from 360 mg. L^{-1} to the highest value of 1071 mg.L^{-1}. The Cachoeira watershed presented lagging sediment concentration behavior. This sediment graph behavior indicates that the suspended sediment concentration increases after the flow increases (Figure 4), which does not usually occur in small watersheds such as Cachoeira (GUY, 1978). The Cachoeira River shows considerable variation in suspended sediment concentrations between 31 and 1021 mg. L^{-1}, representing semiarid climatic variability.

Figure 4 shows that the sediment concentration in the Beberibe River closely follows flow variations, which are common in small watersheds (GUY, 1978), despite the reduced number of samples. All the samples were taken in the Beberibe watershed's forested area; therefore, there was no human interference. The suspended sediment concentration in the Beberibe River varies from 273 to 545 mg.L^{-1}.

Table 1 shows the monthly mean suspended sediment concentrations from the Capibaribe watershed hillslopes collected by 21 sediment measurement campaigns between 2009 and 2011 and the CN values designated according to rainy and flow conditions for these years. Table 2 shows all the watershed conditions considered to assign the CN values for the three Brazilian watershed studies.

Figure 5 shows a linear relationship between the monthly mean suspended sediment concentrations for the assigned months (Table 1), originating from the 21 sediment measurement campaigns in the Capibaribe River watershed, and the curve number values (CNs) considered. The suspended sediment came from the Capibaribe hillslopes, where the sediment was detached and transported to the main watershed channel. This relationship shows that the curve number values were able to represent the lateral water and sediment from the Capibaribe watershed hillslopes.

Figure 6 also shows a linear relationship between the monthly mean SSC and the number curve considered for the Beberibe watershed. This monthly mean suspended sediment concentration corresponds to 7 suspended sediment measurement campaigns between 2009 and 2010, according to the three flow conditions of the number curve method (Table 2). This linear relationship also demonstrates that the curve number values can express the lateral water and sediment fluxes from hillslopes. For the Cachoeira watershed, all 12 suspended sediment measurement campaigns were carried out in only one month because it was impossible to establish a relationship between the SSC and the number curve values.

Table 1. Monthly mean suspended sediment concentration from the Capibaribe River Watershed and Curve number values corresponding to monthly rains and flow conditions.

Months	CN value	Css (mg.L^{-1})
January-February	71	658
March-May	93	909
June - August	83	643
Sept.-December	83	846

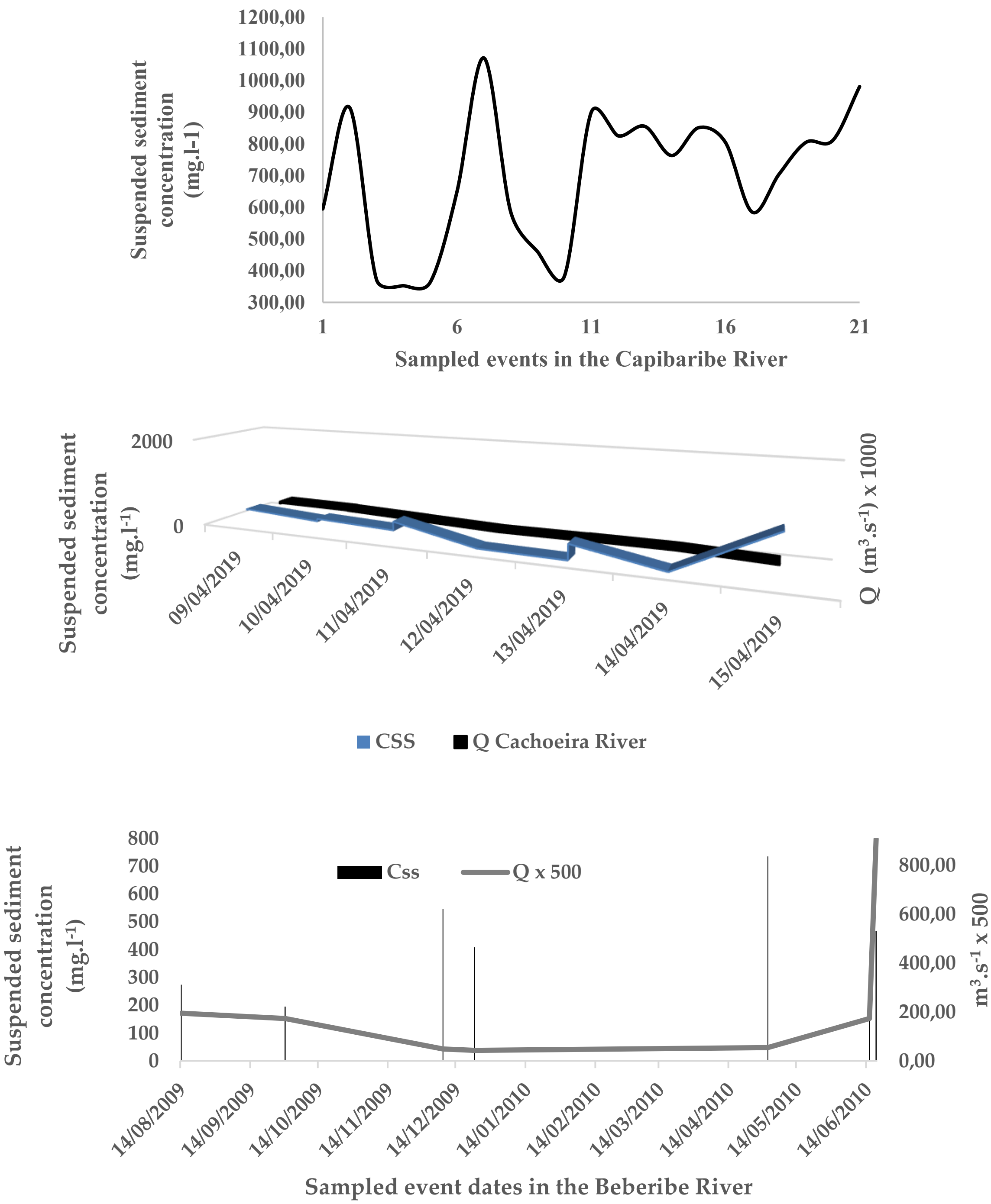

Figure 4. Hydrograph and sediment graph behavior of the Capibaribe, Cachoeira and Beberibe River Brazilian watersheds.

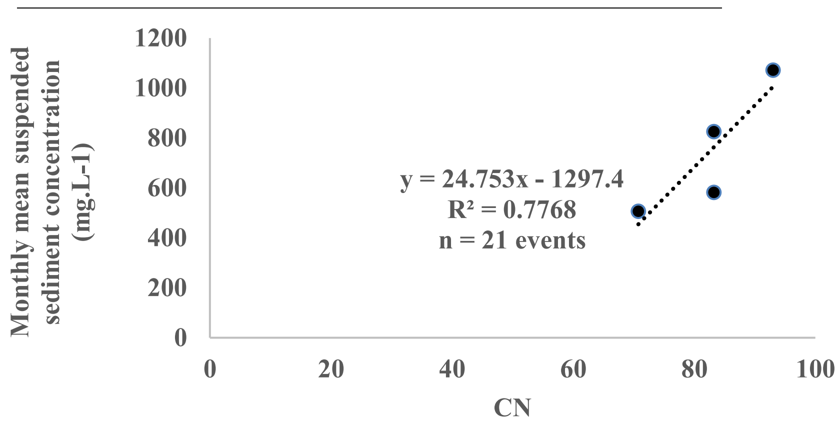

Figure 5. Linear relationship between monthly mean suspended sediment concentration (mg/L) and CN values for the Capibaribe River Watershed.

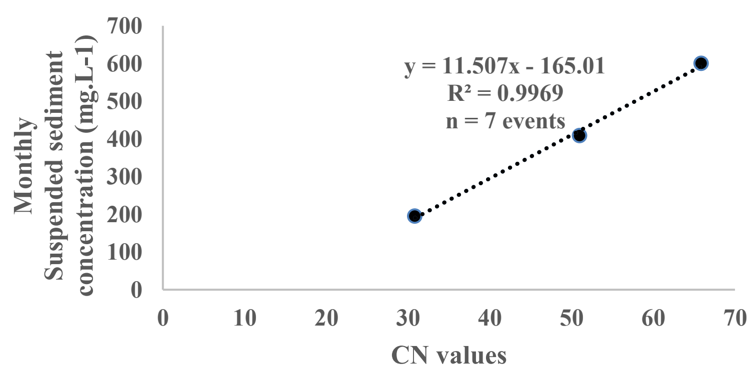

Figure 6. The linear relationship between the monthly average suspended sediment concentration for the specified months (mg.L^{-1}) and assigned CN values for the Beberibe River Watershed.

Table 2. Soils, soil uses, hydrologic group, and curve number considered for the three Brazilian watersheds studies.

	Capibaribe River Watershed			
Soils	**Soil use**	**hydrologic group**	**CN conditions**	
Oxisols	Sugar-cane plantation	A	**CNI =**	70
Ultisols	Sugar-cane plantation	B	**CNII =**	83
Alfisols	Sugar-cane plantation	C	**CN III =**	93
Inceptisols, Entisols	Semi-arboreal vegetation	C		
Aridsoils, Vertisols	Semi-arboreal Shrub	D		

	Beberibe River Watershed			
Soils	**Soil use**	**hydrologic group**	**CN conditions**	
Oxisols and Ultisols	forest	A	**CNI =**	31
Oxisols and Ultisols	Pasture	B	**CNII =**	51
Oxisols and Ultisols	sugarcane	B	**CN III =**	66
Mangue Soils	Mangrove	C		
Oxisoil under urban area	Urban area	C		
	Cachoeira River Watershed			
Soils	**soil use**	**hydrologic group**	**CN conditions**	
Entisol Lithic	Bare soil	D	**CNI =**	79
Entisol Fluvent	Semi-arid crops/clean-tilled soil	C	**CNII =**	81
Entisol Fluvent	Semi-arboreal shrub	C	**CN III =**	91
Entisol Lithic	Arboreal Shrub	D		

As demonstrated by Figures 5 and 6, the suspended sediment concentrations from the Capibaribe and Beberibe rivers were well correlated with the respective curve number values, which means that the lateral sediment transport constituted by the detached and transported suspended sediment on the hillslopes had a linear adjustment to the CN values. These relationships are explained mainly by the soil-cover complex, which, combined with the hydrologic soil group, expresses impedance or resistance to water and sediment movement, conditioning the sediments and flow rates downstream in the hillslopes.

Therefore, as observed by MORAES et al.(2024), the curve number values express the transport phenomenon between hillslopes on the landscape, representing the magnitude of the sediment and water movement to the drainage system. In three Brazilian watersheds, connectivity indexes and CN values were found to influence sediment flux. CN values govern lateral flow and sediment connectivity between hillslopes and the main channel, and it can be used to express the lateral connectivity.

3.2. Bedload plus suspended sediment and shear stress relationship in river flow: soil erodibility at the watershed scale

Figures 7, 9, and 11 show a linear relationship between the suspended sediment from hillslopes from the Capibaribe, Beberibe, and Cachoeira Brazilian watersheds and their corresponding shear stress (τ). These relationships indicate that the same lateral suspended sediment mobilized and transported from hillslopes and correlated with the number curve values is already correlated with the shear stress in the watershed's main channels.

Figures 8 and 10 show a strong correlation between bedload flux plus suspended sediment flux and shear stress (τ) in the Capibaribe and Beberibe Rivers. This relationship is relevant at both the watershed scale and smaller geomorphic scales, such as rills or gullies, as noted by MORAES et al. (2024). For the Capibaribe watershed, the linear adjustment in Figure (7) indicates a critical shear stress of 21.42 Pa and a soil erodibility of 0.2391 kg N^{-1} s^{-1}. Considering the Beberibe River watershed, the watershed critical shear stress (W_{tc}) was 88.4 Pa, and the watershed soil erodibility (Kw) was 9×10^{-8} kg N^{-1} s^{-1}.

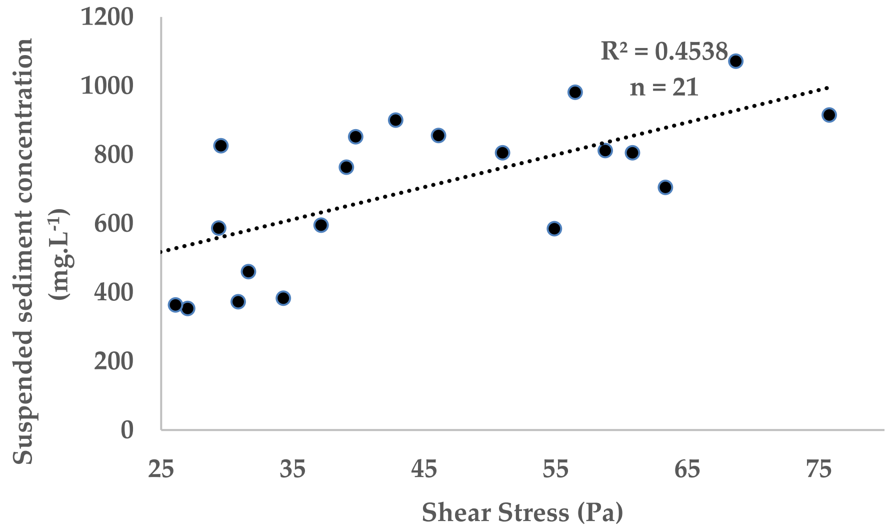

Figure 7. Linear relationship between the monthly mean suspended sediment concentration for the considered months (mg.L^{-1}) and the shear stress τ (Pa) of the Capibaribe River.

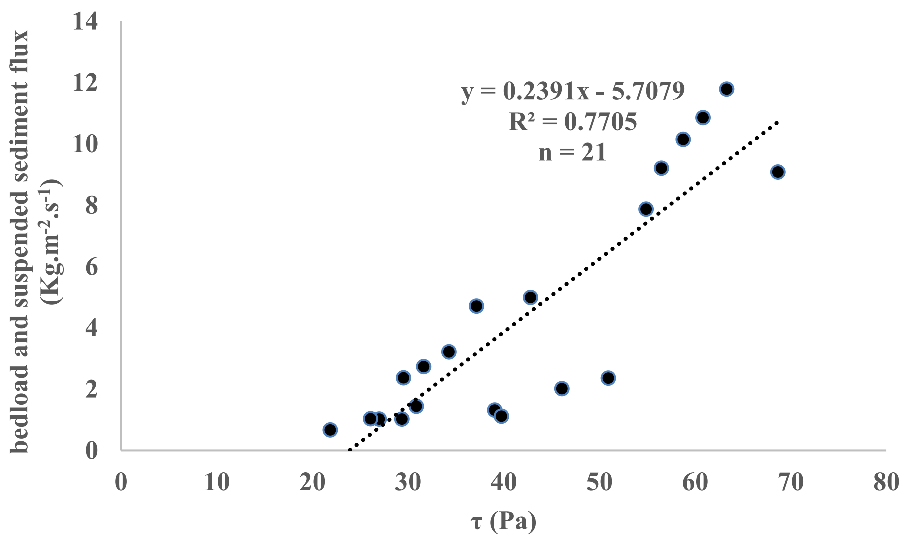

Figure 8. Linear relationship between bedload sediment flux added to suspended sediment flux to shear stress in the Capibaribe River, permitting to access the watershed soils erodibility (K_W) and critical shear stress ($W\tau_c$).

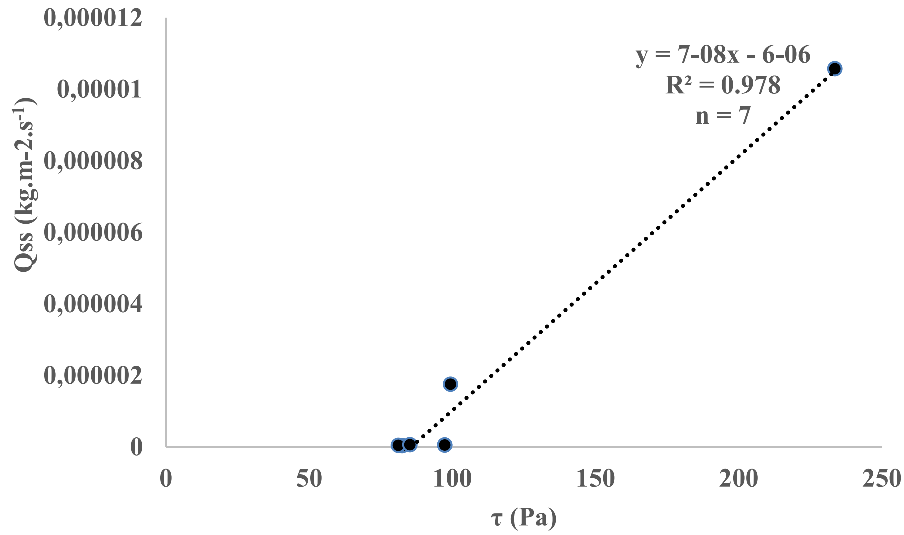

Figure 9. Linear relationship between the suspended sediment flux and shear stress in the main channel of the Beberibe watershed, considering six suspended sediment samples taken between 2009 and 2010.

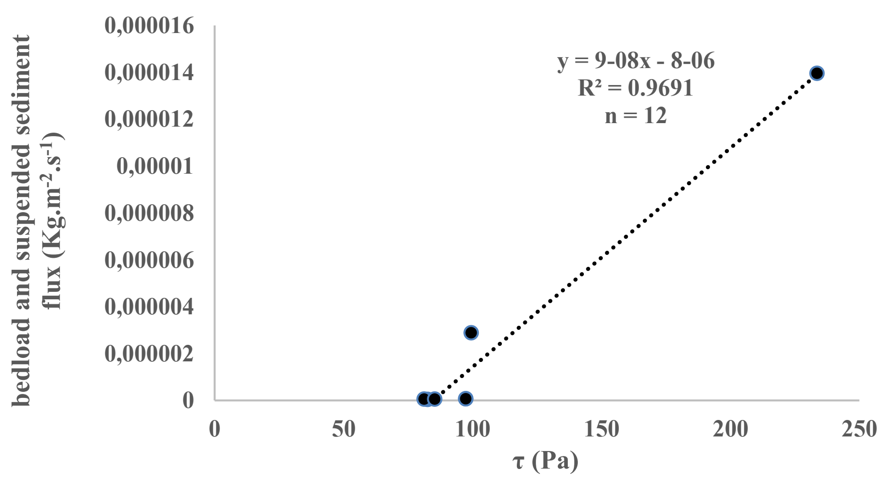

Figure 10. Linear relationship between bedload and suspended sediment flux of the Beberibe River just considering the samples between 2009 and 2010 and shear stress in the main channel, permitting to determine the watershed soil's erodibility *(K_W) and critical shear stress ($W\tau_c$).*

This relationship has already been obtained for the Cachoeira River watershed (Figure 11); however, there is no bedload sampling that considers only the suspended sediment flux and the shear stress (τ). In addition, the suspended sediment flux showed a linear adjustment, with a determination coefficient (R^2) of 0.79. This linear regression was permitted by the interception with the X-axis, which yielded a watershed critical shear stress (W_{tc}) of 7.84 Pa. Owing to the lack of bedload data, reaching the watershed soil erodibility (K_w) for the Cachoeira watershed was impossible.

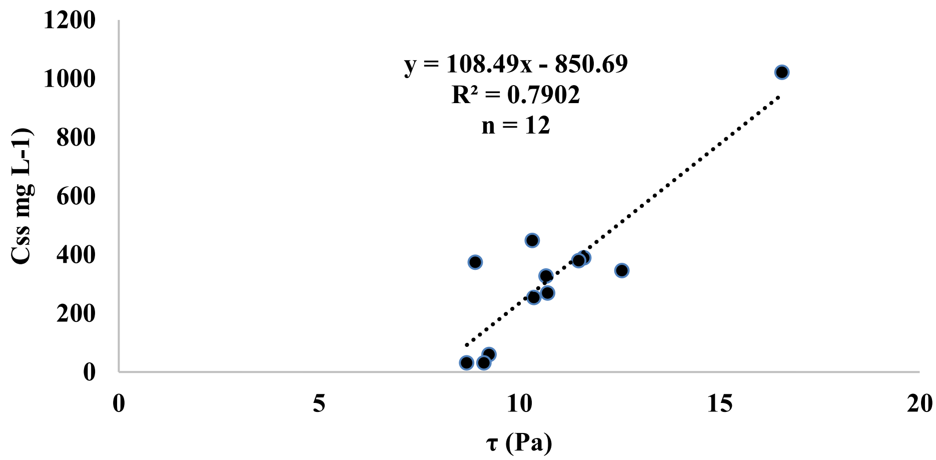

Figure 11. Linear relationship between suspended sediment flux of the Cachoeira River considering eleven sampling between 2009 and 2010, and the shear stress in the main channel, permitting to determine the watershed soils erodibility (K_W) and critical shear stress ($W\tau_c$).

The linear relationship between sediment rates and shear stress is usually applied to find soil erodibility in small geomorphic erosion features, such as rills and gullies (CANTALICE et al. 2005, ZHANG et al. 2014, PARIHIZHAR et al. 2021, LIU et al. 2022, YAMAGUCHI et al. 2022, YUAN et al. 2022), and in cohesive channels (JAIN et al. 2021, GAO *et al*. 2021, PARTHENIADES, 1965), has also been applied here successfully to achieve soil erodibility at the watershed scale, which means that all the soil effects of a watershed are quantified because all the sediment comes from hillslopes, is connected by the *CN* value and is added to the bedload in the river to determine the joint effect of all the soils from the watershed. Furthermore, the soil-cover complex and the hydrologic soil group are crucial in summarizing all interactions between soil, flow, and vegetation in watershed studies.

The large Capibaribe watershed has a critical shear stress (W_{tc}) of 21.42 Pa and a soil erodibility at the watershed scale (K_w) of 0.2391 kg N^{-1} s^{-1}. These values make sense because the Capibaribe watershed has seven soil types: the two most developed, Oxisols and Ultisols, in the coastal part, and the less developed soils, such as Inceptisoils, Entisols, and Aridsols, in the upland part inside the semiarid region of Brazil.

The Cachoeira watershed, which is entirely in a semiarid environment, features less developed soils, such as Entisols Lithic and Entisols Fluvents, between watershed studies and has produced a lower watershed critical shear stress (W_{tc}) value equal to 7.84 Pa.

The Beberibe River watershed is the entire Brazilian coast; therefore, in an environment that generates developed soils, the watershed critical shear stress (W_{tc}) and soil erodibility at the watershed scale (K_w) are greater than those of all other watersheds evaluated here, with 88.4 Pa of the watershed critical shear stress (W_{tc}) and K_w equal to 9×10^{-8} kg N^{-1} s^{-1}. These data are in accordance with those reported by MORAES et al. (2024) for the same watershed based on a more extensive dataset, with a watershed critical shear stress of 87.5 Pa and a watershed soil erodibility of 7.93×10^{-8} (kg N^{-1} s^{-1}).

4. Final considerations

The suspended sediment concentrations were well correlated to respective curve number values, which means the lateral sediment transport constituted by suspended sediment detached and transported on the hillslopes was a linear adjustment to CN values. The linear relationships are primarily attributed to the soil-cover complex, which, together with the hydrologic soil group, indicates impedance or resistance to water and sediment movement, affecting the sediments and flow rates downstream in the hillslopes.

The suspended sediment from hillslopes from the Capibaribe, Beberibe, and Cachoeira Brazilian watersheds also were well-adjusted to their corresponding shear stress (τ), representing that the same lateral suspended sediment mobilized and transported from hillslopes and correlated to number curve values, already are correlated to shear stress in the watershed's main channels.

The linear relationship between sediment rates and shear stress has been applied here successfully to achieve the soil erodibility at the watershed scale, which means that all soil effect of a watershed were quantified due to all sediment came from the hillslopes, connected by the *CN* value and, added to bedload in the river had been permitting to know the joint effect of all soils from the watershed. Therefore, it was demonstrated that the sediment-laden flow in the fluvial system from three Brazilian watersheds received suspended sediment originating from hillslopes through lateral connectivity, as quantified by curve number values. The total load, constituted by bedload and suspended sediment delivered on the fluvial system of the three Brazilian watersheds was very well correlated to all soil, permitting to adress the soil erodibility at the watershed scale, an important environmental demand from decision makers.

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