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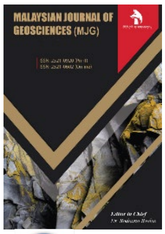

RESEARCH ARTICLE

SUSPENDED SEDIMENT RATING PARAMETERS RELATIONSHIP WITH CATCHMENT CHARACTERISTICS IN THE SEYBOUSE BASIN, NORTHEAST OF ALGERIA

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ABSTRACT

In recent decade (century), variation of streamflow and sediment load in different catchments has received considerable attention due to the complex pattern and trends of the river behavior. Detailed investigations were achieved on the changes of streamflow and sediment concentration through hydro-climatic conditions. Two fundamental questions about the utility of the sediment rating curve technique in the assessment of sediment load in relation to geomorphic conditions were discussed in the present paper: (i) how is the efficiency of the parameters, a and b, to characterize trends in the data?, and (ii) what are the possible relationships of the sediment rating parameters and the hydroclimatic events? For this reason, the present study attempts to examine the relationship of sediment transport and streamflow recorded at three gauging stations in the Seybouse basin in relation to their controls at the annual and monthly levels. The rating parameters obtained from the power functions of sediment discharge and water discharge data were investigated and associated with rainfall and runoff of the selected basins in order to characterize the trends of the parameters a and b at different river water and sediment supply conditions. The relationship between the constant a and the hydraulicity, during humid years, is solely high in the Bouhamdane. The association of a and rainfall includes mainly Mellah catchment. The seasonal models of the relationship between sediment yield and water discharge give for the fall and summer, in Bouhamdane catchment, the highest values of the constant a. This reflects the existence of data that are sometimes extreme which lead to a rise of the value of a, whereas the rate of the produced sediment yield is often low during these often dry seasons. It is outlined from the studied models that they cannot be used every in other basins. Also generalize them to any erosion proves to be a doubtful and inadequate operation.

KEYWORDS

Catchment, sediment discharge, flow discharge, sediment rating parameter, trend analyses.

1. INTRODUCTION

During recent decades, river erosion and sedimentation have been associated to variations in fluvial sediment transport and sediment flux (Asselman, 2000; Zhao et al., 2014; Khaleghi and Varvani, 2018). Suspended sediment carried in streams can comprise not only fine particles, but also chemical elements attached or adsorbed to particle surfaces. In addition, changes in sediment regimes also change the habitats and food sources of aquatic species.

The northeastern part of Algeria represents a complex environment with a long history of human occupation, deforestation and severe problems of land degradation and soil erosion (Khanchoul et al., 2012; Tachi et al., 2020). Although the potential of the rehabilitation measures to reduce runoff and soil erosion have been studied at the hillslope and small catchment scale, the integrated effect of these measures at the medium-sized catchment scale is not well understood. The response of catchments to soil erosion and human interventions is often complex due to scale effects which can buffer changes in sediment supply (Verstraeten et al., 2002; Walling, 2006; Hapsari et al., 2019). Further, many rivers in the northern Algerian hillslopes have a hydrological regime characterized by flash floods, which can provoke a significant geomorphic impact, by exporting great amounts of sediment throughout the basin outlet.

The mobilization of fine matter on the slopes and its transport by watercourses leads to two distinct phenomena, often linked together. This is the average sediment discharge of suspended sediments (Qs in kg/s) and the average water discharge (Q in m^3/s) during a given period from where the relation is usually a power function.

Studies of suspended sediment transport; need monitoring suspended sediment concentration, which is prohibitively expensive. An alternative method to estimate sediment load is to develop the sediment rating curves based on observed data of sediment concentration and water discharge (Asselman, 2000; Selmi and Khanchoul, 2016). The empirical relationship, commonly referred to as a sediment rating curve has already been widely

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found that suspended sediment concentration or sediment discharge is a power function of the water discharge during storm events, and having a number of samples of suspended sediment concentrations at the outlet (Ferguson, 1986, Crawford, 1991; Khaledian et al., 2017).

Changes in sediment rating curve parameters, a and b, have been observed since a long time for many rivers systems (Syvitski et al; .2000; Warrick and Rubin, 2007; Huang and Montgomery, .2013), these changes denote soil susceptibility to erosional processes and supply of sediment in the watershed (Asselman, 2000). It is likely that river sediment concentrations and the associated sediment rating parameters will continue to change in the future (Warrick, 2015; Khaledian et al., 2017). It is, therefore, important to have adequate techniques to quantify and characterize changes to these river systems.

While a few researchers argue that the rating parameters a and b used in the sediment rating curve have no physical meaning (Ferguson .,1986), others state that these coefficients have physical interpretation (Morehead et al. 2003). They claimed that the sediment rating parameter (a) is considered as an index of erosion severity in the river channel (Morgan, 1995; Yang et al., 2007). High a-values occur usually in areas characterized by easily eroded and transported materials. The rating parameter b may show the erosive power of the river. High values are thought to be indicative of rivers that show a strong increase in entrainment and transport with increasing discharge (Tran, 2014). However, b can also reflect the extent to which new sediment sources become available when discharge increases (Vanmaercke et al., 2010; Guzman et al., 2013). It is more b-values can be affected by the grain-size distribution of the material available for transportAccording to (Walling.,1974)

A number of researches, concerned with fluvial sediment transport in different northeastern Algerian catchments have recently been published but little attention has been undertaken to study the significance of rating parameters. The purpose of this study is to extend the understanding of suspended sediment rating curves, the variation of their parameters in relation to the physical characteristics such as rainfall and runoff. This can be treated in two ways: first, computing a power function sediment-rating curve for different storm events of the year-period; second examining how well the parameters a and b characterize trends of the data and depicting the changes to river water and sediment discharge.

2. METHODS

2.1 Study Area

Catchments of northeastern Algeria constitute a Mediterranean domain where different forms of erosion are differently distributed. Most Algerian rivers are developed in areas of young and rugged terrain with usually a very complex geological structure (Khanchoul et al.,2014). The hillslopes developed in the Algerian Tell are formed in marly formations of Cretaceous or Tertiary clay layers that favour the spatial extension of gullies and mass wasting (Kouri and Vogt, 1996). The three selected catchments: Bouhamdane River, Ressoul River and Mellah belong to the Seybouse great basin (6475 km^2).

The Mellah basin (550 km^2) characterized by ridges of the Tell Mountains, its outlet is located at the Bouchegouf gauging station. The Mellah catchment is chosen because it offers particular geomorphic conditions for sediment supply such as topographic, lithologic, soil and vegetational characteristics. The basin shows high topography where 45% of the basin has slope gradients greater than 11% (Figure. 1), located essentially on erodible lithologic formations (marly and clayey rocks). The lithological formations of the Mellah catchment are composed mainly of Cretaceous limestone, Oligocene sandstone, and trasic rocks such as gypsic clay, limestone and marl (Senonian) and the lower Numidian clay (Oligocene). The natural vegetation that protects the soil is more or less important, where 41% of the surface is occupied by forest and shrubs. Grassland is also well distributed in the basin but mostly dominated by overgrazing, observed in pasture and open shrubland. The Mellah basin is characterized by irregular annual precipitation, with a mean annual rainfall of 707 mm and a mean annual temperature of 18°C.

The Bouhamdane catchment (1105 km^2) is controlled downstream by the Medjez Amar gauging station. The basin, with the highest elevation of 1281m, is dominated by Oligocene sandstone beds and Oligo-Miocene conglomerate with important proportion of erodible rocks (marl and clay) and unconsolidated quaternary deposits. The sandstone rocks are weathered under the subhumid climatic conditions, yielding the soils particularly susceptible to erosion and coarsening through the loss of fine particles (Khanchoul et al., 2010). The land is mainly occupied by cultures for more than 50%. In the mountainous areas, the surfaces are essentially covered with forest and sparse bush. The subhumid climate of the basin is Mediterranean type which is characterized by a distinct wet (November–May) and dry (June–October) seasons. The mean annual rainfall of 579 mm and a mean annual temperature of 18°C are recorded in the basin.

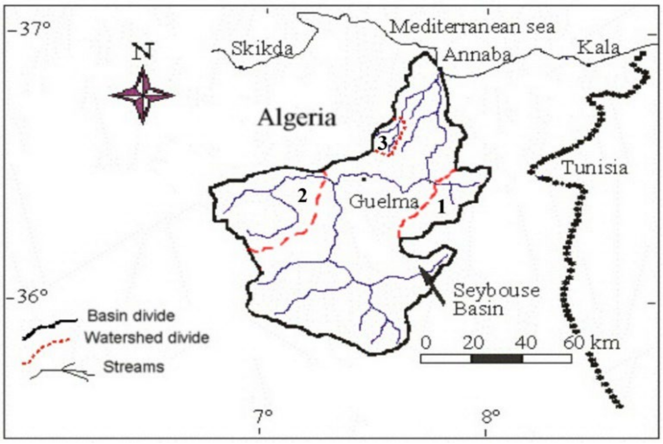

Figure1: Location map of the study area: 1- Mellah catchment; 2- Bouhamdane catchment; 3- Ressoul catchment.

The Ressoul catchment (107 km^2) outlet is located at the Ain Berda gauging station, giving thus its elongated shape (Figure 1). This basin shows a greatly dissected landscape dominated by a high relief with 68% of the basin area exceeding 15% of slope (Khanchoul and Khanchoul, 2019). The steepness of the hillslopes in the upstream part of the basin has affected the soil stability and has contributed to gullying and mass wasting as bank erosion, mudflows and landslides. The Ressoul watershed is essentially composed of Cretaceous marly limestone. The extended marly limestone outcrops, in association with other physical constraints such as steepness of hillslopes (exceeding 15%), poor vegetal cover and torrential rainfall conditions, have given a dense network pattern and scoured surfaces of erodible clayey and silty soils. The sandstone and clayey calcareous sandstone show a less important channeling because they are more protected by a densely and efficient plant cover (cork-oak forest and bushes). The Ressoul catchment is characterized by irregular annual precipitations with mean annual rainfall of 675 mm and mean annual temperature of 17°C.

2.2 Suspended Sediment Measurements

Surveys of suspended sediment concentration and water discharge were carried out in three selected catchments of the northeast of Algeria, which were Bouhamdane River, Ressoul River, and Mellah River. The water sampling was performed at surface water using one-liter plastic bottles, and the analysis of the samples was done in the laboratory by the National Agency of Hydraulics (ANRH) in Annaba and Constantine. The samples were taken every day in dry weather and every quarter-hour or half-hour during flood periods, which makes 650 daily datasets in 29-year period (1984–2012).

2.3 Sediment Rating Curve Development

Reliable estimates of daily suspended sediment load are difficult to obtain in the absence of continuous time series of suspended concentration and water flow. For flood events with no sediment samples, instantaneous flow and sediment transport data were used to develop sediment ratings in order to reconstruct the missing suspended sediment concentration records. The hydrometric records for the chosen gauging stations consist of intermittent daily measurements of suspended sediment concentration.

Consequently, the analysis of the relationship between sediment discharge (Qs) and water discharge (Q) was carried out using data on average daily flow rates and suspended sediment concentrations. A flood may have gaps when measuring the concentration in suspension. The evaluation of the suspended sediment transport of this flood involved the reconstruction of these gaps by carrying out regression relationships in power and exponential forms.

On the basis of the available data of the water discharge and the suspended concentration of the floods, from a period ranging from one day to several days, we deduced the daily average values of the two above-mentioned variables. To determine the variation of parameters a and b, regression models were carried out in the form of a power relationship:

$Qs = a\ Q^b$ (1)

with Qs (kg/s) = Q (m3/s)x C (g/l) (2)

2.4 Computation of Rainfall, Runoff and Hydraulicity Coefficient

2.4.1 Rainfall

Climatic conditions, more than other factors, play a key role in the hydrological behavior of rivers. It is the rainfall (precipitation) which constitutes the essential factor intervening by its water height in order to determine the annual and seasonal rainfall abundance and, by its daily totals, to distinguish the downpours which generate floods and erosion. Thus, the sensitivity of the physical environment is particularly aggravated by rainfall oscillations, which can be very marked and especially abrupt, during certain periods of the year.

To characterize the climate of the research areas, we chose six rainfall stations (Ouled Habeba, Ain Berda, Medjez Ammar, Guelma, Mechroha, Bouchegouf), most of which we have a long series of rainfall data. For all of these stations, we have daily precipitation data. Meticulous work was achieved on annual series and on the flood scale. The study basins have mean annual rainfalls that vary between 573 mm and 687mm for annual series.

2.4.2 Runoff

Hydrometric observations express the hydrological behavior of the catchment at a given point and over a specific time. They statistically reflect the interference of physico-geographic factors. The flow rates of the studied wadis were measured for the series concerned (1984-2012) at the gauging stations of Ain Berda (Ressoul River), Medjez Amar (Bouhamdane River), Bouchegouf (Mellah River). The stations show daily flow rates and instantaneous flow rates for different floods. Hydrological behavior is better defined by the runoff (R), which reflects the interaction of factors having direct or indirect effects on the response time of the basin in question, the saturation of the soil and the storage of water at depth (Khanchoul, 2015). Due to the importance of floods in the transport of sediments in the rivers, the treatment and analysis at the flood scale was undertaken. The computed runoffs for the study basins vary between 67 mm and 184 mm.

2.4.3 Hydraulicity Coefficient

The hydraulicity coefficient (HC) is the ratio of the average water discharge of the year to that of the mean annual discharge of the considered period. This coefficient helps to identify and classify wet and dry years and to provide information on its variation over time. Usually the value equal or more than 1 belongs to the humid period and less than 1 to the dry period. The analysis of the hydraulicity coefficient variation shows that the dry period occupies high rate (> 60%) in the Mellah,basin.

3. RESULTS AND DISCUSSIONS

The study of the power relationship of the sediment discharge (kg/s) and water discharge at the different temporal scales, annual, monthly and on the scale of the flood, reveals a certain trend of evolution of the coefficient a and of the exponent b.

3.1 Annual Series Variation

According to the criterion relating to wet and dry periods, the hydraulicity coefficient is the parameter best used in defining the flow regime. The constant a has the lowest difference at Ressoul River whose values vary between 0.17 and 0.55 while the highest difference is observed at Bouhamdane River where the constant a varies between 0.35 and 2.17. Furthermore, they are the Bouhamdane and Mellah rivers, which have the highest dispersion, with coefficients of variation of 0.55 and 0.46. The exponent b has differences of 1.39 at Ressoul River with a minimum value of 1.05 and a maximum value of 2.44. However, the coefficients of variation are much lower than those of parameter a, whose values vary between 0.14 (at Bouhamdane River) and 0.19 (at Ressoul River).

The relationships obtained from the constant a and the exponent b are very satisfactory, with r ≥ 0.73 (Figure 2). The factor b being directly linked to the drainage area during flood periods (Benkhaled and Remini, 2003), is distinguished by high variation of its values with the hydraulicity coefficient (HC). Indeed, its coefficient of variation is higher, varying between 0.63 at Ressoul River and 0.90 at Bouhamdane River. Likewise, the coefficient a, which also explains the degree of soil saturation, generally illustrates its weak to moderate relationship with hydraulicity (0.33 ≤ r ≤ 0.61), (Figure 3).

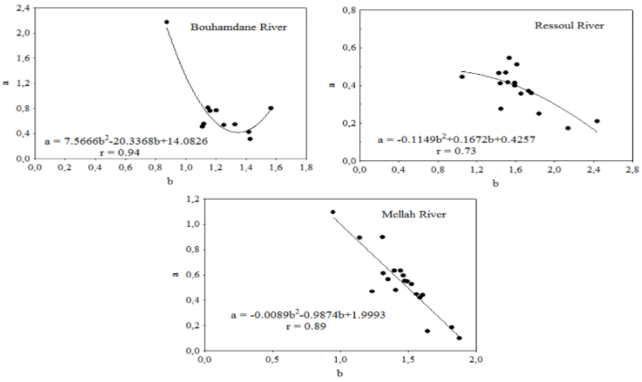

Figure 2: Annual variation of the constant a versus the exponent b.

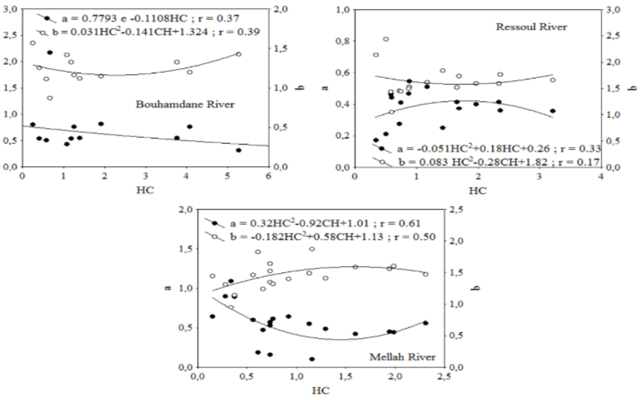

Figure 3: Annual variation of the constant a and exponent b versus the hydraulicity coefficient.

By dividing the period into wet and dry years, the relationship is slightly higher between a and b for either wet years or dry years (Figure 4). For these years the value of a is lower than that of b, which often varies little. However, the dispersion of a is greater with the values of the coefficient of variation varying between 0.18 and 0.79. We also distinguish that the dispersion of a and b in dry years is higher (0.10 ≤ CV ≤ 0.79) than those in wet years which do not exceed 0.10.

The relationship is very good between a and HC for wet years in Bouhamdanr River (Figure 5). It is moderate for dry years in Bouhamdane and Ressoul rivers, with a correlation coefficient exceeding 0.73. Furthermore, by consulting the trend of the scatter plots of the relationship a and HC for the different rivers, we note that for wet years erodibility does not always follow hydraulicity. It can decrease when the flow increases and increase when the flow increases. The first situation is observed in the Bouhamdane River and the second in the Mellah River. This means that they received a large supply of fine materials during three rainy years of 1984/85, 1986/87 and 1999/2000. As for the exponent b, it shows the same trend in its relationship with hydraulicity as the parameter a (Figure 6).

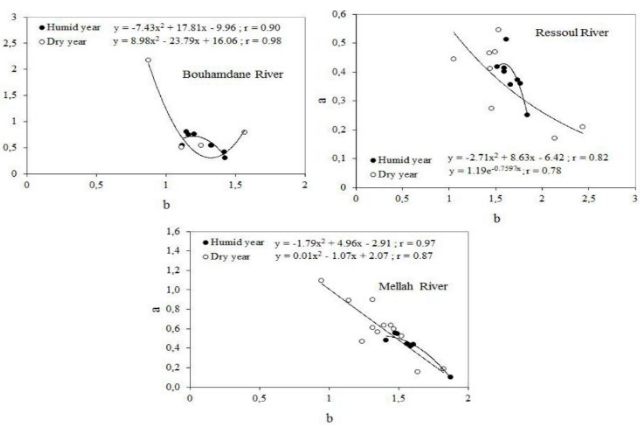

Figure 4: Variation of the constant a versus the exponent b at wet and dry years.

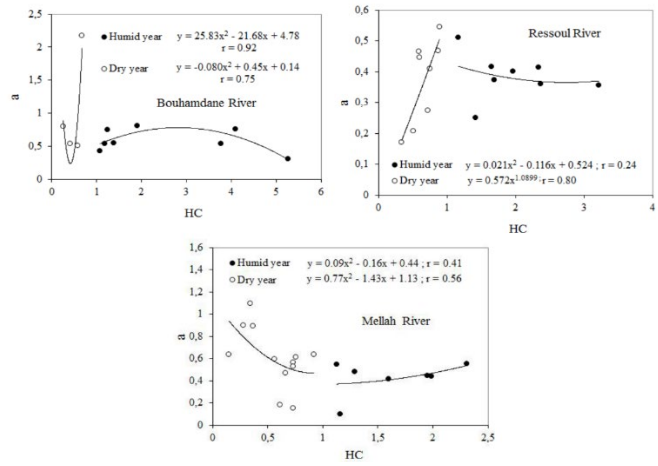

Figure 5: Variation of the constant a versus HC in wet and dry years.

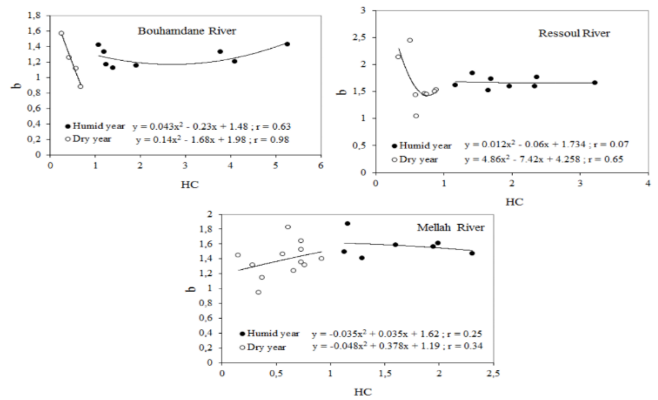

Figure 6: Variation of the exponent b as a function of HC in wet and dry years.

Generally, the relationship of a and b with hydraulicity coefficient in dry periods shows a particular evolution. When the association of HC to the constant a is positively correlated, that of b becomes negatively correlated.

Taking into account the entire period, the relationship between the constant a or the exponent b and the annual rainfall is not significant in all the study rivers (r ≤ 0.40). It becomes more obvious when we consider the humid period, in particular at the Ressoul and Mellah rivers (r ≥ 0.82 with a = f (P) and r ≥ 0.88 with b = f (P)). Moreover, the erodibility index computation may make it possible to understand considerably the effect of rainfall on soil erosion. For Mellah River, the evolution of a is in the same direction as that of rainfall to a certain threshold (655 mm) then it tends to become constant (Figure 7).

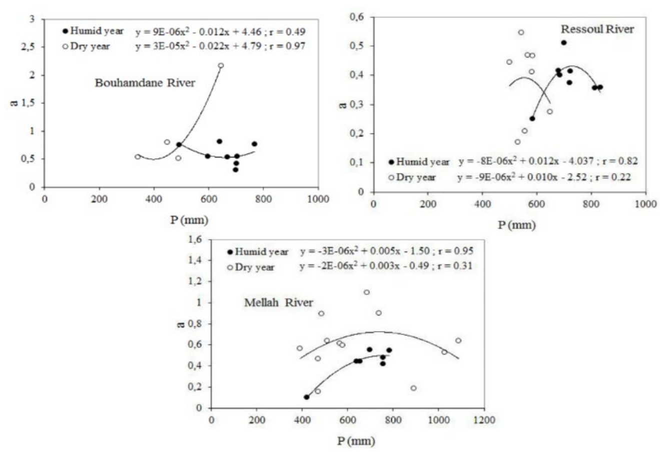

Figure 7: Variation of the constant a versus annual rainfall (P) in wet and dry years.

In this case, heavy rain does not always mean high runoff in the basin and vice versa. Some cases are noted in this analysis those of the years 1989/90 and 96/97 in Mellah River, considered as dry periods with low hydraulicity, while a high annual rainfall of 737 mm and 1088 mm respectively is recorded. Likewise, years considered wet, with hydraulicity greater than 1, are characterized by fairly low annual rainfall. This is the case for the years 2007/2008 at Mellah River and 2010/2012 at Bouhamdane River.

The improvement in the relationship of a and the runoff (R) is not very sensitive, the values of the correlation coefficient of which vary between 0.61 (at Mellah River) and 0.22 (at Ressoul River). This is certainly due to the fact that runoff is the inductive factor of the sediment load, while the height of the rain is a good estimator of the sediment transport (Benkhaled and Remini, 2003). However, by dividing the periods into wet and dry years, we note that the relationship, especially that between the constant a and runoff, becomes more satisfactory (Figure 8). It can be observed at the wet years of the Bouhamdane River (r = 0.79) and dry years of Bouhamdane, Ressoul and Mellah rivers where the correlation coefficients are high (r ≥ 0.79).

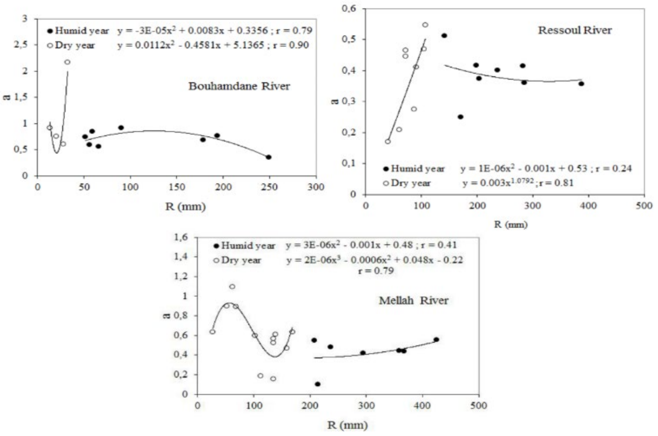

Figure 8: Variation of the constant a versus runoff (R) in wet and dry years.

It appears from the different graphs that the relationship between a and R is not always simple. Thus, the graph in Figure 8 shows as an example two distinct zones of the wet year at Bouhamdane River, one for the years where the flow is between the wet period and close to the dry period and the other for the very humid period (HC > 3). The first phase of the evolution (runoff values between 51 mm and 90 mm), the variation of the constant a versus R has a positive pattern; but beyond 100 mm, this relationship is less accentuated with a negative appearance of this association.

3.2 Monthly Variation

The analysis of the sediment discharge and water discharge using power functions shows an increase in sediment transport (sediment concentration) in spring in the study basins (Table 1). In summer, there is a reduction in the sediment concentration in the Ressoul and Mellah rivers due to the absence or reduction of flow in the river. However, at Bouhamdane sediment transport persists, which implies the presence of a flow, which allows the transfer of fine material towards the outlet. With the first storms of autumn, the suspended concentration increases suddenly in Bouhamdane River, then falls in winter to rise often in March.

Table 1: Relationship between sediment discharge (Qs) and water discharge (Q) in the study catchments.

Rivers	Seasons	Equations	r
Bouhamdane	Fall	$Qs = 1.13Q^{1.25}$	0.90
	Winter	$Qs = 0.420Q^{1.37}$	0.96
	Spring	$Qs = 0.5Q^{1.38}$	0.94
	Summer	$Qs = 0.85Q^{1.13}$	0.98
Ressoul	Fall	$Qs = 0.51Q^{1.61}$	0.89
	Winter	$Qs = 0.31Q^{1.77}$	0.94
	Spring	$Qs = 0.45Q^{1.47}$	0.90
	Summer	$Qs = 0.324Q^{1.35}$	0.94
Mellah	Fall	$Qs = 0.608Q^{1.39}$	0.93
	Winter	$Qs = 0.48Q^{1.53}$	0.95
	Spring	$Qs = 0.56Q^{1.38}$	0.89
	Summer	$Qs = 0.443Q^{1.92}$	0.98

The parameters a and b come from the power relation Qs = F (Q).

The main observations of the analysis on a monthly scale are highlighted in Table 2 as follows:

- the low values of a and b do not only concern the summer months. They are distributed over almost all months of the year in the three study basins,
- the values of the coefficient of variation of parameter a are higher in the Bouhamdane and Ressoul rivers, varying between 0.58 and 0.37 respectively. On the other hand, those of the exponent b are lower, not exceeding 0.25.

The relationship between a and b is more simple in the Mellah and Ressoul rivers, which gives an inverse relationship. The scatter plot in Figure 9 shows a low variation of a and b in the winter and autumn months in Mellah River. The variation appears more significant in spring, especially that of the constant a, certainly due to the hydrosedimentary supply which remain high during this period, which depends in a certain way on the surface state of the soil and the rate of forest cover.

Table 2: Monthly variation of the constant a, the exponent b, mean rainfall (P) and mean runoff (R).

	Bouhamdane River				Ressoul River				Mellah River			
Mois	**a**	**b**	**P (mm)**	**R (mm)**	**a**	**b**	**P (mm)**	**R (mm)**	**a**	**b**	**P (mm)**	**R (mm)**
Sep	1.3753	1.8719	27.74	0.63	-	-	-	-	-	-	-	-
Oct	1.1767	1.5951	47.87	0.81	0.2413	2.7108	61.67	1.51	0.6005	1.5672	58.41	2.44
Nov	0.9645	1.1971	69.51	3.53	0.4930	1.5867	75.80	9.14	0.5749	1.3842	84.12	8.36
Dec	0.5028	1.3969	79.93	16.27	0.3529	1.6921	84.75	16.47	0.4135	1.6156	81.93	18.71
Jan	0.4048	1.4179	77.71	13.67	0.4114	1.6323	85.86	24.17	0.5750	1.4743	81.94	30.75
Feb	0.2993	1.3983	71.53	21.15	0.2209	1.9653	66.03	24.56	0.4539	1.5053	85.57	45.29
Mar	0.2600	1.4816	66.30	10.06	0.3248	1.7358	66.93	21.43	0.5111	1.4806	98.04	28.94
Apr	0.3453	1.2708	58.70	9.76	0.6795	1.2474	60.50	15.57	0.5275	1.3687	78.09	27.61
May	1.0757	1.0158	49.36	1.93	0.4871	1.4203	39.70	5.16	0.7910	1.0581	60.95	13.07
Jun	0.6852	1.6852	17.19	0.66	0.3209	1.3662	14.25	0.77	0.4154	1.8637	19.06	1.01
CV	0.58	0.17	0.37	0.95	0.37	0.25	0.37	0.71	0.22	0.15	0.32	0.75

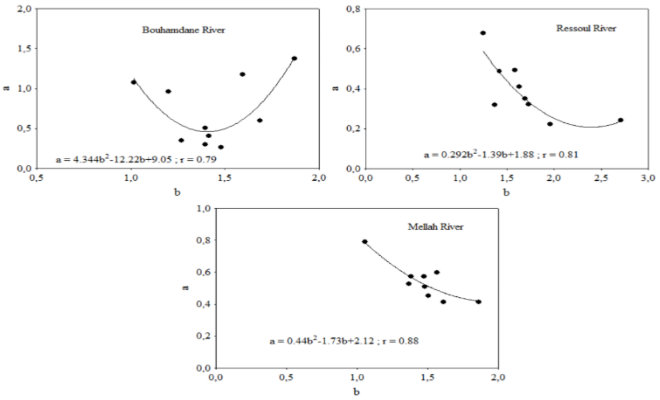

Figure 9: Monthly relationship between the constant a and the exponent b.

The relationship between the constant a and the mean monthly rainfall is moderate in the case of Bouhamdane and Mellah rivers and insignificant in Ressoul River (Figure 10). While that defining the constant a and runoff is more obvious at Bouhamdane and Ressoul rivers, with r ≥ 0.70. The variation of b with rainfall is conclusive at Mellah River but it is less significant with runoff (Figure 11).

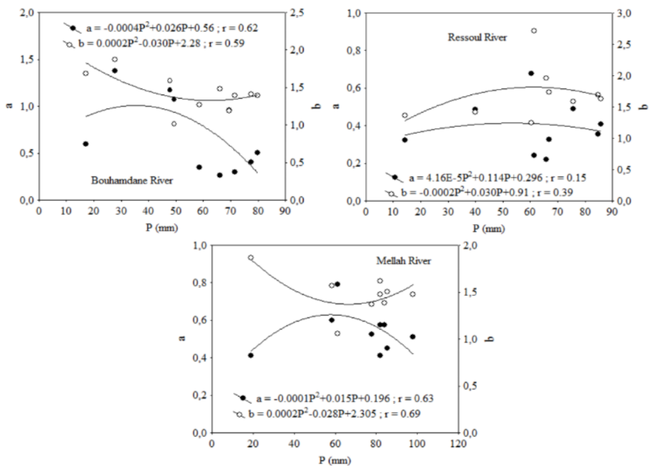

Figure 10: Monthly relationshhip between constant a, exponent b and mean rainfall.

Furthermore, by introducing a multiple regression analysis, we note that the dependent variable (a) is perfectly correlated with the variables of rainfall and runoff at Bouhamdane River (Table 3). This implies particular geomorphic conditions (geology, topography and plant cover) which favor this relationship. Thus, intense rains, which affect erodible rocks and degraded, poorly permeable soils tend to give rise to high flows, thereby causing an increase in soil erodibility (case of the Oued Zenati region, Bouhamdane catchment).

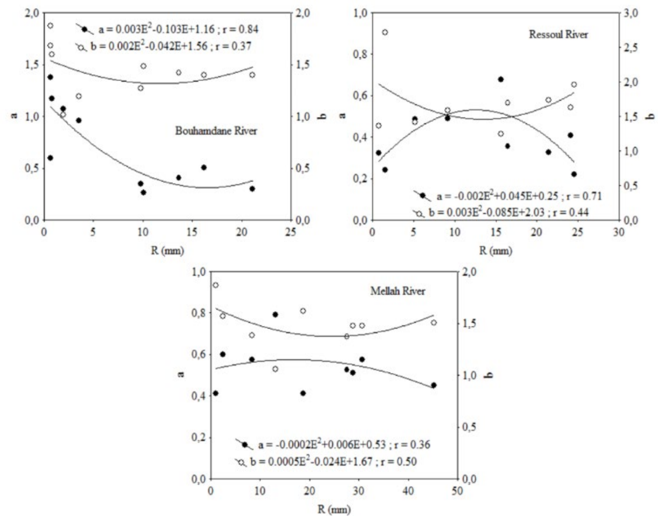

Figure 11: Monthly relationship between the constant a, exponent b and runoff.

Table 3: Multiple regression results.

Catchments	Equations	r
Bouhamdane River	a = 1.13R-0.240P+8.517 b = 0.485R-0.92P+1.916	0.98 0.63
Ressoul River	a = -0.08R+0.088P+0.374 b = -0.51R+0.603P+1.305	0.07 0.46
Mellah River	a = -0.42 R+0.313P+0.493 b = 0.163R-0.53P+1.789	0.31 0.44

It therefore appears from this discussion that rainfall and runoff can contribute to eroding soils and transporting sediments through runoff;

however, soil erodibility also depends on other factors such as slopes and type of vegetation cover. As a result, it seems difficult to comment on the ability of soils to be washed away based solely on hydro-climatic factors.

4. Conclusion

The analysis of erosion models of the constant a, which represents the erodibility of the soil, the exponent b, which explains the hydrological state of the basin or the surface area of the drainage during storm events, and the hydro-climatic parameters which induce the sediment transport led to a conclusion which is as follows: the relationships between these parameters are not simple, they differ from one basin to another. The interaction of erosion factors in particular conditions belonging to each basin would result from a number of processes reflected in the erosion action, despite significant nuances from one sector to another.

Regarding the annual variation, the best relationships between the constant a and hydraulicity or rainfall for wet or dry periods do not affect the three basins as a whole. Even less is the relationship of the constant a and runoff. In any case, the good relationships support the idea that the degree of soil erodibility may provide an understanding in variation of runoff and rainfall.

On a seasonal scale, the analysis of the sediment discharge-water discharge shows a relative increase in sediment transport (sediment concentration) in spring. In summer, there is a reduction in the sediment concentration in Ressoul and Mellah rivers due to the absence of streamflow. In addition, the relationship between the constant a, the exponent b and the mean monthly rainfall is only conclusive in 60% of the basins.

Ultimately, the used models give only part of the reality of the studied basin, which cannot be used everywhere.

References

Asselman, N.E.M. 2000. Fitting and interpretation of sediment rating curves. Journal of Hydrology, 234, Pp. 228-248.

Benkhaled, A., and Remini, B. 2003. Variabilité temporelle de la concentration en sediments et phénomène d'hystérésis dans le bassin de l'Oued Wahrane (Algérie). Hydrological Sciences Journal, 48(2), Pp. 243-255.

Crawford, C.G. 1991. Estimation of suspended sediment rating curves and mean suspended sediment loads. Journal of Hydrology, 129, Pp. 331-348.

Ferguson, R.I. 1986. River loads underestimated by rating curves. Water Resources. Research, 22 (1), Pp. 74-76.

Guzman, C.D., Tilahun, S.A., Zegeye, A.D., Steenhuis, T.S. 2013. Suspended sediment concentration–discharge relationships in the (sub-) humid Ethiopian highlands. Hydrology and Earth System Sciences, 17, Pp. 1067-1077.

Hapsari, D, Onishi, T.., Imaizumi, F., Noda, K., Senge, M. 2019. The use of sediment rating curve under its limitations to estimate the suspended load. Reviews in Agricultural Science, 7, Pp. 88-101.

Huang, M.Y.F., and Montgomery, D.R. 2013. Altered regional sediment transport regime after a large typhoon, southern, Taiwan. Geology, 41, Pp.1223-1226.

Khaleghi, M.R., and Varvani, J. 2018. Sediment rating curve parameters relationship with watershed characteristics in the semiarid river watersheds. Arabian Journal of Science and Engineering, 43, Pp. 3725-3737.

Khanchoul, K. 2015. Erosion hydrique et transport solide; cas de bassins versants du nord-est

Algérien. Collection Presses Académiques Francophones (PAF), édition de OmniScriptum, 312p.

Khanchoul, K., Tourki, M., Le Bissonnais, Y. 2014. Assessment of the artificial neural networks to geomorphic modelling of sediment yield for ungauged catchments, Algeria. Journal of Urban and Environmental Engineering 8(2), Pp. 175-185.

Khanchoul, K., Benslama, M., Remini, B. 2010. Regressions on monthly stream discharge to predict sediment inflow to a reservoir in Algeria. Journal of Geography and Geology 2(1), Pp. 36-47.

Khanchoul, K., and Khanchoul, S. 2019. Estimation of suspended sediment load in the Ressoul Watershed, Algeria. International Journal of Hydrology Research, 4(1), 1-12.

Kouri, L., and Vogt, H. 1996. Détermination de la sensibilité des terrains marneux au ravinement au moyen de système d'information géographique : bassin versant de l'Oued Mina, Tell oranais, Algérie. Bulletin - Réseau Erosion, 1996, (16), Pp. 412-438.

Khaledian, H., Faghih, H., Amini, A. 2017. Classifications of Runoff and Sediment Data to Improve the Rating Curve Method. Journal of Agricultural Engineering, 48(3), Pp. 147-153.

Khanchoul, K., Boukhrissa, Z.A., Acidi, A., Altschul, R. 2012. Estimation of suspended sediment transport in the Kebir drainage basin, Algeria. Quaternary International, 262, Pp. 25-31.

Morgan, R.P.C. 1995. Soil erosion and conservation (2nd ed.). London: Longman.

Revelli, R. and Ridolfi,, L.2002. Influence of suspended sediment on the transport processes of nonlinear reactive substances in turbulent streams. Journal of Fluid Mechanics, 472, Pp. 307-331.

Selmi, K., and Khanchoul, K. 2016. Sediment load estimation in the Mellegue catchment, Algeria. Journal of Water and Land Development, 31(X-XII), Pp. 129-137.

Syvitski, J.P.M., Morehead, M.D., Bahr, D.B., Mulder, T. 2000. Estimating fluvial sediment transport: the rating parameters. Water Resources Research, 36, Pp. 2747-2760.

Tachi, S.E., Bouguerra, H., Derdous, O., Djabri, L., Benmamar, S. 2020. Estimating suspended sediment concentration at different time scales in Northeastern Algeria. Applied Water Science, 10:118.

Tran, V.T.T. 2014. An analysis of the sediment rating curve parameters in the Upper Mississipi River basin at the monthly and annual levels. Master's thesis, University of Tennessee, Knoxville, 124p.

Vanmaercke, M., Zenebe, A., Poesen, J., Nyssen, J., Vertstraeten, G., Deckers, J. 2010. Sediment dynamics and the role of flash floods in sediment export from medium-sized catchments: a case study from the semi-arid tropical highlands in northern Ethiopia, Journal of Soils and Sediments, 10, Pp. 611-627.

Verstraeten, G., Van Oost, K., Van Rompaey, A., Poesen, J., Govers, G. 2002. Evaluating an integrated approach to catchment management to reduce soil loss and sediment pollution through modeling. Soil Use Management, 19, Pp. 386-394.

Walling, D.E. 2006. Human impact on land–ocean sediment transfer by the world's rivers. Geomorphology, 79, Pp. 192-216.

Warrick, J.A. 2015. Trend analyses with river sediment rating curves. Hydrological Processes, 29, 936-949.

Warrick, J.A., and Rubin, D.M. 2007. Suspended-sediment rating-curve response to urbanization and wildfire, Santa Ana River, California. Journal of Geophysical Research - Earth Surface, 112: F02018.

Yang, G., Chen Z., Yu F., Wang, Z., Zhao, Y., Wang, Z. 2007. Sediment rating parameters and their implications: Yangtze River, China. Geomorphology, 85(3-4), Pp. 166-175.

Zhao, G., Mu, X., Strehmel, A., Tian, P. 2014. Temporal Variation of Streamflow, Sediment Load and Their Relationship in the Yellow River Basin, China. PLoS ONE, 9(3): e91048

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