# Estimation of suspended sediment rate by double correlation method in Mouillah basin, North-West of Algeria

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## Abstract

The study deals with the assessment of the solid transport in the wadi Mouillah watershed (Tafna, Algeria). Sediment transport is a complex phenomenon. The quantity of sediment transported is very important, and it fills in the reservoirs. The scale is out of proportion in semiarid areas. Algeria is one of the most affected countries by this phenomenon. A simple method, based on average discharges, easy to implement, has been developed for estimating the sediment yield using double correlation method (a first one between liquid discharge – solid concentration and a second one between solid flow – concentration). It is based on hydrometric data (liquid flow, concentrations and sediment discharges) with applications analysis on seasonal and annual scales for data's of Sidi Belkheir station at the outlet of the wadi Mouillah watershed (North-West of Algeria). The obtained results by the application of this method are very encouraging because of the quite significant correlation coefficients found ($\geq$59% for the first correlation and $\geq$88% for the second correlation). The watershed of Mouillah produces between 43 730 and 56 410 Mg·y$^{-1}$ as suspended sediment load against 48.56·10$^3$ to 53.3·10$^3$ m$^3$·y$^{-1}$ of liquid intake.

**Key words:** *double correlation method, Mouillah, sediment rating curve, sediment yield, watershed*

## INTRODUCTION

The sediment volumes generated by watersheds are sometimes very large, which has prompted enormous efforts from the nations, in the fight against siltation of dams, disruption of hydraulic infrastructure and land degradation.

On a world scale, the average specific degradation of watersheds is estimated at 152 Mg·km$^{-2}$·y$^{-1}$ [MILLIMAN, MEADE 1983], on an African scale, it seems very modest, not exceeding 35 Mg·km$^{-2}$·y$^{-1}$ but it is huge in the Maghreb (North-West Africa), WALLING [1984] assigns it a range between 1000 and 5000 Mg·km$^{-2}$·y$^{-1}$, while PROBST and AMIOTTE-SUCHET [1992] estimates it around of 397 Mg·km$^{-2}$·y$^{-1}$.

Algeria is a semi-arid and even arid country (200–400 mm of rain per year) and a specific erosion rates is between 2000 and 4000 Mg·km$^{-2}$·y$^{-1}$ [DEMMAK 1982]. The water resources are weak and irregular. Algeria, with its hundred dams, mobilizes only 4.5 10$^9$ m$^3$ of water. The sediments deposited there are estimated at 20·10$^6$ m$^3$·y$^{-1}$ of lost volume [KETTAB 2001]. The hydraulic structure of Algeria is cut with a capacity of 45·10$^6$ m$^3$ [REMINI, HALLOUCHE 2004; REMINI *et al*. 2009] due to silting. Unfortunately, problems of erosion and sediment transport can reach a magnitude likely completely sterilizing the development efforts of the rivers of water management authorities.

The processes erosion-sediment transport affects seriously Algeria like other arid and semi-arid countries, in previous years an important number of Algerian researchers have studied this phenomenon in Algeria [BALLA *et al*. 2017; BELARBI *et al*. 2018; BOUCHELKIA *et al*. 2013; BOUCHELKIA *et al*. 2014; BOUCHELKIA, REMINI 2003; DEMMAK 1982; ELAHCENE *et al*. 2013; GHENIM *et al*. 2008; GLIZ *et al*. 2015; MEGNOUNIF *et al*. 2007; REMINI *et al*. 2015; SELMI, KHANCHOUL 2016].

To date, the phenomenon remains deficient, poorly controlled and not yet mastered by researchers. Samples of sediment rates obtained from undertaken studies in some Algerian catchments are summarized in the Table 1. Quantification of suspended sediment transport at the outlet of a watershed is assessed so important that a simple and easy tool was developed in this study. The principle adopted is based on analysis of hydrometric data set gathered from gauging stations with a particular analysis of solid contributions at annual and seasonal scales. This allowed to define an appropriate method to estimate the sediment yield. This study is aiming evaluating the suspended sediment transport in the Mouillah basin using a double correlation method proposed by Bouchelkia in his thesis and published in 2014 by BOUCHELKIA *et al.* [2014].

**Table 1.** Sediment yield of some Algerian basins

| Basin | Basin area (km$^2$) | Sediment yield (Mg·km$^{-2}$·y$^{-1}$) | Reference |
|---|---|---|---|
| Coastal Dahra | 16 | 4 000 | DEMMAK [1982] |
| Sebdou | 256 | 1 047 | MEGNOUNIF *et al.* [2007] |
| Mouilah | 2 650 | 165.3 | GHENIM *et al.* [2008] |
| Mouilah | 2 650 | 17.73–28.41 | BOUCHELKIA *et al.* [2011] |
| Cherf | 1 710 | 350 | KHANCHOUL *et al.* [2012] |
| Bellah | 55 | 610 | ELAHCENE *et al.* [2013] |
| Tafna | 6 900 | 301.45–621.11 | BOUCHELKIA *et al.* [2013] |
| Chellif | 43 700 | 53.77–94.2 | BOUCHELKIA *et al.* [2014] |
| Mellegue | 7 847 | 589.23 | SELMI, KHANCHOUL [2016] |
| Reboa | 328 | 678 | BALLA *et al.* [2017] |
| Soultez | 207 | 575 | BALLA *et al.* [2017] |
| Tafna | 6 900 | 196.11 | BELARBI *et al.* [2018] |

Source: own elaboration.

## STUDY MATERIAL AND METHODS

### STUDY AREA

The watershed of the Mouillah wadi is located at the extreme North-West of Algeria in the South-West of the wilaya of Tlemcen, extends within a perimeter of 230 km and occupies an area of 2650 km$^2$.

The most of its area is found on Moroccan territory covering the plains of Angads and Maghnia (Fig. 1). The fairly varied relief consists of mountains areas, plains and valleys. Its slopes are generally very steep, exceeding 20% in the mountainous areas of Traras Mountains in the North-West and the Tlemcen Mountains in the South. Between these areas with strong relief, there are mild slopes (between 0 and 10%) located on either side of the Mouillah wadi constituting the Maghnia Plain (Fig. 2) [BELARBI 2010]. Moderately elongated (Gravelius compactness coefficient: 1.25), the Mouillah watershed is made up of very heterogeneous areas, made up of mountains (Trara Mountains to the North-West and Tlemcen mountains to the South) and valleys [KHENNANE 2015].

The soils of the basin consist of:
– the limestone soils which run along Mouillah wadi and extend to North-East of Traras Mts. and at the piedmonts of Tlemcen where generally herbaceous vegetation is present;
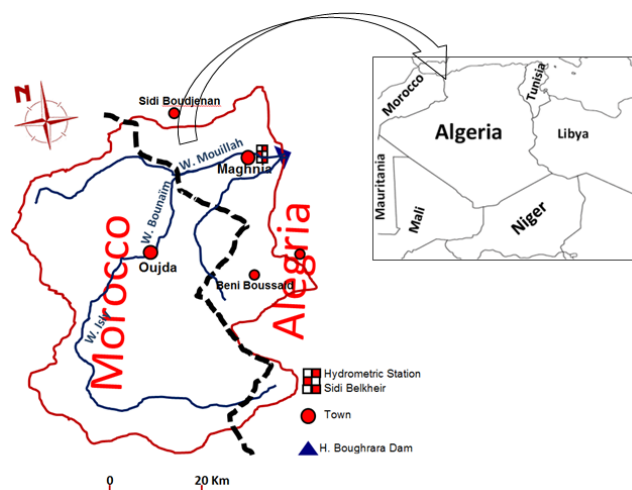


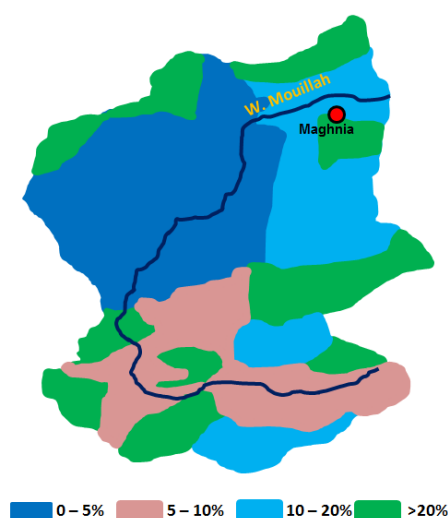Fig. 1. Watershed of Mouillah (Algeria); source: own elaboration



Fig. 2. Slope map of Mouillah basin; source: own elaboration

– calcic soils: stony and shallow, develop especially along the valley of Mouillah wadi;
– Alluvial soils mainly consisted of heavy limestone soils covering the low terraces and the wadis beds are located at North of the Maghnia plain;
– encrusted red soils: these soils made of marls from Miocene, cover a large part of Maghnia Plain where large irrigated cultures are encountered [KHENNANE 2015].

We note that 49% of the area of this basin consists of generally bare land located in its western part and in the rest of the basin, we find extensive crops (21% of the surface), normal forest covers (14% of the surface) and course grounds (Fig. 3).

The Mouillah watershed is characterized by a semi-arid climate, the annual temperatures range from 15.7 to 18.4°C (1977–1995), rainfall is relatively low and unevenly distributed over the year with an average inter-annual of 297 mm (1977–1995 period) [GHENIM *et al.* 2008].

This basin is drained by the Mouillah wadi which originates in El Abed region in Algeria at an altitude of 1250 m. It enters to Morocco and takes the name of wadi Sly and downstream near Oujda (Morocco) it's called wadi Bounaïm and enters late in Algeria around Maghnia under
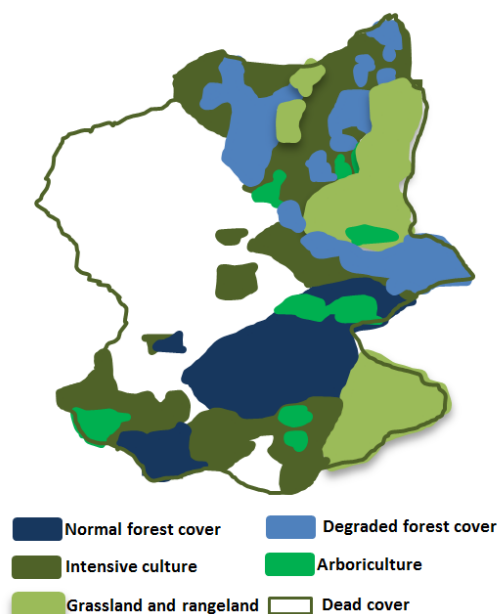
Fig. 3. Land-use map of Mouillah basin; source: own elaboration

the name of Mouillah wadi. The length of the main talweg is 124 km and its average slope is 8 m·km⁻¹ [GHENIM *et al.* 2008].

## STUDY METHODS

The collection of data consists in a systematic analysis of parameters: depth of water and concentration of solid particles collected at the Sidi Belkeir station situated on the Mouillah wadi at the outlet of the basin, these data are from the National Agency of Hydraulic Resources (Fr. Agence nationale des ressources hydrauliques – ANRH). The data series are representative because it spreads out over a period of 24 years (1974/1975–1998/1999) for the liquid flow, it is continuous, complete and without gaps; the choice is to use a complete series without gaps of average monthly discharges instead of a series of average daily discharges with the possibility of using very long very significant series of data, and over a period of 14 years (1986–1999) for the pair liquid discharge, solids concentration ($Q$, $C_S$). The ANRH data are provided in two files:
– average daily discharges without gaps from which the file of the average monthly discharges is elaborated,
–  instantaneous liquid discharges and instantaneous solid concentrations observed by the services of the ANRH over the period 1986/1987–1998/1999 from which the file of pairs of the liquid flow – concentration expressed in daily average is established.
**Note:** in this study, the data used did not exceed 1999, because since then this station is no longer in service when the Hammam Bourghrara dam is filled in the same year (the station was drowned). The application on the data of this station was motivated for the sake of comparison of the results with those of our previous study [BOUCHELKIA *et al.* 2011].

**Double correlation method.** The power model proposed in 1895 by Kennedy (in: LEFORT [1992]) which expresses the suspended sediment flow in function of liquid discharge, is often used for the estimation of sediment load produced in watersheds; this method is based on a single correlation, but in this study we propose an estimation with two correlations (double correlation method).

It is logical to make a correlation between liquid discharge and concentration, like data were collected at the gauging station and complete the estimation of sediment rate with a second correlation between solid concentration and solid flow [BOUCHELKIA *et al.* 2014]; the first one combined with cumulative frequency curve of liquid flows allows estimating the inter-annual average concentration in function of liquid discharges and their frequencies. A second correlation will be made between solid flow and concentration because the solid concentration affects again the suspended sediment yield and to be enable to catch a probable uncertainties of the first correlation [BOUCHELKIA 2009].

**Study steps followed.** After collecting necessary data, three files will be made:
– a first one of couples of values (liquid flow, solid concentration) the longest possible
– a second one of average liquid discharges (continuous and without gaps);
– a last one of pairs values (concentration, solid flow) corresponding to the first file.

After, the application method will follow successively the steps of:
1) creating of the liquid flows cumulative frequency curve;
2) elaboration of first correlation "liquid discharge – concentration" and identify the model $C = F(Q)$ with its parameters;
3) the model $C = F(Q)$ will be combined with the cumulative frequency curve to calculate the inter-annual mean concentration ($Cm$) according to the actions described in "Estimation of suspended sediment load";
4) development of the second correlation model $Qs = F(C)$ between concentration and solid discharge;
5) estimation of suspended sediment yield (which is developed in the next paragraph).

This method was used by BOUCHELKIA [2009] and BOUCHELKIA *et al.* [2014].

**Estimation of suspended sediment yield.** The following steps permit an estimation of the mass of suspended sediments production of the basin:
1) the liquid discharges cumulative frequencies curve is divided of to multiple frequency intervals ($f_i$, $f_{i+1}$);
2) for each frequency interval a liquid flow "$Q_l$" corresponding to the median of this interval is determined, and after a mean liquid discharge "$Q_m$" can be determined by the relationship:

$$Q_m = \sum_{i=1}^{n} Q_{li}(f_{i+1} - f_i) \qquad (1)$$

3) using the statistical model $C = f(Q)$ and for each "$Q_l$" liquid flow, the corresponding inter-annual average solid concentration will be calculated using the relationship:

$$C_m = \sum_{i=1}^{n} C_i(f_{i+1} - f_i) \qquad (2)$$

4) the predetermined model: $Qs = F(C)$ permits an evaluation of the average inter-annual solid discharge $Qs_m$;

5) according to the considerate period, the sediment yield drained by wadi can be estimated by multiplying inter-annual solid flow $Qs_m$ by the number of seconds in this period, in the same way the liquid intake can be determined by multiplying mean liquid discharge $Q_m$ by the number of seconds in this period [BOUCHELKIA 2009; BOUCHELKIA et al. 2014].

## RESULTS

### SUSPENDED SEDIMENT LOAD IN MOUILLAH BASIN

From raw database file of pairs ($Q$, $C$) collected by the ANRH services at Sidi Belkheir station controlling Mouillah wadi (instantaneous data) as well for liquid flow as for solids concentrations a files daily averages couples ($Q$, $C$) are prepared according to considered period (seasonal or annual). The follow-up of the actions described above permit an estimation of suspended sediment rate by double correlation method. Applications for annual and seasonal scales were conducted, given the seasonal influence on the phenomenon of suspended sediments rates; the latter led us to establish relationships between seasonal liquid discharge and sediment loads and to estimate the contribution of suspended sediment from each season. Two groups of seasons have been made, the first treatment with the year seasons (autumn, winter, spring, summer), the second according to the division of the year into two seasons (wet season and dry season) identified through the construction of the ombrothermic diagram of the Maghnia meteorological station, which is located inside the drainage basin. We preferred to use the data from this station rather than from the Sidi Belkheir station for better representation (Fig. 4). The ombrothermic diagrams are used to determine the number of dry months and the number of wet months and therefore they identify the dry season and wet season. In effect, if the value of temperature in a given month is higher than the double of the value of rainfall in this month, it is considered as dry month [WALTER (ed.) 1985]. According to the ombrothermic curve, we notice that the humid season extends from November to April (i.e. six months) against the
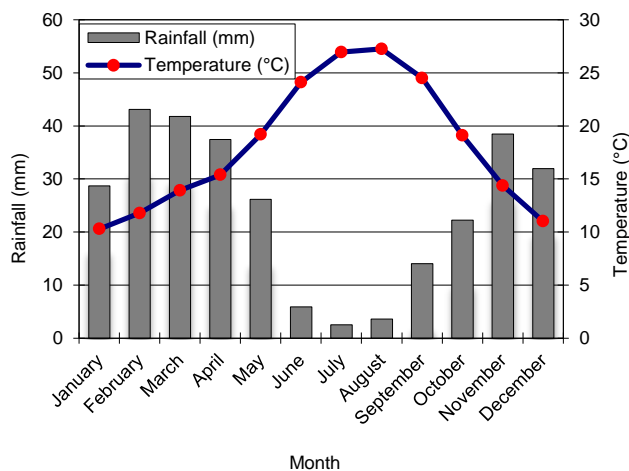
dry season extending from May to October (six months). According to Figure 4, it is evident that the wettest month is February with a rainfall average of 43.15 mm and the driest month is July with 3.0 mm of rain per month while the coldest month is January with an average temperature of 10.3°C and the hottest month is August with 28.3°C.

### LIQUID DISCHARGE FREQUENCIES ANALYSIS

The statistical distribution of liquid discharge observation by classes allowed to trace the flow duration curves (cumulative frequencies curve of average monthly liquid discharge) [MUSY (ed.) 1998] for annual and seasonal periods as shown in Figure 5. For each period the Table 2 summarizes the statistic parameters of liquid discharges.

### FIRST CORRELATION (SOLID CONCENTRATION – LIQUID DISCHARGE)

We selected 1124 couples ($Q$, $C$) for Sidi Belkeir station, covering the period 1986–1999. The relationship between solid concentration and liquid discharge for annual and seasonal is shown Figure 6. We note that according to the point's cloud that the power relationship clearly expresses the link:

$$C = KQ^A \tag{3}$$

Where: $K$, $A$ = coefficients.

This power model has been already proposed by other authors in the world [ETCHANCHU, PROBST 1986; WOOD 1977] and by BOUCHELKIA [2009], BOUCHELKIA et al. [2014] and EL MAHI et al. [2012] for Algerian basins.

Table 3 summarizes the parameters of obtained models.

**Note:** by bringing the values of the couples ($Q$, $C$) to the logarithmic scale, the power model will be linearized and its parameters will be easily estimated by linear regression.

### EVALUATION OF THE INTERANNUAL AVERAGE CONCENTRATION

The previous model $C = KQ^A$ combined with the curve of the cumulative frequencies of the liquid flows makes permit to assess the inter-annual average solid concentration by following the stages quoted previously. This way of acting allows a better evaluation of the average concentration because it not only integrates the liquid flows but also their respective frequencies. The results obtained are presented in Table 4.

### SECOND CORRELATION (SOLID FLOW – CONCENTRATION)

For a reliable estimate of the yield for suspended sediments a second correlation was made between solid flows and concentrations because firstly these two parameters are intimately linked and on the other it can be characterized as a corrective of the first correlation [BOUCHELKIA et al. 2014] where the correlation coefficients are relatively average but acceptable. For Sidi Belkheir station a relations



Fig. 4. Ombrothermic diagram – Maghnia station; period 1978–2004; source: own study
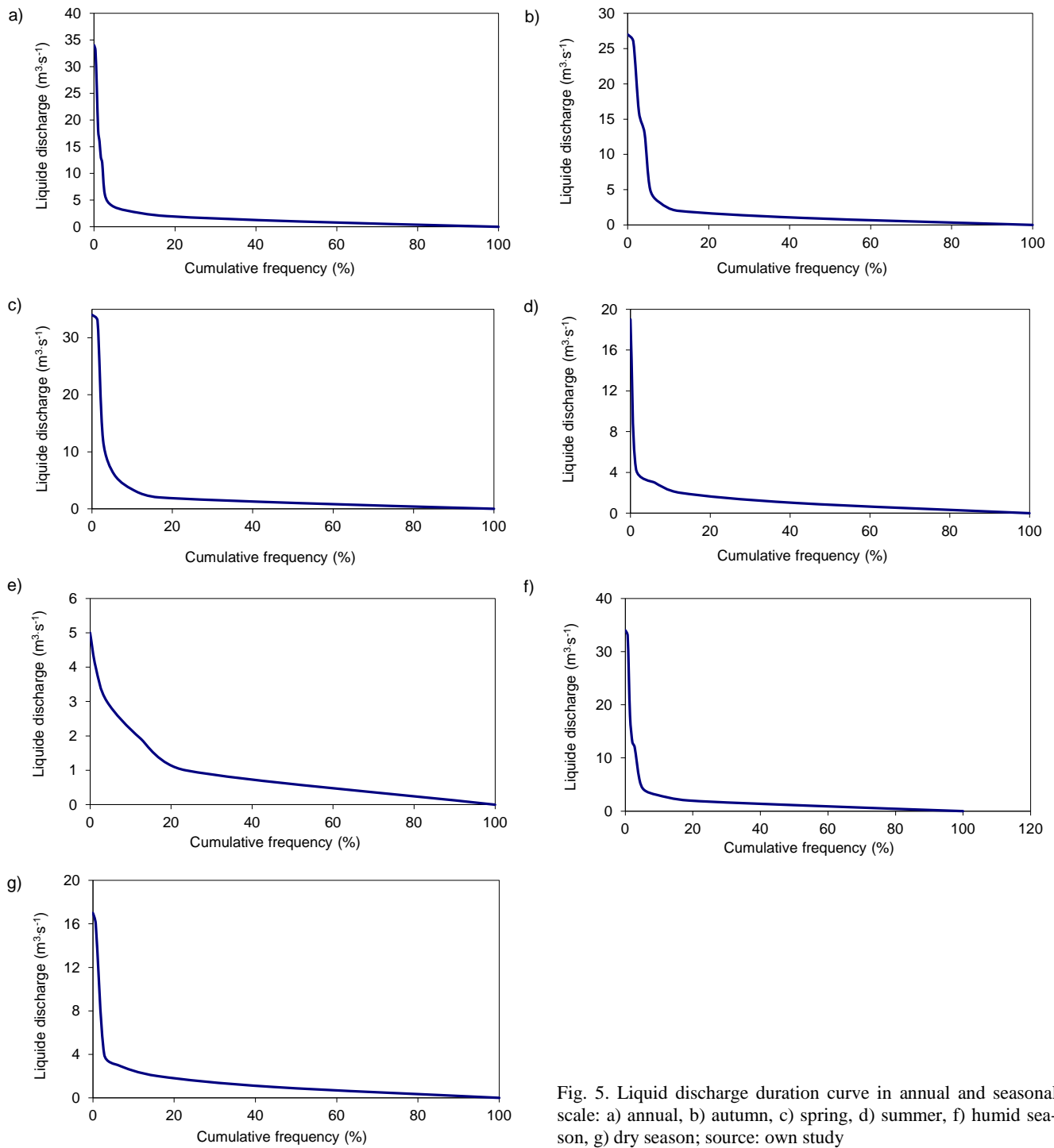
Fig. 5. Liquid discharge duration curve in annual and seasonal scale: a) annual, b) autumn, c) spring, d) summer, f) humid season, g) dry season; source: own study

**Table 2.** Average and standard deviation of average monthly liquid flows

| Period | Size of sample | Average | Standard deviation |
|---|---|---|---|
| | | m³·s⁻¹ | |
| Annual | 288 | 1.59 | 3.05 |
| Autumn | 72 | 1.73 | 3.88 |
| Winter | 72 | 1.82 | 4.21 |
| Spring | 72 | 0.97 | 0.94 |
| Summer | 72 | 0.79 | 0.96 |
| Humid season | 144 | 1.78 | 3.48 |
| Dry season | 144 | 1.21 | 1.62 |

Source: own study.

$Qs = F(C)$ was established for annual and seasonal periods. When the value for data ($C$, $Qs$) was reported on a logarithmic scale plot an excellent correlation of scatter plot were showed (power relationship).

Therefore:

$$Qs = \alpha C^{\beta} \qquad (4)$$

BOUCHELKIA *et al*. [2014] propose the same power relation for Chellif basin.

The annual and seasonal relationships were grouped in Figure 7 and Table 5 summarizes the annual and seasonal relationships and their correlation coefficients.
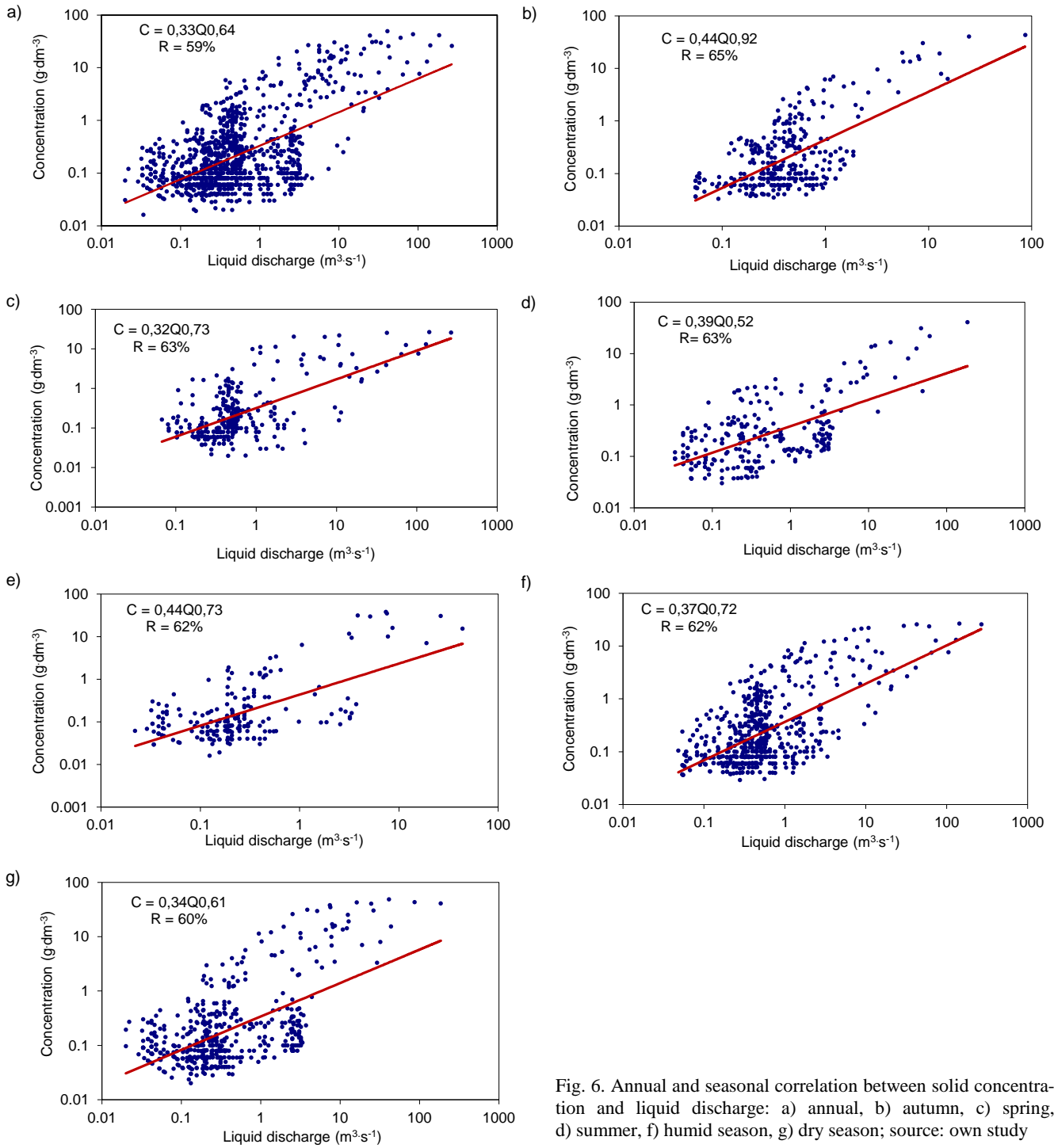
a)

b)

c)

d)

e)

f)

g)

Fig. 6. Annual and seasonal correlation between solid concentration and liquid discharge: a) annual, b) autumn, c) spring, d) summer, f) humid season, g) dry season; source: own study

**Table 3.** Relationships and correlation coefficients – first correlation

| Period | Number of points | Relationship | Correlation coefficient (%) | Prediction interval |
|---|---|---|---|---|
| Annual | 1124 | $C = 0.33Q^{0.54}$ | 59 | ±11.38 |
| Autumn | 355 | $C = 0.44Q^{0.92}$ | 65 | ±08.67 |
| Winter | 302 | $C = 0.32Q^{0.79}$ | 63 | ±07.04 |
| Spring | 252 | $C = 0.39Q^{0.52}$ | 63 | ±8.54 |
| Summer | 215 | $C = 0.44Q^{0.73}$ | 62 | ±10.81 |
| Humid season | 606 | $C = 0.37Q^{0.72}$ | 62 | ±09.89 |
| Dry season | 518 | $C = 0.34Q^{0.61}$ | 60 | ±11.90 |

Source: own study.

**Table 4.** Inter-annual average concentration of Wadi Mouillah

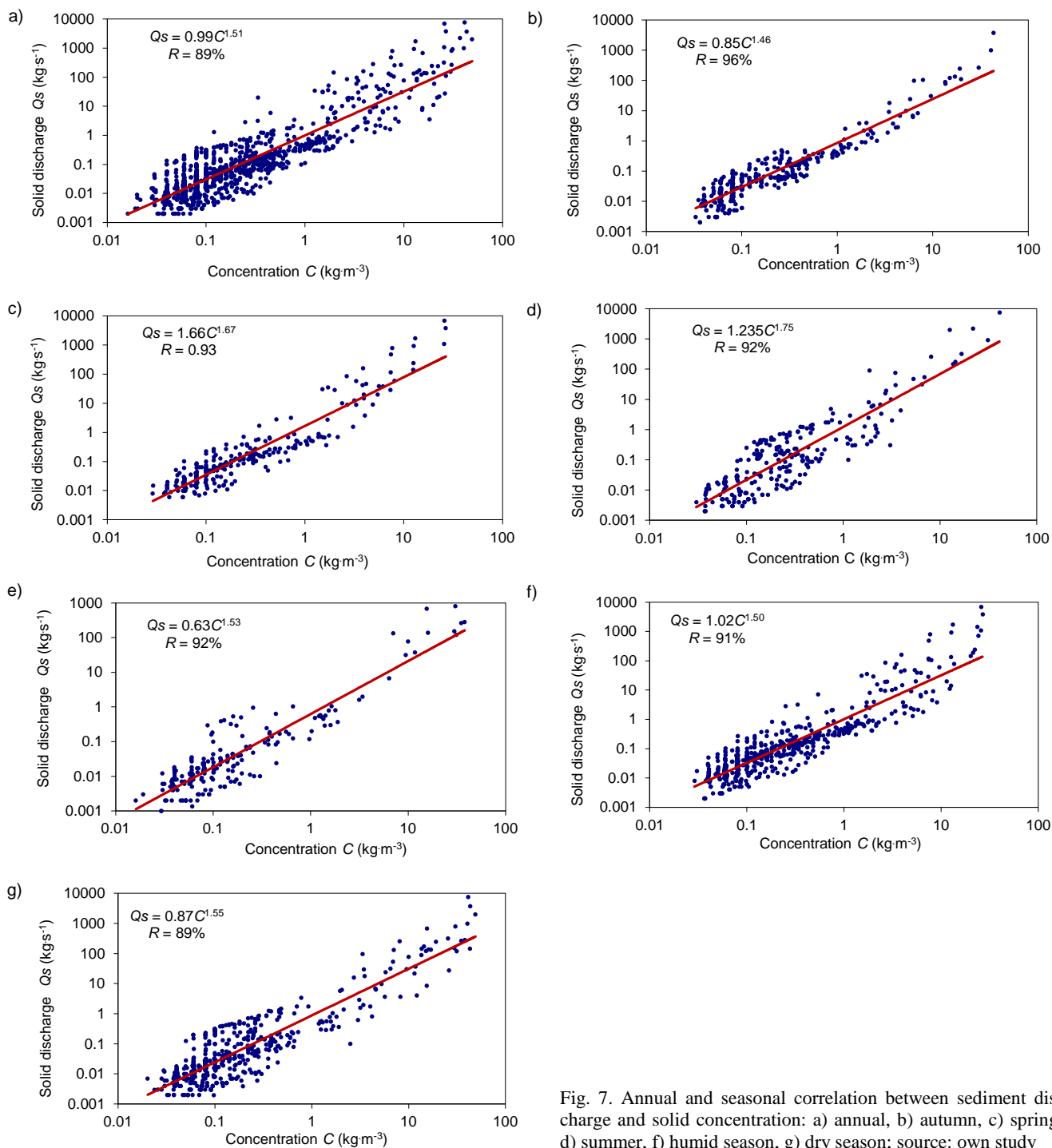| Period | Annual | Autumn | Winter | Spring | Summer | Humid season | Dry season |
|---|---|---|---|---|---|---|---|
| Mean liquid discharge $Q_m$ (m$^3$·s$^{-1}$) | 1.69 | 1.94 | 2.18 | 1.12 | 0.92 | 1.94 | 1.39 |
| Inter-annual average concentration $C_m$ (kg·m$^{-3}$) | 1.25 | 1.78 | 1.73 | 0.55 | 0.61 | 2.01 | 0.97 |

Source: own study.

Fig. 7. Annual and seasonal correlation between sediment discharge and solid concentration: a) annual, b) autumn, c) spring, d) summer, f) humid season, g) dry season; source: own study

**Table 5.** Relationships and correlation coefficients – second correlation

| Period | Number of points | Relationship | Correlation coefficient (%) | Prediction interval |
|---|---|---|---|---|
| Annual | 1 124 | $0.99C^{1.51}$ | 89% | ± 9.45 |
| Autumn | 355 | $0.74C^{2.11}$ | 96% | ± 5.32 |
| Winter | 302 | $1.66C^{1.57}$ | 93% | ± 3.97 |
| Spring | 252 | $1.24C^{1.75}$ | 88% | ± 6.88 |
| Summer | 215 | $0.63C^{1.53}$ | 92% | ± 9.08 |
| Humid season | 606 | $1.02C^{1.50}$ | 91% | ± 8.76 |
| Dry season | 518 | $0.87C^{1.55}$ | 89% | ± 8.32 |

Source: own study.

## SUSPENDED SEDIMENT YIELD IN MOUILLAH BASIN

The obtained model $Qs = \alpha C^{\beta}$ (Tab. 5) allowed to determine the average suspended solid discharge for Mouillah basin, which enabled the assessment of the suspended sediment yield transported by Mouillah wadi and estimate the specific degradation of its watershed. Table 6 summarizes the obtained results.

**Table 6.** Suspended sediment contribution in Mouillah basin

| Period | Annual | Autumn | Winter | Spring | Summer | Humid season | Dry season |
|---|---|---|---|---|---|---|---|
| Average liquid discharge $Q_m$ (m$^3\cdot$s$^{-1}$) | 1.69 | 1.94 | 2.18 | 1.12 | 0.92 | 1.94 | 1.39 |
| Inter-annual average concentration $C_m$ (g$\cdot$dm$^{-3}$) | 1.25 | 1.78 | 1.73 | 0.55 | 0.61 | 2.01 | 0.97 |
| Liquid intake (10$^6$ m$^3$ in period) | 53.30 | 15.30 | 17.19 | 8.83 | 7.25 | 30.59 | 21.92 |
| Average solid suspension flow $Qs_m$ (kg$\cdot$s$^{-1}$) | 1.387 | 2.498 | 3.925 | 0.436 | 0.296 | 2.907 | 0.830 |
| Solid contribution (10$^4$ Mg in period) | 4.373 | 1.970 | 3.094 | 0.343 | 0.233 | 4.545 | 0.330 |
| Specific degradation (Mg$\cdot$km$^{-2}$ in period) | 16.502 | 7.432 | 11.677 | 1.296 | 0.880 | 17.153 | 1.245 |
| Annual liquid contribution (10$^6$ m$^3\cdot$y$^{-1}$) | 53.30 | 48.56 | | | | 52.51 | |
| Annual solid contribution (10$^4$ Mg$\cdot$y$^{-1}$) | 4.373 | 5.641 | | | | 4.875 | |
| Erosion rate (Mg$\cdot$km$^{-2}\cdot$y$^{-1}$) | 16.502 | 21.285 | | | | 18.398 | |

Source: own study.

## DISCUSSION

For the first correlation (liquid flow-concentration) a best correlations are obtained in seasonal scale, especially in autumn, winter and spring, and in summer where the correlation coefficient is 62% basically because of the implication of very rare floods caused by summer rainfalls falling on bare soil freshly cultivated. It's in autumn where we have a most significant correlation (65%) following up a good regularity of water discharges. In the other approaches (annual and semestrial) the correlation coefficients are between 59% and 62% this is surely attributable to the variations and deviations of the seasonal flows intervening on the annual and semestrial scales.

In the second correlation, an excellent correlations were found in all applications (>88%). It should be noted that the biggest average concentrations obtained are in winter and in autumn because in these seasons it is recorded the majority of floods due to strong rains. Moreover in autumn, in raison of the sudden and erratic rainfall falling on dry and bare cultivated soil of vegetation cover increase the turbidity of water of wadi. The lowest concentration was obtained in spring and summer; in spring as a result of permanent leaching of the wadi, in summer because of important deviations in water discharges and solid concentrations.

The specific degradation of the Mouillah catchment is relatively moderated (between 16.5 and 21.3 Mg$\cdot$km$^{-2}\cdot$y$^{-1}$) it is relatively higher than the suspended sediment load found for the same basin (between 17.73 and 28.41 Mg$\cdot$km$^{-2}\cdot$y$^{-1}$ over the period 1974–1999) [BOUCHELKIA 2011] using an estimation with single correlation; it is lower than the result found by TERFOUS et al. [2001] for the same basin (126 Mg$\cdot$km$^{-2}\cdot$y$^{-1}$ over a study period from 1977 to 1993; it should be noted that the estimation in the last two studies does not take into account the frequencies of liquid discharges. It is significantly lower than the results of a previous study on the Tafna catchment area (between 301 and 621 Mg$\cdot$km$^{-2}\cdot$y$^{-1}$) [BOUCHELKIA 2013] (the Mouillah basin is a sub-basin of the Tafna basin).

In terms of this study the sediment intake, the values in annual and seasonal reasoning are relatively similar (4.37$\cdot$10$^4$ Mg$\cdot$y$^{-1}$, 5.64$\cdot$10$^4$ Mg$\cdot$y$^{-1}$ and 4.87$\cdot$10$^4$ Mg$\cdot$y$^{-1}$) but in classical seasonal reasoning (four seasons) the different correlation coefficients are the best; which shows the precision of seasonal approach and indicates that the phenomenon is better defined using the seasonal scale.

In winter the suspended sediment intake are the most important (1.97$\cdot$10$^4$ Mg) because in this season the water discharge are important and more regular and floods are frequent than in other seasons, although the average solid concentration is the greatest in autumn 1.78 g$\cdot$dm$^{-3}$.

We note that the specific degradation found of Mouillah basin (the max. found: 21.3 Mg$\cdot$km$^{-2}\cdot$y$^{-1}$) is below the values advanced by PROBST and AMIOTTE-SUCHETT [1992] and WALLING [1984] for the Maghreb, respectively from 420 Mg$\cdot$km$^{-2}\cdot$y$^{-1}$ to 5000 Mg$\cdot$km$^{-2}\cdot$y$^{-1}$.

## CONCLUSIONS

This estimation method (double correlation method) gives designers and managers of hydraulic infrastructures a simple and quick way to better estimate the sediment inputs produced by a watershed in order to predict the losses of capacity and estimate the life the water mobilization structures. This approach was applied to quantify the load of suspended sediments transiting through the Sidi Belkheir station located at the outlet of the Mouillah watershed during the period 1974–1999. The results have shown that the sediment yield in autumn and winter is the most abundant and that the phenomenon is better defined in classical seasonal reasoning (four seasons). They indicate that the erosion of the Mouillah watershed is moderate, because the maximum value of solid contributions found is 5.64$\cdot$10$^4$ Mg$\cdot$y$^{-1}$, this result confirm our result for the same basin in 2011. The watershed of Mouillah produces between 43 730 and 56 410 Mg$\cdot$y$^{-1}$ as suspended sediment load against 48.56$\cdot$10$^3$ to 53.3$\cdot$10$^3$ m$^3\cdot$y$^{-1}$ of liquid intake.

Through its simplicity, the double correlation method can be easily used for estimating the suspended sediment load of Algerian watersheds but requires improvement and calibration by comparing its results with real and experimental measurements in the field.

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