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Comparison of physic-chemical and metallic characteristics noted in winter and those noted in summer (year 2008/2009) in the water of R'dom river (Morocco)

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ABSTRACT

we have compared the physicochemical characteristics and the degree of metallic contamination, recorded in winter, and those recorded in summer in the water of R'dom river which is a tributary of Sebu river (Morocco). The results have shown that, in places, the waters of this river have an organic pollution and / or métallque. This pollution is both winter and summer in some stations and it is only in winter or in summer in others. The main causes of the variation of this pollution can be attributed to the changes in water flow Oued R'dom and thus to the dilution of wastewater discharges from storm water. While the stations most vulnerable to urban waste, industrial or agricultural have showed a persistently high level of pollution.

KEYWORDS

Water pollution;
Heavy metals;
Physical chemistry;
Variation;
R'dom river;
Morocco.

INTRODUCTION

In many countries the deteriorating of the surface water and groundwater quality is ongoing. Human activity is the main cause[1], and Morocco is not escaping by this phenomenon. In effect, by the rejection of the wastewater, and by his industrial and agricultural activities especially its overuse of fertilizers and pesticides the human degrades the water qualty and even destroys its reserves.

Moreover, inadequate, and sometimes the complete absence, of regulations to control the nature of the rejection of the wastewater and the treatment applied to those water discharges into the environment increase the degration of the superficial and underground water.

In Sebu watershed, the pollution sources are various and beyond all measures of environmental protection[2] including to the use of the water to potability purposes or irrigation. The Biodiversity of aquatic environment is not escaped to this plague.

In many regions, it is therefore necessary to ensure the assessment of the superfificielle water quality because this vital mater is very exposed to degradation factors of various kinds: physical, chemical, biological and organic metal. Thus, in this present work, we have evaluated the physico-chemical and metalic chracterics of water in R'dom river which is a part of a Moroccan large watershed : Sebou watershed that covers two main plains: the plain of Sais and the Gharb. It is divided into three parts:

- The top Sebou;
- The average Sebou;
- The Low Sebou

The bottom is traversed by Sebu and Rdom rivers. The latter receives the urban and industrial wastewater of many human settlements (cities of Meknes and Sidi Kacem). It is therefore improtant to estimate of the physico-chemical, metallic and biological degrees of the pollution in this aquatic biotop.

Thus, we assessed the degree of the metallic contamiation of the water in R'dom River by determining the concentrations of ten heavy metals: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn.

MATERIEL ET METHODES

Study sites

We took into consideration six water sampling stations to be analyzed wich are distributed on R'dom Oued and its two tributaries, Wadi Wadi and Boufekrane Wisslan (Figure 1).

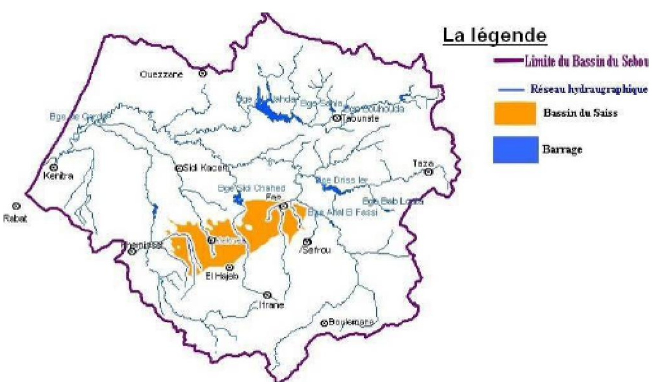

Figure 1 : Framework Hydrological Watershed Sebou; red, the sub-basin of R'dom River.

The geographic situations of surveyed stations are noted in Figure 2:

• S1: upstream of the city Boufkrane

• S2: upstream meknès city and at 2 km downstream Boufekrane

• S3: 7 km downstream from the city of Meknes on Boufrane River

• S4: in R'dom River, downstream the confluence of Wislana river with Boufkrane River

• S5: In R'dom River at 2 km upstream the town of Sidi Kacem (40 km from Meknes).

• S6: In Oued R'dom downstream of Sidi Kacem

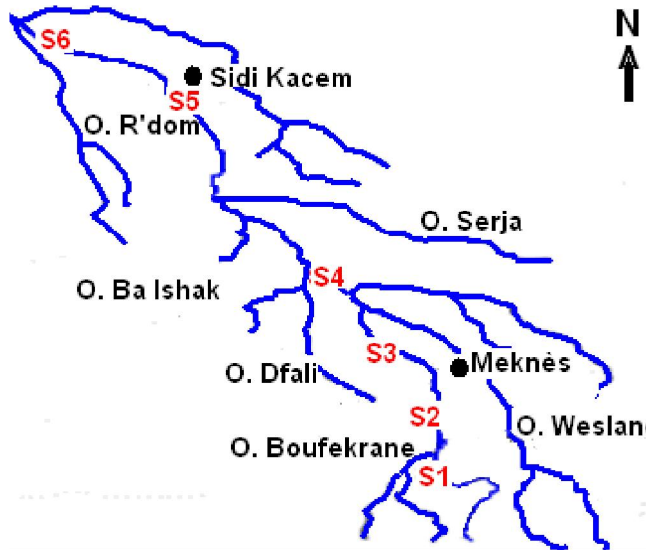

Figure 2 : Location of organizations sampling water

Analysis methods of the metallic elements and physicochemical parameters evaluated

We measured, in June and January, ten metallic elements and six physicochemical parameters. Some physico-chemical measurements were realized in situ such as the water temperature, electrical conductivity and pH. The remaining assessments were made by volumetric filling or spectroscopic assays, according to the methods proposed by Rodier[3].

The measurement of physicochemical parameters was assessed by the following methods:

- The temperature measurement was performed in situ using a portable conductivity meter (WTW Cond. 315 / SET);

- The pH was measured using a micro prosector pH meter HI 8314 (Hanna instruments);

-The dissolved oxygen was measured using a portable oximeter 9143 (HANNA instruments);

- The conductivity was measured with a portable conductivity meter (WTW 315/SET cond);

-The BOD5 was determined with a manometric method (at constant pressure respirometer) in the dark and at 200 ° C;

- The DCO is determined using a strong oxidant: potassium dichromate.

For metallic elements, each sample of 50ml was taken, homogenized; then added 5ml of nitric acid ($HNO3$) concentrated. The resulting solution is placed in a beaker and heated on a hotplate at temperatures around 100 °C to have a volume of 5 ml (1 hour). To this solution was added 5ml of hydrochloric acid (HcL) concentrated and 10ml of distilled water, then heated until complete dissolution of precipitation. Allowed to cool. The resulting solution was filtered (filter with pores of 0.45 mm), then enriched to 50ml with distilled water.

Analysis of data collected

All the data grouping the evaluating values of the studied physico-chemical and metallic parameters was grouped in a data matrix.

Moreover, for the development of a typology of the surveys and the surveyed stations we have statistically analyzed the data matrix with a method of multivariate analysis: PCA. Thus, we developed a final data matrix consisting of 16 variables and 12 observations (one in summer and one spring for each station).

Recall that the A.P.C. is a factorial method that could simplify the description of a measurement chart wich is difficult to handle (Bouroche and Saporta. 1980; FRONTIER, 1981)[4,5]. It is widely used in the field of chemistry and biology.

RESULTS AND DISCUSSION

Results

The results (TABLE 1 and 2) show that the first three axes account for 65.2% of total information explained with 34.7% for the C1 axis, 15.8% for the C2 axis and 14.7% for the C3 axis. To interpret the phenomenon we need to interpret the projection planes of the variables and statements C1xC2, C1xC3 and C2xC3. But to this interpretation we need to know the physico-chemical ecological signification of the three axes C1, C2 and C3.

TABLE 1 : Eigenvalues and percentage of variance explained by three main axes

-	C1	C2	C3
Eigenvalues	5,55576	2,5250	2,3506
% variance	34,7	15,8	14,7
% Cumulative variance	34,7	50,5	65,2

- Physicochemical interpretation of the axes of the typological study

+ Meaning of C1

The results of the analysis (TABLE 2 and Figure 3) show that three physico-chemical variables were significantly correlated with axis C1: dissolved oxygen (DO), BOD5, and COD. The values that can take these three variables dependent of the degree of organic pollution of the environment. Thus, the axis represents an increasing gradient of organic pollution of the aquatic environment.

TABLE 2 : Correlation (in square) between the variables and the axes C1, C2 and C3

Variables	C1	C2	C3
Al	0.3588	0.1844	0.0016
Ba	0.1943	0.0595	0.4093
Cd	O.1601	0.0048	0.6437
Cr	0.4867	0.0344	0.1915
Cu	0.3744	0.0055	0.1701
Fe	0.3151	0.1216	0.2068
Mn	0.3573	0.1396	0.0565
Ni	0.4241	0.1698	0.0227
Pb	0.3053	0.2382	0.0374
Zn	0.0615	0.1235	0.2083
T	0.0035	0.3041	0.0622
pH	0.0009	0.7849	0.0066
Cond	0.2696	0.2305	0.0593
OD	0.7442	0.0543	0.0000
DBO	0.7431	0.0023	0.1479
DCO	0.7614	0.0673	0.1267

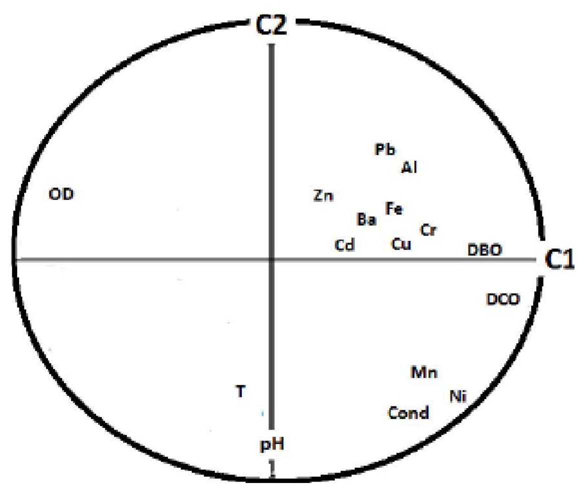

Figure 3 : Graphical representation of variables in C1xC2 plan

+Meaning of C2

The results of the analysis (TABLE 2 and Figure 3) show that only the pH contributes negatively in the composition of the axis C2. The C2 axis is a gradient of decreasing pH from the negative to positive side of C2.

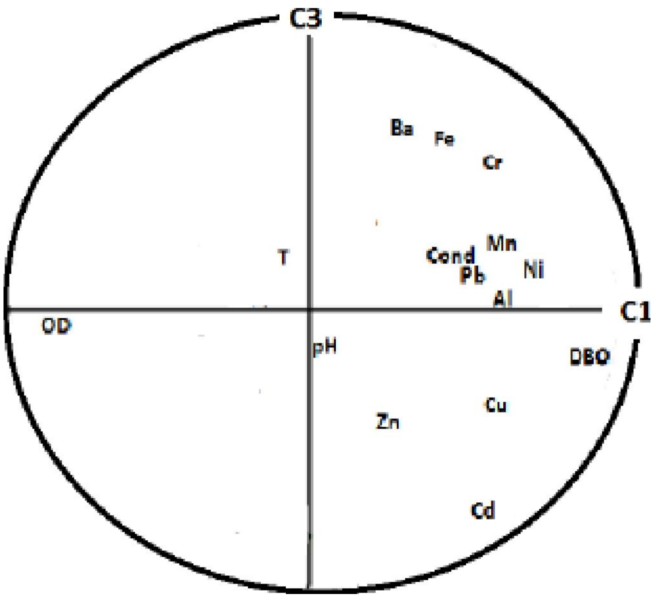

Figure 4 : Graphical representation of variables in C1xC3 plan

+ Significance of C3

The results of the analysis (TABLE 2 and Figure 4) show that only cadmium contributes significantly to the C3 axis. The C2 axis is a gradient of concentration of cadmium in the community. This gradient decreases from the negative to the positive side C2.

- Interpretation of projection planes of the variables and the levies and de

§ Interpretation of the plan C1 x C2

Variables

All the metallic variables are situated in the positive side of the axis C1, because the high concentrations of these elements are consistent with the high values of COD and BOD and the low levels of dissolved oxygen, i.e. with a high degree of organic pollution. It should specify than the magnesium and the nickel are the most abundant elements in when the pH, temperature, and conductivity are important.

Levies

Plan C1xC2 (Figure 5) distinguishes two groups:

- A first group consisting of the following stations and levies: the station S1 and S2 in January and June, and the S5 station in January. All these stations are characterized by the low dissolved oxygen pupils, and the low values of BOD and COD, ie a low degree of organic pollution.

Theoretically, the station S1 is far from any pollution source. The station S2 is located downstream of the village Boufkrane. So, it receives wastewater from the village but during the month of January, these waters are heavily diluted by rainwater, hence their low pollution levels during this season.

The station S5 is located upstream of Sidi Kacem. It is relatively far from sources of organic pollution; this situation and the purifying power of the river explain the low level of organic pollution, even in January.

-A second group consisting of the levies done in January and June in the station S3 and S4, in June in the station S5, and in January and June the station S6. These stations were characterized by a high degree of organic pollution.

In addition, in January and June, the station S6 is characterized by a high pH. In June,

the station S5 were organically polluted and this pollution can be explained by the low rate of the R'dom river during this period. The low water velocity favorites the degradation of the organic matter.

The three stations S3, S4, and S6 are all downstream of major conurbations (S3 and S4 are located downstream from Meknes, and S6 downstream Sidi

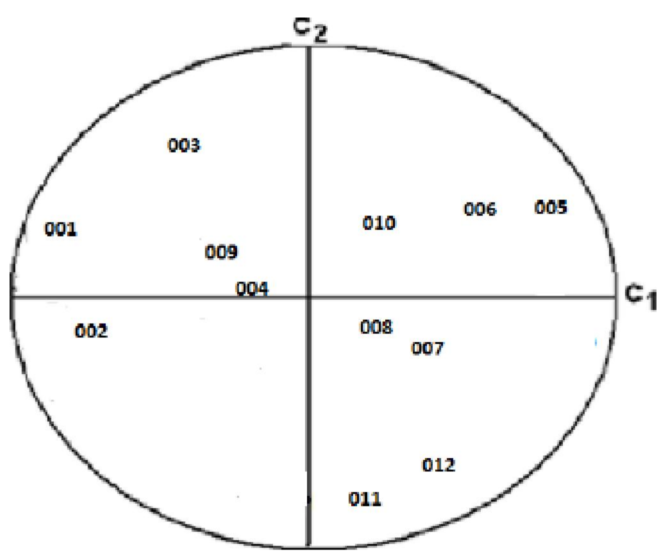

Figure 5 : Graphical representation of levies in C1xC2 plan

Kacem) and subsequently receive large amounts of Sewage from these cities. This explains the high degree of organic pollution of these stations. The relatively high pH noted in the station S6 can be explained by the release and persistence of waste water residues of the refining facility "SAMIR". In addition, in all stations, the pH is slightly alkaline. It is between 7.15 and 7.55. This alkalinity is mainly due to the nature of limestone or marno-limestone land crossed by the river[6].

§ Interpretation of the plan C1x C3

Variables

This plan shows that the C3 axis corresponds to a concentration gradient of cadmium, the highest concentration of zinc and copper corroborate with high concentrations of cadmium. This is not the case for Ba, Fe and Cr. Note that in a aquatic biotope, the cadmium is mainly bound to organic matter[7]. Similarly, this metallic element could be bioaccumulated in the tissues of certain fishs and Shellfishs[8].

The cadmium uptake by plants can be reduced by the presence in the middle of high concentrations of calcium, magnesium and sulfur, while the barium can be bio-accumulated in various foods including various foodstuffs[9].

Also; Tessier et *al.* 1979[10] have reported that the sediments, in particular the fraction bound to oxides, are the largest fixatives of the iron.

Levies

The plan C1xC3 (Figure 6) differentiates the same groups as those shown in the first plane C1xC2, adding that relatively to the C3 axis, the levies of the group n° 2 can be subdivided into two subgroups:

* Subgroup 1: characterized by the following stations: The station S3 and S5 in June, and the station S6 in June and January, which are characterized by medium or low levels of cadmium.

* Subgroup 2: the station in January and S3 and S4 stations in June and January, which were characterized by a high concentration of cadmium and hence high concentrations of Zinc and Copper. The richness of Cd, Zn, and Cu station S3 in January can be explained by the discharges from wastewater enriched by the runoff waters draining the vile of Meknes and those of the rich agricultural areas with the fertilizers during this period. The same observation is valid for the station S4 in January.

The significant contamination of the station S4 in June may be due to the receipt of this wastewater station including those from the new town of Meknes and the common Weslane.

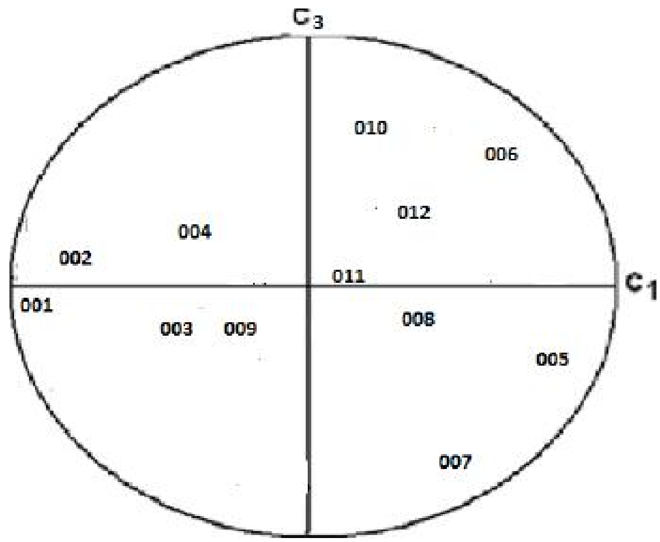

Figure 6 : Graphical representation of levies in C1xC3 plan

Concerning the spatial and temporal variation of pollution levels between the stations and found we note that:

- All stations show a seasonal fluctuation in the level of organic pollution.

- In some stations, metal pollution is permanent throughout the year.

- Some stations have a seasonal variation in the degree of contamination by some metallic elements.

Moreover, most of these metal contaminants are anthropogenic. As an example, a significant accumulation of lead and zinc and may be related to the road traffic in the urban area[1]. The variation of pH (natural or man) seems to be the factor whose action on metal mobility is most critical[11].

CONCLUSION

The results show the existence of a organic and a metallic pollution and, in some stations, the level of this pollution can varies according to seasons. While in others it does not change

The second group of stations have a impotante organic pollution during the winter and the summer, such as

S3, S4, and S6, or have no organic pollution during these seasons, such as S1, S2, and S5. The Variation of the water flow of the river of 'Rdom' and of the degree dillution of wastewater by the rainwater are the main causes of variation in the degree of organic pollution and the degree of metal contamination of the waters of some stations. While the location of some stations, just downstream of discharges of urban waste water and / or industrial agricultural areas could be the main cause of a permanente and high organic and metallic pollution.

In addition, the persistence of low levels of organic or metallic polltion recorded in some stations was due to the fact that these stations are away from sources of pollution and purifying the river such as the S5 station.

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