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Multivariate Statistical Analysis for Evaluate the Quality of Water of the Catchment Area of the Bouhamdane River: North Eastern Algerian

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ABSTRACT

The catchment area of Bouhamdane River is located in the North-East Algerian, occupying the Western part of the Town of Guelma, it being itself on a surface of 1105 km², with a population of 134314 inhabitants (66.37% of the total population of the Town). In order to better understand and manage the quality water of the catchment area of the Bouhamdane river, twenty six (26) points were taken and analyzed partly upstream of the basin (Bouhamdane, Bordj Sabat and Zenati rivers), for two periods; the first rainy season (March 2013 and 2015); the second season dries (June2013) and a series of eleven (11) years of observation (2005/2015) partly downstream (Hammam Debagh dam). The results have been processed statistically by the Principal Component Analysis. This approach of treatment giving a perspective estimate on the quality of surface water of this area catchment in various sectors; upstream and downstream; and the origin of in particular agricultural and domestic sources of pollution.

Keywords: Catchment area of the Bouhamdane River, Quality of water, multivariate statistical analysis, sources of pollution.

1   Introduction

The availability of water becomes a problem in Algeria, as in most Mediterranean countries, because of a constant reduction of total precipitations. This reduction, caused by irregularities in the quantity of the rains and the longer seasons, allowed that water reserves are not renewed correctly. The compensation of this gap by storing surface water is problematic since the sites of construction of the dams are limited by topographic, geological and hydrological conditions. These natural problems are further worsened by the increase in the public, industrial and agricultural requirements. The problem of the availability is exacerbated by a concomitant decline of quality. It is thus important to evaluate the width of these problems in the great systems of water and we chose the catchment area of the Bouhamdane river because it is important water resources which provide drinking water and at agricultural ends with a great area in North-eastern Algeria.

2   Experimental

To ensure the best followed, three sampling campaigns were organized along the Bouhamdane river and these two affluents; Bourdj Sabath and Zenati rivers, with the upstream of the catchment area of the Bouhamdane river , and a series of eleven (11) years of the analyses was observed on the Hammam Debagh dam; downstream from this catchment area. Water samplings; upstream of the catchment area of the Bouhamdane river, were realized for two periods; the first in rainy season(Mars2013- Mars2015) and the second in dry season (June 2013), and water of the downstream part of the basin observed for a series of eleven (11) years which ranging between 2005 until 2015.

3   Results and Discussion

The analysis of the results makes it possible to note that the major part of information is explained by the first three factorial axes. In two factorial designs F1-F2 and F1-F3, the eigenvalues of the components F1, F2 and F3 and their contribution to total inertia are represented in Table I. The three axes taken into

account to describe the correlations between the variables related to the space structures; alone hold 76, 35% of total information with respectively 37, 90 % for the axis F1, 24, 81% for the axis F2 and 13.64% for axis F3.

Table1 Total inertias of the P.C.A of water of the Bouhamdane river and its affluents

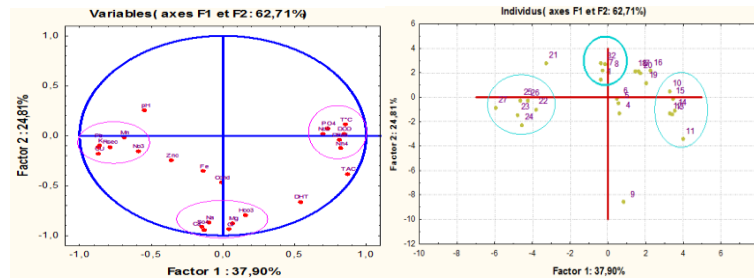| Factors	Eigenvalue	%Variances	Office plurality of eigenvalue	%of cumulated expressed variance
F1	8.35	37. 90	8. 35	37.90
F2	5. 05	24.81	13. 4	62.71
F3	3. 09	13.64	16. 49	76.35

Figure1: Chart of the P.C.A of water of the Bouhamdane river and its affluents according to the F1-F2 axes
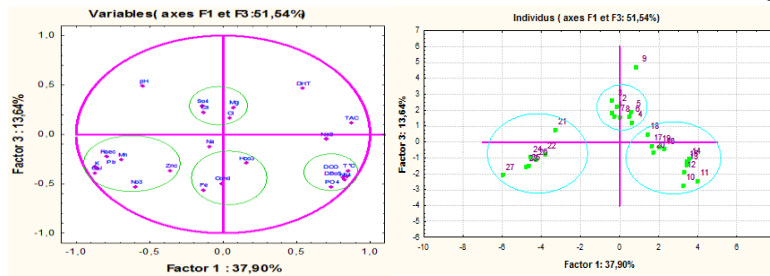

Figure2: Chart of the P.C.A of water of the Bouhamdane river and its affluents according to the F1-F3 axes

4   Conclusions

Indeed, the chart of the P.C.A of water of the Bouhamdane river and its affluents in two factorial spaces F1-F2, F1-F3, highlighted two (2) classes: the first class gathers water which is strongly mineral-bearing or this water having the similar chemical facies, the second class contains polluted water, having high percentages of heavy metals (lead (Pb), copper (Cu), Iron (Fe), Zinc (Zn) and manganese (Mn)).

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