

QUALITY OF SURFACE WATERS AND ANTHROPOGENIC ACTION ON THE WATERS OF THE BENI HAROUN DAM NORTHEAST ALGERIA.

QUALITE DES EAUX DE SURFACE ET ACTION ANTHROPIQUE SUR LES EAUX DU BARRAGE BENI HAROUN NORD-EST ALGERIEN.

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Abstract: The quality of surface water resources is increasingly threatened by pollution; this is related to the discharge of wastewater into rivers and the prolonged drought. The dam of Beni Haroun is subject to human actions it is essential to highlight it because it supplies water to a large area of eastern Algeria. The chemical facies of these waters is sulphated to calcium and magnesium and various statistical tools showed that the mineralized water is especially in connection with Ca^{++} , Mg^{++} , Na^+ , Cl^- , and SO_4^- . The human actions marked by the COD/BOD₅, shows that 96% of the values of this report are greater than 3, which means that much of the organic material is not biodegradable, indicating industrial pollution. The concentration of the various components operate in an inverse manner with the volume of water of the dam, which highlights dilution and concentration phenomena.

Keywords : Surface water, Beni Haroun dam, water chemistry, pollution.

1. INTRODUCTION : The quality of water resources is increasingly threatened by pollution. This unprecedented pollution in the story is attributable to human activities since the last 50 years. In Algeria, the assessment of water resources has revealed a tense situation concerning drinking water resources, especially in dry periods. This assessment generated significant mobilization of resources on the topic of water, both quantitatively and qualitatively from. This resource has always had problems with the quality [Boudoukha A. 2012] in the Beni Haroun basin, the majority of the thirty-two cities, discharge wastewater into watercourses. The only two wastewater treatment plants, El Chelghoum Aid and Constantine, operate partially, clearance does not exceed 32%; So apart from all environmental protection measures, the surface water resource is exposed to potential risks of chronic or episodic alterations [Duffy C. 2001]. This contributed to the degradation of the water quality of the dam Beni Haroun is in this perspective that our work was done.

2. Study Area : The catchment area of Beni Haroun dam is largely located on the southern slope of Tellian bulge. It thus represents an intermediate zone between the field Tellian very strong Mediterranean influence in the north and the high-plains high continental influence in the south.

- Its geology is particularly eventful and structure resulting from the Alpine orogeny in northern Algeria.
- The basin covers an area of 5320

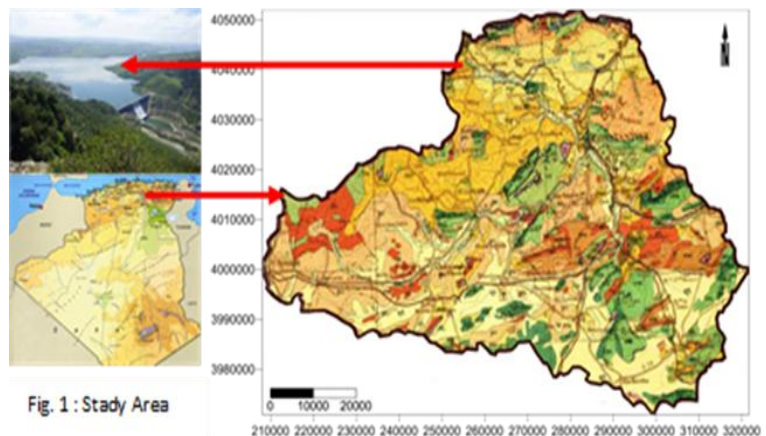


Fig. 1 : Study Area

km² (Figure 1). The average altitude is 806 m with an altitude minimum of 150 and a maximum altitude of 1729 m.

- The climate is subhumid, with an annual average rainfall of 668 mm, an average temperature of 16.5 ° C.
- The study of the water balance by the method of Thornthwaite, showed that real evapotranspiration (ETR) represents 61% of the rainfall, the agricultural deficit (AD) represents 71% of precipitation, while the excess (EX) represents only 39%.
- An annual average fluid intake of about 903 Hm³.

3. Materials and Methods : The data refer to water tests collected from ANRH Constantine , for a period of 10 years , since 2003. The frequency of water sampling is monthly. Each sample is the subject of an analysis and measurement parameters. It is T_{Water} , pH, EC, Ca²⁺, Mg²⁺, Na⁺, K⁺, Cl⁻, SO₄²⁻, HCO₃⁻, NO₃⁻, NO₂⁻, PO₄³⁻, NH₄⁺, COD, BOD₅, MO, O_{2dis}, MES, ALC, satO₂, and turb. To get a better assisted on quality and the relationship between various parameters and the role of each chemical element in the mineralization process, two methods are used, a principal component analysis (PCA) and a hierarchical clustering (AHC). The purpose of these treatments is to identify the key factors that control the chemistry of these waters. These multivariate statistical methods have been widely applied to investigate the phenomena of the environment:

A permit classification of water samples into distinct groups based on their hydrochemical characteristics [[Anazawa et al. 2005](#)]. Successfully used to study and classify different hydrogeochemical processes [[Duffy et al. 2001](#)]. To identify temporal and spatial variations in water chemistry in Lake George in New York. And used to study the trace elements at the tannery effluents in Peshawar, Pakistan [[Tariq et al, 2005](#)].

This work deals with the technical strength multivariate to characterize variations hydrochemical water dam Beni Haroun. These analyzes were processed using STATISTICA ® software (1998) free version. An approach to water quality as pollution elements was also discussed using the grid quality.

4. Results and Discussion

4.1 *Characteristics of dam water :* The application of the Piper diagram (1944) on water samples from the dam Beni Haroun , shows that waters are one facies sulfated calcium magnesium . SO₄²⁺ largely from sewage and industrial waters against Ca²⁺ and Mg²⁺, from the dissolution of carbonate rocks. The study of physicochemical parameters shows that the variation of the water temperature and concomitant with that of air; pH between 7 and 8.2, showing that the water is slightly alkaline in association with the evaporation phenomena and industrial waste [[Dinkaa MO. 2015](#)]. EC varies between 800 and 1900 microseconds / cm and changing inversely proportional to the volume of water of the dam. The proportion of nitrogen elements (NO₃⁻, NO₂⁻, NH₄⁺) and COD and BOD₅ have a surface origin and show an anthropogenic pollution.

4.2 *Principal Component Analysis (P.C.A)* : Although P.C.A an exploratory and descriptive method [Dagnelie 2006], it is widely applied to investigate the environmental impacts and hydrogeochemical processes worldwide [Boudoukha et al. 2012] . This analysis was

performed on a table of 17 variables and 122 individuals. The Kaiser criterion was applied [Kaiser,1960]. Five key components are deductions allowed to have a total variance of 73.82 %. The projection of the variables on the factorial plane F1 / F2 (Figure 2) is determined in part by the positive parameters of the total mineralization (Ca^{2+} , HCO_3^- , K^+ , NO_3^- , PO_4^{3-}). Ca^{2+} , HCO_3^- , are from the weathering of carbonate rocks. This group expressed a water mineralization related to the contact water-rock and mineralization

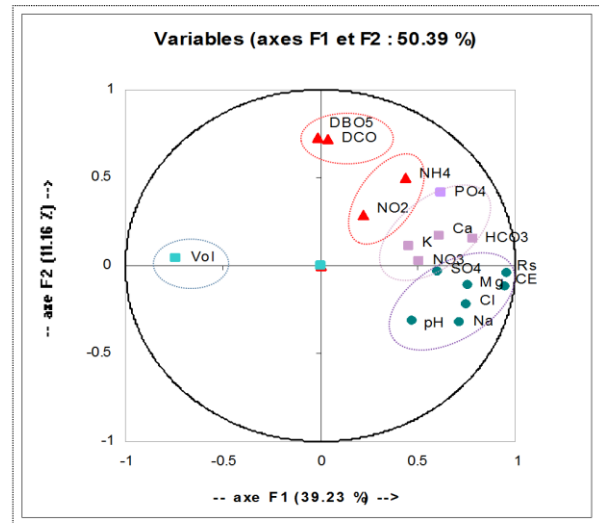


Fig. 2 Projection of variables on the factorial plane F1 : F2

related to agricultural, industrial and domestic. In the negative part of the factor F1, are grouped parameters (EC, Rs , Mg^{2+} , Na^+ , Cl^- , SO_4^{2-} , pH). EC reflects an overall water mineralization. These items are from the weathering of evaporite rocks origin. The F2 factor, is positively determined by the COD and BOD₅, their proximity to this axis F2 means that these two elements are brought into solution by the same phenomenon. The NO_2^- , NH_4^+ , stand out, they have a surface origin and show an anthropogenic pollution. So F1, F2 are assumed to be representative of the chemistry of the acquisition process of water related to water-rock interaction and anthropogenic pollution.

4.3 *Application of Ascending Hierarchical Classification (C.A.H)*: The dendrogram (Figure 3) from the C.A.H highlighted two main varying combinations.

1. The first consists of two groups on EC, Mg^{2+} , Na^+ , K^+ , Cl^- , HCO_3^- , in conjunction with a second group formed by Ca^{2+} , SO_4^{2-} , and NO_3^- . This group highlights human action embodied by sulphates and nitrates and the

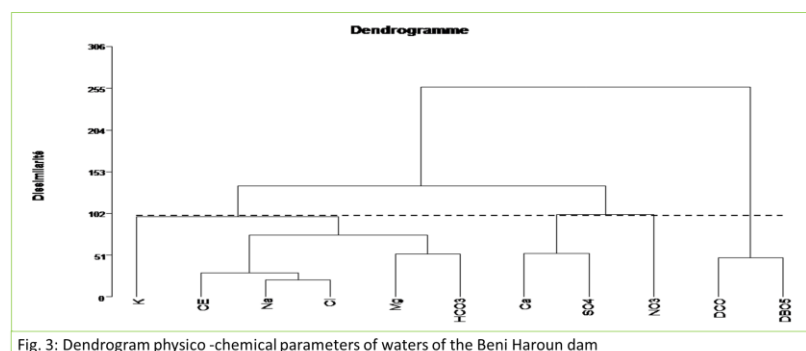


Fig. 3: Dendrogramme physico-chemical parameters of waters of the Beni Haroun dam

phenomenon of dissolution of the rock. The close connection between the sodium and chloride which are connected with the conductivity , the mark role evaporite rocks in the process of mineralization. It should be noted also the close connection of this group with nitrates which reflect the agricultural activity in the watershed or human activity .

2. The second grouping is made by COD, BOD₅, which shows a human activity .

4.4 Study of the pollution indicator elements: In order to assess the water quality of the Beni Haroun dam, we will use the indicator elements of pollution: BOD₅, COD, O_{2dis}, NO₃⁻, NO₂⁻, NH₄⁺. Will refer to Algerian standard surface water quality, we find that 24% of samples had moderate levels and 75% of the results have normal levels. As against the nitrite content present only 17% in normal against 58% experiencing significant pollution. 85% of the sulphate content is middle class to poor. 44% of the chloride content is middle class. 42% of the sodium content is middle class. This linked to the discharge of wastewater and the proximity of irrigated farmland. The ratio COD/BOD₅ (Dinkaa,MO. 2015), up 98% of the samples are greater than 2 which shows that the content in terms of pollution is not biodegradable, and this may explain not only through mainly industrial pollution.

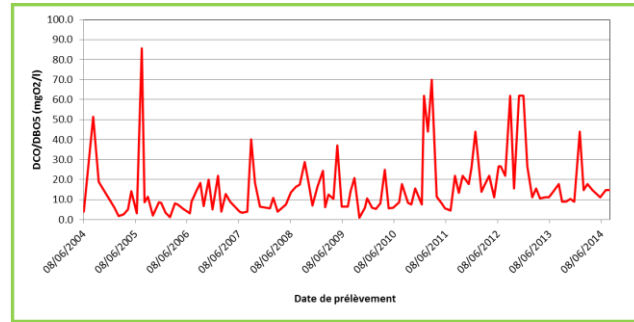


Fig. 4: Temporal evolution of the COD / BOD₅ in the waters of the Beni Haroun dam

4.5 Quality of water as by the quality of grid pollution elements : Examination of the test results shows that the samples have concentrations of COD are in Class IV of excessive pollution, which does not allow the use this water can only be used after specific treatments and expensive. The contents of nitrite and ammonium classifies as Category III (poor water quality) can only be used after a very thorough treatment, reflect an agricultural and urban pollution.

CONCLUSION: The study of anthropogenic action on water quality of the Beni Haroun dam, was carried out with a hundred results of physicochemical analyzes several parameters between (2003-2014). This approach performed using the statistical tool like the ACP and the AHC has shown that the majority of elements evolve in an inverse manner with volume of water in the basin of the dam, it can not be explained as a result of dilution and concentration. The CPA has shown that the chemistry is related to the natural action by dissolving minerals and human action in connection with urban and industrial activity. The ratio COD/BOD₅ shows that the dam water has a high proportion of non-degradable organic material associated with human action allowing that the waters of the Beni Haroun dam can't be used in drinking water supply without prior treatment.

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