

Contamination Of Groundwater By Sewage And Degradation Of Cultures Under Water Stress

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Abstract: Since the eighties, water surpluses caused by discharges of urban waste water without any pre-treatment, joined the traditional channel of Wadi Righ which joins the natural depression of Chott Melghir and Merouane. The lack of an adequate and effective drainage system and overexploitation of aquifers deep waters have caused upwelling, which caused an imbalance in the valley. The physicochemical analysis and pollution, has shown that collector canal waters are of very poor quality, very hard and salt content can exceed 7 g / l of dry residue of high salinity (class C5) electrical conductivity of up to 26,30 ms / cm, a SAR > 28 (S4 class) , a value of TDS of up to 21 g / l, BOD5, COD and TSS levels high. Combined with the presence of a water table near the surface, sterilization of several Agricultural areas was observed, mostly canal water is loaded with minerals, it is a brackish facies the sodium chloride.

1. Introduction

If the river valley Righ escaped the phenomenon of recovered water before the eighty years, thanks to the only major said channel (Oued Righ).The rejection of urban wastewater is done in several points of an anarchic way, some are close to the palm.

Part of this wastewater is without any pre-treatment; joins the main collecting duct and mixes with drainage; the lack of an adequate and effective drainage system had very negative consequences both ecologically and economically. The many groves are flooded in winter (palm Tinedla, Gama'a, Ferdjaouenne, el Goug ... etc), this oasis that could be described rightly sick of too much water oasis [1] that ascent of the table causes the accumulation of salts and / or the high content of a whitish crust on the soil surface .In effect the degree of salinity of the water table ranges from 6 to 7 g / l in Oued Righ [2]. Secondary salinization after irrigation with highly mineralized water, permanent hardness has led the expansion of salinity and degradation of palms including new perimeters set values (Figure.1). In this perspective, we are set us as objective water

analysis at different points in discharges of domestic effluents from neighboring districts in the collecting duct. After that we are study the relationship between the channel and the tablecloth on the date palm cultivation, which is currently experiencing a decline in crop yields.

2. Presentation of the study area

The region of Oued Righ is located in the south eastern Algeria (Figure.2). It stretches over 150 km long and 20-30 km wide, straddling two wilayas between El Goug (w.Ouargla) and Umm El Thiour (w.d'El Oued), it stands as a zone low pressure to permanent water flow to the main sewer drain (channel) which is spread over a length of 136 km. The canal transits an average flow of about 5m³ / s, more than 150 million m³ / year [3].



Figure 1 . Representation of a palm deteriorated following the salinity and water pollution.

The main activity of the valley is oriented phoeniculture, the region called "Oued Righ" in the northern Sahara is a specific economic entity comprised of nearly 50 oasis and covers around 25.000 hectares of palm [4].



Figure 2. Location of the Oued Righ valley

3. Materials and methods

Water samples were taken during the period (February to May, October) of 9 stations flowing into the canal, on a stretch of about 30 km. We guide our research on the waters of the water table through piezometers, our choice is focused on 5 stations on a stretch of about 46 km. The samples were hand made in plastic bottles, wearing identification of each item. Dosing procedures are derived from standard analytical methods. Using a pH-meter, and an electric conductivity which gives directly the conductivity of the sample mmhos / cm, or ds / m at the temperature adopted. BOD₅ using a meter DBO-after sample dilution. COD attack by acid (sulfuric acid) and titration. Finally for the determination of cations and anions a variety of analytical methods

had to be used , titrated metrics, electrochemical or spectroscopic methods.

4. Results and discussion

4.1. Study of physico-chemical parameters and pollution in the waters of the canal

Temperature influences the degree of evapotranspiration and it acts on the water salinity. . In this study an annual average is 22,5 ° C, for all canal water. The results obtained in our analyzes show that the canal waters have the following variations, ranging from minimum to maximum recorded during the period (February, May ,October) for 9 stations traversing the channel. (Table.1).Regarding analyzes performed on the 5 points of piezometric groundwater surrounding the channel during the period of October, the results are reported in (Table.2).

Table 1. Parameters of water quality of river channel Righ

pH	7,3 to 8,3
E.C (ms/cm)	1500 to 26300
T.H (°f)	73 to 582
T.A.C (°f)	17 to 34
T.S.S (mg/l)	210,7 to 4158.3
B.O.D ₅ (mg/l) deO ₂	7 to 65
C.O.D (mg/l) deO ₂	29,2 to 178,8

Table 2. Parameters of water quality of the groundwater of Wadi Righ

pH	7 to 7,71
E.C (ms/cm)	6,04 to 17,90
T.H (°f)	219 to 408
T.A.C (°f)	10 to 32
Turbidity (N.T.U)	6,97 to 1000
B.O.D ₅ (mg/l) deO ₂	3 to 5
C.O.D (mg/l) deO ₂	19,2 to 144

— pH, EC ,TA and TAC values are very important for all the waters of the channel (Table-1-) where the important values of bicarbonate ions in the water [5].

— The values of the canal waters TSS shows two distinct periods ,varying from (166,5 mg / l to 3424.5 mg / l) .These high levels may be the result of a brutal hydrological event (flood), the recorded values are well above the standards of wastewater for irrigation purposes and irrigation and are 150 mg / l [6] In addition these values come up 4158.3 mg / l to ST 7, in summer (figure.3).

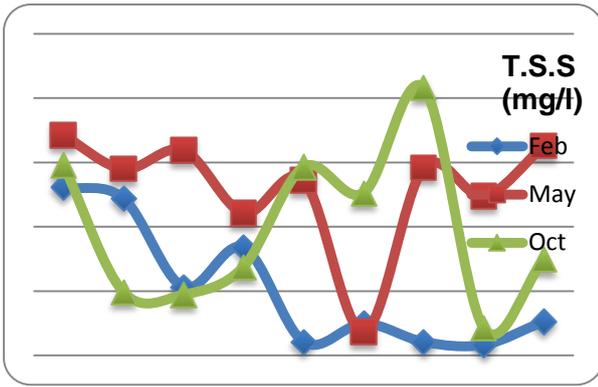


Figure 3. Spatio-temporal evolution of T.S.S water channel

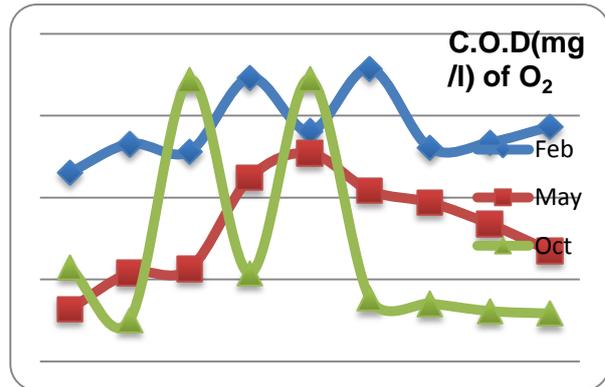


Figure 4. Spatio-temporal evolution of the COD of water of river channel Righ

— The average values of BOD₅ ranging from 07 mg / l to 65 mg / l . However, the increase of BOD₅ in dry periods can be explained by the introduction of degradation of organic matter by microorganisms whose activity increases with warmer waters. This oxygen-consuming activity is the cause of self-purification of water [7]. But in the wet season rain water contribute to the dilution of the organic load of wastewater from different discharge stations in the channel. It can be concluded that the majority of canal waters are of very poor quality.

— The levels of COD recorded at the studied waters (figure.4) are between 25,36 mg / l (October) and reaching to 178,8 mg / l (February) The highest concentrations are recorded in the wet season, these values far exceed the norm of urban waste water in the natural environment, the limits are set at 120 mg / l [8] .

► For all of the tests on the waters of the groundwater table in the region of Wadi Righ, the values of pH and those of the EC and the hardness are high (table.2).

► However it is thought that at this level there may be water contamination of the water table by those of the channel, or there is also the values of BOD₅, the relatively high COD and those of turbidity up to 1000 (NTU) (figure.5) and that later this water is absorbed by the roots of the palm then there would've treated at source before discharge into the canal, as the presence of TSS in different releases may affect significantly the agricultural system and can cause nuisance such as sludge deposits and clogging of aquatic receptors funds. These settled sludge are detrimental to the maintenance of natural biological structures [9] So we can say that the waters of the web has a lower pollution compared to that of the channel except a point which is the ST-12 (Sidi Slimane station) which is a cultivated area surrounding the channel.

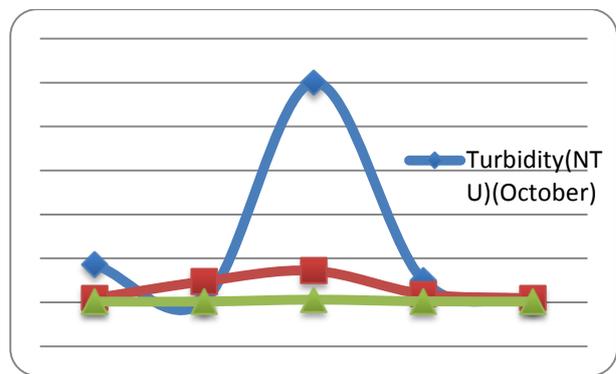


Figure 5. Evolution parameters pollution of groundwater

4.2. Evolution of the hydro-chemical analysis of the water of the canal and groundwater.

The PIPER diagram is particularly suited to the study of the evolution of water when facies mineralization increases, or to compare groups of samples between them and indicate the types of dominant cations and anions [10] (figure.6).

In conclusion the most concentrated water thus correspond facies sodium chloride; sodium and calcium chloride-sulfated, so the dissolution of halite (rock salt NaCl) where gypsum. Gypsum is a constituent part of the ground, and as such it contributes to one's physical and chemical properties [11]. For analyzes of water from the water table surrounding the channel we can say that all the water has a sodium-chloride-type facies, chlorides and sodium ions are majority especially in ST-12, followed sulfate ions. We can say that the soil parent material of the Wadi Righ region is alluvial-colluvial . The alluvial-colluvial come from erosion level encrusted dating from the early Quaternary or Mio-Pliocene. And all these gypsum accumulations represent a major constraint on both the physical and chemical for better soil management and for

sustainable and productive agriculture [12]. The combined action of a climate characterized by intense evapotranspiration and the presence of a shallow water table that most soils undergo the phenomenon of secondary salinization. The type of salinity is sulfated and sulfated sodium-calcium-magnesium and on average, the sodium chloride generally.

4.3. Water-soil relationship and its impact on the culture of the date palm.

Salinization can cause adverse effects on the quality of water for irrigation, and due to the attachment of sodium and chloride in soil colloids the presence of sodium then exerts a harmful effect on vegetation and soil. This risk is determined by (Sodium Absorption Ratio, SAR). The accumulation of soluble salts in the soil rooting negatively affects the growth of palm trees, there were two sets of effects of salinity [13] relate to each plant, the other on the ground, in fact, These salts cause changes in the permeability and aeration of the ground on the one hand, and on the other hand they cause disturbance of the metabolism of plants and the osmotic process thereof. As the Wadi Righ region is characterized by low rainfall, high evaporation and groundwater overloaded chlorides, and sulfates, soil salinization risk is felt good. In this approach we make the estimation of some salinity parameters related to agricultural use for the canal waters and the waters aquifer.

— The SAR canal water varies between $6,16 < SAR < 28,30$. This that takes us to classify our water greatly sodium channel exceptional classroom use since the values of electrical conductivity (EC) exceed 22,5 ds / m where the water is strictly unusable even for the date palm cultivation[14].

— SAR waters of the water table varies between $9,12 < SAR < 27,32$ (figure.7) which allows us to conclude that there may be a water contamination of the water table by the canal[15].

4.4. Study of water parameters for agricultural use

The main factors that degraded the quality of water for irrigation is therefore summarize the concentration of dissolved salts expressed by TDS (Total Dissolved Salts) . The primary effect of the total salinity is reduced crop growth and production. Because excess salts draw water away from the roots of palm shrubs, they may wilt water stress, even when the ground a lot of moisture.

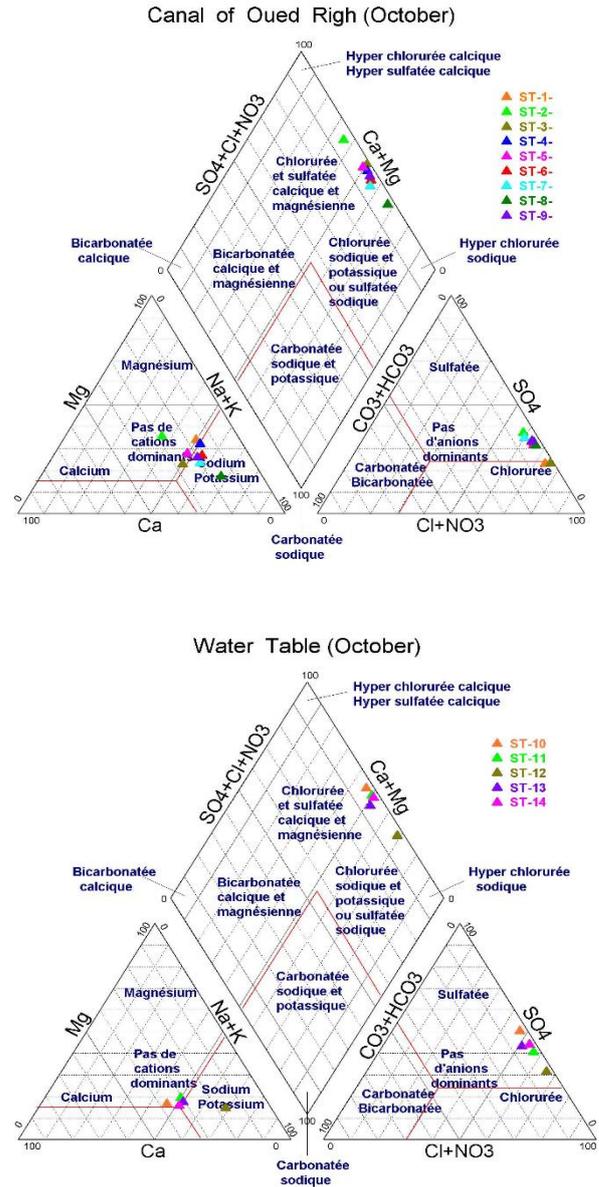


Figure 6. PIPER diagrams for the canal waters and the waters of the water table .

— TDS values of canal waters range from 3,20 g / l up to 21 g / l (figure.8) reflecting a large accumulation of salts that little harm the growth of palm trees. Indeed all irrigated with water to 5000 ppm eventually die and only a few survived the content of 2500 ppm in this study these values sometimes exceed those standards where dieback palms under water stress TDS values > 10.000 ppm should undergo an excellent drainage followed by leaching program and irrigation carefully[16].

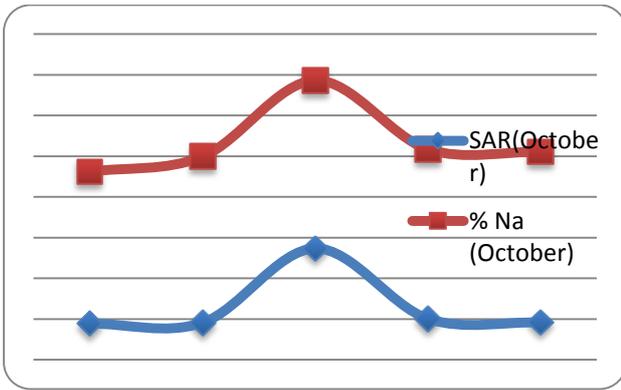


Figure 7. Spatio-temporal evolution of the SAR and Na% water groundwater

► However, on the waters of the water table (figure.9) have a (OP) osmotic pressure and values (TDS) less than that of the channel except the ST-12 where the values are relatively higher compared to other stations, but that remains halophytic plants are among those which are most tolerant to salts, but limits. The salinity have other consequences and effects on crop quality. It usually causes a reduction in the size of agricultural products, leaf burn and loss of organoleptic properties in fruits.

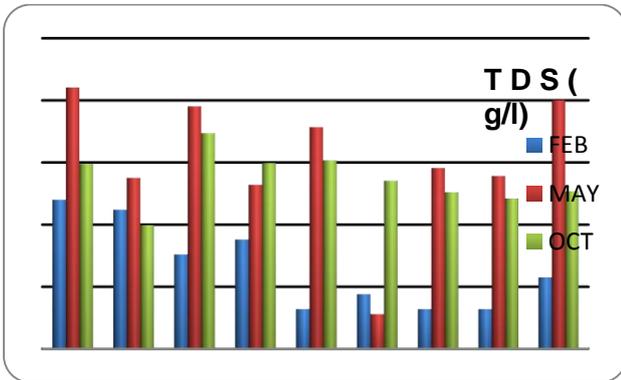


Figure 8. Spatio-temporal evolution of TDS waters of Wadi Righ canal.

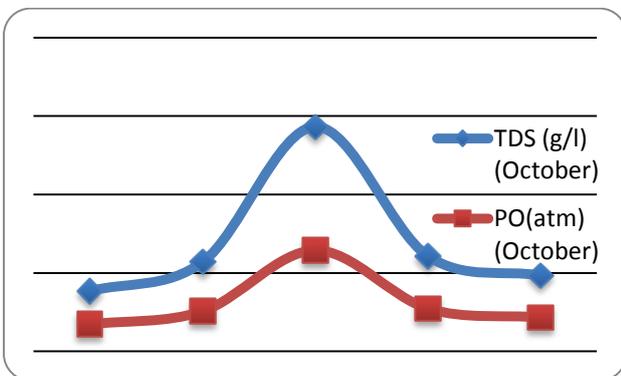


Figure 9. Evolution parameters connecting the ground water groundwater

Conclusion

The results show that the waters of the channel are quite degraded quality. The canal waters are very hard and with a pollution considerations, and very high mineralization .The values found in TSS; possible to say that the canal waters are loaded, thus have little classify this water very bad, and allows to argue that the pollution load is representative of possible eutrophication of the receiving environment (channel). Analyses of pollution parameters performed on the waters of the aquifer of the land surrounding the canal are also very polluted at St-12- (Sidi Slimane station) representing a cultivated area not far from the canal .At this level the channel width is 7,2 m, the average depth is 0,67m, with a water flow of $2,237 \text{ m}^3 / \text{s}$. The felt at the ST-12 is due to possible contamination so by the waters of the channel, as long as irrigation is from the water table or water depth reaches 2,5 m and the cultivated land is in the vicinity of the channel around 2 to 3 km .So we explain the decline of palm groves in this area by two phenomena: Irrigation with polluted water from the canal. And stagnation of the water in the palm groves by lack of adequate drainage. These problems combined with low slope of the canal, with excess irrigation and inefficient drainage network are the palm of Sidi Slimane undergo détériorement in space and in time.

References

- [1] Cote M " oasis sick too much water " drought (1998)123-30
- [2] P.Simonneau ,G.Aubert "The use of saline water in the Sahara",(1963)859-872
- [3] A.Khadraoui " Soils and agricultural water in oases of Algeria , characterization , constraints and development proposals" (2005)317
- [4] A.Mashali " Soil management practices for gypsiferous soils - international symposium on soils with gypsun " Leida , Spain, (1996) 34 -52
- [5] D.Dubost "Ecologie.Aménagement développement and agricultural oases of Algeria " PhD in geography and planning in the Arab world university François Rabellais, rev 2 Tomme . Oct(1991)
- [6] F. Meinck and al " Industrial wastewater ", 2 nd edition , Masson , Paris , (1977) 863
- [7] J.Rodier , B.Legube , N. Merlet et al " Water analysis " 9th edition, Dunod, Paris,(2009).
- [8] Law No. 83-17 of 16 July 1983 on the Water Code "wastewater standards used in Algeria"
- [9] L.Gouaidia " Influence of lithology and climatic conditions on the variation of physico-chemical parameters of water from a groundwater in semi-arid area , Case tablecloth Meskiana northeast Algerian " faculty of

earth Sciences , department of Geology, University Badji Mokhtar Annaba(2008)89 .

[10] R.Simler ,(2012),<http://www.lha.uvinn-avignon.fr/LHA-Logitiels-htm>

[11] OC. Magistad, RF. Reitmeir "Soil solution concentration at the wilting point and Their correlation with plant growth" soil sci, vol 55 , (1943)351-360 .

[12] R.Bremon ,C.Perrodon "Parameters of Water Quality ." Ministry of environment and quality of life. Pollution prevention, 2 nd edition (1979) 259.

[13] S.Benguergoura Laradj , B. Remini "The releases of wastewater in the Oued Righ valley : the palm groves in decline." Faculty of Engineering, Department of Industrial Chemistry, University Saad Dahlab , 9000 Blida , Algeria Desalination and Water Treatment, V.52 Publisher : Taylor & Francis ,London, U.K.(2013)2187-2192

[14] Sogeta Soghea "Participation in the development of the Oued Righ " Pedological study , (1969-1970) 1-54

[15] S.Benguergoura Laradj , B. Remini " Salinization and pollution of water table with wastewater and its impact on oasis crops" Faculty of technologie, Departement of Engineering process, University Saad Dahlab , 9000Blida,Vol.11(8),Doi:10.5897/AJAR 2015.10480, Article N° 373C6A257290, Feb(2016)624-632

[16] L.Gouaidia " Irrigation project in the lower valley of the Medjerda and Ras Jebel ", Guide for monitoring water and soil salinity , Bull, Manage, Soils Tunisia (Orstom - INRGREF) N°18, (2008) 247