

Degradation of the river channel Righ by sewage and contamination of groundwater nearby: Decline of palm in the East northern Sahara of Algeria

Benguergoura Laradj Samia

Department of Process Engineering, Faculty of Science, University Saad Dahlab Blida, 9000, Algeria

Email address:

samialaradj@yahoo.fr

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Abstract: About 150 km along the ancient river channel Righ evacuates water leaching to chott Melghir 50 oasis. Since the eighties, water surpluses caused by discharges of urban wastewater and drainage water, caused the rise of the water table, causing an imbalance in the valley until sterilization of agricultural soils surrounding palm. Our study has shown that the waters of the collecting duct are of very poor quality, very hard, very high salinity (C₅ class), electrical conductivity up to 26300 ms/cm, SAR > 28 (S₄ class), a value of TDS (Total Dissolved Sodium) up to 20 g/l, levels of high COD (Chemical oxygen demand) and suspended solids TSS. So mostly canal water is of very poor quality, loaded with minerals, it is a brackish facies chlorinated sodium.

Keywords: Canal, Decline, Water Pollution, Palmeraie, Oued Righ

1. Introduction

Today saw the multiplication of points of discharge of sewage and drainage into the canal and the lack of adequate natural outlets receiving discharges caused flooding oases, and depletion of the water table resulting in the recovery thereof and soil salinization. The Wadi Righ oasis is rightly called Oasis sick of too much water [1]. Several oases experiencing upwelling resulting in suffocation of some palm trees, and overeating of groundwater (volume of the upper layer). Such as (palm Tinedla, Gama'a, Ferdjaouenne, el Goug ... etc). The channel Wadi Righ, located east of the northern Sahara, in part to avoid the rise of sewage and drainage are without treatment previously (Fig. 1). The secondary salinisation, permanent hardness cause suffocation date palm [2]. Our study follows the impact of these waters and the relationship between the channel and the water on the degradation of culture oasis (Fig. 2).

1.1. Presentation of the Study Area

Region of Oued Righ is located in the eastern part of Algeria (Fig. 3). It is a broad asymmetrical syncline pit characterized by a sandy silica sol and formed pure quartz

[3]. It stretches over 150 km long and 20-30 km wide, straddling two wilaya between El Goug (w.Ouargla) and Oum El Thiour (w.d El Oued), it stands out as an area permanent low pressure water flow to the main collector drain (channel) which extends over a length of 136 km. Canal transits an average rate of about 5m³/s, more than 150 million m³ per year [4]. The main activity of the valley is oriented phoeniculture, the so-called "Oued Righ" in the northern Sahara region is an economic entity which includes nearly 50 oasis aligned on a north-south axis, and covers around 25,000 ha palm [5].



Figure 1. Outfall sewage



Figure 2. Degradation of palm and salinisation of soil

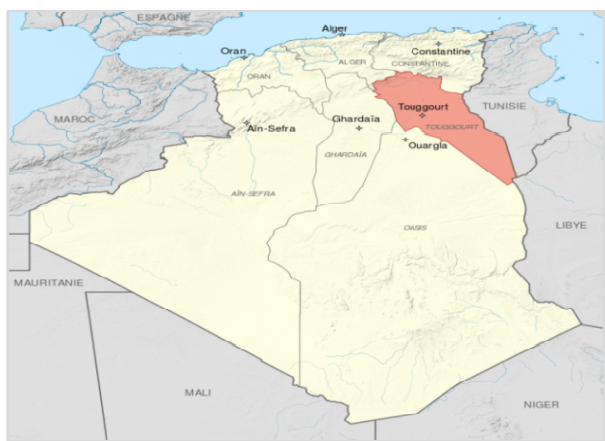


Fig 3. Location of the valley Oued Righ

2. Materials and Methods

Water samples were taken during the period (February 2009 and May, October 2010) of 9 stations discharging into the canal, on a stretch of about 30 km (Fig. 4). We guide our Water Research 5 stations groundwater through piezometers on a stretch of about 46 km, starting from the station Kerdecche to Sidi Slimane. The samples were collected manually in plastic bottles on the identification of each point. The assay procedures are derived from standard analysis methods, passing titrated metric methods, the electrochemical and spectroscopic methods for different experimental trials.

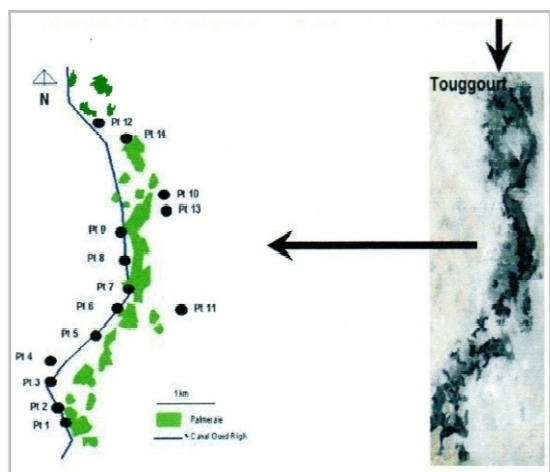


Fig 4. Different sampling points

3. Results and Discussion

3.1. Study of Physico- Chemical Parameters and Pollution in the Canal

The temperature has an important role in the variation of the components of water balance. It influences the degree of evapotranspiration and therefore it acts on the salinity of the water. In this study it from an annual average of 22.5 ° C. The results obtained in our analyzes for 9 stations along the Canal during the period (2009-2010) show the following variations, ranging from minimum to maximum and are reflected in the (Table.1). In assays performed on 5 points piezometric groundwater surrounding the channel during the period of October 2010, the results are in (Table.2)

Table 1. Parameters of water quality of the river channel Righ (2009-2010)

pH	7.3 à 8.3
C.E (ms/cm)	1500 à 26300
T.H (°f)(Total Hardness)	73 à 582
T.S.S (mg/l)	210.7 à 4158.3
C.O.D (mg/l) deO ₂	29.2 à 178.8

Table 2. Parameters of water quality of the groundwater of Wadi Righ (October 2010)

pH	7 à 7.71
C.E (ms/cm)	6.04 à 17.90
T.H (°f)(Total Hardness)	219 à 408
Turbidity (N.T.U)	6.97 à 1000
C.O.D (mg/l) deO ₂	19.2 à 144

pH(hydrogen potential) parameter varies between 7.3 to 8.3 and (EC)(Electrical conductivity) is extremely high. It also notes the Values related to the very high hardness, for all stations water channel during the period (2009-2010) where the presence of high values of bicarbonate ions. [6].

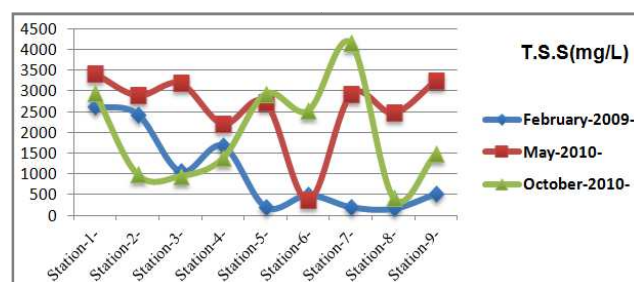


Figure 5. Spatio-temporal evolution of T.S.S water channel

The values of T.S.S (Total suspended solids)water channel (Fig. 5) ranging from (210.7 mg/l to 4158.3 mg/l) values well above the standards of wastewater for irrigation purposes and irrigation [7] and which are (150 mg / l). The presence of T.S.S in discharges can significantly affect the agricultural system, such as sludge deposits and clogging for underwater receivers, which are detrimental to the maintenance of natural biological structures [8].

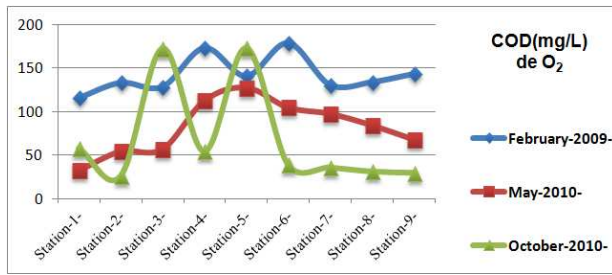


Figure 6. Spatio-temporal evolution of the COD of water of river channel Righ.

The levels of COD recorded water levels studied (Fig. 6) are between 29.2 mg / l (October 2010) and arriving to 178.8 mg / l (February 2009). the highest concentrations recorded in the wet season. The increase of COD can be explained by the leaching of pollutants from various urban locations surrounding the canal, however these values far exceed the norm of ERU (Urban waste water) in the natural environment whose limits are set at 120 mg / l [9]. The grid of Algerian standards then classifies these waters in the senior category which means very significant pollution.

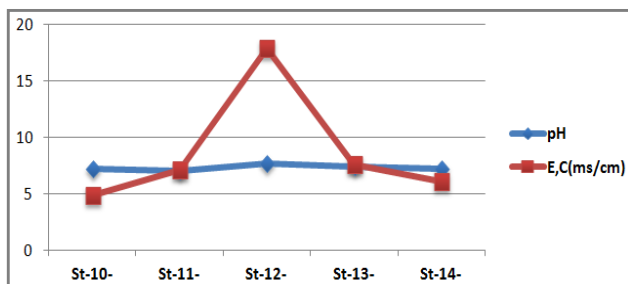


Figure 7. Spatio-temporal Evolution of pH and EC waters of groundwater

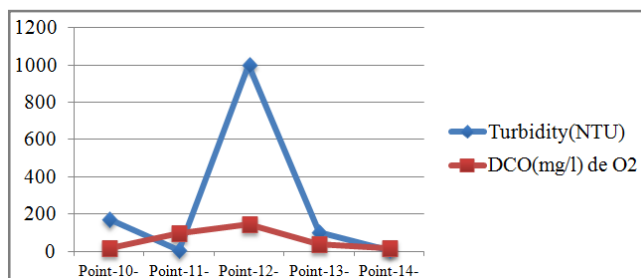


Figure 8. Evolution parameters pollution of groundwater (October-2010).

For most of the tests on the waters of the phreatic water table in Wadi Righ region, the values of pH and those of the EC (Fig. 7) are high and that at the ST: 12 We also note the values of COD as well as relatively high turbidity coming up 1000 (NTU) (Fig. 8). However we can say that the water of the water pollution has a smaller relative to that of the channel except a point that is the ST-12-(Sidi Slimane Station) which is a cultivated area surrounding the channel. One then has this level there may be contamination of the groundwater by those channel thinks, and that thereafter the water is absorbed by the roots of the palm, then there would've treatment source prior to discharge into the channel.

3.2. Study of the Evolution of Hydro- Chemical Analysis of the Waters of the Canal and Groundwater

Minerals in irrigation water salts can cause changes in soil structure and disrupt the development of vegetation. [10]. Degradation oasis meets the distribution of date palm root system in the soil and the effect of contamination of the water by sewage canal. Our study revealed the presence of a facies (100% sodium chloride) for the canal waters. For those in the water table there is a facies (80% sodium chloride and 20% sodium sulfate and 0.00% calcium bicarbonate) and this during the period (October-2010).

It is obvious that the chemistry of water depends mainly on the lithological composition crossings and residence times of water layers, as well as transfer systems and dilution, the concentrations of elements natural Major (Ca^{2+} , Mg^{2+} , Na^{+} ; K^{+} , Cl^{-} , SO_4^{2-} , HCO_3^{2-}) are determined by various factors such as climatic parameters, human activity, exchanges between aquifers and surface waters.

It then signals the sodium chloride- facies mainly with absence of bicarbonate facies. The very high conductivities here coincide with the presence of highly conductive land likely Triassic Gypsiferous clays. Water more concentrated therefore correspond to sodium chloride- facies; sulfated sodium and calcium chloride concentration, so the dissolution of halite (rock salt NaCl) where gypsum. We can therefore say that the parent material of the soil Righ wadi region is mixed alluvial - colluvial and aeolian origin, dating from the ancient quaternary or Mio- Pliocene.

All these gypsum accumulations represent a major constraint on both the physical and chemical plan for better land management and for sustainable and productive agriculture [11]. The combined a climate characterized by intense evapotranspiration and the presence of a shallow water table that most soils undergo the phenomenon of secondary salinisation action.

3.3. Water-Soil Relationship and its Impact on the Culture of the Date Palm

Parameter estimation of salinity in relation to agricultural use is determined using the classification of WILCOX based on electrical conductivity and sodium content in the water percentage (Fig. 9).

► The results we deduce that the quality of canal water and groundwater are of very bad quality, where possible contamination between the two.

► The main factors that degraded water quality for irrigation also summarize the concentration expressed by the TDS (Total Dissolved Salts) and is connected to the electrical conductivity (EC), dissolved salts (Fig.10). The primary effect of the total salinity is to reduce crop growth and production. Because excess salts draw water away from the roots of shrubs palms, they may wilt of water stress. Indeed all irrigated crops with water to 5000 ppm eventually die and only a few survived the content of 2500 ppm [12]. The values of TDS water channel range from 3.20 g / l at ST-5; ST-7 and ST-8 in (February-2009-) and

up to 20 g / l at ST-3 and ST-9-(May-2010) which reflects a high accumulation of salts that little harm the growth of palms. Indeed in the present study these values sometimes exceed the standards hence the decline of palms, under water stress, the values of TDS> 10,000 ppm should have a good drainage followed by a leaching program, more carefully irrigation.

However, on the waters of the water table (Fig. 11) there values (TDS) less than that of the channel except the ST-12-where values are relatively higher compared to other stations. It can be inferred from our study that the station-12- is contaminated the canal waters, and after it there is a reduction in the size of agricultural products, leaf burn and loss of organoleptic properties in fruits.

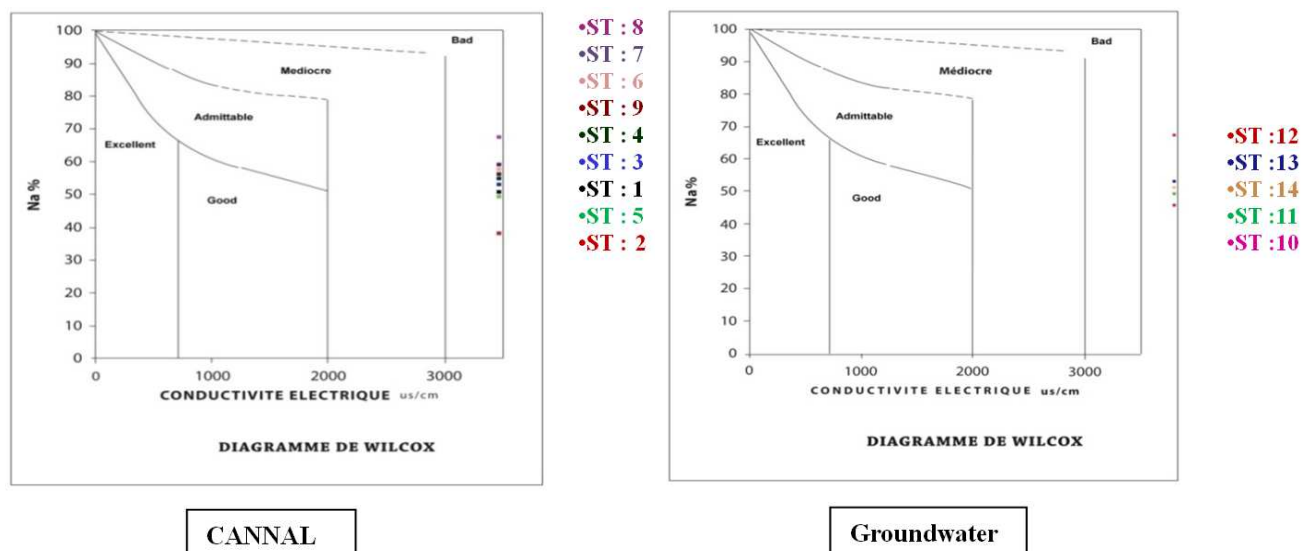


Figure 9. WILCOX Diagram of canal water and groundwater

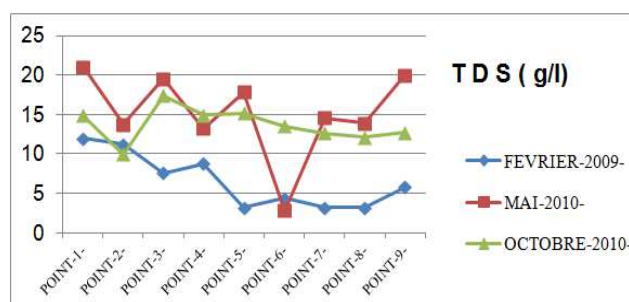


Figure 10. Evolution Spatio-temporelle of T.D.S water canal wadi Righ

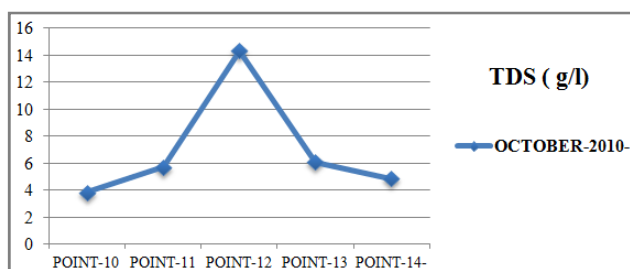


Figure 11. Evolution parameters connecting the water to the ground of

4. Conclusion

The study highlighted the dominance of salt-bearing ions and ions Gypsiferous versus carbonate in the acquisition of salinity. The water is very hard, hyper-chlorinated chemical facies sodium. Irrigation water is of very poor quality and mostly belong to the (class C₅S₄). When to the environmental

aspect of the sources of pollution of the canal have values appear in TSS and COD higher than the national and international standard. Pollution is felt at the upstream station Kardéche channel where the flow velocity is low. Pollution also accentuates Zaouia El Abidia station or the width and depth of the channel decreases and the flow velocity of the water. Monitoring the evolution of the water quality of the water table showed that the contamination of the water is very pronounced at the ST: 12 (Sidi Slimane station) any area near the Canal cultivated. 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 salinisation, resulting in degradation of palm trees surrounding the canal.

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