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Characterization of Mekerra River waters used in irrigation of farmland in Sidi Bel Abbes Country (West of Algeria)

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ABSTRACT

Known by its lands with agricultural vocation and by a deficit of irrigation water, the region of Sidi Bel Abbes in the Algerian west see its farmers used the well water near the Mekkera River like source of irrigation of the cultures. But unfortunately, this river is an outdoor sewer loaded with matter and polluting elements. These accumulate in the soil and reach the groundwater affecting well water.
The aim of this work is to demonstrate the dangers using of Mekerra river waters (country of Sidi Bel Abbes, west of Algeria) in irrigation of farmland, which is the site of drainage of industrial and urban waste water in the region.
The result of the physic-chemical and bacteriological analyzes indicate microbiological contamination and presence of trace heavy metals such as Chromium, Cadmium, and Nickel in water.
Consequently, the direct use of these waters or waters of nearby wells for irrigation water by these few have a detrimental effect to consumers that foods derived from these agricultural lands may accumulated amounts of harmful contaminants for human health.
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KEYWORDS: Mekerra river, pollution, wastewater, irrigation, impact, health, environment.

INTRODUCTION

Like the countries of west Algerian department, Sidi Bel Abbes country suffers from water shortage. In this region, where the flows are characterized by a considerable seasonal and irregularity, the water potentials are low. Water resources in ground or surface are insufficient to meet the needs and growing demands of the urban or rural population [1, 2].
Formerly, the Mekerra River in Sidi Bel Abbes country was used for irrigation of farmland about 30 km long. The river also feeds a part of the groundwater, but currently and unfortunately, it drains the industrial and urban waste water of the city of Sidi Bel Abbes and these localities for order flow 200-300 l/s during peak. During the rainy season flow is more important. Therefore, Mekerra River became a place of open dump which caused him the loss of his previous role (feeding the ancient city) despite having wealth huge natural [3]
Indeed, industrial effluents contributes significantly to the pollution of streams and dam in Algeria and cited as an example Oued Mekerra which partially feeds the groundwater of Sidi Bel Abbes, which contains high levels of nitrate in the order of (60 - 196 mg / l) [4].
Thus, the objective of our work is to characterize the quality of water drained by Oued Mekkera and are used in irrigation of surrounding farmland

MATERIALS AND METHODS

Study area

Situated in the Northwest of Algeria, the pond overturning of Mekerra is a part of the big pond of Macta (Figure 1). There are between the latitude 34°31'-35°21' North and the longitude 1°16'-0°58' West, on a surface about 3114km2 and the 249km perimeter, directed by the South (upstream, 1097m to Ras El MA) in the North (downstream, 500 m, of the city of Sidi Bel Abbes). The average slope of the river until Sidi Ali Benyoub is about 1 in 1,5 %. She is no more than from 3 to 8 % between Boukhanifis and Sidi Bel Abbés, in the part swallows of the paying pond [3, 5].

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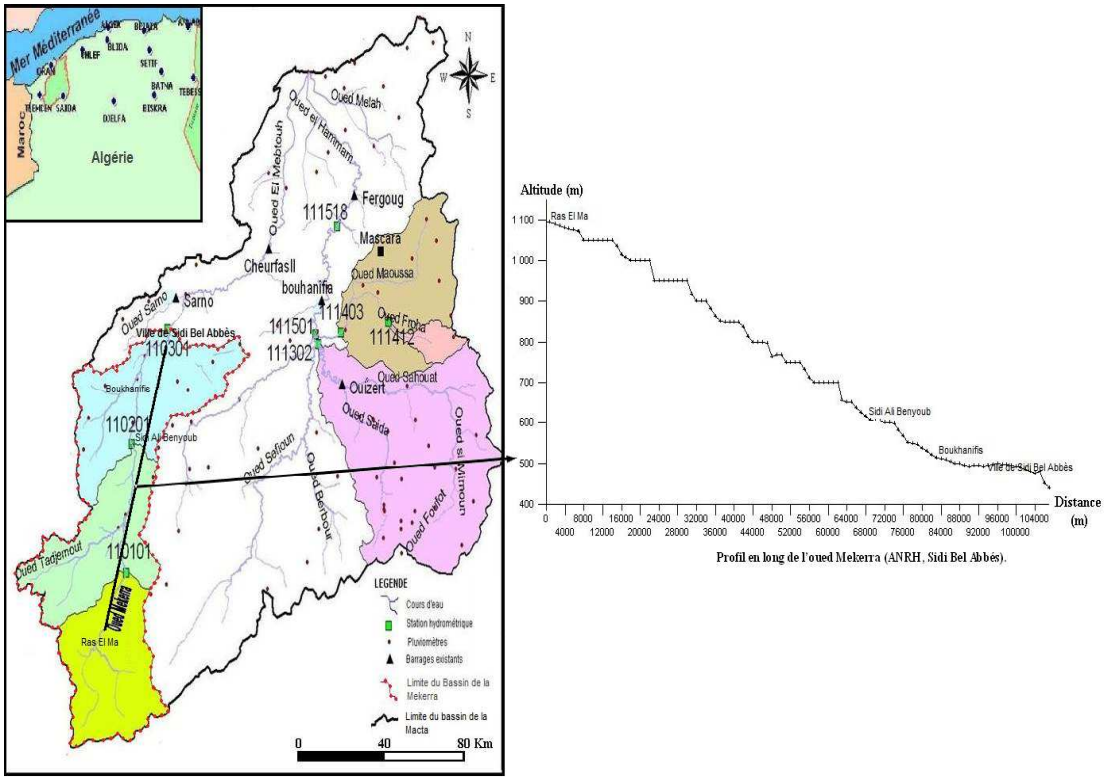

Figure 1 - Geographical situation of the pond overturning of Mekerra [3].

Sampling method

Four stations were selected a long of Mekerra river from the south to the north (TABLE 1).

Table 1 - Geographic situation of different stations

	Geographic coordinates
Station 1	N : 35°13'32" W : 0°36'17"
Station 2	N : 35°13'31" W : 0°36'15"
Station 3	N : 35°12'08" W : 0°36'34"
Station 4	N : 35°11'35" W : 0°38'25"

Physicochemical and bacteriological analyzes

The levies are each time bet in clean bottles for samples intended for physicochemical analysis, and previously sterilized glass bottles for samples for microbiological analyses, all bottles are in a cooler, and thereafter they will be taken over by the laboratory with analytical techniques which differs according to the desired element. The required parameters are: temperature, hydrogen potential, DOB_5, COD, NO_3^-, NO_2^-, PO_4^{3-}, NH_4^+, Fe and Cu. The required germs are: Totals Coliform, Fecal Coliform, E. Coli, Fecal Streptococci and Clostridium.

Statistical processing

Taking into account the available data, the statistical analysis being able to answer our treatments is: the analysis in principal components (PCA) which accounts for affinities between statistically characterized sets. In our case, it is between the microbiological stations and parameters on the one hand and between the stations and the physicochemical parameters of another share for each station along the Mekerra river.

RESULT

From the observed results of physicochemical parameters characterize the water in the studied stations; we found the following results:

the temperature of the water varies slightly at the sampling wells, it is equal to 14.2 ° C in S3 and 16 ° C in S2 (Figure 2).

During our study, we note slight pH variability with values from 8.35 in station S3 to 8.85 at station S1 (Figure 2). pH is a parameter that measures acidity or alkalinity or water [6].

Pollution indicators such as BOD_5 and COD exceed the standards allowed according to the Algerian norms for clean water used for irrigation purposes. In our result we found 117mg/l, 53mg/l and 42mg/l in different station, while the standards are in the order of 30 mg/l [7].
The COD exceeds the standards for 2 samples S2 and S3 with values that are in the order of 145mg/l and 110 mg/l, respectively, while the standards are in the order of 90 mg/l.
For these two parameters, it is noted that there is a decrease in pollution in 2017 compared to 2008 based on the results of the analyses carried out by [7].
At the exit of the purification station (purified water) The BOD_5 was in the order of 52mg/l in 2008 exceeding the standards, while in the same point in our work the BOD5 and the Order of 117mg/l (Figure 2).
For COD in 2008 it was in the range of 420mg/l while in our work it is 35.43 mg/l (Figure 2). This comparison proves that the efficiency of the purification is more important in 2017 than on 2008 for organic matter.
The same remark is made on the suspended material and according to [7] which was 59 mg/l and which 9 mg/l is in 2017.

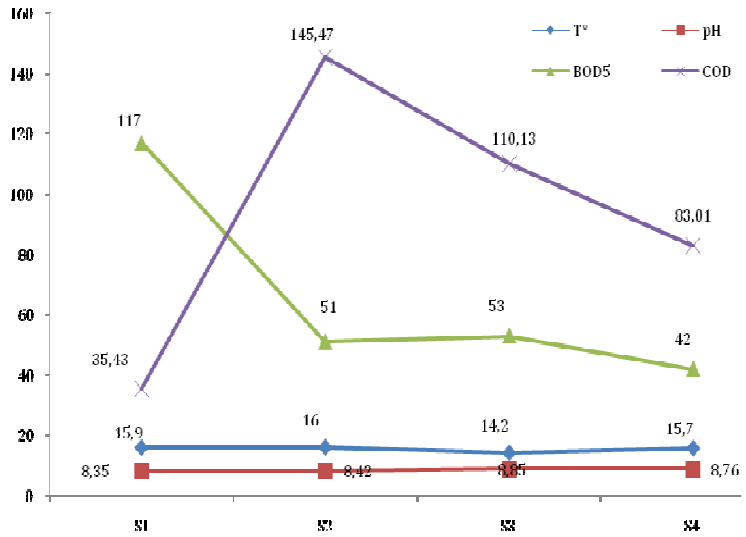

Figure 2 – Values of Temperature, pH BOD5 and COD of different stations

According to the results of the physicochemical analyzes, we find that the nitrates (NO_3^-) and the ammonium (NH_4^+) are in high concentration in the wells of the station S1 with respectively 128mg/l and 23,168mg/l. Copper (Cu), iron(Fe), nitrites (NO_2^-) and phosphates (PO_4^{3-}) are in smaller quantities (Figure 3).

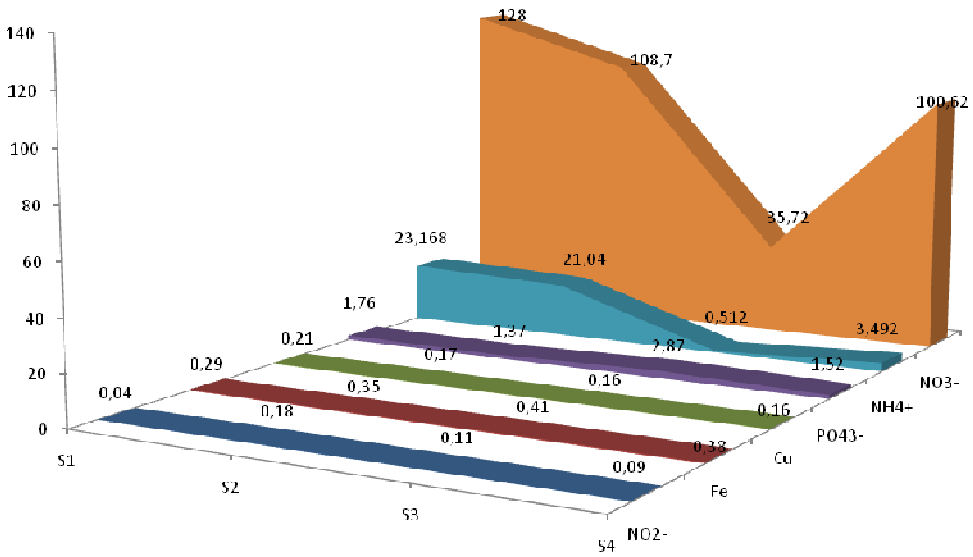

Figure 3 – Values of No_2^-, Fe, Cu, PO_4^{3-}, NH_4^+, NO_3^- of different stations

The results of the bacteriological analysis of the water of the sampling stations indicate a contamination by the different germs, in particular the first and the third station where we recorded respective rates equal to 3320

germs/100ml and 3400 germs/100ml for total coliforms, 3200 germs/100ml and 3330 germs/100ml for fecal coliforms at 22 ° C (Table 2).

Table 2 – Bacteriological analysis results

	Total Coliforms	Fecal Coliforms	E.Coli	Fecal Streptococci	Chlostridium
S1	3320	3200	320	2010	30
S2	332	121	3,4	1000	19
S3	3400	3330	220	220	22
S4	1800	145	5,1	75	11

DISCUSSION

Figure 4 presents the circle of correlation between the variables, where the information is represented on the axis factorial 1 with 53,83% of inertia against 36,49% of inertia represented by the axis factorial 2, show a correlation between temperature and phosphate between pH, nitrates and ammonium BOD5 and iron which are closely related, thus characterizing a group indicating the role which plays this elements in the process of transformation of the organic matter. Indeed,

The temperature of the water is an important factor. It plays a role in the solubility of the gas in the separation of salts, the change in pH, knowledge of the origin of the water and any mixtures, etc. In addition, this measure is important in limnology and in general, it is influenced by the source from which they come superficial or deep [8].

The superposition of the correlation circle on the factorial plane explains the relationship that exists between the different parameters of the water analyzed. Each well is characterized by factors; the well of station S1 and S3 is attached to ammonium, nitrates, iron, copper, phosphates, BOD5 and to the different pathogens in which they record their maximum values.

In fact, ammonium in water usually represents a process of incomplete degradation of organic matter. Ammonium comes from the reaction of minerals containing iron with nitrates. It is therefore an excellent indicator of water pollution by organic discharges of agricultural, domestic or industrial origin. More, ammonium itself is not very toxic but it can cause several problems such as bacterial reviviscence, the decrease in the effectiveness of chlorine treatment and the development of microorganisms responsible for unpleasant odors [9].

Naturally occurring nitrate levels in surface and ground water are generally a few miligrams per litre. In many ground waters, an increase of nitrate levels has been observed due to the intensification of farming practice. Concentrations can reach several hundred miligrams per litre. Nitrate is less toxic than nitrite, which is in higher rate in the well Station S2, and is used as a food source by live plants [10].

On the other hand, phosphates can be of organic or mineral origin, most often their content in natural waters results from their use in agriculture. Their presence in the water of some wells indicates the proximity of manure, septic tanks or the possibility of infiltration of agricultural runoff, rich in fertilizer [11].

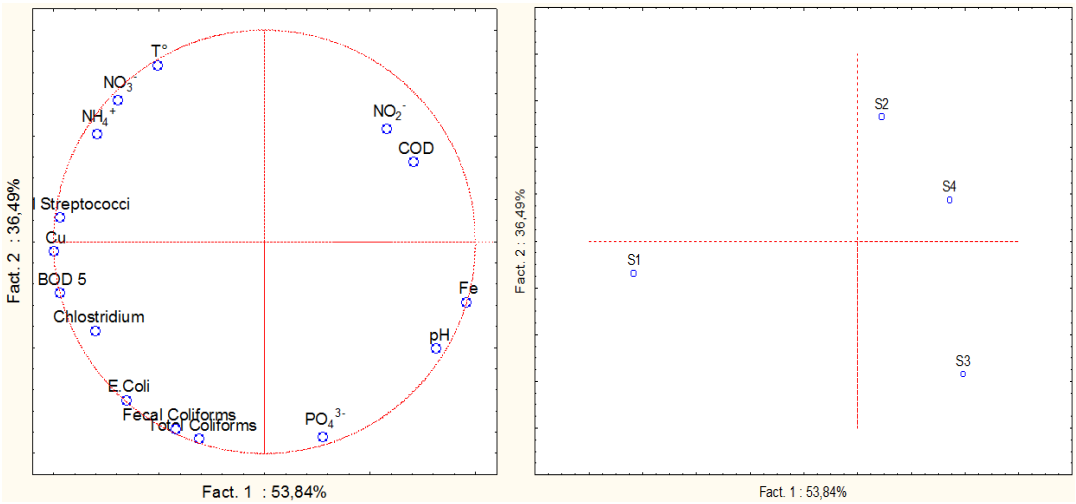

Figure 4 – CPA analyses of physicochemical and bacteriological results

CONCLUSION

Through our results we conclude that the pollution of the Mekerra River is a source of contamination of the groundwater of the plain of Sidi Bel Abbes. The use of well water to its proximity by farmers for irrigating crops is not without effect because harmful elements accumulate in the food grown and will have a negative effect on human health.

It will be necessary to solve the problem of pollution of Mekerra River based on workable and categorical solutions as soon as possible;

- ✓ Connect the part of the Mekkera River not taken on consideration by the sewage treatment plant.
- ✓ To envisage the construction of a pre-treatment station at the exit of the industrial zone and to sensitize each polluter to manage this waste in a definitive way according to the laws of the Algerian Official journal.
- ✓ To envisage in the long term the development of an irrigation system for the Sidi Bel Abbes Plains using purified and treated wastewater after connecting the unpurified part of the River to the Sidi Bel Abbes Sewage Treatment plant.

The treated and purified flow will be intended for irrigation of the agricultural zone of the Sidi Bel Abbes Plain, knowing that agriculture in this country and livestock are socio-economic solutions; Water needs are very important in these areas.

Reuse of wastewater treated and purified and a suitable solution to conserve drinking water from hydric resources. Knowing that the reuse of treated and purified wastewater is recommended in agriculture because these waters are nutrient rich so minimize the use of fertilizers. But the choice of irrigation technique and speculation is done after previous studies.

Farmers in Sidi Bel Abbe are obliged to irrigate their crops; It is time to substitute irrigation with wastewater from treated and purified waters coming out of the country sewage treatment plant which are discharged into the River. To make a study to establish an irrigation system by treated and purified waters coming out of the sewage treatment plant of the city of Sidi Bel Abbes; For the benefit of the agricultural area such as; Sidi Hamadouch, Sidi Brahim and Ain El Berd...

This act will preserve water resources and protect the environment and human beings from the side effects of wastewater use for irrigation.

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