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The effects of wastewater on groundwater quality of the Bechar Aquifer , south west of Algeria

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Abstract –

In urban areas, population growth generates significant quantities of wastewater that is treated in sewage treatment plants discharged directly or specialize in short uncontrolled water in Bechar Oued. Because of their different origins (domestic waste).Consequently groundwater can be contaminated by chemical and microbiological pollutants.
The physicochemical and microbiological characteristics from 18 grandwater samples were measured to evaluate the impact of wadi Bechar wastewater on the Bechar aquifer.

The results showed that the majority of samples are contaminated. It revealed alarming levels of chlorides, nitrates, nitrites, sulfates and ammonium. Eighteen groundwater samples are showing signs of recent contamination confirmed by the high rate of tested microorganisms (210 CFU coliform, fecal coliform CFU 91, streptococci D 38 CFU, *Clostridium* sulfite reducers 4 CFU).

Keywords: Bacteriological quality, Chemical quality, groundwater, wastewater, Pollution Bechar.

Introduction

Water resources in southwest of Algeria are under pressure due to low and irregularly distributed rainfall, high temperatures, wind, and low humidity, which often results in the occurrence of drought. As water needs for human population increase over time, the recourse to new water resources is necessary (El heloui *et al.*, 2015).

The population growth in the town of Bechar generates considerable quantities of sewage discharged into the Wadi of Bechar which divides the city into two banks of large agglomeration where water resources are heavily used for various activities.

Degradation of water quality of the water is caused, firstly, by the nature of the limestone-dominated soil that allows easy infiltration, and secondly by waste liquids. The burden of these releases is increasingly growing with the population development of the town of Bechar. The discharge of this sewage is a source of pollution for agricultural land and wells. The groundwater depth and the distance between wells and pollution source are two important criteria in determining the quality of ground water. A physicochemical study releases preliminary study showed the possibility of contamination of groundwater by seepage of wastewater (Maazouzi *et al* .,2011)

2. Materials and methods

2.1. Sampling

Eighteen groundwater samples (W1 to W18)) were collected from the wells located along of Bechar wadi, which crosses the city of Bechar , southwestern Algeria (Figure 1). Site selection was determined after a preliminary study of the physicochemical parameters, frequency of use by local residents, and according to the direction of the wastewater flow.

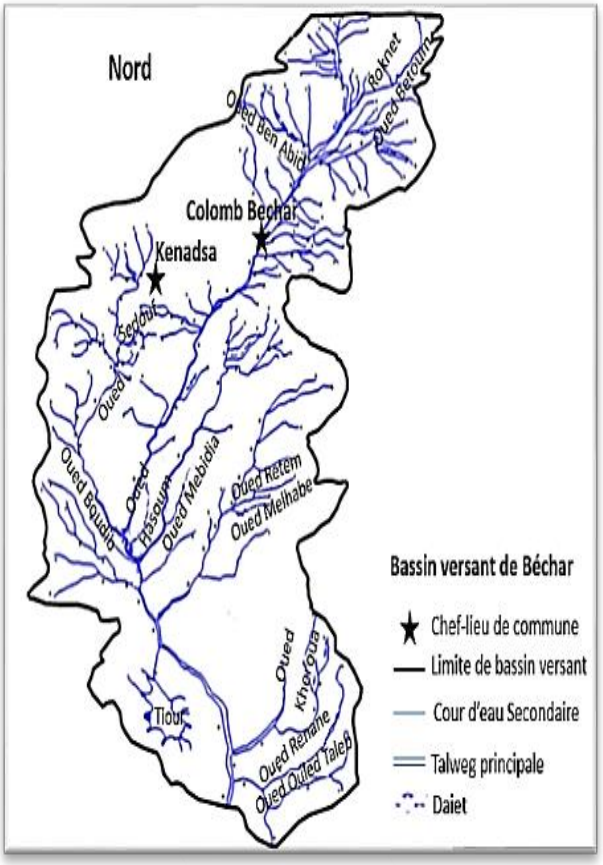

Figure1: Wadi Bechar watershed (Bouhelala and Cherif, 2014).

2.2. Microbiological analyses

Waters should be collected in sterile glass vials. Microbiological analyses must be started less than six hours after sampling, the transport must be compulsory in a cooler at a temperature lower than 4° C (Makhloufi and Abd Elouahid,2017) .

The organisms sought are: revivifiable organisms (GR) at 20° C and 37° C (ISO 6222,1999), Coliforms in liquid media

(NPP) (AFNOR NF T90-413,1985), and by filtration (AFNOR NF T90-414,1985) , faecal Streptococci (SF), *Clostridium* Sulfito-Reducers (CSR) (ISO 6461-1,1993), (Rdier,1996).

2.3. Chemical and physical analyses

The physical parameters are: pH, salinity and conductivity. The chemical parameters are: sulfate, chloride, nitrate, nitrite, sodium, and potassium, using standard techniques of analysis. Assay methods used are as follows (Rodier ,1996)

-pH, salinity and conductivity, potentiometric method (Consort 861)

-Spectrophotometry was used for the determination of sulfates, ammonium, nitrates and nitrites;

-Flame spectrophotometry to determine the content of sodium and potassium.

3. Results and discussion

Where soil and groundwater conditions are favorable for recharge of groundwater through infiltration basins, a high degree of pollutants brought in by non treated wastewater effluent can seep into the soil and move down to the groundwater

3.1. Estimation of pollution load of domestic wastewater of Wadi Bechar

3.1.1. Microbiological characteristics of groundwater in the town of Bechar

The microbiological analysis of water allows assessing the risk from pathogenic microorganisms, may be found in waters used by humans, and thereby cause disease, and can also monitor the effectiveness disinfection treatments (Makhloufi and Abd Elouahid 2017).

Microbiological quality measurements were taken for 18 wells. The analyses considered fecal streptococci and sulphite reducing clostridium (SRC) in each well, detected in at least one measurement. Streptococci and coliforms were detected in the majority of the wells with a high risk of contamination, while these pathogens were detected in only 16 wells (73.3%) of the 18 wells with a low risk. SRC was also observed in a higher percentage (55%) of wells positive for high risk (Table 1).

Microbiological analysis indicated that the microbial load is very important and reveal that there are signs of contamination in the samples where the majority number of organisms sought exceeds the standard (1400 CFU coliforms and fecal coliform CFU 210 (Table1).

240 CFU streptococci D, except for two sampling (W9et W11) where there is no sign of contamination.

Table 01: Microbiological quality of groundwater

Wells	MTAF 37°C	MTAF 37°C	Coliforms	Fecal coliforms	*Streptococci*	*Clostrisium*
W1	180	220	7	7	15	00
W2	138	180	9	4	38	00
W3	134	126	1400	210	240	02
W4	420	800	1400	210	38	04
W5	90	100	7	4	240	00
W6	100	122	4	4	240	04
W7	160	200	9	9	38	01
W8	20	42	4	4	8,8	02
W9	10	26	0	0	0	00
W10	72	90	9	4	21	01
W11	10	90	0	0	00	00
W12	140	196	4	4	2	00
W13	100	180	15	15	2,2	00
W14	960	1220	210	15	240	04
W15	100	140	93	4	2,2	00
W16	1100	1308	29	29	190	01
W17	500	624	43	43	12	03
W18	1020	1224	43	43	38	03

3.1.2 Conductivity, Salinity and pH

From table 2, Samples W6 and W15 show the highest conductivities (5.5 and 6 ms/cm) respectively. Conductivity increases from south (2 mS / cm) to the north (6 mS / cm) denoting the same shape of the dissolved salts carried by these waters, which proves that the samples analyzed are loaded. The groundwater from the Wadi Bechar characterized by alkaline gave pH values ranging between 7.20 and 8.1.

Table 02: Results of Conductivity, Salinity and pH

Wells	Conductivity (ms/cm)	Salinity (mg/ml)	pH
W1	4.5	1.2	8
W2	2	0.8	7.82
W3	4.6	1.3	7.86
W4	4.4	1.2	7.22
W5	4.6	1.3	7.86
W6	5.5	1.4	7.88
W7	1.8	0.88	7.20
W8	2.5	0.9	7.26
W9	1.9	0.9	8
W10	5	1.4	8.1
W11	1.2	0.85	7.66
W12	1.4	0.8	7.15
W13	1.5	0.85	8
W14	1.7	0.79	7.45
W15	6	1.6	7.26
W16	5	1.55	7.85
W17	1.2	0.87	8
W18	4.5	1.2	7.49

3.1.3. Sodium and Potassium

The sodium content of groundwater reached a maximum of 430 mg/L of W14 and 12 mg/L K^+ for W13 south of Wadi Bechar. A lower concentration was observed to the north, reaching 160 mg/L of Na^+ and 2 mg / L K^+. The evolution of these ions with others can explain the evolution from South to North. This increase appears sufficient to cause the infiltration of wastewater.

Table 3: Result of Sodium and Potassium

Wells	Na mg/l	K mg/l
W1	180	4
W2	160	5.2
W3	280	4.3
W4	270	3.9
W5	350	4.2
W6	300	5
W7	310	6
W8	170	2.2
W9	305	2
W10	425	3.8
W11	300	2
W12	180	3.9
W13	315	12
W14	430	5.8
W15	310	3.8
W16	310	5.6
W17	300	2.5
W18	180	4.1

3.1.4. Nitrate, nitrite, and ammonium

According to the results shown in table 4. The nitrates, nitrites, and ammonium concentrations were significant, a maximum of 225 2.22and 2.8 mg / l was observed in (W15) respectively. This results confirm the presence of nitrogen in urban wastewater and detergents based on ammonium, ammonification reactions can occur that transforms organic nitrogen into ammonium NH_4^+ (reduced form of nitrogen), because the oxygen demand for ammonia is very high they are molecules (nitrogen compounds) to the origin of fragrant odors (Badri *et al.*, 2011).

Table 4: Results of pollution indicators

Wells	Nitrates mg/l	Nitrites mg/l	Ammonium
W1	50	0.11	0.8
W2	50	0.14	1.2
W3	65	0.18	1.5
W4	80	0.2	1.6
W5	80	0.18	1.65
W6	180	0.21	2.8
W7	170	0.22	2.5
W8	25	0.1	0.7
W9	25	0.11	0.8
W10	150	0.2	2.4
W11	35	0.12	0.9
W12	25	0.11	1
W13	15	0.8	0.8
W14	20	0.87	0.9
W15	225	2.22	2.8
W16	25	0.9	0.9
W17	130	1.8	2.2
W18	120	1.56	2

Nitrates in drinking water are a major contaminant , they are nowadays

frequently found in aquifers. In arid and semiarid regions, sources of nitrates in groundwaters have either been linked with direct anthropogenic pollution in towns or with leaching of fertilizers in agricultural areas. Nitrate (NO3−) concentrations of the phreatic waters (Table 1) were found far above the World Health Organization (Fahdi *et al.*,2016)

4. Conclusion

The results obtained during this study (Analysis of physicochemical and microbiological of groundwater) show that the majority of groundwater were contaminated by wastewater in Wadi Bechar. This problem requires an urgent intervention of local state by installing adequate systems for the routing of discharges in appropriate pipes to a sewage treatment in the south of Bechar city

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