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REVIEW ARTICLE

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Inorganic Quality of Wastewater from the Gharb-Morocco Water Table

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ABSTRACT

The importance of water for life is well established. This resource meets the basic needs of human life. It is a key staple of development. It is fundamental in agriculture, fishing, energy production, industry, transport, tourism. In addition, water is vital for all the ecosystems of the world. However, water is a precious good that must be preserved and protected. Today, the quality of water and the environment concerns us all to guarantee a life in good and perfect health because most diseases are related to water. This is why water quality control is a permanent concern for management and the protection of the environment. The results of the analyzes carried out on these underground waters of the Gharb region during the year 2016 to 2017 show that these waters are heavily loaded with inorganic pollution. It is therefore concluded that these waters require certain treatments in order to render them of good quality fit for food.

Keywords : Inorganic Quality, Wastewater and Environment.

INTRODUCTION

Water is a renewable resource as evidenced by the well-known cycle of water : evaporation, condensation, precipitation and runoff, then new evaporation and repetition of the cycle [*Kirzner, 2001*]. From this perspective, the quantities of water should not be depleted.

However, we realize today that drinking water is not inexhaustible. The acceleration of population growth is leading to a vertiginous increase in water needs. In addition, they produce, no longer waste (agricultural, industrial) that contribute to polluting water irreversibly, especially in the absence of a water purification system, as is the case in several developing regions.

It is therefore because water stocks are disappearing that the issue of water becomes problematic, it is mainly because the polluting activities of humans, in the absence of sanitation networks, poison the water. Water and that the resource is unequally distributed geographically.

All living organisms contain water. In humans, water is the main component of the body. The body of an adult contains up to 70% water. Blood, for its part, contains 82% water, while some fruits, vegetables and marine animals are made up to 95%**.** Of course, the water needs are very large since it contributes to the proper functioning of the body by facilitating the circulation of blood and breathing, transporting nutrients to the cells and promoting the elimination of waste and toxins. Water is therefore essential for all living organisms.

We present in this section head, stationary changes in physicochemical parameter for twenty nine stations G harb region, in the form of graphs the annual average value of each well.

As well as, Principal Component Analysis (PCA) was performed from all the analyzes, during a sampling year (February 2016 to January 2017).

MATERIAL AND METHODS

Medium of Study

According to the last census of the population of 2014, the region of Rabat-Salé-Kenitra is ranked in 2nd place after the Casablanca-Settat region, with a population of 4.580.866 representing a share of 13.53% of the total population of the country.

The average annual growth rate of the region over the period 2004-2014, 1.31% is equivalent to the national average (1.25%). However, this regional average hides fairly large disparities between the provinces and prefectures of the region.

The Gharb tablecloth with an area of 390 km², with 126 m^3/year of renewable resources and a relatively balanced water budget. It has a hydrogeological interest at the regional scale characterized by a heavy recharge by water infiltration precipitation and from the edges of the Gharb Basin.

Study method

Choice of stations: Twenty-nine selected stations consist of wells distributed throughout the Gharb region. Twenty-nine of them are chosen in the urbanized district and the others distributed in the rural districts.

Sampling and water analysis: Sampling was conducted between February 2016 and January 2017. Four samples were taken per well and per season. Samples were taken at each well using a small bucket, weighted and stored for 72 hours in 1.5L mineral water plastics for analysis. However, pH, conductivity and temperature were measured in the field using a portable multimeter (HANNA, HI 991300). The other parameters were determined by a spectrophotometer (HACH, DR 2400) according to the methods recommended by Rodier (2009) at the ONEP laboratory.

Statistical analyzes: The Principal Component Analysis was performed on the annual average values of the physicochemical parameters characterizing the twenty-nine wells . This analysis made it possible to highlight the correlations existing between the different parameters of the water. In order to get a better assignment of individuals to their class.

RESULT OF PHYSICOCHEMICAL PARAMETERS

Temperature

The temperature of the water is a very good descriptor of the functioning of the underground ecosystems, it gives information on the origin of the water and the importance of the superficial contributions [Creuzé Des Chatelliers and Dole-Olivier, 1991]. According to [Morette, 1964], from 12 to 15 meters deep, the soil temperature is independent of its surface layer and therefore of the external temperature

Thermal surveys carried out at the studied stations showed significant stationary thermal variations (Figure 1), 1 9, 98° C in the Gharb.3 well, with an average temperature of 21.5°C. These results corroborate those already reported by Matthess [1994]; the underground environment is also recognized as thermally very stable; it approaches the annual average thermal surface water.

In Morocco, Boulal [2002] reported, southwest of Marrakech, as the temperature resistance of ground water in wells of Tiznit, where the annual average temperature is 22°C with a variation of 0.4°C. In fact, same findings have been reported recently by Aït Boughrous [2007] and Hallam [2010].

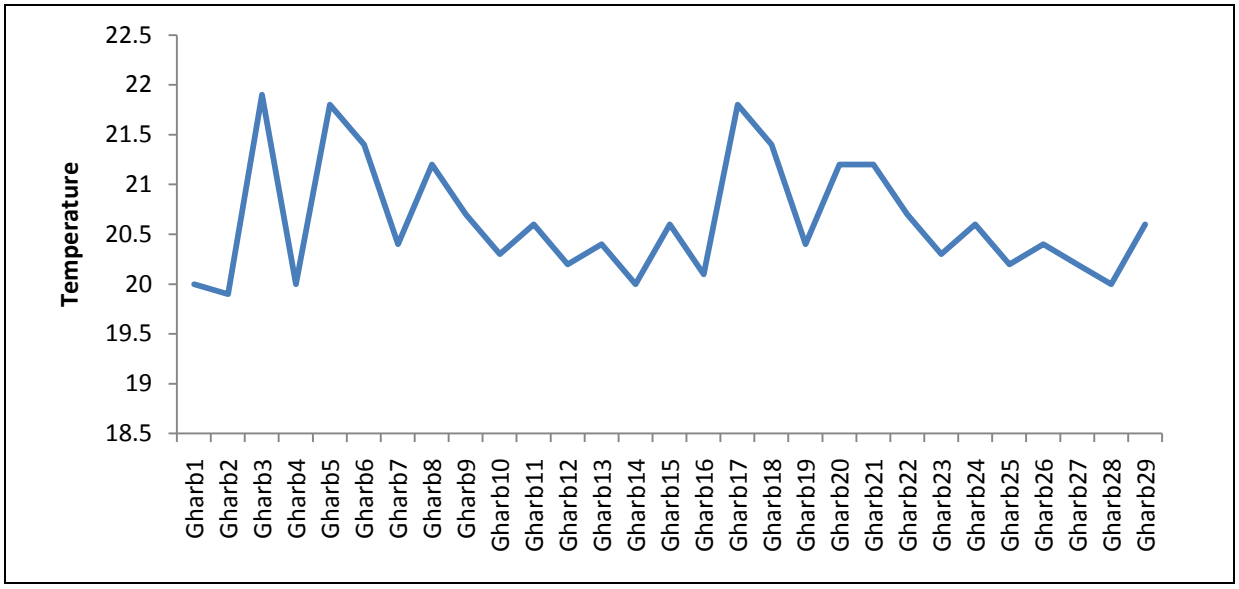

Figure 1. Variation in temperature as a function of water withdrawal from the Gharb aquifer wells. Potential hydrogen.

The results obtained from the analyzes carried out are illustrated in the figure (2).

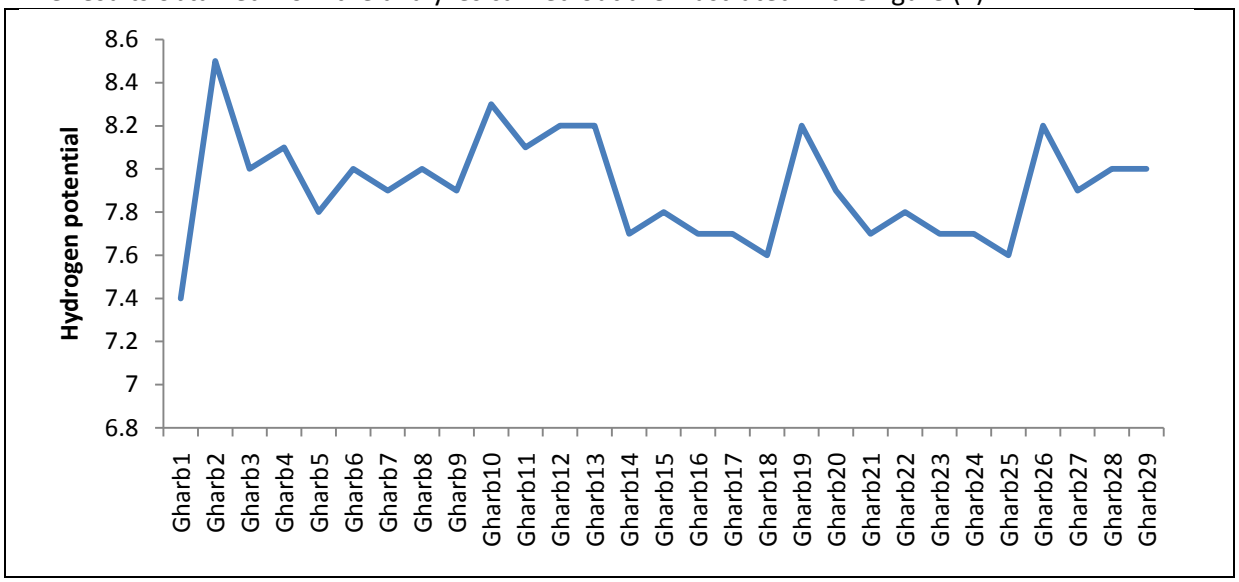

Figure 2. Variation of the hydrogen potential as a function of water withdrawal from the Gharb aquifer wells.

The values obtained are close to neutrality, while referring to Moroccan standards (pH between 6.5 and 8.5) for drinking water, according to the selection table on 100% of the analyzed waters are recommended for human consumption [Nwala et al., 2007, Dégbey et al., 2008].
Indeed, the groundwater of the Garb aquifer do not require a pH correction that could be human overload.

Conductivity

The results of the analyzes are shown in Figure 3 has.

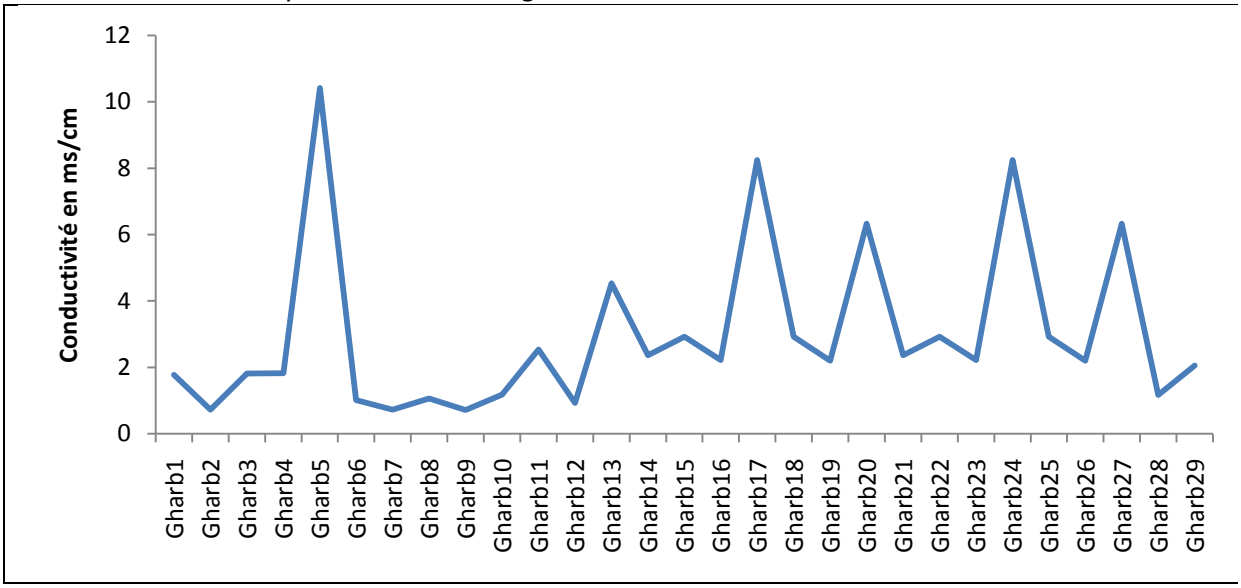

Figure 3. Variation of the conductivity as a function of water withdrawal from the Gharb aquifer.

Electrical conductivity refers to the ability of the water to conduct a current. During our study the values of the conductivity vary between 0.72 to 10,41 m s/cm for the water from the wells of the Garb aquifer. The maximum allowable value (VMA) is fixed at 2 ,7 ms/cm according to Moroccan standards of potability. According to this study, these values are very variable and greater than the maximum allowable value, so the high content of this parameter is explained by the high content of chloride ions (Cl^-), and the strong mineralization due to the contact of these underground waters with rock formations.

Strong mineralization of well water obtained is contrary to Tampo results [2014]. However, the values obtained during the present study are comparable to those mea Rees by Adejuwon MBUK and [2011].

Calcium (Ca^{2+})

The results obtained from the analyzes carried out are illustrated in the figure 4:

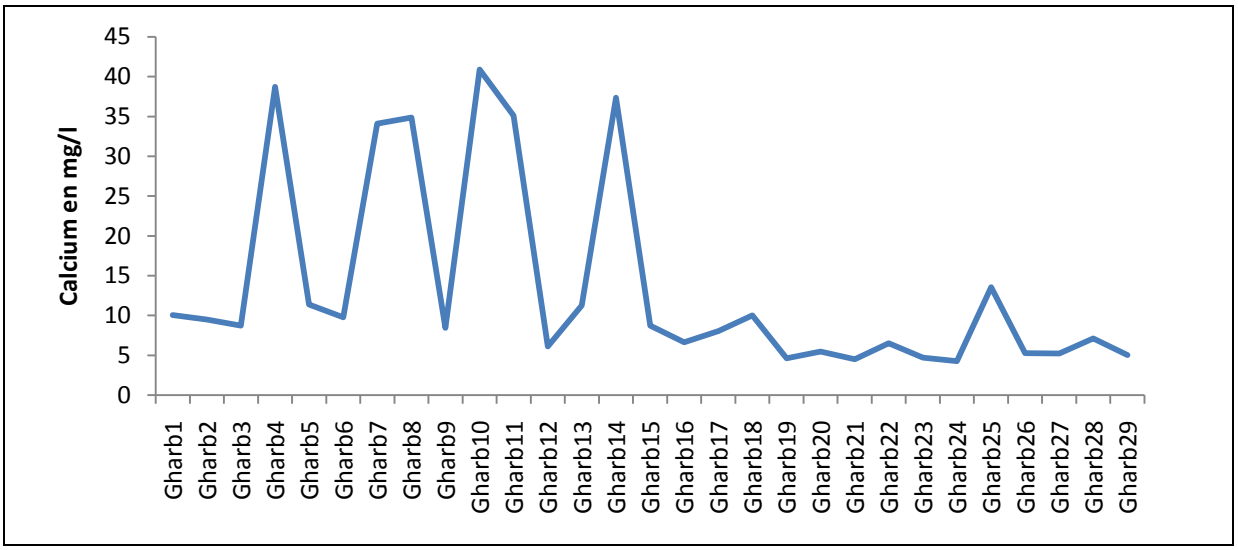

Figure 4. Calcium variation according to the wells of the Gharb aquifer.

During our study the values in calcium hardness oscillate of 4.26 at 40.9 meq /l with an average of 13.65. This high content of Ca^{2+} can be explained by the high total hardness (TH).

Manganese

The results of the analyzes are shown in figure 5

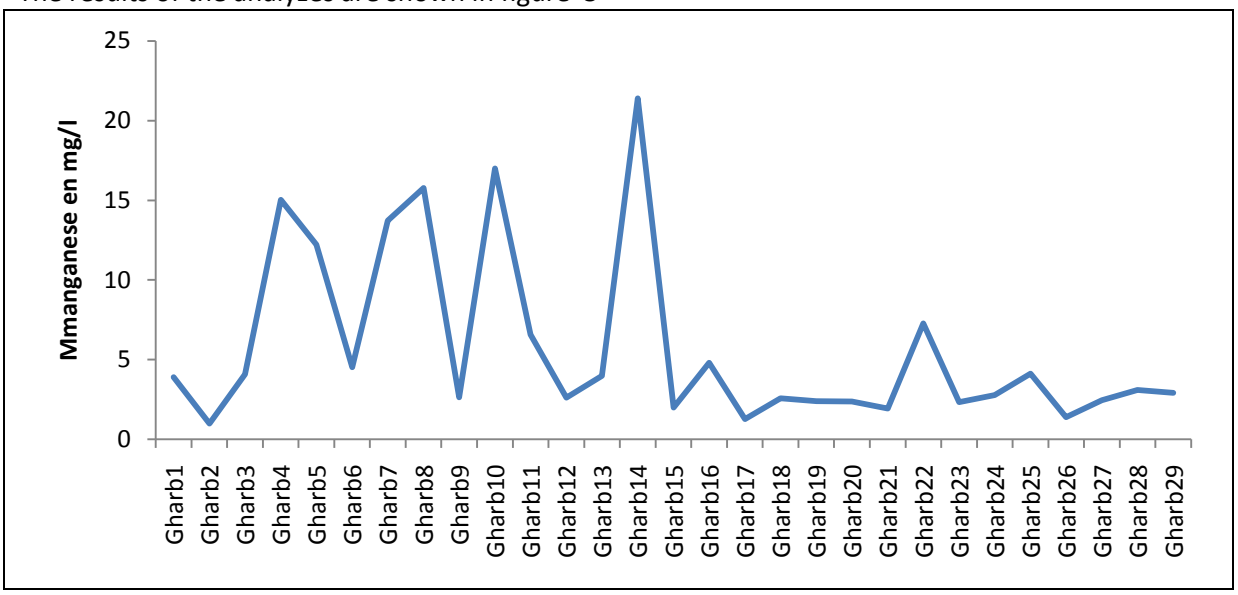

Figure 5. Variation of the concentration of manganese as a function of water withdrawal from the Gharb aquifer wells.

The manganese concentration varies during the study of 1 to 21, 4 mg / l for water of the web of Garb, the normal level of manganese is set at 0.1 mg / l according to Moroccan standards of potability. These levels exceed 100% the water standards of the G arb aquifer .

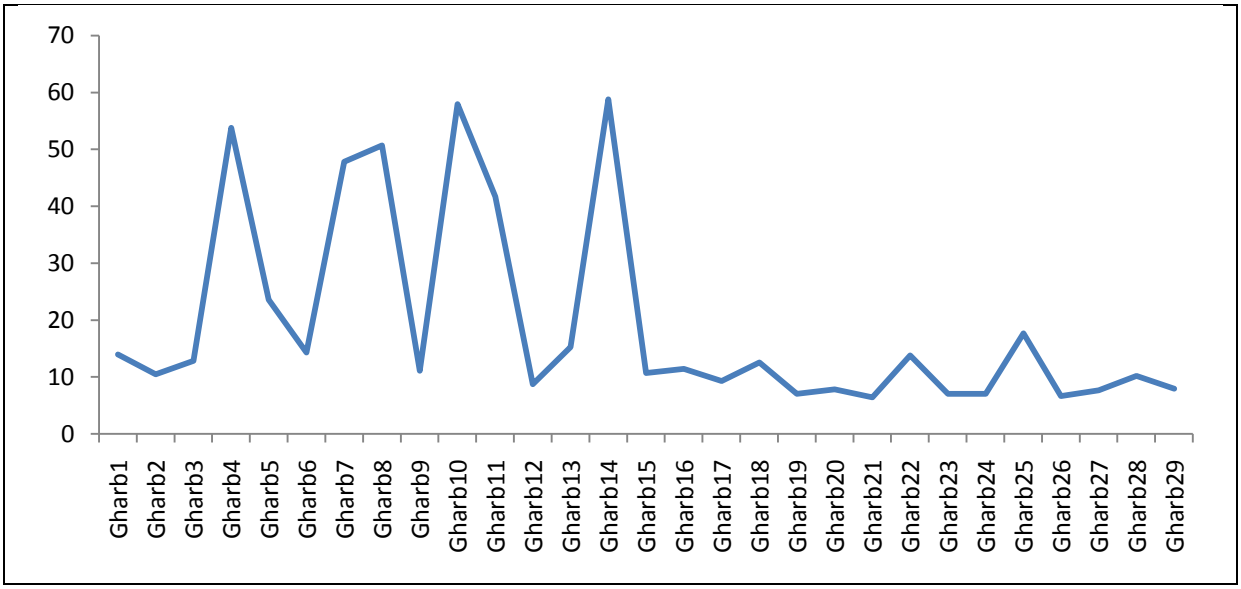

Figure 6. Variation in Hardness as a function of water withdrawal from the Gharb aquifer wells.

Hardness (Ca^{2+}) + (Mg^{2+})

The values of this parameter in the studied waters are very variable as can be seen on the (Figure 6, with a saw variation throughout the year. Very high levels of the order of 19.49 mg /L, with an average value of 58.76 mg/l characterize the well P3, these high values could be explained by the

nature of the sedimentary rocks crossings massive limestone nature and dolomit're Lias Sup. [Boumir, 1987] In fact, the average annual contents are between 168.83± 78.56 mg /L in the well P2 to 568.73 ±48.74 mg/L at the well P5. These results corroborate those of Ait said [13] of the tablecloth of the city of sidi kacem.

Sodium (Na^+)

The mean annual sodium value shown at the wells level is 31.46 mg/l, the maximum concentration 148 mg/l is recorded in the wells 4, 5, 10 (Figure 7).

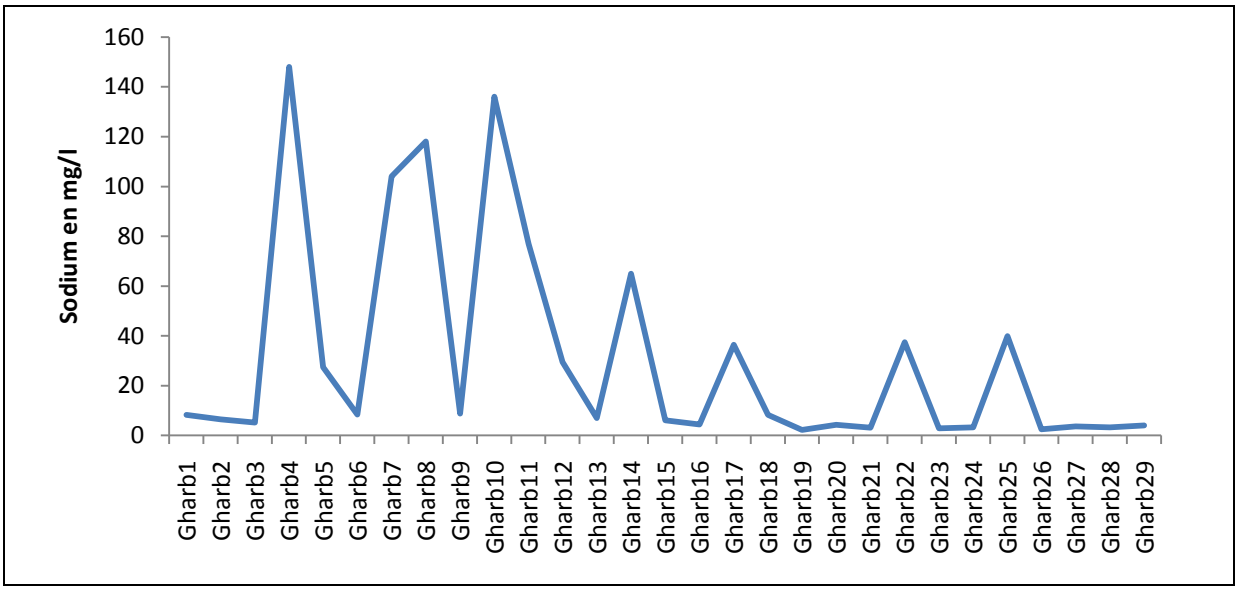

Figure 7. Sodium variation according to the wells of the Gharb aquifer.

Ammonium NH_4

The results of the analyzes are shown in figure 8.

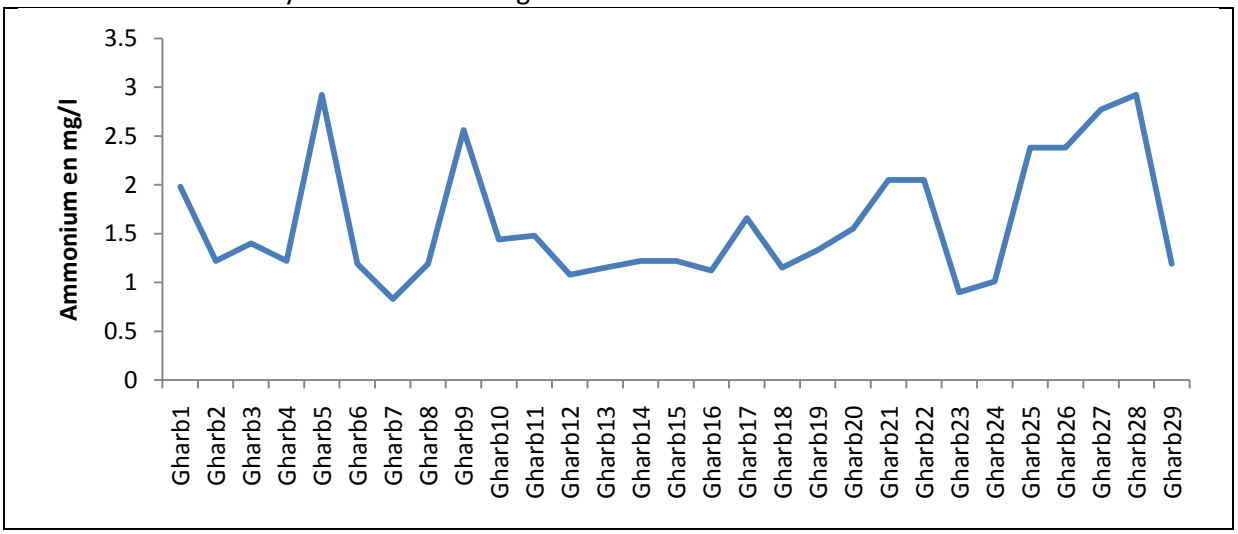

Figure 8. Variation of the ammonium concentration according to water withdrawal from the wells of the Garb aquifer.

Ammonium is the product of the final reduction of nitrogenous organic substances and inorganic matter in water and soil. It also comes from the excretion of living organisms and the reduction and biodegradation of waste, without neglecting domestic, industrial and agricultural inputs.

This element exists in a small proportion of less than 0.1 mg/l of ammonia nitrogen in natural waters. In the superficial waters, it comes from nitrogenous organic matter, and gas exchanges them between water and the atmosphere [Chapman and Kimstach, 1996].
During our study the ammonium values oscillate from 0, 83 to 2 , 92 mg/ l, its normal rate is fixed at 0.5 mg/l according to Moroccan standards of potability, so these values always remain higherthan the maximum admissible value this may be justified by the presence of a sufficient quantity of oxygen which favors the operation of nitrification (transformation of ammonium into nitrites and then nitrates).

Chloride Cl^-

The results obtained from the analyzes carried out are illustrated in the figure 9:

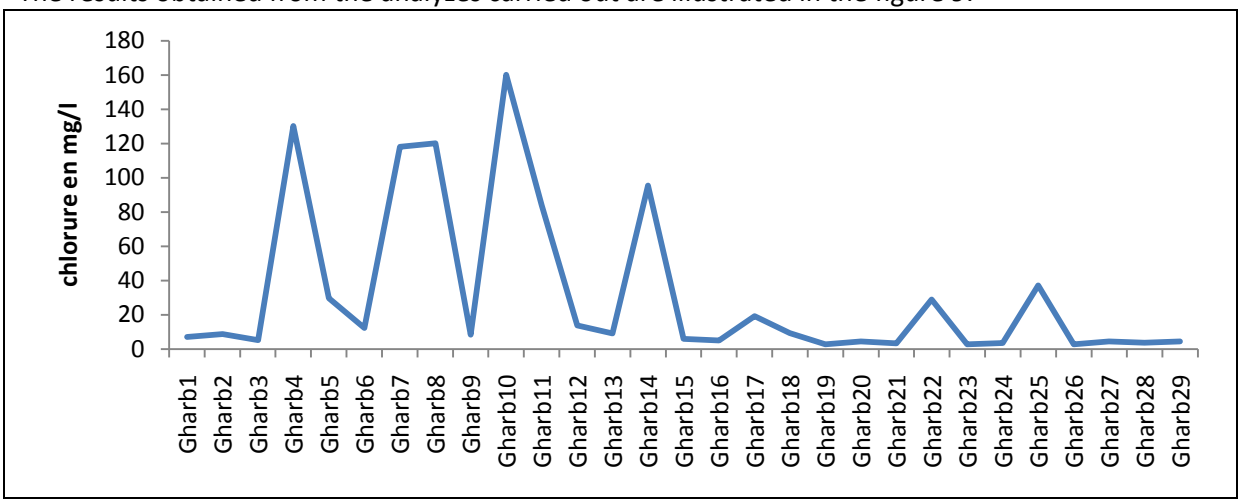

Figure 9. Variation of chloride concentration as a function of water withdrawal from Gharb wells.

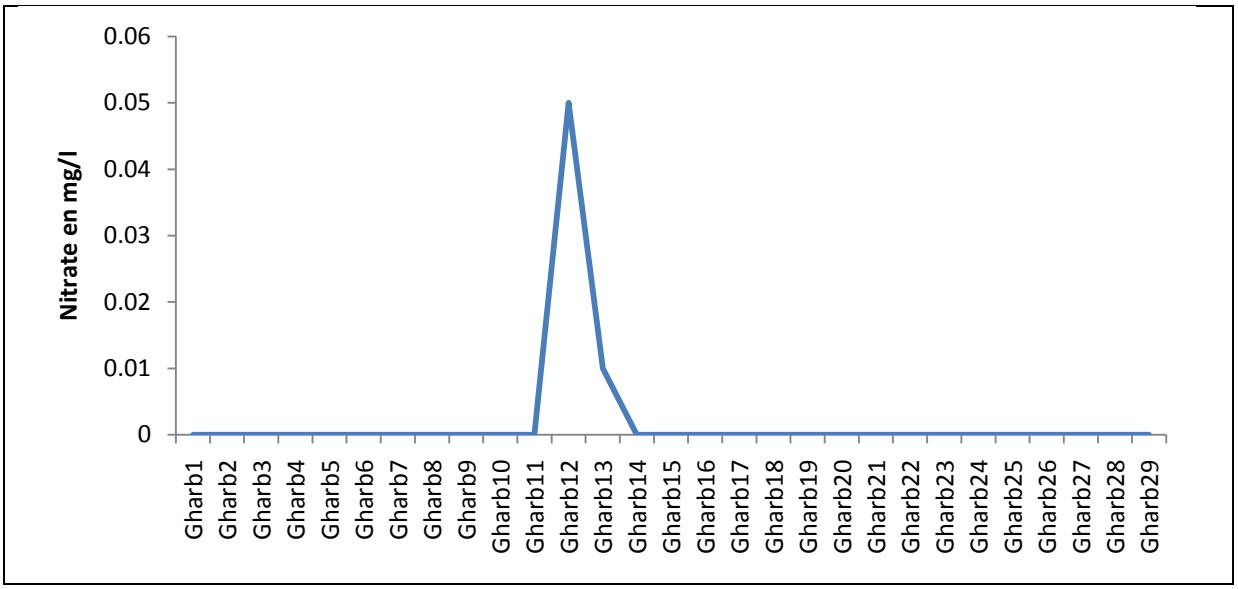

Figure 10. Variation in nitrite concentration as a function of water withdrawal from the Gharb aquifer.

During our study the values of the concentration of chloride ions oscillate between 2.68 to 160 mg/l for the water of the Gharb aquifer, its normal rate is set at 750 mg/l according to the Moroccan standards of potability, these values always remain stable and below the maximum allowable values.

Nitrites NO_2

Sources of nitrates and nitrite are Human Activities ; deficient septic systems [Levallois and Phaneuf, 1994], fertilizers, sewage, landfills, runoff, leaching of land by precipitation and oxidation of nitrogen, oxidation of nitrites by bacteria following the infiltration of wastewater; feces of warm-blooded animals, cesspools [Mfonka et al., 2015]. The results of the analyzes are shown in figure 10 :

The nitrite content varies during the study from 0 to 0.05 mg/l for water with average 0.0021 mg/l, the normal rate of nitrite is set at 0.1 mg/l according to the standards Moroccan potability.

Nitrite is toxic to the human body, the presence in large quantities degrades the quality of water. The toxicity related to nitrite is very significant because of their oxidative power.

Despite the fact that the Gharb area is known for its agricultural activities, nitrite levels remain low and comply with standards.

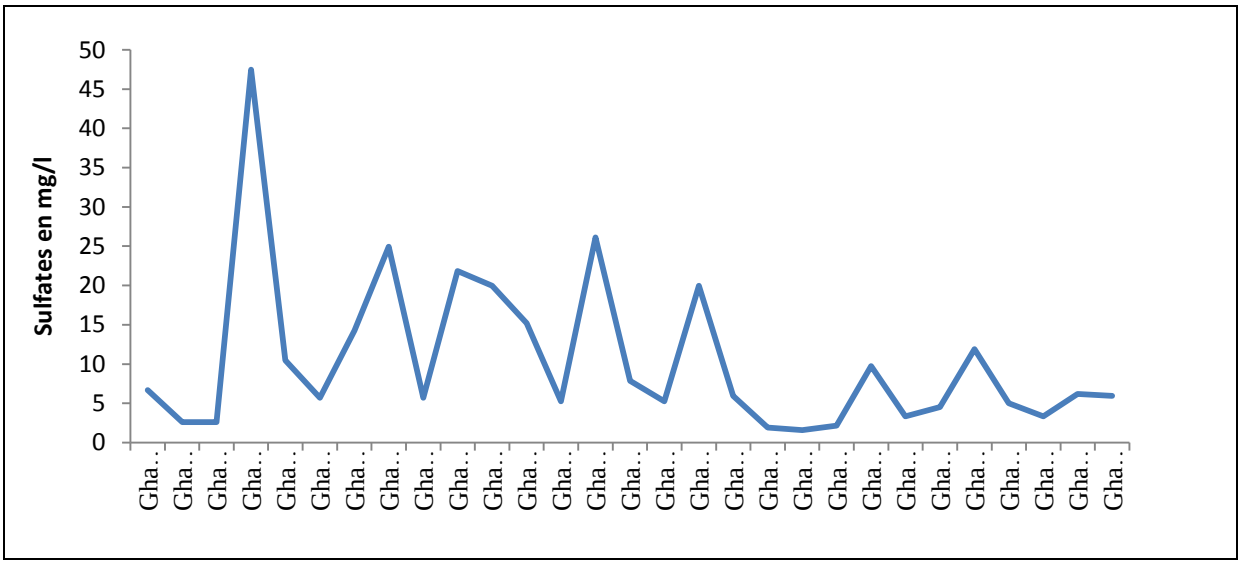

Figure 11. Variation in sulphate concentration as a function of water withdrawal from Gharb aquifer wells.

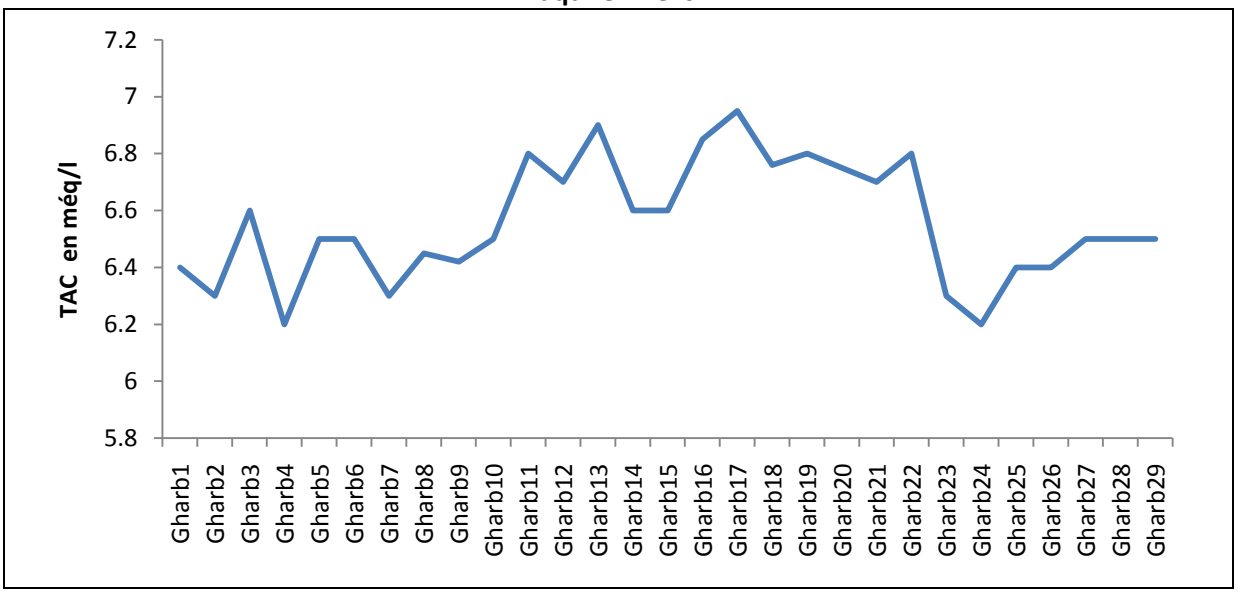

Figure 12. Variation in TAC based on gross water withdrawal, filtered water and treated water.

Sulfates SO_4^-

The results of the analyzes are shown in a figure 11, During our study the values of the concentration of sulphates oscillate between 1,57 to 47,5 mg/l for the raw water of the water table,

its averagerate is of 10,45 mg/l, according to the Moroccan standards of potability, these values always remain sands and lower than the maximum allowable value, so this water at this level is recommended for human food poses no risk to the health of consumers.

Full Alkalimetric Title (TAC)

The results obtained from the analyzes carried out are illustrated in the figure 12.

The water TAC in the study ranged from 6.2 meq /l to 6.95 meq /l for raw water, with an average of 6.55±0.21. TAC is an indicator of the presence of carbonate ions, bicarbonates, hydroxides.
The values obtained are generally stable, and based on the pH values which are always less than 8.3 (TA = 0), then the TAC values represent only the concentrations of bicarbonates.

Statistical Analysis of Physicochemical Parameters in Principal Components (PCA)
Descriptive statistics

Table 1 represents the descriptive statistics of the physicochemical parameters

Table 1. Descriptive tatistics S of the web d u Gharb.

Variable	Minimum	Maximum	Average	Standard deviation
T	19.9	21.9	20.646	0.604
pH	7.4	8.5	7,907	0,245
C. E	0.72	10.41	3,027	2,556
O_2	0.42	4.39	1,919	1.84
Ca^{2+}	4.26	40.9	13.954	12.446
Mg^{2+}	1	21.4	5.964	5,608
Na +	2.3	148	32.496	43.993
K +	0.08	6.5	0.699	1,313
HCO	2.5	23.3	7,871	5.793
Cl	2.7	160.02	33.387	47.179
SO_4^{2-}	1.57	47.5	10.652	10.252
NO_2 -	0	0.05	0,002	0.01
NO_3 -	3.47	31.74	11,038	6,841
SiO_2	21.34	22.76	21.951	0.359
NH_4 +	0.83	2.92	1,578	0.624
TAC	6.20	6.95	6.564	0.212
SAR	2.04	21.73	6,516	4,668

Projection of the physicochemical variables on the two axes F1-F2

Analys e in the Main Components performed on a composite data matrix of 29 lines representing the sampled stations and 17 columns representing the physicochemical parameters.
The variance provided by the first two components F1 and F2 from the PCA of all the variables is satisfactory. Indeed, it allows us to explain 51.86 % of the total varian ce (Table 2).

Table 2. Contribution of the first two components (F1-F2) to the total variance of the physico-chemical variables.

	F1	F2	F3
Own value	6,350	2,466	1,988
Variability (%)	37.355	14.506	11,694
% cumulated	37.355	51.861	63.555

The projection of the stations (described by physico-chemical parameters) in terms of the first two factorial axes of the PCA (Figure 13) makes it possible to clearly distinguish the presence of asingle group of wells that are loaded with mineral elements.

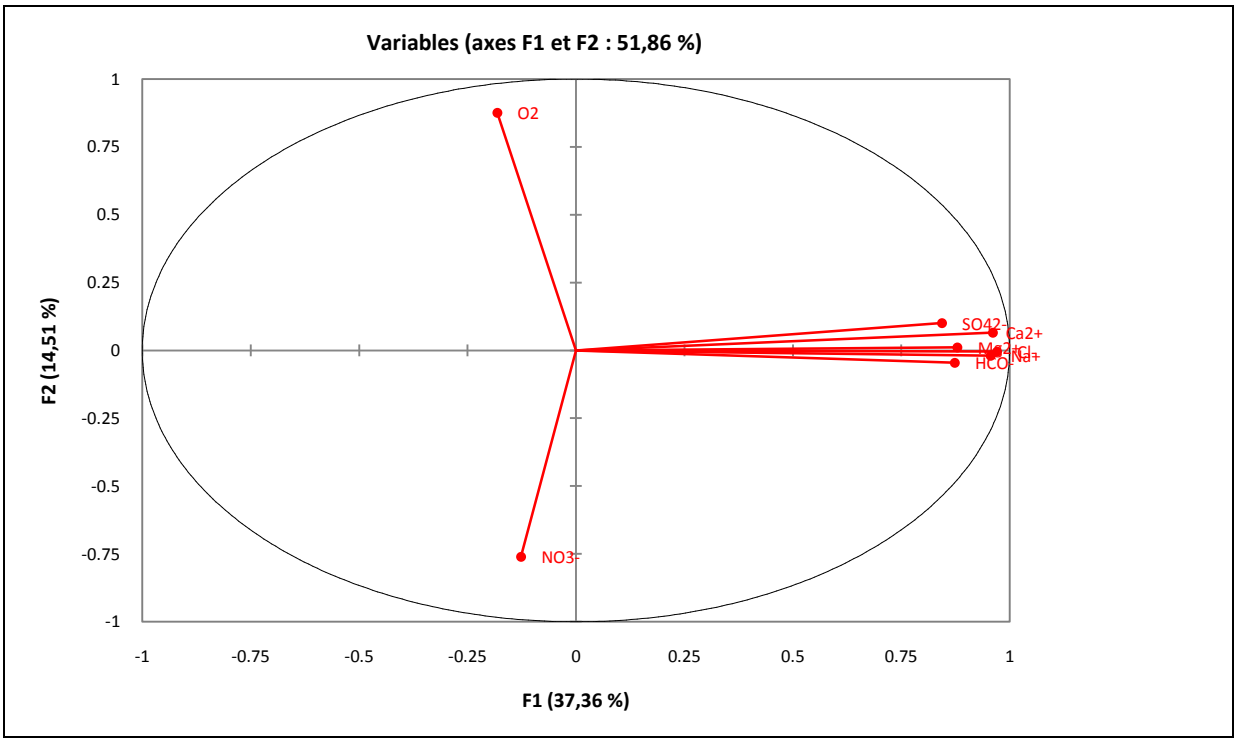

Figure 13. Projection of the physicochemical variables on the two axes F1-F2.

CONCLUSION

Conclusion of this study has made it possible to highlight the state of water pollution in some sampling points of the Gharb aquifer. The vast majority of the water analyzed is well water. These waters are confronted with chemical contamination. Of all the water types exploited by urban populations, well water is more exposed to contamination problems. Pollution factors are of anthropic or natural origin. The state of water pollution varies from one sampling point to another.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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