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REVIEW ARTICLE

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Water resource assessment of Sidi Allal Tazi-Gharb-Morocco

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ABSTRACT

The environmental concern presupposes a certain basic dynamism aimed at safeguarding ecosystems against all types of pollution and better management of the environment. The objective of our work is to determine the degree of pollution of the water table of Sidi Allal Tazi from the Kenitra region (Morocco), we selected physico-chemical elements as inorganic pollution indicator. The samples were taken on 10 wells (T1 .... T10) , the physico-chemical analyzes of samples taken during one year showed a large fluctuation of certain parameters such pH, Ca^{2+},Mg^{2+}, Na^{+}, NH^{4+}, Cl^{-}, NO_3, SO_4^{2-}. For example, the hydrogen potential is of the order of 7.41±0.164, the electrical conductivity is of the order of 1720.1±187 µS / cm, the turbidity is of the order of 1.72 ± 2.33 NTU, Mg^{2+} is of the order of 74.74 ± 120 NTU, chloride, nitrates and sulfates are respectively of the order of 529.17 mg, 43.35 mg and 100.93 mg. Also, the results were compared with the WHO standards. These results reveal that the groundwater quality of Sidi Allal Tazi exceeds national standards and poses a serious problem for their direct consumption.

Keywords: Groundwater, Sidi Alala Tazi, physico-chemistry and Morocco.

INTRODUCTION

Groundwater is the world's largest freshwater reservoir and as such is considered a water resource for human consumption and not a complete aquatic ecosystem [Bosca, 2002]. Groundwater accounts for a total of about 97% of the liquid inland freshwater and the presence of man and his ability to survive depend in many parts of the world on the existence and quality of this limited and fragile resource: 75 to 90 % of the world's population uses groundwater [Malard et al., 1997a].

In Morocco, groundwater is a very important part of the hydraulic heritage. They have certain advantages over surface water in terms of coverage of needs and uses. There are 32 deep aquifers and more than 46 surface water tables and the groundwater resources that can be mobilized are estimated at 4 billion m3, distributed unequally in the different regions of the kingdom [Bosca, 2002].

In certain regions of Morocco, these groundwater, which is the only source of drinking water for human populations, is dependent on a set of natural and anthropogenic factors. They are threatened by arid climate and intense human activity. These resources suffer disturbances, which lead to a deterioration of their physicochemical quality. All of the work done to date in the Gharb-Morocco region has been limited to the city of Kenitra [Dussart, 2000, Bermond and Vuichaard 2010]. These studies have shown that the factors responsible for the deterioration of water quality are most often related to localization in rural areas or to non-protection and lack of well maintenance [Bermond and Vuichaard 2010]. These wells are generally located in areas characterized by an abundance of septic tanks and lack of hygiene.

MATERIAL AND METHODS

Study site

Sidi Allal Tazi is a city in Morocco located in the region of Gharb-Chrarda-Beni Hssen between the coastal area and Oued Sebou northwestern Morocco. The geographic coordinates 34° 30'36 "N and 6° 19'12" W in DMS (degrees, minutes, seconds) or 34.51 and 6.32 (in decimal degrees) (Figure 1).

Sample Rate

A monthly sampling frequency was conducted at the well during two study companions, was 2016 (June, July and August) and winter (November, December and January).

Study Method

The samples collected in polyethylene bottles were transported as quickly as possible to the ONEP Kenitra laboratory to undertake the analyzes, where we studied the following parameters: Wastewater samples for other physico-chemical analyzes : Potential Hydrogen (pH), electrical conductivity (EC).

And also the heavy metals were carried out in the laboratory : The Office national drinking water, in Kenitra. These Samples were kept according to the general guide for the preservation and handling of samples according to ISO 5667/3 (1994).

RESULTS AND DISCUSSION

Hydrogen potential

The pH depends on the origin of water, the geological nature of the substrate and through watershed [Alexander and Wood 2005, Metcalf and Eddy, INC. 1991]. It is very sensitive to temperature, salinity, and breathing organisms [Arcand et al., 1989].

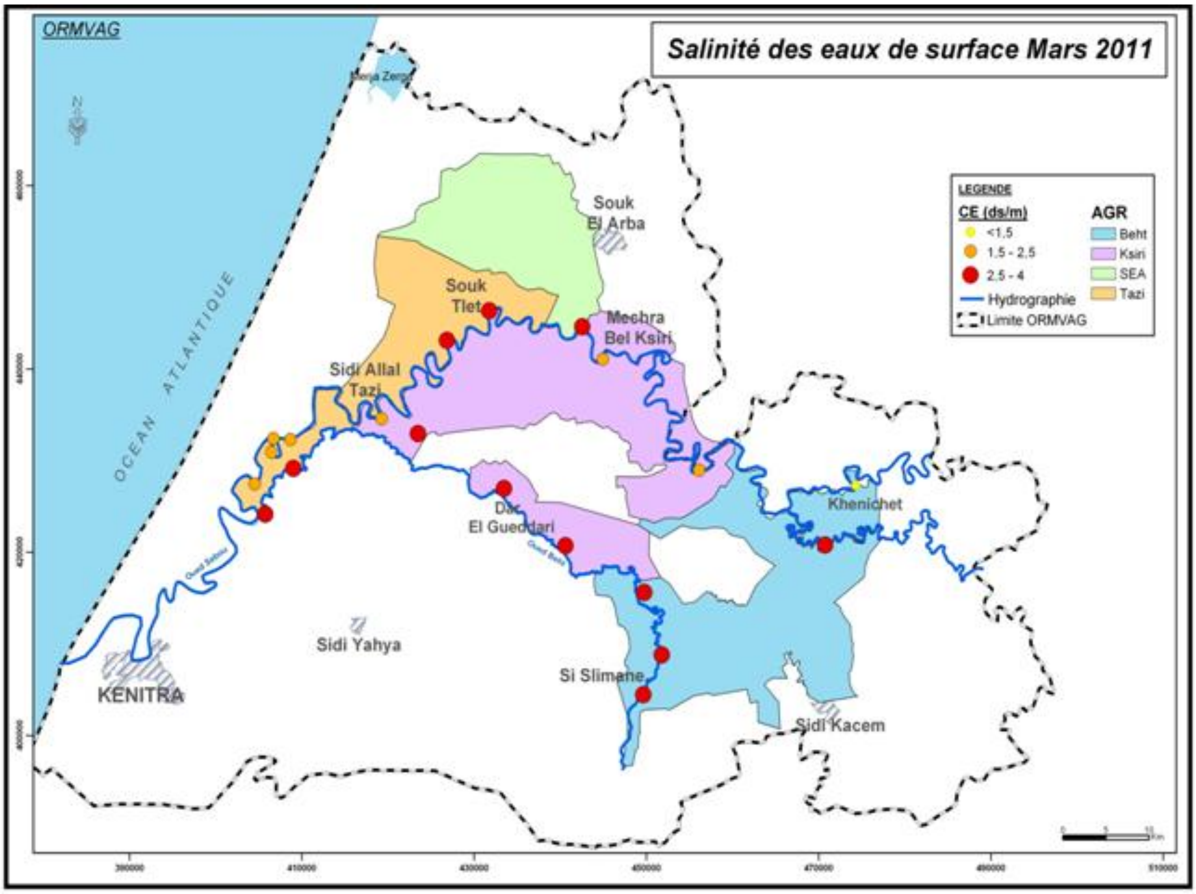

Figure 1. Sampling site map Sidi Tazi Alal wells.

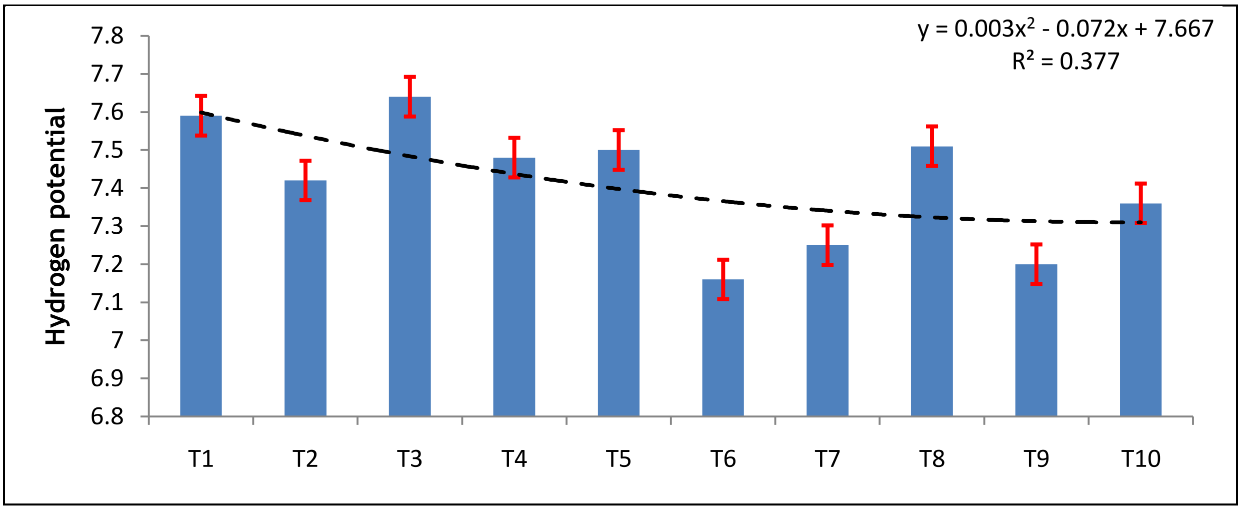

Figure 2. Variation of the stationary hydrogen of potential (pH) well water of Sidi Allal Tazi.

Stationary variations are shown in Figure (2). The regression equation of the evolution of the pH versus sampling stations is kind of polynomial with a coefficient of determination of 0.38. This evolution is marked by slightly basic pH with an average of 7.41.
For irrigation water, generally the recommended pH is between 6.5 and 8.5 [HCEFLCD, 2006] because low pH promotes the growth of filamentous fungi and other responsible

bodies floating sludge [El-Kharmouz, 2013]. The measured pH values are acceptable according to Moroccan standards of the quality of groundwater and which are generally between 5.5 and 8.5 (Ministry of Environment, 2002).

Electrical conductivity (EC)

Electrical conductivity is a good marker of the Origin of water reflects its total mineralization [Khattabi, 2001]. Indeed, the measurement of the conductivity makes it possible to appreciate the quantity of dissolved salts in the water.

Conductivities illustrated in Figure (3) show that a mean value of the conductivity of well water of Sidi Allal Tazi is 1720 µS /cm with a minimum value of 440 µS /cm and a maximum value of 7550 mS/cm.

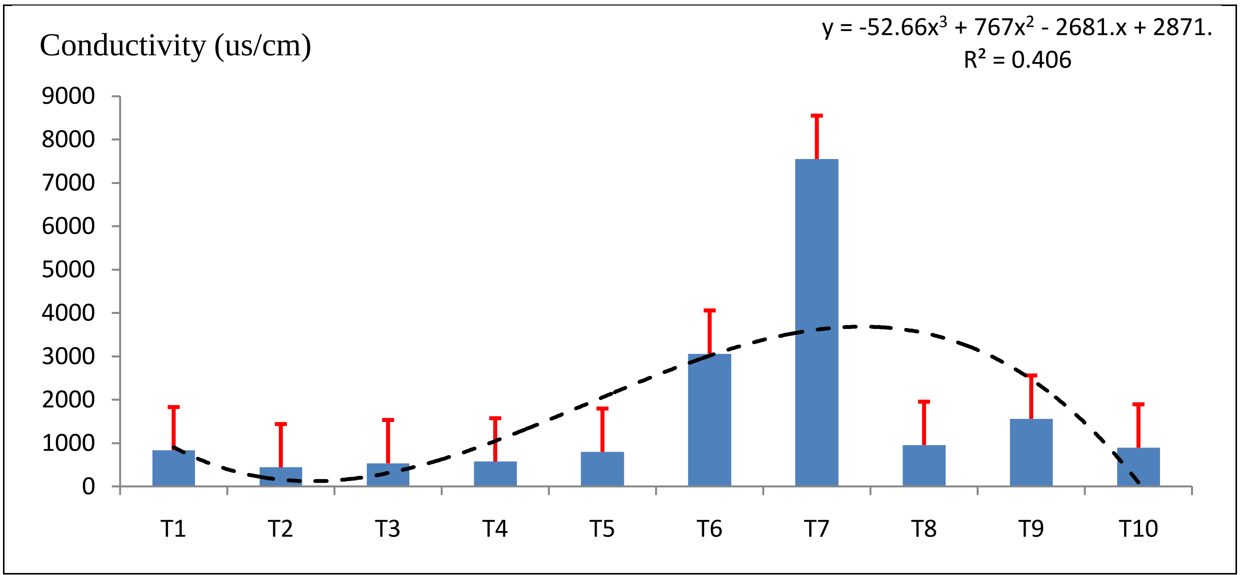

Figure 3. Evolution the electrical conductivity of Sidi Allal Tazi of well water.

This pollution will then spread in the same direction as that of the flow of the water, to reach the wells located wadi near the site. This explains the high conductivity values recorded at the nearest well wadis. These results agree with those obtained [Samake, 2002], and higher than those found by Khattabi [Levallois and Phaneuf, 1994].

Many factors p ourraient locally influence the conductivity of water such as the amount of mineral or organic solids, the physicochemical quality of urban discharges, agricultural or industrial and evaporation phenomenon. The thus determined average value is greater than 2.7 ms/cm, considered direct discharge limit value.

Durete: Calcium (Ca^{2+}) + (Mg^{2+})

The total hardness of water is produced by the calcium and magnesium salts it contains. V stationary aviation hardness of well water is situated in the study area (kénitra region), averaged 222.10 mg/l with a minimum value of 75.92 mg/l and a maximum value of 693.51 mg/l (Figure 4). Analysis of variance well effect "Shows a very highly significant difference between the average annual Ca^{2+} Mg^{2+} studied well (Fisher = 124, 29; p <0.000).

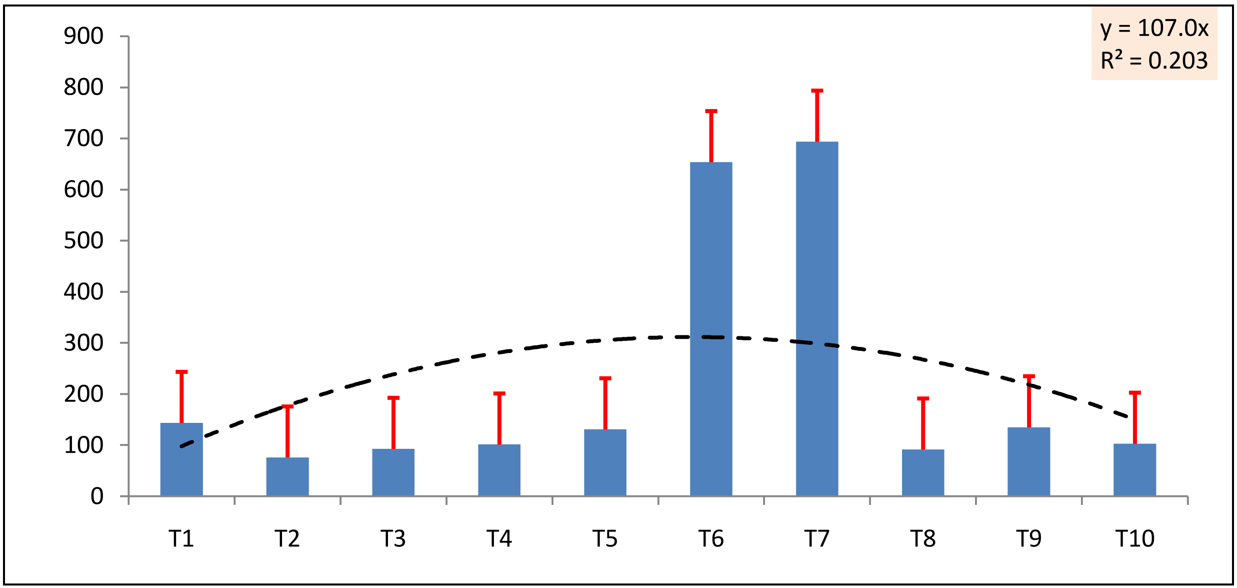

Figure 4. Variation of the stationary hardness mg/l water well.

The evolution of annual and stationary average of the content of Ca^{2+} $Mg^{2+}$is marked by an increase at T6 and T7 wells. This increase begins to decrease to reach minimum values at T8 wells. The correlation therefore has shown very low non-linear (R2= 0.2). In addition, the recorded concentrations far exceed those set as appropriate limits by the Moroccan authorities. These values indicate that the waters are mostly the first two groups are supposed harsh (Figure 4). The total hardness of water is produced by the calcium and magnesium salts it contains. This parameter has a large variation that would be related to the lithological nature of the aquifer formation and in particular to its composition of magnesium and calcium. Rock formations containing divalent metals (Mg^{2+}, Ca^{2+}) responsible for this hardness.

Calcium (Ca^{2+})

The lowest content (64 mg/l) is stored in the T10 wells and a maximum concentration of 464 mg/l is shown in the T6 well (Figure 5).

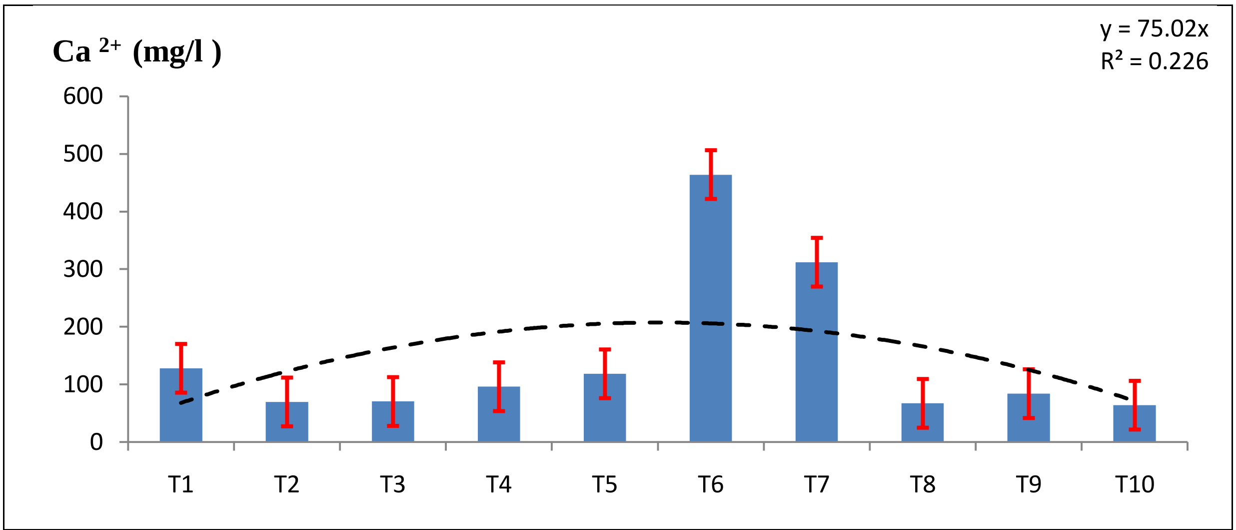

Figure 5. Stationary calcium Variation mg / l of water well.

From Figure (5), these values often exceed accepted standards for drinking water 120mg/l according to Moroccan standards. This reflects a pollution of groundwater by calcium.

3-5-Magnesium (Mg^{2+})

The spatial structure of the concentrations calculated in magnesium on the samples extracted from the 10 wells studied shows a strong heterogeneity between them. In addition, T2 and T4 are well distinguished from the rest by the maximum values that do not exceed 7 mg / l for an average of 5.84 mg/l.

This variation is much lower, while. Nevertheless, T1 wells, T3, T5, T8, T9 and T10 are distinguished from the rest by the maximum values that do not exceed 60 mg/l for an average of 27.45 mg/l. concerning the maximum values recorded in the T6 and T7 wells with an average annual value of 285.52 mg/l (Figure 6).

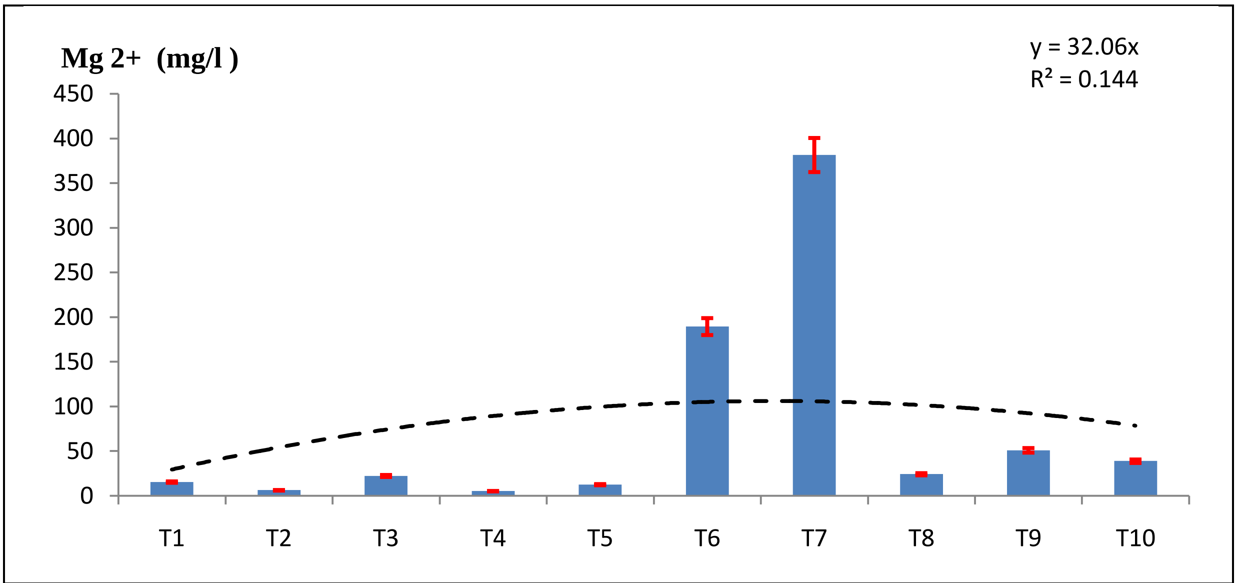

Figure 6. Average Change anneals magnesium (Mg^{2+}) mg/l water well.

The distribution of the concentration of Mg^{2+} as a function of months define a polynomial equation and a low correlation in the order of 0.14. From Figure (6) the highest concentration of magnesium is observed e at T6 and T7 wells with anneals average 285.52 mg/l beyond what the Moroccan standard set at 50 mg/l. (Ministry of the Environment, 2002), this implies a change in the mineralization of waste leaking into the groundwater village of Sidi Allal Tazi.

Sodium (Na^+)

The representation of the distribution of the sodium contents in the studied wells showed a strong dispersion, in addition, the has average annual value sodium Illustrated to the wells is 240 mg/l, the maximum concentration (644 mg/l) is recorded in the T9 well (Figure 7).

Despite the differences in concentrations displayed, the annual average comparison of the wells studied with the standard of ISO 11885 ICP-QES which sets the amount of Na^+ in 200mg/l finds that we result exceeds the standard. This may be due to the direct effect

of releases that are continent fairly large amounts of sodium, and also the strong use of the latter in the field of el agriculture.
The SAR calculated in our sample gave a value greater than 9. So the water is not recommended for use irrigation (6.0 <SAR <9.0).

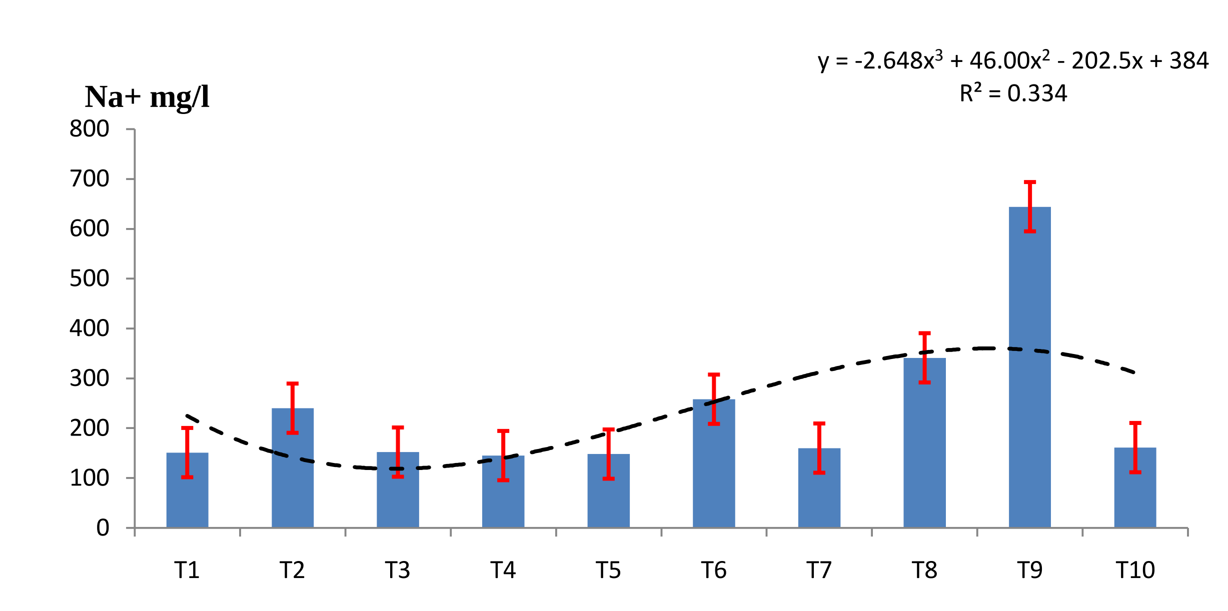

Figure7: annual and seasonal variation of the sodium (Na+)mg / l well water

L'ammonium (NH4+)
Ammonium is a nitrogenous compound whose presence in drinking water results from contamination mainly related to domestic and industrial effluent discharges or a natural reduction of nitrates. The variation of ammonium and remains zero, it complies with Moroccan standards then can classify it waters of the great class.

Chloride (Cl-)
The waters rich in chlorides are laxative and corrosive. The concentration of chlorides in the water also depends on the terrain crossed.
The annual average chloride per well is shown in Figure (8). The maximum value is 728 mg/l recorded in well water T6 and the minimum value is 60 mg/l displayed in well T2
According to the figure (8), The Evolution of the chloride content in the wells study takes no pace (R2= 0.37).
According to Moroccan standards for water quality, the maximum recommended chloride concentration (CMR) is 300 mg/l). A while after our results the average value annel chloride does not exceed the standards.

Nitrates (NO3-)
Nitrates are present in water by leaching of nitrogen products in the soil, by decomposition of organic matter or synthetic fertilizers or natural resources [HCEFLCD, 2006]. Nitrogen is an indispensable element in the construction of the cell.
The average of the content of NO_3 as a function of the wells is 43.35 mg/l, with a maximum value of 120 mg/ l noted in the T5 wells and a minimum value of 1 mg/l recorded in the well T6 (Figure 9).

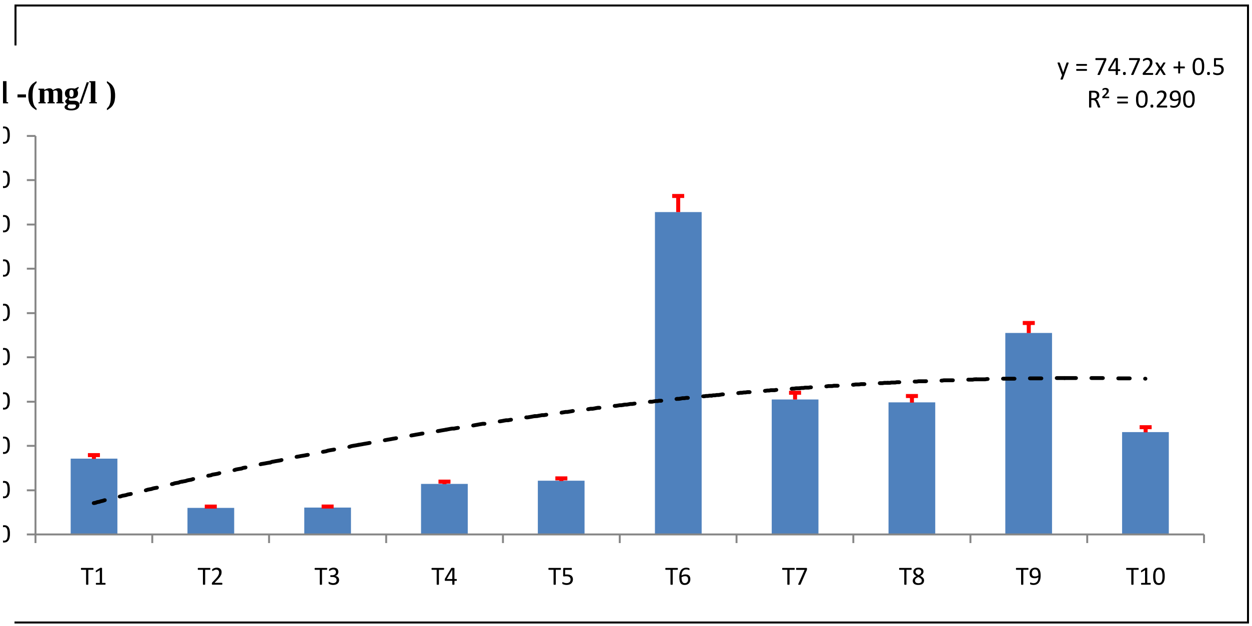

Figure 8. Annual variation Chloride (Cl^-) mg/l water well SIDI ALLAL TAZI.

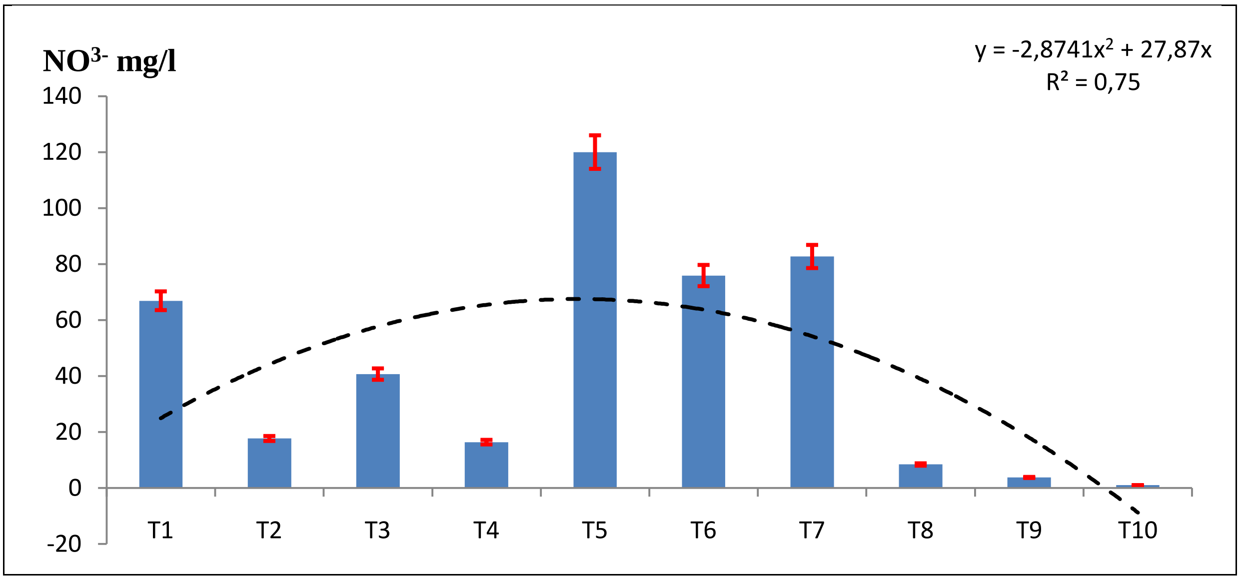

Figure 9. Annual and seasonal variation of nitrate (NO_3^-) mg /l water wells.

The evolution of the content of NO_3 in terms of months shows that these two variables are highly correlated (R2= 0.75).

Many authors have conducted studies at the M'nasra area [Khattabi, 2001] have confirmed that 74% of 189 wells sampled show levels exceeding 50 mg/l.

Research efforts are then focused on cultural practices that reduce the amount of chemicals such as nitrates and pesticides. Indeed, the results found meet Moroccan standards (45 to 50 mg/l), and according to the grid groundwater, they are classified average quality (25-50 mg/l) to poor (50-100 mg/l).

Sulphate (SO_4^{2-})

Sulphates (SO_4^{2-}) from runoff or infiltration into gypsum MTB. They also result from the activity of certain bacteria (chlorothiobacteria, rhodothiobacteria, etc.). This activity can oxidize sulphuretted hydrogen sulphide (H_2S) to sulphate [Levallois and Phaneuf, 1994].

The stationary variation of sulphate ions ranges from 10 mg/l and 534 mg/l, with an average of around 100.93mg/l (Figure 10).

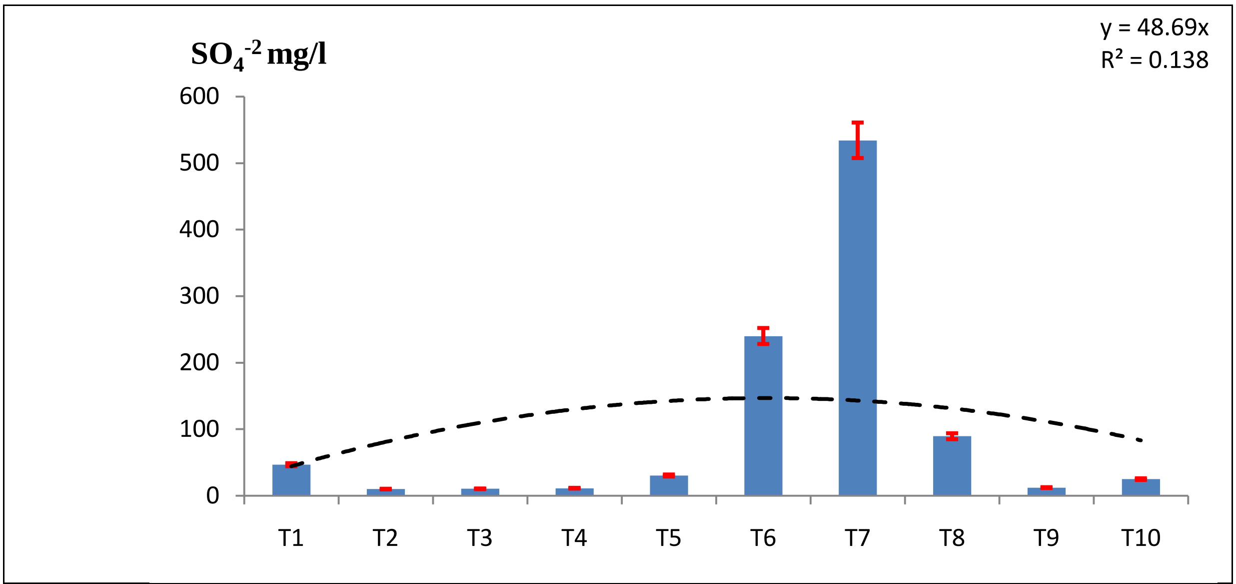

Figure 10. Annual and seasonal variation of s ulfate (SO_4^{2-}) mg / l of well water.

By against the maximum allowable value is set to 400 mg/l according to Moroccan standards potability of water, so the values of the area of Sidi Allal Tazi do not exceed the maximum permissible value.

The TAC of water varies during the study than 2.6 mEq/L to 11 mEq/L (Figure 11) .The TAC is a factor indicators of the presence of carbonate ions, bicarbonates, hydroxides. The values obtained are generally stable, and based on the pH values which are always lower than 8.3 (TA=0), then the TAC values represent only the concentrations of bicarbonates.

During our study TH values range between 4 mEq/l to 47 mEq/l (Figure 12), we see that the TH values obtained are generally high because the groundwater is in contact with rock formations containing divalent metals (Mg^{2+}, Ca^{2+}) responsible for this hardness.

Statistical Analysis of physicochemical parameters Main components (ACP)

Descriptive statistics

We statically studied physicochemical data by principal component analysis (PCA). This factorial method based on the hierarchical analysis of the correlations between the variables whose reduction of the number of characters is done by the construction of new synthetic characters or principal components is obtained by linear combination of the initial characters, it is widely used in the field of biology.

The kaiser criterion leads us to retain the first two components, because they alone absorb 77.94% of the total inertia. Each cloud of points (variables and individuals) is constructed in projection on the factorial planes: a factorial plane is a reference of the plane defined by the two factorial axes retained. The examination of the factorial plan will make it possible to visualize the correlations between the variables and to identify the groups of individuals having taken close values on certain variables.

The complete alkalinity (TAC)

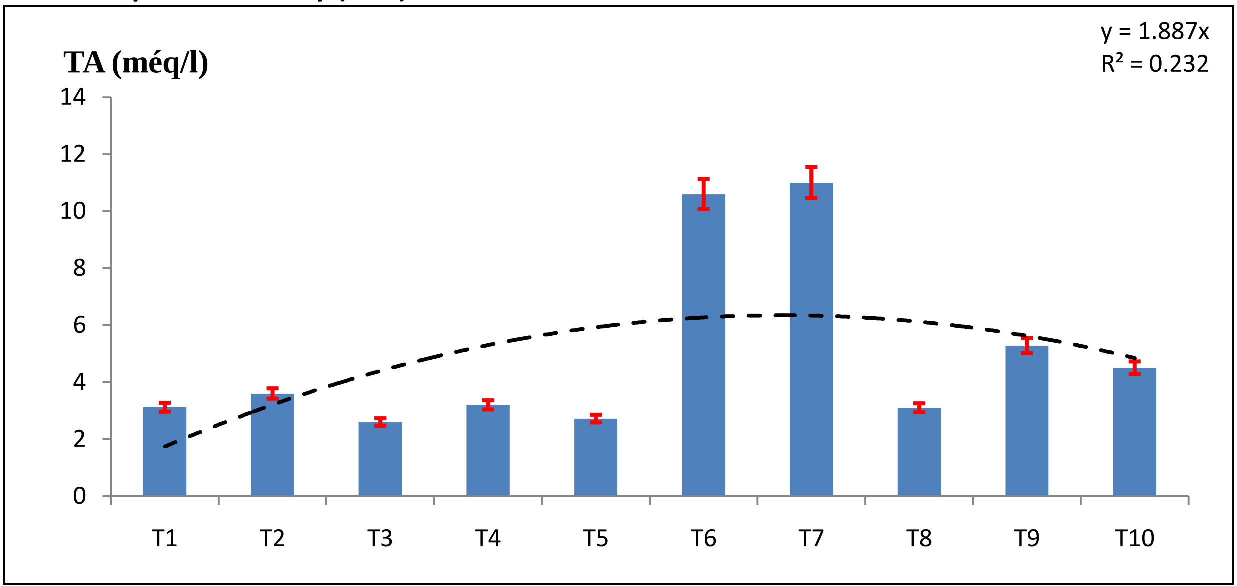

Figure 11. Change the complete alkalinity based on samples.

Total hardness (TH)

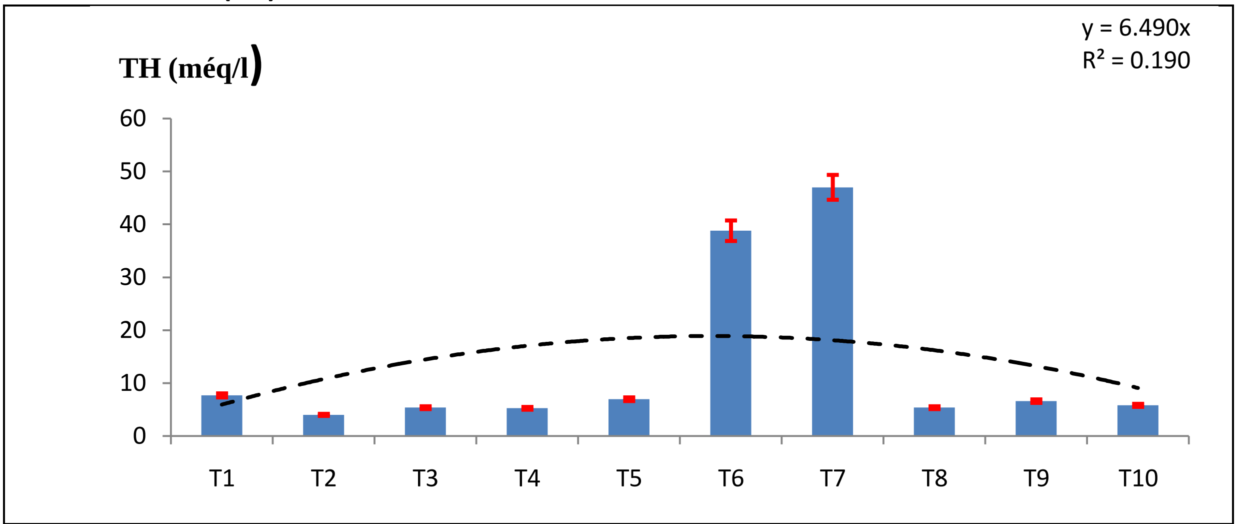

Figure 12. Anneals average variation of total hardness.

According to the diagram of components in the space after rotation, the physicochemical parameters form with the axis 1 a percentage of inertia equal 61.64%, However, for the axis 2 forms a percentage of inertia 16,3%, two opposite groups of variables (Figure 13): those that contribute positively to the axis 1 (NO_3-, Cl-, Mg^{2+}, Cond, TA, TH, Duration, Ca^{+}), those which contribute negatively (pH, Fe, Tur, Na^{+}). Moreover, these parameters form a single group of correlated variables and according to their coordinates we can say that the following parameters contribute better to the formation of new components after rotation (These are the ones that have a large coordinate in absolute value on the axis.)

Figure (14) shows the cloud of individuals (wells) that contribute most to defining two axes 1 and 2. Therefore, the axis 1 opposes the wells 21, 22 and 23 having a high concentration of Mg^{2+},Na^{+},NH^{4+};Cl^{-},$SO_4^{2-}$and NO_3^{-},with the remaining wells, which are characterized by medium or low levels of these parameters. Indeed, wells 13 and 21 represent the two extreme sites, the first to be exploited beforehand for irrigation the second is not authorized for exploitation.

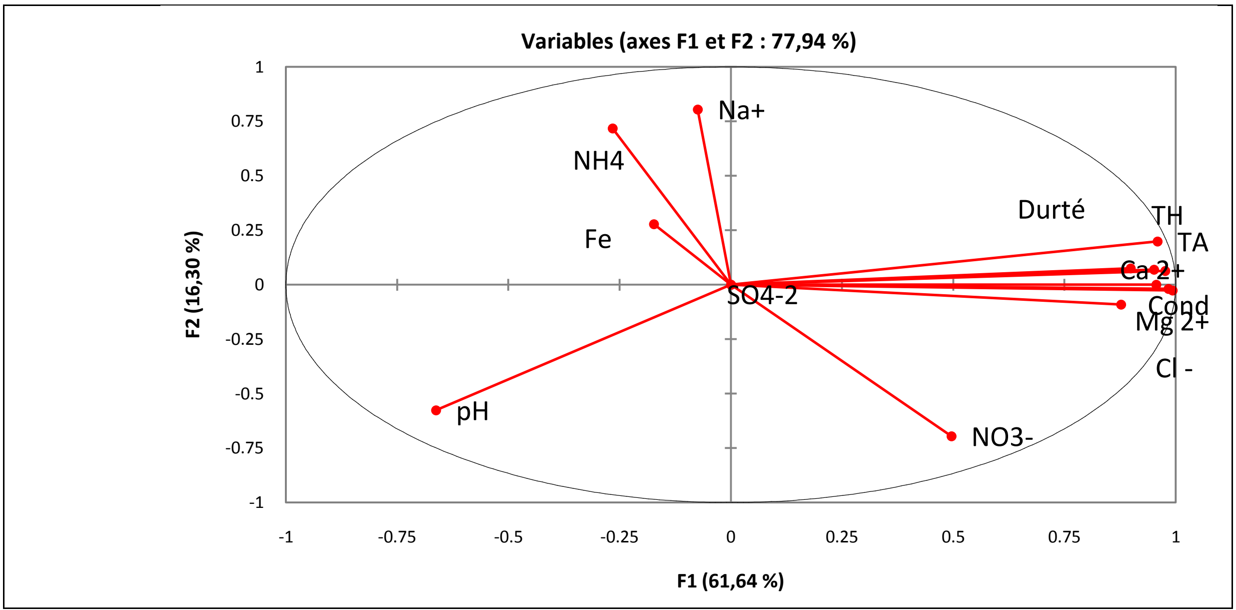

Figure 13. Screening of the physico-chemical variables on the two axes F1-F2.

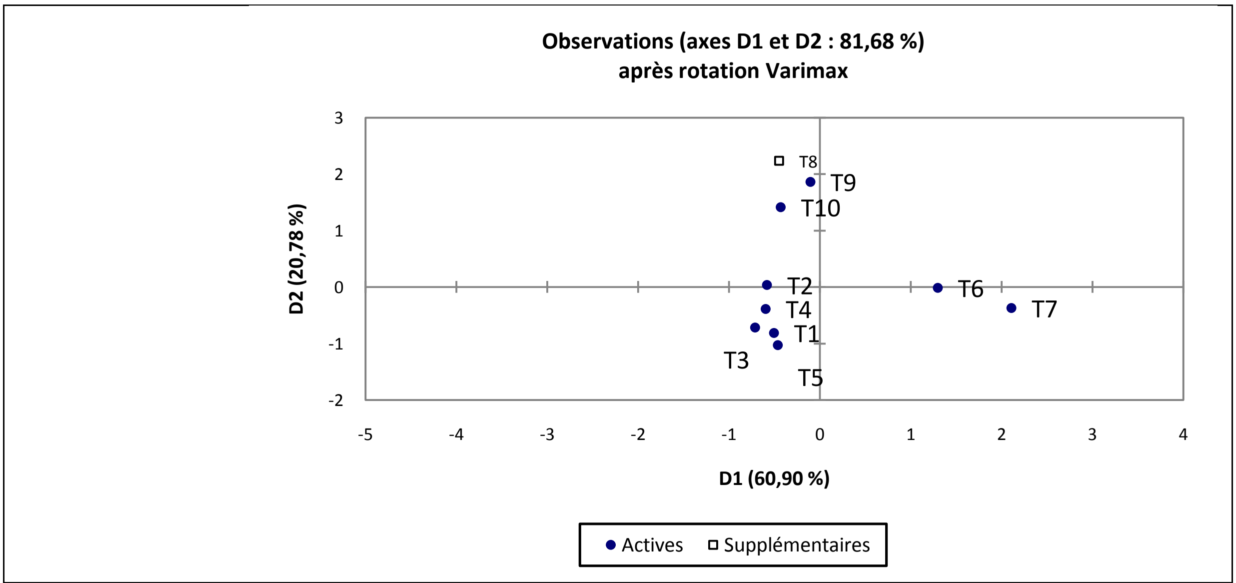

Figure 14. Screening of individuals (wells) on the two axes 1 and 2.

CONCLUSION

Water resources are threatened today by pollution that causes the deterioration of water quality. The superficial pollutants can infiltrate through the ground towards the aquifers. The danger of pollution depends on the types and concentrations of pollutants.

The physicochemical quality of the groundwater of 10 wells in the SIDI ALLAL TAZI-Gharb-Morocco region was assessed while carrying out the analyzes of the 12 physicochemical and chemical parameters in the ONEP laboratory. The results of some parameters analyzed do not respect the standards of the directive of WHO. So, in general, the physicochemical quality of the groundwater in the study area is relatively average.

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