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Physical and chemical parameters of groundwater area agricultural Sidi Abdelrrazak (province of Khemisset)

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Abstract
The Sidi Abdelrazzak zone (province of Khemisset) is an agricultural zone, whose population supplies water starting from water of well. This even underground water is vulnerable to agricultural, industrial pollution from where health risks in the area thus .This study is important and will be thus based on the analysis of the physicochemical parameters of 20 wells and 2 sources and of the Targisst River .The results revealed that the Tagrisst River shows a certain hydraulogical and chemical stability. On the other hand the wells testify to a variable and notable presence of an organic load related to the productivity of these wells by the development of phytoplankton or the zooplankton. For nitrates the analysis allowed us to raise an appreciable presence, particularly on the level of P13 (29 mg/l) in relation to the productivity recorded in these wells (presence of organic matter), This study requires a follow-up of the quality of ground waters by spreading out the field of study to the neighbouring rural communes in order to make sure of this quality for demolished medical population.

Keywords: quality, groundwater, physicochemical parameters, impact, Khemisset, Morocco.

1- Introduction
The groundwater is a treasure which should be protected because of its indispensability to life. It is very much used for captaining drinking water, for industry and for agriculture, even hidden and invisible, is fragile and often vulnerable to the many sources of industrial and agricultural contaminations [1]. Its pollution can be dangerous for human health [2] and the good progress of these activities. The ground waters provide the basic flow of a good amount of Rivers and can thus influence the quality of surface water [3]. The objective of this study is to evaluate the quality of ground waters of the agricultural Sidi Abdelrrazak zone (province of Khemisset), by the follow-up and the analysis of certain physical and chemical tracers .Thus 20 wells (P1 to P20) were listed and two sources (S1 and S2) S1: source Magronate and S2: source Sidi Athmane and a point on the level of the Tagrisst River. View the importance of groundwater quality for the health of the population and its relationship with all the rings of the food chain that interfere. This study will be flush with the agents of this pollution and propose some suggestions for good prevention of our environment

2-1 Introduction to the study area
The rural district Sidi Abdelrrazak belongs to the command of the province Khemisset within the area Rabat-Salé-Zemmour-Zaër. It is with 18km to Tiflet city and 70km to Rabat (**figure1**). In the community of Sidi Abdelrazzak, the ground waters constitute an important water resource

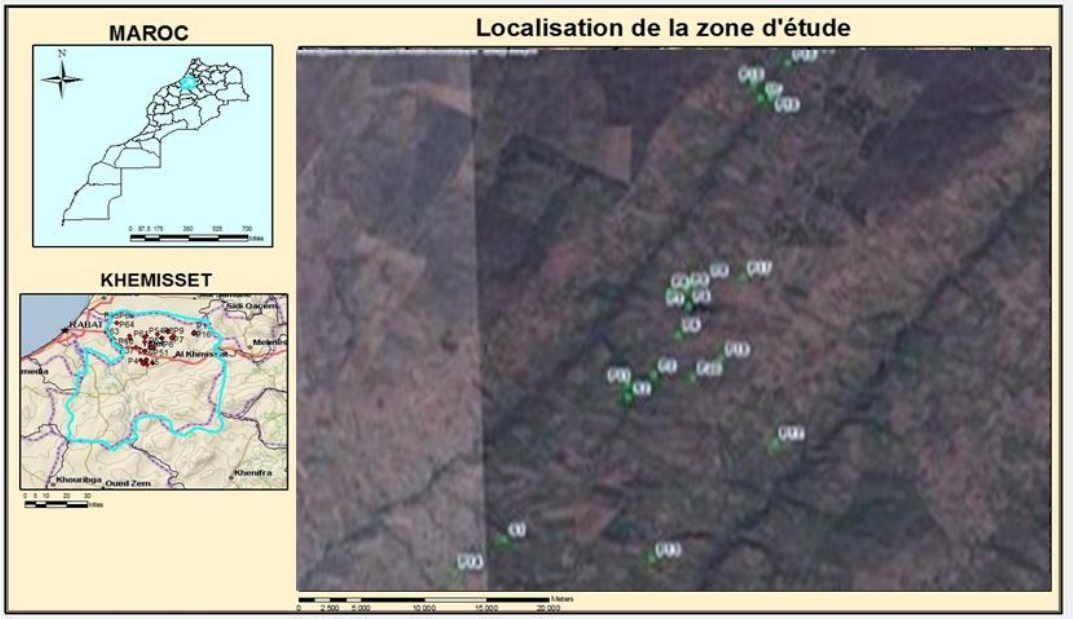

Figure 1: Location of the study area (A) and sampling points (C)

2-2 Analytical Protocol

The Statements of these physico-chemical parameters pH, T°, Salinity, TDS, and conductivity were carried out on the ground using a multiparameter of analysis Models Consort C561. The other parameters MES, COT, NO3, DCO [4], DBO5 were analyzed using a specific device of PASTEL UV SECOMAM type at the National Hygiene Institute in Rabat

2-3 Statistical Data Processing

This treatment was made using the ACP which allowed to synthesize information while basing on the reduction the number of the character and the simultaneous construction of new synthetic character [5]. The ACP [6] particularly illustrates the correlations between the variables [7]. This ACP is carried out on a matrix of the data made up of 23 samples in which 10 variables (temperature of water, pH, salinity, conductivity, salinity, suspended matter, total organic carbon, nitrates, chemical oxygen demand and biological oxygen demand) were measured

3-Results and discussions:

3-1-physical and Chemical Characterization of Groundwater

The results of the physico-chemical analyses are represented in Table 1 and The whole of the results will be discussed according to the MOROCCAN STANDARDS (2002) (official Bulletin N° 5062 of the 30th Ramadan 1423 which sets the norms of potability in human consumption) [8] and WHO [9].

3-1-1-water temperature:

The water temperature is a parameter of major importance in the lives of aquatic ecosystems. It has an influence on many physical, chemical and biological processes [10].

The values obtained are between 18 °C like minimal value and 24.2°C as maximum value recorded on the level of the Tagrisst River whose water blade does not exceed a depth of 30 cm and consequently reflects the effect of the temperature of the air. However, this variation does not seem to be related to the depth (**figure 2**).

3-1-2 water pH:

The pH of water summarizes the stability of balance established between the various shapes of carbon dioxide related to the origin of water, the geological nature of the crossed medium It depend on the temperature, of salinity and of the rate of CO2 [11]. Thus it was shown that the mineralization of the organic matter causes a fall of the pH [12]. pH thus results from the ionic composition of water and primarily of the presence of carbonates .

Table 1: Results of physical and chemical analyzes of groundwater (wells and Tagrisst River)

wells	Depth (m)	pH	T°C	Salinity (mg/l)	TDS (g/l)	Conductivity (µs/cm)	MES (mg/l)	COT (mg/l	NO3 (mg/l	DCO (mg/l	DBO5 (mg/l
P1	17	7.64	18.2	0.3	0.41	780	236	8.3	11.5	29	10.8
P2	28	7.78	20.4	0.2	0.77	520	55	1.9	18	6.7	2.5
P3	26	7.73	18.4	0.2	0.3	580	182	6.3	14.7	22.2	8.3
P4	2O	7.58	22.5	0.2	0.31	590	28	3.1	20.2	10.5	3.9
P5	24	7.58	21.3	0.2	0.27	510	99	3.4	17	12.1	4.5
P6	30	7.44	22.4	0.3	0.35	650	208	7.2	15.8	25.4	9.5
P7	30	7.54	21	0.3	0.37	690	290	10.2	9.6	35.5	13.3
P8	26	7.49	21.2	0.2	0.27	510	35	3.8	14.1	11.4	4.2
P9	22	7.63	21.7	0.1	0.21	400	182	6.3	10.6	22.2	8.3
P10	3,5	7.45	18	0.4	0.47	890	202	7	17.4	24.8	9.3
P11	26	7.58	22.4	0.3	0.38	740	296	10.4	6.1	36	13.6
P12	28	7.49	21.4	0.3	0.4	760	226	7.8	13.7	27.6	10.3
P13	20	7.49	20.1	0.3	0.35	660	224	7.8	29.2	27.4	10.3
P 14	28	7.44	20.1	0.3	0.39	750	109	3.8	10.1	13.4	5
P15	38	7.39	22.5	0.3	0.37	700	258	9	19	31.5	11.8
P16	24	7.3	20.1	0.6	0.7	1330	236	8.3	15.2	28.8	10.8
P17	27	7.39	22.8	0.3	0.35	660	244	8.5	1.4	29.8	11.2
P18	28	7.63	21.6	0.2	0.32	610	232	8.1	18	28.4	10.6
P19	22	7.49	20.1	0.4	0.45	860	330	11.6	15.2	40.5	15.2
P20	28	7.77	21.6	0.1	0.22	410	305	10.7	5.5	37.5	14
S1	-	7.35	18	0.3	0.37	710	23	3.7	15.2	11.4	4
S2	-	7.31	18.1	0.4	0.49	940	246	8.6	6	30.2	11.3
Tagrisst River	30 cm	7.85	24.2	0.8	0.93	1760	32	6.2	2.6	16.6	8.7

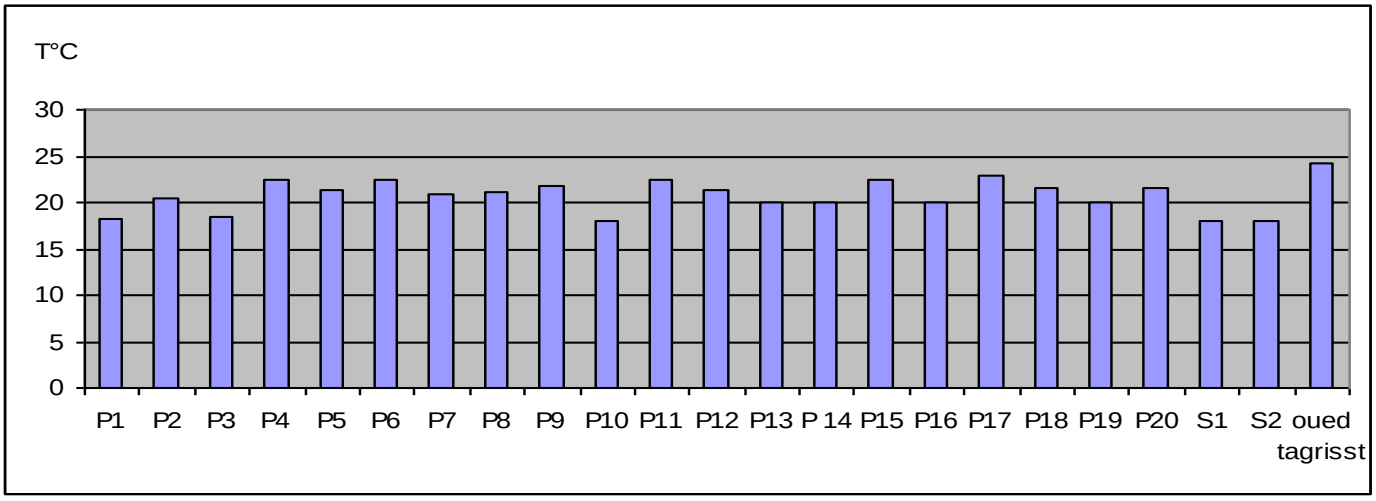

Figure 2: Evolution of temperatures in the different wells (P), source (S)and tagrisst River(oued tagrisst)

Generally the measured values of pH(**figure3**) are of a light alkalinity. They range between 7.30 like minimal value and 7.85 like maximum value recorded in the Tagrisst River (tagrisst oued).

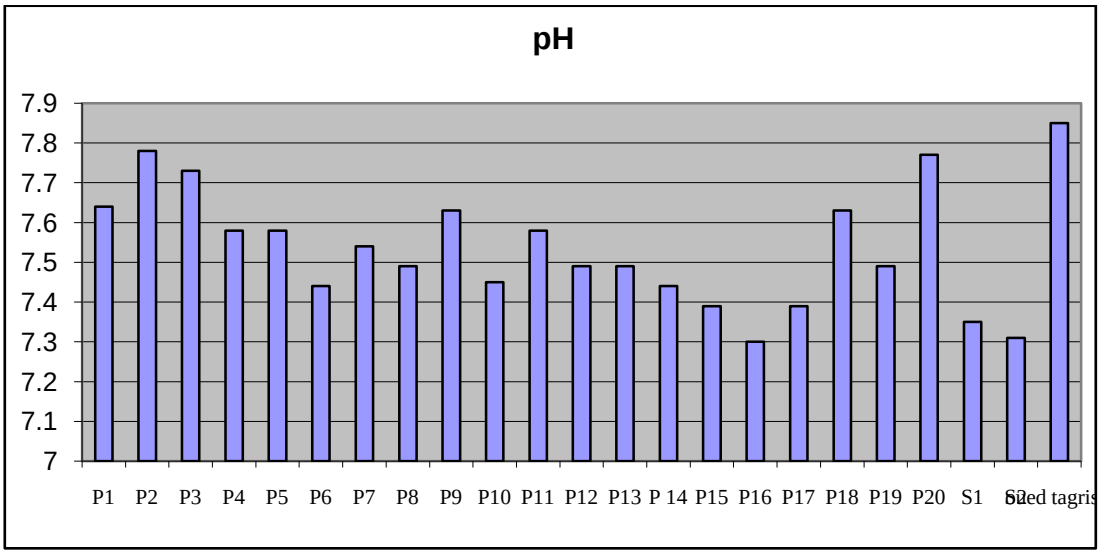

Figure 3: the spatial evolution of the pH of the samples

3-1-3 Electrical conductivity and salinity

Conductivity gives an idea of the mineralisation of water and is thus a marker of the Origin of water (HCEFLCD, 2006) [13]. All the dissolved elements are thus ionized and contribute to the water conductivity [14].

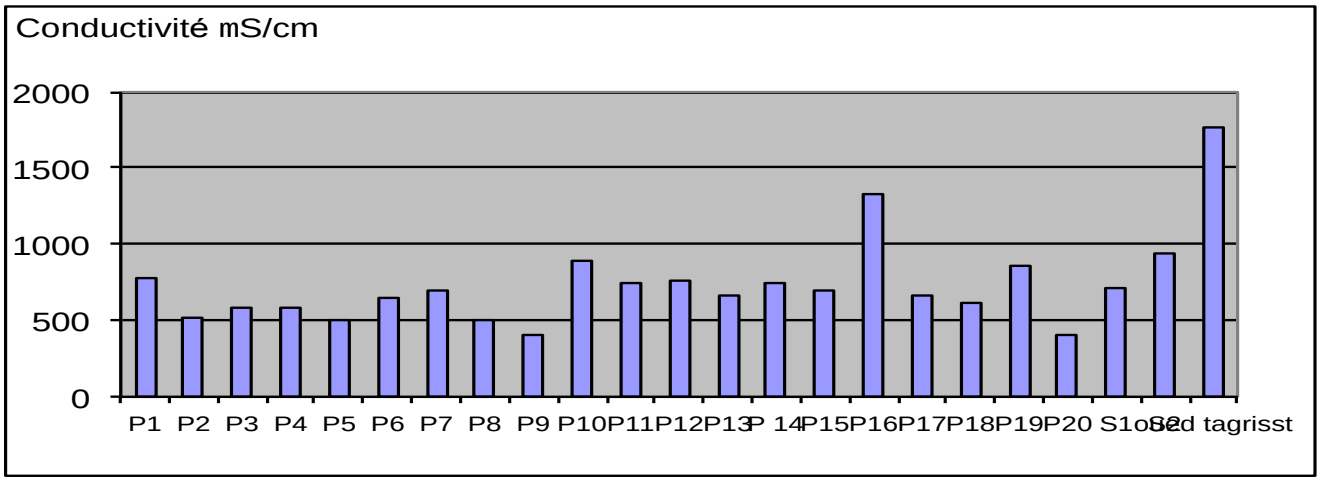

Figure 4 - Spatial variation of the conductivity on groundwater.

The analysis of the evolution of the conductivity (**figure4**) can distinguish three classes according to Moroccan standards (Table 2):

1- Excellent class whose value is less than 750 µs/ cm. These are wells 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 14, 15, 17, 18, 20 and the source S1
2- Good class whose conductivity is between 750 and 1300µs/cm. It includes Wells 1, 10, 19, and the source S2.
3- Middle class whose conductivity is between 1300 and 2700 µs/ cm , two points represent this class oued Tagrisst and well 16 .

In addition, the evolution of these parameters is similar to that of salinity [15] and highlights the role of the effect of geological nature on the quality of water. This influence is very visible with the level of the Tagrisst River where mineralisation is highest in relation to the scrubbing of the grounds bordering (argillaceous and marly ground) and the haulage of dissolved salt water strongly charged (**figure 5**).

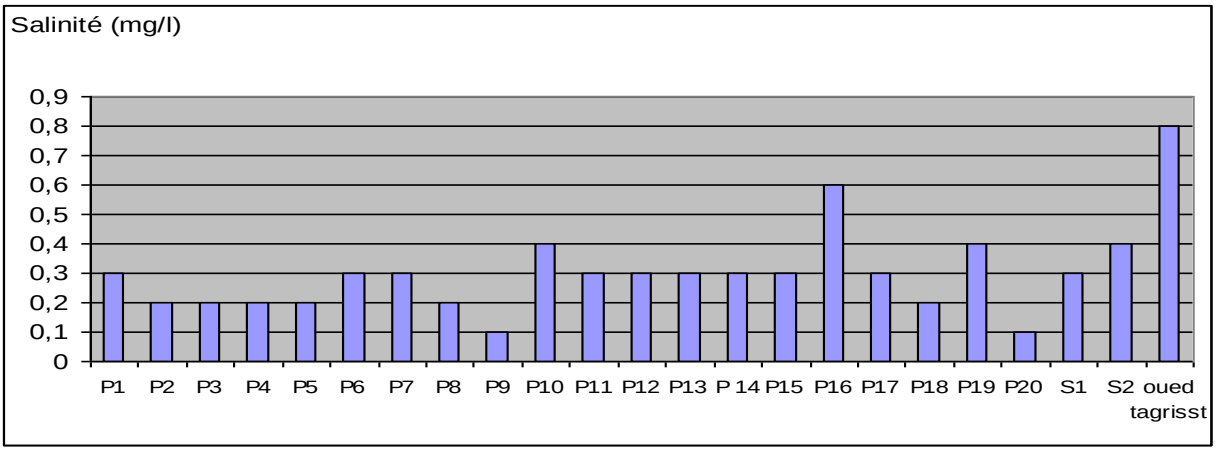

Figure 5 - Spatial variation of salinity in groundwater and tagrisst River(oued tagrisst).

3-1-4 T. D. S.

TDS represents the total concentration of the dissolved substances in water [16] the values of TDS measured in our samples classify water in the excellent category with good (values ranging between 0.3 - 0.6 g/l) (**figure 6**). Only the wells 2, 16 and the Tagrisst River are located in the passable class (0.93 g /l). This result gives information about well 16 and the Tagrisst River with the very mineral-bearing nature of water, on the other hand for well 2 with probably a development of the dissolved organic matter (productivity of water).

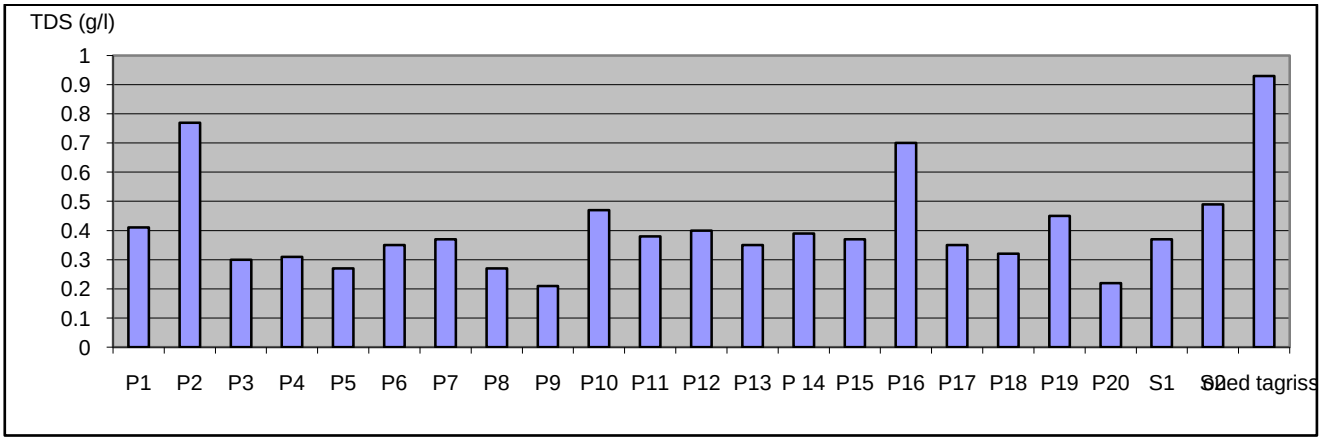

Figure 6: Spatial variation of the TDS (g / l) in groundwater and tagrisste River(oued tagrisst)

3-1-5-Suspended solids (MES) and total organic carbon (COT)

In water, the MES [17] can come either from the effects of natural erosion from the area catchment following violent precipitations, or urban or industrial waste water rejections, or of a strong productivity of micro-organisms (phytoplankton or zooplankton).

The COT is the percentage of carbon related to the organic matter. It represents the sum of the dissolved organic matters and those in suspension. It is an important composite parameter in the determination of the organic contamination of water. All the values obtained in this study (**figure7**) do not exceed standard 30 mg/l, thus a good quality. It varies between 1.9 mg/l (P2) and 11.6 mg/l (P19). However, the similarity of variation between the MES and the COT confirm the good presence of matter of natural organic origin (productivity or the anthropogenic).

The values of MES (**figure 8**) vary between 23 mg/l (source 1) (excellent class) and 330 mg/l (middle class) recorded on the level of P19. The value recorded on the level of the River shows a certain hydrological stability in this River. On the other hand the wells testify to a variable and notable presence of MES which could explain the presence of productivity in these wells by the development of phytoplankton or the zooplankton. The organic contamination of these wells is not to draw aside.

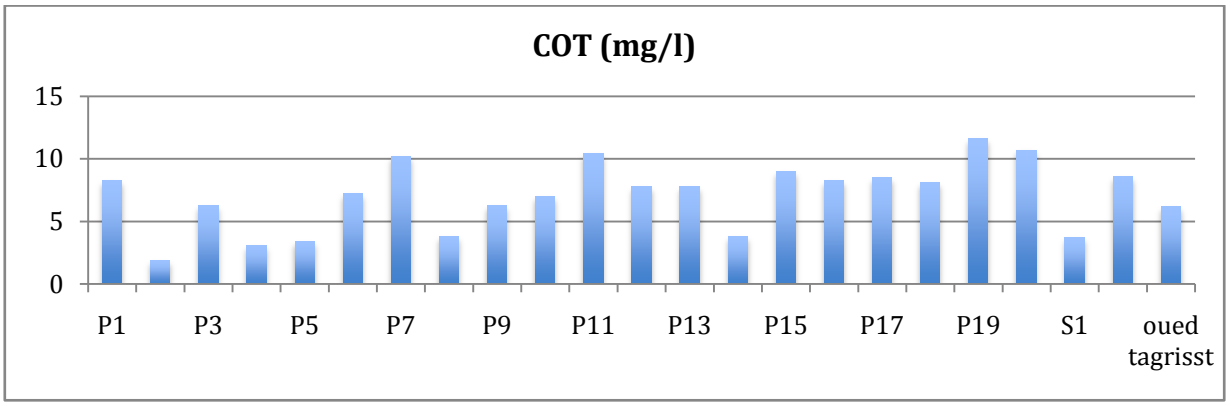

Figure 7: Spatial variation COT in groundwater levels and River Tagrisste(oued tagrisst)

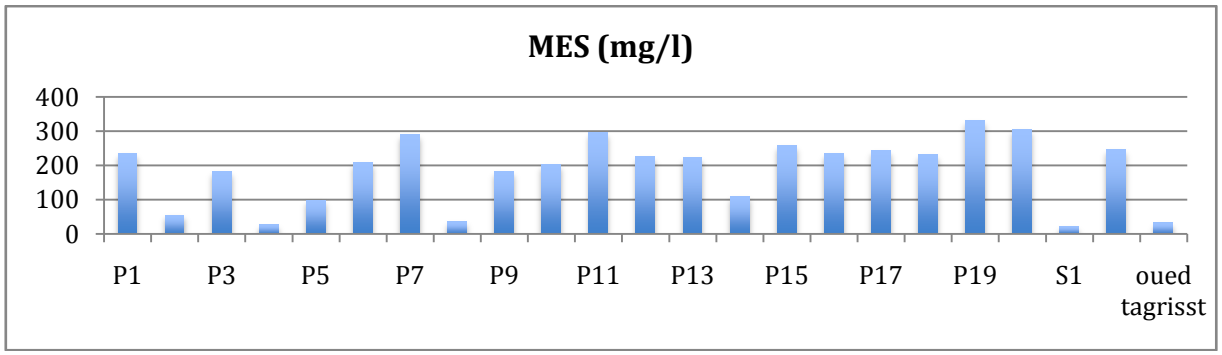

Figure 8: Spatial variation MES in groundwater levels and Tagrisste River(oued tagrisst)

3-1 6- Biological demand and chemical oxygen (DBO5) / DCO) and nitrate

Many studies of the quality of groundwaters highlighted pollution by the nitrates and elements of metalic traces, [21]. The effect of nitrates on the human health was the object of very many studies at the origin of the current regulation (WHO). The introduced nitrates are excreted by the organism, are or transformed into nitrites by reduction under the influence of a denitrifying action [22]. The nitrites can then involve the formation of methemoglobin or made up N-nitrosated famous carcinogens, compound 75% of the nitrosamines have a carcinogenic power [23]. The nitrites oxidize the ferrous ions of haemoglobin in ferric ions. haemoglobin is transformed then into methemoglobin, which is unable to transport oxygen to the cells. Various symptoms appear being able to evolve to death by cellular anoxia [24].The international and Morrocan standards stipulate that the content nitrates of drinking waters should not exceed the concentration of 50 mg/L. The majority of the recorded values are lower than the acceptable value for drinking waters (**figure9**). However, an appreciable presence of nitrates is to be raised particularly on the level of P13 (29 mg/l) in relation to the good productivity recorded in these wells (presence of organic matter). In addition, the very low value recorded on the level of the Tagrisst River shows the good self-purification of this area (high temperature, presence of vegetation, etc).

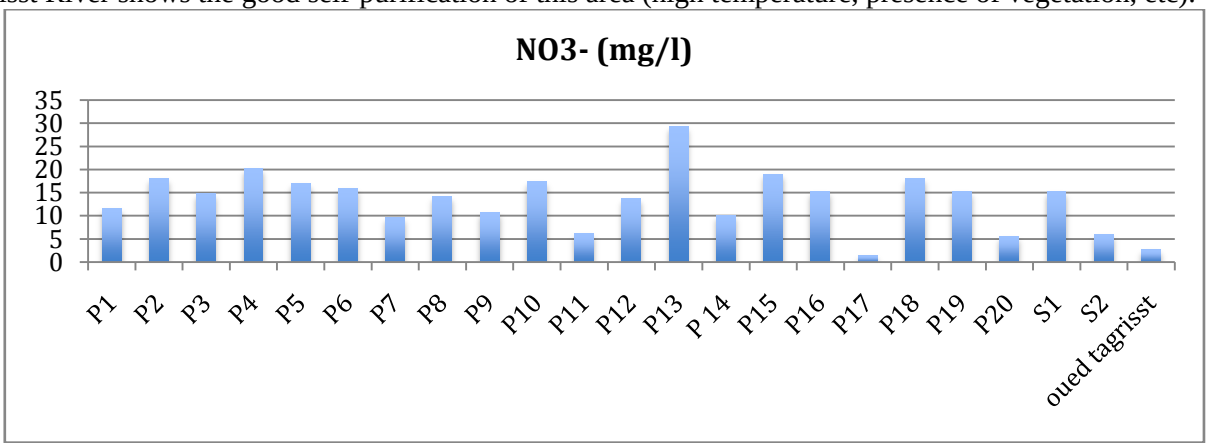

Figure 9: The spatial evolution of nitrates in groundwater and Tagrisst River (oued tagrisst)

The DBO reflects the quantity of oxygen necessary for the degradation of the biodegradable organic matter by the development of micro-organisms [18]. The values recorded for the DBO5 (**figure10**) indicate a notable presence of the organic matter particularly for wells 7.11, 19 and 20. For the rest, the quality is average for the DCO, the values are higher. They are located between the excellent class (the majority of the wells) and bad (P19). The Report DBO5/DCO is of the order of 0.3 allows us to conclude that water of the wells is charged enough by inorganic components not very biodegradable.

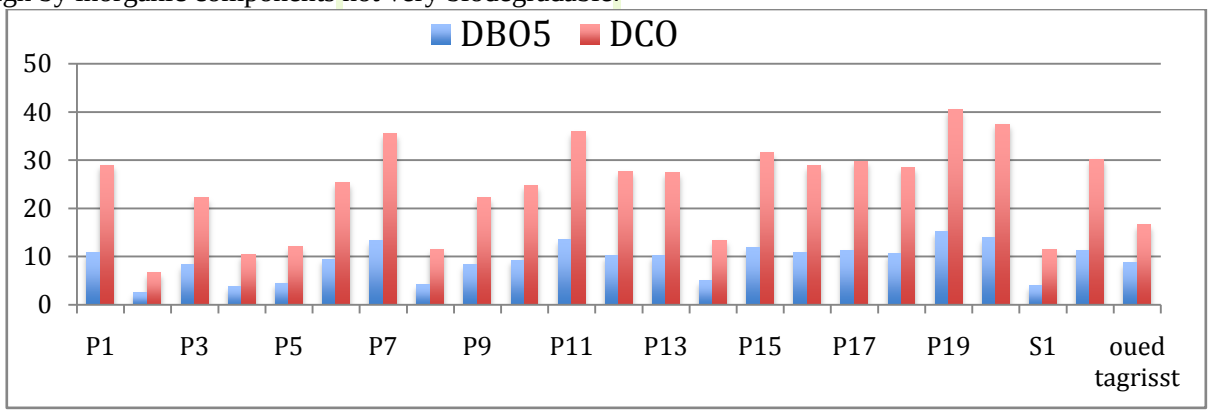

Figure 10: The spatial evolution BOD5 level of groundwater and Tagrisste River (oued tagrisst)

Table 2: Classification of the wells, S1, S2 and the tagrisst River according to quality physicochemical parameters

wells	depth m	TDS (g/l)	Conductivity µs/cm	MES mg/l	COT mg/l	NO3 mg/l	DBO5 mg/l	DCO mg/l
P1	17	good	good	average	good	good	bad	Excellent
P2	28	good	Excellent	good	good	good	Excellent	Excellent
P3	26	good	Excellent	good	good	good	average	Excellent
P4	20	good	Excellent	Excellent	good	good	good	Excellent
P5	24	good	Excellent	good	good	good	good	Excellent
P6	30	good	Excellent	average	good	good	average	Excellent
P7	30	good	Excellent	average	good	good	bad	average
P8	26	good	Excellent	average	good	good	good	Excellent
P9	22	good	Excellent	average	good	good	good	Excellent
P10	3,5	good	good	average	good	good	average	Excellent
P11	26	good	Excellent	average	good	good	bad	average
P12	28	good	good	average	good	good	bad	Excellent
P13	20	good	Excellent	average	good	good	bad	Excellent
P 14	28	good	Excellent	good	good	good	average	Excellent
P15	38	good	Excellent	average	good	good	bad	good
P16	24	good	average	average	good	good	bad	Excellent
P17	27	good	Excellent	good	good	good	bad	Excellent
P18	28	good	Excellent	average	good	good	bad	Excellent
P19	22	good	good	good	good	good	bad	bad
P20	28	good	Excellent	average	good	good	bad	Excellent
S1	-	good	Excellent	Excellent	good	good	good	Excellent
S2	-	good	good	average	good	good	bad	good
Tagrisst River	30 cm	bad	average	Excellent	good	good	average	Excellent

According to the classification only some points have a good quality to excellent (P2, P4, P5, S1).

Nitrates (NO_3) are present naturally in water. They result indeed from the natural cycle of degradation of the organic matter [19]. However, contributions due to the farmings (fertilizers and breedings), [20] industrial and domestic (untreated rejections), remain dominating.

2.3-Assessment of the groundwater quality

With an aim of releasing an assessment of the quality of these groundwaters [25] we subjected the whole of the physico-chemical data collected to an analysis in normalized principal component (ACPN) [26] which allow us to release a total synthesis of the information given. This method was used successfully by several authors [27-28-29-30-31-32]

3-2-1 Results and Interpretation of the ACP

The Eigenvalues of the two components C1 and C2 and their contribution to total inertia are represented in the Table 3

Table 3-Distribution of inertia between the three axes of analysis (F1XF2)

	F1	F2	F3
Eigenvalue	4.076	2.848	1.424
Variability (%)	40.760	28.477	14.23 9
Cumulative%	40.760	69.236	83.475

In the circle of correlation (**figure 11**), the 1st component (axis 1) contributes with 40,76% of inertia, is defined by the organic matter parameters knowing that DBO (0.99), DCO (0.98) and MES (0.93).

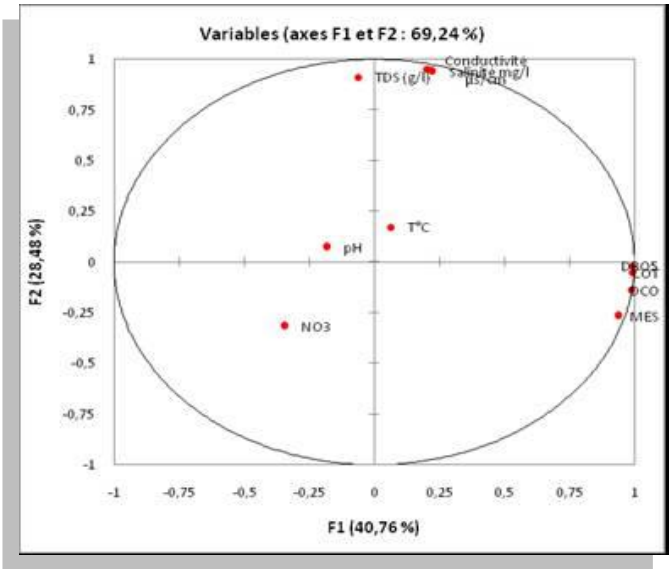

Figure 11: Correlation circle of variables in the analysis

With an inertia of 28.47% the second component (axis 2) is defined by the parameters of mineralisation knowing that the TDS (0.9), salinity (0.94) and the conductivity (0.95). The factorial axis (F1) defines an organic gradient of contamination which results in an increase in the organic load represented by the DBO, DCO and the MES. The factorial axis (F2): Axis 2 defines a gradient of mineralisation represented by the TDS, conductivity and salinity.

The typological structure released by plan F1XF2 (**Figure12**) shows the organization of the wells and sources according to their degree of contamination out of organic matter or their mineralization. Indeed, the wells are organized according to axis 1 from the less loaded pole on organic matter (well 14,15,16,19) to the most loaded wells (well 4 and 12).According to the gradient of mineralisation only well 18 appears most mineral-bearing compared to the whole of the points. However, the climatic variation seems to have little influence on the spatial organization of the wells.

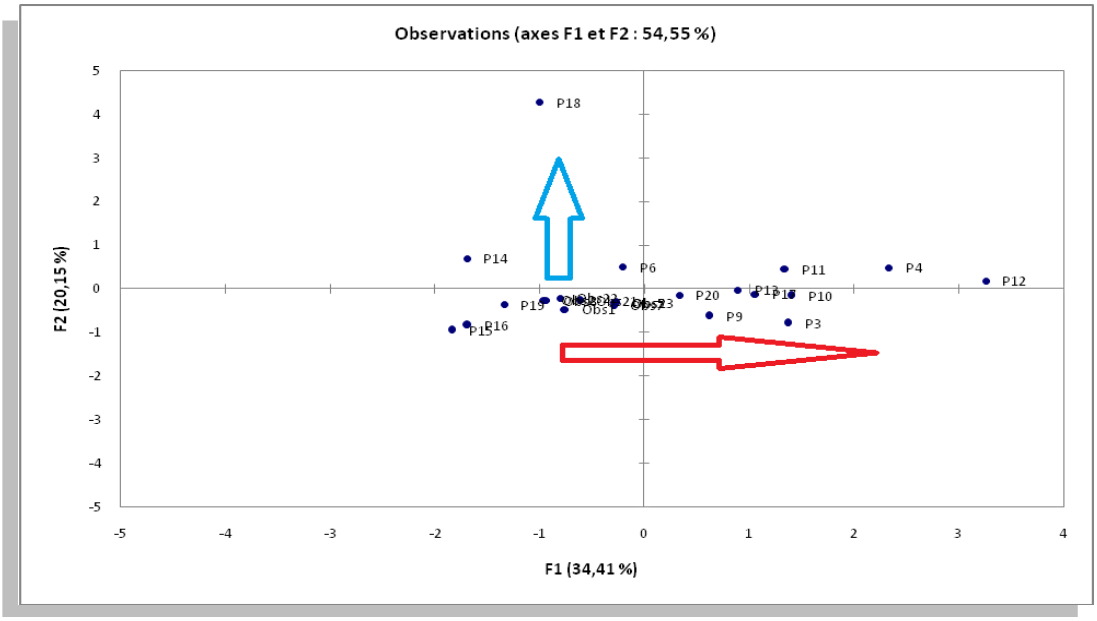

Figure 12: Graphical representation of the PCA analysis in accordance with the terms F1XF2

Conclusion

The quality of groundwaters released by the follow-up of several physical and chemical tracers shows that the Tagrisst River shows a certain hydraulogical and chemical stability . On the other hand the wells testify to a variable and notable presence of an organic load related to the productivity of these wells by the development of phytoplankton or the zooplankton. For nitrates the analysis made it possible particularly to raise an appreciable presence on the level of P13 (29 mg/l) in relation to the good productivity recorded in these wells (presence of organic matter). In addition, the very low value recorded on the level of the Tagrisste River shows the good self-purification of this area (high temperature, presence of vegetation, etc). Report DBO5/DCO of the order of 0.3and allow us to conclude that the water of the wells is charged enough by not very biodegradable inorganic components in perspective requires a follow-up of the quality of groundwaters while spreading out the field of study to the neighbouring rural communes in order to make sure this quality for will not harm the population's health

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