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**Quality of Groundwaters of the Rural District EL Ganzra (Province of Khemisset,
Morocco)**

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Abstract

The study of groundwater quality in the rural commune of EL GANZRA by agricultural excellence is of importance for the use of groundwater for various activities (drinking, irrigation, patenting ...) to do a follow-up of several physicochemical tracers. there was held samples of 19 wells spread throughout the area concerned. Results emit conductivity and salinity highlighting the role of the effect on the geological nature of the water quality and that a change in MES and COT which confirms the presence of natural organic matter origin (productivity) or anthropogenic (human). The DBO5/DCO ratio is about 0.3 can be concluded that the water from these wells are quite loaded with poorly biodegradable inorganic components. For nitrates values are noted below the WHO standard allowable, except P19 in which there is a high value of 33mg / l which is probably due to agricultural activity characterized by the use of fertilizers.

Keywords: groundwater quality, physico-chemical tracers, nitrates.

Introduction

The groundwaters undergo meadows or by far the impacts of pollution [1] and can harm the human health [2], which became a world concern .In Morocco like any country with intense farming and whose groundwaters constitute a significant portion of the hydraulic heritage[3] and whose rural districts supply groundwaters and as study zones the rural district El ganzra (province khemisset) or the groundwaters are the main resource of drink, irrigation, brevetage of the animals and sight the sequence of these rings by the trophic links, of the producers (plants) to the consumers (animal and the man) however the pollution of these groundwaters will undoubtedly have reflected on the environment

and public health .The evaluation of the quality of these groundwaters by the study of the physico-chemical parameters proves of an importance . thus taking away of 19 well were made on the place of study in order to determine the impact of pollution on these groundwaters in question.

Materials and methods

Introduction To The Study Area

The rural commune El Ganzra falls under the command of the province khemisset within the region Rabat-salé- Zemmour-zair and it is 90 km from Rabat .

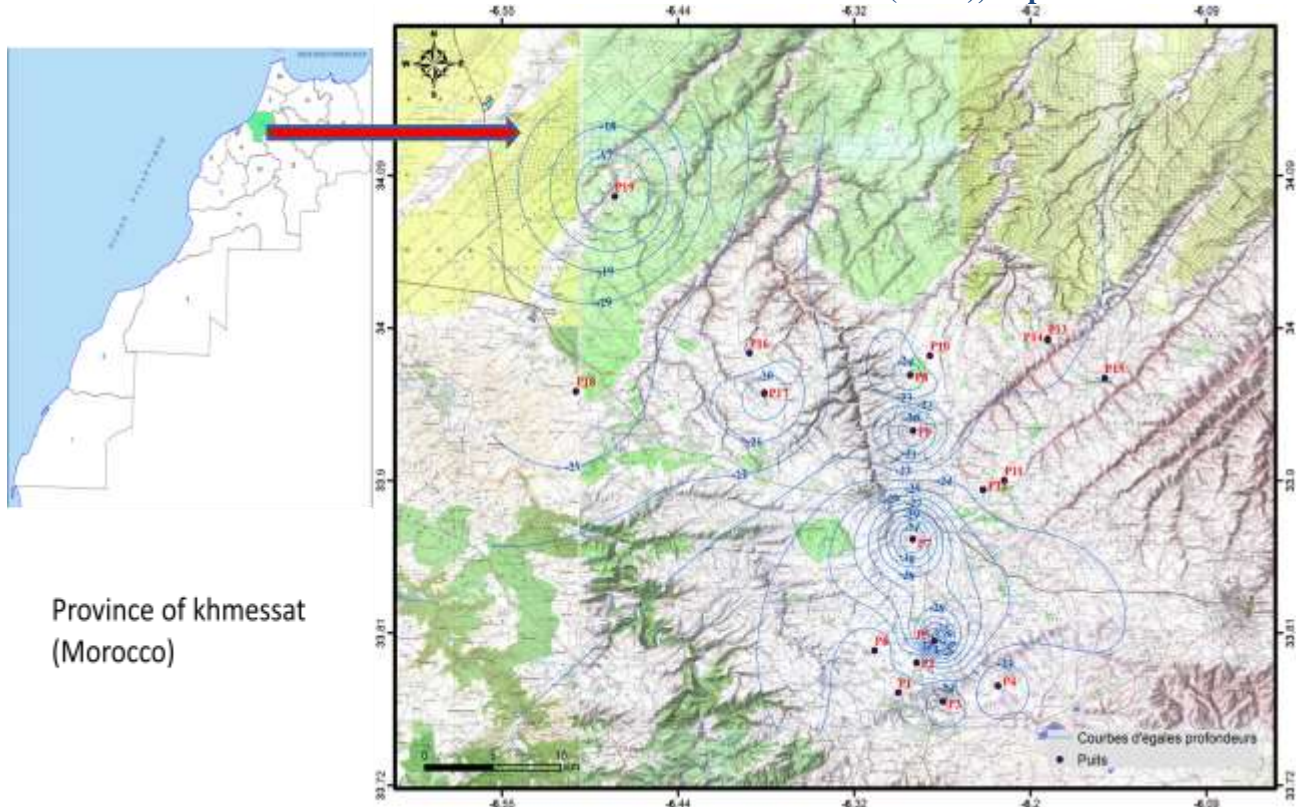


Figure 1: Location of the study area

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 type PASTEL UV SECOMAM at the National Hygiene Institute in Rabat.

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 19 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

Results and discussions

3-1-physical And Chemical Characterization Of Groundwater

The whole of the results of the physico-chemical analyses are represented in the table1 and The whole of the results will be discussed according to the MOROCCAN STANDARDS (2002) (official Bulletin N° 5062 of the 30 Ramadan 1423 which sets the norms of portability at human consumption). [8] and WHO [9]

Table 1: Results of physical and chemical analyzes of groundwater

wells	pH	T°C	Salinity (mg/l)	TDS (g/l)	Conductivity (µs/cm)	MES (mg/l)	COT (mg/l)	NO3 (mg/l)	DCO (mg/l)	DBO (mg/l)
P1	7,98	21,6	0,2	0,41	510	118	24	5,7	143	34
P2	8,53	21,6	0,2	0,77	580	45	9	7,4	54	12,9
P3	8,3	21,8	0,27	0,3	530	106	22	4,7	128	30,5
P4	8,02	21,3	0,2	0,31	580	129	26	2,6	156	37
P5	8,73	22,2	0,2	0,27	600	64	13	2,3	78	18,6
P6	8,67	22,4	0,3	0,35	640	60	12	4,6	73	17,4
P7	8,26	22,5	0,2	0,37	520	125	25	8	152	36
P8	8,6	20,2	0,2	0,27	580	90	18	5,7	109	25,8
P9	8,63	21,4	0,3	0,21	810	58	12	11,6	71	16,8
P10	8,73	20,6	0,2	0,47	520	62	12	7,5	75	17,8
P11	8,31	22	0,3	0,38	720	89	18	2,6	109	25,6
P12	7,59	25,1	0,9	0,4	2060	48	9	<0,5	58	13,7
P13	7,76	23,3	1	0,35	2010	69	14	<0,5	84	19,8
P14	8,03	23,1	0,6	0,39	1400	41	8	<0,5	50	12
P15	7,93	23,5	0,6	0,37	1320	33	6	<0,5	40	9,6
P16	7,97	23,2	0,8	0,7	1780	75	15	<0,5	91	21,4
P17	7,85	23,2	0,8	0,35	1780	131	27	<0,5	160	37,5
P18	8,45	22,2	0,2	0,32	530	51	10	2,5	63	14,8
P19	8,2	20,4	0,6	0,45	1310	204	42	33	248	58,5

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] Generally from deep waters are characterized by freshness throughout the year. The values obtained were between 20.4 °C as a minimum value at P8 and 25 °C as the maximum value recorded at P12, which classify these waters in good quality by Moroccan standards

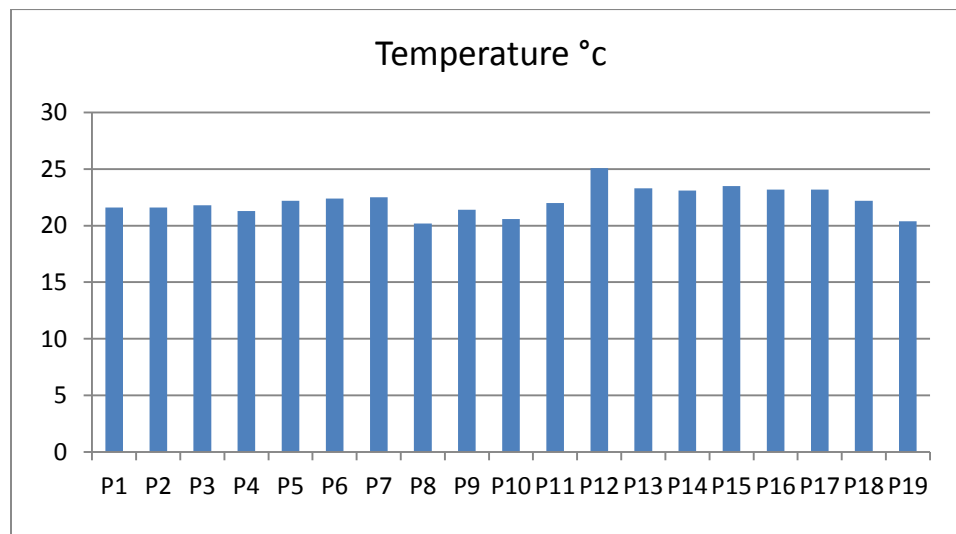


Figure 1: Evolution of temperatures in the different wells (P),

3-1-2 water pH:

According to Moroccan standards all the values are between 6.5 and 8.5 are an excellent class except the wells P5 and P10 that show a maximum value of 8.73 which is the middle class.

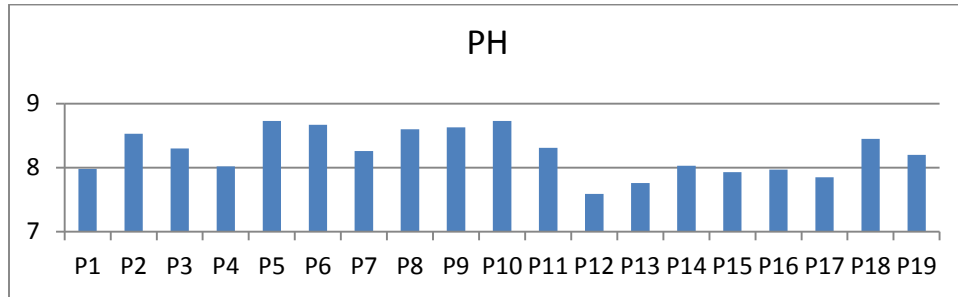


Figure 2 the spatial evolution of the pH of the samples

3-1-3 Electrical conductivity and salinity

Conductivity gives an idea of the mineralization of water and is therefore a marker of the origin of water [11]. All dissolved elements are ionized and therefore contribute to the water conductivity [12]. The analysis of the evolution of the conductivity can distinguish two classes according to Moroccan standards:

- Excellent class whose value is less than 750 $\mu\text{s} / \text{cm}$. These wells 1, 2, 3, 4, 5, 6, 7, 8, 9, 10,11,18.
- Middle class whose conductivity is between 1300 and 2700 $\mu\text{s} / \text{cm}$ The wells with this class are: P12, P13, P14, P15, P16, P17, P19.

Furthermore. the evolution of this parameter is similar to the salinity [13] and highlights the role of the geological nature effect on water quality.

This influence is very visible at P12 and P13, where mineralization is highest in relation to the leaching from land surrounding (clay and marl field) and bedload waters heavily loaded with dissolved salts

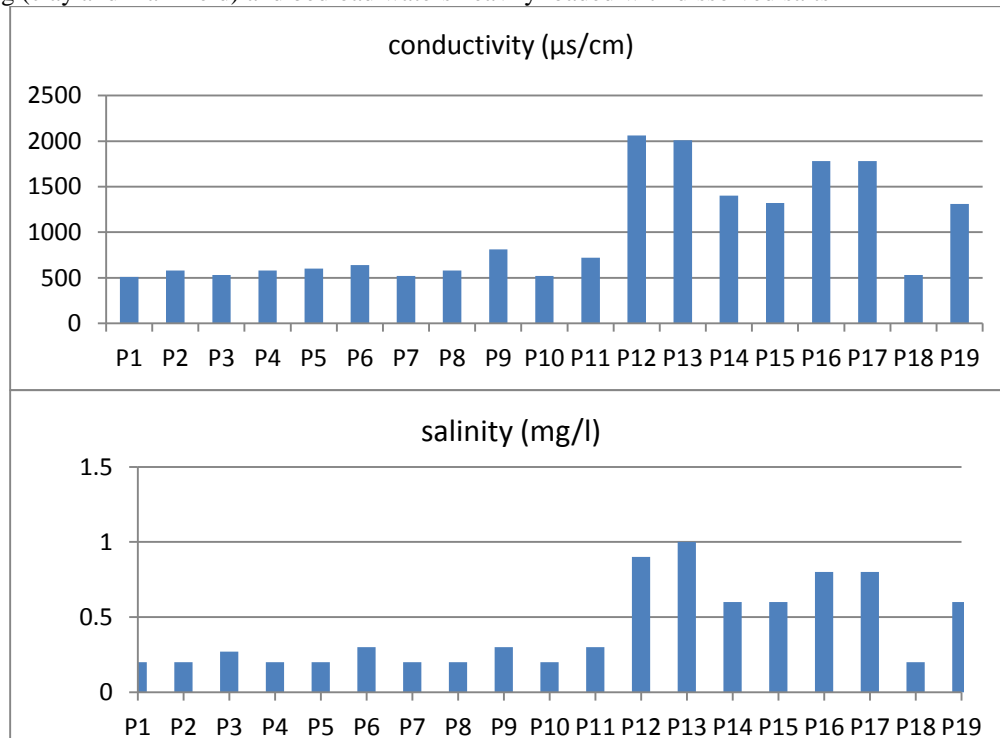


Figure 3 - Spatial variation of salinity and conductivity in groundwater

3-1-4 T. D. S.

TDS is the total concentration of substances dissolved in water [14]. TDS values measured in our samples within these waters classified categories good to excellent (values between 0.3-0.6 g / l) (Figure 4). Only the wells, 2

and 16 which are in the passable class (0.7 g / l). This is to be related to wells 2 and 16 with the highly mineralized nature of water or probably a development of the dissolved organic matter (water productivity).

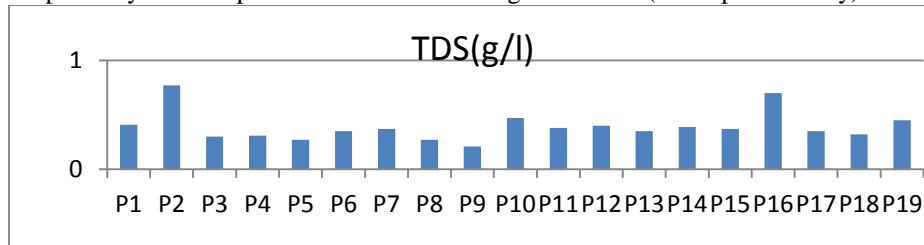


Figure 4: Spatial variation of the TDS (g / l) in groundwater

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

MES values <50 mg / l (excellent level) it is about wells 2,14,15 and other wells are part of the good class. The COT is the carbon content related to the organic matter. It represents the sum of dissolved organic matter and suspended[15]

It is an important composite parameter in the determination of the organic contamination of the water. All values obtained in this study do not exceed the standard 30 mg / l therefore a good quality. However, the similarity of variation between MES and COT confirms the good presence of matter of natural organic origin (productivity) or anthropogenic. Organic contamination of these wells is not to dismiss

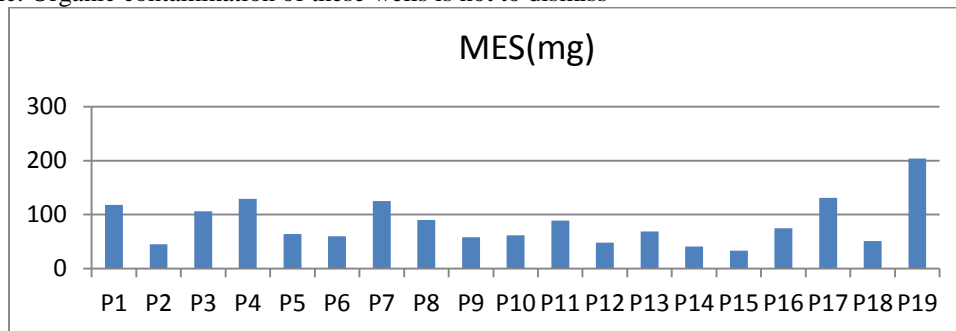


Figure 5: Spatial variation MES in groundwater levels

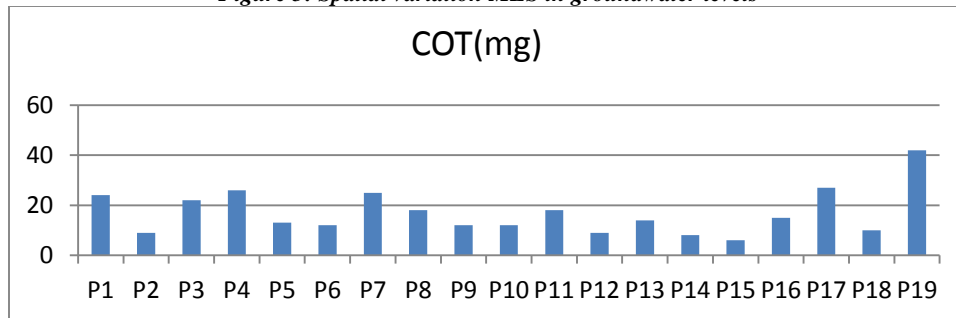


Figure 6: Spatial variation COT in groundwater levels

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

The DBO5 is able to inform us about the quantity of oxygen necessary for the degradation of the biodegradable organic matter by the development of micro-organisms.[16] The values recorded for the DBO5 particularly indicate a notable presence of the organic matter for wells 7, 11, 19 and 20 For the rest quality is average

For the DCO, the values are higher. They are located between the very bad class at bad. Report DBO5/DCO is of order of 0.3 makes it possible to conclude that water of the wells is charged enough by not very biodegradable inorganic components.

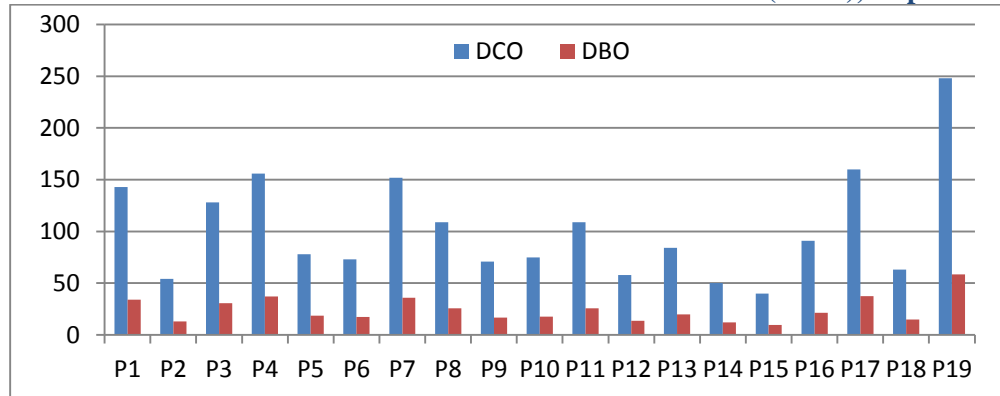


Figure 7: The spatial evolution BOD5 level of groundwater

Nitrates (NO₃) are present naturally in water. They result indeed from the natural cycle of degradation of the organic matter. [17] However contributions due to the farmings (fertilizers and breedings), [18] industrial and domestic (untreated rejections), remain dominating

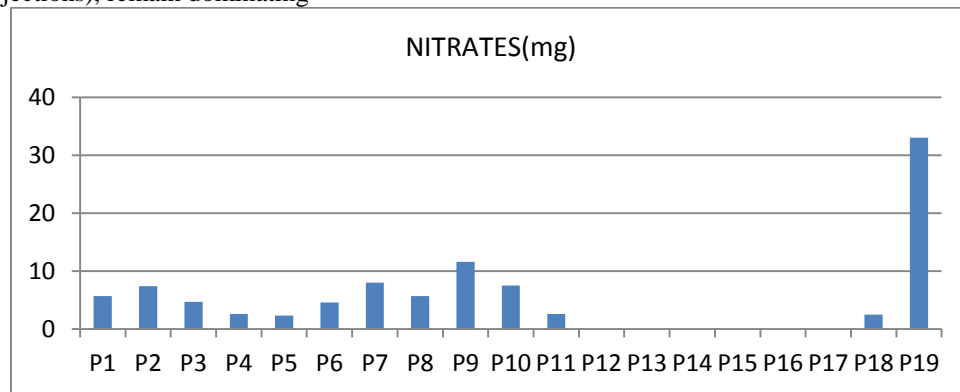


Figure 8: The spatial evolution of nitrates in groundwater

The international and Moroccan 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. However, an appreciable presence is to be raised particularly on the level of P19 in relation to the good productivity recorded in this well (presence of organic matter) that is probably with the localization of this well near a rural settlement or the septic tank not answering the regulations in force what allows water untreated to infiltrate.

Table 2: Classification of the wells, according quality physicochemical parameters

wells	TDS (g/l)	Conductivity μs/cm	MES mg/l	CO T mg/l	NO ₃ mg/l	DCO mg/l
P1	good	Excellent	good	good	Excellent	very bad
P2	average	Excellent	Excellent	good	Excellent	bad
P3	good	Excellent	good	good	Excellent	very bad
P4	good	Excellent	good	good	Excellent	very bad
P5	Excellent	Excellent	good	good	Excellent	bad
P6	good	Excellent	good	good	Excellent	bad
P7	good	Excellent	good	good	Excellent	very bad
P8	Excellent	Excellent	good	good	Excellent	very bad

P9	Excellent	Excellent	good	good	good	bad
P10	good	Excellent	good	good	Excellent	bad
P11	good	Excellent	good	good	Excellent	very bad
P12	good	average	good	good	Excellent	bad
P13	good	average	good	good	Excellent	very bad
P 14	good	average	Excellent	good	Excellent	bad
P15	good	average	Excellent	good	Excellent	bad
P16	average	average	Bonne	good	Excellent	very bad
P17	good	average	Bonne	good	Excellent	very bad
P18	good	Excellent	Bonne	good	Excellent	bad
P19	good	average	Bonne	good	average	very bad

2.3-Assessment of the groundwater quality

With an aim of releasing an assessment of the quality of these groundwaters [19] we subjected the whole of the physico-chemical data collected to an analysis in normalized principal component (CPA) [20] which allow us to release a total synthesis of the information given. This method was used successfully by several authors [21, 22,23,24,] 20,21,22,23

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 axis of analysis (FIXF2)

	F1	F2	F3
Eigenvalue	4,805	2,949	1,045
Variability (%)	48,050	29,489	10,452
Cumulative%	48,050	77,539	87,991

In the circle of correlation (figure 9), the 1st component (axis 1) contributes with 40,76% of inertia, is defined by the organic matter parameters in knowing DBO, DCO, COT and NO3 With an inertia of 29,49% the second component (axis 2) is defined by the parameters of mineralisation in knowing the TDS, salinity and conductivity) . the factorial axis (F1) defines a gradient of organic contamination which results in an increase in the organic load represented by DBO, DCO, and them MES. The factorial axis (F2): Axis 2 defines a gradient of mineralisation represented by the TDS, conductivity and salinity.

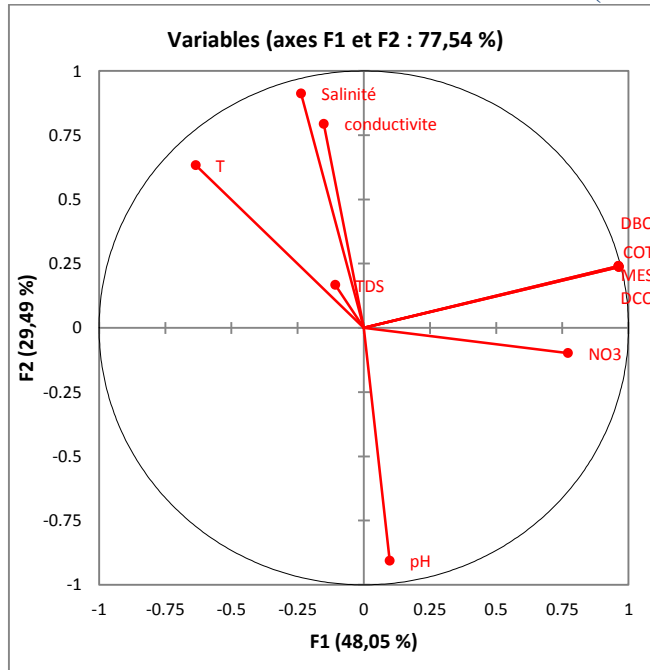


Figure 9: Correlation circle of variables in the analysis

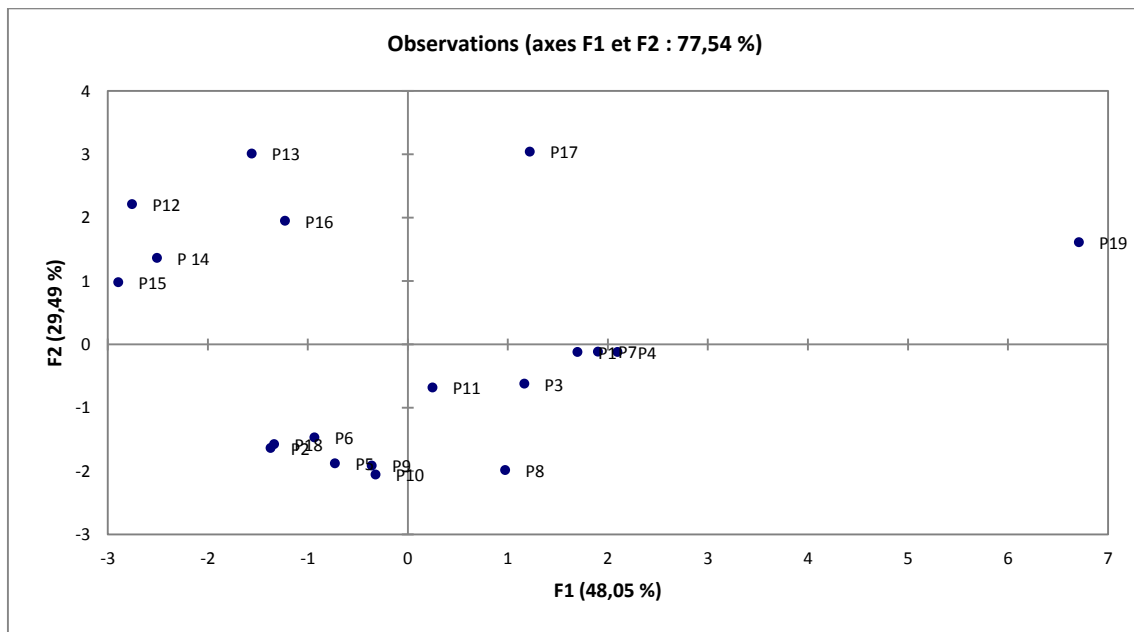


Figure 10 : Graphical representation of the CPA analysis in accordance with plan F1XF2

The typological structure released by plan F1XF2 (Figure11) shows the organization of the wells according to their degree of contamination out of organic matter or their mineralization. Indeed, the wells are organized along the axis 1 of the pole the least loaded in organic matter wells (12,14, 15, 16) to the most highly charged wells (19.4 , 7, 3).

According gradient mineralization wells 12, 13, 16, 17 appear most mineralized compared all points. However, climate change seems to have little influence on the spatial organization of the wells.

Conclusion

The quality of groundwaters of the rural district El Ganzra (province khemisset) released by the follow-up of several physical and chemical tracers, testify to a presence an organic load related to the productivity of these wells by the development to phytoplankton or of the zooplankton. For nitrates the analysis made it possible particularly to raise an appreciable presence on the level of P19 (33 mg/l) in relation to a productivity recorded in these wells (presence of organic matter). Report DBO5/DCO is order of 0.3 makes it possible to conclude that water of these wells is charged enough by not very biodegradable inorganic components and like prospect required for a spreading out of the field of study to the neighbouring rural communes for a follow-up of the quality of groundwater in order to preserve the environment and public health .

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