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LEVEL OF CONTAMINATION BY TRACE METALS IN GROUNDWATER IN THE AGRICULTURAL AREA OF EL GANZRA PROVINCE OF KHÉMISSET, MOROCCO

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ABSTRACT

The population of the agricultural zone El Ganzra supplies water for various uses (drink, irrigation, brevetage…) primarily groundwaters (wells) since the majority of the inhabitants do not have drinking water adduction yet nor of cleansing of waste waters , from where importance of this study which aims to determine the quality of this water by the follow-up of the metal elements traces (Cd, Cr, Cu, Zn, Al) . The analysis of the ETM in these groundwaters shows an absence of contamination of this water by these elements, except for Copper on the level of the well P5 and the presence of a possible impact of agriculture indicates on the quality of this water. However, the value of 251 µg/l raised for Aluminium on the level of the P12 exceeding the allowed value by the Moroccan standards, let think of a possibility of local contamination by the deep layers of the area and opens the voice with a future investigation for better determining this presence.

KEYWORDS: groundwater, trace metals, toxicity, impact, contamination level

INTRODUCTION

parallel to the sustained efforts development management of the water resources [1], granted by the Moroccan persons in charge (administrative, enquiring,…)within the framework of green the Morocco plan who projects an improvement of the agricultural production and a new more adapted spatialization of agriculture taking account of the climatic and hydrous context current. However, any improvement necessarily passes by a recourse increased to the use of manure and plant health products to improve the outputs [2] . This process is not without risks of contamination of groundwaters by these substances if the agricultural good practices are not respected [3] One of the current problems which marks the degradation of the groundwaters and which threatens pubic health in particular in the rural areas like on the environment, is the presence of elements traces in particular heavy metals such as cadmium, coppers, mercury, lead, etc) [4-5] who deteriorates water quality[6] in general and becomes public health problems [7-8] because of their accumulating effects organic [9] in the various matrices of the ecosystems (water, sediment) and at the living organisms

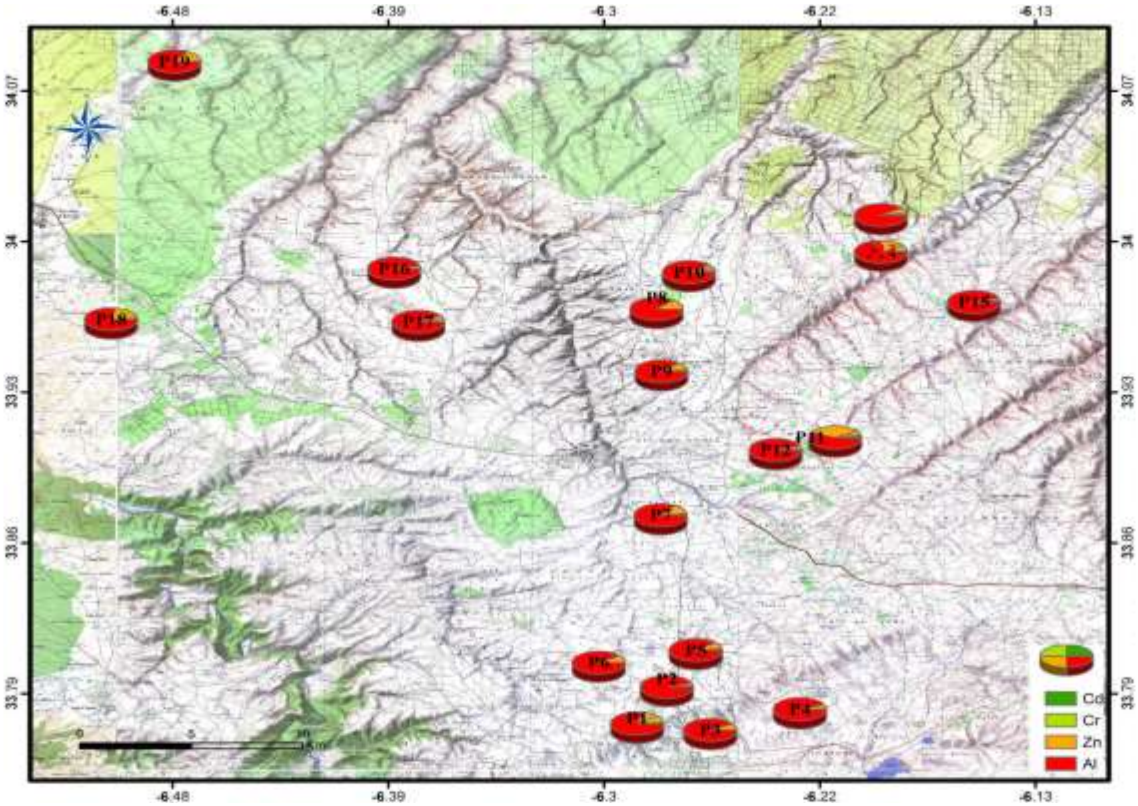

Figure 1: Location of the study area

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 .

For the study of trace metals, 20 wells (P1 to P20) were selected (Figure 1). The geographical coordinates of the different sampling points identified in these sites

Sampling for the analysis of metallic trace elements are made directly to the wells using a non-metallic container, in polyethylene tubes containing 50 ml of nitric acid (Merck, 65%) of high purity for attaching metallic trace elements [10].The samples are transported at low temperature (4°C) in portable coolers to the Department of Hydrology and Toxicology at the National Institute of Hygiene for analysis. The contents of trace metals such are determined directly without treatment by a near Atomic Absorption Spectrophotometer with Graphite Furnace (GF-AAS) Type VARIAN, 240 Zeeman

RESULTS AND DISCUSSION

The results are shown in Table 2 below, as well as figures 2 through 6:

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Table 2: Values of trace elements analyzed in groundwater

wells	Cr (µg/l)	Cu(µg/l)	Zn(µg/l)	Cd(µg/l)	Al(µg/l)
P1	2,000	1.86	3	0.387	22.06
P2	1,200	1.89	3	0.520	97.98
P3	0.450	1.87	5	0.387	67.87
P4	0.170	2.14	6	0.208	121.50
P5	1.840	2.70	8	0,304	102 ,07
P6	0.630	0.79	8	0.516	95.17
P7	1.340	1.67	10	0.324	75.86
P□	0.164	1.00	6	0.061	47.48
P9	1.99 0	1.74	12	1.027	120.00
P10	2.34 0	0.76	4	1.110	90.81
P11	1.210	1.93	10	0.659	14.77
P12	2.82 0	1.17	9	0.497	251.00
P13	2,510	2.19	7	0.967	107.00
P 14	1.700	1.93	6	0.341	23.16
P15	1.75 0	1.87	3	0.600	118.00
P16	0.342	1.90	3	0.517	102.41
P17	2.110	2.05	4	0.345	85.1s0
P18	0,2 41	0.95	7	0.394	27,80
P19	0.250	0.85	5	0.321	30.00
P20	0.231	0.81	8	0.340	26.25

The contents raised for chromium in the various wells are very variable (fig.2). They vary between 0.164µg/l (P8) and 2,820 µg/l (P12). However, all the values are lower than the tolerated Moroccan standard (50 µg/l).
Copper shows an absence of contamination of this water by this element, the values obtained are lower than the Moroccan standard (2 mg/l) and indicates the absence of a possible impact of agriculture on the quality of this groundwater
In spite of the presence of some peaks (P7,P9 and P11) the values obtained for Zinc are lower than the Moroccan standard which is of 3mg/l and classify this water in the good quality category.
For cadmium , the values obtained are between the minimum value of 0.061(P8) and the maximum value of 1,110 µg/l at the P10. Despite this presence, all these values are less than the value of 3 µg/l which is the maximum value according to the Moroccan standards and classifies the water in the right category.
All values recorded for Aluminium show a presence of this element in these waters, but which remain below the maximum value (0.2 mg/l) and rank these waters in the excellent category. Moreover, the value of 251 µg/l identified at the wells P12 suggests to us a natural origin (soil geochemistry) [11]. The value of 251 µg/l raised on the levels of P12, is 0,251mg/l exceeding the acceptable value 0,2mg/l
Despite the presence of some peaks of Lead especially at the well (P4 and P12) values obtained are lower than the Moroccan standard which is 10 µg/l and rank these waters in the category: good quality. Thus, the presence of metallic trace elements is due to their bioaccumulative power may accumulate even at low doses in different organs and therefore reach the toxic threshold that can lead to disturbances in populations that consume these waters [12]

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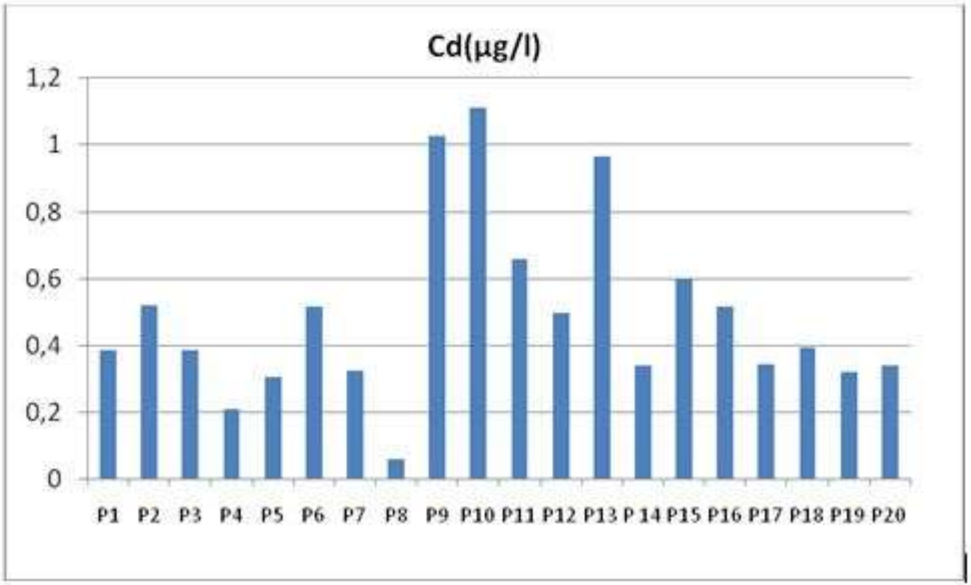

Figure 2 - Spatial evolution of cadmium (µg/l) in groundwater

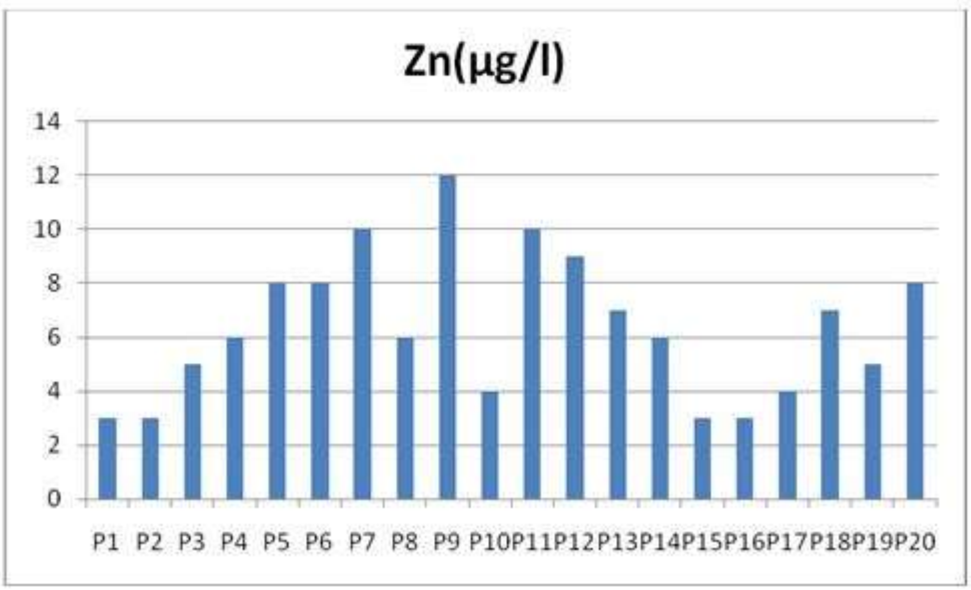

Figure 3 - Spatial evolution of Zinc (µg/l) in groundwater

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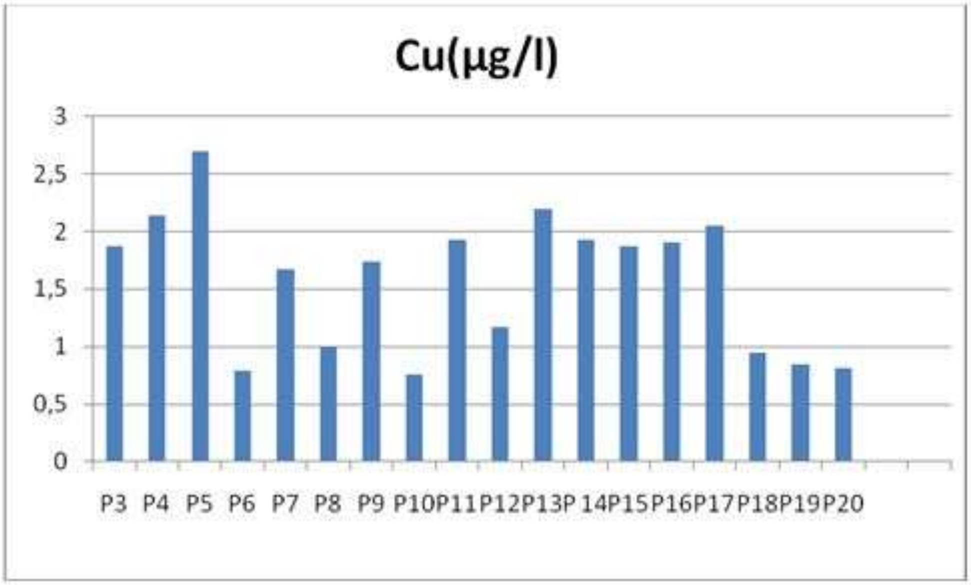

Figure 4 - Spatial evolution of copper (µg/l) in groundwater

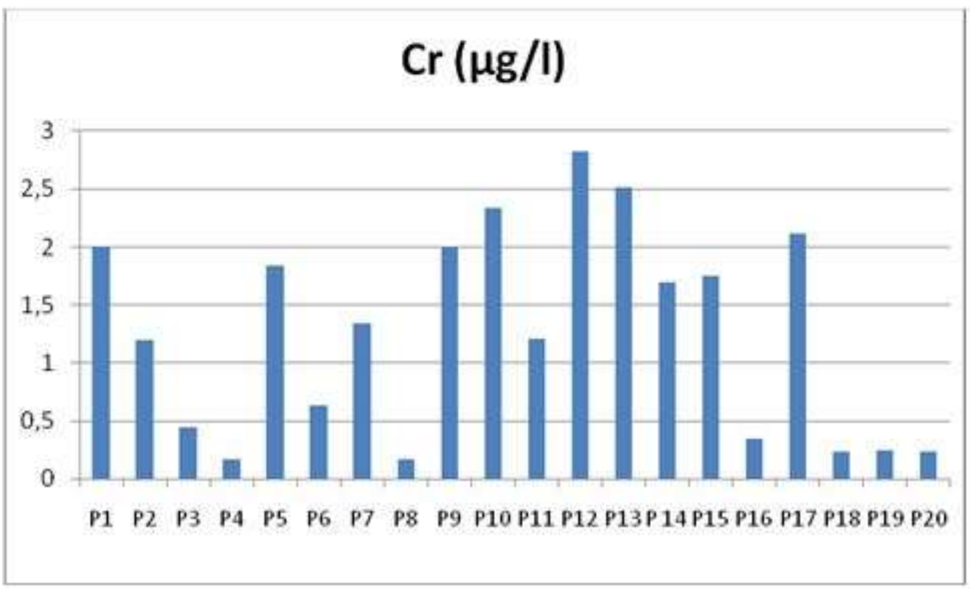

Figure 5 - Spatial evolution of chromium (µg/l) in groundwater

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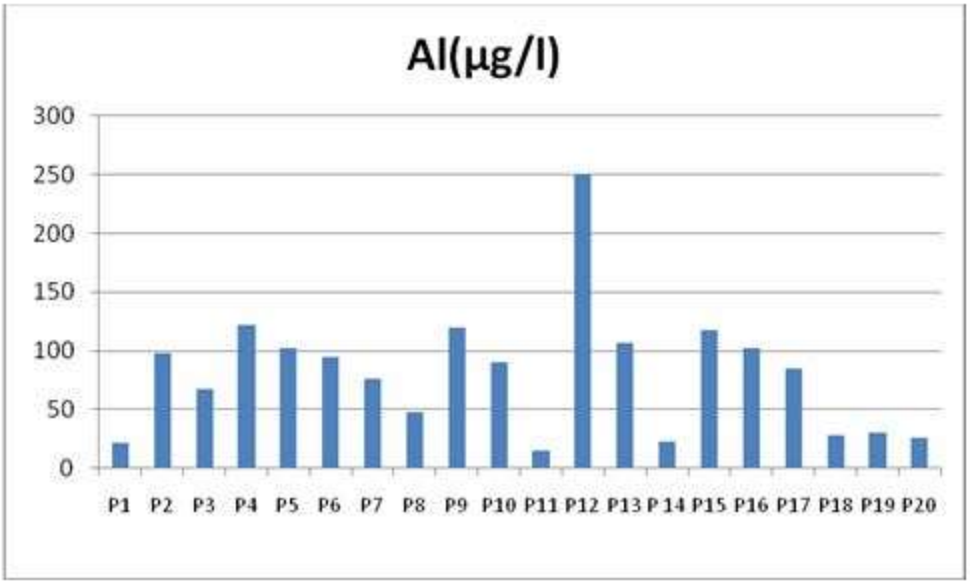

Figure 6 - Spatial evolution of Aluminum (µg/l) in groundwater

To generate a spatial typology of this presence, we performed a multivariate analysis (Principal Component Analysis). The CPA [13] is used to classify and process information on the physico-chemical parameters [14] made during the study period by establishing correlations between all the variables [15]. On the data matrix consists of 20 samples in which the 5 variables (Cr, Cd, Cu, Zn and Al) were measured. The results are shown in Tables 3 and 4.

Tableau 3 : Distribution of inertia of the three axes of the analysis (F1XF2)

	F1	F2	F3
Eigen values	1,921	1,088	0,897
Variability(%)	38,430	21,767	17,940
%cumulative	38,430	60,197	78,137

Tableau 4 : Correlations between variables and factors.

	F1	F2	F3
Cd	0,524	-0,264	-0,452
Cr	0,622	0,186	-0,214
Cu	0,155	0,852	0,285
Zn	0,292	-0,412	0,794
Al	0,479	0,024	0,197

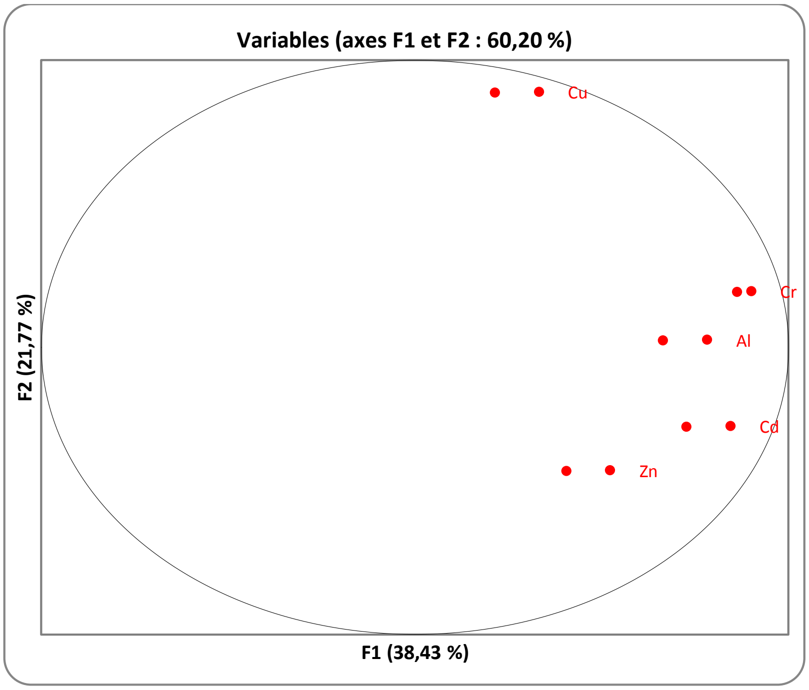

Figure 7: Circle of correlation of the analysis variables.

In correlation circle (Figure 7), the 1st component (axis 1) defined by metals Cr(0,6) and Cd(0,5) contributes with 38.4% of inertia. With inertia of 21.7% in the second component (axis 2) is defined by a single metal, Cu (0.852).

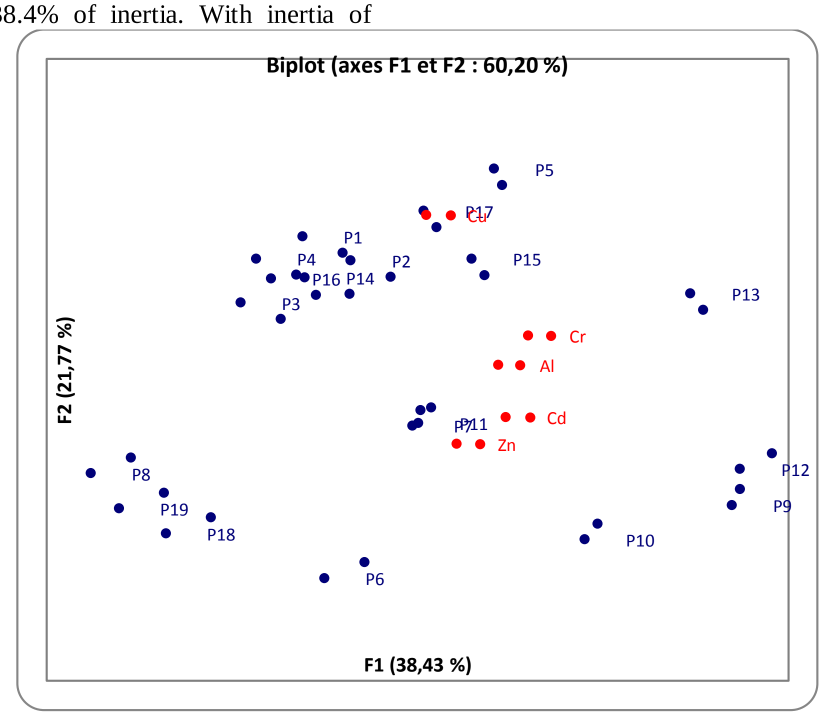

Figure 8: Graphical representation of factorial plan 1X2 of the analysis.

The analysis of the different approaches shows that the component (F1) defines a gradient notable presence of Cr and Cd .The factorial axis (F2): Axis 2 defines a gradient presence of copper only.

The typological structure generated by the F1XF2 plane (Figure 8) shows the organization wells of average presence of metallic trace elements [16, 17] analyzed. Indeed, the wells are organized along the axis 1 of the pole the least loaded in Cd and Cr (wells

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8,18,19) to wells most highly charged (wells 9,12 and 13).In the same gradient wells 12 is charged in Al and come off by the significant presence of Al in their water. According to the second Gradient, the wells 5,17 seems most loaded of copper relatively to the set of points and however seems under the influence of local effects of agriculture.

CONCLUSION

The study conducted to El Ganzra and which is based on the analysis of the elements metal traces in groundwaters, enabled us to conclude that these groundwaters are not contaminated by these elements except for Copper on the level of the well P5 and the presence of a possible impact of agriculture indicates on the quality of this water. However, the value of 251 µg/l raised for Aluminium on the level of the P12 exceeding the allowed value by the Moroccan standards, let think of a possibility of local contamination by the deep layers of the area and opens the voice with a future investigation for better determining this presence, in order to protect the population like environment of the impacts of these ETM .

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