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EFFECT OF ANTHROPIC ACTIVITIES ON THE QUALITY OF SUBSOIL WATERS IN RURAL MEDIUM IN THE AREA OF MEKNES (MOROCCO)

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ABSTRACT

A partner of taking away of subsoil water was carried out in 2010 in wells located in rural medium, these taking away were the analysis object according to techniques of evaluation of quality of water described by Rodier (1978 and 2009) and with the recommendations of the World Health Organization (WHO).The physicochemical analysis showed that the studied wells present concentrations lower than the standards recommended by WHO and Morocco. From bacteriological point of view, the studied wells present a strong bacteriological pollution in all the wells studied without exception. The very high presence of the microbial germs in water could constitute a threat for the inhabitants who take water necessary to their needs starting from water for these wells.

Key words: Subsoil water, Quality, Well, Physic chemistry, bacteriology

RESUME

Une compagne de prélèvement d'eau souterraine a été effectuée en 2010 dans des puits situés en milieu rural, ces prélèvements ont fait l'objet d'analyse selon les techniques d'évaluation de qualité de l'eau décrites par Rodier (1978 et

2009) et aux recommandations de l'organisation mondiale de la santé (OMS). L'analyse physico-chimique a montré que les puits étudiés présentent des concentrations inférieures aux normes recommandées par l'OMS et par le Maroc. De point de vue bactériologique, les puits étudiés présentent une forte pollution bactériologique dans tous les puits étudiés sans exception. La présence très élevée des germes microbiens dans l'eau pourrait constituer une menace pour les habitants qui prennent de l'eau nécessaire à leurs besoins à partir de l'eau de ces puits.

Mots clés : Eau souterraine, Qualité, Puits, Physico-chimie, bactériologie

INTRODUCTION

Water is the base of any form of life, it constitutes an essential element of all the terrestrial ecosystems (Meerm, 2009).The human activity is the principal enemy of the natural quality of subsoil waters (Tabyaoui and al., 2006). In Morocco the question of water is one of the strategic questions of our most difficult time and because it's associated the life (Almae, 2005).The subsoil water in the area of Meknès is one of the principal resources for the supply drinking water and the agricultural production by the irrigation. The area of Meknès constitutes a rather significant economic pole in Morocco, of share it's reserves out of subsoil water, the quality of it's fertile grounds and it's primarily agricultural vocation. Considering the increase in the demand for water, the improvement of the standard of living, the intensification of the agricultural activity and the use of the septic tanks not controlled for the domestic worn drainage and the storage of the manure on the level of the agricultural land without preliminary precaution, the sources of pollution water multiply and diversify by threatening it's quality. The underground water pollution represents one of the most worrying aspects and the use of this water at food ends represents a danger to health (Laferrière and al., 1996). Moreover, the consumption of water contaminated by the micro-organisms is the origin of epidemics (Angulo and al., 1997). Some research tasks were completed on the quality of subsoil waters in the area of Meknès (Belghiti and al., 2009; Bengoumi and al., 2004; Chadli and al., 2004).This work will be a complement with already quoted work. It is interested in the impact study of the anthropic activities on quality physicochemical and bacteriological of water of some wells in medium rural in the area of Meknès in order to determine the importance of pollution in order to find solutions likely to improve the situation.

GENERAL PRESENTATION OF THE ZONE Of STUDY

The studied zone belongs to a vaster unit, Saïs de Meknès-Fès, which extends on approximately 100 km from west in, is and on 30 to 40 km of north in the south and at an altitude which varies from 1000 m on the level of El Hajeb to 550 m on the level of the town of Meknes. It's geographical co-ordinates Lambert lie between: 465 < X < 545 km and 335 < Y < 385 km, adding up a surface of approximately 2100 km2 (ABHS, 2005).This basin dominates the Oued Beht in the west which separates it from the area from Zemmour-Maamora and Sebou in the east. It is framed by the Wrinkles prérifaines in north and the edge of average causse atlasic in south (Chadli and al., 2004).The rivers which cross the zone of study are river Boufekrane, river Ouislane, river Nja. these rivers occur either on the level of the Causse (the Tizguit river in particular), or starting from emergences located in edge of Causse.The principal direction of water run-off in these rivers is SSE towards the NNW and the average slope is 2 to 3 % in general (ABHS, 2005).

On the geological and hydrogeologic level, the area of study is characterized by outcrops of miocene and pliocene especially made up of limestones resting on sandy formations which appear by places to cover considerable surfaces.With regard to the context hydrogeologic, the basin of Saïss contains two tablecloths of unequal interest (ABHS, 2005): the ground water which circulates in sands, conglomerates and by places in water limestones of Plio-Villafranchien (ground water of Plio-Quaternary); the deep tablecloth which circulates in dolomitic limestones of Lias and is put in load under the thick series of impermeable marls of Miocène (deep tablecloth of Lias).

These two tablecloths communicate between them by places, through flexures and faults or indirectly by ascending drainage (ABHS, 2005). The climatic point of view, the climate of under basin of Fés-Meknès is regarded as a climate of the Mediterranean type semi arid at moderate winter (ABHS, 2005).It is characterized by a rather significant annual pluviometry, variable between 547,92 mm/year during the period 2006/2007 and 472,49 mm/ year at the station of Meknès during period 2007/2008 (Belghiti and al., 2009).

MATERIEL AND METHODS

The study was undertaken of water samples coming from some wells in rural medium in the area of Meknès lasting the winter period in 2010 (figure 1). Initially the samples were put in bottles out of glass of 1000 beforehand sterilized ml and were intended for the bacteriological analysis. In the second time the test sample selections for the physicochemical analysis were put in plastic bottles then conveyed at the laboratory for the analysis. On the whole 10

water samples were collected, 5 samples at Community level of Lbridia and 5 samples at Community level of Bouderbala in the area of Meknès in Morocco.

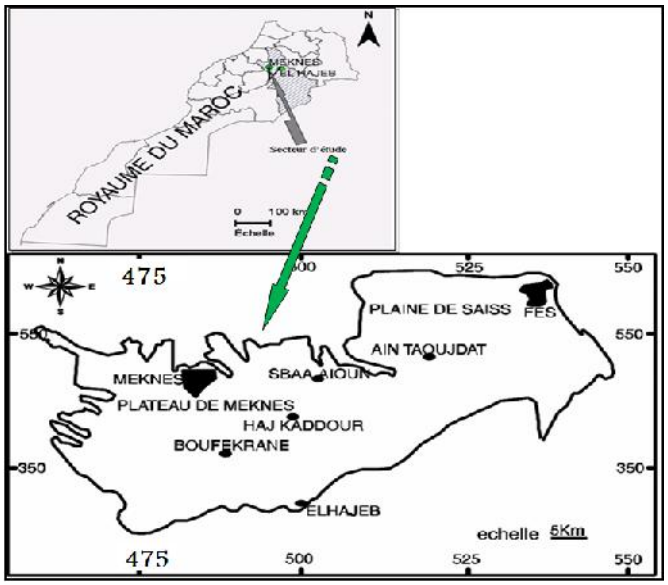

Figure1: Geographical chart of situation of the two communities (Lbridia and Bouderbala) in the area of Meknès.

Determination of the physicochemical parameters of water of various studied wells

The physicochemical analyses of water were carried out according to the methods of analyses described by Rodier (1978 and 2009) and with the recommendations of WHO. The test sample selections of water were carried out on the level of the wells in rural medium in the area of Meknès.

Determination of the bacteriological quality of water of various studied wells:

We proceeded during our work to the research of the indicator germs of pollution following: The total flora (TF), Total coliform (TC), fecal coliform (FC), fecal streptoccus (FS), sulfite reducing clostridia (SRC) and Pseudomonas aeruginosa (PA). These germs were required according to techniques of evaluation of quality of water described by Rodier (1978 and 2009) and with the recommendations of WHO.

RESULTS AND DISCUSSION

Physicochemical quality of water

The results of the physicochemical analyses of human feed waters are presented in figures 2 at 13 below. The results of the physicochemical analysis presented in this work, showed that almost the majority of the studied parameters answer the criteria of a drinking water. In the area of study, the results obtained show that the degree of the temperature does not present great variations of one well at the other (Figure 2), with a minimum of 17,5 °C and a maximum of 21.5 °C recorded for the two communities. The values of the pH recorded on the level of the two communities are compatible with the standards set by the WHO and Morocco (Figure 3).The pH depends on the origin of water, of the geological nature of the substrate and the catchment area crossed (Dussart, 1966; Bermond and Vuichard, 1973). In the majority of natural water, the pH is usually included/understood between 6 and 8,5 whereas in tepid water, this one is included/understood between 5 and 9 (HCEFLCD, 2007). In the case of the area of study, the recorded values vary between 6.75 to 7.89 in the community of Lbridia and between 7.13 to 7.65 in the community of Boudrebala, which testifies to a light alkalinity of the medium. Electric conductivity gives an idea of the mineralization of water and is for this reason a good marker of the Origin of water (HCEFLCD, 2006). Electric conductivity records values inferieurs to the standards set by the WHO and by Morocco, the values recorded during the period of study vary from 744 to 933 µS/cm at Community level of Lbridia and 800 to 837 µS/cm in the community of Bouderbala (figure 4). According to this parameter thus discussed, the quality of subsoil waters in the area of Meknès is good in all the studied wells. The variation of the total hardness noted between the various wells can be related to the nature of the ground in the area. The recorded values vary between 4.43 to 4.9 meq/l in the community of Lbridia and between 4.1 to 4.55 meq/l in the community of Bouderbala (figure 5), according to Morocco standards relating to the potability of water, this parameter answers the criteria of a drinking water. The sulphate concentrations According to the results of the analyzed samples (figure 6), the recorded values remain lower than the value guide (<200mg/l) according to the Moroccan standard relating to the quality of the water intended for the production of drinking water for the whole of the wells of the two communities. The variation of dissolved oxygen presents significant variations of a well at another for the two studied communities (figure 7).The minimal values were recorded in well N° 5 at Community level of Lbridia with a value of 3.5 dissolved oxygen mg/l and on the level of well N° 1 and N° 5 in the community of Bouderbala, the recorded values are successively 4.5 and 3.44 dissolved oxygen mg/l. It is significant to announce here that only the already quoted wells which does not

meet the Morocco standards. The variation of the Nitrate concentration between the various wells for the two studied communities shows that the recorded minimum is about 4.22 mg/l in the community of Bouderbala and the maximum nitrate value recorded is about 15.45 in the community of Lbridia (figure 8). For the whole of the studied wells, the nitrate concentration is quite lower than 50 mg/l (according to Moroccan standards' relating to the potability of water). The two communities (figure 9).The highest nitrite value is about 0.09 mg/l and the minimal value is about 0.011 mg/l in the community of Bouderbala, in the community of Lbridia, the concentration out of nitrites varies between 0.015 to 0.028 mg/l. In the whole of the zone of study, no value exceeding the 0.1mg/l according to WHO, is recorded. The Magnesium content varies between 18 to 32 mg/l in the community of Lbridia and varies between 27.5 to 33.4 mg/l in the community of Bouderbala (figure 10), according to Moroccan standards, no value exceeding the 100 mg/l. This parameter thus discussed answers the criteria in force. The Calcium, This parameter varies like Magnesium and it's concentration in water also depends on the crossed geological substrate. The calcium content lies between 67.44 to 78.22 mg/l at Community level of Lbridia and lies between 62.33 to 77.23 mg/l in the community of Bouderbala (figure 11). On the basis of result of the analyses carried out, the recorded values are lower than the standards recommended. The Chlorides, the contents chlorides vary from 72 to 142 mg/l for the whole of the wells studied (figure 12). On the level of the area of study, the contents chlorides do not exceed 150 mg/l on the level of all the wells. According to Moroccan standards relating to the potability of water, the maximum chloride concentration recommended is of 300 mg/l whereas the acceptable maximum is of 750 mg/l. So the quality of water on the level of the area of study is excellent. Iron, the contents of iron in the area of study vary from 0.003 to 0.051 mg/l for the two communities (figure 13), the recorded values are lower than the Moroccan standard relating to the portability of subsoil waters. The values of various physicochemical parameters presented in this work are shown in another study on same area (Belghiti and al., 2009; Bengoumi and al., 2004).

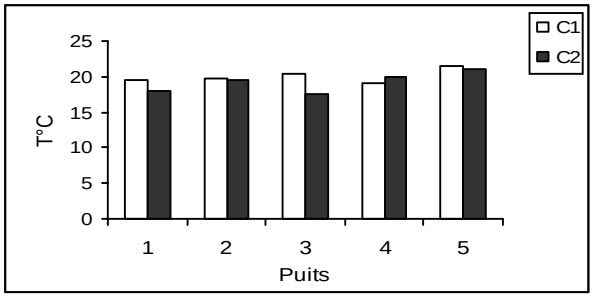

Figure 2: Space variation of the values of the temperature on the level of C1

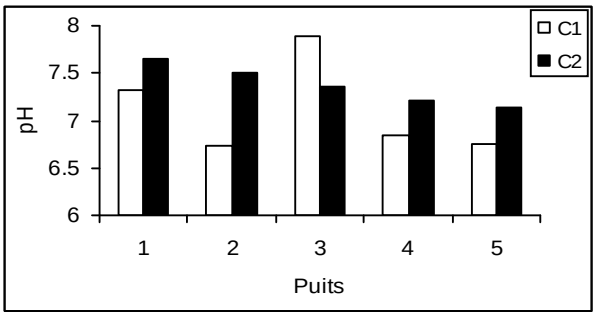

Figure 3: Space variation of the values of pH on the level of C1 and C2.

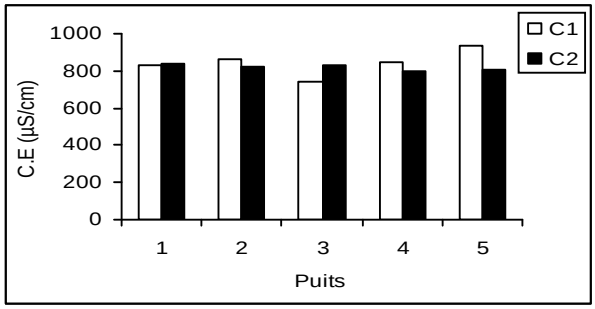

Figure 4: Space variation of the values of electric Conductivity (EC) on the level of C1 and C2.

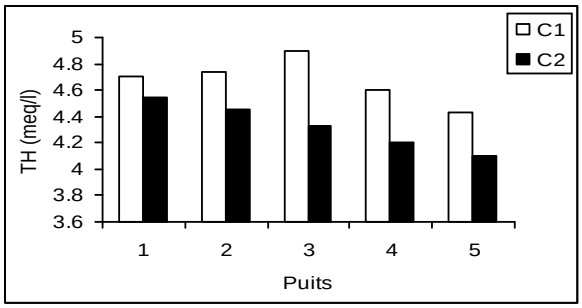

Figure 5: Space variation of the values of total hardness on the level of C1 and C2.

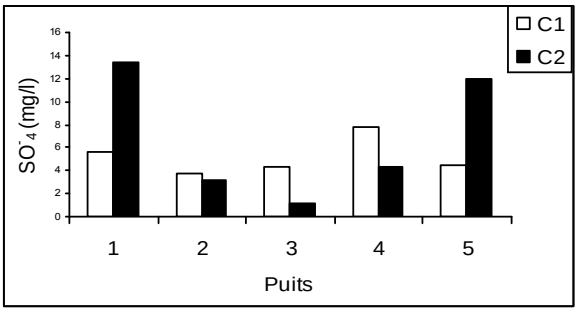

Figure 6: Space variation of the values of Soleplates on the level of C1 and C2.

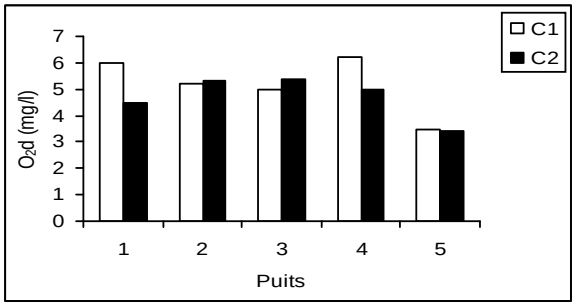

Figure 7: Space variation of the values of the Oxygen dissolved on the level of C1 and C2

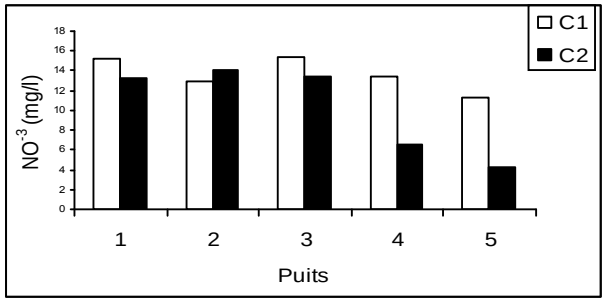

Figure 8: Space variation of the values of Nitrates on the level of C1 and C2.

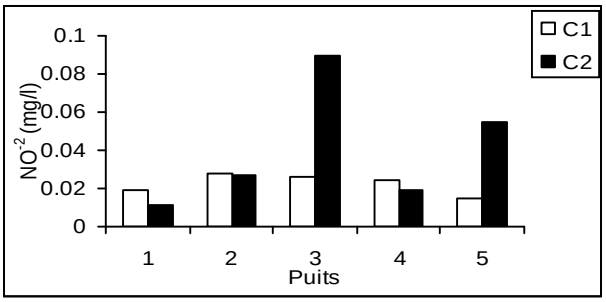

Figure 9: Space variation of the values of Nitrites on the level of C1 and C2.

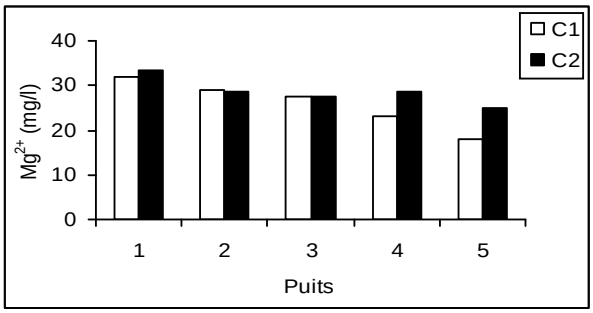

Figure 10: Space variation of the Magnesium values on the level of C1 and C2.

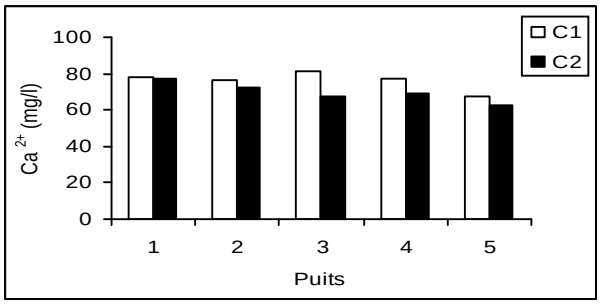

Figure 11: Space variation of the Calcium values on the level of C1 and C2.

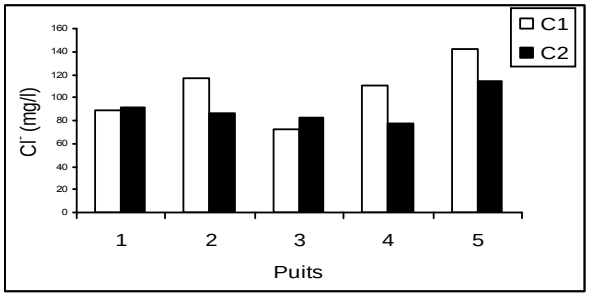

Figure 12: Space variation of the values of Chlorides on the level of C1 and C2.

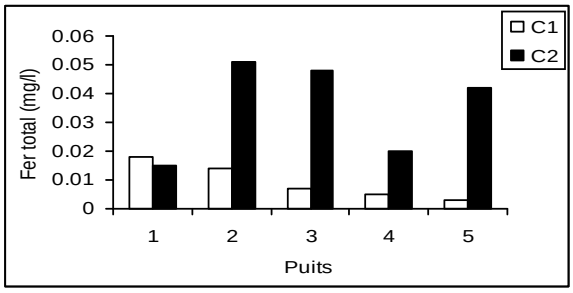

Figure 13: Space variation of the Iron values on the level of C1 and C2.

Captions:(C1: Lbridia and C2:Bouderbala)

Bacteriological quality of water

The results of the bacteriological analyses show that all the studied wells are soiled by the microbial germs of contaminations (table I), the various sampled wells present a strong contamination by the sought germs, and almost all the recorded values are higher than the standards set by the World Health Organization and Morocco. Concerning these microbiological parameters, water of well analyzed during this study is not acceptable with human consumption because they do not answer the criteria of a drinking water. The strong contamination by these microbial germs could be explained by the bad protection of the well on the one hand and by the impact of the anthropic activities on the other hand. The results obtained show well the impact of the use of the septic tanks and the deposit of the household refuse. The high values of the indicating germs of the fecal contamination are reported in another study on the area of Meknès (Belghiti and al., 2009 and Bengoumi and al., 2004), the values raised in germ of fecal contamination in rural medium in the area of Meknès to those are found similar on the level of the ground water of M'nasra

in Morocco (Bricha and al., 2007) and on the level of the ground water with Yeumbeul in Senegal (UNISCO, 1997).

Table 1: Results partial of the bacteriological analyses of the water of the wells in rural medium in the area of Meknès

Community	Wells	Numbers of germ in water						Interpretation of the Results
		TF/ ml En Log10 UFC	**TC / 100ml**	**FC/ 100ml**	**FS/ 100ml**	**PA/ 100ml**	**SRC/ 20ml**	
LBRIDIA	P1	2.44	> 100	> 100	55	> 100	1	NDW
	P2	2.19	> 100	> 100	> 100	> 100	2	NDW
	P3	2.041	> 100	> 100	> 100	> 100	8	NDW
	P4	2.42	> 100	> 100	> 100	> 100	0	NDW
	P5	2.29	> 100	> 100	> 100	> 100	18	NDW
BOUDERBALA	P1	2.18	> 100	> 100	80	> 100	28	NDW
	P2	2.24	> 100	> 100	12	> 100	4	NDW
	P3	2.33	> 100	> 100	36	> 100	1	NDW
	P4	2.20	> 100	> 100	> 100	> 100	10	NDW
	P5	2.15	> 100	> 100	32	> 100	22	NDW

Caption:

-NDW= Non-drinking water, WGBQ = Water of Good Bacteriological Quality.
- Total flora=TF , total coliform =TC, fecal coliform =FC, fecal streptoccus= FS, sulfite reducing clostridia =SRC and Pseudomonas aeruginosa = PA.

CONCLUSION

The results of the physicochemical analysis of subsoil water in rural medium in the area of Meknès obtained during this period of study are in conformity with those of the directives of the World Health Organization (WHO) on the one

hand and with the Moroccan standards on the other hand for the majority of the studied wells. On the bacteriological level, water of studied wells, presents very high values in germs of fecal contamination in all the wells without exception, which undoubtedly constitutes a threat for the inhabitants who draw water necessary to the major part of their needs starting from water for these wells. These results confirm the impact of the anthropic activities on the quality of subsoil water.

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