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IDENTIFICATION OF POLLUTION UPSTREAM FROM THE GUENITRA DAM IN SKIKDA (EAST ALGERIAN)

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Abstract

This study concerns the Guenitra Dam, located about sixty kilometers south of the capital of the Wilaya of Skikda (North-East Algeria), aims to identify the sources of pollution from the dam , analyze and interpret the physicochemical data from water samples in the basin of the Guenitra Dam and the different (tributary) wadis that feed it (Fessa, Cherfa, Magraman, Mellouh, Essouk). The determination of the origin of surface water pollution was carried out by comparing the physical parameters of the major elements and nitrogen components by the standards admissible by the OMS. The results illustrate that Wadi Magureman and Mellouh waters are infected by urban pollution explained by the levels of SO4 and agricultural (NH4 and NO2), while Wadi Chorfa is affected only by pollution of agricultural origin. On the other hand, Wadis Essouk and Fessa are affected by the dilution of the deposits reported in the region due to excessive values of Magnesium, Calcium and Iron.

Keywords: Agricultural Pollution, Urban Pollution, Family Farming, Agricultural Development, Groundwater, Guenitra Dam.

1. INTRODUCTION

In Algeria, water is strategic due to its scarcity, naturally disturbed and unbalanced cycle. Whether it is groundwater or surface water, resources are limited and given demographic problems and space occupancy (knowing that nearly 60% of the Algerian population are concentrated in the northern fringe of the territory which represents only one tenth of the total area of the country). If in 1962, the theoretical water availability per capita and per year was 1500 m3, it was only 720 m3 in 1990, 680 m3 in 1995, 630 m3 in 1998. Estimated at about 500 m3 at present, it will be only 430 m3 in 2020 and would be even more reduced to water resources available (BOUDJAJA and MESSAHEL, 2003).

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Algeria by its climate is confronted with a scarcity and an irregular distribution of rainfall in time and space. Nevertheless, these water resources, both surface and underground, constitute one of the main assets on which the prosperity of this country depends in the future, as well as the success of its economic, agricultural and social development.

The shortage of water requires the preservation of all available resources against all forms of pollution and to use it in a rational and scientific way in order to satisfy the needs of the different sectors (AEP industry, irrigation).

Socio-economic development and rapid urbanization have had a negative impact on the quality of water resources. Many cases of industrial and urban pollution have been observed in dams, the latter being the outlet of extremely polluting discharges. (HARRAT N and ACHOUR S, 2010).

To compensate for the deficit observed in the exploitation of groundwater considered as potable, the mobilization of surface water by the construction of dams and hill reservoirs is essential in the north of Algeria where the reliefs and climatic conditions are favorable.

However, the lifetime of these storage infrastructures and their exploitation can be reduced mainly by climate erosion or human action that makes the stored volume unfit for consumption in the case of acute pollution as a result of thoughtless action. (Belhaj, 2006)

The Guenitra Dam is located southwest of the wilaya of Skikda, is intended ,among other things, for the supply of drinking water to the towns of the location of wilaya, however the interior work carried out by ANRH and ABH identified issues related to the quantitative and qualitative aspects of the latter (Hadef, 2018)

The Guenitra Dam is built on the bed of Wadi Fessa, in a point of coast 110 m and with a sub-catchment of about 202 km2. The maximum altitude of this basin is 1364 m; and characterized by: A large hydrographic network (4.04 km/ km2) characterized by the Wadi Fessa, main stream feeding the dam and its various tributaries.

The Guenitra dam's water is of fair quality. The only likely source of pollution would be urban. In other words, a central question deserves to be asked and around which the different aspects of this work will focus:

What kind of pollution is the Guenitra Dam facing? And what is the share of the Wadis (tributaries) in this pollution?

1.1. Objective of the study

The objective of this study is summarized in two main areas:

1. Determine the source of pollution in the Guenitra Dam watershed.
2. Assess the impact of water use on public health and crops in the short and medium term.

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2. MATERIEL AND METHODS

2.1. The general purpose of handling: Perform physicochemical analyses of surface water in the Guenitra region.

2.2. The various parameters to be analyzed:

Table 1: The different parameters to analyze

Physical parameters	Units	standards	Chemical parameters	Units	standards	Nitrogen component	Units	standards
Ph	-	6.5-8.5	**Ca++**	(mg/L)	140	**NO2-**	(mg/L)	0.1
T°	(c°)	15-25	**Mg++**	(mg/L)	150	**Po4**	(mg/L)	0.5
Conductivity	(us/m)	1500	**CL-**	(mg/L)	250	**NH4+**	(mg/L)	0.5
Turbidity	(NTU)	5	**Fe ²+**	(mg/L)	0.3	/	/	/
MES	(mg/L)	120	**$SO4^{2-}$**	(mg/L)	250	/	/	/
/	/	/	**DBO5**	(mg/L)	3	/	/	/

2.3. Selection of sampling stations

Due to the complexity and diversity of rejections, it is difficult to make a wise choice. The sampling points are the junction of the five wadis with the dam, therefore the difficulties of access and sampling were taken into account as sampling should be done before wadi water is mixed with dam water.

Samples are taken under strict aseptic conditions to avoid accidental contamination during handling. The sampling points are defined in the figure below.

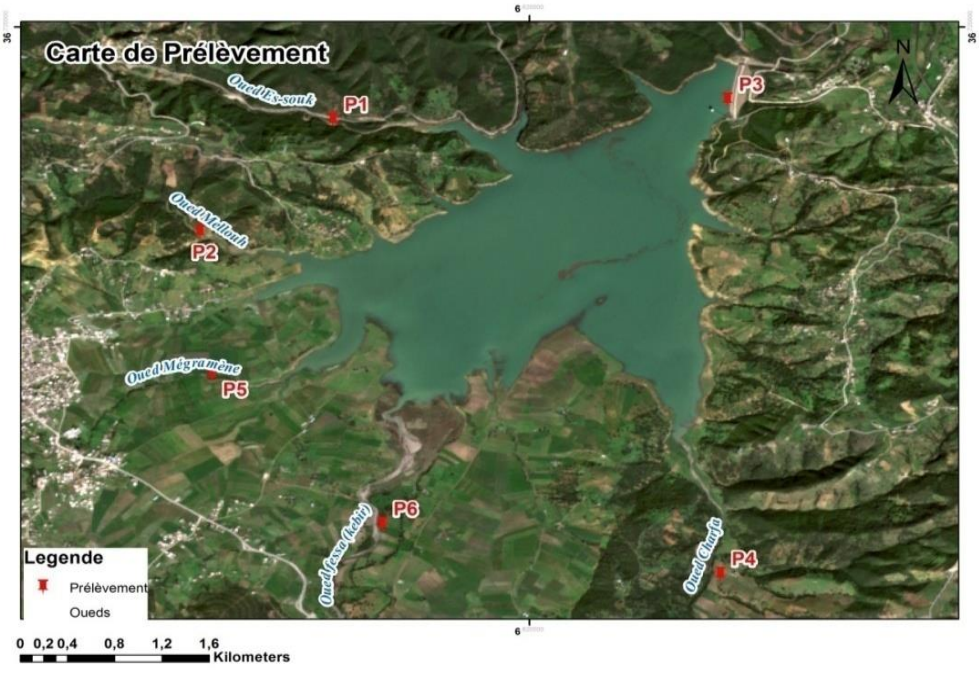

Figure 1: Sampling sites

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3. RESULTS AND DISCUSSION

3.1. Spatial evolution of physical parameters

3.1.1. Hydrogen Potential (pH)

Hydrogen potential measures the concentration of H+ protons in water; it expresses the alkalinity or acidity of the medium.

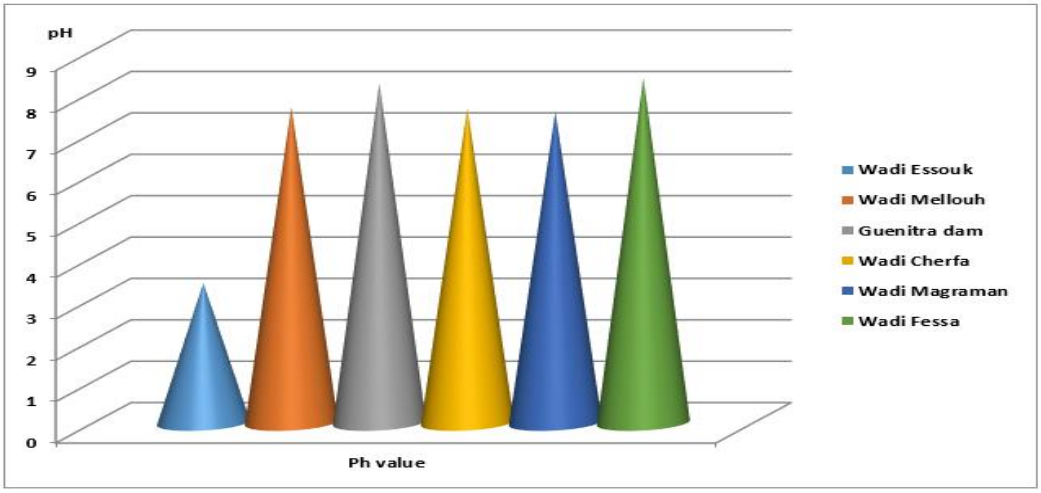

Figure 2: Distribution of pH measurements in the Guenitra Dam and its tributaries

Figure 2 illustrates that the pH of the 4 tributaries is between 7.52 and 8.34. This means that the medium is slightly neutral to alkaline. This alkalinity is related to the presence of carbonates. On the other hand, there is a pH below 7 in Wadi Essouk with 3.38 which is outside the range allowed by the World Health Organization (WHO) (6.5-8.5).

3.2.2. Temperature

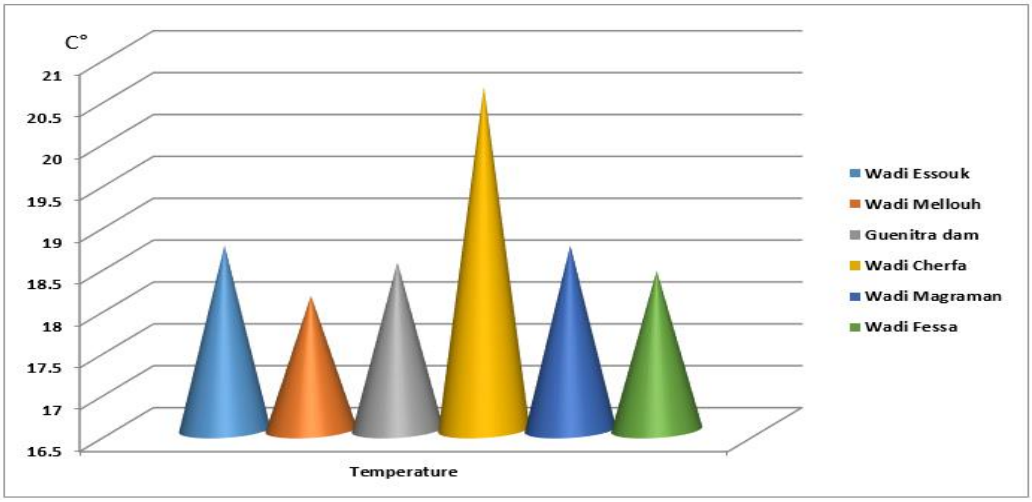

Figure 3: Temperature in the Guenitra Dam and its tributaries

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Water temperature is a crucial ecological factor. It regulates the solubility of gases, dissolved salts, and the speed of chemical and biochemical reactions. It also affects the metabolic activity of aquatic organisms.

The analysis of the results highlights that the water temperature of the Guenitra Dam and its 5 tributaries is included in the WHO allowable range (15C°-25C°) and ranges from 18.1 C° to 20.6 C°.

3.2.3. Electrical Conductivity (EC)

Conductivity is a parameter widely used in processes using ion exchange resins to produce water of different qualities. All the electrolytes present in a solution condition its electrical conductivity and thus reflect its total mineralization. Electrical conductivity reflects the ability of an aqueous solution to conduct electric current.

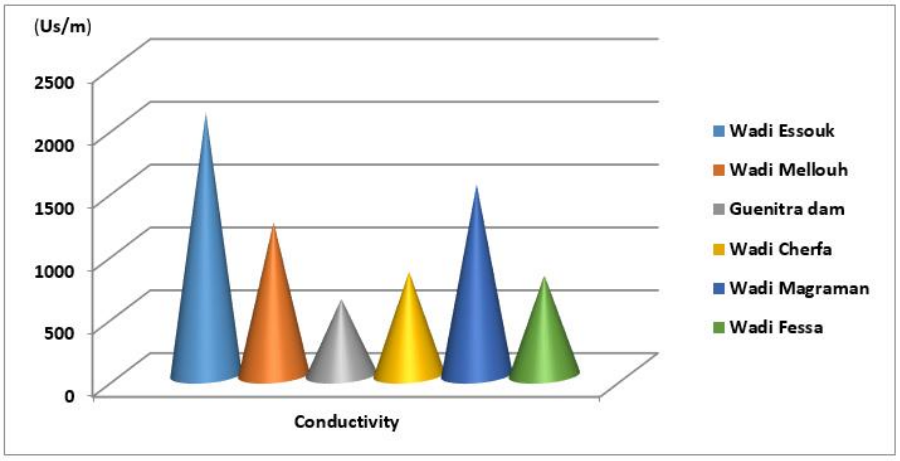

Figure 4: Evolution of conductivity in the Guenitra Dam and its tributaries

According to (figure 04) The electrical conductivity is between 607 and 2090 µS/m, whose values below the standard recommended by the WHO (1500 µs/m) are recorded in Wadi Mellouh, the Guenitra Dam, Wadi Cherfa, and Wadi Fessa successively with values of 1218, 607, 824, 794 µs/m. Values exceeding the WHO allowable potability standard are recorded in Wadi Magraman and Wadi Essouk successively with values of 1519 µs/m and 2090 µs/m.

3.2.4. Turbidity

It is a parameter, which varies according to colloidal compounds (clays, rock debris, microorganisms, etc.) or humic acids (plant degradation) but also pollution that disturb the water.

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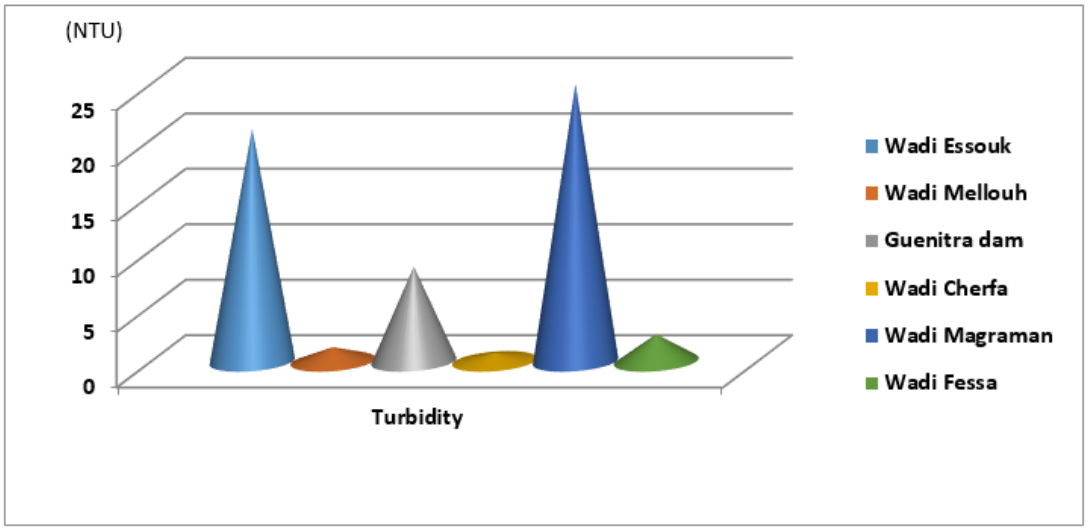

Figure 5: The degree of turbidity in the Guenitra dam and the 5 tributaries

Figure 05 represents the high turbidity according to the standard recommended by the WHO (5) in each of the Wadi Essouk, the Dam and Wadi Magraman successively with values of 21, 8, 55, 25. Values below the standard are recorded in Wadi Mellouh, Wadi Cherfa and Wadi Fessa which have the values of 1.29, 0.79 and 2.46 respectively.

3.2.5. Suspended Matter (SM)

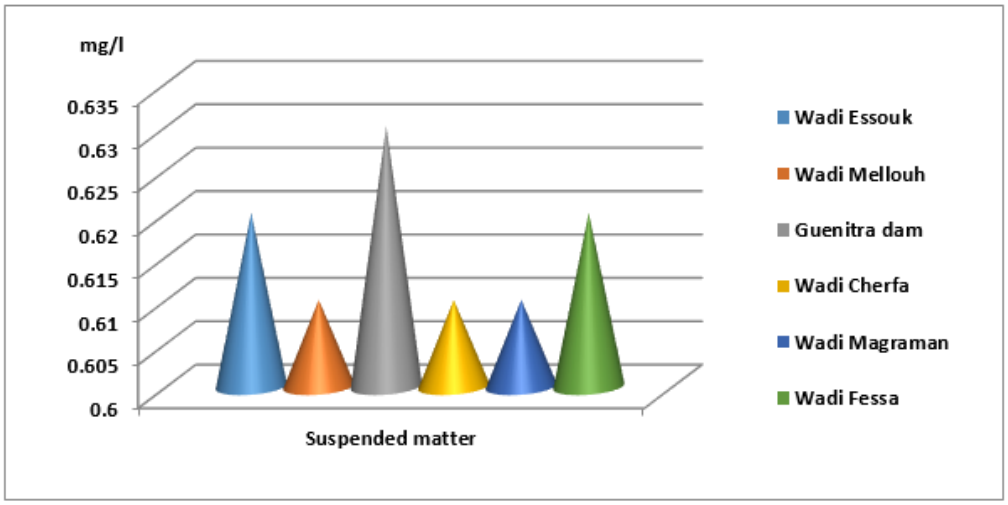

Figure 6: Suspended matter in the Guenitra Dam and its tributaries

The results of the analyses interpreted by (figure 06) demonstrate that all the ESM concentrations of the Guenitra Dam and its 5 tributaries are inferior than the standard recommended by the WHO (120 mg/L). Suspended solids range from (0.61 mg/l) to (0.63 mg/l).

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3.3. Spatial evolution of chemical parameters

3.3.1. Calcium (Ca2+)

Calcium is an alkaline-earthy metal extremely widespread in nature, its presence in eastern water comes essentially to two natural origins either from the attack and leaching of carbonate formations, or the dissolution of gypsous formations.

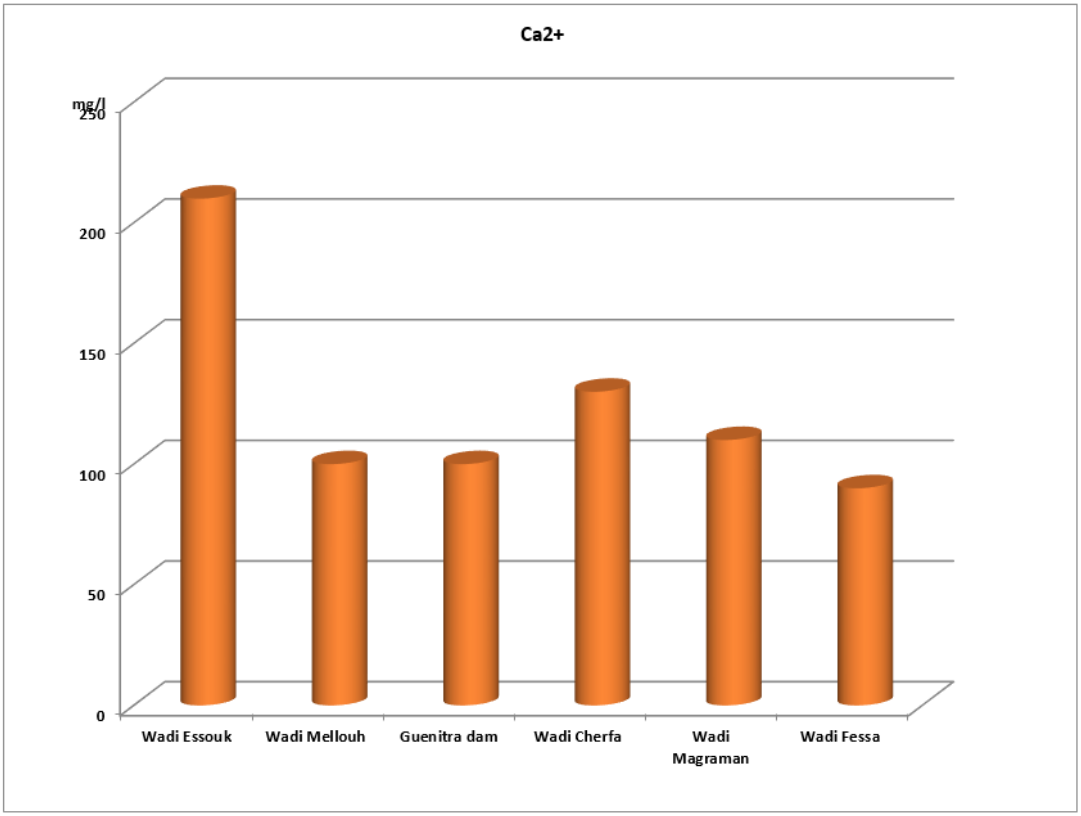

Figure 7: Evolution of Calcium in the Guenitra Dam and its tributaries

According to Figure 07, calcium levels vary between 90 and 130 mg/L in dam water and the 4 tributaries (Wadi Mellouh, Wadi Cherfa, Wadi Magraman and Wadi Fessa), with values below the standard (140mg/L) successively 100,100,130,110 and 90 mg/L . Only the maximum value of 210 mg/l that exceeds the WHO drinking standard (140 mg/l) is recorded in Wadi Essouk.

3.3.2. Magnesium (Mg2+)

It is an element that often accompanies calcium, it comes from the dissolution of dolomite, dolomitic limestone and ferromagnesian minerals (magnesite and dolomite) widespread in the study area.

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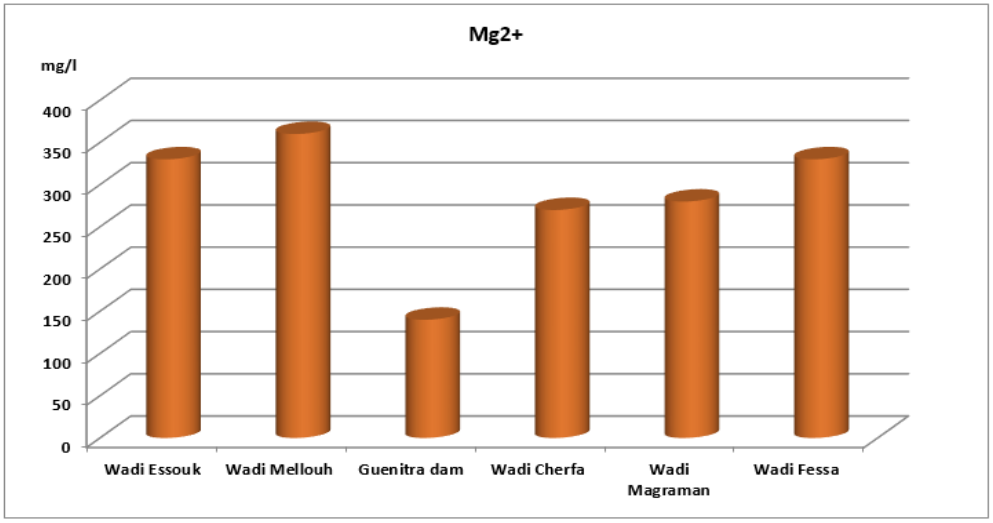

Figure 8: Evolution of Magnesium in the Guenitra Dam and its tributaries

According to Figure 08, magnesium levels are above the WHO drinking standard (150 mg/l). This is both in Wadi Essouk, Wadi Mellouh, Wadi Cherfa, Wadi Magraman and Wadi Fessa with values ranging from 270 to 360 mg/L. However, the value below the WHO standard (150 mg/l) is recorded in the Dam with 140 mg/L.

3.3.3. Iron (Fe2+)

The presence of iron in water can have a natural (leaching of clay soils) or industrial (in metallurgical or steel industries).

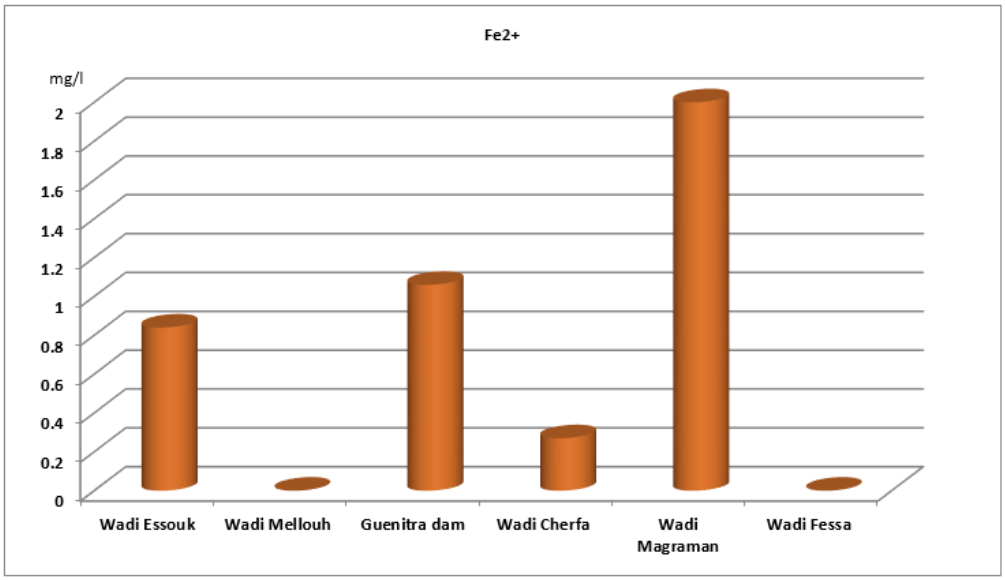

Figure 9: Evolution of Iron in the Guenitra Dam and its tributaries

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Figure 09 shows that the Fe2+ contents in the tributaries of Wadi Essouk, Guenitra Dam and Wadi Magraman have values higher than the WHO drinking standards (0.3), which are successively 0.84; 1.06 and 2 . At Wadi Cherfa the value is 0.27 which is below the standard, while the two Wadis (Mellouh and Fessa) recorded a value (0).

3.3.4. Anions

a. Chlorides (Cl-)

Chlorides can have a multiple origin, either from the intrusion of marine waters, contamination by wastewater, or from the dissolution of salts by leaching from salt soils.

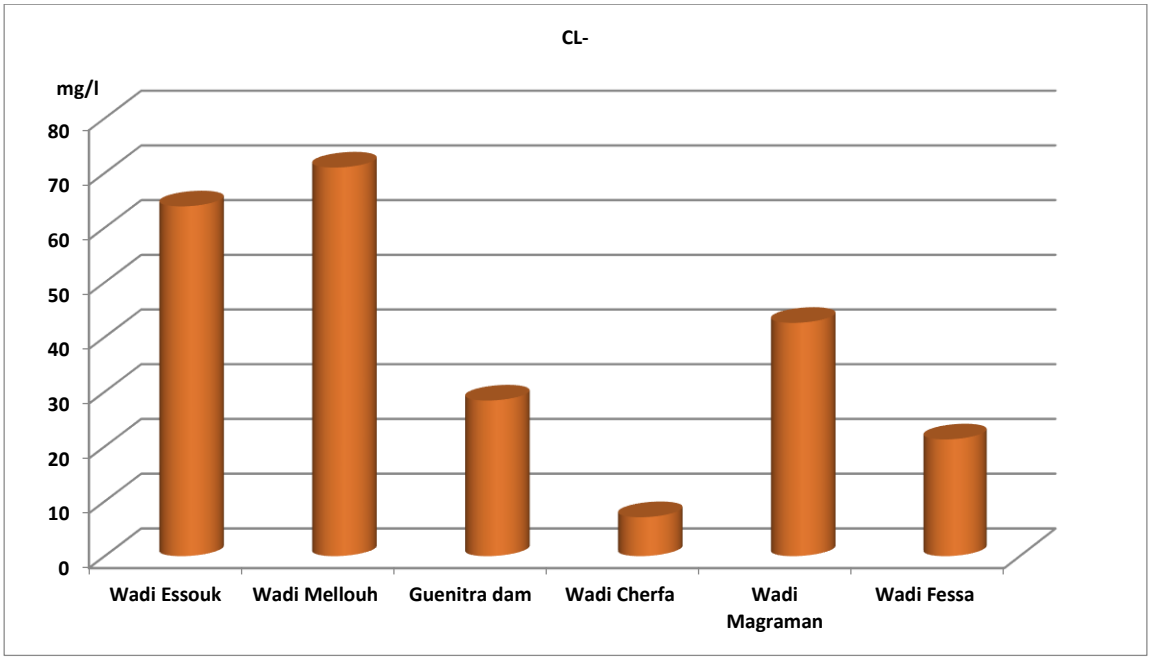

Figure 10: Evolution of Chlorides in the Guenitra Dam and its tributaries

Figure 10 portrays the inferiority of all chloride levels (Cl-) to the WHO drinking standards (250 mg/l) ranging from 7.1 to 71 mg/L, with the minimum value of (7.1mg/l) recorded at Wadi Cherfa. On the other hand, the maximum value of (71mg/l) is observed at Wadi Mellouh.

b. Sulphates (SO4 2-)

The origins of sulphates in water are multiple, they are related to rainwater (evaporation of seawater) and the solution of evaporitic sedimentary rocks particularly the dissolution of the gypsum formation and the agricultural activities that characterize the site drained by this wadi.

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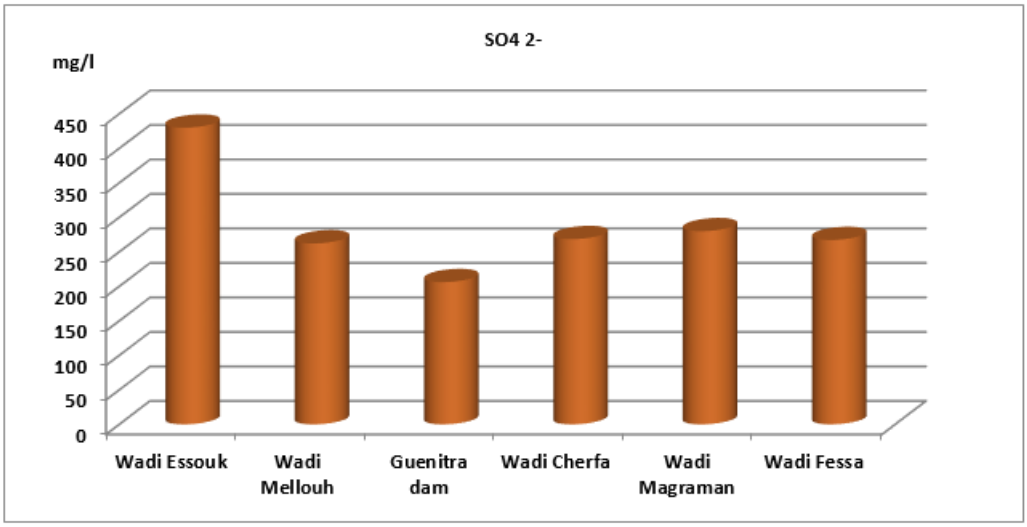

Figure 11: Evolution of Sulphates (SO4 2-) in the Guenitra Dam and its tributaries

Figure 11 demonstrates the concentrations variety from one zone to another, the low concentrations of sulphates below the WHO standard (250 mg/l) are recorded in the Guenitra Dam with 206.17 mg/l, while high concentrations above the WHO standard (250 mg/l) are recorded in the 5 tributaries Wadi Mellouh, Wadi Cherfa, Wadi Magraman and Wadi fessa with values ranging from 262.29mg/L to 280 mg/l. The highest value of 430mg/l is recorded in Wadi Essouk.

3.3.5. The components of Nitrogen

a. Nitrites (NO2 -)

The presence of nitrates in the water depends on the supply of fertilisers to the agricultural land (spreading, livestock and fertiliser discharges) and on discharges of human origin (domestic water).

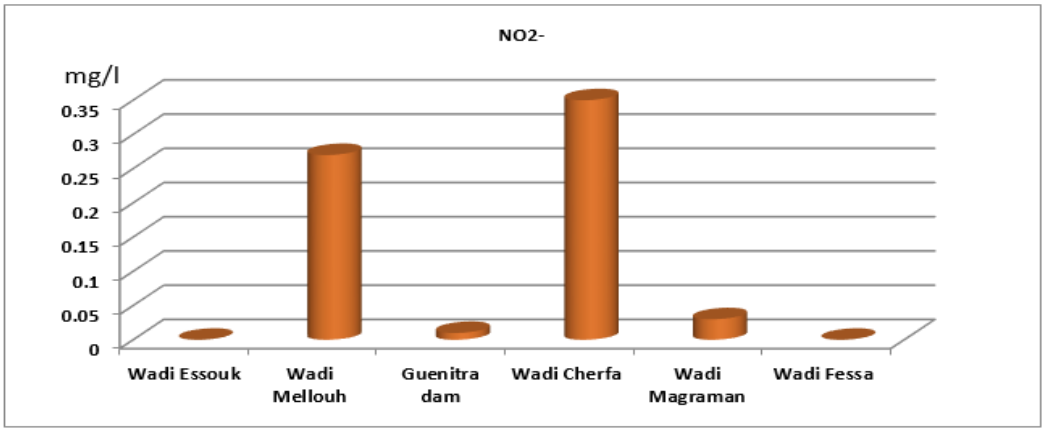

Figure 12: Evolution of nitrates in the Guenitra Dam and its tributaries

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Figure 12 illustrates that the majority of samples below the WHO standard (0.1 mg/) have lower to zero levels at Wadi Essouk, Guenitra Dam, Wadi Magraman and Wadi Fessa, and both values (0.27mg/L) and (0.35mg/L) above the standard are recorded at Wadi Mellouh and Wadi Cherfa.

b. Phosphate (PO4)

The presence of phosphates in water may be from natural sources, the decomposition of living matter, or anthropogenic (due to human activity), plant debris and algae, plants or grasses from the bed or river banks.

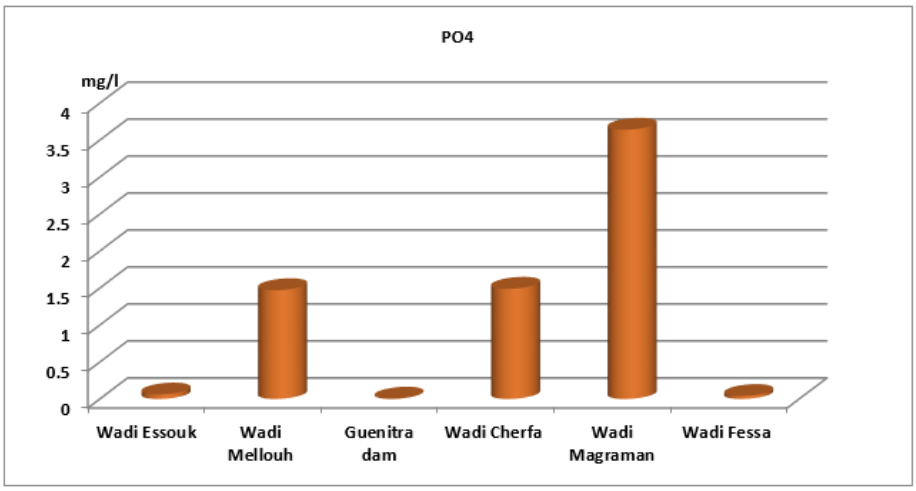

Figure 13: Phosphate evolution in the Guenitra Dam and its tributaries

Figure 13 demonstrates that (PO4) contents vary from one tributary to another, where values below the WHO standard (0.5 mg/l) are recorded at Wadi Essouk (0.06Mg/l), Guenitra Dam (0.004mg/l), and Wadi Fessa with the value (0.04mg/l), while the values recorded at Wadi Mellouh, Wadi cherfa and Wadi Magraman are successively higher than the WHO standard (0.5 mg/l), 1.47 mg/L, 1.49 mg/L and 3.64 mg/L as the maximum value.

c. Ammonium (NH4+)

The presence of Ammonium depends on the supply of fertilizers to agricultural land and discharges of human origin (domestic water) and high concentrations of (NH4 +) evidence of contamination by human and animal manure and leaching of fertilizer from crops.

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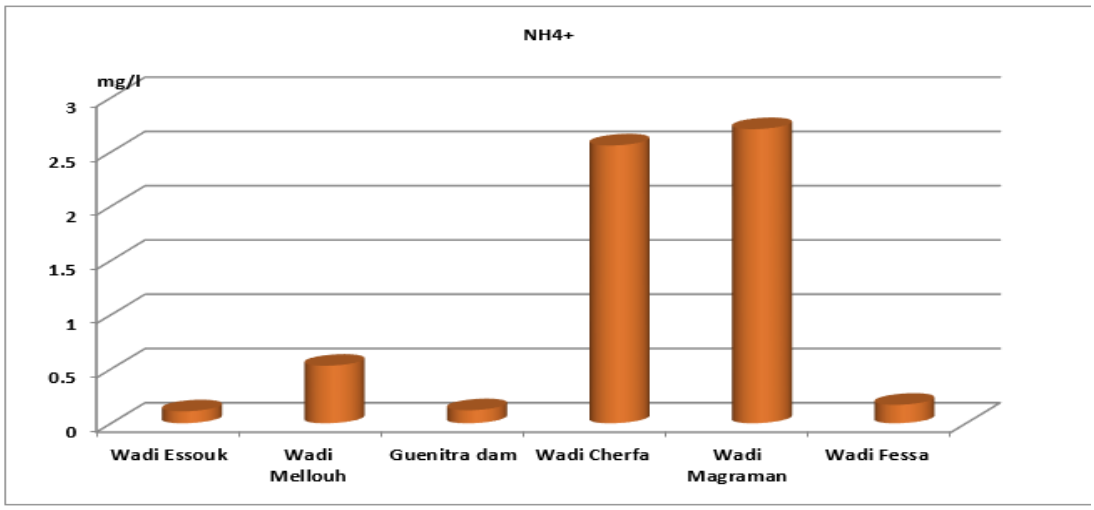

Figure 14: Ammonium evolution in the Guenitra Dam and its tributaries

Figure 14 represents the high concentrations recorded at Wadi Cherfa which are of the order of (2.56 mg/L) and Wadi Magraman with (2.71mg/L), while Wadi Mellouh recorded a value very close to the potability standard set by the WHO which is (0.5 mg/L). In contrast, values below the WHO standard (0.5 mg/l) are recorded at Wadi Essouk, while the Guenitra and Wadi Fessa dams recorded values of 0.11mg/L, 0.12mg/L and 0.17 mg/L

d. Biological oxygen demand (BOD5)

Biochemical oxygen demand (BOD) is a measure of water pollution by organic matter; it expresses the amount of the necessary oxygen for the destruction or biodegradation of organic matter present in wastewater by microorganisms in the medium for a period of five days (BOD5). The higher the BOD5, the higher the amount of organic matter in the water.

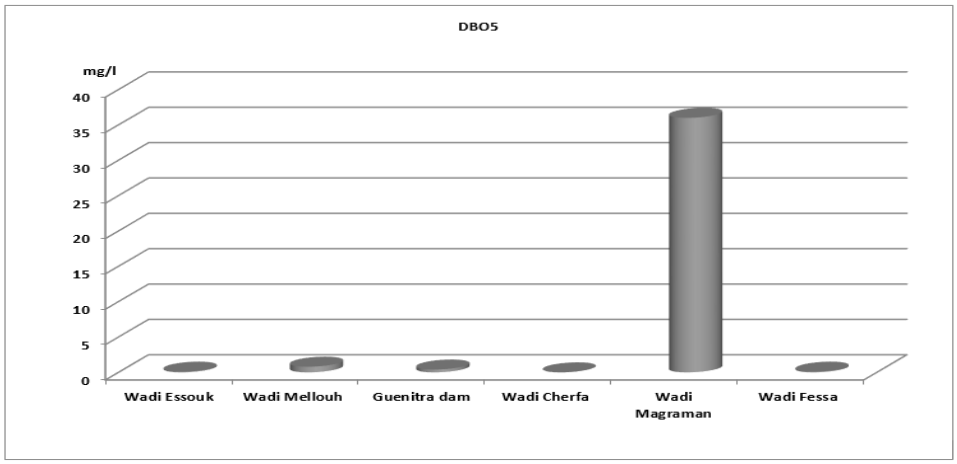

Figure 15: Evolution of BOD5 in the Guenitra Dam and its 5 tributaries

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Figure 15 illustrates that all sampling points with concentrations below the standard set by the WHO (3mg/) are lower to zero with the exception of Wadi Magraman where the BOD5 content reaches 36 mg/l.

4. INTERPRETATION OF RESULTS

The physico-chemical study of surface waters consists in giving an overview on the water quality of tributaries (Essouk, Mellouh, Cherfa, Magraman and Fessa) and the Guenitra Dam.

The interpretation of the analysis' results makes it possible to identify the type of pollution and its origin present in these tributaries, we distinguish the following:

- Pollution at Wadi Essouk is the result of natural contamination related to the geology of the area.
- Wadi Mellouh is contaminated by agricultural and urban pollution.
- Guenitra Dam:no significant pollution.
- Wadi magraman is affected by urban and agricultural pollution.
- Wadi Cherfa is affected by agricultural pollution.
- Wadi fessa is affected by contamination from geological dilution.

5. CONCLUSION

This research work was carried out at the Guenitra Dam, mainly for the supply of drinking water to the city of Skikda (37000m3), the surrounding agglomerations and the industrial zone (16000m3), it is also intended to provide irrigation for the perimeters of Emdjez-Edechich and the valley of Saf-Saf with an area of 5650 hectares. This dam is fed by 05 tributaries (wadis) that have undergone sampling in order to publish determined the physicochemical characteristics and the degree of pollution of each.

The hydro climatological study of the Geunitra Dam watershed demonstrated that the climate is Mediterranean, characterized by mild rainy winters and hot, dry summers.

This precipitation is variable and irregular from one year to another and conditions the seasonal flow, directly influencing the regime of the streams.

The region of Oum Toub is an agricultural area but regularly nibbled by concrete due to the urban extension of the Commune and neighboring Villages. These two characteristics are the main sources of imbalance at the level of the dam mainly affected by three types of pollution namely agricultural, urban and geological.

As a result, agricultural activities and discharges from surrounding agglomerations upstream of the dam are the main sources of pollution, their degrees vary from one area to another according to their intensification. At the same time, there is pollution resulting

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from the dilution of the carbonate formations and the influence of the geological deposit is caused by the corrosion of the rock under the precipitation impact.

References

1) ASSAAD A 2014. Pollution anthropique de cours d'eau: caractérisation spatio-temporelle et estimation des flux. Thèse Doctorat: Génie des Procédés pour l'Énergie et l'Environnement: université de lorraine, 226p.

2) BALLOUKI K 2012. Étude de la qualité physico-chimique et biologique de trois sources dans la région Midelt (Haut Moulay). Master Sciences et Techniques: Hydrologie de Surface et Qualité des Eaux: Université Sidi Mohammed Ben Abdellah, 76p.

3) BELHADJ M-Z 2006. Étude de la pollution du Barrage de Zit-Emba Commune de Bekkouche Lakhdar wilaya de Skikda. Thèse de Magister. Université de Batna 107p. Algérie.

4) BELHADJ M 2017. Qualité des eaux de surface et leur impact sur l'environnement dans la Wilaya de Skikda. Doctorat en sciences: Sciences Hydrauliques : Université Mohamed Khider Biskra, 172p.

5) Mohamed Ben Ali R 2014. Évaluation de la pollution des eaux issue de la zone industrielle de Skikda. Thèse Magister: Pathologie des Écosystèmes Forestiers: Université Constantine 1,145p.

6) Ben Ayache N 2014. Évaluation du niveau de la pollution organique des eaux des barrages Hammam Grouz et Béni-Haroun. Diplôme de Master 2: Pollution des écosystèmes et Eco toxicologie : université constantine1, 50p.

7) Benrabah S 2006. État actuel des ressources en eau dans la wilaya de Skikda (Essai de synthèse) bilan – gestion- perspective. Thèse de magister: Hydrogéologie: université Badji mokhtar-Annaba-, 209p.

8) Bonne font Jean-Claude. Réflexion sur la pollution agricole en Lorraine. In: Revue Géographique de l'Est, tome 32, n°1, 1992. Environnement et population dans la France de l'Est. pp. 25-42.

9) Boudjadja A, Messahel M et Pau H 2005. Assessment of Water Resources in Northern Algeria. Revue des sciences de l'eau / Journal of Water Science. Volume 16, numéro 3, 2003, p. 285–304.

10) BOUKHRISSA M 2015. Collecte des rejets et système d'épuration des eaux usées de la commune d'Oum Toub. Wilaya de Skikda. Master en Hydraulique: Hydraulique urbaine: université Abderrahmane mira de Bejaia, 91p.

11) Chartier Marcel M. Les types de pollutions de l'eau. In: Norois, n°82, Avril-Juin 1974. pp. 183-193;

12) Durand D 1969. Mise au point sur la structure do nord-est de la Béribérie. Publ. Serv. Géol. Algérie. Nll. Sér., 39, 89-131.

13) Foufou A. 2015. The Development of Mountain Agriculture in the wilaya of Skikda (eastern Algeria) Facing New Legal Framework. "Program Evaluation in Action and Future Prospects". International Journal of Advanced Research (2015), Volume 3, Issue 5, 824-834.

14) و ضمان الـ غذائ ي الأمن دعم أجل من الـ جزائ ر ف ي الـ زراع ية الإذ تاج ية رف ع ضرورة .2016 .ر وحوي ش ي تي ع ف وف و الـ ت نم ية ف ي وال بحوث مخ برال درا سات .69-55 ص 5 رق م .الـ ت نم ية ودرا سات أب حاث ج لة .الاج تماعي الا س ت قرار .الـ ري ف ية

15) Hadef S 2018. La qualité des eaux superficielles du sous bassin versant de Guenitra, wilaya de Skikda, N-E Algérien. VIth Inter-national Symposium—2022:"Biosphere & Environ-mental Safety." Proceedings book... P-p 230-238.

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16) Harrat N et Achour S 2010. Pollution physicochimique des eaux de la région d'ElTarf. Impact sur la chloration. Larhyss Journal, ISSN 1112-3680, n° 08, Juin 2010, pp. 47-54

17) Labar S 2009. Évaluation de la pollution des eaux souterraines dans un milieu industriel (Cas de la zone industrielle de Skikda, N.E. algérien). Thèse Doctorat: Sciences en Géologie : université Badji Mokhtar-Annaba, 168p.

18) Mebarki A 2005. « Hydrologie des bassins de l'Est Algérien : ressources en eau,

19) Aménagement et environnement » thèse de Doctorat d'État, Université Mentourii Constantine.360 p.

20) Mecibah I 2008. Les ressources en eau et gestion intégrée du bassin versant d'Oued Guebli (Nord-Est Algérien).Thèse de magister: Hydrogéologie :université Badji Mokhtar-Annaba, 262p.

21) Bosc P-M 2014. L'agriculture familiale : Définition, caractéristiques et implications pour les politiques : Journée Mondiale de L'Alimentation (JMA) 2014 : Université d'Antananarivo,18p.

22) Raoult J.F 1966. Nouvelles données sur les flysch du Nord du Kef Sidi Driss et dans la zone du Col des Oliviers (Nord du Constantinois, Algérie), Bulletin de la Société Géologique de France, 7 :516-543.

23) Remrem K and al 2006. Contribution à l'étude du bassin versant de Guenitra de la willaya de Skikda et sa protection contre l'érosion hydrique. Diplôme d'ingénieur d'état en science agronomiques: université du 20 aout 1955Skikda, 79p.

24) Rodier J and al 1996. « L'analyse de l'eau: eaux naturelles, eaux résiduaires, eau de mer » 8ème Edition. Dunod. Paris.

25) Salhi K 2015. Étude de la dégradation des milieux aquatiques par différents types de rejets. Diplôme de Master: Gestion durable des Écosystèmes et protection de l'environnement: Université des Frères Mentouri Constantine, 62p.

26) Sari H 2014. Contribution à l'étude de la qualité physico-chimique et bactériologique de l'eau. Mémoire de Master en sciences des aliments: Université Abou-Beker Belkaid Tlemcen, 92p.

27) Touati B 2010. Les barrages et la politique hydraulique en Algérie: état, diagnostic et perspectives d'un aménagement durable. Thèse de Doctorat d'État: Aménagement du Territoire: université Mentouri – Constantine, 384p.

28) Villa, J. M 1980. La chaîne Alpine d'Algérie orientale et des couffins Algéro-Tunisiens. Thèse doctorat d'état, université Paris VI, 3 volumes, 650p.

29) Zeghoud M-S 2014. Étude de système d'épuration des eaux usées urbaines par lagunage naturel de village de Méghibra. Mémoire de Master... Université d'El-Oued, 90p.