

## The quality of groundwater in the Boumalne region

GHACHOUI Hayat<sup>1</sup>, LOQMAN Souad<sup>1</sup>, ALGOUTI Ahmed<sup>2</sup>, TOUDAMRINI Hanane<sup>2</sup>,  
ABOULFARAJ Abdelfattah<sup>2</sup>, MOUJANE Said<sup>2</sup>, AGLI Saloua<sup>2</sup>, and BENALI Hafssa<sup>1</sup>

<sup>1</sup> Department of Medical biology, Cadi Ayyad University, Faculty of Medicine and Pharmacy, University, Morocco

<sup>2</sup> Department of Geology, Cadi Ayyad University, Faculty of Sciences, University, Morocco

\*(hayat.17.mdc@gmail.com) Email of the corresponding author

**Abstract** – The negative contribution of humans has unbalanced the climate chain (biosphere, hydrosphere, geosphere, cryosphere, atmosphere). Because of the demographic explosion and industrial development. This has given rise to the notion of water scarcity. The contamination by chemical molecules and pathogens with clinical relevance represents a challenge for global public health, specifically in arid zones such as the Boumalne region. Thus, groundwater quality monitoring is necessary to provide early warnings and guide public policies to protect these precious resources. The present project focused, on the physical, chemical, and biological, characterization of the groundwater Dad. This investigation consists of analyzing 18 samples which were taken, of stations extending all Dades's river starting from the upstream till the downstream. Boumalne's groundwater has a good pH with excellent total iron levels. However, electrical conductivity, fecal coliforms, fecal streptococci, and total coliforms are varied from low to excellent. Nitrate levels vary from average to excellent. Physico-chemical and biological quality decreases from upstream to downstream.

**Keywords** – Groundwater – Contamination- Physical, Chemical, Biological Characterization-Water Quality

### I. INTRODUCTION

The demographic explosion is putting increased pressure on ground water, as the various household, hospital, industrial, and agricultural activities are producing pollutants that are hazardous to public health [1]. Among the multiple physicochemical and biological pollutants, the contamination of surface water by pathogens resistant to medicines is alarming, as they affect the ability to treat a variety of infections caused by bacteria, parasites, viruses, and fungi [2][3]. More than 46% of people in the West Pacific and 22% of people in Africa have fecal colonization with Enterobacteriaceae that produce extended-spectrum beta-lactamases (ESBLs)[4].

priority pathogens (WHO, 2017), such as carbapenem-resistant Enterobacteriaceae and vancomycin-resistant Enterococcus spp, are progressively appearing in aquatic ecosystems around the world [5]. With the increase in human activities, the discharge of waste into the soil leads to the infiltration of pathogens into the vadose zone, depending on soil typology, porosity and organic matter content [6]. Emerging pathogens percolate into groundwater, causing the emergence of diseases that are harmful to public health. [7]. Unfortunately, very few studies have looked at the microbial contamination of Moroccan groundwaters. Morocco's natural water resources

are twenty-two billion m<sup>3</sup> per year, the equivalent of 750 m<sup>3</sup> /inhabitant/year, which represents a critical threshold indicating the emergence of shortages and latent water crises [8]. Unfortunately, in the last fifty years, the nation of pollution has become more and more important, and it worsens with time, because of human activities, such as agriculture, industry, and urbanization that produce solid and liquid discharges, which continents of pathogenic agents (bacteria, viruses, parasites...) that can cause dangerous effects on the public sanitation [9]. Therefore, man must think of ways to protect his environment, for himself, and for future generations. Consequently, Morocco is interested in preserving its natural resources by improving the quality of life of its citizens and strengthening the sustainable management of natural resources. [10] Since the Dades region is a particularly critical area in Morocco, the groundwaters of the Dades basin are very susceptible to anthropic pollution. So, the objective of this study is to evaluate the quality of the waters of the study area by analyzing groundwaters' physicochemical and bacteriological parameters.

## II. MATERIALS AND METHOD

### A. Presentation of the study area

The Dades Valley is on the southern slope of the limestone High Atlas. The valley is extended in the south-Atlasic zone. The Dades River merges into the Mansour-Eddahbi dam, where it joins the Draa which is Morocco's main river [14].

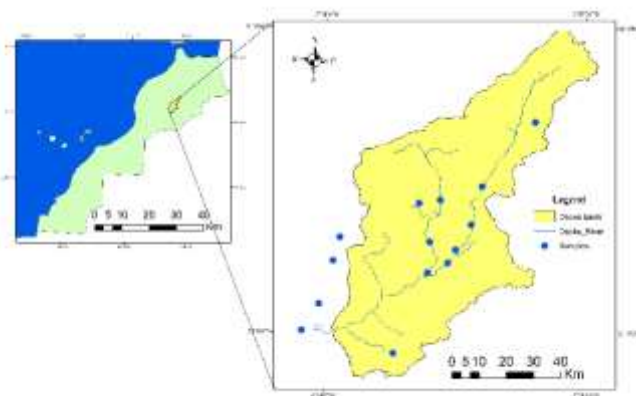


figure 1: geographical situation of study area

This investigation consists of analyzing 18 samples that were taken, of stations extended all Dades's river starting from the upstream till the downstream.

The collection of samples was based on the Moroccan ISO standards (ISO/IEC, 2005)[12]. 500ml of water from each well was gathered in sterilized polyethylene bottles. Keeping them in an icebox at 4°C until they're transported to the laboratory for bacteriological and chemical analysis in less than 24 hours[13] .

### B. Physicochemical analyses

The PH was measured in situ by the pH meter (HANNA HI8014), the conductivity and the dissolved oxygen were measured by the same device (Multi 340i), and the temperature by a digital thermometer with a probe. All the measurements are made after calibration of the

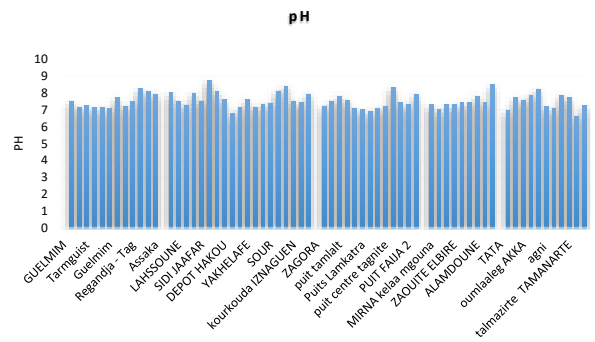
material[15]. Then determine the GPS points of the sampling point. The nitrate levels were measured in the laboratory. By using a sulphuric acid medium in the presence of copper (II) and a catalyst (titanium oxide), the mineralization of organic nitrogen is promoted and the condensate collected is measured by volumetric acid/base assay [16].

### C. Bacteriological analyses

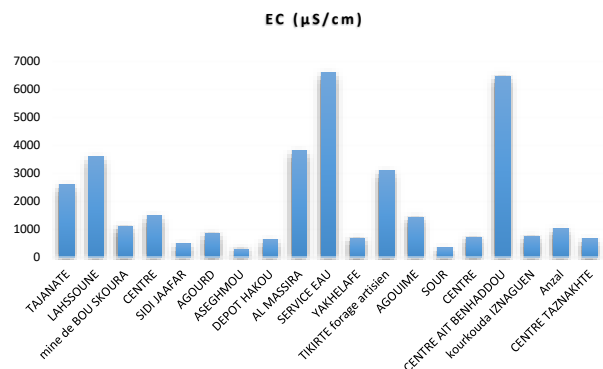
The assessment of water quality consists of to detect the presence of pathogenic bacteria with the classical microbiological methods. The analyses began with the culture of the stock solution of each sample, then a series of dilutions (10-1, 10-2, 10-3) was applied to all samples in 9 ml of physiological solution (NaCl 9%). A volume of 1 ml of each sample was streaked on 90 mm diameter Petri Plates with different culture media to incubate the different bacteria of each sample. We mention the "Mac Conkey Agar" for *Enterobacteriaceae*, the "Cetrimide Agar" for *Pseudomonas*, the "Bile Esculin Agar" for *Enterococci*, and the "Chapman" and "Tryptone-Soja" media for *Staphylococci*. Then spread 1ml of each sample in each medium under sterile conditions. Then incubate all plates in the incubator at 37°C +/- 0.5°C for 24 hours. Then the enumeration of bacteria in the media.

### III. RESULTS

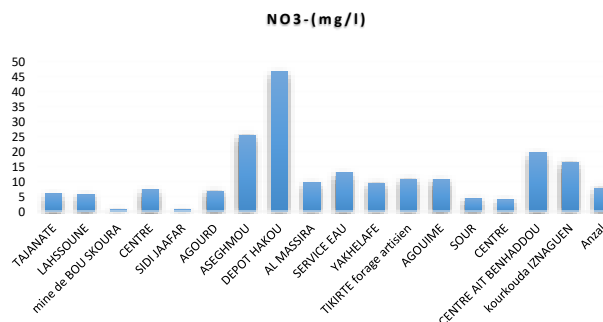
Physicochemical data for all the boreholes are summarized in graph 1 pH ranging between 6 and 8.5. The maximum temperature recorded was 23.7 C. High electrical conductivity (EC)(graph 2) values were measured in (1556 mS/m). The maximum level of nitrates NO<sub>3</sub>. is 49 mg/l (graph3).



Graph 1:pH

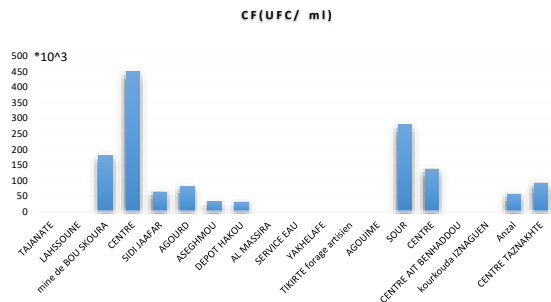


Graph 2:Conductivity

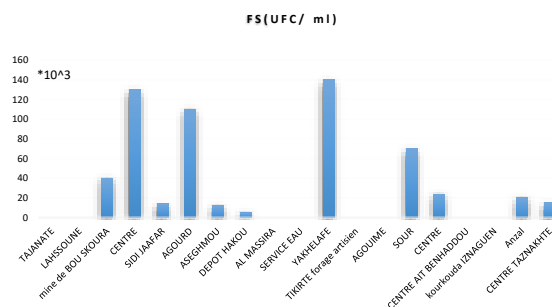


Graph 3:Nitrates NO3-

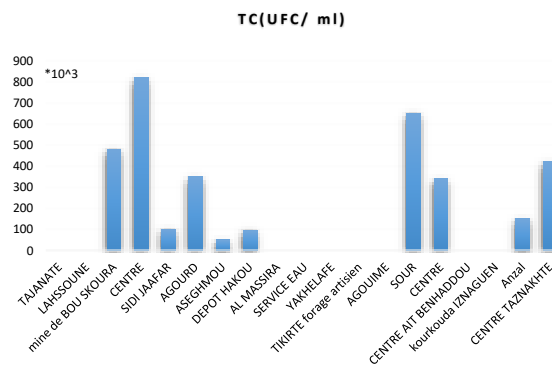
Samples were collected at the various sites upstream and downstream. The bacterial analyses showed that the maximum of: *fecal coliforms* (CF) 450000UFC/ ml, *fecal streptococci* (FS) 140000 UFC/ ml, and *total coliforms* (TC)500000 UFC/ ml.



Graph 4: Fecal Coliforms CF



Graph 5:Fecal Streptococci FS



Graph 6:Total Coliforms TC

#### IV. DISCUSSION

This investigation consists of analyzing 18 samples which were taken, of stations extending all Dades's river starting from the upstream till the downstream. Boumalne's groundwater has a good pH with excellent total iron levels. However, electrical conductivity, fecal coliforms, fecal streptococci, and total coliforms are varied from low to excellent. Nitrate levels vary from average to excellent. Physico-chemical and biological quality decreases from upstream to downstream. This pollution is due to the human's activity,

#### V. CONCLUSION

Morocco's water resources are still in a critical state, requiring immediate action. This means launching new management plans to address current problems. With the existence of uncontrolled waste dumps, sewage treatment plants (STEP), quarries and mines, the vulnerability and risk of water contamination, and more specifically groundwater contamination, is increasing, which explains the high level of bacterial contamination in the study area. This is why this study has been carried out to determine the quality of water in the region.

#### ACKNOWLEDGMENT

I would like to express my sincere thanks to all the scientific team and specifically to my supervisors Mrs LOQMAN Souad, and Mr ALGOUTI Ahmed.

#### REFERENCES

- [1] James A. Ayukekbong, Michel Ntemgwa and Andrew N. Atabe, "The threat of antimicrobial resistance in developing countries: causes and control strategies", 2017
- [2] (2017/2018) The WHO website. [Online]. Available: <https://www.afro.who.int/fr/search/googlecse?keys=watre>
- [3] J Huang, MR Templeton, N Graham - Water research, "Occurrence and control of nitrogenous disinfection by-products in drinking water—a review", 2011
- [4] Y Tian, JD Robson, S Riekehr, N Kashaev, L Wang, T Lowe, A Karanika, Metallurgical and Materials Transactions A, "Process optimization of dual-laser beam welding of advanced Al-Li alloys through hot cracking susceptibility modelling", 2016
- [5] L.Huang, Y.Xu, J. Xu, J.Ling, J. Chen, J.Zhou, L.Zheng, Q. Du, "ntibiotic resistance genes (ARGs) in duck and fish production ponds with integrated or non-integrated mode" 2017
- [6] S Lata, SR Samadder "Removal of arsenic from water using nano adsorbents and challenges: a review", 2016

- [7] Nishiyama and al., 2017; Q. Wang, T. Hisatomi, Y. Suzuki, Z. Pan, J. Seo, M. Katayama, T. Minegishi, H. Nishiyama, T. Takata, K. Seki, A. Kudo, T. Yamada, and K. Domen” Particulate Photocatalyst Sheets Based on Carbon Conductor Layer for Efficient Z-Scheme Pure-Water Splitting at Ambient Pressure”2017
- [8] Taučer-Kapteijn and al., 2016) Maja Taučer-Kapteijn, Wim Hoogenboezem, Laura Heiligers, Danny de Bolster, Gertjan Medema,” Screening municipal wastewater effluent and surface water used for drinking water production for the presence of ampicillin and vancomycin resistant enterococci”2016
- [9] Y Fang, BE Logan ,“ Bacterial transport in gas-sparged porous medium”1999
- [10] F. Schijven; J. H. C. Mülschlegel; S. M. Hassanizadeh; P. F. M. Teunis; A. M. de Roda Husman,” Determination of protection zones for Dutch groundwater wells against virus contamination - uncertainty and sensitivity analysis”2006
- [11] National Water Plan (Final report -2013).
- [12] 2018 The WHO website. [Online]. Available:<https://www.afro.who.int/fr/search/googlecse?keys=watre>
- [13] (Integrated Water Resources Development Master Plan (IWRDMP), 2004).
- [14] L. Riser and G. Trecolle ,” Présentation géographique (J. Riser)”1994
- [15] Jeffrey L. Smith, John W. Doran,” Measurement and Use of pH and Electrical Conductivity for Soil Quality Analysis”,1997
- [16] Purificación Sáez-Plaza, Tadeusz Michałowski, María José Navas, Agustín García Asuero & Sławomir Wybraniec,” An Overview of the Kjeldahl Method of Nitrogen Determination. Part I. Early History, Chemistry of the Procedure, and Titrimetric Finish”2013