proceedings

MDPI

Extended Abstract

Characteristics of Mediterranean Sea Water in Vicinity of Tangier Region, North of Morocco †

Imane Bourouhou [1,*], Farida Salmoun [1] and Yusuf Gedik [2]

[1] Department of Chemistry, Abdelmalek Essaadi University, Tangier 90090, Morocco; salfari2001@yahoo.fr
[2] Department of Environmental Engineering, Cumhuriyet University, 58000 Sivas, Turkey; ygedik35@gmail.com
* Correspondence: ibourouhou@uae.ac.ma; Tel.: +212-638967072
† Presented at Environment, Green Technology and Engineering International Conference (EGTEIC 2018), Caceres, Spain, 18–20 June 2018.

Published: 18 October 2018

Abstract: Coastal areas play a crucial role in maintaining the ecological balance of ecosystems and developing the social and economic wellbeing of the countries bordering it. However, the pressure on both terrestrial and marine resources, the use of oceans as a wastes deposit, the growth of population and the increasing of urbanization and human activities in coastal areas are all causes for marine and coastal degradation. The present situation constitutes a significant danger in many places. As an example, the pollution of the coastal waters in the Mediterranean has increased in recent years. Industrialization, tourism and ports activities along the coastline of the Mediterranean are the main sources of many pollutants that have effects on human's health and environment. So that, it is very important to examine seawater quality in order to protect the marine and coastal areas from degradation. Hence, comes the need to consider a physicochemical and bacteriological study to evaluate the quality of Tangier coastal seawater using the Water Quality Index (WQI). A campaign of 25 sampling points was conducted and the results of the WQI calculation have highlighted the Tangier water was between medium and bad.

Keywords: Tangier coastal seawater; pollution; water quality Index; sampling; water quality parameters

1. Introduction

The pollution produced by anthropogenic activities in coastal areas has harmful short and long-term effects on human health, the ecological systems, and the environment. So, it is very important to evaluate the quality of coastal seawater in the vicinity of Tangier. Reflecting the composite influence of different water quality parameters, the water quality index WQI is also useful for the classification of waters and can give an indication of the health of the water [1].

This study aims to evaluate the physicochemical and bacteriological quality of coastal waters using the water quality index in order to study human health effects and the environmental impact.

2. Materials and Methods

2.1. Study Area

The region of Tangier-KsarSghir is located in north Morocco. The capital city Tangier covers an area of 11,570 km², representing 1.6% of the total area of the Moroccan Kingdom. It is bordered by the Mediterranean Sea to the north, the Atlantic Ocean to the west, the region of Taza-Al Hoceima-Taounate to the east and the Gharb-Chrarda-Beni Hssen South [2].

2.2. Methods of Sampling and Analysis

A campaign of 25 sampling points was conducted to have a representation of the coastal seawater pollution in the region of Tangier. The sampling strategy used is stratified random sampling. In fact, because of the heterogeneity of the longitudinal distribution and the dispersion of the pollution in the study area, the estimate of the overall water quality will be biased if random samples ignore areas of high concentration [3].

The following physicochemical variables: temperature, pH, and conductivity were measured directly in situ. For bacteriological analysis, samples were collected using sterile bottles. To avoid any contamination, special precautions have been taken during collection and storage according to ISO 5667-1, ISO 5667-2, and ISO 5667-3. The maximum shelf life of samples for analysis is 24 h provided that they are kept at a temperature of 5 +/− 3 C. Germs test of fecal contamination (GTFC) chosen according to Normalizes Moroccan 03.7.001 are: *Escherichia coli* (The most significant species of faecal contamination), Total coliforms, Fecal coliforms, and Fecal streptococci.

In this study, the Water Quality Index (WQI) is used to evaluate the coastal seawater pollution. The index is basically a mathematical means of calculating a single value from multiple test results.

2. Results and Discussion

The WQI is one of the most widely used of all existing water quality procedures. The overall results of nine separate tests can be used to determine if a particular stretch of river is healthy. The WQI consists of nine tests: Dissolved Oxygen, Fecal Coliform, pH, BOD (Biochemical Oxygen Demand), Temperature, Total Phosphate, Nitrates, Turbidity, Total Solids.

The results of the nine tests are recorded and transferred to a weighting curve chart where a numerical value is obtained. For each test, the numerical value or Q-value is multiplied by a "weighting factor". For example, dissolved oxygen has a relatively high weighting factor; because it is more significant in determining water quality than the other tests. The nine resulting values are then added to arrive at an overall water quality index (Table 1). The highest score a body of water can receive is 100 [4].

Table1. Water quality Index ranges.

Index Ranges	Water Quality
0–25	Very bad
25–50	Bad
50–70	Medium
70–90	Good
90–100	Excellent

The standard formula to calculate water quality index can give the best results for estimating water quality, but sometimes it is difficult to get the concentration of all nine quality parameters which are requested for WQI calculations. To overcome this problem, Srivastava and Kumar (2013) suggested the following Equation (1) that gives a chance to calculate water quality index without having the concentration of all parameters [5].

$$WQI_{MP} = \sum W_y \cdot Q_y / \sum W_y \quad (1)$$

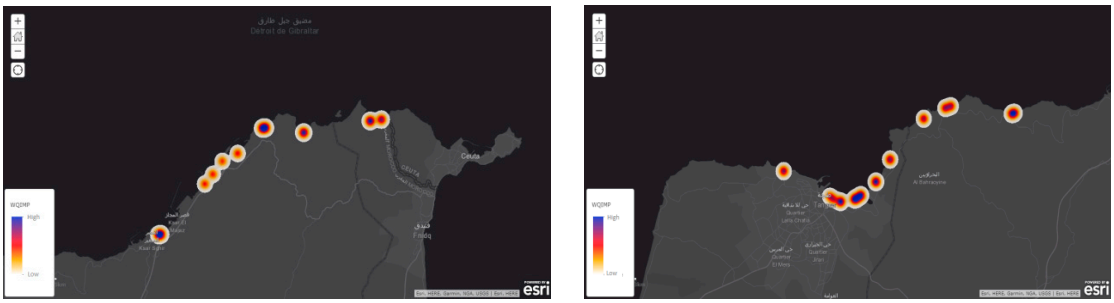
where, Y = available parameters, Q_Y = q-values of available parameters, and W_Y = weighting factors of available parameters. The values of WQI of the present study at each station are listed in Table 2.

Water Quality Index of the present waterbody is established from important three physicochemical parameters (pH, temperature, conductivity) and bacteriological parameter (Fecal coliforms). The Q-value of various parameters is calculated according to the Water Research Center (2014) [6]. It was observed that the minimum value of WQI (26.45) was observed at stations 24 in the region of the Tangier Med port summer while the maximum value (59.39) was observed at station 18 in Tangier city beach.

Table 2. Water Quality Index values during 2017.

Sampling Station	WQI_{MP}
S1	46.21
S2	59.16
S3	57.18
S4	51.55
S5	49.09
S6	40.43
S7	41.55
S8	40.25
S9	41.48
S10	44.05
S11	44.18
S12	39.14
S13	46.86
S14	58.93
S15	57.18
S16	38.55
S17	45.09
S18	59.39
S19	29.91
S20	30.00
S21	45,64
S22	29.57
S23	29.29
S24	26.45
S25	31.41

The classification of water quality index which is based on the physicochemical and bacteriological parameters in the investigated area ranged from medium to bad water. This water quality rating study clearly shows that the status of the waterbody is bad in the different sampling sites in the Tangier-Med port area (Figure 1a). The pollution in this region could result from the discharges of ships or hydrocarbons (refueling, cleaning of boats, leaching of roads or car parks, etc.) which are among the pollutants characteristic of port areas [7]. It is also observed that the pollution load is relatively low in the sampling sites S2, S3,S4 located in the Benyounech, Oued el Marsa and Dalya beaches. The above water quality calculated shows a water of bad quality among almost all other regions (Figure1b).



(**a**) (**b**)

Figure 1. Classification of Water Quality Index in the study area. (**a**) Ksar Sghir region; (**b**) Tangier-Assilah region.

3. Conclusions

The results obtained during the present study signified that the Tangier region is characterized by a relatively low to moderate seawater quality. The harmful effects of port activities and industrial effluents reaching the coastal area principally, responsible for lowering the classification of WQI (medium to bad) and hence may cause a sharp decrease in the stock total catch of many fish species. Accordingly, proper treatments of these effluents are highly desired before their disposal into this region.

Author Contributions: I.B. performed the experiments and led the writing of this paper. The first draft was written and then sent to F.S. for her comments and edits. Y.G. and I.B. analyzed the data and then F.S. and I.B. produced the final paper.

Acknowledgments: We appreciate the efforts of all researchers who have worked hard to advance knowledge and improve outcomes of seawater quality evaluation. We also thank the National Office of Food Safety (ONSSA) for providing us with materials and equipment for this work.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Gharib, S.M.; El Sherif, Z.M.; Halim, A.M.A.; Radwan, A.A. Phytoplankton and environmental variables as a water quality indicator for the beaches at Matrouh, south-eastern Mediterranean Sea, Egypt: An assessment. *Oceanologia* **2011**, *53*, 1–18.
2. Laghzal, A.S.F.; Boudinar, B.; Khaddor, M.; Cherroud, S.; Fihri, M.; Mammad, C. Evaluation of physico-chemical and bacteriological quality of water springs by using a principal component. *J. Mater. Environ. Sci*. **2016**, *7*, 456–462.
3. Loubersac, L.*Pollution du Littoral Français par les Macrodéchets*; Méthodologie-Etat de référence; Ministère de l'environnement, Centre Océanologique de Bretagne, Département Environnement Littoral, CNEXO: Paris, France, 1982; 27p.
4. Srivastava, G.; Kumar, P.Water Quality Index with Missing Parameters. *IJRET* **2013**, *2*, 609–614.
5. Abdel-Halim, A.M.; Aly-Eldeen, M.A. Characteristics of Mediterranean Sea water in vicinity of Sidikerir Region, West of Alexandria. *Egypt Egypt. J. Aquat. Res.* **2016**, *42*, 133–140.
6. B. Oram, Monitoring the Quality of Surface Waters. In *Calculating NSF Water Quality Index (WQI);* Water Research Center: Dallas, PA, USA, 2014.
7. CREOCEAN, Agence Spéciale Tanger Méditerranée (TMSA). *Projet d'extension du complexe portuaire (Tanger Med II), Etude d'Impact sur l'Environnement*; Version Finale; TMSA: La Seyne sur Mer, France; Casablanca, Morocco, 2010; 187p.