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Quality Control of Bemapaza Lake Water in the Borough of Dzamandzar Located in the Nosy-Be Hell-Ville District (Province of Diego Suerez)

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Abstract The district of Nosy-Be is located in the Mozambique Channel in northwestern Madagascar. It is located in the region of DIANA, Autonomous province of Diego Suerez. It is divided into 5 districts; Lake BEMAPAZA is located in the DZAMANDZAR district. The objective of this work is to know the quality of the lake water compared to the quality required for international standards. Temperature 15.9 ℃, turbidity 1.68 NTU, pH 7.04 and the conductivity is 64.7 μS / cm, the quality for the physical parameters are good. For dissolved oxygen 1.6mg / L, salinity 0.05mg / L, alkalimetric titre 1.6 °f, nitrate 0.85 mg / L, total hardness 7.2 mg / L, total iron 0mg / L, ammonium 0.02mg / L, sodium 11.5mg / L, potassium 10mg / L, Calcium 10.4 mg / L, magnesium 11.7 mg / L, aluminum 0 mg / L, copper 0.02mg / L, Lead 0 mg / L, chloride 17.75 mg / L. The quality of the chemical parameters of BEMAPAZA Lake water is acceptable in relation to the standards required for drinking water. For microbiological quality: microorganisms at 22 ℃ is 50 cfu / mL, microorganisms at 36 ℃ is 8 cfu / mL, total coliforms is 0.002 cfu / 100 mL, Escherichia coli is 0.005 cfu / 100 mL, intestinal enterococci is 0.004 cfu / 100 mL and Anaerobic Spores is 0 Ufc / 100mL. The quality of BEMAPAZA Lake bacteria is acceptable for international drinking water standards.

Keywords Water, Physicochemical parameters, Microbiological and quality control

1. Introduction

Nosy-Be is an exceptional island because of its relief, in the island there are 10 sacred lakes, so the work is done in lake BEMAPAZA located in the district of DZAMANDZAR.

The number of inhabitants in this borough is given by the following table

Table 1. Shows population counts in the DZAMANDZAR Borough

Borough	Male	Female	Stranger
Dzamandzar	14400	15340	430
TOTAL	30170		

Among the 10 sacred lakes called Lake BEMAPAZA, this lake is located in the district of Dzamandzar, it is located in the West of the island. The population around this lake uses this water as drinking water. For that my goal is to know the quality of the water this lake.

The characteristics of BEMAPAZA Lake

Table 2. Gives the characteristics of BEMAPAZA Lake

Lake	Area (ha)	Volume (m^3)	Mean Depth (m)	Maximum depth (m)
BEMAPAZA	13	360	3	5

This study has four parts, the bibliographic synthesis in the first part, the measurement results for the physicochemical and microbiological parameters in the second part followed by the interpretation and the discussion of these results in the third, we will conclude with the conclusion.

Bibliographic synthesis

The structures of water is liquid, solid and gaseous, the general formula is H2O

The water dissociates into H + proton and OH- hydroxide, the separation of two ions is measured by the hydrogen potential.

The water consists of dissolved oxygen-base

Gas, it is contains several organic materials of varying concentrations.

Metals can exist in the water under a trace. The existence of pollution in water is very dangerous, it turns into a microbe.

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Quality standard

We refer to the recommendation of the European Union (EU), the World Health Organization (WHO) and the Malagasy State (EM)

Norm of quality

1 - Recommendation of the WHO

2 - Recommendation of EU

3 - Recommendation of the EM

Table 3. Recommendation of the WHO

Designation of the parameters		Limit acceptable	units
Parameters microbiological	Microorganism to 22℃	<100	Ufc/ml
	Microorganism to 36℃	<20	Ufc/ml
	Coliformes	0	Ufc/100ml
	Coli	0	Ufc/100ml
	Enterocoques	0	Ufc/100ml
	Spores	0	Ufc/100ml
Parameters of aesthetic	Turbidity	5	NTU
	Temperature	25	℃
	pH	6,5 to 8,5	mg/l
Parameters inorganic	Chlorides	250	-
	Magnesium	50	-
	Sodium	200	-
	Calcium	400	-
	Potassium	<12	-
	Aluminum	0,2	-
	Nitrates	44	-
	Ammonium	<0,5	-

Table 4. Recommendation of the EU

Designation of parameters		Limit acceptable	units
Parameters organoleptiques	Turbidity	<5	NTU
Parameters physic-chemical	Temperature	25	℃
	pH	6,5 to 9,5	
	Chlorides	250	mg/l
	Magnesium	50	-
	Sodium	200	-
	Potassium	12	-
	Aluminum	2	-
	Toughness	50	°F
Parameters concerning the substances undesirable	Nitrates	50	mg/l
Parameters toxic	Lead	<0,5	mg/l

Table 5. Recommendation of the EM

Designation of the parameters		Limit acceptable	unitis
Parameters organoleptiques	Turbidity	<5	NTU
Parameters physic-chemical	Temperature	25	℃
	pH	6,5 to 9	
	Chlorides	250	mg/l
	Magnesium	50	-
	Calcium	400	-
	Sodium	150	-
	Potassium	<12	-
	Aluminum	0,2	-
Parameters concerning the substances undesiranle	Nitrates	50	-
	Iron	0,2	-
Parameters concerning substances toxic	Lead	0,05	-
Parameters microbiological	Coliformeses total	0	Ufc/100ml
	Streptococcifecal	0	Ufc/100ml
	Coliforme thermotolerant	<1	Ufc/100ml
	Sulfite-Reducing	<1	Ufc/20ml

PARAMETERS OF ANALYSIS

- Turbidity: it is the transparency of water.
- pH: to know the water is acid, base and neutral, it depends on the variation of this pH.
- Conductivity: allows appreciating the quality of salt dissolved in water.
- Organic matter: allows estimating the quality of organic matter in water, BOD and COD.
- Salinity: it is the measure of the concentration of salt in water.
- Alkalimetric title: this is the basic salt content, that is to say to know the concentration of OH- ion in water.
- Nitrate assays: determination of the nitrate concentration that exists in water.
- Total hardness: determination of the calcium and magnesium content that exist in water.
- Iron determinations: to know the concentration of iron in water, it is in the form of trace.
- Ammonium: the ammonium ion indicates an existence of pollution in water.
- Sodium: is responsible for the hydro-electrolyte balance.
- Potassium: plays a role as calcium in human life.
- Calcium and magnesium: concentrations are very important in drinking water.
- Aluminum, Lead and Copper: are lord metals, their existences in the drinking water doing not accept for the international standards.

2. Results of Measures

I- Physical parameters

1- Temperature [3]

Table 6. Temperature measurement

Site	Temperature
Lake BEMAPAZA	15,9
WHO	<25
EU	<25
EM	<25

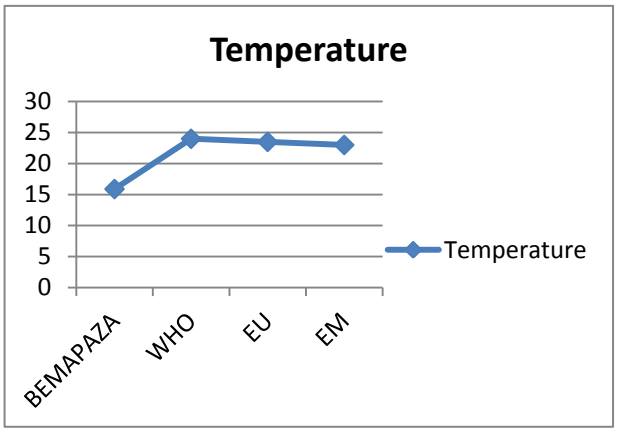

Figure 1. Shows the temperature measurement

The value of the temperature found is 15.9 °C is below 25 °C so it is acceptable for international standards.

2- Turbidity [4]

Table 7. Turbidity measurement

Site	Turbidity (NTU)
Lake BEMAPAZA	1,68
WHO	5
EU	5
EM	5

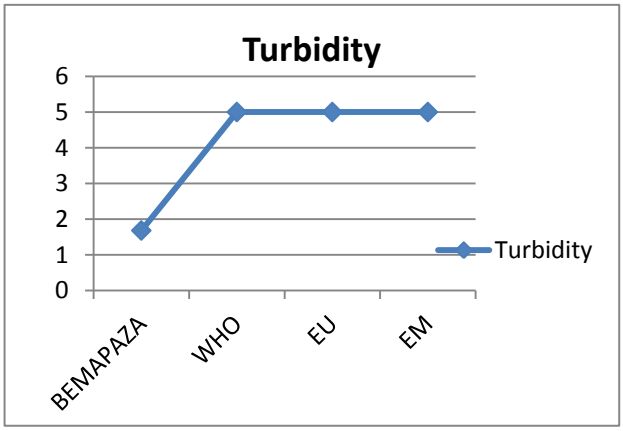

Figure 2. Shows the Turbidity measurement

The value of the turbidity found is equal to 1.68 NTU so less than 5 NTU, the water of Lake BEMAPAZA is clear.

3- Le pH [3]

Table 8. pH measurement

Site	pH
Lake BEMAPAZA	7,04
WHO	6,5 – 8,5
EU	6,5 – 9,5
EM	6,5 – 9

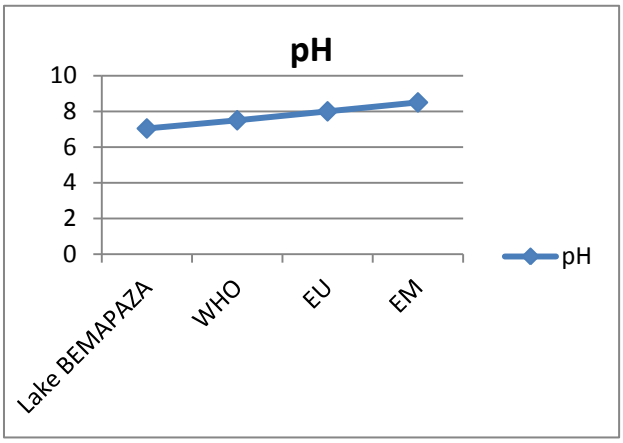

Figure 3. Shows the pH measurement

The value of the pH found is equal to 7.04, so it is eligible for the value required for drinking water.

4- Conductivity

Table 9. Conductivity measurement

Site	Conductivity (°f)
Lake BEMAPAZA	64,7
WHO	180 – 1000
EU	180 - 1000
EM	3000

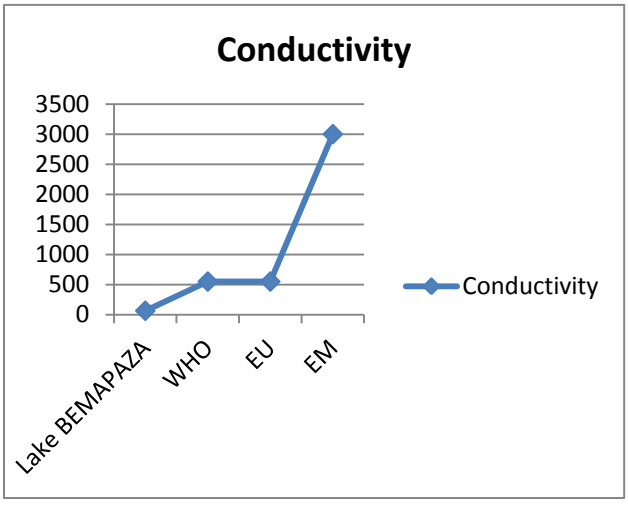

Figure 4. Shows the Conductivity measurement

He conductivity value found is 64.7 °f therefore allowable for the standard of potability of water.

II- CHEMICAL PARAMETERS

1- Dissolved oxygen

Table 10. Dissolved oxygen measurement

Site	Dissolved oxygen (mg/L)
Lake BEMAPAZA	1,6
WHO	<2
EU	<2
EM	<2

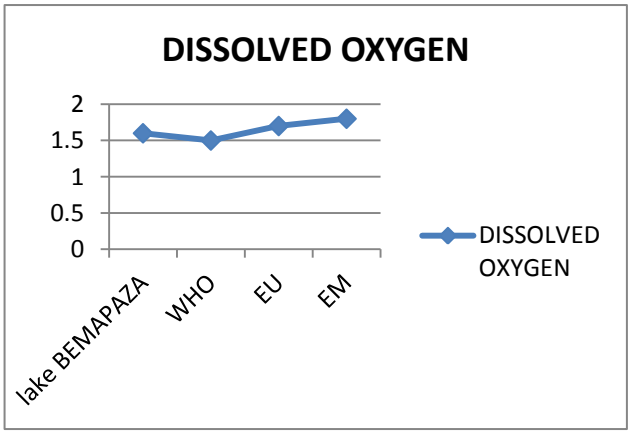

Figure 5. Shows the Dissolved oxygen measurement

The amount of organic matter in BEMAPAZA Lake water is low compared to the three standards for drinking water.

2- Salinity

Table 11. Salinity measurement

Site	Salinity (mg/L)
Lake BEMAPAZA	0,05
WHO	0
EU	0
EM	0

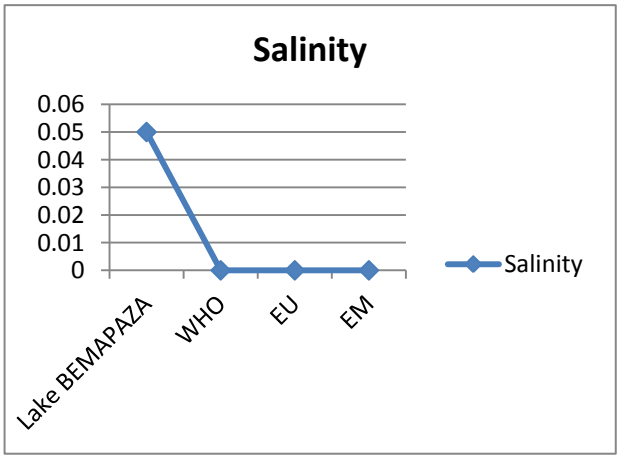

Figure 6. Shows the Salinity measurement

The concentration of salt in BEMAPAZA Lake water is a little higher than the standard required for drinking water because the required concentration is 0 mg / L while for lake water is 0.05mg / L.

3- Ammonium [6]

Table 12. Ammonium measurement

Site	Ammonium (mg/L)
Lake BEMAPAZA	0,02
WHO	<0,5
EU	<0,5
EM	<0,5

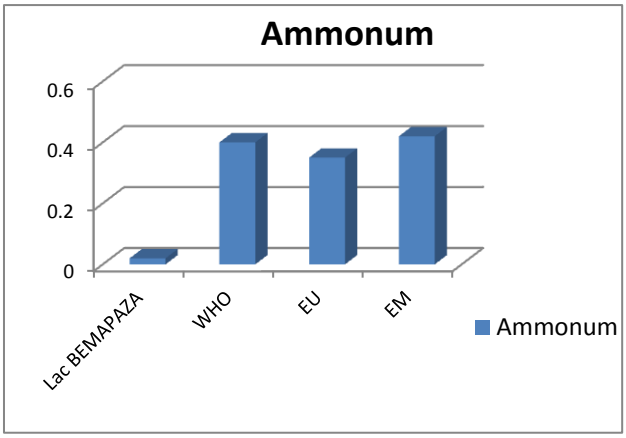

Figure 7. Shows the Ammonium measurement

The concentration of ammonium in the lake water is 0.2mg / L, i.e. less than 0.5mg / L the value required for potash water, i.e. the lake water is not polluted.

4- Complete alcalimetric title [1]

Table 13. Complet Alcalimetric title measurement

Site	Complete alcalimetric title (mg/L)
Lake BEMAPAZA	1,6
WHO	>11
EU	>11
EM	>11

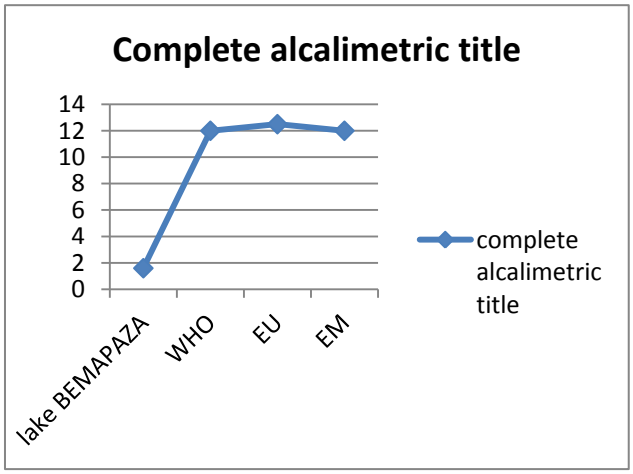

Figure 8. Shows the Complet Alcalimetric title measurement

The basic salt content of the lake water is very low because the concentration found is 1.6mg / L, but the required concentration is higher than 11mg / L.

5- Nitrates

Table 14. Nitrates measurement

Site	Nitrates (mg/L)
Lake BEMAPAZA	0,85
WHO	44
EU	50
EM	50

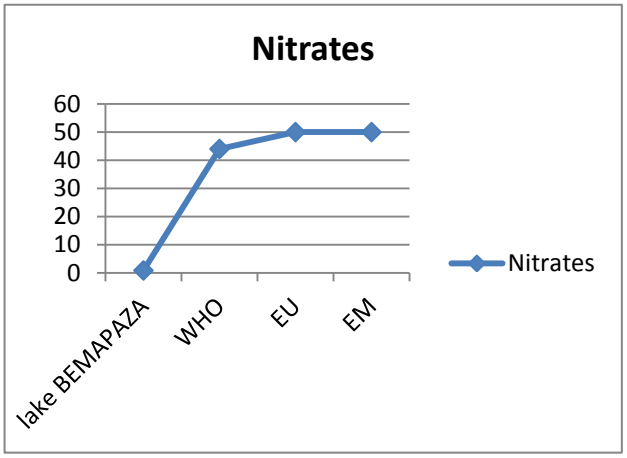

Figure 9. Shows the Nitrates measurement

The concentration of Nitrates in the lake water is 0.85mg / L, it is very small compared to the concentration required 44mg / L for WHO.

6- Total hardness [11]

Table 15. Total hardness measurement

Site	Total hardness (mg/L)
Lake BEMAPAZA	7,2
WHO	50
EU	50
EM	50

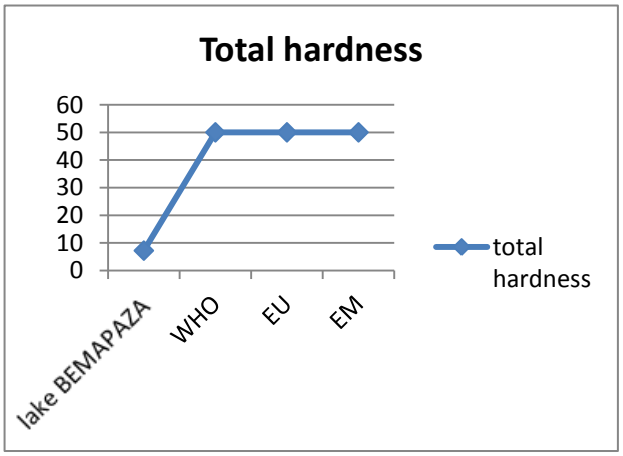

Figure 10. Shows the Total hardness measurement

The lake water is not hard because the concentration found is 7.2mg / L, fully eligible in the three international standards 50mg / L.

7- Iron dosage [10]

Table 16. Iron dosage measurement

Site	Iron dosage (mg/L)
Lake BEMAPAZA	0
WHO	0,2
EU	<0,5
EM	<0,5

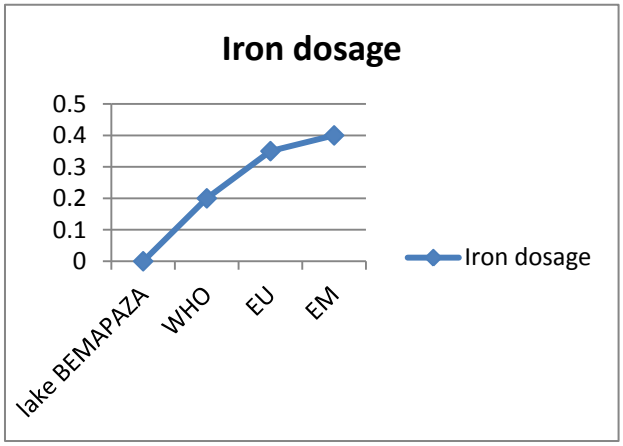

Figure 11. Shows the Iron dosage measurement

Iron does not exist in the water of Lake BEMAPAZA because the concentration is 0mg / L.

8- Sodium [13]

Table 17. Sodium measurement

Site	Sodium (mg/L)
Lake BEMAPAZA	11,5
WHO	200
EU	200
EM	200

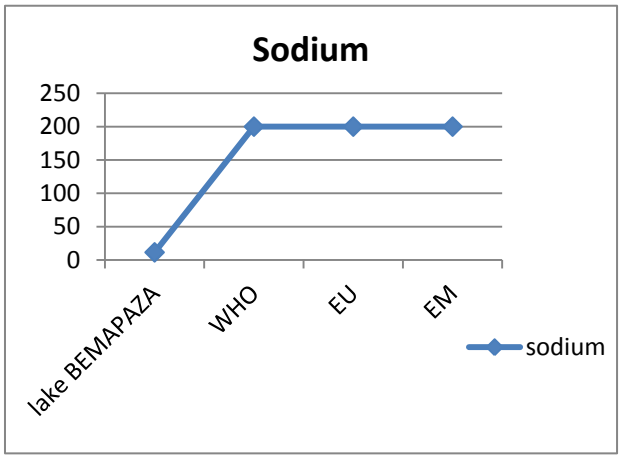

Figure 12. Shows the Sodium measurement

The sodium concentration found is 11.5 mg / L, but the required value is 200mg / L for drinking water, so the lake water is low in Sodium.

9- Potassium [13]

Table 18. Potassium measurement

Site	Potassium (mg/L)
Lake BEMAPAZA	10
WHO	<12
EU	12
EM	<12

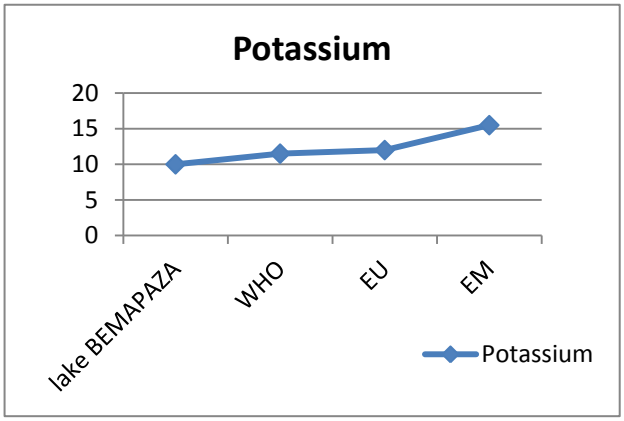

Figure 13. Shows the Potassium measurement

The Potassium concentration of the lake water is 10mg / L, so it is normal compared to the concentration required for international standards.

10- Calcium [7]

Table 19. Calcium measurement

Site	Calcium (mg/L)
Lake BEMAPAZA	10,4
WHO	400
EU	400
EM	400

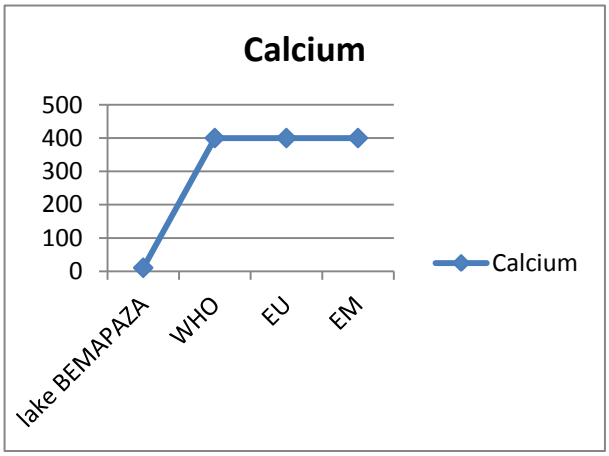

Figure 14. Shows the Calcium measurement

The calcium concentration of the lake water is 10.5mg / L, it is very low compared to the value required for drinking water standards 400mg / L.

11- Magnesium [11]

Table 20. Magnesium measurement

Site	Magnesium (mg/L)
Lake BEMAPAZA	11,17
WHO	50
EU	50
EM	50

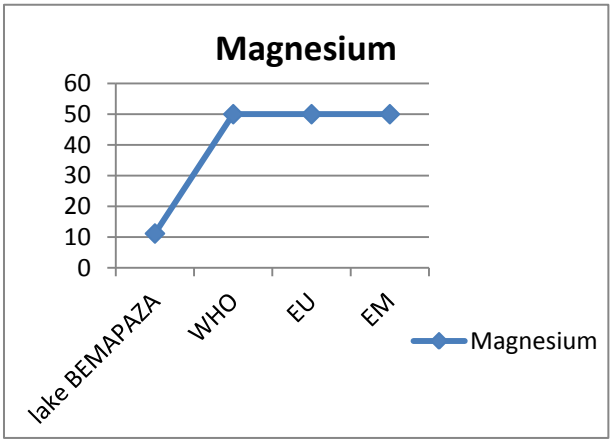

Figure 15. Shows the Magnesium measurement

The Magnesium concentration of the lake water is 11.17 mg / L, it is insufficient compared to the value required for drinking water standards 50mg / L.

12- Aluminum [5]

Table 21. Aluminum measurement

Site	Luminum (mg/L)
Lake BEMAPAZA	0
WHO	<0,2
EU	2
EM	<0,2

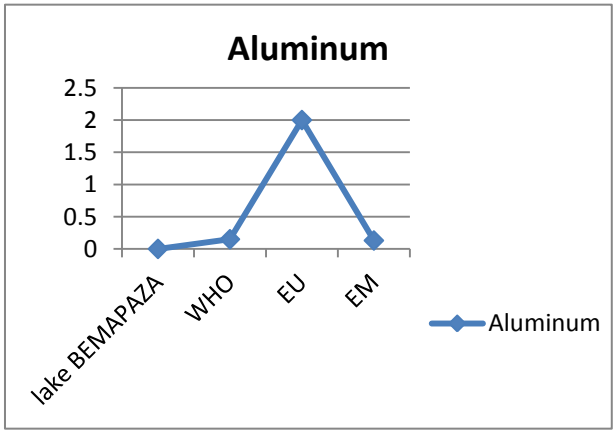

Figure 16. Shows the Aluminum measurement

Aluminum does not exist in BEMAPAZA lake water.

13- Copper [9]

Table 22. Copper measurement

Site	Copper (mg/L)
Lake BEMAPAZA	0,02
WHO	<5
EU	5
EM	5

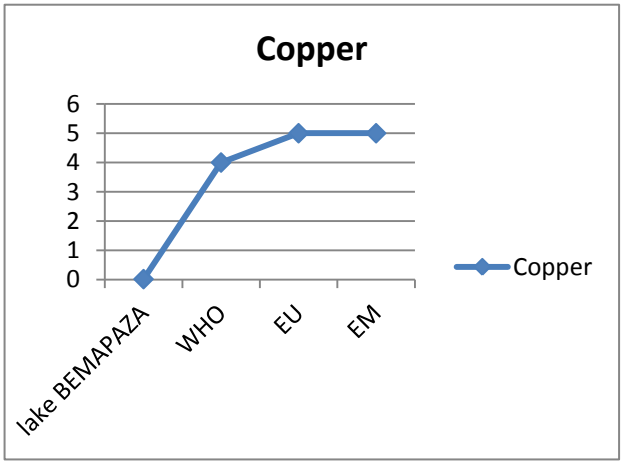

Figure 17. Shows the Copper measurement

The concentration of copper is 0.02 mg / L, it is almost negligible compared to the value required for standards of drinking water is less than 5mg / L.

14- Lead [5]

Table 23. Lead measurement

Site	Lead (mg/L)
Lake BEMAPAZA	0
WHO	<0,5
EU	<0,5
EM	<0,5

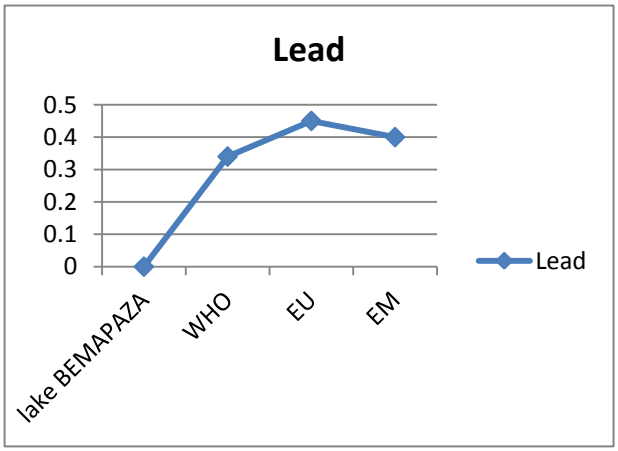

Figure 18. Shows the Laed measurement

Lead does not exist in BEMAPAZA lake water.

15- Chloride[8]

Table 24. Chloride measurement

Site	Chloride (mg/L)
Lake BEMAPAZA	17,75
WHO	<250
EU	<250
EM	<250

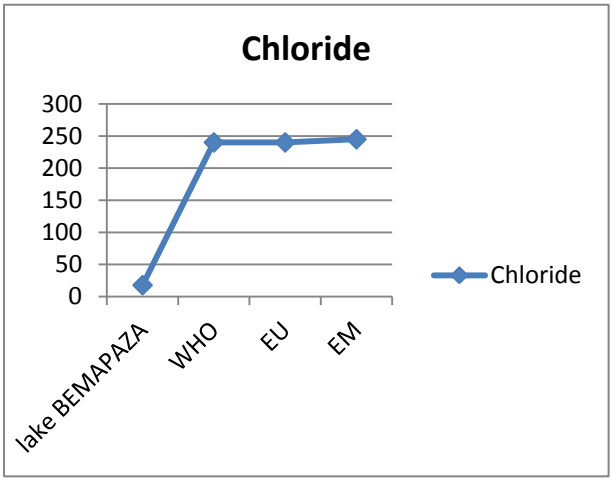

Figure 19. Shows the Chloride measurement

The concentration of chloride in the water of the lake is 17,75mg / L; it allows the values required for drinking water standards lower 250mg / L, in spite of their insufficiency of the found concentration.

3. Microbiological Analysis [14]

The concentrations of the bacteria found in the lake water are acceptable to the potability standards at the level of microbiological analysis, so the lake water is microbial.

Results interpretation:

Physical parameters

The temperature is 15.9 ℃, lower than 25 ℃, the pH is7.08 between 6.5 to 8.5, the turbidity is 1.68 NTU below 5NTU and the conductivity is 64.7µS / cm included between 180 to 1000 µS / cm; BEMAPAZA Lake water quality control for physical parameters are good compared to drinking water standards.

Chemical parameters

Dissolved oxygen is 1.6 mg / L less than 2 mg / L, salinity is 0.05mg / L greater than 0mg / L, T.A.C is 1.6mg / L less than 11mg / L, Nitrates is 0 85mg / L less than 44mg / L, the total hardness is 7.2mg / L less than 50mg / L, total iron is 0mg / L, ammonium is 0.02mg / L less than 0.5mg / L, sodium is 11.5mg / L less than 200mg / L, Potassium is 10mg / L, less than 12mg / L, calcium 10.4mg / L less than 400mg / L, Magnesium is 11.17mg / L less than 50mg / L, Aluminum

is 0mg / L, copper is 0.02 mg / L less than 5mg / L, lead is 0mg / L, and chloride is 17.75mg / L less than 250mg / L; the chemical parameters are acceptable at the standards required for drinking water standards, but there are some deficiencies in the concentrations for calcium, magnesium, sodium and chloride.

Microbiological

According to this concentration found for bacteriological analysis, the water of Lake BEMAPAZA perfectly meets the conditions required for drinking water, that is to say the water is not microbial.

Table 25. Measurement results for the bacteria

Lake Bemapaza	Results	Unit	OMS	EU	EM
Reviviable microorganisms à 22°C	50	Ufc/mL	<100	<100	<100
Reviviable microorganisms à 36°C	8	Ufc/mL	<20	<10	<10
Coliform bacteria	0,002	Ufc/100mL	0	0	0
Escherchia coli	0,005	Ufc/100mL	0	0	0
Intestinal Enterococci	0,004	Ufc/100mL	0	0	0
Spores of microorganisms	0	Ufc/mL	0	0	0
Conclusion	**C**				

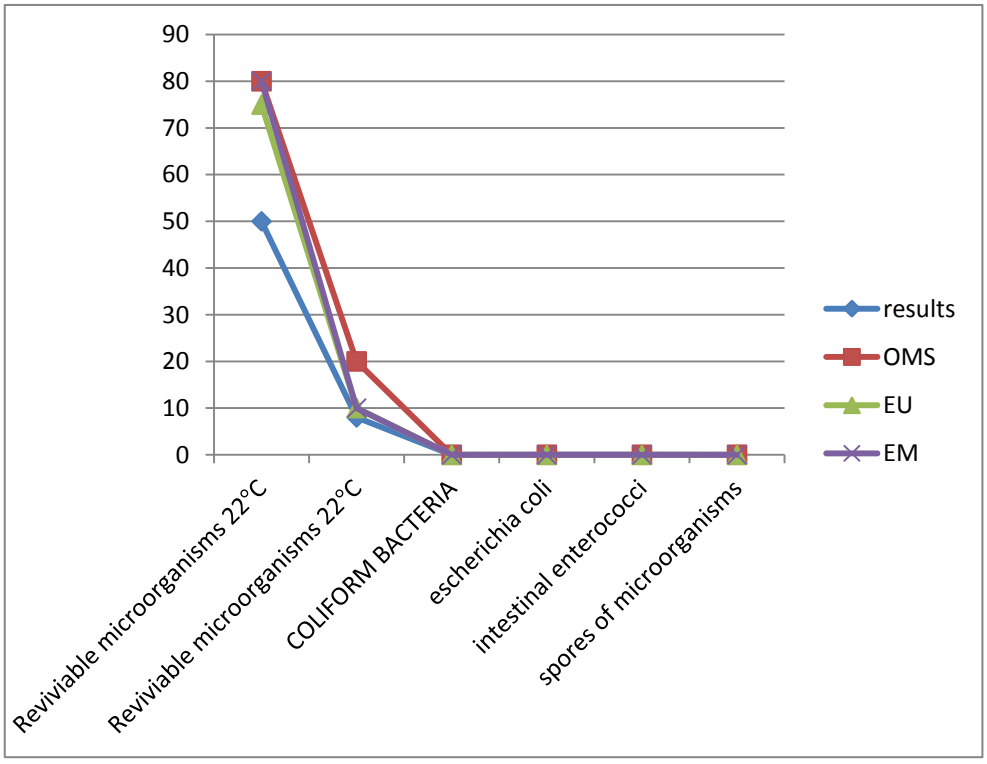

Figure 20. Shows the Bacteria measurement

4. Conclusions

To conclude, the physical parameters are eligible for international standards, chemical parameters almost perfectly meets the standards required for drinking water, especially the chloride concentration is 17.75mg / L, magnesium is 11.17mg / L, and in calcium is 104mg / L.

Their concentrations are insufficient compared to the required standards.

Bacteriological water from Lake BEMAPAZA is not microbial I propose you increased the levels of calcium, potassium, magnesium and chloride by the REMINERALIZATION method.

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