



PHYSICO-CHEMICAL PARAMETERS AND COMPARATIVE STUDIES ON GROUND WATER IN SONGEA, TANZANIA

¹Jakeer.N, ²Nicholas Daniel.A

¹ASenior Secondary Teacher Chemistry, ²Lecturer

¹Indian School Muscat, Oman, Department of Chemistry

²School of Mathematics and Natural Sciences, Mukuba University, Zambia

ABSTRACT

In the present study assessment of some physicochemical and microbial parameters of the ground water in Ruhuwiko, Songea, Tanzania were determined during the month of October 2014 to November 2014 with an objective to analyze the physicochemical characteristics like water temperature, transparency, total suspended solids, total dissolved solids, pH, dissolved oxygen, total alkalinity, hardness, BOD and minerals studies has been done during the investigation period. Total solids, total suspended solids, total dissolved solids and turbidity were minimum, which may be due to the gradual disturbances in sedimentation of solids as well as dust particles deposited along with runoff rainwater. The values of pH, conductivity, hardness, calcium, dissolved oxygen and biological oxygen demands were identified. This study enhances the quality of ground water in Songea.

KEY WORDS: Physico-chemical characteristics, Electrical conductivity, Minerals, BOD and COD.

I. INTRODUCTION

Among all the natural resources, water is the most precious one, and life is not possible without water. Groundwater is sustaining important ecosystems as well as providing river base flows in dry season, spring flows and soaks or seeps. Groundwater supports productive wetlands and other terrestrial vegetation. If properly developed, protected and managed groundwater can help in solving the water crisis in many countries. Although the global fresh water in our planet is about 1500 million cubic kms^[5] but most of its useless for us since it contains too much of salt. Total amount of estimated available fresh water on our planet is only 84.4 million cubic kms in recent years, rapid population growth increasing living standard; wide spheres of human activities and industrialization have resulted in greater demand of good quality of water, while on the other hand pollution of water resources is also increasing steadily^[4].

The problems relating to water attract the attention to the regency for investigating causes and suggest remedies in a bid to prepare future of action for maintenance of portable waters and related development issues. Fresh water is finite resource, essential for agriculture, industry and even human existence, without fresh water of adequate quantity and quality, sustainable development will not be possible^[1,3]. The lakes are large or considerable body of water within land^[3]. The maintenance of a healthy aquatic ecosystem is dependent on the physico-chemical properties of water and the biological diversity.

Nowadays, the ecology of reservoirs is under stressed condition due to fast pace of development, deforestation, cultural practices and agriculture. Fresh water resource is becoming day-by-day at the faster rate of deterioration of the water quality is now a global problem^[2]. The main purpose of analyzing physical, chemical and microbiological characteristics of water is to determine its nutrient status.

It is not possible to understand biological phenomena fully without the knowledge of water chemistry as the limnobiological and limnochemical components of the ecosystem. Physicochemical and microbiological characteristics may describe the quality of water^[8]. The present study has provided detailed information on physicochemical and mineral parameters of the ground water at Songea with an objective to indicate changes in the quality of waters at the beginning and lower end. The study will be helpful in estimating the impact of the ground water on various physicochemical and mineral parameters of the water.

II. MATERIALS AND METHODS

Physico-chemical Characteristics

For the present study water samples were collected from the ground water at Songea, for the period of two months (October 2014 to November 2014), water sampling spots were fixed at the time of 10 to 11 am in order to maintain uniformity. The physical characteristics included temperature, colour, conductivity, turbidity, total dissolved solids (TDS), total suspended solids (TSS) and total solids (TS). The chemical characteristics included alkalinity, hardness, pH, dissolved oxygen (DO), minerals (Ca, Mg, Fe, Na, Cl₂, SO₄, Si, PO₄, NO₃, Total organic carbon, K), chemical oxygen demand (COD) and biological oxygen demand (BOD). The samples were pretreated in the field to fix the samples and immediately brought to the laboratory for an on-spot physical and chemical analysis of various parameters following the standard methods^[1].

III. STUDY AREA

Songea is in the Ruvuma region, situated in the Southern part of Tanzania. The region extends between latitudes 9° 35' to 11° 45' South of Equator and longitudes 34° 35' to 38° 10' Meridian. Ruvuma region borders the Republic of Mozambique in the South, Lake Nyasa in the West and Iringa in the North-North East and bordered by Mtwara Region to the West. The lowlands in the Eastern part of the region are 300 meters above sea-level while the Northern and Western parts of Lukumburu and Matengo mountains rise to the level of 2,000 meters above sea level. 70% of labor forces in Songea were engaged in agriculture^[6].

Figure:1 Study Area Map



IV. CLIMATE

Songea, Ruvuma region has a moderate temperature averaging 23° C depending on altitude and season. In the months of June, July and August were found to be chilly with the temperature dropping to 13° C. October and November are the hottest months with an average temperature of 30° C. Annual rainfall of Songea were estimated to be 65mm but rainfall varies substantially, seasonally and geographically. The monsoon dominates the annual weather cycling of ground water at Songea in December.

V. RESULTS

Data of the seasonal variations in the physico chemical parameters of the Ground water of Songea for a period of two months (October 2014 to November 2014) are presented in the Table I and Table II.

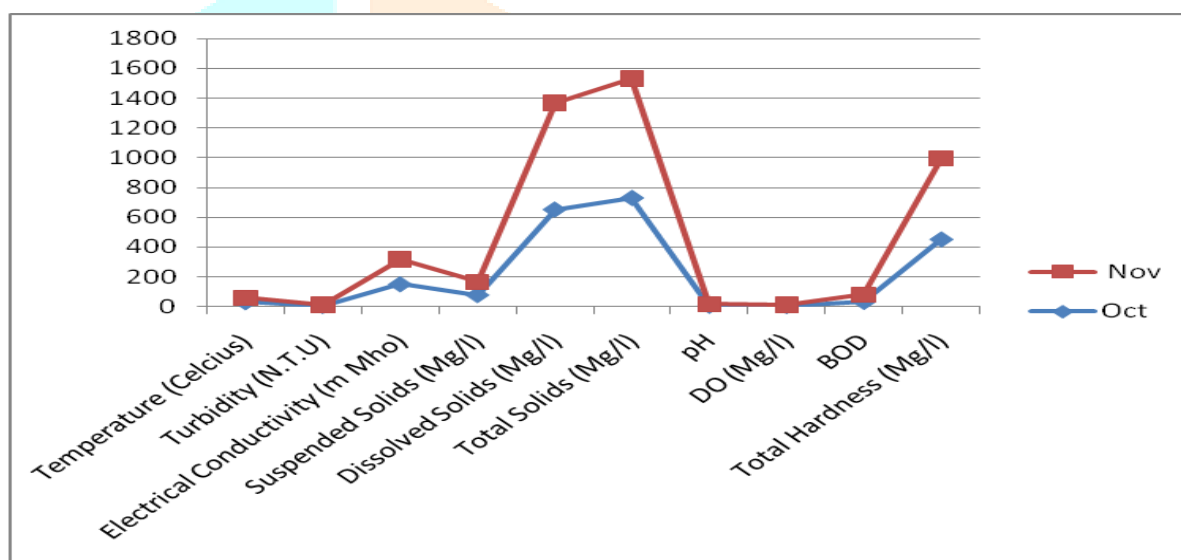
Table- I: Variations in the nutrient content of the Ground Water of Songea

Month	Ca	Mg	Fe	Na	Cl	SO ₄	Si	PO ₄	NO ₃	Organic Carbon	K
Oct	325	125	0.08	58	25	35	0.12	31	25	75	35
Nov	375	170	0.15	64	26	35	0.18	34	29	83	41
Mean Values	350	147.5	0.115	61	25.5	35	0.15	32.5	27	79	38

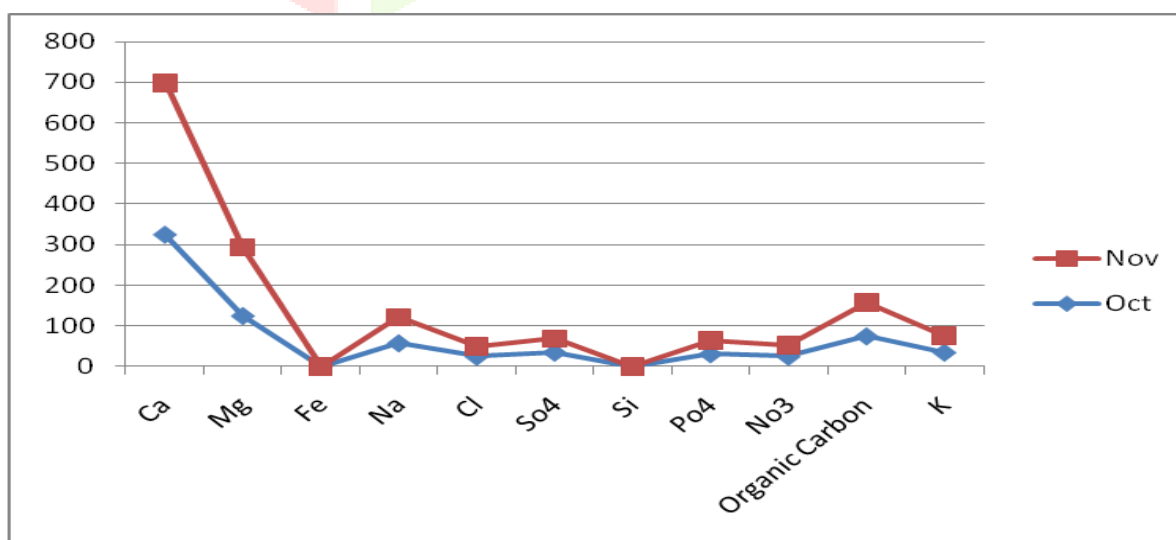
Table-II: Physicochemical characteristics of Ground water for the period of (Oct and Nov 2014)

Month	Oct	Nov
Temperature (Celsius)	30	28
Colour	C	C
Turbidity (N.T.U)	5	4
Electrical Conductivity (m Mho)	150	165
Suspended Solids (Mg/l)	78	85
Dissolved Solids (Mg/l)	650	720
Total Solids (Mg/l)	728	805
pH	6.5	6.2
DO (Mg/l)	4	5
BOD	32	45
Total Hardness (Mg/l)	450	545

Graph I: Showing the Comparative data on water parameters from October to November 2014



Graph II: Showing the Comparative data on Mineral Content from October to November 2014



5.1 Temperature

The water temperature was ranging from its tropical latitude; the ground water is generally cool, having a surface temperature that ranges from 28 to 30° Celsius. Temperature falls between 15 to 18° Celsius.

5.2 Turbidity:

The turbidity value was ranging from 5 N.T.U to 4 N.T.U in the ground water. The maximum turbidity value was recorded in the month of October when compare to the month of November. The mean value of turbidity in Ground water of Songea is 4.5 N.T.U.

5.3 Electrical Conductivity:

The electrical conductivity value of the water was ranging from 150 to 165 $\mu\text{S cm}^{-1}$. The minimum electrical conductivity value of 150 μS was recorded in the month of October and maximum electrical conductivity value of 165 μS in the month of November.

5.4 pH

The pH value of the ground water was ranging from 6.5 to 6.2. The minimum pH value was recorded as 6.5 in the month of October. Maximum value of pH 6.2 was recorded in the month of November. The mean value of pH is 6.35.

5.5 Dissolved Oxygen

The dissolved oxygen value was ranging from 4 mg/l to 5 mg/l. The minimum dissolved oxygen value was recorded as 4 mg/l in the month of November and the maximum value of dissolved oxygen 5 mg/l was recorded in the month of October. The mean value of dissolved oxygen is 4.5 mg/l. whereas the same was reported that under natural condition the running water typically contains a relatively high concentration of dissolved oxygen tending towards saturation^[11].

5.6 Biological Oxygen Demand

The BOD value of ground water was ranging from 32 mg/l to 45 mg/l. The minimum BOD value was recorded as 32 mg/l in the month of October and the maximum value of BOD 45 mg/l was recorded in the month of November. The mean value of B.O.D was 38 mg/l.

5.7 Calcium

The value of calcium ranging from 325 mg/l to 375 mg/l and magnesium ranging from 125mg/l to 170 mg/l. Minimum amount was recorded at the month of October and maximum value was noted in the month of November. High concentration of calcium is due to its presence in rocks from where it was leached to water.

5.8 Iron and Sodium

The value of iron was ranging from 0.08 mg/l to 0.15 mg/l. and sodium ranging from 58 mg/l to 64 mg/l. The minimum amount of sodium was recorded in the month October and maximum value was noted at the month of November. The international recommended standards of iron with a permissible limit of 0.03 mg/l and excessive limit of 0.1 mg/l in drinking water^[16].

5.9 Chloride

The value of chlorides ranging from 25 mg/l to 26 mg/l, minimum amount was recorded in the month of October and maximum value was noted in the month of November. Chloride is a pollution indicating parameters and it is responsible for the salty taste of water, chloride increases degree of eutrophication^[11]. The direct correlation between chloride concentration and pollution load^{[12][14]}.

5.10 Sulphate

The value of sulphate ranging from 35mg/l. Excess sulphate content induces cathartic effect on human health sulphate may have laxative effect if magnesium is present at an equivalent concentration^[13].

Silicate:

The value of silicate ranging from 0.12 mg/l to 0.18 mg/l, minimum amount was recorded at the month of October and maximum value was noted at the month of November. The value of phosphate ranging from 31 mg/l to 34 mg/l, minimum amount was recorded at the month of October and maximum value was noted at the month of November. Phosphate are nutrients their concentration above normal range is found to be cause eutrophication^[15].

5.10 Nitrate

The value of nitrates ranging from 25 mg/l to 29 mg/l, minimum amount was recorded at the month October of and maximum value was noted at the month of November. Nitrate is one of the several inorganic pollutants contributed by the nitrogenous fertilizers, organic manures, human and animal wastes.

VI. DISCUSSION

Water samples collected in the Songea showed low temperature in the night hours. In the daytime it was found to be high in temperature. Temperature is also an important role in the metabolic activities of the organism to maintain the biological factor^[7].

The water was found colorless in most of the days; this may be due to the less turbidity at acceptable limit. Turbidity of ground water in Songea is due to the natural sources that can include erosion from upland areas, Amriparian cause, stream bank, and stream channel areas passing in to the ground water.

The pH of the ground water is maximum of 6.5 which indicates the maximum level of dissolved solids and the acidic condition of the water bodies.

The value of BOD and COD were increased with increase in the pollution load^[3] pointed out that the minimum dissolved oxygen content in water for maintaining fish life in healthy condition is 5 in the present study amount of dissolved oxygen content. The higher amount of carbonate and bicarbonate might be due to the combination of excess carbon dioxide with mono carbonate forming bicarbonate has also observed^[10]. In the present study a reverse condition was observed.

The dissolved salt content in the form of Sulphate, Phosphate, Calcium, Iron and Sodium in the sample shows slight variation with respect to various national and international drinking water quality standards.

The living population in Songea region uses the ground water for domestic as well as drinking purpose in all the seasons throughout the year. This indicates that the water table index is just good enough for further water treatment in a cost-effective way.

This article is not much intended to discuss the pathological parameters to fit with drinking purpose.

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