International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 04
February 2018

Physico Chemical Analysis of Surface Water Resource in Somavathi River Basin, Ananthapur District, Andhra Pradesh, India

U.Imran Basha[1], U.Suresh[1], G.Veeraswamy[2], S.Ramanaiah[3]
1. Research Scholar, Department of Geology, Sri Venkateswara University, Tirupathi
1.Asst.Professor, Department of Geology, Sri Venkateswara University, Tirupathi
2. Research Scholar, Department of Geology, Sri Venkateswara University, Tirupathi
3...Prof.Department of Geology , , Sri Venkateswara University, Tirupathi.
EMAIL:Imrandudekulla@gmail.com

Abstract:
The present study deals with surface water quality of Somavathi river basin Area. Samples were collected from river Somavathi river basin area. The collected samples were analysed in Sri Venkateswara University, Department of Geology, and geochemistry laboratory. The parameters were pH, Conductivity, Sodium, Potassium, Total dissolved solids, Hardness, Fluoride, Nitrate, chlorides. It is to evaluate the water quality of Somavathi River by using Canadian Council of Ministers of Environment Water Quality Index (CCME WQI) method, as the river has been subjected to enormous contamination in recent times. Stream water samples from higher order streams in all quadrants were collected from 11places. The water samples data plotted on piper diagram and indicates that the sample no.W1,W2, W3, W4, W5, W7, W8 and W9 falls under Ca-HCO$_3$ category indicating temporary hardness. Sample no. W6 falls under mixed Ca-Mg-Cl category were rich in Alkali carbonates. The most important factors to determine the suitability of water use in agriculture were P^H, salinity, relative proportion of sodium to calcium and magnesium, and the relative percentage of bicarbonate to calcium and magnesium. The quality of irrigation water has been judged by studying the respective graphical representations, which is functional for display purposes and for emphasizing similarities and differences. The dominant ions such as calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulphate and chloride in a water sample can be represented in several ways.The most abundant ions found in natural waters are HCO_3^-, C1-, Ca^{2+}, Na^+, Mg^{2+}, SO_4^{2-} (HCO_3, SO_4 & CI - anions) Na^+, K^+, Ca^{2+} & Mg^{2+} - Cations).

Keywords: Somavathi River, Water quality index, Piper diagram, Irrigation water quality standards

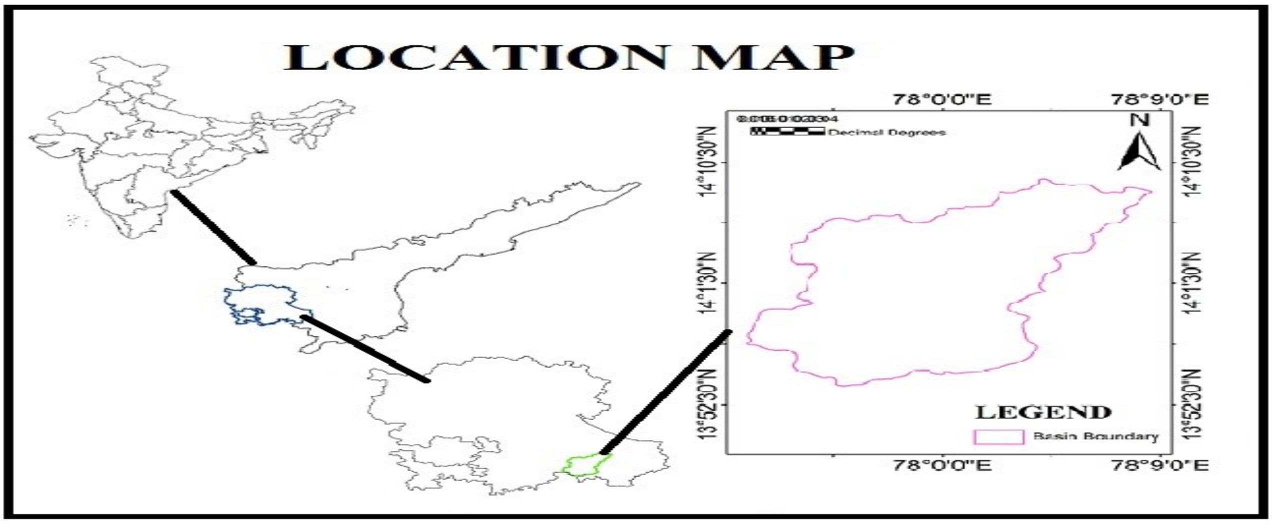
1.Introduction:

Water is an essential constituent of all the animal and plant life. A river and its tributaries play an important role in industrial and social development. Growing population, accelerating industrialization and intensification of agriculture and also urbanization exert heavy pressure on our vast but limited water resources. Waste water from mining and other related industries is the most common source of water pollution and it is increasing day by day Kanae (2006) have introduced river is now an important source of safe water which globally serves about 2,000 km3 freshwater. It is therefore a growing civilization with lots of human activities is seen to the banks of rivers. However, rising trend of civilization has put a great threat to the river water quality particularly in developing countries. It is noted that increasing scenario of population density, land development along river basin, urbanization and industrialization have been subjected for water pollution and environmental deterioration to the rivers water (Sumok, 2001) .One of the reasons behind the deterioration of river water quality is demonstrated that most of the rivers are considered as the end point of urban effluent discharges without any prior treatment. It was also found that an extent of the industrial, agricultural and other anthropogenic activities in the basin and reduced river discharges has introduced foremost problem for safe water (Sing et al., 2004). Addressing a complex set of reasons that is, drinking water, irrigation, and transportation; river is considered a major sources of water supply in Bangladesh. Near about 230 rivers flow through the country including 53 international rivers (Sarwar, 2010). Water pollution not only affects water quality but also threats human health, economic development, and social prosperity (Milovanovic 2007). River basins are highly vulnerable to pollution due to absorption and transportation of domes 596 Environ Monit Assess (2010) 171:595–609 tic, industrial, and agricultural waste water; therefore, it is significant to control water pollution and monitor water quality (Simeonov et al. 2003; Simeonovaetal.2003). Various geostatistical concepts are used for the interpretation of complex data sets which allows a better understanding of the water quality parameters (Kumar and Ahmed 2003; Suk and Lee 1999; Isaaks and Srivastava 1989). Assessing risk involves identifying the hazard associated with a particular occurrence, action, or circumstance and determining the probability of that hazard occurring (Smith 2001). One of the most interesting aspects of hydrochemistry is the occurrence of water bodies with different water chemistries in very close proximity to each other. This has been variously attributed to the surface and subsurface geology (Stallard and Edmand 1983), small climatic differences (Petrovic 1980) and the flow direction (Lyons et al. 1992,. Water quality assessment in Akpabuyo, Southeastern Nigeria indicated that the waters are acidic, soft and characterized by low sodium adsorption ratio, and the waters are also classified into four chemical facies: Ca–Cl, Na–Cl, Ca–SO4 and Ca–HCO3 (Offiong and Edet 1998. Thus, the analysis of irrigation performance is often done by applying water balance models to irrigation schemes that develop performance indicators based on average values for the whole irrigation area (Kloezen and Garce ́Restrepo 1998; Molden et al. 1998; Burt and Styles 1999). In this context, water quality and management for drinking and irrigation have become among the biggest concerns in this area. Zhang et al. (1995) and Xiao et al. Yang (2007).

2. Study Area:

Somavathi River rises in the south eastern part of Anantapur district, a moderate drought affected region. The Somavathi watershed is located in the Survey of India Toposheet Nos: 57 J/3, 57 J/4, 57 G/3, and 57 K/1 on 1: 50,000 scale and lies between North longitudes 77^{0} 48' 25" to 78^{0} 02' 45" and East latitudes 14^{0} 05' 55" to 14^{0} 26' 48" (Fig.1). The watershed comprises total geographical area of 456 sq. km and covers parts of Obuladevuracheruvu, Gorantla Amadaguru, Nallamada and Kadiri. Obuladevuracheruvu occupies more than half of the watershed area (52%) followed by Gorantla, Amadaguru, Nallamada and Kadiri (27%). Corresponding schematic diagram is shown in figure 1.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 04
February 2018



Fig; 1 Somavathi River basin

Climate & Rainfall:

The climate of the area is sub –tropical type (mostly dry) and temperature ranges from 38°C – 43°C during summer and between 22°C – 30°C during winter months. The area is in the rain shadow zone and the normal rainfall is 533mm and an annual mean rainfall is 568.5 mm. The south –west monsoon (June to September) contributes 58 percent; north-east monsoon (October to December) 28 percent; hot weather period (March to May) about 13 percent; and cold weather period (January and February) 1 percent. (source: Ballal et.al 1965).

Geology of the study area:

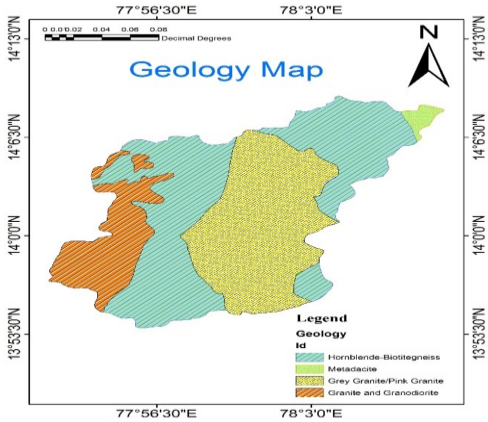
Rocks of Dharwar Super group, Peninsular Gneissic Complex-II (PGC-II) and basic intrusive form the geology of the area. The Dharwar Super group is represented by the Kadiri Metamorphic, which occur as an N-S trending belt (Kadiri Schist Belt) and as small lenticular within PGC-II. These rocks include metamorphosed acid volcanics with litho-unitslike quartz porphyry, rhyolite, rhyodacite, quartz-feldspar porphyry and met basics like hornblende andesite basalt and quartz-muscovite-sericite schist, amphibolite, pyroxene and thin bands of autoclastic conglomerate. The major part of the area is occupied by the PGC-II. It comprises mainly hornblende biotite granite/gneiss, biotite granite/granodiorite. he hornblende-biotite granite/gneiss is medium to coarse grained varying in color with different shades of grey. Syn to post kinematic plutons and tongues younger biotite granite occurs covering a large part of the area in the western part. It is considered equivalent to Close pet granite. The granite forms monolithic blocks, bare tors and knolls and constitute the hill ranges. It is coarse grained, porphyritic, massive and feebly foliated with foliation trending NNW-SSE along the margins. In hand specimen, it is composed of quartz, pink-grey feldspar and small amounts of biotite. These dykes are abundant in the northern and western part of the area. Most of the dykes have ENE-WSW to E-W trend and few are having NW-SE trend. These are

International Journal of Research
Available at https://edupediapublications.org/journals

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 04
February 2018

compact, medium to coarse grained and show spheroidal weathering

.



Materials and method:

Calculation of the CCME WQI

The CCME WQI model consists of three measures of variance from selected water quality objectives (scope, frequency, amplitude). These three measures of variance combine to produce a value between 0 and 100 (with 1 being the poorest and 100 indicating the best water quality) that represents the overall water quality. Within this range, designations have been set to classify water quality as poor, marginal, fair, good or excellent. These same designations were adopted for the indices developed here. The CWQI calculated by select a set of eleven parameters based on both importance and availability of data. These thirteen parameter are pH value, Total Dissolved Solids, Calcium, Alkalinity, Ammonia, Nitrate, Nitrite, Turbidity, chloride. CCME WQIs were computed for the three sites in the Tigris River using sets of standard values.

The detailed formulation of the WQI, as described in the Canadian WQI 1.0–Technical Report is as follows:

The measure for scope is F1 ($Scope$). This represents the extent of water quality guideline

Non-compliance over the time period of interest

$$F1 = \frac{\text{Number of Variables}}{\text{Total Number of Variables}} \times 100$$

The measure for frequency is F2 ($Frequency$). This represents the percentage of individual tests that do not meet objectives (failed tests).

$$F2 = \frac{\text{Number of failed test}}{\text{Total Number of Variables}} \times 100$$

F3 AMPLITUDE

The measure for amplitude is F3. This represents the amount by which failed tests do not meet their objectives. This is calculated in three steps:

Step 1- Calculation of Excursion. Excursion is the number of times by which an individual concentration is greater than (or less than, when the objective is a minimum) the objective.

When the test value must not exceed the objective

$$ecur = \frac{\text{Failed Test Value I}}{\text{Obj ective}} - 1$$

When the test value must not fall below the objective:

$$ecur = \frac{\text{ObjectiveI}}{\text{Failed Test Value I}} - 1$$

Step 2- Calculation of Normalized Sum of Excursions. The normalized sum of excursions is the collective amount by which individual tests are out of compliance. This is calculated by summing the excursions of individual tests from their objectives and dividing by the total number of tests (both those meeting

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 04
February 2018

objectives and those not meeting objectives).

$$nse = \frac{\sum_{N=1}^{I} \text{excursion}}{\text{Number of Tests}}$$

Step3- Calculation of F3. F3 (*Amplitude*,)is calculated by an asymptotic function that scales the normalized sum of the excursions from objectives to yield a range from 0 to 100.

$$F3 = \left[\frac{\text{nse}}{0.01\ \text{nse} + 0.01}\right]$$

The WQI is then calculated as:

$$CWQI = 100 - \left[\frac{\sqrt{F_1 2 + F_2 2 + F_3{}^2}}{1.732}\right]$$

S.NO	pH	E.C	T.D.S	HCO3	CL	SULPHATE	Na	k	Ca	Mg	F	No3	Total hardness
1	7.3	325	210	134	7	38	12	5	34	10	0.5	5	125
2	7.4	145	95	73	4	5	5	5	20	1	0.2	5	55
3	6.8	295	190	171	7	6	5	5	52	2	0.3	5	130
4	7.5	875	570	311	28	141	83	5	40	38	2.0	5	255
5	7.2	515	335	238	11	45	47	9	26	23	1.5	5	160
6	7.3	525	340	275	18	12	85	6	22	7	1.3	5	85
7	7.2	205	135	98	4	8	7	5	22	5	0.8	5	75
8	7.0	160	105	79	7	5	8	5	18	1	0.4	5	50
9	7.6	180	440	384	28	11	75	5	36	22	1.3	5	180
10	7.5	195	420	280	15	16	5	5	14	5	1.6	5	120
11	7.2	680	390	180	6	15	7	4	20	6	1.8	5	125

Table : 3 Surface Water samples Chemical Analysis Data

Surface water sampling (W):

Stream water samples were collected during post-monsoon period from flowing streams in grids to represent the chemical parameters distribution of that particular drainage basin . The temperature and pH content of water samples were determined in the field itself. pH value recorded in the field ranging from 6.8 to 7.6 indicating normal to slightly alkaline nature. Maximum value of pH (7.6) is noted in sample no.W9.

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 04
February 2018

INTERPRETATION OF WATER SAMPLES

Surface water samples were collected on grid pattern. A total of 11 Nos. samples were collected from the 11 quadrants of the toposheet no: 57 J/3, 57 J/4, 57 G/3, and 57 K/1,and locations selected for these surface water samples are mainly from 3rd order and 4th order streams. Eleven (11) sets of bottles with 1 liter quantity were taken to field and collected water samples and analyzed for chemical analysis.

CHEMISTRY OF STREAM WATER SAMPLES:

Stream water samples from higher order streams in all quadrants were collected from 9sites. Bicarbonate ranges from 73 to 384 ppm; the highest value 384 ppm is detected in sample no.9. The Na+ content (ranges from 5 to 85 ppm) in the samples is more than K+ (<5 ppm) possibly due to higher mobility of Na. Ca ranging from 18 to 52 ppm and Mg from 0 to 38 ppm shows sympathetic relationship.

pH :

The pH value of water samples ranges from 6.8 to 7.6 indicating normal to slightly alkaline nature of water in the area and the range is narrower which indicates the reduced soils and arid climatic conditions. and pH is most important chemical properties of natural waters, where pH is a measure of the hydrogen ion activity (abundance of protons). Rivers and lake water generally has a low pH, low dissolved solid content and a high Eh. The most abundant found in natural waters are HCO3-, C1-, Ca+2, Na+, Mg+, SO4$^-$ (HCO_3, SO_4 & CI $^-$ anions) Na^+, K^+, Ca^+ & Mg^+ -- Cations).

Total dissolved solids :

A commonly reported item in water analysis is Total Dissolved Solids (TDS). The significance of the volume found for TDS lies in its indication of the post and present environment of the water. TDS range from 95 to 570 ppm. The lowest TDS value recorded in the area is 95 ppm in samples no. W2. The Environmental Protection Agency (EPA),which regulates public water supply, allows for a TDS maximum contamination level of 500 ppm. Anything above 1,000 PPM is considered unfit for human consumption. One sample recorded value 570 ppm in W4 which need attention. High levels of TDS are in direct relation to the presence of sodium, chlorides and potassium.

EC :

Electrical conductivity ranges from 145 to 875 µS/cm. Increasing electrical Conductivity(EC) indicates more clay over burden at the source. It is evident from the results that conductivity is directly proportional to the value of TDS as shown in fig.As per prescribed limits for drinking water, 5 samples are showing EC values below normal .

Total Hardness

Total Hardness varies from 50 to 255 ppm. Increase of water hardness suggests calcite contamination and also may be due to higher concentration of Mg+2and Ca+2 indicating basic to ultra-basic source. Know the chemistry of the surface water of the area which is indicating that the

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 04
February 2018

sample no. W1,W2, W3, W4, W5, W7, W8 and W9 ,W10,W11 falls under Ca-HCO3 category indicating temporary hardness. Sample no. W6 falls under mixed Ca-Mg-Cl category are rich in Alkali carbonates

Water quality Index(WQI)

Data Summary	Overall	Drinking	Aquatic	Recreation	Livestock
WQI	38	32	25	25	46
Categorization	Poor	Poor	Poor	Poor	Marginal
F1 (Scope)	57	60	100	100	33
F2 (Frequency)	44	54	55	40	33
F3 (Amplitude)	80	85	61	74	81

	Overall	Drinking	Aquatic	Recreation	Irrigation	Livestock
Number of variables tested	7	5	2	1	0	3
Number of variables that failed	4	3	2	1	0	1

Table 1.1 water quality index

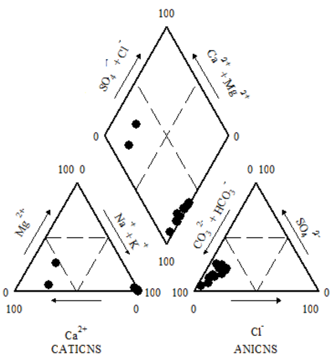
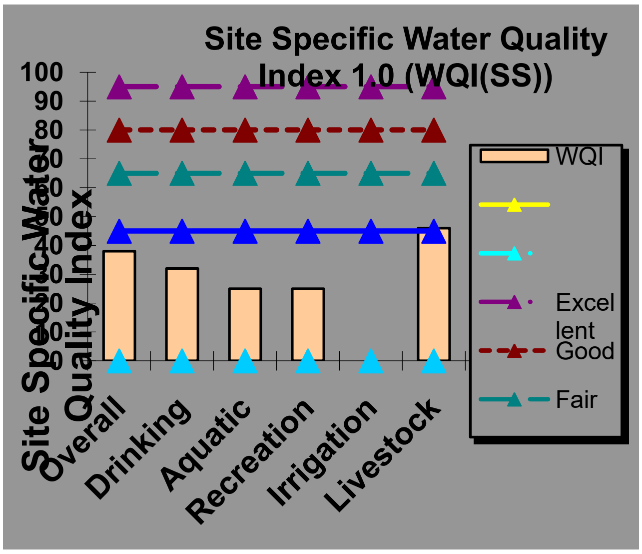


Fig: 2 Piper diagramme



IRRIGATIONAL WATER QUALITY STANDARDS:

Irrigation water quality can best be determined by chemical laboratory analysis. The most important factors to determine the suitability of water use in agriculture are PH, salinity, relative proportion of sodium to calcium and magnesium, concentration of boron and the relative percentage of bicarbonate to calcium and magnesium. The quality of irrigation water is judged by studying the respective graphic representations, which

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 04
February 2018

is functional for display purposes and for emphasizing similarities and differences. The dominant ions such as calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulphate and chloride in a water sample can be represented in several ways.

Sodium Adsorption Ratio (SAR)

Sodium concentration in groundwater is important because increase in sodium concentration in water upshot deterioration of soil properties there by reducing permeability. Sodium adsorbed on the clay surface as substitute for calcium and magnesium may smash up the soil structure making it compact and impervious. The processes leading to the cation exchange reactions in soil may also be studied from sodium adsorption ratio (SAR) is expressed as Where, the concentrations are expressed in equivalents per million (epm) Classification of water with reference to SAR (Herman Bouwer, 1978) is presented in table

SAR Values	Quality	Number of Samples
0 - 6	No problem	9 samples
6 - 9	Increasing problem	No samples
> 9	Severe problem	No samples

Table: 2 SAR values

Residual Sodium Carbonate (RSC)

Residual Sodium Carbonate is defined as

$$RSC = [CO_3^- + HCO_3^-] - [Ca^{2+} + Mg^{2+}]$$

When the sum of carbonates and bicarbonates is in excess of calcium and magnesium, there occurs a complete precipitation of the later (Raghunath, 1987). A high value of RSC in water leads to an increase in the adsorption of sodium on soil, leading to the formation of soda alkali soils. This type of hazard caused on soils by excess of carbonate and bicarbonate ions in irrigation water is called bicarbonate hazard. According to Eaton (1950), irrigation water can be classified into three categories based on RSC values (Nagaraju.a et al 2017).

RSC classification

RSC values (epm)	Category
<1.25	Safe
1.25 – 2.5	Permissible
>2.5	Unsuitable

7 out of 9 samples showing RSC values are less than 1.25 epm which consider as safe for irrigation. Two samples W6 and W9 showing RSC value 2.7 & 2.8 epm respectively which is fall in the unsuitable category.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 04
February 2018

.CONCLUSIONS:

The water samples data plotted on piper diagram indicating that the sample no.W1, W2, W3, W4, W5, W7, W8 and W9, W1O, W11 falls under Ca-HCO3 category indicating temporary hardness. Sample no. W6 falls under mixed Ca-Mg-Cl category are rich in Alkali carbonates. The chemical quality of water samples were studied from percent sodium v/s specific conductance (EC) which indicate that all the samples falling in excellent to good quality category and suitable for agricultural purposes. Chlorine and fluorine contamination is find out in A2, higher Cl value (28.36 ppm) may probably due to leaching. Fluorine value is recorded above normal as per prescribed limit of drinking water and the water quality idex shows the not suitable for the drinking ,aquatic, recreation and marginal suitable for the live stocks.

References: .

[1]. Arveti Nagaraju,Golla Veeraswamy,Yenamala Sreedhar,Arveti, Thejaswi Assessment Of Ground Water Quality In Gudur Area Of Andhra pradesh,South India Vol 26-No.5/2017 Pages 3597-3606 .

[2]. Reza, R. and Singh, G. (2010) Assessment of Heavy Metal Contamination and its Indexing.Approach for River Water. International Journal of Environmental Science and Technology, 7, 785-792. http://dx.doi.org/10.1007/BF03326187Milovanovic, M. (2007). Water quality assessment and determination of pollution sources along the Axios/ Vardar River, Southeastern Europe. Desalination, 213, 159–173.

[3]. Simeonov, V., Stratis, J. A., Samara, C., Zachariadis, G., Voutsa, D., Anthemidis, A., et al. (2003). Assessment ofthesurfacewaterqualityinNorthernGreece .Water Research, 37, 4119–4124.

[4]. Kumar, D., & Ahmed, S. (2003). Seasonal behaviour of spatial variability of groundwater level in a granitic aquifer in monsoon climate. Current Science, 84(2), 188–196.

[5]. Smith, K. (2001). Environment hazards: Asessing risk and reducing disaster (3rd ed., p. 324). London: Routlege.

[6]. Stallard RF, Edmond JM (1983) Geochemistry of the Amazon 2. The influence of geology and weathering environment on the dissolved load. J Geophys Res 88:9671–9688

[7]. Offiong OE, Edet AE (1998) Water quality assessment in Akpabuyo, Cross River basin, South-Eastern Nigeria. Environ Geol 34:167–174

[8]. Kloezen WH, Garce ´s-Restrepo C (1998) Assessing irrigation performance with comparative indicators: the case of the Alto Rio Lerma Irrigation District, Mexico. Research Report 22. Irrigation Water Management Institute, Colombo

[9]. Lumb A, Halliwell D, Sharma T (2006). Application of CCME water

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 04
February 2018

Quality Index to Monitor Water Quality: A Case of the Mackenzie, River Basin. Canada Environ. Monit. Assess. 113:411–429.

[10]. Sumok P (2001). River water quality monitoring: Sharing Sarawak experience. In Proceedings of 6th SITE Research Seminar pp. 1–4.

[11]. Chowdhury MMI, Farhad M, Haque MA (2004). Status of surface water treatment plant in Bangladesh. Undergraduate Thesis, Shahjalal University of Science & Technology.

[12]. Sarwar MI, Majumderb AK, Islam MN (2010). Water Quality Parameters: A Case Study of Karnafully River, Chittagong, Bangladesh. Bangl. J. Sci. Ind. Res. 45(2):177-181.

[13]. Zhang J, Takahashi K, Wushiki H, Wushiki H, Yabuki S, Xiong JM, Masuda A (1995) Water geochemistry of the rivers around the Taklimakan Desert (NW China): crustal weathering and evaporation processes in arid land. Chem Geol 119:225–2371

[14]. ¨zcan H, Ekinci H, Baba A, Kavdır Y, Yu ¨ksel O, Yig ˘ini Y (2007) Assessment of the water quality of Troia for the multipurpose usages. Environ Monit Assess 130:389–402.

[15]. CCME, Canadian Council of Ministers of the Environment (2001). "Canadian Water Quality Guidelines for the Protection of Aquatic Life: Canadian Water Quality Index 1.0 Technical Report". In Canadian Environmental Quality Guidelines, Winnipeg, Manitoba.