Journal of Basic and Applied Engineering Research
Print ISSN: 2350-0077; Online ISSN: 2350-0255; Volume 2, Number 3; January-March, 2015, pp. 211-214

http://www.krishisanskriti.org/jbaer.html

Physico-Chemical Parameters and Drainage Types of River Siang in Arunachal Pradesh, India

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Abstract—*River Siang is the main river of East Siang district and also it is one of the most important tributary of the mighty River Brahmaputra drainage system. River Siang plays an important role in lives of the surrounding inhabitants viz. fishing, bathing, washing, disposal, industrial wastes, and other human activities and most importantly the water of River Siang are uses by PHE of East Siang district for drinking purpose of water. Assessments of physico-chemical parameters were carried out during 2012 to 2014 in the six different study sites of River Siang. A major and important different water quality parameters were measured in all collected samples, including Water Colour, Air Temperature, Water Temperature, pH, DO, FCO_2, Conductivity, Total alkalinity, Turbidity, Total hardness, TSS and TDS. The results that are recorded in the different stations are compared with the different seasons and also with the different year.*

An analysis of the drainage network of a part of River Siang was undertaken to reveal the role of drainage water activity of the area. A number of fluvial geomorphic anomalies have been identified in the area. A prominent annular pattern is observed in the central part of the area. The total length of River Siang in Arunachal Pradesh is 293.9 km. This study revealed that the development of topography and drainage system of the study area have been influenced by active subsurface geological structures.

Keywords*: Physico-Chemical Parameters, WHO, East Siang, Remote Sensing and GIS, Arunachal Pradesh.*

1. INTRODUCTION

Water is the most vital resources for all kinds of life on this planet. Water is one of the nature's most important gifts to mankind. Rivers are vital and vulnerable freshwater systems and are essential for the sustenance of all life. The entire territory of Arunachal Pradesh forms a complex hill system with varying elevation, traveled throughout by a number of rivers and rivulets (Das and Kar, 2011). The unique drainage system of the state falls under upper Brahmaputra basins. Rivers provides main water resources for domestic, industrial and agricultural purposes. The modern civilization, urbanization and prolonged discharge of industrial effluents, domestic sewage and solid waste dump cause the water to became polluted. Wildand domestic animals using same drinking water can also contaminate the water through direct defection and urination (Jain, 2009).

A number of fluvial geomorphic anomalies have been identified in the drainage basins of Siang River within the East Siang valley in Arunachal Pradesh. The Himalayan belt in the north and the east has been controlling deposition of the stratigraphic formations and development of structural features throughout the Tertiary period till recent time (Halbrook, 1999).

2. STUDY SITE

The River Siang, is largest river of Brahmaputra river system, originates from Chema Yungdung Glacier near Kubi at 5150 m in Tibet. In Tibet it is popularly known as Tsang-Po, flows in West–East direction. After traversing a distance of about 1625 km river in Tibet and then it takes a turn in south direction, enters the territory of India near Tuting in the Upper Siang district of Arunachal Pradesh and flows through North–South direction in East Siang district towards Assam and finally it merges with Lohit and Dibang in Assam and it becomes the mighty River Brahmaputra (Das *et. al.* 2014).

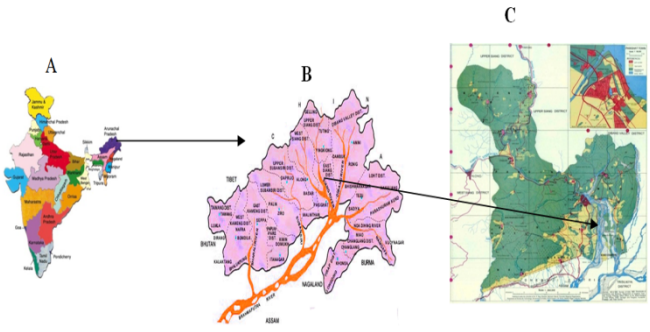

Fig. I: Map of (A) India indicating Arunachal Pradesh, (B) Arunachal Pradesh indicating to East Siang District, (C) In East Siang district highlighting River Siang (Study Area) of Arunachal Pradesh.

3. MATERIALS AND METHODS

Water was collected and stored in clean polyethylene bottles that have been pre washed with de-ionized water. Water colour, air temperature, water temperature and pH were determined in the field because of their unstable nature. Water temperature and air temperature were measured with the help of mercury thermometer and pH was measured with pen type pH meter in the field and other parameters was analyzed in the laboratory using standard procedure of APHA (2010) and using Perkin Elmer Atomic Absorption Spectrophotometer (AAS).

The study area covers a major part of East Siang District of Arunachal Pradesh latitudes $28^0 02' 43.16''$ - $28^0 10' 28.87''$N and longitudes $95^0 13' 05.30''$- $95^0 21' 39.00''$ E and altitude 501-1681 Ft.; which is included in the Survey of India (SoI) topographic map nos. 82 O/11, 82O/12, 82 O/15, 82 O/16, 82P/9, 82P/10, 82P/11, 82P/12, 82P/13, 82P/14, 82P/15, 82P/16, 83M/5 and 83M/9 on 1:50,000 scale. The satellite Images LISS III were collected from the NRSC Hyderabad, India, Bhuvan and also from USGC. The present study is confined to both the plain and hill areas because drainage anomalies in the plains and hills indicate the influence of subsurface structures, which are active in nature (Saha *et al.*, 2006; Saders and Tabuchi, 2000; Das *et al.*, 2014).

4. RESULTS AND DISCUSSION

The present study of physico-chemical parameters of the River Siang revealed the below mentioned parameters and the parameters are discussed in the below:

1. **Water Colour:** The colour of water colour was clear in most of the study sites but the colour is pale green in the mid-stream of the river.
2. **Air Temperature:** The value of air temperature is highest in summer season in the Ranaghat, 35 degree Celsius and minimum in the winter season in Ranaghat 21 degree Celsius.
3. **Water Temperature:** The value of water temperature is highest in Pasighat (summer) 30 degree Celsius and minimum in Mebo (winter) 15 degree Celsius.
4. **pH:** The pH of a water body is very important in determination of water quality since it affects other chemical reactions such as solubility and metal toxicity. During the present study the value of pH is found normal in every portion of the river; the total ranges of value is lies between 6-8. The highest value of pH was recorded as 7.91 in Post-Monsoon season at Rottang and the minimum recoded as 6.3 in winter season at Ponging.
5. **Dissolved Oxygen:** The maximum value of DO is recorded as 8.8 mg/L in summer at Rottang and minimum recorded in minimum recorded as 4.9 in Pre-Monsoon at Ranaghat. The maximum DO value in Monsoon (summer) is due to bright sunlight as it influences the % of soluble gases. The long day period of high intensity of sunlight accelerated photosynthesis which resulted to increase DO in summer.
6. **Free Carbon-di-oxide:** Free carbon-di-oxide (FCO_2) dissolves in water varying amounts and the dissolution depends on partial pressure and temperature. At low dissolved oxygen concentration, presence of high FCO_2 hinders oxygen uptake. The value of FCO_2 ranges between 3.4 to 7.1 mg/L. The value was minimum in winter at Ponging while it was recorded as high also in Ponging in post-monsoon season.
7. **Conductivity:** Conductivity of water varies directly with the temperature and it is proportional to its dissolved mineral matter content. The value of conductivity ranges between 7-14 ppm. The value highest at Bodag and the lowest value in Mebo of River Siang.
8. **Total Alkalinity:** Natural waters with high alkalinity are generally rich in phytoplankton, especially the blue greens. It is an important factor for productivity of an aquatic ecosystem. Total alkalinity of water is due presence of mineral salts in it. It is primarily caused by the carbonate and bicarbonate ions.
9. **Turbidity:** The observed values of the turbidity were within the limit range of WHO standards. The minimum values were recorded at Bodag as 78.1 and maximum values were recorded at Rottang as 99.9. The both minimum and maximum values were recorded in in pre-monsoon season.
10. **Total Hardness:** The value of total hardness is maximum in winter recorded as 88.5 mg/L at Bodag and minimum in pre-monsoon recorded as 64.7 at Mebo of river Siang.
11. **Total Suspended Solids:** Total Suspended Solids (TSS) varied from 101.8 mg/L to 129.3 mg/L. the maximum value was observed at Ranaghat in winter season and minimum value was recorded at Bodag in Pre-Monson season. The both minimum and maximum values are in the WHO standards. TSS is typically composed of fine clay or silt particles, plankton, organic compounds, inorganic compounds or other microorganisms.
12. **Total Dissolved Solids:** The quality of the Total Dissolved Solids (TDS) is in general proportional to the degree of pollution.TDS of the water sample varied from 4 ppm to 9 ppm which is below the permissible limits of WHO standards. The maximum value at Pasighat and the minimum value were recorded at Bodag. The value of TDS is higher in Monsoon seasons than that of winter and other seasons.TDS can be influenced by changes in pH. Changes in the pH will cause some of the solutes to precipitate or will affect the solubility of the suspended matter.

SL NO	PARAMETERS	Mean ± S.D.			
		WINTER	PRE-MONSOON	MONSOON	POST-MONSOON
1	Air Temperature C0	16.17 ± 1.47	27.17 ± 1.94	36.67 ± 9.87	27.50 ± 1.64
2	Water Temperature C0	13.50 ± 3.08	24.00 ± 4.05	27.17 ± 1.72	25.33 ± 3.93
3	pH	6.60 ± 0.30	6.83 ± 0.44	6.91 ± 0.19	7.16 ± 0.42
4	DO (mg/l)	5.30 ± 1.15	7.67 ± 0.77	7.97 ± 0.95	6.62 ± 0.27
5	FCO2(mg/l)	8.47 ± 1.20	4.87 ± 0.86	7.23 ± 1.38	7.92 ± 1.50
6	Conductivity (ppm)	13.83 ± 2.23	13.17 ± 2.04	8.00 ± 2.10	9.33 ± 2.07
7	Total Alkalinity (mg/l)	68.54 ± 5.75	84.47 ± 9.50	69.53 ± 13.83	80.27 ± 9.08
8	Turbidity (NTU)	93.08 ± 6.83	87.79 ± 9.24	82.60 ± 8	89.43 ± 9.86
9	Total Hardness (mg/l)	72.08 ± 3.33	77.13 ± 8.04	96.98 ± 24.57	69.67 ± 3.69
10	TSS (mg/l)	117.48 ± 9.33	120.08 ± 15.72	256.93 ± 3.38	120.87 ± 6.87
11	TDS (ppm)	6.17 ± 1.17	5.17 ± 1.60	5.75 ± 1.89	7.67 ± 2.07

The regional drainage pattern of the area under study is nearly parallel to sub-parallel, whereas a prominent annular pattern is observed in the central part of the area. An attempt is made here to examine how are drainage networks influenced by underlying neotectonically active structures (Roy, 1975). In River Siang catchment area the major drainage can be delineated as dendritic, sub-dendritic, sub-parallel, trellis and rectangular pattern.

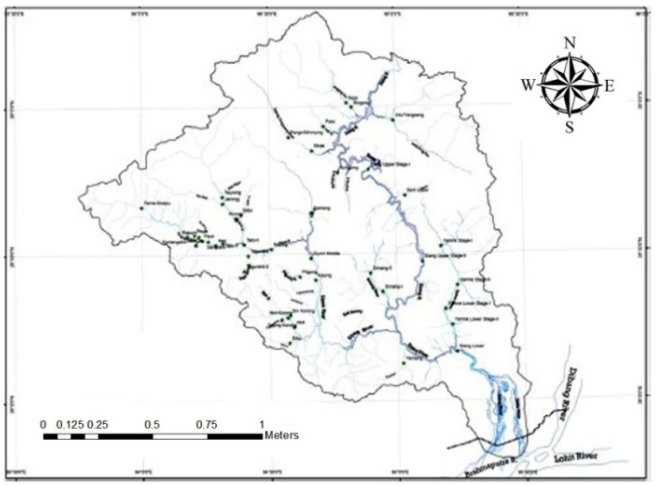

Fig. II: Drainage Basin Map of River Siang

The drainage of the most of the part of the river catchment area is collected from the available topographic maps. Drainage was controlled by the structure and the lithology of the area.

Table II: Different types of Drainage Pattern of River Siang and their Geological Significance

Sl. No	Type	Description	Geological Significance
1	Dendritic	Irregular branching of streams, Haphazardly, Resembling Tree	Homogenous materials and crystalline rocks, Horizontal beds, gentle regional slope
2	Trellis	Main streams running parallel and minor tributaries joining the main streams nearly at right angles	Dipping or folded sedimentary or low grade meta-sedimentary rocks, areas of parallel fractures
3	Rectangular	Streams having right-angled bands	Jointed rocks e.g. sand stones, quartzities etc.
4	Sub-Parallel	Channels running nearly parallel to each other	Steep slopes; also in areas of parallel elongate landforms

5. ACKNOWLEDGEMENT

The authors are thankful to Assam University, Silchar and to the UGC, New Delhi for granting UGC-Fellowship to the First author.

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