International Journal of Theoretical & Applied Sciences, **5**(1): 67-74 (2013)
ISSN No. (Print): 0975-1718
ISSN No. (Online): 2249-3247

Assessment of Water Quality and Pollution Status of Nambol River, Manipur

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(Received 05 December, 2012, Accepted 02 January, 2013)

ABSTRACT: The present study was carried out to assess the water quality of the Nambol river, Manipur. Nambol river is one of the most important rivers which drains into the Loktak Lake, which is one of the lakes of international importance i.e. Ramsar site. The dumping of solid waste, discharge of sewage, domestic garbage etc. have severely affected the water quality of the river. Physico-chemical parameters like water temperature, pH, DO, Free Carbon Dioxide, COD, BOD, total hardness, Chloride, Nitrate and Phosphate were analysed during January 2010 to December 2010. The study was carried out through the collection and laboratory analysis of the samples taken from the river. The samples were collected on monthly basis and five replicates of water samples were collected from the two sampling sites, upstream and downstream. Results indicated high value of BOD, COD, Nitrate and Phosphate in downstream area than in the upstream area of the Nambol river. This is mostly due to the anthropogenic activities.

Keywords: Physico-chemical, Nambol river, upstream, downstream.

I. INTRODUCTION

Rivers are the most important freshwater resource for man. They are vital and vulnerable freshwater systems that are critical for the sustenance of all life forms. However, the declining quality of the water in these systems threatens their sustainability and waterways of strategic importance across the world providing main water resources for domestic, industrial and agricultural purposes. Water is an essential requirement of human and industrial developments and it is one the most delicate part of the environment. In the last few decades, there has been a tremendous increase in the demand for freshwater due to rapid growth of population and the accelerated pace of industrialization. Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions (Okeke and Igboanua 2003). For instance, in most towns in Manipur, the rivers passing through them have been converted into dump sites or latrines, with consequent adverse effects on the health of downstream users. Manipur is endowed with many rivers and streams of which many are feeding the important lakes of the state. Nambol river arises from the western side of the state and passes through Senapati,Imphal West and Bishnupur districts of Manipur. It then drains into the Loktak lake i.e. Ramsar sites. Before it drain to the Loktak lake, it meets Nambul rivers, which is one of the polluted river that also drainsinto the lake. The meeting point is called Yangoi Karong. Hence the assessment of the status of the river becomes of paramount importance. The river water is deteriorated by the sewage discharge, chemical fertilizers, pesticides, dumping of solid waste and other activities like washing, bathing etc. Therefore, with the objectives of conserving these water bodies from further deterioration, the present investigation has been taken up to assess the water quality and pollution status of the Nambol river.

II. MATERIALS AND METHODS

Surface water samples were collected on monthly basis from the study sites during the study period. For each month five replicates of water samples were selected from the sampling stations, upstream and downstream. Physico-chemical analysis was done following the standard method of APHA *et al*, (1995), Trivedi and Goyal, (1986).

The average of the five samples taken for each parameter under study was conducted as one reading. the Physico-chemical analysis was done following the standard method of APHA (1995) and Trivedi and Goyal, 1986. Parameters like temperature, p^H,Free CO_2were taken at the spot. For DO analysis the sample was collected in a 250 ml reagent bottle and filled at the spot and analysis was done in the laboratory. Investigation of other parameters was done in the laboratory after collecting the sample.

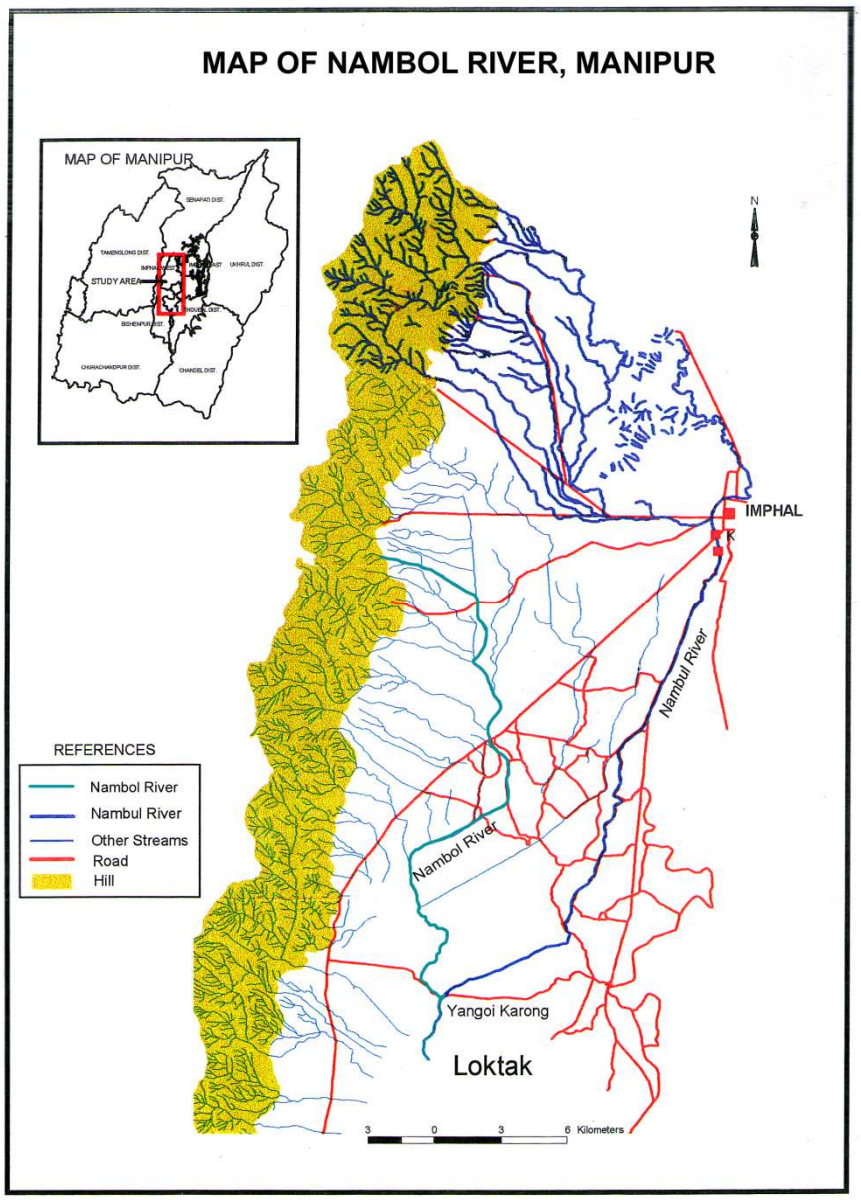

Fig. 1.

III. RESULTS AND DISCUSSION

The results of the Physico-chemical analysis are presented in table 1 and table 2.

(i) Temperature: During the investigation, it was found that the temperature varied from 18^0C to 27^0C in the upstream whereas in the downstream it varied from a minimum of 17^0C to the maximum temperature of 27^0C and observed in the month of August. In both the station the water temperature was high during the summer season. During the study period the minimum rainfall was reported during the month of February (7.0mm) 2010 while the maximum rainfall (300mm) was recorded in the month of July, 2010. The ombrothermic diagram for the hydrological year 2010 is shown in fig. 2.

(ii) pH: In the study areas, the p^H of water collected at different points and at different times of year ranged from 6 to 7.5 in upstream and 6.6 to 7.4 in downstream. In upstream, the pH value is high during the month of April with a value of 7.5 whereas in downstream the value is highest during the month of May with a Value of 7.4. the highest value was due to high base saturation with low volume of water during dry season. On the other hand the low value of pH in the upstream was found during the month of August and in downstream it was found during the month of October.

This is due to dilution effect as suggested by several authors Sundaramanichan *et al.,* 2008). The increase in P^H can be attributed to organic pollution and the domestic waste discharge draining into the river system as it traverse the habited City.

(iii) Dissolved Oxygen (DO): The investigation of dissolved oxygen revealed that the value is lower in the downstream when compared to the upstream. The high value of DO is observed in upstream with a value of 4.6 mgl^{-1}. The lowest value of DO is obtained in the downstream with a value of 2.65 mgl^{-1}. The lower DO is the downstream implies that the river is more polluted downstream.

Domestic, agricultural, industrial effluent and waste discharge into rivers is a usual practice and high pollution of the downstream. Besides high number of aquatic plants and algae affects DO along rivers in daytime.

The values of DO downstream were higher than upstream values in all the sampling months. According to the USDA (1992), the level of Oxygen depletion depends primarily on the amount of waste added, the , velocity and turbulence of the stream, the initial DO level in the water and in the stream, and the temperature of the water. Following this, the higher DO values downstream could be due to the velocity and the more turbulent nature of the stream from anthropogenic activities such as bathing, washing, and water abstraction etc. occurring in between upstream and downstream. This result corroborates with that of the workers like A. Abdul-Razak *et al.,* (2009).

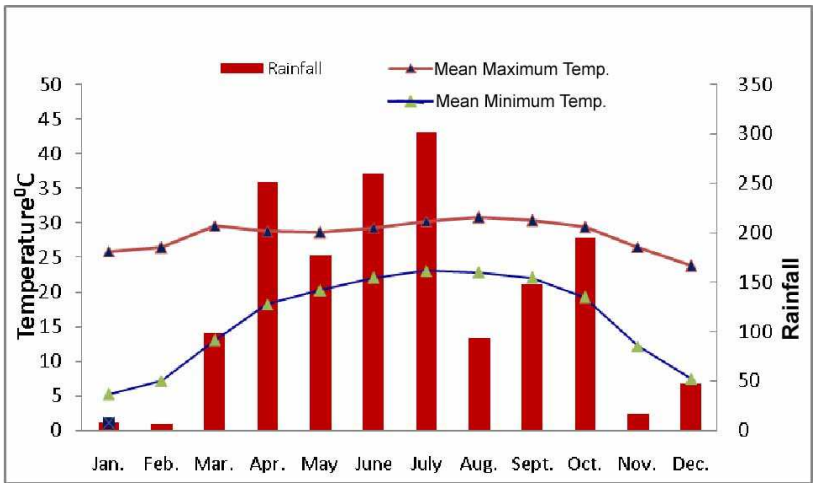

Fig. 2. Ombrothermic Diagram for the hydrological year 2010.

Fig. 3 : Monthly variation of the Physico-chemical characteristics of downstream of Nambol river of the year 2010.

(iv) Free CO_2: The value of Free CO_2 varied from 4.5 mgl^{-1} to 6.8 mgl^{-1} in upstream whereas it fluctuate from 3.6mgl^{-1} to 6.2mgl^{-1} in downstream. The higher value of Free CO_2 in downstream shows the pollution status.

(v) Chemical Oxygen Demand (COD): The value of chemical Oxygen demand fluctuate between 3.8 $mgl^{-1}$to 4.2 mgl^{-1} in upstream. In downstream it ranged from 5.25 mgl^{-1} to 8.7 mgl^{-1}.

According to the United State Public Health (USPH) standard, 4 mgl^{-1} of COD indicate the quality for domestic and decanting water (De, 1993). High value of COD at downstream indicate the pollution of rivers with organic and chemical pollutants.

(vi) Biological Oxygen Demand (BOD): During the period of investigation the value of BOD was found to varied from 6.02 $mgl^{-1}$and 8.82 mgl^{-1}in upstream. In downstream the value lies between 8.9 $mgl^{-1}$and 12 mgl^{-1}.

The BOD values rise in downstream was most due to constant increase in effluent discharge to the stream and also organic water. This is an agreement with works of authors like A. Abdul-Razak *et. al*, 2009 and Dulo *et.al.*, 2008.

(vii) Total hardness: The variation of total harness among the sampling months along the course of the upstream lies in the value of 30 $mgl^{-1}$to 41 $mgl^{-1}$and 28 $mgl^{-1}$to 41 mgl^{-1}in downstream. The high value might be due to the solubilised of salts along the river course and also may be due to anthropogenic activities such as farming as the river set in. In both the upstream and downstream it was observed that the high value is obtained during the dry season. This could be as a result of low water levels and the concentration of ions. This agrees with the result of Oladimeji (2004) for Shinoro Lake, Ufodike *et. al.,* (2001) for Ookowa mine lake, Ibrahim *et al.,* 2009.

(viii) Chloride : The value of chloride lies between 17 $mgl^{-1}$to 19.9 mgl^{-1}in upstream and 17.43 $mgl^{-1}$to 25 mgl^{-1}in downstream. The sources of chloride in the studied sites are likely to be from hydrochloric acid, common salt (NaCl) and other Chloride containing compounds. Compared to standard limits, the value obtained at all the study sites are lower than that value (200.00-500.00 mgl^{-1}) recommended limit by WHO (1999).

(ix) Nitrate : Nitrate is a form of nitrogen and a vital nutrient for growth, reproduction and the survival of organisms. High nitrate levels (>1 mgl^{-1}) are not good for aquatic life. The value of nitrate was 0.142$mgl^{-1}$to 0.160 mgl^{-1}in upstream and in downstream it varied from 0.112$mgl^{-1}$to 0.188 mgl^{-1}.

The high nitrate concentration is due to the run off of fertilizer from the nearby field areas and also due to the flush out of deposited nitrate from near surface. The high nitrate concentration in the downstream areas is due to the runoff of sewage containing nitrate.

(x) Phosphate : In the present study the value of phosphate lies between 0.071 $mgl^{-1}$to 0.082 mgl^{-1}in the upstream and 0.071 $mgl^{-1}$to 0.091 mgl^{-1}in the downstream. Phosphate is considered to be the most significant among the nutrients responsible for eutrophication of the rivers. There are various sources of phosphate to river such as firm rock deposit, runoff from surface catchments and interaction between the water and sediment from dead plant and animals remains at the bottom of the river. The high concentration in the downstream could be due to impacts of industrial effluents from the surrounding area.

The present observation on nutrients agrees well with the observation of Choudhury and Panigraphy (1991) as the distribution and behaviour of nutrients in the river exhibit considerable seasonal variation depending upon the local condition like rainfall, inflow of water and biological activities such as phytoplankton uptake and regeneration.

In conclusion, it was observed that there is variation in the degree of pollution and water quality among upstream sites and downstream sites. Comparatively, the downstream sites are more polluted than the upstream sites. This might be due to various factors like site siltation, addition of urban and agricultural run off, addition of waste water etc.

These problems may cause serious health hazard as the inhabitants use the water for domestic, agricultural as well as industrial purposes. In this regard, it is highly recommended that environmental awareness campaigns must be conducted regularly to give awareness to the local people to make them utilize the surface water in a more hygienic way.

Table 1 : Monthly variation in Physico-chemical characteristic of upstream of Nambol river of the year 2010.
Note : All parameter are expressed in mgl $^{-1}$ except Water Temperature and p^H.

Water Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	SD
Water temperature	18.35	18.00	20.80	25.25	24.00	27.00	27.00	27	25	24	21	19	23.03	3.445
P^H	7.2	7.2	7.3	7.5	7.10	7.30	7	6	7	7.4	6.9	6.9	7.06	0.387
DO	3.03	3.2	3.3	4.0	4.23	4.2	4.26	3.26	3.92	4.02	4.3	4.6	3.86	0.522
Free CO_2	4.5	5.0	5.2	6.0	6.0	6.5	6.8	6.4	6.2	5.2	5.3	5.4	5.70	0.704
COD	4.04	4.2	3.8	3.9	4	4.01	3.9	3.9	3.8	3.9	4.0	4.2	3.97	0.132
BOD	8.82	7.74	8.01	7.00	6.02	6.03	8.9	7.9	7.8	7.6	8.02	7.04	7.57	0.919
Total hardness	32	36	30	32	34	34	37	39	40	41	36	37	35.66	3.393
Chloride	17.01	17.05	18	18.01	17	17.3	18.01	18	18.03	19.46	19.9	17.04	17.90	0.950
Nitrate	0.150	0.152	0.160	0.160	0.158	0.151	0.152	0.153	0.142	0.151	0.152	0.150	0.152	0.005
phosphate	0.071	0.072	0.082	0.071	0.081	0.081	0.080	0.080	0.082	0.079	0.072	0.081	0.077	0.005

Table 2 : Monthly variation in Physico-chemical characteristic of downstream of Nambol river of the year 2010.
Note: All parameters are expressed in mgl^{-1} except Water Temperature and p^H.

Water Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	SD
Water temperature	17.00	20	21	23	24	25	26	27	25	23	20	18	22.41	3.204
P^H	7.2	7.3	7.4	6.9	7.4	6.8	6.9	7	7.2	6.6	7	7.3	7.08	0.255
DO	2.65	2.7	2.8	2.7	2.9	3.0	3.06	3	3.06	3.2	3.4	3.2	2.97	0.232
Free CO_2	4.3	4.0	4.2	3.6	6.2	6.0	4.5	5.3	4.2	4.9	5.0	5.2	4.78	0.798
COD	5.25	6.0	6.8	6.7	6.7	6.5	7.04	7	7.9	8.7	7.9	7.7	7.01	0.931
BOD	10.45	9.67	9.8	8.9	9.64	10.17	10.9	9.6	9.9	10	11	12	10.16	0.818
Total hardness	38	36	39	30	41	32	28	38	34	38	40	41	36.25	4.330
Chloride	18.42	17.43	18	22	24	24	25	24.01	22	23	22	21	21.73	2.557
Nitrate	0.188	0.116	0.112	0.152	0.156	0.174	0.172	0.170	0.167	0.163	0.161	0.172	0.158	0.023
phosphate	0.087	0.082	0.075	0.079	0.074	0.072	0.083	0.079	0.081	0.082	0.083	0.091	0.080	0.005

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