Environment & Ecology 35 (4C) : 3362—3367, October—December 2017
Website : environmentandecology.com ISSN 0970-0420

Anthropogenic and Environmental Factors Influencing the Water Quality of Wah Umkhrah River

Maitreyee Roy

Received 25 March 2017; Accepted 28 April 2017; Published online 20 May 2017

Abstract Water pollution is a major global problem which requires on going evaluation and revision of water resource policy at different levels. The river wah Umkhrah, once a crystal clear water, originates from natural springs in the southeastern part of shillong peak range near Damthring (91°54.30° E and 25°34.30° N) at an altitude of about 1,600 meters above mean sea level. In recent years the river Wah Umkhrah is under serious threat and pressure from both anthropogenic and natural factors and the river has lost its unique characteristics. The significance of river Wah Umkhrah for Shillong is quite immense. There are no treatment plants in Shillong. sewage is drained in the river as a result small fishes have been killed and the river is lifeless. In this research, the levels of physico-chemical and bacteriological parameters were determined in water samples collected from the river. After the analysis of the data, it can be said that the river water at present is highly polluted. The results indicated that most of the parameters from the river are beyond the WHO limits for drinking and sustainable use.

Keywords Wah Umkhrah river, Crystal clear, Physico-chemical, Bacterial, Environmental degradation.

Maitreyee Roy*

Department of Environmental Management, William Carey University, Nondmonsong, Umkdait, Shillong 793003, India
e-mail :royshivani35@yahoo.in
*Correspondence

Introduction

Clean, fresh and safe water is vital for the survival of all living organisms and smooth functioning of the eco-system, communities and economics. The water quality is threatened as a result of human population growth, industrial activities and the climate change has threatened the hydrological cycle. Polluted rivers have extremely harmful effect on river ecosystems mostly because water pollution causes significant drop in oxygen levels, and many animals are not able to tolerate low levels of oxygen in rivers. The life of aquatic eco-system depends on the water quality. The river Wah Umkhrah once crystal clear water originates from natural spring in the southeastern part of Shillong peak range near damthring. During the recent years the river Wah Umkhrah is under serious threat and pressure from both anthropogenic and natural factors and the river has lost its unique characteristics. The problem of

Table 1. pH.

Sampling Site	Oct 2015	Nov	Dec	Jan 2016	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 2016
Demseiniong	7.0	6.2	6.5	6.8	7.0	7.0	7.0	6.5	7.0	6.7	7.0	6.8
Pynthor Umkhrah	7.0	6.2	6.2	7.0	7.0	6.8	6.8	6.3	7.0	6.8	7.0	7.0
Polo ground	6.5	6.5	6.2	7.0	6.8	6.4	7.0	7.0	6.9	7.0	7.0	6.9
Wahingdoh	6.5	6.8	6.3	6.9	7.0	6.3	6.9	6.9	7.1	6.9	6.6	7.0
Mawlai Nonglum	6.9	6.0	6.6	7.0	6.5	6.3	6.8	7.0	7.0	7.0	6.9	7.0

river water pollution has become gigantic as a result of urbanization and unplanned use of fresh water resources. During the recent years the river bed has witnessed a growing pressure of population. The gross pollution of Wah Umkhrah river water is both from point and non-point sources.

Low public consciousness about the overall scarcity and economic value of water results in its wastage and inefficient use. In addition, there are inequities distribution and lack of a unifed perspective in planning, management and use of water resources. Realizing the significance and scarcity attached to the fresh water and the fact that it is an essential requirement for sustaining all forms of life, it has to be planned, developed, conserved and managed with utmost prudence and care. In developing countries, about 1.8 million people mostly children, die every year as a result of water related disease [1]. In India 70% of the surface waters have become polluted due to the discharge of domestic sewage and industrial effluents into natural water resources, such as rivers, streams as well as lake [2].

There should be a periodical reassessment of the river water potential on a scientific basis, taking into consideration the quality of water available and economic viability of its use. The detrimental environmental consequences of over exploitation of river water need to be effectively prevented by the Central and State Governments. The demand for water has increased significantly in the State of Meghalaya as a result of both high population growth and significant economic growth. The need and competition for water for multiple purposes is increasing. Growth processes and the expansion of economic activities inevitably lead to increasing demands for water for diverse purposes : Domestic water supply, agricultural, industrial, hydropower, transport, recreation.

The significance of river Wah Umkhrah for Shillong is quite immense since it passes through various important locations of the city till it meets river Umiam. Since there are no treatment plants in Shillong, all the sewage and wastewater enters directly into the river. The river is polluted by the defecation and toilet discharging directly into the river. Several streams/drains also join the various commercial activities like quarrying, automobile workshops and servicing centers, hotels,restaurants,

Table 2. Turbidity (NTU).

Sampling site	Oct 2015	Nov	Dec	Jan 2016	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 2016
Demseiniong	19.0	10.0	16.0	11.0	36.0	45.0	19.0	17.0	15.0	11.0	11.0	21.0
Pynthor Umkhrah	14.0	19.0	11.0	12.0	11.0	16.0	18.0	12.0	11.0	17.0	12.0	18.0
Polo ground	14.0	11.0	15.0	16.0	15.0	54.0	32.0	30.0	20.0	18.0	31.0	19.0
Wahingdoh	19.0	12.0	10.0	19.0	26.0	38.0	16.0	14.0	31.0	21.0	32.0	30.0
Mawlai Nonglum	28.0	13.0	12.0	58.0	38.0	28.0	25.0	22.0	19.0	48.0	41.0	35.0

Table 3. Conductivity.

Sampling site	Oct 2015	Nov	Dec	Jan 2016	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 2016
Demseiniong	165.0	210.0	220.0	470.0	450.0	270.0	250.0	220.0	200.0	250.0	220.0	202.0
Pynthor Umkhrah	173.0	169.0	190.0	270.0	290.0	100.0	119.0	250.0	175.0	230.0	261.0	210.0
Polo ground	133.0	125.0	125.0	162.0	194.0	130.0	135.0	128.0	161.0	195.0	141.0	158.0
Wahingdoh	172.0	180.0	180.0	270.0	300.0	177.0	181.0	160.0	192.0	141.0	173.0	113
Mawlai Nonglum	390.0	280.0	250.0	390.0	270.0	290.0	230.0	234.0	300.0	227.0	127.0	280.0

slaughter houses and markets located along the banks of this river add to the pollution load of the river.

The study will provide insight into the ecological status of the water body and sustainable water management schemes that can be implemented for restoration of the water quality. The findings will clearly indicate the challenges and opportunities for improvement of the water quality so that the ecosystem of the water is restored and can be used.

Materials and Methods

Study area and sampling stations

The present study was conducted at the Wah Umkhrah river, Shillong, Meghalaya. Five stations were selected for the present study (Demseiniong-91°54′30′′E /25°34′30′′N, Pynthor Umkhrah-91°54′54.0′′ E / 25°35′′N, Polo ground 91°53′ 0′′ E / 25°35′0′′ N, Wahingdoh 91°53′ 0′′ E / 25°35′0′′ N and Mawlai Nonglum-91°52′30′′ E / 25°35′ 30′′ N). Sampling sites were selected based on anthropogenic activities. The objective of the study was to provide baseline information on its physico-chemical and bacteriological characteristics of the river water . Analysis of the water was carried out for duration of one year (October 2015 to September 2016).

Physico-chemical parameters of water were determined as per standards of APHA. The different parameters taken into consideration were Temperature, Turbidity, Conductivity, pH, Alkalinity, Dissolved Oxygen, Biochemical Oxygen Demand, Nitrate and total coliform bacteria. Water samples were collected in pre-cleaned polythene bottles and preserved till all analysis was completed. pH of the water samples were measured by pH meter (Modal 111) using standard solutions. Conductivity was measured by digital conductivity meter 602. Turbidity was measured by nephelometer and was expressed in Nephloturbidity unit. Alkalinity of the water sample was determined by titration method. Methyl orange was used as an indicator.

Dissolved oxygen was measured by Winkler's method. Alkalinity of the water sample was determined by titration method using sulfuric acid (H_2SO_4). For estimation of nitrate phenoldisulphonic acid method have been used. Nitrates react with phenoldisulphonic acid which in alkaline solution develops yellow color. APHA method was used for total coliform bacteria count. Microbiological analysis was done by thin porous flexible plastic disc.

Results and Discussion

During the study period the surface water tempera-

Table 4. Alkainity (mg/1).

Sampling site	Oct 2015	Nov	Dec	Jan 2016	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 2016
Demseiniong	66.0	68.0	46.0	70.0	70.0	50.0	116.0	108.0	38.0	40.0	44.0	58.0
Pynthor Umkhrah	50	47	53	67	74	30	50	58	35	36	56	54
Polo ground	50	56	51	62	74	30	52	54	37	36	50	90
Wahingdoh	81	83	75	92	93	36	43	80	75	57	60	72
Mawlai Nonglum	87	81	86	89	90	47	89	100	97	85	56	43

Table 5. Dissolved oxygen (mgL^{-1}).

Sampling site	Oct 2015	Nov	Dec	Jan 2016	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 2016
Demseiniong	3.5	3.1	2.6	3.4	1.6	2.6	2.6	2.7	1.7	2.5	1.7	1.5
Pynthor Umkhrah	3.0	2.6	2.4	3.2	2.9	2.4	2.4	3.0	2.7	1.7	2.7	1.7
Polo ground	3.4	1.9	3.3	0.9	2.0	2.4	2.4	3.8	2.3	2.9	2.5	0.4
Wahingdoh	1.9	1.3	3.2	3.3	1.2	1.2	1.2	2.9	2.5	2.4	2.7	1.2
Mawlai Nonglum	1.7	2.2	2.9	4.4	1.5	3.5	3.5	3.5	3.0	1.9	2.5	1.9

ture ranged from 17°C to 25°C. Temperature of water plays an important role in influencing the quality and ecology of rivers. It affects not only the physical nature of water by changing the viscosity, density and types of chemical reactions that occur within. Water temperature is thus an important factor that influences the rate of all biological activities. Temperature can therefore be used as a first step in predeicting the effects of mans activities on the aquatic ecosystem [3]. pH is one the important ecological parameters. Neutral pH of the water body is determined by CO_2 and bicarbonates. The water was found more acidic during winter season. During other seasons the water gets more diluted because of rains. pH value ranged from 6.2 to 7.0 (Table 1). In most of the study sites the pH value do not fall within the recommended range (6.5 to 9) reported as suitable for aquatic life. The pH in the different study sites showed no significant difference. This reflects that the water body is homogeneous in terms of pH. Turbidity is the measure of relative clarity of a liquid; it is one of the most important parameter of water. Turbidity makes water cloudy or opaque; this is due to high concentration of particulate matter present in the water body. Pollutants and impurities present in the water have a detrimental effect on the quality of the water body. It is a dream that once a crystal clear river is slowly dying. At different sampling sites the turbidity values varied and maximum level of turbidity was recorded at polo ground 54 NTU (Table 2). This is due to surface runoff.

In the present investigation, the value of conductivity of river Wah Umkhrah varies from 113 to 470 ($\mu mhocm^{-2}$) (Table 3). The increased value of conductivity in the river water is due to the presence of bicarbonates and carbonates. Increasing levels of conductivity and cations are the products of decomposition and mineralization of organic materials [4]. Water with high conductivity effects water heaters, food plant.

In the present study alkalinity value varied from 30 to 116 (mg/1) Table 4. The ionic concentration in the water is referred as the alkalinity. The total alkalinity has the tendency to neutralize the hydrogen ions. Total alkalinity is the measure of capacity of water to neutralize the acids. Alkalinity increases as the amount of dissolved carbonates and bicarbonates increases [5]. Buffering capacity determines the alkalinity of river water. The alkalinity value was high during the summer months this may be due to increased carbonate content in the water [6].

Table 6. Biochemical oxygen demand ($mg\ L^{-1}$).

Sampling site	Oct 2015	Nov	Dec	Jan 2016	Feb	Mar	Apr	may	Jun	Jul	Aug	Sep 2016
Demseiniong	90.7	92.8	100.0	35.7	24.2	82.8	90.7	70.8	172.1	124.2	49.2	74.2
Pynthor Umkhrah	74.2	64.2	92.8	85.7	16.4	107.0	74.2	165.7	49.2	174.2	75.0	74.2
Polo ground	157.1	64.2	128.5	71.4	124.2	116.4	132.8	174.2	50.0	182.8	91.4	90.7
Wahingdoh	49.2	85.7	100.0	178.5	16.4	99.2	141.4	41.4	149.2	165.7	173.5	149.2
Mawlai Nonglum	91.4	71.4	42.8	28.5	91.4	75.0	207.1	74.2	157.8	207.1	157.8	91.4

Table 7. Nitrate-N (mg/l).

Sampling site	Oct 2015	Nov	Dec	Jan 2016	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 2016
Demseiniong	1.2	1.7	2.1	4.2	1.2	9.3	2.2	6.2	4.5	3.2	2.8	1.9
Pynthor Umkrah	5.3	3.5	0.1	0.1	1.3	2.5	0.8	1.6	3.8	3.1	2.3	1.3
Polo ground	2.3	2.0	1.0	4.3	2.5	5.2	5.1	8.0	4.5	3.7	4.2	2.1
Wahingdoh	1.2	2.8	1.2	1.9	2.9	5.7	1.7	3.2	4.8	1.9	3.5	1.4
Mawlai Nonglum	2.8	4.6	1.2	1.3	1.3	1.4	1.5	2.2	4.8	1.8	4.4	2.0

Assessment of dissolved oxygen is one of the most inportant parameter of water quality and reflects the biological and physical condition of water. In the present study the value of measured dissolved oxygen ranged from 0.4 to 3.8 mg/l (Table 5). Lower levels of oxygen indicates higher rate of respiration and organic decomposition. The measure of dissolved oxygen is indication the degree of pollution in the river water and is not sufficient to support aquatic life. Correlation of dissolved oxygen with water body gives direct and indirect information e.g. bacterial activity, photosynthesis, availability of nutrients, stratification [7]. Dissolved oxygen concentration above 4mg/L is good while below 4 mg/L is detrimental to the aquatic life. BOD is an excellent parameter for water and measures the amount of biodegradable organic material present In a water body. in the present study BOD ranged between 16.4 to 207.1 mg/l (Table 6). The BOD values were high in some of the months in the year of investigation this may be due to increased microbial activity.

Nitrate content of the river water showed a variation from 0.1 to 9.3 mg/l (Table 7). Nitrates are formed in water due to bacterial action and are the most oxidized forms of nitrogen. Biological decomposition of all nitrogenous organic matter such as sewage and animal wastes contribute to nitrite value in water body. The presence of nitrate value from my study is indicating pollution of river water and is very high for aquatic life. The nitrate pollution would cause eutrophication, which affects the water quality [8].

All the water samples collected during the study were positive with respect to the coliform occurrence well above the permissible limits though the counts were variables. The values ranged from 3400 MPN/100ml to 240000 MPN/100 lm (Table 8). The results indicate that none of the water samples was fit for use. High bacterial counts are attributed to contamination by domestic sewage [9]. Pungent smell has engulfed some of the localities. From the present investigation it was evident that the river water is highly contaminated and also denotes the potential public health hazards.

Conclusion

The river Wah Umkhrah is suffering from receiving organic refuge and drains from the houses by its bank

Table 8. Total coliform (MPN/100ml).

Sampling site	Oct 2015	Nov	Dec	Jan 2016	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 2016
Demseiniong	3400	3400	3400	4300	7900	6300	9400	4600	6300	7000	13000	28000
Pynthor Umkhrah	13000	22000	35000	24000	22000	18000	22000	18000	14000	18000	17000	35000
Polo ground	7000	18000	11000	17000	7900	11000	13000	13000	13000	13000	18000	28000
Wahingdoh	60000	22000	11000	92000	92000	28000	54000	28000	28000	35000	54000	22000
Mawlai Nonglum	53000	92000	25000	92000	92000	92000	240000	35000	18000	28000	35000	150000

as a result of which it is not in a position to sustain aquatic life as well as domestic or industrial use. We should remember that Wah Umkhrah river receives its water from Demthring which is the purest form of water in Shillong. Today as sewage is drained in the river small fishes have been killed and the river is lifeless. No attempt has been taken to clean the water body. In many places heavy walls have been constructed on both the banks which have reduced the size of the river resulting in to inundation of its surroundings causing damage to life and property. People of Shillong are not allowing the normal flow of the water as a result during the rains the low laying areas are flooded e. g. polo ground. The restoration of the Wah Umkhrah river water quality is an important challenge to the Government of Meghalaya and the Environmentalists. Prevention of pollution must be taken up on priority basis for the integrated development of the water body. A legal framework should be set up to stop dumping of garbage in the river water. For resource conservation and sustainable utilization of the natural resource education, training and support must be provided to the hill communities. For the same scientific management of these resources is necessary to achieve these objectives.

References

1. Parita K (2014) Physico-chemical and microbial analysis of drinking water in Rajkot District, Gujrat. Int J Environm Sci 5 : 2.
2. Kesalkar VP (2012) Physico-chemical characteristics of waste water from paper industry. Int J Engg Res and Appl (IJERA) 2 : 4.
3. Moor NA, Jewit, GPW, Weeks DC (2004) Water temperature and fish distribution in the sabie system towards the development of an adaptive management tool. WRC Report No 1065/1/04. Water Resarch Commission, Pretoria.
4. Abida B, Harikrishna (2008) Study on the quality of water in some streams of Cauvery river. J Chem 5 : 377—384.
5. Gupta N, Yadav K, Kumar V, Singh D (2013) Assessment of physico-chemical properties of Yamiuna river in Agra City. Int J Chem Tech Res.
6. Hujare MS (2008) Seasonal variation of physico-chemical parameters in the perennial tank of Talsande, Maharashtra. Ecotoxicol Environ Monitor 18 : 233—242.
7. Vikal P (2009) Multivariant analysis of drinking water quality parameters of lake Pichhola in Udaipur, India. Bio Forum, An Int J 1 : 97—102.
8. Jemila K, Rose P, Kokila A (2013) Chemical analysis of Kodhaiyar river in Tamilnadu, India. Int J Engg Res Appl 3 : 1502—1507.
9. Kowsaly R, Uma A, Meena S, Saravakumar K (2010) Assessment of microbiological quality of Porur Double Lake, —ERTTAIERII, Chennai. Asian J Microbiol Biotech Environ Sci 12 : 667—671.