Deterioration and Degradation of Aquatic Systems Due to Brick Kiln Industries – A Study in Cachar District, Assam.

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http://dx.doi.org/10.12944/CWE.10.2.10

(Received: April 01, 2015; Accepted: July 07, 2015)

ABSTRACT

Brick industries are unorganised, rural, small scale industries in Cachar district of Assam which play an important role in economic development of the entire region. It has been observed during the study that these brick industries are responsible for large scale environmental problems like land degradation, air pollution, water quality degradation and loss of biodiversity. The present study deals with the quality of water in the selected brick kilns in Cachar district and its degradation during Jan-Dec 2014. The existing water bodies are contaminated with different compounds and continuous siltation from the brick kilns. The research focuses on the variation of various physico-chemical parameters such as water temperature, pH, conductivity, Total alkalinity, Dissolved oxygen, Carbondioxide, Nitrate, Phosphate, Transparency in the selected water bodies. The studied ponds were found to be in degrading state with less productivity. Moreover, the result obtained showed the need and urgency to restore the physical, chemical and biological management tactics to conserve and preserve the ecological imbalance and disturbance in the hydro-geo-chemical and hydro-biological cycles that adversely affect the food chain and food web in the brick kiln affected aquatic bodies.

Key words: Siltation, Ecological imbalance, Hydro-geo-chemical, Hydrobiological cycles, degradation, Food web**.**

INTRODUCTION

The brick kiln industries occupy a very significant place in the unorganised sector, confined mainly to rural and semi –urban areas. Small and medium sized traditional brick kilns are growing in cities of developing countries around the globe supplying the urban population with cheap construction material [1]. Fired clay brick is one of the most important building materials in the country. There are no reliable estimates of brick makers in India. The current (2001) annual brick production in the country is estimated at 140 billion bricks. The number of brick producing units in the country is estimated to exceed 100,000 [2]. There are around 50,000 brick kilns in the whole of country [3]. Brick kiln industry has its own unique characteristic like instability, short duration and poor technology. In Cachar brick kiln industry is a major employer of unskilled and semi-skilled labours. In brick kiln industry work is a seasonal activity and occurs largely between October to May and remains shut down during monsoon period,[4]. Though the brick fields of Cachar are playing a vital role in economic development of the region, at the same time we cannot ignore the pollution risks associated with the brick fields. There are several environmental impacts of brick kiln of which the major problems are land degradation, water quality loss, deterioration and air pollution. Due to degradation of top soil layer from the agricultural land ultimately the eroded soil goes to the nearby aquatic system through catchment channels. Water reflect its ecological potential and sustenance quality by it biological, chemical and physical characteristics. Now a days due to increasing anthropogenic influences in and around the catchment area of the aquatic systems causes large extent of nutrient enrichment in the aquatic systems and leads to deterioration in water quality. The brick industries highly affects the physico-chemical and biological properties of aquatic systems [5]. In Ujjain (India) high pollution levels in Kshipra river near these industries has been noticed, which could be possibly due to leaching of compounds from raw materials used in brick industries [6]. This observation is also made in this paper. The present research paper highlights the variation in physico-chemical properties in aquatic bodies present near the brick kiln industries and comparison with the ponds of Chatla floodplain wetland. In the Chatla floodplain wetland the presence of different types of habitats like fisheries, beels, ponds, inlets and outlets make an unique hydrology here and maintain the ecological balance among rivers, streams and floodplains.

MATERIALS AND METHODS

For water sampling three stations Bariknagar, Silcoorie and Natun bazaar have been selected which have brick kiln industries, then three ponds from the vicinity of each brick kilns i,e. 18 sites (A1,A2,A3,B1,B2,B3,C1,C2,C3,D1,D2,D3E1, E2,E3,F1,F2,F3) were chosen randomly, 6 control sites (A4,B4,C4,D4,E4,F4) have been selected away from the brick kilns (10-15 kms) and 3 sites (G1,G2,G3) were selected from Chatla floodplain wetland in Cachar district for comparison [7]. Water samples have been collected using standard methods [8,9]. Samples were collected on bi-monthly basis for one year. To study the impact of these industries on the aquatic bodies physico–chemical properties of like WT, pH, EC, Transparency, TA, DO, FCO_2, Nitrate and Phosphate was analyzed by using Standard Methods [8,9].

RESULTS

A survey was done to understand the brick making process and to select the sites in brick kiln industry to study its impact on the aquatic bodies. The results of different physico-chemical parameters are depicted in the (Table.1,2). Values show mean and SD for different sites studied during January to December 2014.The study shows the value of WT ranged from 19.8ºC to 26.5ºC. WT was higher in site F2 and lower in site D4 which was a control site. The value of water transparency ranged from 2.4 cm to 18.2 cm and was found higher in site C4 and lower in site F2. pH indicates acidic and basic nature of water. In the present study the average pH value recorded was 4.5 to 7.1. pH value was lower in C3 and higher in site B4. The average range of EC recorded was 13 µs/cm to 119 µs/cm. EC was recorded maximum in brick kiln affected site C2 and minimum in site G2 which was in Chatla wetland. The DO values ranged between 2.8-12.3 mgl^{-1}. DO of water samples was found maximum in site C4 whereas site B1 exhibits least concentration of DO. The FCO_2 value of the water bodies varied between 3.35-18.1 mgl^{-1}. Maximum level of FCO_2 was observed in C2 and minimum level in E4. The average range of TA recorded was 14.3-54.3 mgl^{-1}. Higher value of TA was recorded in site F4 and lower value in site C3 near brick kiln industry. The value of Nitrate content recorded was between 0.15 mgl^{-l} to 1.14 mgl^{-l}. Nitrate level was found maximum in site B3 and minimum in site B4. The values of Phosphate content ranged between 0.14-1.37 mgl^{-1}. Phosphate level was observed high in site C1 and low in site F4 near brick kiln.

DISCUSSION

Water temperature of an aquatic body shows very close association with ambient temperature [10] and plays important role in metabolism of different organisms. In the present study increase in WT might be due to the emissions of heat from the kilns which slightly raise the water temperature in nearby aquatic systems which is very much comparable with the heat losses from other brick kilns of the country [11]. During the study water is more turbid in affected site which might be due to dumping of ashes, extraction of sand and cutting of land that causes high silt content in water from the catchment areas [12]. The high turbidity might be responsible for high level of water temperature in the aquatic bodies near brick kiln industry because the suspended particles absorb the heat from the sunlight making the water warm [13,14]. Measurement of pH indicates the level of acidic and basic nature of the aquatic system. During the study pH was slightly acidic in some of the affected sites which might be due to leaching of some elements or acidic substances into the water bodies from the vicinity of the brick kilns [6]. However fluctuations in pH is also related with input loads of pollutants in the aquatic systems [15]. The fluctuations in EC might

Table 1: Effect of Brick kiln industry on water quality (Mean±SD)

Stations	Sites	WT(°c)	Transparency (cm)	pH	EC (µs/cm)	DO (mgl^{-1})	FCO_2 (mgl^{-1})	TA (mgl^{-1})	Nitrate (mgl^{1})	Phosphate (ml^{-1})
BARIKNAGAR	A1	22.3±2.5	5.8±0.5	6.2±0.54	25±0.04	3.3±0.16	7.8±0.3	44.5±1.7	0.63±0.08	0.52±0.02
	A2	22.4±2.5	4.8±0.5	6.5±0.6	26±0.01	3.4±0.17	9.1±0.5	48.3±0.9	0.54±0.07	0.87±0.03
	A3	23.8±2.9	6.9±0.8	6.4±0.5	55±0.01	4.3±0.2	8.7±0.1	39.7±0.5	0.66±0.06	0.43±0.05
	BI	24.1±2.6	3.4±0.5	5.4±0.2	32±0.01	2.8±0.5	10.7±0.5	21.3±7.2	0.85±0.07	0.88±0.08
	B2	24±2.8	5.4±0.7	5.8±0.1	53±0.01	2.9±0.4	8.6±0.9	34.5±6.5	0.54±0.14	0.67±0.11
	B3	23.6±2.2	6.6±0.4	5.7±0.2	62±0.01	4.5±0.5	11.6±0.8	22.5±5.3	1.14±0.11	0.57±0.06
SILCOORIE	C1	23.7±2.9	4.4±0.4	5.6±0.1	65±0.07	3.8±0.5	13.5±0.7	47.7±4.8	0.57±0.13	1.37±0.04
	C2	23.5±3.2	5.1±0.4	5.2±0.5	119±0.01	5.1±1.3	18.1±1.3	27.3±2.1	0.86±0.17	0.35±0.05
	C3	25.2±2.8	3.4±0.4	4.5±0.3	82±0.02	3.75±0.3	6.4±0.1	14.3±1.3	0.45±0.14	0.33±0.08
	D1	23.4±2.1	3.3±0.6	5.6±0.1	43±0.01	2.9±0.2	8.5±0.9	29.4±0.2	0.87±0.11	1.02±0.09
	D2	25.2±3.2	5.4±0.5	6.3±0.6	34±0.02	4.47±0.7	9.5±0.2	38.5±0.7	0.72±0.12	0.43±0.07
	D3	25.2±2.6	4.3±0.8	6.1±0.8	51±0.02	3.4±0.2	7.6±0.1	43.2±0.2	0.37±0.11	0.19±0.09
NATUN BAZAR	E1	24.5±2.1	3.7±0.8	5.8±0.8	27±0.03	4.2±0.7	14.1±0.5	42.7±0.4	1.04±0.09	0.56±0.04
	E2	25.1±2.6	5.2±0.3	5.6±0.1	64±0.08	5.07±0.5	14.8±0.5	30.4±0.3	0.84±0.05	0.34±0.07
	E3	23.1±2.1	4.2±0.9	5.3±0.2	36±0.01	3.85±0.4	11.7±0.3	35.1±0.3	0.75±0.05	0.44±0.06
	F1	25.4±2.8	3.3±0.2	6.2±0.1	33±0.01	5.3±0.1	10.3±0.3	38.5±0.4	0.55±0.07	0.73±0.08
	F2	26.5±3.3	2.4±0.7	5.4±0.8	14±0.08	3.3±0.1	15.3±0.1	32.6±0.3	0.74±0.07	0.35±0.05
	F3	25.8±1.5	3.3±0.1	6.1±0.6	72±0.05	3.6±0.1	5.6±0.3	36.4±0.4	0.66±0.11	0.25±0.06

Table 2: Water quality in aquatic bodies at control sites (Mean±SD)

Stations	Sites	WT (°c)	Transparency (cm)	pH	EC (µs/cm)	DO (mgl^{-1})	FCO_2 (mgl^{-1})	TA (mgl^{-1})	Nitrate (mgl^{-1})	Phosphate (ml^{-1})
Bariknagar	A4	20.7±1.7	12.02±0.7	6.7±0.1	24±0.03	7.6±0.17	5.2±0.1	31.3±0.2	0.23±0.12	0.35±0.02
	B4	21.9±1.8	15.8±0.6	7.1±0.1	56±0.04	11.5±1.4	6.4±1.5	34.6±5.1	0.15±0.15	0.32±0.06
Silcoorie	C4	22.3±3.1	18.2±0.5	6.9±0.4	103±0.02	12.3±0.6	7.1±1.3	29.9±0.3	0.32±0.17	0.38±0.07
	D4	19.8±1.1	14.7±0.9	6.7±0.1	43±0.01	9.6±0.2	3.4±0.3	55.3±2.2	0.17±0.09	0.34±0.05
Natunbazar	E4	21.5±1.4	16.7±0.6	6.5±0.5	56±0.02	7.3±0.2	3.35±0.1	46.3±1.2	0.48±0.05	0.16±0.04
	F4	22.1±2.2	15.6±0.9	6.6±0.1	91±0.02	8.5±0.2	5±0.1	54.3±0.4	0.22±0.12	0.14±0.15
Chatla	G1	23.4±3.6	17.03±1.5	6.2±0.8	18±0.08	6.4±0.2	4.3±0.3	19.1±0.5	0.26±0.11	0.33±0.12
	G2	23.2±2.2	16.2±1.4	6.8±0.1	13±0.03	6.2±0.3	3.5±0.2	35.6±0.4	0.22±0.15	0.38±0.13
	G3	24.7±1.7	14.4±1.2	6.3±0.2	62±0.01	9.4±0.3	6.3±0.2	20.8±0.6	0.37±0.17	0.48±0.14

be due to fluctuations in total dissolved solids and salinity [16]. Water conductivity is mainly attributed to the dissolved ions liberated from the decomposed plant matter [17] and input of organic and inorganic waste [18]. DO shows inverse relationship with both water temperature and free carbon dioxide [16,19,20]. Free CO_2 in water originates from the respiration of aquatic biota and decomposition of organic matter which reacts with water and form carbonic acid that lowers the pH [21]. High level of FCO_2 might be due to increased rate of decomposition of organic matter in the lower level of the aquatic system. High level of TA is followed by high level of pH. Utilization of CO_2 from HCO_3 for photosynthesis by algae may increase the amount of TA in water body [22]. Algae and other plants use nitrate as a source of food which might have caused reduction in nitrate concentration of the water body. The concentration of Nitrate plays an important role for primary production [23]. Lack of Phosphate is often the chief cause of poor productivity of water. Presence of organic matter had increased the level of phosphate. Natural waters having a phosphorous content more than 0.2 mgl^{-1} (PO_4) are likely to be quite productive [24]. The low value of Nitrate and Phosphate might be due to lower input of pollutants in the aquatic bodies [25].

CONCLUSION

Thus, the present study clearly reveals the extent of aquatic degradation at the aquatic bodies in the brick kiln industry area. The data obtained clearly shows the extent of contamination at the study sites near the brick kiln industry which leads to deterioration and degradation of water quality. It directly affects the sustainability of the biotic components in the ponds and causes ecological imbalance in a particular aquatic ecosystem. The results show urgency to restore the chemical, physical and biological restoration of these aquatic bodies. So, it is very essential to adopt some mitigation measures and to implement appropriate regulatory measures regarding the maintenance of environment and also important to follow several conservation strategies to prevent the ecological imbalance which affects the hydrological cycles and finally disturbs the food chain and food web in the aquatic bodies near the brick kiln industries.

ACKNOWLEDGEMENT

The first author is grateul to the Dept. of Ecology and Environmental Science, Assam University, Silchar for providing the necessary infrastructure and laboratory facilities throughout the tenure of the research work. The author also likes to acknowledge DST/INSPIRE, GOVERNMENT OF INDIA, MINISTRY OF SCIENCE AND TECHNOLOGY for providing financial assistance to carry out the research work.

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