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Water Quality of Wetland Ecosystems - A Sample Study from Kozhikode District, Kerala

KEYWORDS: Wetlands, Water Sampling, Physicochemical Parameters

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ABSTRACT *Wetlands are areas of land that are either temporarily or permanently covered by water. Wetland ecosystems are one of the most productive ecosystems and play crucial role in hydrological cycle. Water quality plays an important role in maintaining wetland ecosystems.Water samples were collected in a random manner from a few wetland regions of the district, including inland and coastal areas. Analysis of quality for some physicochemical parameters of water such as color, odor, pH, chloride, fluoride, nitrate, iron and presence of coliform bacteria etc. were conducted. Samples were collected during three seasons during one complete year – pre monsoon, monsoon and post monsoon seasons from the same sites. Many of the samples analyzed were found to have varying pH levels ranging from 4 to 7. Some other parameters analyzed like turbidity, suspended solids etc. were also found to be varying from sample to sample. Turbidity was more frequently observed during monsoon season. Presence of coliform bacteria was detected in many of the sampling sites.*

INTRODUCTION

Wetlands defined as areas of land that are either temporarily or permanently covered by water, exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry. This means that a wetland is neither truly aquatic nor terrestrial; it is possible that wetlands can be both at the same time depending on seasonal variability. Because of their transitional nature, the boundaries of wetlands are often difficult to define. Wetlands form 4.79% of the total geographical area of Kozhikode. (National Wetlands Atlas Kerala, 2010). They are regarded as crucial natural resources. Wetlands are one of the most productive ecosystems and play crucial role in hydrological cycle.

Water quality plays an important role in maintaining wetland ecosystems. As water is recycled through the earth, it picks up many things along its path. Water quality will vary from place to place, with the seasons, and with various kinds of rock and soil which it moves through. Utility wise, wetlands directly and indirectly support millions of people in providing services such as storm and flood control, clean water supply, food, fiber and raw materials, scenic beauty, educational and recreational benefits. Increase in urbanization, industrialization, agriculture activity and various human activities have increased the pollution of surface water & ground water.

The wetland area estimated in Kozhikode is 7690 ha including 117 small wetlands (< 2.25 ha). The major wetland types are River/Stream, Reservoirs/Barrages, tanks/ponds and Water logged areas/ Paddy fields. Analysis of wetland status in terms of open water and aquatic vegetation showed that around 90 percent of wetland area is under open water category during post-monsoon and pre-monsoon respectively (National Wetlands Atlas: Kerala, 2010).

MATERIALS AND METHODS

1. Sampling methods for physicochemical analysis of water samples

a. Collection of Water Sample

Correct sampling, storage and transportation are critical to the accuracy of analysis. This has important consequences for sampling regimes, sampling procedures, and methods of sample preservation and storage. One hundred and twenty samples were collected randomly from same sites from natural and manmade inland and coastal wetland ecosystems in various regions of Kozhikode district during pre-monsoon, monsoon and post monsoon seasons by grab sampling technique and brought to the laboratory immediately for analysis. Samples were collected carefully to make sure the most representative sample possible is obtained. Only clean containers were used for collecting samples. Samples were immediately preserved, and analytical procedure of APHA, AWWA, 1999 was adopted.

b. Storage of Samples

The time between sampling and analysis was kept to a minimum. Storage in glass or polyethylene bottles at a low temperature (4°C) in the dark was done whenever needed. Residual chlorine, pH, and turbidity were tested immediately after sampling as they would change during storage and transport.

c. Sampling Frequency

The samples were collected three times during one complete year- pre monsoon, monsoon and post monsoon seasons from the same sampling sites..

2. Quality Analysis

Simple observation of the sample for its colour, odour, taste etc. provided some clues on the possible contamination of the sample (Table 1)

Table 1 : Water Pollution Indicators

Sl No	Water Observations	Possible Contaminants
1	Black in colour	Bacteria growth
2	Brown, Yellow or Reddish in colour	Iron

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3	White Deposits or Scale	Hardness, dissolved metals
4	Chlorine Odour	Chlorine
5	Bitter or Metallic Taste	pH
6	Fluoride Odour	Fluoride

Physicochemical Parameters

1. Chloride

Environmental impact of chlorides is not usually harmful to human health. Chlorides may get into surface water from several sources including rocks, agricultural run-off, waste water from industries, oil well wastes, and effluent waste water from waste water treatment plants. Chlorides can contaminate fresh water streams and lakes. Fish and aquatic communities cannot survive in high level of chlorides.

2. Fluoride

Fluoride can naturally occur in groundwater and some surface water. A small amount of fluoride in water is generally good for strengthening teeth and preventing decay. At higher amounts over time, it can cause dental fluorosis and damage teeth by staining and pitting. Over many years, fluoride can build up in bones, leading to skeletal fluorosis characterized by stiffness and joint pain. In severe cases, it can cause changes to the bone structure and crippling effects

3. Iron

Iron can be naturally found in groundwater and some surface water. Iron can come in two forms in water: dissolved and suspended. Surface water containing iron will be a red-orange colour. Iron is present in significant amounts in soils and rocks, principally in insoluble forms.

4. Nitrate

The sources of iron are oxidation of ammonia, agricultural fertilizer run-off etc. High nitrate levels can cause serious illness by acute exposure. The nitrate itself is not a direct toxicant but is a health hazard because of its conversion to nitrite. Values greater than 0.03 mg/l may indicate sewage pollution.

5. pH

The presence of dissolved carbon dioxide is usually the main acidity factor in unpolluted surface waters forming carbonic acid. This is an important limiting chemical factor for aquatic life by disrupting biochemical reactions of the aquatic organism. Changes in pH can change the aspects of water chemistry. For example, as pH increases, smaller amounts of ammonia are needed to reach a level that is toxic to fish. As pH decreases, the concentration of metal may increase because higher acidity increases their ability to be dissolved from sediments into the water (Streamkeeper, 1991)

6. Turbidity

Turbidity is a measure of the cloudiness of water. Moderately low levels of turbidity may indicate a healthy, well-functioning ecosystem, with moderate amounts of plankton present to fuel the food chain. However, higher levels of turbidity pose several problems for stream systems. Turbidity blocks out the light needed by submerged aquatic vegetation. It also can raise surface water temperatures above normal because suspended particles near the surface facilitate the absorption of heat from sunlight. High turbidity may result from sediment bearing runoff, or nutrients inputs that cause plankton blooms (Streamkeeper, 1991).

7. Hardness

The sources of hardness are rock formations - limestone etc. Total hardness is taken to comprise the calcium and magnesium concentrations. The widespread abundance of these metals in rock formations leads often to considerable hardness levels in surface and ground waters.

8. Solids, Settleable

This is not a normal determinant in analysis of water unless it is grossly polluted. This parameter is not normally determined in water analysis where reliance is placed on suspended solids, but is one of those measured in the analysis of sewage effluents.

9. Solids, Suspended

Matter which is suspended in quiescent water consists of finely divided light solids which may never or very slowly settle. The solids may in fact consist of algal growths and hence be indicative of severely eutrophic conditions; they may indicate the discharge of washings from sandpits, quarries or mines; they will reduce light penetration in surface waters and interfere with aquatic plant life; they will seriously damage fishery waters and may affect fish life.

Aesthetic Parameters

10. Colour

Natural colour reflects the presence of complex organic molecules derived from vegetable matter such as peat, leaves, branches and soon. Its effect can be enhanced by the presence of suspended matter but this is normally eliminated in the analysis by filtration. Obviously, the more vegetable matter in the water the greater is the colour.

11.Odour

Odour may occur due to presence of inorganic or organic contaminants in water. Its cause is normally dissolved volatile organic compounds small concentrations of which may have great organoleptic effects.

12.Taste

Taste of water may change due to Presence of offensive solutes, natural or added. As with odour, taste is a parameter which can lead to severe consumer reaction which may necessitate the condemnation of a water supply. Astringent tastes can be caused by the presence of excessive amounts of metals or dissolved salts. Purely organoleptic taste problems arise most commonly from algae and from phenols after chlorination. Decaying algal masses can release trace organic compounds to the water producing offensive taste.

Other analyses of relevance to health

13.Presence–absence Tests for Microbiological Analysis

Presence–absence tests were conducted using culture vials prepared with growth medium enriched strips. 20 ml of the sample was taken in the culture vial and kept airtight for 24 hours. Colour change was observed after 24 hours of inoculation. Development of deep black colour was taken as the indication for presence of bacteria. Development of brownish yellow colour was the indication of absence of bacteria. Because coliform bacteria are most commonly associated with sewage or surface waters, the presence of coliform bacteria indicates the presence of other pathogens also. Fecal matters of wild animals, including birds, can also cause contamination.

RESULTS

Results are summarized in Table 2. Several physicochemi-

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cal and aesthetic parameters were analyzed and comparisons between sources and seasons were made. After the analysis it was observed that pH of water was slightly acidic and there was minor fluctuation in pH levels. Many of the samples analyzed were found to have varying pH levels ranging from 4 to 7. pH values below 6 are considered to be above permissible limit, for normal functioning of the ecosystem. Comparison of water quality between the three seasons was made and some of the parameters showed considerable variations according to the seasons in the same site. Presence chloride, fluoride, iron, nitrate etc. was also found to be fluctuating between the samples. The value of total hardness was found to be high at the coastal regions. Turbidity and solid levels were high during the monsoon season. Presence absence criteria were used for parameters like turbidity, solids, colour, odour, taste, coliform bacteria etc. Presence of coliform bacetria was detected in many of the sampling sites irrespective of the source.

DISCUSSION

Ecosystems provide habitat for flora and fauna and they play an important role in maintaining biological and genetic diversity. The quality of the water is a crucial factor in the normal functioning of ecosystems. It is increasingly realized that earth is facing grave environmental problems with fast depleting natural resources and threatening the very existence of most of the ecosystems. Wetlands are the first target of human interference and are among the most threatened of all natural resources. The very existence of these unique resources is under threat due to developmental activities, and population pressure. Maintenance of the wetland ecosystems in the proper way can control many of the environmental problems including pollution, global warming, climate change etc.

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Table 2: Water Quality over the three seasons - Pre Monsoon, Monsoon & Post Monsoon

Season	Type of water body		% of samples with parameters above permissible limits													
			Physicochemical									Aesthetic			Coliform Bacteria	
			Chloride mg/l	Fluoridee	Iron	Nitrate	pH	Turbidity	Hardness	Solids settleable	Solids suspended	Odour	Colour	Taste		
Pre monsoon	Inland	Man made	10	5	17	13	43	21	8	12	8	9	14	18	23	
		Natu-ral	9	8	23	18	45	26	5	9	9	17	19	16	29	
	Coastal	Man made	16	6	13	12	23	17	19	9	6	3	7	7	15	
		Natural	19	3	10	9	39	22	23	11	8	9	11	20	30	
Monsoon	Inland	Man made	4	3	12	7	22	33	9	19	18	2	9	6	13	
		Natu-ral	2	3	16	15	27	36	5	12	18	19	14	4	20	
	Coastal	Man made	4	4	12	11	18	11	12	18	15	9	16	7	20	
		Natural	5	5	12	13	38	28	19	16	8	17	15	20	25	
Post monsoon	Inland	Man made	8	5	17	13	40	12	10	12	7	9	14	18	20	
		Natural	9	5	17	13	21	16	8	10	7	10	14	18	35	
	Coastal	Man made	10	5	17	13	19	17	15	12	15	12	14	20	30	
		Natural	12	4	15	10	35	13	20	10	15	12	14	18	33	

REFERENCE 1. Streamkeeper (1991) Field Guide: Watershed Inventory and Stream Monitoring Methods. | 2. National Wetland Atlas: Kerala, SAC/RESA/AFEG/NWIA/ATLAS/14/2010, Space Applications Centre(ISRO), Ahmedabad, India, p 130. | 3. American Public Health Association, American Water Works Association, Water Environment Federation (1999) Standard method for examination of water and waste water. |