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Studies on the Physico-chemical parameters of Mangrove vegetations after deluge in Thrissur District, Kerala, India

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Abstract

Mangroves are the most productive and complex ecosystems on earth, which can fertilise the sea, potentially protect the coastal zone and serve as the breeding, feeding and nesting ground for many animals. The present study was conducted in mangroves of Thrissur District analyze various Physico-chemical characteristics of water and soil after deluge. Rainfall brings vital changes in the hydrological characteristics of estuarine and marine environment. The present study was conducted September 2018 to February 2019.

Key words: Physico-Chemical parameters, Deluge, Mangroves

Introduction

Mangroves are the most productive ecosystems, which can fertilize the sea, potentially protect the coastal zone and serve as breeding grounds for many animals. The mangrove forests are sometimes called as “tidal forests”, “Oceanic rain forests” and “Coastal woodlands”. These plants exist in very inhospitable conditions. They exist in conditions like high salinity, tidal extremes, wind velocities, high temperatures and muddy anaerobic soil. They have “breathing roots” or “prop roots” and also have other adaptations such as support roots, viviparous germination, salt excreting leaves, knee roots etc. Mangroves in Kerala are distributed in eightcoastal districts of which Kannur (755 ha) has the largest followed by the districts of Kozhikkode (293 ha), Ernakulam (260 ha), Alappuzha (90 ha), Kottayam (80 ha) and Thrissur (22 ha).The present study deals with the Physico-chemical parameters of Mangrove vegetations after deluge in Thrissur District, Kerala, India

Materials and Methods

The present study conducted from September 2018 to February 2019.The Experimental sites was visited many times to collect samples.Three index stations were established in the mangrove vegetations in Thrissur. Composite sampling method was adopted, that is collecting the samples at various times from a locality undergoing fluctuations and combining that to analyseaverage chemical characteristics. Water samples of one litre, each were collected in sterile bottles and he dissoved oxygen content was estimatedfor.BOD bottles were used for the collection and determination of dissolved oxygen. All bottles were washed thoroughly and rinsed with water samples before collecting it.Care had been taken to avoid contamination during collection and transportation. All the collected samples brought to the laboratory and different Physico-chemical parameters determined by routine laboratory methods.

Water Quality Parameters

Different parameter of water was analyzed by standard estimation procedures and calculations.

a) Atmospheric and water temperature

The temperature of atmosphere and aquatic system were recorded using

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thermometer at the time of sample collection.

b) Estimation of Dissolved oxygen

Dissolved oxygen content in water was analyzed using Winkler's method. The water titrated with 0.01N sodium thiosulphate, by the addition of MnSo4, KI, and Con.H2So4 with starch as indicator and the values can be calculated using the formula

$$DO= \frac{\text{Vol of } Na_2S_2O_3 \times \text{ N of } Na_2S_2O_3 \times \text{Eq. Wt of } O_2}{\text{Effective N of } H_2O}$$

c) Estimation of Carbon dioxide

Co2 content in the water can be observed by titrating the water sample against NaoH. Phenolphthalein is used as indicator.

$$DO= \frac{Vol.om_2 f\, Na_2}{r^2}$$

d) Estimation of Hardness

Ammonia solution and Eriochrome black 'T'indicator is added to 25ml of water sample and titrated against 0.02N EDTA. Hardness in ppm is calculated with the formula

$$\text{Hardness}= \frac{0.001 \times \text{Vol of EDTA} \times 10^6}{\text{Vol of water sample}}$$

e) Determination of PH

Value of PH can be observed using PH meter. Before determining the PH value, PH meter can be standardized against buffer solution.

f) Estimation of Chlorinity and Salinity

Chlorinity and Salinitywas determined by titrating 10ml of water sample against 0.0141N silver nitrate by the addition of 2 drops of potassium chromate.

$$\text{Chlorinity}= \frac{0\text{Vol of 0.0141N AgNo3} \times \text{N of Agno3} \times \text{Eq. wt of AgNo3}}{\text{Vol of water sample used}} \text{ x1000}$$

$$\text{Salinity}= \frac{0.3+1.805 \times \text{Chlorinity of water in mg/l}}{1000}$$

Soil Quality Parameters

a) Determination of PH

PH can be analyzed using PH meter. Before determining the PH, PH meter standardized with appropriate buffer solutions.

b) Determination of moisture content

Moisture content wasdetermined by drying 1gm of soil in a petridish to about 1 hour in oven. Weigh the petridish before and after drying. Percentage of moisture content was calculated by the formula,

$$\text{Moisture} = \frac{\text{0.Wt of petridish with moist soil-Wt of petridish with dried soil}}{\text{Wt. of soil sample}} \text{x100}$$

c) Estimation of Chlorinity

Chlorinity was determined by titrating 0.0141N AgNO3 against 10ml of water containing soil by the addition of 2 drops of potassium chromateagainst the prepared blank.

$$\text{Chlorinity} = \frac{V_1 \times N_1 \times \text{Amount of distilled water}}{\text{Vol of water sample}}$$

V1= Vol. of AgNO3 used for(sample-blank)

N1=Normality of AgNO3

d) Estimation of Organic Carbon

To 1gm of dried and sieved soil potassium dichromate, Con.H2So4, distilled water, orthophosphoric acid, and diphenyl amine indicator is added and it is titrated against ferrous ammonium sulphate until the colour changes from blue violet to brilliant green. Organic carbon wascalculated the formula

$$\text{Organic carbon (\%)} = \frac{\text{10-(B -S)} \times 0.003 \times 100}{\text{BxWt. of soil sample}}$$

B= Vol of Fe (NH4)2(SO4)2used for Blank

S=Vol of Fe (NH4)2(SO4)2 used for soil sample

e) Estimation of Calcium

To the weighed soil add 100ml 1N Hcl and covered with cover glass. To 20ml pipetted sample, added bromothymol blue indicator and titrated against 1N NaoH until the colourless solution changed to blue/green. Run a blank at the same time.

% of CaCo3= (Reading of Blank-Reading of soil sample) ×5

Results and Discussion

The observed physico-chemical parameters of water, atmosphere and soil of the mangrove regions were summarized in table 1 and 2.

Table: 1. Various Physico-Chemical Parameters of Water and Atmosphere in Mangrove

Months	Parameters							
	Temperature (°C)		P^H	Oxygen (mg/l)	CO_2 (Mg/l)	Chlorinity (ppt)	Salinity (ppt)	Hardness (ppm)
	Atm.	H_2O						
Sep	28	29	8.01	0.956	5.32	2.60	4.99	692
Oct	22	25	7.45	0.973	5.32	0.035	0.363	0.02
Nov	25	27	7.10	0.910	5.95	0.255	0.760	0.08
Dec	23	28	8.10	0.829	8.8	7.48	13.80	1840
Jan	28	29	8.22	0.747	9.21	13.40	26.30	4700
Feb	29	31	8.45	0.747	9.36	18.54	33.77	7004

Table: 2. Physico-Chemical Parameters of Soil Observed During Study Period

Months	PH	Salinity	Organic Carbon	Calcium	Moisture
September	6.57	0.145	1.357%	2.8%	43%
October	6.97	0.039	0.5%	1.5%	64%
November	6.62	0.069	1.690%	3.4%	45%
December	6.41	0.219	1.666%	3.2%	46%
January	5.6	1.479	2.159%	3.6%	36%
February	4.2	1.514	2.307%	4%	55%

Temperature of atmosphere and water was maximum in February and minimum in October. Although there was no marked variations in temperature between atmosphere and water, but the temperature shows fluctuations because of strong land breeze, monsoonal clouds, humidity and precipitation (Table.1).

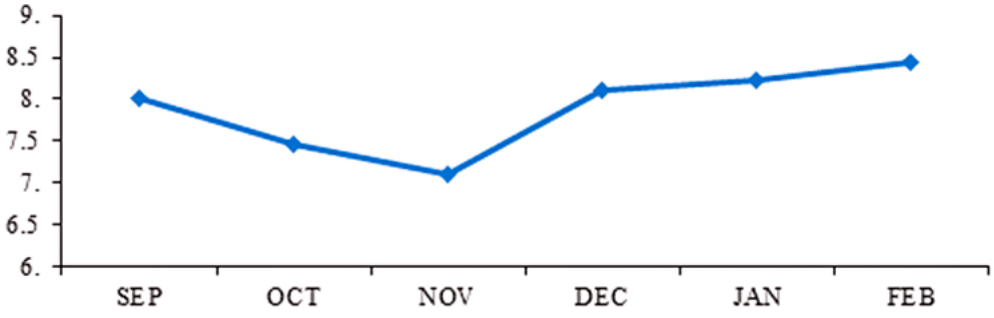

Fig.1.Graph showing PH of water during the study period

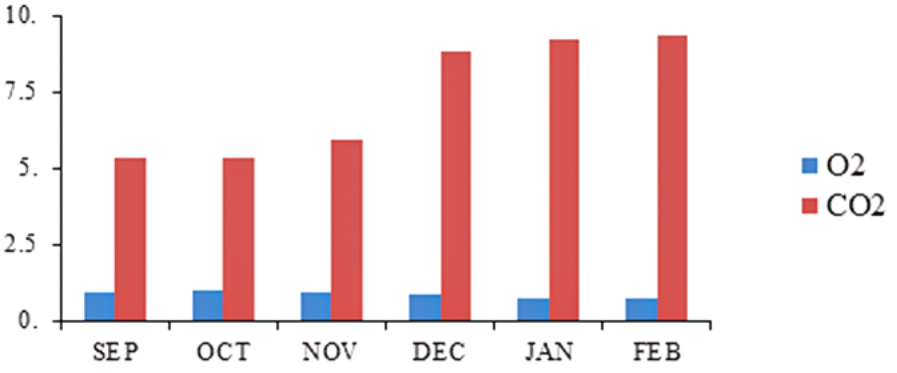

Fig.2.Graph showing Dissolved O2 an Co2 of water during the study period

During observation the PH shows small variations (Table.2 and Fig.1). In September, December, January and February, the PH value indicates the alkaline condition. Remaining two months shows slightly neutral PH, it was the result of rainfall, fresh water inflow and precipitation. It was noted that December onwards the alkaline condition increases and reach the value from 8.10-8.45

Dissolved oxygen showed higher value in October, which may be due to the cumulative effect of higher wind velocity coupled with heavy rainfall and the resultant mixing of fresh water and its value is minimum in February. The variation of dissolved

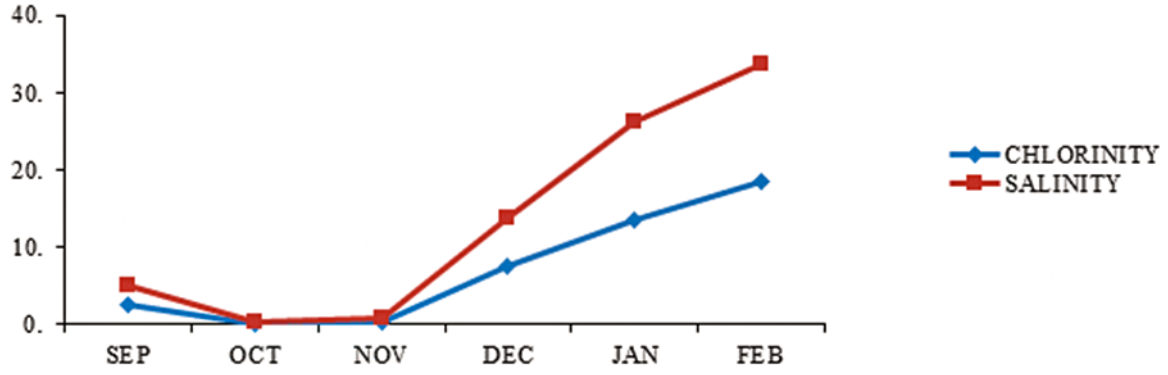

Fig.3. Graph showing Chlorinity and Salinity of water

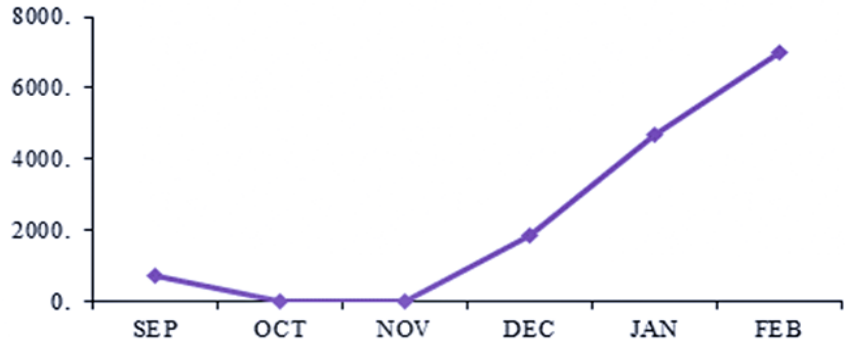

Fig.4. Level of Hardness of Water during the study

oxygen is mainly due to fresh water inflow and outflow and terrigenous impact of sedimentation. Like this CO2 also shows variations. Maximum value is obtained in February and minimum in October. There is an inverse relationship between CO2 and DO. Whenever CO2 level increased, DO level decreased. The discharge of sewage and garbages was leadto O2 deficiency and thereby increase in CO2 (Fig.2).

Chlorinity and Salinity of Water

In the present study Chlorinity was maximum in February and minimum in October(Fig.3). This minimum value is due to precipitation and less evaporation. It directly related to salinity. So salinity also showed high value in February and low in October. These two parameters show slight variations. Salinity varies according to topography, low and high tides and fresh water inflow. It was clearly observed that there is a positive correlation between salinity and chlorinity.

The water hardness is very high during September, December, January and February in the ascending order (Fig.4). In the middle two months the water was very soft due to fresh water inflow, rainfall, mixing etc. A high concentration of multivalent cations may be the reason behind increased hardness. List of Physico-chemical parameters of soil studied. Mangroves are salt tolerant plants evolved various adaptations to survive and thrive in harsh conditions. They have pneumatophores to absorb oxygen, and provide shelter, protection and food for numerous organisms.. It acts as barriers to shoreline erosion and it also serve as important nurses, feeding and refuge areas for a wide variety of organisms.

The present study was conducted in mangroves of Thrissur to analyze various physico-chemical characteristics of water and soil. Rainfall brings vital changes in the hydrological characteristics of estuarine and marine environment. In this study temperature of atmosphere and water shows

slight variations due to climatic changes. Atmosphere and water shows maximum temperature in February and minimum in October and may be due to monsoonal clouds. In December atmospheric temperature was low. During October – December water temperature recorded was low because of strong land breeze and precipitation. The high temperature could be attributed to high solar radiation. Throughout the study period PH showed a wide range of values, it varied from neutral to slightly alkaline. This is a typical character of estuarine environment. Alkaline PH recorded in certain months may be due to the removal of carbon dioxide by photosynthetic organisms. So there is a positive correlation between alkaline PH and enhanced rate of photosynthesis and slightly neutral PH could be attributed to the dilution of saline mangrove water while fresh water inflow. Salinity varies according to different factors salt water inflow and out flow, low and high tides, fresh water inflow and mixing. In the present study saline condition of water was high in February due to fresh water evaporation and it is low in October because of rainfall and less evaporation. Chlorinity also showed changes with respect to increased and decreased value of salinity. So, chlorinity is high in February and low in October. Based on hardness, water can be classified into soft, medium and hard. In September, December, January and February the hardness of water was lying in the range of 692-7004. During these months rate of evaporation and salt content was very high. But in October and November water was soft because of dilution of salt water with high rainfall. In the present study dissolved oxygen indicates higher value in October which could be due to the cumulative effect of higher wind velocity coupled with heavy rainfall and the resultant mixing of fresh water. Minimum amount of oxygen was present in February and January. Seasonal variation of dissolved oxygen is mainly due to fresh water flow and terrigenous impact of sedimentation. Carbon dioxide level in water showed fluctuations. It reaches its maximum in February and minimum in October. Mathew (1978) observed an inverse relationship between carbon dioxide and oxygen. Whenever dissolved oxygen decreased, carbon dioxide increased. The discharge of sewage and waste materials will lead to oxygen deficiency and there by increase the carbon dioxide. There is a positive correlation between temperature and carbon dioxide. PH of soil was slightly acidic. Acidic PH was observed in February and slightly neutral PHobserved during other months. That was during summer, soil was more acidic than monsoon this occurs due to decomposition of dead animals and plant parts and less water contents.

High moisture content was observed in this area because soil is partially or completely submerged in water. Slight variations are observed during monsoon and high tide soil is completely submerged in water and during summer and low tide soil is partially submerged in water. So moisture content shows slight fluctuations based on tides and climatic conditions. Maximum salinity was observed in February and minimum salinity in October. This is due to the climatic changes and intrusion of salt water. That is during summer much evaporation and percolation were occurred and during monsoon evaporation and percolation was less. So salinity is high during summer and low during monsoon. Maximum organic carbon was observed in February and minimum organic carbon content was observed in October. The soil collected from study area showed high organic carbon in all months except October. Presence of low organic carbon may be due to heavy rainfall. High organic carbon contentmay be due to the decomposition of dead animals and plants and climatic changes. Present study reveals that organic carbon was positively correlated with salinity and negatively correlated to PH. When organic carbon increases, salinity also increases which in turn decreases PH.

Calcium present in the soil is absorbed by plants. There is a balance calcium budget existing in ecosystem. Maximum calcium content was recorded in February and it was minimum in October. The calcium content of the acidic soil is generally high,

regardless of texture as a result of low rainfall and little leaching. Calcium is also positively correlated with organic carbon.

The present study showed that the terrible flood in the month of August was not completely affected the Physico –Chemical parameters of the ecosystem in comparison of previous studies reported in other areas. But long term studies should be needed in this area to identify and mitigate the issues of the precious ecosystem.

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