

# Analysis of Physico-Chemical Parameters of Mangroves and Wetland Soils of Visakhapatnam Coast, Bay of Bengal, India

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**Abstract**—Mangroves and wetlands are estimated to be one of the largest bio sources of carbon sinks. The current study mainly focuses on soil analysis of different factors like - Percentage of Organic Matter, Texture of the Soil, Moisture Content, Electrical Conductivity, Total Dissolved Solids, pH and Salinity of mangroves and wetlands of Visakhapatnam urban coastal environment. This study helps to find out the ecological status of Mangrove and Wetland soils, for their restoration and management in the Visakhapatnam coast of Andhra Pradesh.

**Keywords**— Mangrove Swamps, Wetlands, Physicochemical parameters, Multiparameter

## I. INTRODUCTION

Mangrove forests cover an area of approximately 160,000 km<sup>2</sup> all over the world, in which the largest forest areas are found in Malaysia, India, Bangladesh, Brazil, Venezuela, Nigeria and Senegal [1]. Mangrove forests play a very important role in coastal ecosystems located at the interface between land and sea in tropical and subtropical areas of the world. Soil analysis is a natural medium as it supplies the essential nutrients for the growth of plants. Mangrove plants may grow in different types of soils; therefore, their vegetation, species composition and structure may vary considerably at the global, regional and local scales [2]. Water in the soil is an important solvent and transporting agent. It maintains the texture and compactness of soil and makes it habitable for microbes, plants and animals. The moisture content in soil is mainly from infiltration of precipitated water. Its content in soil depend upon the water holding capacity of soil, evaporation, soil texture, porosity, etc. [3]. Mangrove soils are of marine alluvium, transported as sediment and deposited by rivers and the sea. Soils are made up of sand, silt and clay in different combinations and mud actually refers to mixture of silt and clay, both of which are rich in organic matter.

## II. STUDY AREA

The Mangrove swamps and wetlands are located at north-eastern part of Visakhapatnam characterized by swamps and wetlands of inter tidal in origin, have embodied Eastern Ghats ridges, which are abutting the Sea (Bay of Bengal) in the eastern side [5]. Soils in this area have mainly sandy texture with largely contaminated industrial effluents. The swamps are occupied with dominant mangrove trees of black mangroves [6] (*Avicennia officinalis* and *Avicennia marina*). Climatic conditions of the study area shows three well defined seasons; dry, rainy and cold. The study areas include Pudimadaka and Bheemunipatnam of Visakhapatnam coast. Pudimadaka is situated at latitude and longitude of 17°35'N & 83°1'E respectively. The wetlands and mangroves of Pudimadaka were associated with back waters of intertidal zone. Other study area Bheemunipatnam mangroves and wetlands were associated with the back waters of rivers Gosthani and Meghadrigedda.

## III. METHODOLOGY

The soil samples from both of the salt marshes, wetlands as well as mangrove swamps of Pudimadaka and Bheemunipatnam of Visakhapatnam coastal environment were collected during pre-monsoon period. The soil samples and plant species were collected in an air-tight plastic covers during field visits conducted to the study sites. The collected samples were analyzed for different physicochemical parameters like Percentage of Soil Organic Matter, Texture of the Soil, Moisture Content, Electrical Conductivity, Total Dissolved Solids, pH and Salinity. Soil organic matter was estimated in the laboratory by Walkley & Black method as it is widely followed in many laboratories because it is rapid and affordable [7, 8]. Texture of the soil was estimated by the sieving process and entering the values of different types of soil in the soil texture triangle provided by the Natural Resources Conservation Service Soils, United States Department of Agriculture. Moisture Content was calculated in the standard method. With the help of the instrument Multimeter, all these parameters - Electrical Conductivity, Total Dissolved Solids, pH and Salinity were estimated. The soil samples from both of

the salt marshes, wetlands as well as mangrove swamps were collected.

#### IV. RESULT AND DISCUSSION

Both physical and chemical parameters of soil were analyzed at two regions of mangroves and wetlands i.e., Pudimadaka and Bheemunipatnam. The soils in mangrove forest are characterized by the combination of various physical, chemical and biological factors, which may vary considerably among different forest sites. Organic wetland soils tend to be acidic, particularly in oligotrophic peatlands. Mineral wetland soils are more neutral or sometimes alkaline.

##### A. Soil Organic Matter

The percentage of organic matter in Pudimadaka (1.26%) is more than the Bheemunipatnam mangroves (0.7%). The wetland soil of Pudimadaka area (0.3%) has higher moisture content than Bheemunipatnam area (1.18%) during post monsoon season.

##### B. Moisture Content

The percentage of moisture content in Pudimadaka mangroves (79.05%) is more than the Bheemili mangroves (30.8%), and in the wetland region Bheemunipatnam area (85.5%) has higher moisture content than Pudimadaka (75.35%) during pre-monsoon season.

##### C. Soil Texture

Pudimadaka and bheemunipatnam mangrove soils are rich in sand, silt and clay and hence has maximum water holding capacity. The nature of soil textures was characterized by the abundance of silty loam, silty clay and silty clay loam. Similarly, Pudimadaka and Bheemunipatnam wetlands soils are Loamy sand in texture.

##### D. Soil pH

Pudimadaka and Bheemunipatnam mangrove soils have shown that the pH value of 8.1 on an average during pre-monsoon season. This indicates that the soils are alkaline. Pudimadaka and Bheemunipatnam wetlands also showed the pH value of 8.5 on an average during pre-monsoon season. This also shows that the wetland soils are alkaline.

pH is a measure of the acidity and alkalinity in soils. pH levels range from 0 to 14, with 7 being neutral, below 7 acidic and above 7 alkaline. pH of the soil is a good measure of the indication of acidity or alkalinity of soil. Mangroves prefer low pH i.e. The sediments may become acidic due to the reduction of sulphides to sulphate with consequent formation of sulphuric acid in anoxic conditions.

##### E. Salinity

Pudimadaka and Bheemunipatnam mangrove soils has the salinity of and 2.6 and 2.06ppt on an average during pre-monsoon season. Pudimadaka and Bheemunipatnam wetlands showed 499 and 480ppm respectively.

The consequence of flooding previously drained wetland soils is usually to push the pH toward neutrality, whether formerly acid or alkaline. The increase in salt content in mangrove sites may be due to estuarine water and the decaying mangrove litter. Decreased salinity in the monsoon season may

be due to the leaching of salt ions as a result of precipitation [4]. Mangrove soils showed high values for organic carbon. It is due to the microbial degradation of mangrove litter.

##### F. Total Dissolved Solids (TDS)

Total Dissolved Solids of Pudimadaka and Bheemili soils range about 2.53 and 2.04ppt in premonsoon season. In Wetlands it is 470 and 443ppm.

Total dissolved solids (TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular suspended form. Certain naturally occurring total dissolved solids arise from the weathering and dissolution of rocks and soils

##### G. Electrical Conductivity (EC)

Electrical Conductivity of pre monsoon season ranges about 3.1 and 2.5 $\mu$ s in Pudimadaka and Bheemunipatnam mangroves. In wetlands the EC ranges about 677 and 618 $\mu$ s respectively.

Electrical Conductivity gives a clear idea of the soluble salts present in the soil. Conductivity of soil is usually lower than that of water.

#### V. SUMMARY

The present paper deals with the physicochemical parameters in Mangrove and Wetland soils of Visakhapatnam coast, Bay of Bengal, India. It is clearly evident there is a degradation of mangrove species and habitat loss was observed in area wise and species composition was mainly due to the industrial pollution, loss of nutrients in soils and some anthropogenic activities. This study helps to know the various factors influencing these ecosystems and thereby conservation measures are initiated in collaboration with Andhra Pradesh forest department and local NGO's for protection of these threatened mangrove swamps.

#### VI. TABLES AND FIGURES

TABLE I. SHOWING THE SOIL ORGANIC MATTER (%) IN MANGROVES AND WETLANDS OF PUDIMADAKA AND BHEEMUNIPATNAM

S.No	Mangroves		Wetlands	
	Pudimadaka	Bheemuni patnam	Pudimadaka	Bheemunipatnam
1.	1.44	0.10	1.18	0.05
2.	1.13	0.46	1.24	0.46
3.	1.49	1.18	1.6	0.56
4.	1.18	1.49	1.39	0.15
5.	1.08	0.31	0.5	0.62

TABLE II. SHOWING THE MOISTURE CONTENT (%) IN MANGROVES AND WETLANDS OF PUDIMADAKA AND BHEEMUNIPATNAM

S.No	Mangroves		Wetlands	
	Pudimadaka	Bheemuni patnam	Pudimadaka	Bheemunipatnam
1.	84.4	36.6	80.5	92.8
2.	70.44	29.4	79.5	84.39
3.	72.19	34.2	72.75	78.31

4.	80.64	28.1	71.4	87.25
5.	87.58	26.1	72.6	84.87

TABLE III. SHOWING THE ELECTRICAL CONDUCTIVITY ( $\mu$ S) (%) IN MANGROVES AND WETLANDS OF PUDIMADAKA AND BHEEMUNIPATNAM

S.No	Mangroves		Wetlands	
	Pudimad aka( $\mu$ S)	Bheemuni patnam ( $\mu$ S)	Pudimad aka ( $\mu$ S)	Bheemuni patnam( $\mu$ S)
1.	3.5	2.57	667	659
2.	2.9	2.6	785	583
3.	3.2	2.4	650	592
4.	2.8	2.35	601	622
5.	3.1	2.8	683	634

TABLE IV. SHOWING THE TOTAL DISSOLVED SOLIDS (PPT/PPM) IN MANGROVES AND WETLANDS OF BHEEMUNIPATNAM

S.No	Mangroves		Wetlands	
	Pudimad aka (ppt)	Bheemuni patnam (ppt)	Pudimad aka (ppm)	Bheemuni patnam (ppm)
1.	2.52	1.81	471	458
2.	2.8	2.2	538	476
3.	2.83	1.9	432	434
4.	1.9	2.3	424	386
5.	2.6	2	485	462

TABLE V. SHOWING THE pH IN MANGROVES AND WETLANDS OF PUDIMADAKA AND BHEEMUNIPATNAM

S.No	Mangroves		Wetlands	
	Pudimad aka	Bheemuni patnam	Pudimad aka	Bheemuni patnam
1.	7.8	8.1	8.1	8.7
2.	8.2	7.9	7.3	8.6
3.	7.9	7.7	8.1	8.7
4.	8.2	8.3	8.1	8.5
5.	8.3	8.5	8.1	8.4

TABLE VI. SHOWING THE SALINITY(PPT/PPM) IN MANGROVES AND WETLANDS OF PUDIMADAKA AND BHEEMUNIPATNAM

S.No	Mangroves		Wetlands	
	Pudimad aka (ppt)	Bheemuni patnam (ppt)	Pudimad aka (ppm)	Bheemuni patnam (ppm)
1.	2.7	2.01	505	489
2.	2.9	1.8	574	496
3.	1.8	2.2	454	486
4.	2.8	2.4	449	475
5.	2.9	1.9	517	456

TABLE VII. SHOWING THE PHYSICOCHEMICAL PARAMETERS IN MANGROVES AND WETLANDS OF PUDIMADAKA AND BHEEMUNIPATNAM

Parameters	Mangroves		Wetlands	
	Pudimad aka	Bheemuni patnam	Pudimad aka	Bheemuni patnam
Organic Matter (%)	1.26	0.7	1.18	0.3
Moisture Content (%)	79.05	30.8	75.35	85.5
Electrical Conductivity (	3.1	2.5	677	618
Total Dissolved Solids	2.53	2.04	470	443
pH	8.08	8.1	7.94	8.58
Salinity	2.6	2.06	499	480

Graphs showing the different Physicochemical Parameters in Pudimadaka and Bheemuni patnam Mangrove and Wetland Regions, Visakhapatnam Coast.

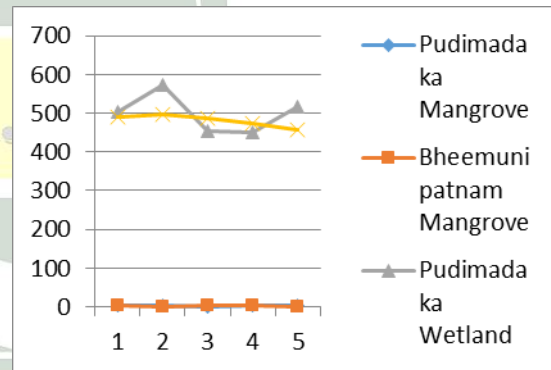


Fig. 1. Organic Matter (%) in Soils.

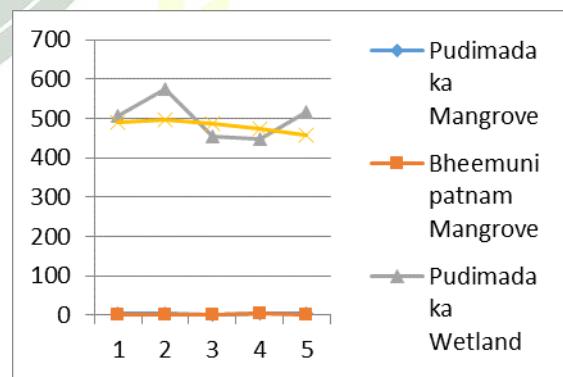


Fig. 2. Moisture Content (%) in Soils.

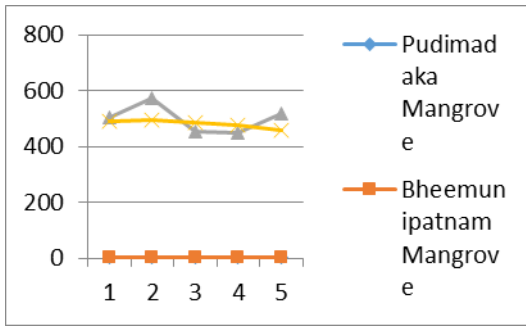


Fig. 3. Electrical Conductivity (µs) in Soils.

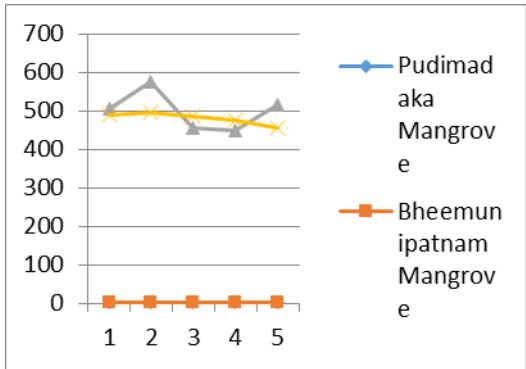


Fig. 4. Total Dissolved Solids (ppm) in Soils.

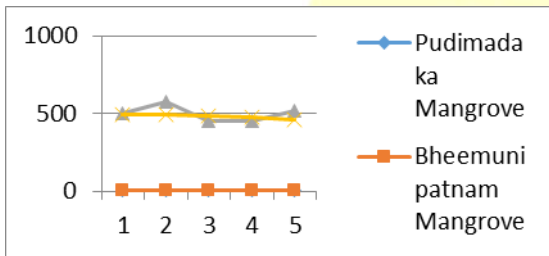


Fig. 5. pH in Soils.

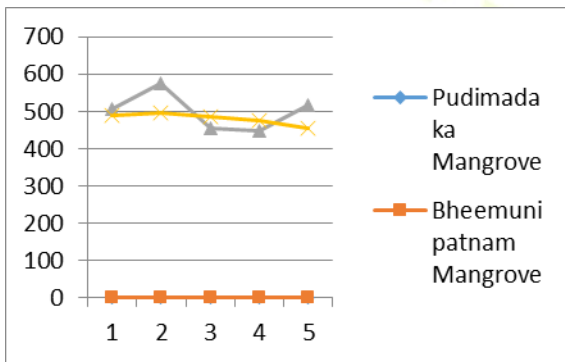


Fig. 6. Salinity (ppm) in Soils.



Fig. 7. Mangroves of Pudimadaka region, Visakhapatnam Coast.



Fig. 8. Wetland of Pudimadaka region, Visakhapatnam Coast.

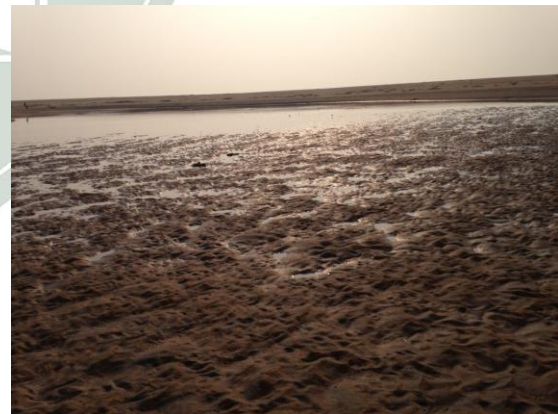


Fig. 9. Wetland of Bheemili region, Visakhapatnam Coast.



Fig. 10. Mangroves of Bheemili region, Visakhapatnam Coast.

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