Physico-Chemical Analysis of Mangrove Soil in the Machilipatnam Coastal Region, Krishna District, Andhra Pradesh

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Abstract: Mangrove soil condition was essential factor in mangrove reforestation and coastal rehabilitation projects. The present survey was made to study of the some physico-chemical parameters of soil at five places of Machilipatnam coastal regions during the year 20012-2013 at four-seasonal intervals. This study was carried out using field determination of colour and texture, and a low-cost electrochemical approach was used for pH, salinity measurements The soil properties, colour, texture, pH , salinity,electrical condititivity, organic carbon, macronutrients (N,P)and micronutrients(Zn,Mn,Fe,Cu,P_2O_5) are determined in mangrove ecosystem. The results showed that soils in the mangrove forest are dark black in colour, and are made up of both clay and silt, soil pH range from(8.35 to 8.79) which are alkaline. Soil salinity range from (20 to 32 ppt) decreased with increasing distance from the tidal coast electric conductivity range from (10.26 to 16.22 m.mohs/cm).Available nitrogen(29.4 to 81.2ppm),phosphorous range from(3.32 to 5.89 ppm) were maximum in monsoon and minimum in summer . The micronutrients such as zinc(0.31 to 0.64ppm), copper(0.9 to8.8 ppm) , iron (9.50 to 19.7)and manganese(17.9 to60.2 ppm) have variation in comparison to different areas

Keywords:Mangrove ecosystem, seasons,Physico-chemical parameters.

INTRODUCTION

Mangrove forests are one of the most productive ecosystems, growing on sheltered shores and in estuaries in the tropics and can be found in some subtropical area (Hogarth, 1999). Mangroves are important for coastal protection and as a source of fire wood and charcoal, and many of the coastal marine organisms in the mangrove ecosystem are natural sources of protein (Aksornkoae *et al.*, 1992; Macintosh *et al.*, 2002).Mangroves trap sediment with their roots as well as absorbing wave energy and slowing the hydrological flow of storm surges. (Mazda *et al.*, 1997; Massel *et al.*, 1999; Valiela *et al.*, 2001; Chong, 2005). Mangrove forests are very important tropical coastal tidal ecosystems and grow on nutrient-rich muddy substrates that are low in oxygen and undergo variations in salinity (Ferreira, 2007). Mangrove forests are high in values, multiple roles and important for human and microbes continuity. Mangrove communities often exhibit distinct patterns of species distribution (Chapman 1976; Lugo& Snedaker 1974; Macnae 1968; Tomlinson 1986).Waring & Major (1964) reported that a complex of environmental factors determines the actual distribution of plants in nature, although each plant has a certain tolerance for each factor. Since the mangrove habitat is basically saline, several studies have attempted to correlate salinity with the standing crop of vegetation and productivity (Chen & Twilley 1998, 1999; Lugo 1980; Mall *et al.* 1987; Ukpong 1991) Soil properties of mangrove forest such as soil chemical properties can indicate the current status and determined the characteristics of tested soil. Data obtained may represent the soil fertility thus to plan a proper action for enhancement of soil quality and governing ideal ecosystem. As medium of growth, soil should supplies enough nutrients and have good characteristic to ensure better tree performance and establish greater forest ecosystem for wildlife conservation, economic value and most important to balancing environmental condition. The objective of this study was to compare selected soil chemical properties of three different areas and aims to address the problem by characterizing the soil properties of colour, texture, pH, electric conductivity and other parameters in the mangrove ecosystem which is physical foundation of every ecosystem and for nutrient retention.

Study Area

Machilipatnam is between 16°10'N to 16.17°N latitudes and 81°09'E to 81.13°E longitudes on the southeast coast of India and in the east corner of Andhra Pradesh. Mangroves in this area lie between latitude 16° 0' - 16° 15'N latitude and 81° 10' - 81° 15' E longitude. The northern distributary of Krishna River drains in this area near Hamsaladeevi. Machilipatnam sea coast is receiving a stream called Upputeru from Kolleru region at Pedapatnam. So, Pedapatnam is a riverine based mangrove region. The other field stations viz. Gilakaladindi, Polatitippa, Kotha Pallethummalapalem, Bhavanipuram and Malakayalanka of the region are the mangrove areas receiving sea water by tidal effect. Hence these field stations gain significance in the study of mangroves. The Mangrove Vegetation is shown in Figure 1.

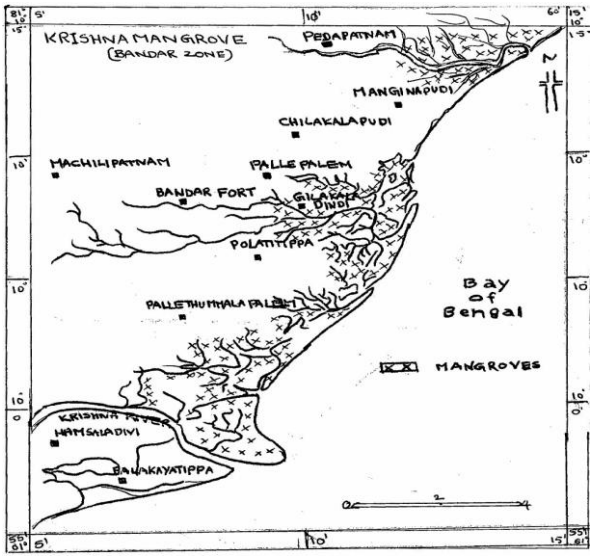

Figure 1: Map showing the Mangrove Vegetation in Machilipatnam Region

Mangrove vegetation is a fragile ecosystem. Krishna mangroves are changing rapidly due to natural calamities, deforestation, aquaculture, over-exploitation, absence of proper management, conservation etc. Mangrove vegetation is a natural protector from natural threats like cyclones, tsunamis etc. The cyclone in 1977 and the tsunami in 2004, which devastated Diviseema and Machilipatnam regions respectively, are examples of natural threats. It is proved that mangroves act as natural protectors to control the cyclonic winds and tsunami waves, with densely populated mangrove vegetation (Banerjee, 1998). Therefore, a detailed study of Krishna mangroves is very important. The Krishna deltaic region is in tropical humid climate, with hot summers and moderate winters. The hottest months are April, May and June, when the average highest temperature is 45 C. The coldest month is January, when the highest temperature is 23 C. Maximum temperature varies from 23 C to 45 C and the minimum value ranges between 19 C to 23 C during a year. Machilipatnam gets annual rainfall due to the southwest monsoon. The average normal rainfall in the district is 110 cm, as obtained from the data collected from 2009-2013.

Soil properties:

The soil of the Krishna mangroves is clayey. The major riverbeds - Gollalamatapaya, adimeru and Krishna - are found to be clayey rather than silt. The overall soil texture may be classified as silty clay.Soil samples were collected from both degraded and growth areas of the Krishna mangroves before taking up restoration work. The samples were analysed for soil salinity, pH, electric conductivity and other parameters including soil texture. The soil is mostly clayey inside mangrove areas, but sandy clayey in a few places. Soil salinity is greater in summer than in winter or the rainy season, because of the high rate of evaporation during summer. Soil pH in the areas studied ranges from 7 to 8.8, with an average of 8.0. The average is slightly higher in degraded areas. Organic matter content is low in degraded areas and creeks and slightly high in dense areas. The phosphorous content is low in matter content is low in degraded areas and creeks and slightly high in dense areas. The phosphorous content is low in general

Materials and methods:

The study was conducted at coastal regions of Machilipatnam. Soil sampling was done in November 2013 and January 2014 respectively. Three soil samples were collected from each site from a rooting depth of 30 cm in polythene bags immediately after the soil was withdrawn the colour and texture were identified and documented and brought to the laboratory. The soils were air-dried, crushed using a pestle and mortar and then passed through a 10-mesh (2 mm) screen before analysis. The soil analysis was completed within two months after collection. pH was determined in (1:2X40g soil+80ml water suspension using a pH meter (Jackson 1978) and Electrical conductivity was determined using a Systronics conductivity meter. Macronutrients (nitrogen, potassium) and macronutrients (zinc, iron, copper, and manganese) are determined by standard methods.

Results and Discussion:

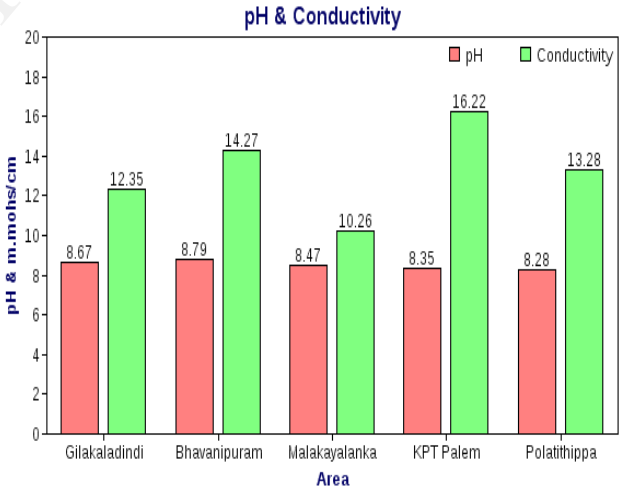

Figure 2: Graph showing pH and conductivity

pH and conductivity of different samples from all five places shows that PH variations Is very less but conductivity is more in KPT Palem region in comparison to other four places and very less in Malakayalanka.

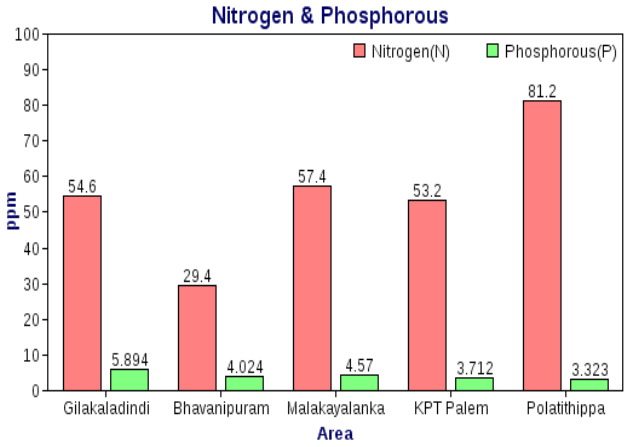

Figure 3: Graph showing Macronutrients

Nitrogen is a part of chlorophyll, the green pigment of the plant that is responsible for photosynthesis. Helps plants with rapid growth, increasing seed and fruit production and improving the quality of leaf .The results in five different regions showed less nitrogen presence in soil and its has on inpact on leaf colour and growth of plants and tress in these five regions.

Like nitrogen, phosphorus (P) is an essential part of the process of photosynthesis.Involved in the formation of all oils, sugars, starches, etc.Helps with the transformation of solar energy into chemical energy; proper plant maturation; withstanding stress.Effects rapid growth.Encourages blooming and root growth inthese all five regions because of significant amount of phosphorus presence.

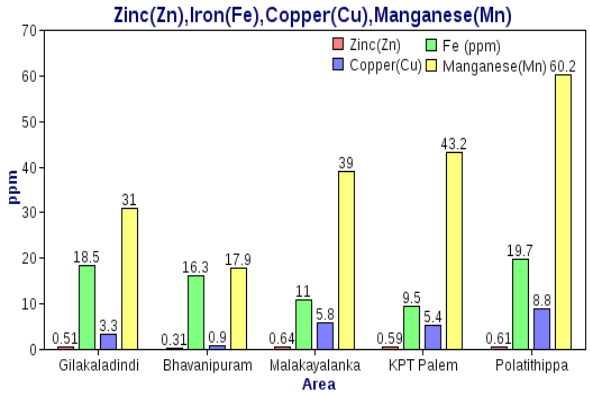

Figure 4: Graph showing Micronutrients

Coming to micronutrients analysis was done on Zinc, Iron, Copper and Manganese, results showed that Zinc is deficient in all five regions . Zinc is plants' most common micronutrient deficiency; it is particularly common in high-pH soils. Plants that grow in soils that are zinc-deficient are more susceptible to disease which is seen in these five areas.

Iron is essential for chlorophyll synthesis, which is why an iron deficiency results in chlorosis in two regions when compared with rest of three regions.

Copper is a component of some enzymes,symptoms of copper deficiency include browning of leaf tips and chlorosis which was observed in Bhavanipuram region and other regions do not have copper deficiency.

Manganese activates some important enzymes involved in chlorophyll formation. Manganese deficient plants will develop chlorosis between the veins of its leaves. The availability of manganese is in significant amounts in all regions .

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