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Full Length Research Paper

Physico chemical properties of Wetland soils in Lakkavalli range of Bhadra Wildlife Sanctuary Karnataka India

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Abstract
Studies on the nature and properties of soil of forest ecosystems are important for proper management of the environment and utilization of resources. The present study is on lakkavalli range of bhadra wildlife sanctuary which highlights the physico - chemical properties of soils in different wetlands of lakkavalli range. The texture of the forest soils varied from sandy to loamy. All soil parameters are within permissible limits. The ph of soil is lightly acidic due to more soil organic matter. Micronutrients are within the acceptable limits. Among the primary nutrients, wetland soils were found to have relatively low nitrogen availability and high in potassium. Phosphorus content didn't differ significantly between the forest wetland types. Soil analysis revealed that nutrients present in the soil were found to be favourable for optimum growth of flora. The soil attributes were correlated and the coefficient values of soil macro nutrients in koramagudda kere and mavinahalla kere, has revealed the significant positive relationship with the available phosphate and available nitrogen, while negative relationship with the available potassium concentration, among the soil micro nutrients the iron concentration has showed the significant positive relationship with the zinc concentration in anegundi kere , mavinahalla kere , ramannana kere and koramagudda kere where as in ramannana kere, mavinahalla kere site it has revealed negative relationship with the manganese and copper in pickup kere.

Keywords: *wetland, lakkavalli, physico-chemical properties, soil*

Introduction

Since the beginnings of scientific study of wetlands, soils have been recognized as an important feature of wetlands. Plant ecologists and geologist a like found that the nature of the soils had a profound effect on plant growth and the formation of the peat deposits (a mineral resource). Over time, several terms have been used to describe wetland soils. Soil, like climate plays a vital role in the development of forests. They provide water, nutrients for trees and other forest vegetation (Richard and Dan, 2000). Land or soils not only provide a solid substratum for us to live on, but also it feeds us (Asthana and Meera Asthana, 2003). Soil is a complex physico-biologic al system providing water, mineral salts nutrients dissolved oxygen and anchorage to plants .Healthy soils give us clean air and water, forest product, range land, diverse wildlife and beautiful landscapes (Herrick, 2000). They have revealed tremendous scope for environmental management as soil conditioner, biofertilizers, bioindicators, ,biomonitors, feed for animals, protein supplement and rehabilators of degraded ecosystem through bioabsorption of pollutants (Whitton and Potts, 2000). Soils are complex mixtures of minerals organic compounds and living organism that interact continuously in response to natural and imposed biological chemical and physical forces. Soils are the natural bodies in which plant grows. Most soils are capable to some degree of adsorbing and detoxifying many pollutants to harmless levels through chemical and biochemical processes. The soil perform five essential functions of resulting water, sustaining animal and plant life, filtering potential pollutants, cyclic nutrients and supporting structure. Studies on the nature and properties of soil of forest ecosystems are important for proper management of the environment and utilization of resources. Without adequate knowledge of the dynamic interaction between soil, climate and forest management we cannot develop a proper soil management system. The present paper highlights the physico - chemical properties of soils in different wetlands of lakkavalli range.

Materials and methods

The study was carried out in Lakkavalli range of Bhadra Wildlife Sanctuary, consisting an area of 223.17 km2 (13° 34' to 13° 46' N and 75° 29' to 75° 45' E) in the Karnataka state of Southern India. physico – chemical Soil assessment was made in selected five wetlands over a period of two years (Map-1) *viz.*, Anegundi kere lies in (13° 35' 506" N and 75° 38' 620" E). Ramannana kere lies in (13° 36' 562" N and 75° 37' 943" E), Koramagudda kere lies in (13° 37' 173" N and 75° 39' 095" E), Pickup kere lies in (13° 36' 957" N and 75° 39' 307" E) and Mavinahalla kere (backwater) lies in (13° 38' 518" N and 75° 39' 271" E). The sampling is made at an interval of 30 days. In each of these localities based on preliminary survey, 10-10m quadrates were selected around the wetlands. The habitat characteristics of each quadrate viz., physical parameters and chemical parameters of soil sampling were made concurrently. These samples were preserved in inert polythene bags, were labelled and transported to laboratory. In laboratory, the soil samples were shade dried, finely powdered using pestle and mortar. Later samples were sieved through the 10 mesh (2mm) sized sieve. The processed soil samples were stored in labeled inert polythene container for analysis and taken to the

soil testing centre of Krushi Vignanya Kendra (KVK) in Shimoga. After processing the soil samples, the analysis was made for the following parameters.

*pH:*Soil pH was determined in 1:2.5 soil-water / KCl / $CaCl_2$ suspension using Systronic digital pH meter (Baruah and Barthakur, 1998).

Electrical conductivity (dsm^{-1}): The electrical conductivity of the soil was determined in 1:2.5 soil-water extract using Systronics Conductivity Bridge (Baruah and Barthakur, 1998).

Organic Carbon (%): The organic carbon was determined by the Walkley and Black's Wet Oxidation method by oxidizing organic matter with chromic acid making use of the heat of dilution of sulphuric acid for the reaction as described by Tan (1995).

Available Nitrogen ($kg\ ha^{-1}$): Available Nitrogen is estimated by the method of Subbaiah and Asija (1956).

Available Phosphorus ($kg\ ha^{-1}$): For determining plant available P in soils, two methods are commonly used. The Olsen's method (Olsen, 1954) is used for neutral- alkaline soils while the Bray and Kurtz P1 method (Bray and Kurtz, 1945) is used for acids soils.

Available Potassium ($kg\ ha^{-1}$): Available potassium was extracted from the soil with neutral normal ammonium acetate solution and estimated flame photometrically (Jackson, 1973).

*Exchangeable Cations [Ca^{2+}, Mg^{2+}] (c.mol (P^{+}) kg^{-1} :*The exchangeable cations Ca^{2+} and Mg^{2+} were determined in the ammonium acetate extract as described by Black (1965). Exchangeable Ca^{2+} and Mg^{2+} were estimated by Versenate titration method (Jackson, 1973).

*DTPA extractable iron, copper, manganese and zinc ($mg\ kg^{-1}$):*DTPA-extractant (0.005 M diethylene triamine penta acetic acids, 0.01 M $CaCl_2$ + 0.1N triethanol amine pH 7.3) was used for extracting iron, copper, manganese and zinc and the concentration of micronutrients in the extract was determined by using atomic absorption spectrophotometer (AAS) as outlined by Lindsay and Norvell (1978).

pH, Electrical conductivity (dsm-1),Organic Carbon (%),Available Nitrogen (kg ha-1),Available Phosphorus (kg ha-1),Available Potassium (kg ha-1),Exchangeable Cations [Ca2+, Mg2+] (c.mol (P+) kg-1,DTPA extractable iron, copper, manganese and zinc (mg kg-1).

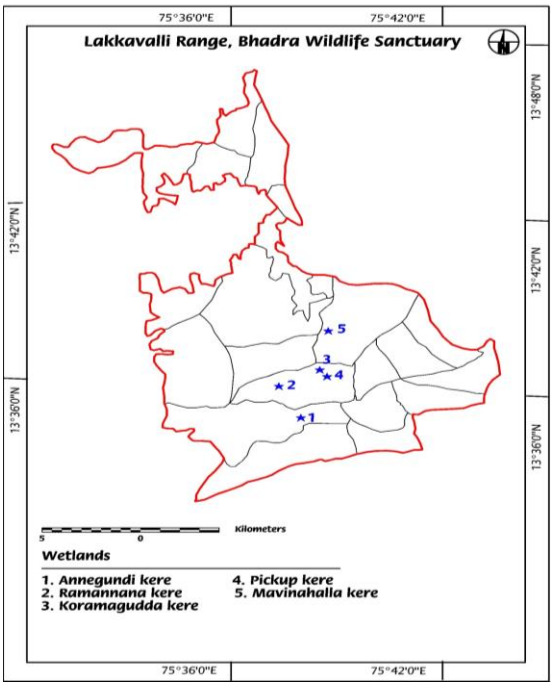

Fig 1. Image of the selected wetlands in the study area

Results and Discussion

The soil analysis data are depicted in Table 1. The data clearly indicates that the pH of the soil was found to be acidic (5.57 to 6.90). Electical conductivity of the soil solution is a convenient parameter for estimation of salinity of soil. It ranges from 0.022 dsm-1 to 0.102 dsm-1. The organic carbon was recorded high in Ramannanakere of 0.63% and lowest value of 0.39% in Pickup kere. Nitrogen is low in all studied wetlands except Ramannanakere it is medium. Phosphorus is medium (22.5-55) in all

wetlands, while potassium is high in all wetlands. Calcium and Magnesium are the two most abundant alkaline earth cations in soil. Calcium is high 4.2 c.mol (P+) kg-1 in Anegundi kere and low in Mavinahalla kere 3.2 c.mol (P+) kg-1, Magnesium is 2.3 c.mol (P+) kg-1 in Anegundi kere where 1.7 c.mol (P+) kg-1 in Pickup kere. Iron, zinc, copper and manganese are in permissible limits. All soil parameters are within permissible limits. The pH of soil is lightly acidic due to more soil organic matter. Temperature and precipitation are two active soil forming factors which help weathering and soil development (Sandeep et.al., 2014).The acidification of soil depends on the type of species, the environmental condition. Calcium and magnesium are in permissible limit. Similar observations were seen in Laokhowa wildlife sanctuary Assam by Sanjeeb and Sarma (2008). In the soil nitrogen also available as nitrates, nitrites and ammonium salts but nitrates alone can be used by plants. It promotes growth and imparts green colour to the leaves. Over supply of nitrogen encourages excessive vegetation growth, insufficient supply leads to stunted growth. The soil provides appreciable quantity of phosphorous in the form of phosphates. Phosphorous helps in maturation, flowering, fruiting and lateral and fibrous root development. Whereas, potassium is essential for plant growth and development of chlorophyll with other compounds. Micronutrients are within the acceptable limits. These obseravations are in agreement with Gururaj (2002) and Ishwar Bhat (2008). The Karl Pearson's correlation coefficient was calculated among the soil parameters to understand the relationship between them (Table. 2). The soil pH recorded in Anegundi kere and Ramannana kere wetlands has revealed the significant positive relationship with the electrical conductivity of the soil. In Koramagudda kere has revealed the significant positive relationship with the electrical conductivity, while the electrical conductivity has showed the significant negative relationship with the organic concentration of the soil. The soil of the Pickup kere has revealed the relationship among the parameters recorded. The soil pH has showed the significant positive relationship with the electrical conductivity, while the organic carbon has represented the significant negative relationship with the soil pH and electrical conductivity. In Mavinahalla kere, the organic carbon has exhibited the significant negative relationship with the soil pH and electrical conductivity.

Correlation coefficient of macronutrients of wetlands soil

The Karl Pearson's correlation coefficient was calculated among the soil macro nutrients to understand the relationship between them (Table .3). In Koramagudda kere and Mavinahalla kere, the available nitrogen in the soil has revealed the significant positive relationship with the available phosphate, while negative relationship with the available potassium concentration. In Pickup kere, the available nitrogen has showed the significant positive relationship with the available phosphate concentration.

Table 1. Estimation of soil analysis of selected wetlands in Lakkavalli range of Bhadra Wildlife Sanctuary

Parameters	Anegundi kere	Ramannana kere	Koramagudda kere	Pickup kere	Mavinahalla kere
pH	6.39	5.58	6.90	6.14	**5.57**
EC (dsm^{-1})	0.102	0.056	0.060	0.065	**0.022**
Organic carbon (%)	0.49	0.63	0.53	0.39	**0.51**
Available nitrogen ($kg\ ha^{-1}$)	272.83	319.87	275.97	222.66	**269.70**
Available P_2O_5 ($kg\ ha^{-1}$)	45.53	52.00	32.51	42.26	**53.31**
Available K_2O ($kg\ ha^{-1}$)	481.15	325.25	357.50	341.38	**255.36**
Exchangeable Ca (c.mol (P^+) kg^{-1}	4.2	3.8	4.0	3.9	**3.2**
Exchangeable Mg (c.mol (P^+) kg^{-1}	2.3	2.2	1.8	1.7	**2.1**
Fe ($mg\ kg^{-1}$)	58.82	62.84	71.40	62.72	**76.00**
Zn ($mg\ kg^{-1}$)	1.424	0.790	1.124	1.482	**3.204**
Cu ($mg\ kg^{-1}$)	8.594	4.138	4.802	7.702	**6.674**
Mn ($mg\ kg^{-1}$)	33.10	41.00	20.88	17.30	**30.76**
pH	6.39	5.58	6.90	6.14	**5.57**
EC (dsm^{-1})	0.102	0.056	0.060	0.065	**0.022**
Organic carbon (%)	**0.49**	**0.63**	**0.53**	**0.39**	**0.51**

Correlation coefficient of secondary macronutrients of wetlands soil

Correlation coefficient calculated among the concentration of exchangeable calcium with the concentration of exchangeable magnesium recorded in the study sites during the study period. In Ramannana kere, Koramagudda kere and Pickup kere, the positive significant relationship has been obtained (Table .4).

Correlation coefficient of micronutrients of wetlands soil

The Karl Pearson's correlation coefficient was calculated among the soil micro nutrients to understand the relationship between them (Table .5). In Anegundi kere and Koramagudda kere, the iron concentration has showed the significant positive relationship with the zinc concentration. In Ramannana kere, the iron concentration has revealed the significant positive relationship with the zinc and negative relationship with the manganese. The copper in the study site has revealed the significant negative relationship with the manganese. In Pickup kere, the iron concentration has revealed the significant positive relationship with the zinc and negative relationship with the copper. The copper in the study site has revealed the significant negative relationship with the manganese. In Mavinahalla kere, the concentration of the iron has showed the significant positive relationship with the zinc and negatively with the copper concentration. The zinc concentration has showed the significant positive relationship with the copper and negative relationship with the manganese. Soil analysis revealed that nutrients present in the soil was found to be favourable for optimum growth of flora. The soil attributes were also correlated and the coefficient values have revealed the various levels of relationship among the parameters

Table 2. Correlation coefficient of wetlands soil

a. Anegundi kere

Parameters	pH	EC	OC
pH	1	**0.537**	**-0.293**
EC		1	**-0.196**
OC			**1**

b. Ramannana kere

Parameters	pH	EC	OC
pH	1	**0.647**	**-0.094**
EC		1	**-0.284**
OC			**1**

c. Koramagudda kere

Parameters	pH	EC	OC
pH	1	**0.558**	**-0.124**
EC		1	**-0.566**
OC			**1**

d. Pickup kere

Parameters	pH	EC	OC
pH	1	**0.648**	**-0.587**
EC		1	**-0.916**
OC			**1**

e. Mavinahalla kere

Parameters	pH	EC	OC
pH	1	0.487	**-0.784**
EC		1	**-0.645**
OC			**1**

Bold letters indicates significant at the 0.05 level

Table 3. Correlation coefficient macronutrients of wetlands soil

a. Anegundi kere

Parameters	Available N	Available P_2O_5	Available K_2O
Available N	1	0.347	**-0.036**
Available P_2O_5		1	**-0.349**
Available K_2O			**1**

b. Ramannana kere

Parameters	Available N	Available P_2O_5	Available K_2O
Available N	1	0.487	**-0.463**
Available P_2O_5		1	**-0.281**
Available K_2O			**1**

c. Koramagudda kere

Parameters	Available N	Available P_2O_5	Available K_2O
Available N	1	**0.557**	**-0.634**
Available P_2O_5		1	**-0.124**
Available K_2O			**1**

d. Pickup kere

Parameters	Available N	Available P_2O_5	Available K_2O
Available N	1	**0.512**	**-0.157**
Available P_2O_5		1	**-0.426**
Available K_2O			**1**

e. Mavinahalla kere

Parameters	Available N	Available P_2O_5	Available K_2O
Available N	1	**0.657**	**-0.681**
Available P_2O_5		1	**-0.457**
Available K_2O			**1**

Bold letters indicates significant at the 0.05 level

Table 4. Correlation coefficient of secondary macronutrients of wetlands soil

Wetland	'r' value
Anegundi kere	-0.031
Ramannana kere	**0.561**
Koramagudda kere	**0.587**
Pickup kere	**0.681**
Mavinahalla kere	0.148

Bold letters indicates significant at the 0.05 level

Table 5. Correlation coefficient of micronutrients of wetlands soil

a. Anegundi kere

Parameters	Fe	Zn	Cu	Mn
Fe	1	**0.667**	-0.350	**-0.201**
Zn		1	0.353	**-0.066**
Cu			1	**-0.276**
Mn				**1**

b. Ramannana kere

Parameters	Fe	Zn	Cu	Mn
Fe	1	**0.577**	-0.130	**-0.561**
Zn		1	0.255	**-0.058**
Cu			1	**-0.716**
Mn				**1**

c. Koramagudda kere

Parameters	Fe	Zn	Cu	Mn
Fe	1	**0.567**	-0.140	**-0.211**
Zn		1	0.353	**-0.065**
Cu			1	**-0.156**
Mn				**1**

d. Pickup kere

Parameters	Fe	Zn	Cu	Mn
Fe	1	**0.651**	**-0.850**	**-0.351**
Zn		1	0.353	**-0.416**
Cu			1	**-0.516**
Mn				**1**

e. Mavinahalla kere

Parameters	Fe	Zn	Cu	Mn
Fe	1	**0.548**	**-0.510**	**-0.201**
Zn		1	**0.523**	**-0.666**
Cu			1	**-0.314**
Mn				**1**

Bold letters indicates significant at the 0.05 level

Conclusion

Lakkavalli range of Bhadra Wildlife Sanctuary, comprising an area of 223.17 sq. kms. The area consists of most undulating terrains with valley and steep hill locks Most of the physic- chemical properties of soil were found varying in Wetlands. Climatic factors including rainfall and temperature and vegetation type can be considered the main factors for these variations in soils. The soils in general had a sandy to loam texture, acidic pH, high organic carbon, and available nitrogen and potassium contents. Extractable phosphorus was medium and available calcium and magnesium contents were low in all Wetland soils. The pH of soil is lightly acidic due to more soil organic matter. Micronutrients are within the acceptable limits. Therefore, the present research strongly suggest supporting the further research programme for better understanding of the wetland soils, which will be useful in better wetland management and conservation.

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