Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.2391

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **4 (5):** 103-107 (2016)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Assessing Soil Fertility Status of Rehabilitating Degraded Landscape of Rourkela Forest Division

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Received: 17.10.2016 | Revised: 28.10.2016 | Accepted: 30.10.2016

ABSTRACT

The present study was conducted on assessing soil fertility status of rehabilitating degraded landscape of Rourkela Forest Division at different soil depth (0-15 cm and 15-30 cm) of six different forest ranges. The analyzed indicated that soil pH was acidic in all of the ranges. There was an urgent need for rehabilitating of the degraded land and to restore the ecosystem. The results indicate that each range shows a close affiliation to variable soil properties.

Key words: *Electrical Conductivity (E.C), Soil Organic Carbon (SOC), Soil Organic Matter (SOM).*

INTRODUCTION

An assessment of forest soil fertility status could provide fundamental information on soil suitability for species preferences and improve the effective technique for future rehabilitation program[7]. The vegetation of an area influences the physicochemical properties of forest soil[8]. Soil properties are various factors which influence land use and climate change. Forest rehabilitation activity on degraded landscape should emphasise on ecosystem involving soil properties, soil fertility and vegetation of the area[2]. Forest soil in comparison to other soil is characterized by the presence of micro flora, high porosity, high permeability, more stable soil aggregate and greater water holding capacity. The tree may play a major role in increasing the soil fertility in forest[14]. As most of work was focusing on species selection for planting proposes at degraded forest, assessing soil fertility status under the rehabilitating program at the degraded area are still limited[7]. Therefore this study was a preliminary assessment of rehabilitating program in relation to soil fertility status. The objective of this study was to characterize the soil properties and identify the soil fertility status of rehabilitated degraded forest of Rourkela Forest Division.

Cite this article: Sahani, S., Dhupper, R., Kumar, S., Rout, S., Parveen, S. and Patra, S.S., Assessing Soil Fertility Status of Rehabilitating Degraded Landscape of Rourkela Forest Division , *Int. J. Pure App. Biosci.* **4(5):** 103-107 (2016). doi: http://dx.doi.org/10.18782/2320-7051.2391

MATERIALS AND METHODS

Site Description

Rourkela having Co-ordinates 22^0 14' 57" N, 84^0 52' 58" E is a metropolitan city located in Sundargarh (District) of Odisha (State) is surrounded by a range of hills and encircled by rivers. Its greenery is maintained by Rourkela Forest Division with help of local people. This division contains 84 Reserve Forests, 269 UDPF, and 35 village forests along with all un-classed forest, DLC land having the total area of 79414.64 ha. This division comprises of an elongated patch of land running kin East-West direction whereas the central part contains a vast plain area with isolated hillocks along with the small chain of mountains. The plain land gradually ascends in the western and southern direction of Sundargarh district. In this hill range the highest peak is Didarpahad having an altitude of 766m the other peak of Division is Katang (604m) and Bhainsamunda (681m) on the South-eastern side having good forest located bordering Saranda forests of Jharkhand state. The North – eastern portion an almost plain area dominated by cultivated land. A large part of the division is occupied by the para-metamorphic rocks of Gangpur series occurring under the soil and alluvium occupying mainly the plain land and low lying hill slopes between Jaraikela-Birmitrapur, Sundargarh and Lephripara. Soil derived from mica-schist and gneiss covers the major portion of the forest area. The soil derived from mica-schist, Phyllites is red in colour. It is poor in water containing capacity but supports good forest cover both Sal and Non-Sal depending upon the aspect. The summer starts from March and continues up to June. The Rainy season continues from July to October whereas winter season continues from November to February. The maximum temperature recorded is 45.5^0C during the month of May whereas minimum temperature recorded 6°C in the month of January. Prolonged summer with severe forest fires results in high % of mortality of forest seedling. The southern Ranges of this division check the south western monsoon for which plain area of Rajgangpur and Panposh receives less rainfall resulting in high humidity which supports good forest covers. As per champion and Seth classification this division comes under Peninsular Sal and dry deciduous forest types. Sal the dominant species fully established and abundant in these forests varying from a fairly pure to a mixed crop and occurs throughout the area. The main associates of Sal are Asan (*Terminalia tomentosa*), Kurum, Bijasal or Piasal (*Pterocarpus marsupium*), etc. The other noteworthy tree species are *Buchanania, Semecarpus, Terminalia, Cassia, Adina, etc.* Mixed with these species *Cochlospermum, Boswellia, Hardwickia* and *Bassia*, etc is seen. *Dendrocalamus strictus* is the prominent bamboo species available[13].

Soil collection and preparation of soil sample

The surface of the soil is scraped by Phawraah or Spade. The weeds or surface litter were removed by khurpi. A 'V-shaped' pit is dug by Phawraah up to the required depth i.e. 0 to15 cm, 15 to 30 cm in Rourkela forest division six ranges [Banki (2yrs), Rajganpur (3yr), Kuarmunda (4yr), Bisra (0 yr), Panposh (1yr), Birmitrapur (3 yr)]. Then, the slices of one to two cm thickness are removed from lighter one side or both side of the pit. The entire soil sample is collected in a container; soil sample from all spot is collected during February to March 2016 and mixed. Now the resultant soil sample is called composite soil sample. In order to assess the available nutrient in the soil. Soil samples were air-dried and processed as per standard methods in the laboratory. Stones and plant fragments were removed from forest soil by passing the dried grounded soil samples through a 2mm sieve. All the samples were then stored in a polythene container and kept ready for analysis[15] with labels and laboratory analysis of soil samples in three replication was carried out during May, 2016.

Physico-chemical analysis of soil

Determination of Colour

Soil colour is commonly and widely determined by Munsell soil colour chart[9].

Determination of soil texture

Soil texture is determined by Bouyoucos hydrometer methods[5].

Determination of pH and EC

pH of the soil is determined by a pH meter and EC (Electrical Conductivity) by conductivity bridge[1].

Determination of organic matter and carbon content

Organic carbon was determined by Walkley and Black titration method[4]. Organic matter was measured by Walkley and Black method[10].

Determination of available N, P, K

Available N of the soil was determined by alkaline $KMnO_4$ method[16]. Available P was estimated using Olsen's extractant[6] and available K was determined using ammonium acetate extractant[6].

RESULTS AND DISCUSSION

The results of soil analysis from different forest ranges in rehabilitating degraded landscape of Rourkela forest division have given in Table.1 and Table. 2. In case of 0-15 cm depth, maximum pH was recorded in Rajaganpur (6.91) and minimum was recorded in Bisra (6.01), whereas, E.C. maximum was recorded in Banki (0.084) and the minimum was recorded in Birmitrapur (0.031). From the perusal of data recorded that maximum sand % in Birmitrapur (86.0), slit % (12.0) in Rajganpur, clay % (16.0) in Panposh. Minimum sand % was recorded in Panposh (73.0), slit % in Birmitrapur (5.0) and clay % in Kuarmund (7.0). The soil texture of most of the ranges was loamy sand i.e., Banki, Rajganpur, Kurmund and Birmitrapur whereas sandy loam was recorded in Bisra and Panposh. MC % maximum was recorded in Panposh (7.38) and minimum was recorded in Rajganpur (2.96). In case of SOC % maximum was recorded in Banki (1.68) and minimum was recorded in Birmitrapur (0.19). SOM % maximum was recorded in Banki (2.896) and the minimum was recorded in Birmitrapur (0.327). Mean while, the available Nitrogen maximum was recorded in Birsa and Panposh (137.5), Phosphorus in Rajganpur, Kuarmund, Bisra (5.63) and Potash in Kuarmund (356.1). The minimum available Nitrogen (87.5), Phosphorus (4.51) and Potash (21.6) was recorded in same Banki range (Table.1).

In case of 15- 30 cm depth soil analysis, the results indicated that the maximum pH was recorded in Kuarmund (6.78) and minimum was recorded in Rajganpur (6.02), whereas, E.C. maximum was recorded in Banki (0.063) and minimum was recorded in Bisra (0.024). From the perusal of data recorded that maximum sand % was recorded in Banki (80.0), slit % (18.0) in Panposh, clay % (17.0) in Rajganpur and Bisra. Minimum sand % was recorded in Panposh (68.0), slit % in Kuarmund (6.0) and clay % in Banki and Birmitrapur (11.0). The soil texture of most of the ranges was Sandy loam i.e., Rajganpur, Kurmund, Bisra and Birmitrapur whereas loamy sand was recorded in Banki and loam in Panposh. MC % maximum was recorded in Panposh (8.77) and minimum was recorded in Rajganpur (5.28). In case of SOC % maximum was recorded in Banki (1.25) and minimum was recorded in Rajganpur (0.14). SOM % maximum was recorded in Banki (2.155) and minimum was recorded in Rajganpur (0.241). Mean while, the available Nitrogen maximum was recorded in Banki (175.0), Phosphorus in Rajganpur (5.63) and Potash in Kuarmund (321.2). The minimum available Nitrogen (87.5) was recorded in Birmitrapur, Phosphorus (2.25) was recorded in Panposh and Potash (61.8) was recorded in Rajganpur range (Table.2). Vegetation and soil factor shows dependence on each other but vegetation showed a strong effect on the vertical dimensions of the soil profile[12]. From the perusal of data revealed that the soil at all location was acidic. It may be due to rapid weathering and intense leaching under high rainfall condition factors the development of soil acidity and also effect of geological and environmental factors, land use pattern and uncontrollable climate change[11].Variation in soil nutrients across the ranges may be due to natural and human driven factors or activities[3].

Table-1: Physicochemical Properties of Soil of Six Forest ranges of Rourkela Forest Division (0-15cm depth)

					Soil Colour								Available Nutrients (Kg/ha)			
Sl. No	Sample No	Range	pH	E.C (ds/m)	Notation	Colour	Sand (%)	Silt (%)	Clay (%)	Textural class	MC (%)	SOC (%)	N	P_2O_5	K_2O_2	SOM (%)
1	1	Banki (2yrs)	6.71	0.084	7.5YR4/3	Brown	81.0	10.0	9.0	Loamy Sand	5.49	1.68 (High)	87.5	4.51	21.6	2.896
2	3	Rajganpur (3yrs)	6.91	0.067	5YR5/6	Yellowish brown	77.0	12.0	11.0	loamy Sand	2.96	0.33 (low)	100.0	5.63	60.5	0.569
3	7	Kuarmunda (4yrs)	6.78	0.063	10YR5/6	Yellowish brown	83.0	10.0	7.0	loamy Sand	3.87	0.66 (mid)	125.0	5.63	356.1	1.137
4	9	Bisra (0yr)	6.01	0.039	5YR4/4	Reddish brown	77.0	10.0	13.0	Sand Loam	5.16	0.59 (mid)	137.5	5.63	90.0	1.017
5	11	Panposh (1yr)	6.37	0.04	7.5YR5/6	Stnong brown	73.0	11.0	16.0	Sand Loam	7.38	0.82 (mid)	137.5	5.07	99.5	1.413
6	13	Birmitrapur (3yrs)	6.19	0.031	7.5YR6/6	Reddish Yellow	86.0	5.0	9.0	Loamy Sand	3.99	0.19 (low)	100.0	5.07	129.0	0.327

Table-2: Physicochemical Properties of Soil of Six Forest ranges of Rourkela Forest Division (15-30cm depth)

					Soil Colour								Available Nutrients (Kg/ha)			
Sl. No	Sample No	Range	pH	E.C (ds/m)	Notation	Colour	Sand (%)	Silt (%)	Clay (%)	Textural class	MC (%)	SOC (%)	N	P_2O_5	K_2O_2	SOM (%)
1	2	Banki (2yrs)	6.70	0.063	7.5YR4/3	Brown	80.0	9.0	11.0	Loamy Sand	6.92	1.25	175.0	4.51	208.3	2.155
2	4	Rajganpur (3yrs)	6.02	0.029	5YR5/8	Yellowish Red	75.0	8.0	17.0	Sandy loam	5.28	0.14	100.0	5.63	61.8	0.241
3	8	Kuarmunda (4yrs)	6.78	0.054	10YR5/6	Yellowish brown	79.0	6.0	15.0	Sandy loam	5.42	0.49	125.0	3.38	321.2	0.844
4	10	Bisra (0yr)	6.08	0.024	5YR4/3	Reddish brown	71.0	12.0	17.0	Sandy loam	8.64	0.45	137.5	2.81	90.0	0.775
5	12	Panposh (1yr)	6.44	0.035	7.5YR5/6	Stnong brown	68.0	18.0	14.0	Loam	8.77	0.43	112.5	2.25	98.1	0.741
6	14	Birmitrapur (3yrs)	6.14	0.029	7.5YR5/8	Stnong brown	80.0	9.0	11.0	Sandy Loam	6.81	0.39	87.5	2.81	149.2	0.672

CONCLUSION

It was concluded that the soil under Rourkela Forest Division found to be acidic and red in colour due to presence of more Phyllites (iron containing substance). Soil texture is loamy sand in most of the ranges of this division. Soil organic matter is the key component of soil because of its influence on soil properties. Restoration of degraded land is to a functioning ecosystem is often assess the soil fertility status. Based on the result it's proved that rehabilitating of these degraded forest land will halt further degradation and present environment quality.

REFERENCES

1. APHA, Standard Methods for Examination of Water and Wastewater. 20th Edn., American Public Health Association, Washington D. C., New York (2011).
2. Arfin, A., Sota, T., Shamshuddin, J., Ibrhim, Z. and Hatorri, D., Soil characteristics under rehabilitation of degraded forest land in peark, peninsular. *Malaysia Pedologist*., **51:** 76-78 (2007).
3. Bhandari, B. and Ficklin, R.L., Characterizing the Variability of Physical and Chemical Properties across the Soil Individuals Mapped as Amy Silt Loam Soils in South eastern *Arkansas. J. the Arkansas Academy of Science*., **63:** 34-43 (2009).
4. Black, C.A., Methods of Soil Analysis, Part 2 (ed.), *American Society of Agronomy*. Inc. Madison, Wisconsin, USA. (1965).
5. Gee, G.E. and Bauder, J.W., Particle-Size Analysis. In: Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods, Klute, A.E., (Ed.), Soil Science Society of America, Inc. and America Soc. Agronomy, Inc., Madison, Wisconsin, pp: 399-404 (1986).

6. Jackson, M.L., Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi, India. (1973).
7. Jamaluddin, A. S., Abdu, A., Abdul-Hamid, H., Hadi Akbar, M., Banga, T., Jusop, S. and Majid, N., Assessing soil fertility status of rehabilitated degraded tropical rainforest. *American Journal of Environmental Science.* **9(3):** 280-291 (2013).
8. Karlikar, B.H. and Solanki, H.A., Estimation of micronutrients and Physico-Chemical analysis of soils of Gandhinagar district, Gujarat, India. *Life Sciences Leaflets*. **48:** 49-54 (2014).
9. Munsell Colour Company. Munsell soil colour chart, revised ed., Macbeth Division of Rollmorgen, New Windsor, N.Y. (1994).
10. Nelson, D.W. and Sommers, L.E., Total carbon, organic carbon, and organic matter. p. 961-1010. In: Black, C.A., ed. Methods of soil analysis. Part 3. Chemical methods. Soil Science of America and American Society of Agronomy, Madison, WI, USA. (1996).
11. Patil, S., Thingujam, U., Badole, S.P., Pal, B., Das, H. and Saha, A.K., Nature and distribution of soil acidity in different land use pattern of Terai region of west Bengal. *The Ecoscan.* **8(3&4):** 353-357 (2014).
12. Rathod, R. and Devar, K.V., Effect of different plantations on soil physical properties. *Karnataka J. Agricultural Science*., **16(3):** 487-488 (2003).
13. Sahani, S., Dupper, R., Kumar, S., Rout, S., Parveen, S. and Patra, S.S., Vegetation structure and species diversity in rehabilitating degraded landscapes of Rourkela Forest Division. *Advances in Life Sciences*, **5(18):** 7466-7482 (2016).
14. Singh, K., Pandey, V.C., Singh, B. and Singh, R.R., Ecological restoration of degraded sodic lands through afforestation and cropping. *Ecol Eng.,* **43:** 70-80 (2012).
15. Singh, M., Muller, G. and Singh, I.B., Heavy metals in freshly deposited stream sediments of rivers associated with urbanization of the Ganga plain, India. *Water, Air and Soil Pollution,* **141:** 35–54 (2002).
16. Subbiah, B.V. and Asija, G.L., A rapid procedure for estimation of available nitrogen in soils. *Current Science,* **25:** 259-260 (1956).