Journal of Soil Science & Plant Health

Research Article

Study of Association of Soil Parameters with Various Density Classes of Forests of Mukundpur, Satna, Forest Division and Madhya Pradesh

Prachi Singh[1], Sherendra Sahu[2], PK Singh[3*] and Neeta Singh[1]

Abstract

Mukundpur forest range is situated in Amarpatan Tahsil of Satna district of Madhya Pradesh India. The range has geographical area of 589.71 km^2 with forest area111.55 km^2. This area is under high disturbances and ecological stress due to manmade activities, the associations of soil parameters like pH, electrical conductivity, availability of major nutrients (Nitrogen, Phosphorous and Potassium) and micro nutrients like (Copper, Manganese, Iron and Zinc) with forests density are analyzed. This will help for the restoration of density of present forests for management purposes. The result indicates that all density classes soil pH does not change significantly. Electrical conductivity plays an important role in various density classes. In blank, encroachment and stocked density classes organic carbon content is significantly higher than the average value of organic carbon content of the study area. The forest soil till it remains in natural state and there is no breaking of land takes place, it tries to retain and check the organic matter content. As long as forest of the study area remains in UN degraded state, the average value of available nitrogen maintains the average value of study area. The observed value of available phosphorous in kg/ha maintains its average value of available phosphorous till the degradation in density take place from stocked forest to blank forest, but breaking of land in encroachment category increases the available phosphorus. The average value of available K_2O in blank, encroachment and stocked classes do not change significantly with average K_2O value of study area. The average value of Zn, Fe, Mn and Cu in encroachment category changes significantly with average value of the study area. When we take combined effect of pH, electrical conductivity and organic carbon on study area it indicates no significant association with respect to various density of classes. Similarly when we take the combined effect of macro nutrient (nitrogen, P_2O_5, K_2O), and micro nutrient (Zn, Fe, Mn and Cu) on study area these combined parameters do not indicate significant association with respect to various density classes.

Keywords

Forest density; pH; Electrical conductivity; Organic carbon content; Macro nutrients and Micro nutrients.

*Corresponding author: PK Singh, Chief Conservator of Forest, Satpura Bhavan, Bhopal, Madhya Pradesh, India, 462004, Tel: 9425675083; E-mail: prachisingh8727@gmail.com; pksinghifs88@gmail.com

Introduction

India, a land of physical, cultural, social and linguistic diversity is endowed by nature with enormous biological diversity. As a result India ranks amongst one of the 12 mega biodiversity countries of the world and harbors 17,000 flowering plant species. It accounts for 8% of the global biodiversity with only 2.4% of the total land area of the world [1,2].

In Satna district of the Madhya Pradesh, observation of medicinal importance of Sacred Plants of Chitrakoot Region Satna (M.P.). This study discussed the 13 sacred plants species which are medicinally used by the tribes of Chirtakoot region district Satna, Madhya Pradesh. The local people believe in the efficacy of these herbs along with some divine power, but the knowledge is restricted to very few elderly folks only.

The headquarter of Mukundpur range is in Mukundpur village, situated in Amarpatan Tahsil of Satna district in the state of Madhya Pradesh, India. This range has geographical area of 589.71 km^2 with forest area of 111.55 km^2. The first white tiger safari is established at this village.

The forest area of Mukundpur range is surrounded by mining areas of bauxite, limestone. The nearby located cement factories are always in search of new areas, besides exploiting existing known areas. These houses may obtain non forest land as compensatory forest land in other district of Madhya Pradesh for diversion. The emission of CO_2 in cement manufacturing across the world accounts for 5% of global CO_2 emission due to intensive and extensive mining activities. Thus area is encountering impact of temperature rise, industrialization, desertification, shifting in the growing seasons of plants, loss of pollinators and seed dispersers, causing extinction of precious plants. The forest area is also susceptible to illicit felling, encroachment and illicit mining. Similarly the forests are more prone to developmental activities specially widening of roads. Thus area of Mukundpur forest is under high ecological stress and forests disturbances.

Looking at the above reasons, the study area is under high disturbances. The forests of the Mukundpur range have been changing from stocked - under stocked - blank forests. Studies emphasize the need of research on forest disturbances ecology including: (1) the basic characteristics of disturbed forests; (2) the processes of natural and human disturbances; (3) the responses of forests ecosystem to the disturbances; (4) the main ecological processes or the consequential results of disturbed forests, including the change of biodiversity, soil nutrient and water cycle and carbon cycle, regeneration mechanism of disturbed forests and so on; (5) the relationships between disturbances and forest management; and (6) the principles and techniques for the management of disturbed forests [3].

The CO_2 emission produced by human actions as cement manufacturing, deforestation, mismanagement of land and biota for agriculture, etc. is one of the biggest contributors to climate change. Healthy forests can play a key role in climate change and climate change mitigation, the toughest environmental challenge of the twenty-first century.

Forests are important carbon pools that continuously exchange CO_2 with the atmosphere. Forests have several carbon pools vegetations,

dead wood and litter, soil organic matter, and the humus. At the global level, 19% of the carbon in the earth's biosphere is stored in plants and 81% in the soil. In all forests, tropical, temperate, and boreal together, approximately 31% of the carbon is stored in the biomass and 69% in the soil. In tropical forests, approximately 50% of the carbon is stored in the biomass and 50% in the soil IPCC [4].

Forests have a role in climate change through the sequestration of emission of carbon dioxide and other important GHGs. Biological growth can increase forest stocks and deforestation can increase carbon emissions. Carbon is captured in tree biomass and in forest soils [5]. Forests account for approximately 30% of terrestrial land cover FAO [6] and store about 45% of the of the carbon in terrestrial ecosystems [7].

Physico-chemical properties of soils from different land use systems viz. agriculture, olericulture and two dominant forest types (*oak; Quercus leucotrichophora and pine; Pinus roxburgii*) in Uttarakhand, India were analyzed by Tewari et al. [8].

Some physico-chemical parameters were selected as indicator of soil quality and were investigated by Juri et al. [9] in the study under the selected different land use system in Dimoria Development Block under Kamrup District of Assam. Zaman et al. [10] studied the assessment of impact of deforestation on soil through a comparative analysis of soil physicochemical properties of natural forest and deforested areas. Chandra [11] had discussed about the temperate and dry deciduous forest covers major portion of terrestrial ecosystem in India.

Grigal et al. [12] reported about influence of soil organic matter on forest productivity. Mohd-Aizat [13] studied about relationship between soil pH with selected soil biological and chemical properties.

Thus looking towards the high disturbances and ecological stress, the density of forests area of Mukundpur range is required to be studied with chemical properties of the forest soil as nutrient cycling takes place from non-living components to living components and living components to non-living components. The rock and soil in the forests is the store house of the nutrient the various soil parameters will play important role in ecological function of the forest. In the present study the associations of soil parameters like pH, electrical conductivity, availability of major nutrients (Nitirogen, Phosphorous and Potassium) and micro nutrients like (Copper, Manganisum, Iron and Zinc) with forests density are analyzed. This will help for the restoration of density of present forests for management purposes.

Study area

Mukundpur region mainly comprises the present area of Mukundpusr range of Satna forest division. The range has geographical area of 589.71 km² with forest area 111.55 km². The area lies between north latitude of 24°11'35" to 24°26'25" and east longitude of 81°6'35" to 81°22'20". The map of the study area is shown in Figure 1.

The forest area of this range exists in 7 forest blocks namely Mand, Govindgarh extension, Papra, Jhinna, Sarhai, Kokahansar and Mankesar. The forest blocks of Govindgarh extension and papra extend in Satna and Rewa forest districts. The part of Mankesar forest block lies in submerged area of Bansagar dam.

Northern boundary lies with Beehar River demarcating Satna and Rewa district. Eastern boundary lies mainly with the district boundaries bifurcating Rewa and Satna districts. The famous Charaki ghati forms one of its boundaries. Southern boundary lies mainly with submerged area of Son River and it extends to district boundaries of Shahadol and Satna districts.

The Soil in study area has the origin of Vindhyan formation and it consists of materials from sand stone, limestone and shale. The soil is mainly siliceous, aluminous and stony nature. It is lateritic in some places. The physical and chemical characteristics of the soil mainly depend on parent rock material. The record of average annual rainfall in study area was noticed from 354.1 mm to 1748.4 mm with mean annual rainfall of 1074.26 mm. The area receives nearly 51 rainy days in year. South western mansoon plays the active role of precipitation in study area starting form middle of June month. The average highest daily temperature ra nges within 24.06°C to 41.73°C with mean temperature of 32.24°C. The highest daily temperature recorded was 47.7°C Similarly the average lowest daily temperature was 8.85°C to 27.72°C with minimum daily temperature of 1.7°C the minimum temperature varies in the months from November to February.

The major study area has northern tropical dry deciduous mixed forest types with some patches of southern tropical dry deciduous teak forests especially in Mand reserve. The compositions of main vegetation are :-

- **Trees** :- *Anogeissus latifolia, Diospyros melanoxylon, Terminalia tomentosa, Lannea coromandelica, Sterculia urens, Boswellia serrata, Madhua indica, Tectona grandis, Terminalia belerica, Pterocarpus marsupium, Buchanania lanzan, Salmalia malabarica, Emblica officinalis, Mitragyna parviflora, Schleichera oleosa, Miliusa tomentosa, Terminalia arjuna* etc.

- **Shrubs** - *Nyctanthus arbortristis, Lantana camara, Carissa spinarum, Zizyphus marritianna, Woodfordia fruiticosa, Vitex negundo, Grewia hirsuta, Adhatoda vasica* etc.

- **Bamboo** - *Dendrocalamus strictus* on slopes.

- **Herbs** - *Cassia tora, Xanthium strumarium, Sida cardifolia* etc.

- **Grasses** - *Heteropogon contortus, Themeda quadrivalvis, Apluda aristala, Ischacmum rugosum, Sehima nervosum, Cynodon dactylon* etc.

- **Lianas (woody climbers)** - *Zizyphus oenoplia, Butea superb, Ventilago calyculata, Ichnocarpus frutscens, Celastrus paniculata, Gymnema sylvestris, Smilaz macrophylla, Heruidesnus indicus* etc.

Materials and Methods

For the assessment of Forest resource survey of Mukundpur range, the vegetation sampling was done for the trees, shrubs, herbs, climbers, grasses and tubers. Stratified systematic random sampling method was used for sampling the vegetation [14]. For determining minimum number of sample points, the formula used is $n = z^2 \, pq \, E^2$

Where E= difference between population proportion mean and sample proportion average, p = population proportion, q= 1 - p, z=1.96 for a level of significance of 95% [15].

Based on the secondary data from Mukundpur range and Satna forest division, the sample size for various tree parameters i.e. number of trees per hectare, volume per hectare and established regeneration per hectare was calculated at 10% error (E) between population and sample proportion at 95% level of significance keeping in view time and other resources [16].

Minimum 95 numbers of sample points were calculated from the above formula to assess the vegetation. The forest maps of Mukundpur range on survey of India topo sheet is of the scale of 1:15000.
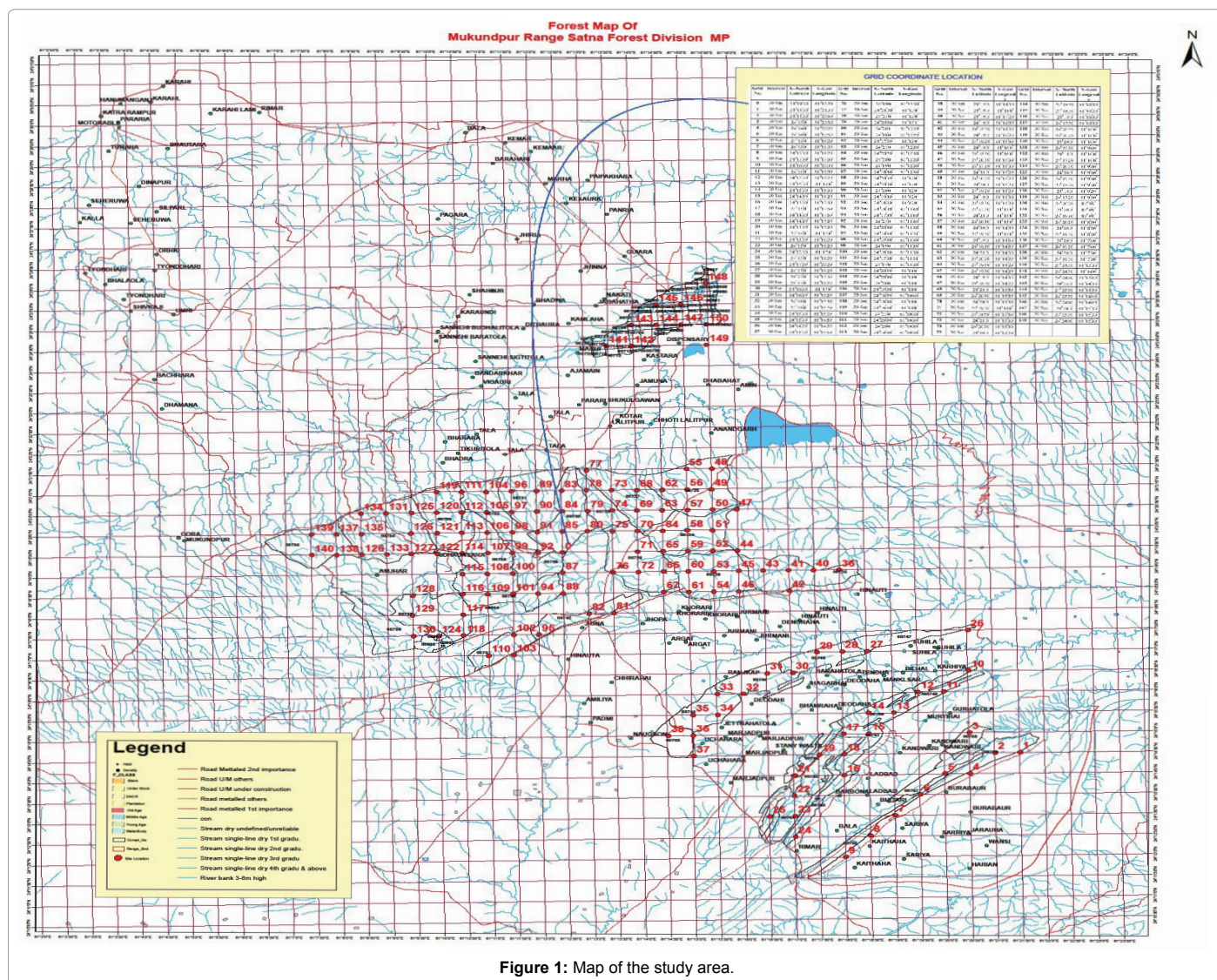
Figure 1: Map of the study area.

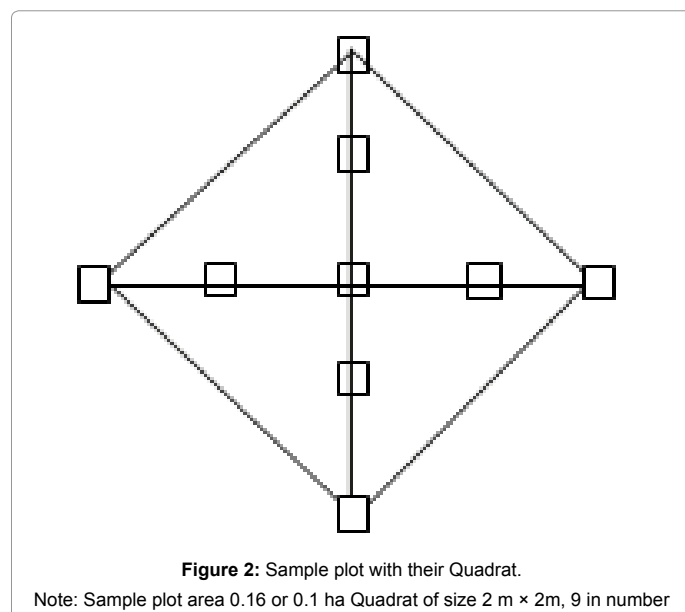Each sample points were located on ground with the help of GPS.

The grids at 35"x 35" and 30"x30" intervals are drawn by trial and error, for systematic random sampling. For drawing the grids, GIS software is used. With this software 35"x 35" and 30"x30" grids are drawn on the map of Mukundpur forests range, so that criteria for minimum number of 95 grids are achieved. The 111 and 151 random points were recorded on above grid. The 151 sample points at 30"x 30" were selected on safer side, so that points may fall in river bed, submergence and encroachments to maintain minimum criteria of 95 numbers. The longitudes and latitudes of 151 points were noted and listed from top of sheets. Out of 151 points, 67 points are on blanks, 9 points are on stocked forests, 55 points are on under stocked forests and remaining 8 points are on submerged areas of son river reservoir.

At each sample points, the layout of sample plot of 0.16 hectare with 9 quadrate of 2 m×2 m on ground as shown in Figure 2 was done with the help of prismatic compass [14]. At these points recording of data of the girth and species of the trees, along with species of shrubs, climbers and tubers (numbers) were taken on whole sample plot of 0.16 hectare and data for species of herbs, grasses and established regeneration

was recorded at each 9 quadrate of 2mX2m. Half kg of soil sample was collected from central quadrat from the depth of 30 cm from the sample point and sent to office of Assistant Soil Testing officer at soil testing lab Rewa to assess the soil parameter pH, electrical conductivity (in mili mhos/cm),organic carbon (in %), available nitrogen (in kg/ha), available P_2O_5 (in kg/ha), available K_2O (in kg/ha) and micronutrient analysis for availability of zinc (in ppm), iron (in ppm), manganese (in ppm) and copper (in ppm) [17]. The Microsoft access program was developed to evaluate the above soil parameters in various density classes of forests.

Theses density classes are described by Anon [14] as below. Forest Density: Depending upon canopy density it is defined as Blank – Density less than 0.2, under stocked- Density between 0.2 to 0.4, Stocked – Density above 0.4, Others – Encroachment, submerged areas, rocks and river beds.

The average value of different soil parameter in different density class and in whole study area is evaluated and standard error for whole study area is calculated. In order to assess the association of various soil parameters within various density classes, testing of hypothesis at 5%

Figure 2: Sample plot with their Quadrat.

Note: Sample plot area 0.16 or 0.1 ha Quadrat of size 2 m × 2m, 9 in number

level of significance is done using Z statistics. The Z value is calculated from the formula given below:

Z_{cal} of particular soil parameter = | (Observed average value of the soil parameter in particular

Density class - average value of the soil parameter in study area) / Standard error of the soil parameter in study area |

At 5% level of significant following hypothesis is formulated:

- **Null hypothesis (H_0):** There is no significant difference in average value of the soil parameters and average value of the soil parameter of study area.

- **Alternate hypothesis (H_i):** There is a significant difference in average value of the soil parameters and average value of the soil parameter of study area.

At 5% level of significance, the testing of hypothesis has been done by following decision rules:

- If Z **calculated** < Z **tabulated** Null hypothesis is not rejected. It means there is no significant difference in average value of the soil parameters and average value of the soil parameter of study area.

- If Z **calculated** > Z **tabulated** Null hypothesis rejected. It means there is a significant difference in average value of the soil parameters and average value of the soil parameter of study area.

After calculating Z value of various soil parameters the combined effects of following parameters are studied using χ^2 analyses at 5% level of significance:

- Combined effect of pH, electrical conductivity and organic carbon within various density classes of study area.

- Combined effect of Macro nutrient (available N, P_2O_5 and K_2O) within various density classes of study area.

- Combined effect of Macro nutrient (available Zn, Fe, Mn and Cu) within various density classes of study area.

At 5% level of significant following hypothesis for χ^2 analysis is formulated:

- **Null hypothesis (H_0):** There is no significant difference combined effect of above studies within various density classes of study area.

- **Alternate hypothesis (H_i):** There is a significant difference combined effect of above studies within various density classes of study area.

At 5% level of significance, the testing of hypothesis for χ^2 analysis following decision rules are followed:

- If χ^2 **calculated** < χ^2 **tabulated** Null hypothesis is not rejected. It means There is no significant difference combined effect of above studies within various density classes of study area

- If χ^2**calculated** > χ^2 **tabulated** Null hypothesis rejected. It means There is a significant difference combined effect of above studies within various density classes of study area $\chi2$ is calculated with the formula as $\chi2$

Results and Discussion

Association of individual soil parameters in various density classes

The soil parameters studied are pH, Electrical conductivity (milli mhos/cm), organic carbon in %, available Nitrogen (in kg/ha), available Phosphorous and available potassium (in kg/ha), Zn, Fe, Mg, Cu (in ppm). Calculated value of these parameters in various forest density classes are analyzed and presented in Table 1 of this section.

pH: pH of various density classes i.e. blanks, Encroachments, stocked and under stock varies from 7.06 to 7.11 with average pH is 7.09. Results indicate that in all density classes Z_{cal} < Z_{tab} **(1.645).** In all density classes soil pH does not change significantly.

Electrical conductivity: Average Electrical conductivity for soil of study area is 0.28. This varies from 0.27 to 0.35 for various density classes from stocked to encroachments. Results indicate that when forest density decrease from stocked to under stocked and blank, the electrical conductivity does vary significantly as Z_{cal} > Z_{tab} **(1.645).** As

Table 1: Various soil parameters with in various density classes.

Density	pH	O/C (in %)	N kg/ha.	P_2O_5 (kg/ha)	K_2O (kg/ha)	Zn (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)
Blank	7.060	0.660	247.820	38.210	213.030	0.180	4.460	1.660	0.270
Encroachment	7.110	0.380	178.000	45.130	202.000	0.040	1.910	1.000	0.420
Stock	7.110	0.600	234.980	38.740	217.780	0.170	4.890	1.270	0.310
Under Stock	7.080	0.630	240.920	36.630	198.350	0.240	5.390	1.170	0.310
Average	**7.090**	**0.630**	**240.060**	**37.980**	**210.190**	**0.190**	**4.900**	**1.350**	**0.300**
Std err	**0.022**	**0.013**	**3.383**	**1.196**	**5.540**	**0.027**	**0.320**	**0.109**	**0.021**

From the Table 1 the Z $_{calculated}$ for various soil parameters within various density classes of study area is presented below in Table 2:

Z_{cal} is 1.667, 11.667, 1.667 and 1.667 in blank, encroachment, stocked and under stocked category. Thus electrical conductivity plays an important role in various density classes. But as encroachment happens i.e. breaking of forest soil for agriculture its electrical conductivity parameter becomes highly significant.

Organic carbon content: The observed values of organic matter content in percentage for various density classes i.e. blank, encroachment, stock and under stock categories and for all over study area are 0.66, 0.38, 0.60, 0.63, 0.63 respectively. The result indicates that in blank, encroachment and stocked density classes organic carbon content is significantly higher than the average value of organic carbon content of the study area as $Z_{cal} > Z_{tab}$ (1.645). But in under stocked category organic carbon content is equal to average organic carbon value of the study area as $Z_{cal} < Z_{tab}$ (1.645). The breaking of land due to agriculture reduces the soil organic carbon significantly as it assumes the value of 0.380 less than average value of 0.630. Thus forest soil till it remains in natural state and there is no breaking of land takes place, it tries to retain and check the organic matter content [18,19].

Available nitrogen: Results for average value of Nitrogen availability for whole forest of study area is 240.06 kg/ha. Results indicate that the average value of available nitrogen is 247.820, 178.00, 234.98 and 240.92 kg/ha in blank, encroachment, stocked and under stocked density classes respectively. The average value of available nitrogen in blank and encroachment category significantly changes from average value of the available nitrogen of the study area as $Z_{cal} > Z_{tab}$ (1.645). The average value of available nitrogen in stocked and under stocked category do not change significantly with average value of available nitrogen of the study area as $Z_{cal} < Z_{tab}$ (1.645). Thus as long as forest of the study area remains in un degraded state the average value of available nitrogen maintains the average value of study area. As soon as it is converted into blank and encroachment due to degradation, average value of available nitrogen changes significantly. It decreases very significantly when it comes to encroachment category.

Available phosphorous: The results of available phosphorous in kg/ha for study area is 37.98 kg/ha. The average value of available phosphorous in blank, stocked and under stocked density classes do not change significantly with average value of available phosphorous of the study area as $Z_{cal} < Z_{tab}$ (1.645). The average value of available phosphorus in encroachment category is significantly is higher than the average value of available phosphorous of the whole study area as $Z_{cal} > Z_{tab}$ (1.645). The observed value of available phosphorous in kg/ha maintains its average value of available phosphorous till the degradation in density take place from stocked forest to blank forest. When there is a breaking of forest land due to agriculture there is a significant increasing available phosphorous. This means breaking of land exposes the rocks, soil and geology devoid the vegetation, which increases the available phosphorous.

Available potassium: Results of available K_2O in kg/ha for study area is 210.190 kg/ha. The average value of K_2O in blank, encroachment, stocked and under stocked density classes are 213.030, 202.000, 217.780 and 198.350 kg/ha respectively. The average value of available K_2O in blank, encroachment and stocked classes do not change significantly with average K_2O value of study area as $Z_{cal} < Z_{tab}$ **(1.645).** In under stocked category the average value of K_2O shows significant change with average value of K_2O of the study area.

Available zinc: The result of the average value of zinc in study area is 0.19 ppm. The average value of zinc in blank, encroachment, stocked and under stocked is 0.180, 0.040, 0.170 and 0.240 ppm respectively.

The average zinc value in blank and stocked density classes do not change significantly with average value of the study area as $Z_{cal} < Z_{tab}$ (1.645). But average value of zinc in under stocked and encroachment category changes significantly with average value of the study area. Results indicate that breaking of forest land results in major loss in Zn availability.

Available Iron: The result of available Fe for study area is 4.9 ppm. The average value of Fe in blank, encroachment, stocked and under stocked category is 4.460, 1.910, 4.890 and 5.390 ppm respectively. The average value of Fe in blank, stocked and under stocked category do not change significantly with the average value of as $Z_{cal} < Z_{tab}$ (1.645). But average value of Fe in encroachment category varies significantly with average value of the study area as $Z_{cal} > Z_{tab}$ (1.645). Thus breaking of land due to agriculture significantly lowers the Fe content in encroached soil.

Available manganese: The results of average observed value of available Mn for study area is

1.35 ppm. The average Mn value for blank, encroachment, stocked and under stocked category is 1.660, 1.000, 1.270 and 1.170 ppm respectively. The average value of Mn in under stocked, blank and encroachment category varies significantly with the average value of the study area as $Z_{cal} > Z_{tab}$ **(1.645).** But average value of Mn in stocked category does not change significantly with average value of study area as $Z_{cal} < Z_{tab}$ (1.645). It means that when degradation from stocked forest to under stocked, blank and encroachment takes place there is a significant change in Mn value.

Available copper: The results for study area indicate that average observed value of Cu is 0.30 ppm. The average Cu value for blank, encroachment, stocked and under stocked category is 0.270, 0.420, 0.310 and 0.310 ppm respectively. The average values of Cu with in stocked under stocked and blank density classes do not change significantly with average value of the study area as $Z_{cal} < Z_{tab}$ (1.645). But average value of Cu in encroachment category significantly changes with average value of study area as $Z_{cal} > Z_{tab}$ **(1.645).** Thus degradation in the form of breaking of lands should be avoided in the forest area.

Association of combined soil parameters (pH, EC, Organic Carbon) in various density classes of study area:

From Table 2 the Z value of pH, EC and organic carbon various density classes of study area is given in Table 3:

To understand the association about the combined effects of the pH, EC and organic carbon within various density classes of study area, these values are converted into Z scores to maintain the same dimensional unit and hypothesis is done using χ^2 analysis. In Table 3 represented in bracket and bold represent the expected Z value.

χ^2 cal = 6.703

For degree of freedom = (4 - 1) * (3 - 1) = 6, at 5% level of significance

χ^2 tabulated = 12.592

Since χ^2 cal < χ^2 tabulated, null hypothesis is accepted. Hence overall impact of pH, EC and organic carbon do not have significant association within various density classes of study area.

Association of combined macro nutrient of soil parameters (Nitrogen, P_2O_5 and K_2O) in various density classes of study area

From Table 2 the Z value of Nitrogen, P_2O_5 and K_2O within various density classes of study area is given in Table 4:

Table 2: $Z_{calculated}$ for various soil parameters within various density classes.

| Soil Parameters | Density Classes | | | | | | | | Z_{table} at 5% level of significance (one tailed test) |
| | Blank | | Encroachment | | Stock | | Under stock | | |
	Average	Z_{cal}	Average	Z_{cal}	Average	Z_{cal}	Average	Z_{cal}	
pH	7.060	1.360	7.110	0.909	7.110	0.909	7.080	0.455	1.645
EC	0.270	1.667	0.350	11.667	0.290	1.667	0.270	1.667	1.645
O/C	0.660	2.300	0.380	19.200	0.600	2.308	0.630	0	1.645
N	247.820	2.293	178.000	16.345	234.980	1.501	240.920	0.254	1.645
P_2O_5	38.210	0.192	45.130	5.978	38.740	0.635	36.630	1.129	1.645
K_2O	213.030	0.513	202.000	1.478	217.780	1.370	198.350	2.137	1.645
Zn	0.180	0.370	0.040	5.560	0.170	0.740	0.240	1.852	1.645
Fe	4.460	1.375	1.910	9.343	4.890	0.031	5.390	1.531	1.645
Mn	1.660	2.840	1.000	3.211	1.270	0.734	1.700	1.651	1.645
Cu	0.270	1.429	0.420	5.714	0.310	0.476	0.310	0.476	1.645

From the Table 2 for results of the study of soil parameters in various density classes of study area are discussed below:

Table 3: Z value of pH, EC and Organic Carbon within various density classes.

Density	pH	EC	O/C	Total
Blank	1.36 (**0.439**)	1.667 (**2.013**)	2.3 (**2.875**)	5.327
Encroachment	0.909 (**2.617**)	11.667 (**12.008**)	19.2 (**17.151**)	31.776
Stock	0.909 (**0.402**)	1.667 (**1.846**)	2.308 (**2.636**)	4.884
Under Stock	0.455 (**0.175**)	1.667 (**0.802**)	0 (**1.145**)	2.122
total	**3.633**	**16.668**	**23.808**	**44.109**

Table 4: Z value of Nitrogen, P_2O_5 and K_2O within various density classes.

Density	N	P2O5	K2O	Total
Blank	2.293 (**1.874**)	0.192 (**0.664**)	0.513 (**0.460**)	2.998
Encroachment	18.345 (**16.127**)	5.978 (**5.714**)	1.478 (**3.960**)	25.801
Stock	1.501 (**2.191**)	0.635 (**0.776**)	1.37 (**0.538**)	3.506
Under Stock	0.254 (**2.200**)	1.129 (**0.780**)	2.137 (**0.540**)	3.52
Total	**22.393**	**7.934**	**5.498**	**35.825**

Table 5: Z value of Zn, Fe, Mn and Cu within various density classes.

Density	Zn	Fe	Mn	Cu	Total
Blank	0.370 (**1.373**)	1.375 (**1.979**)	2.84 (**1.359**)	1.429 (**1.304**)	6.014
Encroachment	5.560 (**5.438**)	9.343 (**7.840**)	3.211 (**5.383**)	5.714 (**5.166**)	23.828
Stock	0.740 (**0.453**)	0.037 (**0.654**)	0.734 (**0.449**)	0.476 (**0.431**)	1.987
Under Stock	1.852 (**1.258**)	1.531 (**1.813**)	1.651 (**1.245**)	0.476 (**1.195**)	5.510
Total	**8.522**	**12.286**	**8.436**	**8.095**	**37.339**

To understand the association about the combined effects of the Nitrogen, P_2O_5 and K_2O within various density classes of study area, these values are converted into Z scores to maintain the same dimensional unit and hypothesis is done using χ^2 analysis. In Table 4 represented in bracket and bold represent the expected Z value.

χ^2 cal = 10.436

For degree of freedom = (4 - 1) * (3 - 1) = 6, at 5% level of significance

χ^2 tabulated = 12.592

Since χ^2 cal < χ^2 tabulated, null hypothesis is accepted. Hence overall impact of Nitrogen, P_2O_5 and K_2O do not have significant association within various density classes of study area.

Association of combined macro nutrient of soil parameters (Zn, Fe, Mn and Cu) in various density classes of study area

From Table 2 the Z value of Zn, Fe, Mn and Cu within various density classes of study area is given in Table 5:

To understand the association about the combined effects of the Zn, Fe, Mn and Cu within various density classes of study area, these values are converted into Z scores to maintain the same dimensional unit and hypothesis is done using χ^2 analysis. In Table 5 represented in bracket and bold represent the expected Z value.

χ^2 cal = 5.607

For degree of freedom = (4 - 1) * (4 - 1) = 9, at 5% level of significance

χ^2 tabulated = 16.919

Since χ^2cal $< \chi^2$ tabulated, null hypothesis is accepted. Hence overall impact of Zn, Fe, Mn and Cu do not have significant association within various density classes of study area.

Conclusion

The effects of individual soil parameters on various density classes of forests are summarized below:

In blank category class individual effects of pH, P_2O_5, K_2O, Zn, Fe and Cu do not vary significantly while individual effects of electrical conductivity, organic carbon, available nitrogen and manganese do vary significantly with average values of corresponding parameters of the average value of study area.

In encroachment category individual effect of pH does not vary significantly with respect to average value of pH of study area. But in average value of other soil parameters like electrical conductivity, organic carbon, available nitrogen, P_2O_5, K_2O, Zn, Fe, Mn and Cu in this category do vary significantly as compared to average values of corresponding parameters of the study area. The breaking of land in forest area for agriculture adversely affects the various soil parameters except pH.

In stocked density class the individual effects of pH, available nitrogen, P_2O_5, K_2O, Zn, Fe, Mn and Cu do not vary significantly with the average value of corresponding parameters of study area. The average value of electrical conductivity and organic carbon in this class vary significantly with average value of the corresponding parameters of the study area.

In under stocked category the individual effects of pH, organic carbon, nitrogen, P_2O_5, Fe and Cu do not change significantly with average value of corresponding parameters of study area. The average value of electrical conductivity, K_2O, Zn and Mn parameters show significant change with average value of corresponding parameters of the study area.

When we take combined effect of pH, electrical conductivity and organic carbon on study area it indicates no significant association with respect to various density of classes. Similarly when we take the combined effect of macro nutrient (nitrogen, P_2O_5, K_2O), and micro nutrient (Zn, Fe, Mn and Cu) on study area these combined parameters do not indicate significant association with respect to various density classes.

Acknowledgment

References

1. Anderegg WR, Berry JA, Smith DD, Sperry JS, Anderegg LD, Field CB (2012) The roles of hydraulic and carbon stress in a widespread climate-induced forest die-off. Proc Natl Acad Sci 109: 233-237.

2. Anonymous (1996) Working plan code published by Chief Conservator Forests, working plan Satpuda Bhawan Bhopal, Madhya Pradesh Forest department, India.

3. Anonymous (2004), Technical report Soil Testing lab, Department of Agriculture, Bhopal, Madhya Pradesh, India.

4. Chandra LR, Gupta S, Pande V and Singh N (2016) Impact of forest vegetation on Soil characteristics: a correlation between soil biological and physic-chemical properties, 3 Biotech 6: 188.

5. Elhance D.L. (1994) Book estimating sample size for population proportion, Allahabad, India.

6. FAO (2006) Global forest resource assessment 2005 Main Report Forestry paper 147, Rome, Italy.

7. Grigal DF, Vance ED (2000) Influence of soil organic matter on forest productivity N Z J For Sci 30:169-205.

8. Hajra PK(1997) Plant diversity hotspots in India: an overview. Kolkata: Botanical Survey of India col Illus En Plant records Geog.

9. IPCC (2000) Special reports on land use, land - use change and forestry. In: Watson RT, Noble IR, Bolin B, Ravindranath NH, Verardo DJ, Dokken DJ (eds) Intergovernmental Panel on Climate Change (IPCC), Cambridge University Press, Cambridge, UK.

10. Jain SK and Rao RR (1983) An assessment of threatened plants of India, Botanical survey of India, Calcutta, India.

11. Jain AK IFS (2008) Forest resource survey, Part-1, Page 47 to 53, working plan of Satna revised for 2008-09 to 2017-18, Government of Madhya Pradesh Forest Department, Chapter of Forest resource survey.

12. Baishya J, Sharma S (2017) Analysis of Physico-Chemicals Properties of Soil under Different Land Use System with Special Reference to Agro Ecosystem in Dimoria Development Block of Assam, India. Int J Sci and Edu 13: 5.

13. Singh P, Sahu S, Singh PK, Singh N. Study of Forest Resources in Mukundpur Forest Range of Satna, Forest Division, Madhya Pradesh, India.

14. Mohd-Aizat A, Mohamad-Roslan MK, Sulaiman WN, Karam DS(2014) The relationship between soil pH and selected soil properties in 48 years logged-over forest. Int J Sci and Edu 4: 1129.

15. Reddy CS (2008) Catalogue of invasive alien flora of India. Life Sci J 5: 84-89.

16. Sedjo R, Sohngen B (2012) Carbon sequestration in forests and soils. Annu Rev Resour Econ 4: 127-144.

17. Geeta T, Deepti K, Lata R, Poonam Y, Chitra P, et al. (2016) Assessment of Physicochemical Properties of Soils from Different Land Use Systems in Uttarakhand, India J Chem Eng and Chem Res 3: 1114-1118.

18. Zaman MA, Osman KT and Haque Sirajul SM (2010) Comparative study of some soil properties in forested and deforested areas in Cox's Bazar and Rangamati Districts, Bangladesh J Forest Res 21: 319-322.

19. Zhu J, Liu Z (2004), A review of disturbance ecology of forest. Ying Yong Sheng Tai Xue Bao 15: 1703-1710.

Author Affiliation   Top

[1]Department of Botany,Govt.Girls PG College, Rewa, India

[2]Department of Biolotechnology,A.P.S.University, India

[3]Chief Conservator of Forest,Satpura Bhavan,Bhopal, India