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SOIL PROPERTIES AS INFLUENCED BY ELEVATION: A FACTOR ANALYSIS

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Abstract: Soil properties in 0-100 cm layer of three different elevations, 150 (E_1), 750 (E_2) and 1450 (E,) m asl were subjected to factor analysis. Out of the nine variables studied viz., gravel, sand, pH, water holding capacity, organic carbon, cation exchange capacity, total N, P and S, factor analysis identified three factors in E_1 and E_3 and two factors in E_2 in the 0-100 cm layer. In E_1 and E_3 three factors accounted for 70% and 78% variations, respectively while in E_2 two factors accounted for 67% variation.

Key Words: Elevation, factor analysis, forest management, soil properties.

INTRODUCTION

As a result of the variation in elevation and changes in climatic conditions, quite contrasting flora grow at different elevations which in turn influence the development of soils and hence their properties (Gangaopadhyay *el al.*, 1990). Factor analysis brings out soil relationships among sets of interrelated variables by a small set of relatively independent and interpretable but not directly observable factors. This investigation was undertaken to study the factor analysis of soil variables in different elevations.

MATERIALS AND METHODS

A hilly region was selected at Arippa, E_1 (150 m asl) in Trivandrum Forest Division, Chandanathod, E, (750 m asl) in Wynad Forest Division and Myladumpara, E_3 (1450 m asl) in Munnar Forest Division. In each hilly region, areas of 250 m x 250 m were demarcated in the upper and lower slopes to represent square plots. There were five subplots, each of 50 m x 50 m and one soil pit was taken from every sub-plot at random. Samples from 0-15, 15-50 and 50-100 cm layers of soil were collected. Gravel (G), sand, pH, water holding capacity (WHC), organic carbon (OC), cation exchange capacity (CEC), total N, P and *S* of soils were found out following standard procedures (ASA, 1965 and Jackson, 1958).

The soil properties in the 0-100 cm layer of E_1, E, and E_3 were subjected to factor analysis. To find out the factors associated with soil properties in different elevation, the principal factor analysis as described by Harman (1976) was used. Kaiser's (1958) varimax rotation was also incorporated in the programme.

RESULTS AND DISCUSSION

Factor analysis of soil properties in the 0-100 cm layer identified three factors in E, and E_3 and two factors in E_2. The proportion of variance explained by common factors is called the communality of the variables. The factor loadings and the communalities after iteration are given in Table 2. Three factors accounted for 70% and 78% variations among nine variables in E_1 and E_3, respectively while in E, two factors accounted for 67% variation.

Five soil variables under factor 1 (G, OC, N, CEC and S) were found to have positive loadings. This factor contributed 46% to the total variability. The soil variables were mainly on measuring 'nutrient capital' of the soil. Factor 2 had only two soil variables (WHC and P), with positive loadings which could measure physical component and nutrient capital of the soil. There were two soil variables vi/.., sand and pH under factor 3 and were found to measure textural and physical components of the soil, respectively.

Factor 1 of E, contributing 52% to the total variability had six soil variables with positive loadings. The soil variables were mainly on measuring physical component, organic matter component and nutrient capital of the soil. There were only three soil variables (G, sand,

Table 1 Mean values of soil properties in different elevations and depths

Elevation	Depth (cm)	Gravel (%)	Sand (%)	pH	WHC (%)	OC (%)	N ppm	CEC cmol(+) kg^{-1}	P ppm	S ppm
E_1	0-15	17.31	65.52	6.10	40.90	1.45	1306	12.38	532.7	291.2
	15-50	14.00	60.38	6.08	34.52	1.27	981	11.45	304.2	232.2
	50-100	12.83	59.71	5.95	34.57	0.99	720	10.53	215.9	216.8
E_2	0-15	10.79	58.58	5.74	47.58	2.05	1620	16.85	932.8	502.9
	15-50	10.71	55.92	5.44	39.35	1.50	1120	13.26	371.4	448.2
	50-100	8.30	54.88	5.34	35.95	1.09	1027	13.18	306.8	350.1
E_3	0-15	8.37	54.38	5.12	55.97	3.62	2120	21.83	1382.9	839.5
	15-50	6.15	49.42	4.70	51.24	1.83	1603	17.80	564.1	597.4
	50-100	6.32	48.91	4.76	44.60	1.69	1297	15.95	875.9	527.1

Table 2 Factor loadings and communalities of soil properties of E_1, E, and E_3 in the 0-100 cm layer (values are in 10^{-4})

Variables	Communalities	E_1			Communalities	E_2		Communalities	E,		
		F_1	F,	F,		F,	F,		F,	F,	F,
Gravel	7255	8493	-466	444	7438	-103	8624	7072	684	8206	1708
Sand	6626	1822	2127	7643	6833	2054	8007	9097	1670	707	9364
pH	6943	3932	4559	-5760	7222	5991	6027	8799	1660	3506	8540
WHC	8650	141	9298	182	5815	7511	854	7227	851	8361	1281
OC	7605	6991	5197	402	8315	8962	1683	7702	5752	5816	3178
N	6081	6741	3658	1405	7599	8682	784	8489	9171	244	849
CEC	5044	6980	6866	1120	5887	6959	3231	8476	9069	1172	1068
P	7980	5004	7023	3137	8244	9049	749	6146	5030	5892	1202
S	6580	6826	3708	2337	3118	5380	1494	6853	6732	3304	3507

pH) under factor 2, which was found to measure the textural and physical component of the soil.

Factor 1 of E_3 was positively associated with N, CEC and S and could measure nutrient capital of the soil. Four soil variables under factor 2 (G, WHC, OC and P) had positive correlation. These variables were mainly on textural component, physical component, organic matter component and nutrient capital of the soil. Factor 3 had only two soil variables (sand and pH) with positive loadings.

The soil variables under factor 3 could found to measure textural and physical component of the soil. The reason for considering the 0-100 cm layer is that from a previous study (Rugmini and Balagopalan, 1994), it has been observed that certain factors in 0-15, 15-50 and 50-100 cm layers were common with those in the 0-100 cm layer. As such, for generalization purposes, it is more advisable to go for the soil pit i.e., 0-100 cm layer instead of interpreting the different factors in each layer. The factors identified will be of use in rating the soil in forest management programme.

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