INVESTIGATIONS ON THE SOIL EDAPHIC AND CHEMICAL FACTORS IN THE LEEWARD SIDE OF SOUTHERN WESTERN GHATS IN PANDALAM HILL MOUNTAIN

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Abstract :*Comparison between the study areas in the leeward side of southern western Ghats in the Pandalam Hill Mountain on the basis of soil edaphic like temperature, pH,Moisture content,Organic carbon content(OC) ,Exchangeable Acid(EA) ,Exchangeable Base(EB) ,sand, silt, clay and soil chemical factors like nitrogen, phosphorus, potassium, calcium and magnesium contents. 25 sites from Mekkarai, 25 sitesfrom kottavasal and 25 sitesfrom Achenkovil were selected.Soil samples of 5×5 cm^{2}area from a depth of 5 cm were randomly selected from these areas. Monthly samples were collected and pooled into four seasons like pre monsoon,monsoon,post monsoon and summer. Mean with standard deviation were taken. Season wise and site wise variation were analysed by using two way ANOVA.*

Key words :Organic carbon content, Soil edaphic factors, Soil chemical factors

1.INTRODUCTION

Soil is a natural ecosystem characterised by dynamic processes like energy flow and nutrient cycling. Soil provides an ideal habitat for the life activities of a wide range of microbes and invertebrates. The composition of soil may vary depending on physical and chemical factors. Soil is important because it provides a place for plants to grow and contains a lot of living and non living materials like rocks, minerals, bacteria, animals and nutrients.

The soil quality analysis includes an analysis of parameters and processes which effects on soil to operate efficiently as a component of a sound ecosystem. (Sangita et al.,2015). Mineral portion of the soil which consists of three distinct particle sizes sand, silt, clay. Sand cannot hold nutrients, so sandy soils are not productive in nature. Moisture and temperature also influences the fertility of the soil. In most soil the majority of carbon is held as soil organic carbon. The amount of organic carbon in the soil depends on various factors like soil texture ,climate, vegetation and land use. Soil organic matter is the major source of energy for soil microorganisms. Soil composition changes due to environmental factors, along with the influence of man and land use.

The present study was undertaken for investigating the comparative analysis of soil from three different sites in the leeward side of south Western Ghats. It is based on soil edaphic factors like soil temperature, pH ,Exchangeable acid, Exchangeable base ,Organic carbon content, Moisture content, sand, silt, and clay content and soil chemical factors like Nitrogen, Phosphorus, Potassium, Calcium and Magnesium content.

2.MATERIALS AND METHODS

2.1 Study area

The study areas were selected in the Thirunelveli Districts of Tamil Nadu and Pathanamthitta Districts of Kerala in the leeward side of Southern Western Ghats in the Pandalam Hill Mountain. Mekkarai, lies between co-ordinates of 9^0 03' N latitude and 77^0 13' E longitude; Kottavasal lies between 11^0 08' N latitude and 79^0 35' E longitude, Achenkovil lies between 9^0 05' N latitude and 77^0 07' E longitude were selected.

2.2Collection and transportation of sample

Three location were selected from the leeward side of South western Ghats -Mekkarai, Kottavasal and Achenkovil. From each site 25 sampling sites were selected. From these sites soil samples of 5×5 cm^2 area from a depth of 5 cm were randomly collected from places of different altitudes in Thirunelveli and Pathanamthitta Districts using a soil auger. The monthly data will be pooled to seasonal data taking into consideration June-August as Monsoon season; September-November as post monsoon season; December-February as summer season and March-May 2019 as pre monsoon season. Collected soil samples were taken into laboratory in polythene covers.

2.3 Soil edaphic factors analysis

From the soil samples the soil edaphic factors like soil temperature, pH ,Exchangeable acid and Exchangeable base ,Organic carbon content, Moisture content,sand,siltand clay content were detected. The soil chemical factors like Nitrogen, Phosphorus, Potassium, Calcium and Magnesium content were analysed. The soil temperature was measured from the site using soil thermometer. Soil pH was measured using soil pH meter . Exchangeable acid and Exchangeable base,Calcium and Magnesium by the 0.05methods of Jackson(1987). Edaphic factors will be estimated as per the procedure of Trivedy and Goel (1987). Soil organic carbon content was measured by using the procedure of Walkley and Black (1934). Soil moisture content was measured by gravimetry method.

2.4Soil chemical factors analysis

Soil samples are air dried and sieved, from this soil samples the chemical factors like Nitrogen, Phosphorus, Potassium, Calcium and Magnesium were analysed. The Nitrogen content was analysed by Kjeldahl distillation method , the Phosphorus content was analysed by Molybdate stannous chloride method. Potassium content was analysed by flame photometry method (APHA, 2012). The Calcium and Magnesium content of the soil were analysed by the methods of Jackson (1958).

2.5 Statistical analysis

Descriptive statistics were done by using Microsoft excel software. Two way Analysis of variance (ANOVA) was conducted to determine any significant difference in the value of each parameter between sites and season using SPSS package

3 .RESULTS

3.1 Mekkarai

3.1.1.Soil edaphic factors

In Mekkarai the soil edaphic factors like soil temperature, p^H, exchangeable acid, exchangeable base, organic carbon content, moisture content,sand ,silt, clay content were detected.

Soil temperature in Mekkarai was at an average of 27.3^0C in pre monsoon, 24.2^0C in monsoon, 26.2^0C in post monsoon, 28.5^0C in summer (Table 1). The two way ANOVA showed no significant variation between sites ($P>0.05$) and significant variation between seasons ($P<0.05$) (Table 2). The soil pH in Mekkarai was an average of 4.2 in pre monsoon, 4.06 in monsoon, 4.08 in post monsoon, 4.1 in summer (Table 1). The sites of Mekkarai was acidic in nature. The two way ANOVA showed

the pH of the soil have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 2). The moisture content in Mekkarai was an average of 77% in pre monsoon, 89% in monsoon, 82% in post monsoon, and 76% in summer (Table 1). The two way ANOVA showed the moisture content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 2)

The organic carbon content in Mekkarai was an average of 2.16% in pre monsoon, 2.03% in monsoon, 2.03% in post monsoon , and 2.08% in summer (Table 1). The two way ANOVA showed the moisture content have significant variation between sites (P<0.05) and showed significance variation between seasons (P<0.05) (Table 2). The exchangeable acid in Mekkarai was an average of 3.13% in pre monsoon, 3.08% in monsoon, 3.08% in post monsoon, 3% in summer (Table 1). The two way ANOVA showed the exchangeable acid content in Mekkarai have significant variation between sites (P<0.05) and showed significance variation between seasons (P<0.05) (Table 2). The exchangeable base in Mekkarai was an average of 9.1% in pre monsoon, 9% in monsoon, 9.1% in post monsoon, 8.9% in summer (Table 1). The two way ANOVA showed the exchangeable base content in Mekkarai have significant variation between sites (P<0.05) and showed significance variation between seasons (P<0.05) (Table 2)

The sand content in Mekkarai was an average between 54.4% and 55.4%. The silt content was an average between 12.7% and 18.8%. The clay content was an average between 3.8% and 8.9%. The two way ANOVA showed the sand content have no significant variation between sites (P>0.05) and significance variation between seasons (P<0.05) (Table 2). The two way ANOVA showed the silt and clay content have significant variation between sites (P<0.05) and showed significance variation between seasons (P<0.05) (Table 2).

Table 1: Soil edaphic factors of Mekkarai at different seasons (Mean±SD)

Season	Temperature (^{0}C)	pH	Moisture (%)	OC%	EA%	EB%	Sand%	Silt%	Clay%
Pre Monsoon	27.32±1.46	4.24 ±0.04	76.67±2.05	2.16± 0.05	3.13±0.10	9.10±0.22	55.4±0.54	12.86±0.59	3.91±0.53
Monsoon	24.28±0.34	4.062±0.04	88.83±0.87	2.03± 0.01	3.08±0.07	9.09±0.30	54.8±0.83	17.18±0.80	7.30±0.41
Post Monsoon	26.29±0.43	4.08 ±0.07	82.03±1.37	2.03± 0.02	3.08±0.13	9.12±0.31	55.4±0.54	18.8±0.55	8.9±0.48
Summer	28.51±0.50	4.12 ±0.06	75.8±1.12	2.08± 0.08	3±0.18	8.94±0.30	54.4±1.14	12.79±0.58	3.86±0.53

Table 2 : Two way ANOVA showing Soil edaphic factors in Mekkarai

Parameter analysed	Comparison aspects	F value	F critical value 5 % level	P Value
Temperature	Between sites	0.696113	2.456281	0.704406
	Between season	2.96E-21	3.554557	2.96×10^{-21}
p^H	Between sites	1.169199	3.259167	0.372367
	Between season	7.735113	3.490295	0.003868
Moisture content%	Between sites	2.178872	2.250131	0.057002
	Between season	1051.498	2.960351	4.63×10^{-28}

OC%	Between sites	5.929068	3.259167	0.007169
	Between season	14.74826	3.490295	0.00025
EA%	Between sites	6.058294	3.259167	0.006615
	Between season	2.031398	3.490295	0.163237
EB%	Between sites	98.62586	3.259167	4.52×10^{-9}
	Between season	10.92746	3.490295	3.490295
Sand%	Between sites	3.367347	3.259167	0.045649
	Between season	2.938776	3.490295	0.076372
Silt%	Between sites	32.34151	3.259167	2.43×10^{-6}
	Between season	990.338	3.490295	1.24×10^{-14}
Clay%	Between sites	126.2031	3.259167	1.08×10^{-9}
	Between season	4173.314	3.490295	2.26×10^{-18}

3.1.2 Soil chemical factors

Table 3: Soil chemical factors of Mekkarai at different seasons (Mean ± SD)

Season	Nitrogen(ppm)	Phosphorus(ppm)	Potassium(ppm)	Calcium(ppm)	Magnesium(ppm)
Pre Monsoon	2264.6±20.01	3.62±0.31	107.2±1.92	208.2±2.58	52.4±0.54
Monsoon	2362.6±95.45	3.56±0.24	130.8±10.98	221.4±18.51	59±1.58
Post Monsoon	2863±199.6	5.88±0.40	158.8±1.92	205.4±64.82	80.6±3.64
Summer	2257.6±24.87	3.53±0.32	105.8±2.38	206.8±3.03	51.8±0.83

Table 4 : Two way ANOVA showing Soil chemical factors in Mekkarai

Parameter analysed	Comparison aspects	F value	F critical value 5 % level	P Value
Nitrogen(ppm)	Between sites	1.77556	3.259167	0.19856
	Between season	39.62913	3.490295	1.67×10^{-06}
Phosphorus(ppm)	Between sites	0.93498	3.259167	0.476321
	Between season	60.44134	3.490295	1.63×10^{-7}
Potassium(ppm)	Between sites	1.40011	3.259167	0.292226
	Between season	101.9386	3.490295	8.36×10^{-9}
Calcium(ppm)	Between sites	1.548945	3.259167	0.250363
	Between season	0.272262	3.490295	0.844237
Magnesium(ppm)	Between sites	1.8	3.259167	0.193715
	Between season	260.3571	3.490295	3.5×10^{-11}

In Mekkarai , the soil chemical factors like nitrogen, phosphorus, calcium and magnesium were analysed. The nitrogen content in Mekkarai was an average of 2264.6 ppm in pre monsoon, 2362.6 ppm in monsoon, 2863 ppm in post monsoon, 2257.6 ppm in summer.

The phosphorus content was an average of 3.62 ppm in pre monsoon,3.56 ppm in monsoon, 5.88 ppm in post monsoon, 3.53 ppm in summer. The potassium content was an average of 107.2 ppm in pre monsoon, 130.8 ppm in monsoon, 158.8 ppm in post monsoon, 105.8 ppm in summer (Table 3). The two way ANOVA showed the nitrogen, phosphorus and potassium content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 4). The calcium content in Mekkarai was an average of 208.2 ppm in pre monsoon, 221.4 ppm in monsoon, 205.4 ppm in post monsoon, 206.8 ppm in summer. The magnesium content in Mekkarai was an average of 52.4 ppm in pre monsoon, 59 ppm in monsoon, 80.6 ppm in post monsoon ,51.8 ppm in summer (Table 3). The two way ANOVA showed the calcium has no significant variation between sites and season (P>0.05). Magnesium has no significant variation between sites(P>0.05) and showed significance variation between seasons (P<0.05) (Table 4).

3.2 KOTTAVASAL

3.2.1 Soil edaphic factors

In Kottavasal the soil edaphic factors like soil temperature, pH,exchangeable acid, exchangeable base, organic carbon content, moisture content, sand, silt, and clay content were detected.

Soil temperature in Kottavasal was an average of 27.3^{0}C in pre monsoon, 23.5^{0}C in monsoon, 26.9^{0}C in post monsoon, 27.9^{0}C in summer (Table 5). The two way ANOVA showed no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 6). The soil pHin Kottavasal was an average of 4.12 in pre monsoon, 4.16 in monsoon, 4.12 in post monsoon and 4.16 in summer (Table 5). The soil was acidic in nature. The two way ANOVA showed the pH have no significant variation between sites and season (P>0.05) (Table 6). The moisture content in Kottavasal was an average of 76% in pre monsoon, 84% in monsoon, 78% in post monsoon and 71% in summer (Table 5). The two way ANOVA showed the moisture content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 6). The organic carbon content in Kottavasal was an average of 5.6% in pre monsoon, 2.41% in monsoon, 2.38% in post monsoon and 5.44% in summer (Table 5). The two way ANOVA showed the organic carbon content have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 6).

The exchangeable acid in Kottavasal was an average of 2.6% in pre monsoon, 3.35% in monsoon, 3.36% in post monsoon and 2.54% in summer (Table 5). The exchangeable base in Kottavasal was an average of 12.5% in pre monsoon, 9.3% in monsoon, 9.3% in post monsoon and 12.46% in summer (Table 5). The two way ANOVA showed the exchangeable acid and exchangeable base content in Kottavasal have no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05) (Table 6). The sand content in Kottavasal was an average between 55% and 59.2%. The silt content was an average between 11.09% and 17.32%. The clay content was an average between 4.6% and 9.7%. The two way ANOVA showed the sand has no significant variation between sites (P>0.05) and showed significance variation between seasons (P<0.05). The two way ANOVA showed the slit and clay have significant variation between sites (P<0.05) and showed significance variation between seasons (P<0.05) (Table 6)

Table 5: Soil edaphic factors of Kottavasal at different seasons (Mean±SD)

Season	Temperature (0 C)	pH	Moisture (%)	OC%	EA%	EB%	Sand%	Silt%	Clay%
Pre Monsoon	27.34±1.597	4.12 ±0.04	75.56±0.989	5.6±0.18	2.6±0.24	9.10±0.22	59.2±1.09	11.51±1.66	4.90±0.76

Monsoon	23.53±0.544	4.16 ±0.11	83.8±1.698	2.41 ±0.16	3.08±0.07	3.35±0.17	59.2±2.58	17.20 ±1.77	5.3±0.68
Post Monsoon	26.90 ±0.443	4.12 ±0.08	78.4±1.115	2.38 ±0.19	3.08±0.13	3.36±0.17	55±2.23	17.32±1.73	9.7±0.89
Summer	27.99±0.325	4.16±0.05	71.03±0.789	5.44±0.20	3±0.18	2.54±0.27	59±1	11.09±1.54	4.61±0.7 3

Table 6 : Two way ANOVA showing Soil edaphic factors in Kottavasal

Parameter analysed	Comparison aspects	F value	F critical value 5 % level	P Value
Temperature	Between sites	0.528398	2.250131	0.840946
	Between season	1854.549	2.960351	2.45×10^{-31}
p^H	Between sites	1.477612	3.259167	0.269566
	Between season	0.477612	3.490295	0.703769
Moisture content%	Between sites	1.165202	2.250131	0.355149
	Between season	1219.919	2.960351	6.33×10^{-29}
OC%	Between sites	1.316882	3.259167	0.318818
	Between season	491.2314	3.490295	8.11×10^{-13}
EA%	Between sites	0.277138	3.259167	0.887132
	Between season	16.94285	3.490295	0.00013
EB%	Between sites	3.42328	3.259167	0.043571
	Between season	68.97064	3.490295	7.77×10^{-8}
Sand%	Between sites	4.479821	3.259167	0.019122
	Between season	11.5157	3.490295	0.00076
Silt%	Between sites	438.8134	3.259167	6.82×10^{-13}
	Between season	2315.523	3.490295	7.71×10^{-17}
Clay%	Between sites	17.9728	3.259167	5.26×10^{-5}
	Between season	253.2597	3.490295	4.12×10^{-11}

3.2.2 Soil chemical factors

In Kottavasal soil chemical factors like nitrogen, phosphorus, potassium, calcium and magnesium were analysed. The nitrogen content in Kottavasal was an average of 2273.4 ppm in pre monsoon,2382.2 ppm in monsoon, 3346 ppm in post monsoon, 2262.6 ppm in summer. The phosphorus content was an average of 9.18 ppm in pre monsoon, 5.42 ppm in monsoon, 9.47 ppm in post monsoon, 9.02 ppm in summer. The potassium content was an average of 105.8 ppm in pre monsoon, 146.8 ppm in monsoon, 162.8 ppm in post monsoon, 105.2 ppm in summer (Table 7). The two way ANOVA showed the NPK content have no significant variation between sites ($P>0.05$) and showed significance variation between seasons ($P<0.05$) (Table 8).

The calcium content in Kottavasal was an average of 206.6 ppm in pre monsoon, 238.2 ppm in monsoon, 240.8 ppm in post monsoon, 205.8 ppm in summer. The magnesium content in Kottavasal was an average of 52.4 ppm in pre monsoon, 54.6 ppm in monsoon, 84.4 ppm in post monsoon and 51.74 ppm in summer (Table 7). The two way ANOVA showed the calcium content have significant variation between sites and seasons ($P<0.05$) (Table 8), but in magnesium content have no significant variation between sites ($P>0.05$) and showed significance variation between seasons ($P<0.05$) (Table 8).

Table 7: Soil chemical factors of Kottavasal at different seasons (Mean±SD)

Season	Nitrogen(ppm)	Phosphorus(ppm)	Potassium(ppm)	Calcium(ppm)	Magnesium(ppm)
Pre Monsoon	2273.4±27.01	9.18±2.30	105.8±2.58	206.6±1.94	52.4±0.79
Monsoon	2382.2±144.6	5.42±0.21	146.8±11.9	238.2±18.9	54.6±5.12
Post Monsoon	3346±156.8	9.47±0.202	162.8±3.34	240.8±20.27	84.4±3.04
Summer	2262.6±32.35	9.02±2.33	105.2 ±2.38	205.8±2.28	51.74±1.19

Table 8 : Two way ANOVA showing Soil chemical factors in Kottavasal

Parameter analysed	Comparison aspects	F value	F critical value 5 % level	P Value
Nitrogen(ppm)	Between sites	0.481626	3.259167	0.749007
	Between season	100.586	3.490295	9.03×10^{-9}
Phosphorus(ppm)	Between sites	2.713469	3.259167	0.080675
	Between season	9.603985	3.490295	0.001638
Potassium(ppm)	Between sites	1.337006	3.259167	0.312164
	Between season	110.5496	3.490295	5.24×10^{-9}
Calcium(ppm)	Between sites	3.660586	3.259167	0.035882
	Between season	15.85677	3.490295	0.000178
Magnesium(ppm)	Between sites	1.352227	3.259167	0.307227
	Between season	143.9242	3.490295	1.13×10^{-9}

3.3 ACHENKOVIL

3.3.1 Soil edaphic factors

In Achenkovil the soil edaphic factors like soil temperature, pH , exchangeable acid, exchangeable base, organic carbon content, moisture content, sand, silt, and clay content were detected.

Soil temperature in Achenkovil was an average of 27.3^0C in pre monsoon, 23.5^0C in monsoon, 26.9^0C in post monsoon, 27.9^0C in summer (Table9). The two way ANOVA showed no significant variation between sites ($P>0.05$) and showed significance variation between seasons ($P<0.05$) (Table10). The soil pH in Achenkovil was an average of 5.56 in pre monsoon, 5.56 in monsoon, 5.78 in post monsoon and 5.46 in summer (Table 9). The soil was acidic in nature. The two way ANOVA showed the pH have significant variation between sites and season ($P<0.05$) (Table10). The moisture content in Achenkovil was an average of 76% in pre monsoon, 84% in monsoon, 78% in post monsoon and 71% in summer (Table 9). The two way ANOVA showed the moisture content have no significant variation between sites ($P>0.05$) and showed significance variation between seasons ($P<0.05$) (Table 10). The organic carbon content in Achenkovil was an average of 2.19% in pre monsoon, 2.28 % in monsoon, 2.35% in post monsoon and 2.14% in summer (Table 9). The two way ANOVA showed the organic carbon content have significant variation between sites ($P<0.05$) and showed significance variation between seasons ($P<0.05$) (Table 10).

The exchangeable acid in Achenkovil was an average of 82.4% in pre monsoon, 83.4% in monsoon, 85.6% in post monsoon and 80.6% in summer (Table 9). The exchangeable base in Achenkovil was an average of 8.78% in pre monsoon, 9.9 % in monsoon, 11.36% in post monsoon and 7.78% in summer (Table 9). The two way ANOVA showed the exchangeable acid and exchangeable base content in Achenkovil have significant variation between sites ($P<0.05$) and showed significance variation between seasons ($P<0.05$) (Table 10). The sand content in Achenkovil was an average between 7.94% and 8.86%. The silt content was an average between 0.55% and 0.67%. The clay content was an average between 15.6% and 17.4%. The two way ANOVA showed the sand has significant variation between sites ($P<0.05$) and showed significance variation between seasons ($P<0.05$). The two way ANOVA showed the silt and clay have significant variation between sites ($P<0.05$) and showed significance variation between seasons ($P<0.05$) (Table 10)

Table 9: Soil edaphic factors of Achenkovil at different seasons (Mean±SD)

Season	Temperature (0 C)	pH	Moisture (%)	OC%	EA%	EB%	Sand%	Silt%	Clay%
Pre Monsoon	27.34±1.597	4.12 ±0.04	75.56±0.989	5.6±0.18	2.6±0.24	9.10±0.22	59.2±1.09	11.51±1.66	4.90±0.76
Monsoon	23.53±0.544	4.16 ±0.11	83.8±1.698	2.41 ±0.16	3.08±0.07	3.35±0.17	59.2±2.58	17.20 ±1.77	5.3±0.68
Post Monsoon	26.90 ±0.443	4.12 ±0.08	78.4±1.115	2.38 ±0.19	3.08±0.13	3.36±0.17	55±2.23	17.32±1.73	9.7±0.89
Summer	27.99±0.325	4.16±0.05	71.03±0.789	5.44±0.20	3±0.18	2.54±0.27	59±1	11.09±1.54	4.61±0.7 3

Table 10: Two way ANOVA showing Soil edaphic factors in Achenkovil

Parameter analysed	Comparison aspects	F value	F critical value 5 % level	P Value
Temperature	Between sites	0.528398	2.250131	0.840946
	Between season	1854.549	2.960351	2.45×10^{-31}
p^H	Between sites	1.477612	3.259167	0.269566
	Between season	0.477612	3.490295	0.703769
Moisture content%	Between sites	1.165202	2.250131	0.355149
	Between season	1219.919	2.960351	6.33×10^{-29}
OC%	Between sites	1.316882	3.259167	0.318818
	Between season	491.2314	3.490295	8.11×10^{-13}
EA%	Between sites	0.277138	3.259167	0.887132
	Between season	16.94285	3.490295	0.00013
EB%	Between sites	3.42328	3.259167	0.043571
	Between season	68.97064	3.490295	7.77×10^{-8}
Sand%	Between sites	4.479821	3.259167	0.019122
	Between season	11.5157	3.490295	0.00076
Silt%	Between sites	438.8134	3.259167	6.82×10^{-13}
	Between season	2315.523	3.490295	7.71×10^{-17}
Clay%	Between sites	17.9728	3.259167	5.26×10^{-5}
	Between season	253.2597	3.490295	4.12×10^{-11}

3.3.2 Soil chemical factors

In Achenkovil soil chemical factors like nitrogen, phosphorus, potassium, calcium and magnesium were analysed. The nitrogen content in Achenkovil was an average of 2288.4 ppm in pre monsoon,2288.6 ppm in monsoon, 2439.4 ppm in post monsoon, 2194.2 ppm in summer. The phosphorus content was an average of 2.47ppm in pre monsoon, 2.5ppm in monsoon, 2.59ppm in post monsoon, 2.42ppm in summer. The potassium content was an average of 124.8ppm in pre monsoon, 129.6 ppm in monsoon, 136 ppm in post monsoon, 116.8 ppm in summer (Table 7). The two way ANOVA showed the NPK content have significant variation between sites ($P<0.05$) and showed significance variation between seasons ($P<0.05$) (Table 8).

The calcium content in Achenkovil was an average of1387 ppm in pre monsoon, 1444 ppm in monsoon, 1473.4 ppm in post monsoon, 1340.8 ppm in summer. The magnesium content in Achenkovil was an average of 69.4 ppm in pre monsoon, 71.2 ppm in monsoon, 73.6 ppm in post monsoon and 64 ppm in summer (Table 7). The two way ANOVA showed the calcium content have significant variation between sites and seasons ($P<0.05$) (Table 8), but in magnesium content have significant variation between sites ($P<0.05$) and showed no significance variation between seasons ($P>0.05$) (Table 8).

Table 11: Soil chemical factors of Achenkovil at different seasons (Mean±SD)

Season	Nitrogen(ppm)	Phosphorus(ppm)	Potassium(ppm)	Calcium(ppm)	Magnesium(ppm)
Pre Monsoon	2288.4±88.38	2.47±0.43	124.8±9.23	1387±168.6	69.4±4.77
Monsoon	2288.6±130.9	2.5±0.44	129.6±17.7	1444±173.8	71.2±13.14
Post Monsoon	2439.4±97.27	2.59±0.44	136±20.21	1473.4±206.2	73.6±13.3
Summer	2194.2±48.49	2.42±0.43	116.8±8.46	1340.8±188.61	64±3.39

Table 12 : Two way ANOVA showing Soil chemical factors in Achenkovil

Parameter analysed	Comparison aspects	F value	F critical value 5 % level	P Value
Nitrogen(ppm)	Between sites	17.84172	3.259167	5.46×10^{-5}
	Between season	29.14698	3.490295	8.57×10^{-6}
Phosphorus(ppm)	Between sites	536.2958	3.259167	2.06×10^{-13}
	Between season	19.48053	3.490295	6.62×10^{-5}
Potassium(ppm)	Between sites	11.54975	3.259167	0.000443
	Between season	5.40077	3.490295	0.01386
Calcium(ppm)	Between sites	110.1841	3.259167	2.37×10^{-9}
	Between season	13.06331	3.490295	0.000435
Magnesium(ppm)	Between sites	6.852497	3.259167	0.004123
	Between season	2.123273	3.490295	0.150589

4. DISCUSSION

Soil edaphic were analysed from Mekkarai , Kottavasal and Achenkovil. Soil edaphic factors like soil temperature, pH, exchangeable acid, exchangeable base, organic carbon content, moisture content, sand, silt and clay content were detected. The temperature influences the fertility of the soil, if the temperature increases the decomposition of organic matter increases. The samples from Kottavasal showed an optimum range of temperature. Environmental factors, can affect soil pH ,the pH ranges showed that the three areas were acidic in nature. The plants and soil life forms prefer either alkaline or the acidic nature of the soil. pH can also affect the availability of nutrients in the soil. The organic carbon content was more in Kottavasal than Achenkovil and Mekkarai. The soil samples from Kottavasal was sandy in nature, leaching is active in sandy soils. The clay content was more in samples from Achenkovil. The clay content and organic matter, which influence the exchange capacity of the soil.

The soil chemical factors like nitrogen, phosphorus, potassium, calcium and magnesium contents were analysed. Nutrient balance is very important in soil habitat. The mobility of nutrients within the soil is closely related to the chemical properties of the soil. The present study showed the samples from Kottavasal had high amount of nitrogen, phosphorus, potassium. The very high level of nitrogen and phosphorus content in Kottavasal is due to the chemical fertilizers during agricultural activity (Thomas , 1994). Phosphorus, nitrogen and potassium contents are very essential for the normal growth of plants. The magnesium and calcium content were more in the samples from Achenkovil. Low magnesium levels will affect grass yield as well as mineral balance in the animal.

Compared the soil samples from Mekkarai, Kottavasal and Achenkovil based on soil edaphic factors like soil temperature, pH , exchangeable acid, exchangeable base, sand, silt, and clay content, soil chemical factors like nitrogen, phosphorus, potassium, calcium and magnesium content. In each site 25 sites were selected for soil study . Soil samples were taken from each study site monthly during the pre monsoon, monsoon, post monsoon and summer seasons. Mean with standard deviation were taken for each parametervalue. Two way ANOVA was conducted to test whether the samples have variation in values between sites and seasons. From this study found that Kottavasal is more fertile than Mekkarai and Achenkovil.

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