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SOIL QUALITY – COMPARATIVE STUDY BETWEEN SACRED AND NON SACRED GROVE FORESTS

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SUMMARY

Soil is the source and sink of all nutrients on the planet. The soil quality parameters vary across various landscapes based on the variation in parent material, climatic variations, topography and type of vegetation. The Western Ghats is the area of interest in this research. It has been declared as one of the 35 Bio Diversity hotspots of the world, also as one of the eight hottest hotspots and is titled as one of the World Heritage Sites by the UNESCO. A biodiversity hotspot is a bio-geographic region that is both a significant reservoir of biodiversity and is threatened with destruction (Science daily). Several studies have been done to quantify the flora and fauna of the region. This paper deals with the soil quality comparative study between selected sacred and non sacred groves in the Central Western Ghats; also called *kans* and non *kans* respectively. Physical analyses reveal that the soils in both the sacred and non sacred groves have high moisture content and bulk density. As the samples were collected during the peak of the monsoon season, moisture content as high as 62% was recorded in Yaana and Torme *kans* and the least value of 18% was recorded in Hosagunda non *kan*. Bulk density values were highest in Kattalekan region (1.98g/cc) and least in Torme *kan* (0.52g/cc). Torme *ka*n had the most porous soil with a porosity of 79.39% whereas Hosagunda non *kan* had the least value of porosity (23.84%). The pH analysis of the *kan* and non *kan* soils showed acidic to near neutral for both *kans* and non *kans*. The Electrolytic Conductivity of the Hosagunda *kan* soil was the highest (263 µS/cm) and the least value (50µS/cm) was found at Mooruru and Vibuthi non *kans*. The available Potassium value was highest at Hosagunda*kan* area and least in Heravalli non *kan.* The soil sodium values were highest in Kattalekan region and least in Baruru non *kan* region.

Keywords: Western Ghats, biodiversity hotspots, *kan*, non *kan*.

INTRODUCTION

Soil is the loose top layer of the earth's crust composed of weathered rock, minerals and partly decayed organic matter. It is responsible for anchoring the plants on to the earth's surface, supplying it with water and nutrients required for its growth, (Alan Wild, 1993). Soil is a reservoir of nutrients in one form or other and differs from the parent material and among themselves in the morphological, physical, chemical and biological properties, (Ramachandra, 2006). Soil components include soil minerals, air, water and organic matter. Soil organic matter, derived from plant and animal residue, is the main source of food for soil organisms. The microorganisms in the soil play an important role in breaking down nutrients into a form which can be easily taken up by plants. Thus they play a major role in the Carbon and Nitrogen cycles. Organic Carbon, which is the portion of carbon present in soil organic matter, is the main source of energy for soil microbes. Soil carbon is obtained by the conversion of atmospheric carbon dioxide into the soil through the Carbon cycle. Soil sequesters double the amount of carbon dioxide sequestered by vegetation. The chemical properties of forest soils give insights to the actual nutrient status of that region as forests are relatively less disturbed by anthropogenic activities. The physical parameters of forest soils namely porosity, moisture content and water holding capacity regulate the water infiltration, ground water recharge and replenishment of streams. The nutrient levels in the forest soils are the indicators of the type of vegetation existing in the region. The organic matter content in forest soils and its stage of decomposition is an indication of the activity level of the macro and micro organisms dwelling in it.

The Western Ghats of India is covered by a blanket of lush green forests.The Western Ghats start from the Satpura range which is in southern part of Gujarat enters the states of Goa, Karnataka, Kerala and ends at Kanyakumari in Tamil Nadu with a 30km break in Kerala called the Palghat gap (Radhakrishna, 2011). The Northern half of the Western Ghats is made of basaltic rocks of volcanic origin whereas the southern half is of Pre Cambrian Rocks (Chandran *et al* 2010).The sacred groves of the Western Ghats are forests that have been worshipped and preserved by the Malnadu communities due to the presence of deities (Ramachandra *et al* ., 2012). The Uttar Kannada and Shimoga districts are rich in thick green forest cover called *kans* (Joshi and Gadgil 1991). The non sacred groves on the other hand are forests which do not have any deities associated with them and are managed by the Forest department. The Uttar Kannada district has the highest forest cover in the state, estimated to be around 5000-6000km^2 (Reddy *et al*., 1986, Gadgil *et al*., 1987). The Malnadu region, which includes the eastern and western slopes of the Western Ghats and covers the districts of Belgaum, Chikkamagaluru, Shimoga, Uttar Kannada, Kodagu and Hassan in Karnataka, India. The rocks of the Malandu region mainly consist of Dharwar (chlorite) schists granitic gneisses and charnockites derived from the Archean complex (Kamath 1985, Bourgeon 1989). The main objective of this study is the assessment of the soil nutrients, the organic matter content, the mineral content, the extend of moisture, porosity, water holding capacity of the soils in the *kans*, non *kans* and other land use land cover types in the study area. This involved (i) To analyze the physico chemical parameters of the soil samples from sacred and non sacred groves (ii) To do a comparative study on the nutrient distribution in the soils of the agricultural & plantation lands adjacent to the sacred and non sacred groves.

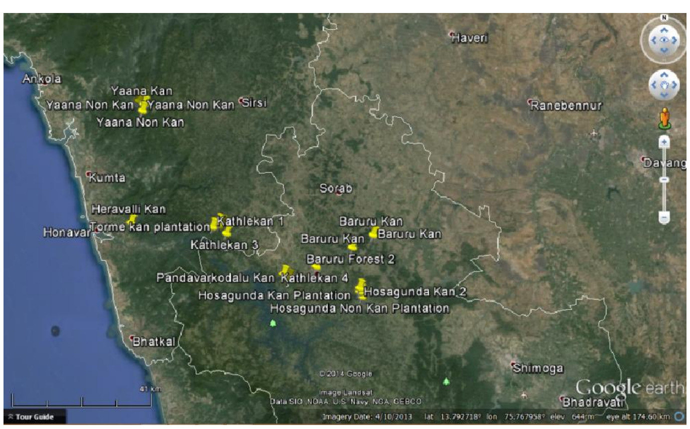

Figure: 1 Study area

STUDY AREA: The study area constitutes the sacred and non sacred grove forests in Uttar Kannada and Shimoga districts of Karnataka, India. The study area includes the *kans*, non-*kans*, agricultural fields and plantations in Vibuthi, Kathlekan, Pandavarkodalu, Hulkodu, Baruru, Hosagunda, Torme, Yaana, Heravalli and Mooruru as shown in figure 1. The soil type in the region was determined by digitizing the Traditional and Taxonomical soil maps prepared by NBSS LUP, Bangalore; and overlaying the GPS points of the study sites on the vector layers of these maps (figures 2 and 3). The study sites in Uttar Kannada have clayey soils which mainly include deep Laterite gravelly clay soils and deep brown forest soils. The Pandavarkodalu and Hulkodu regions in Shimoga have shallow red gravelly soils whereas Hosagunda has deep Laterite clayey soils and Baruru has deep alluvial loamy stratified soils. As per taxonomical soil classification, the study sites in Uttar Kannada are of Kaolinitic and Ustic origin and the study regions in Shimoga are a mix of Kaolinitic and Aquic origin. The detailed soil type of the study sites is shown in figures 4 & 5. The soil samples were collected during the monsoon season July-September 2014.

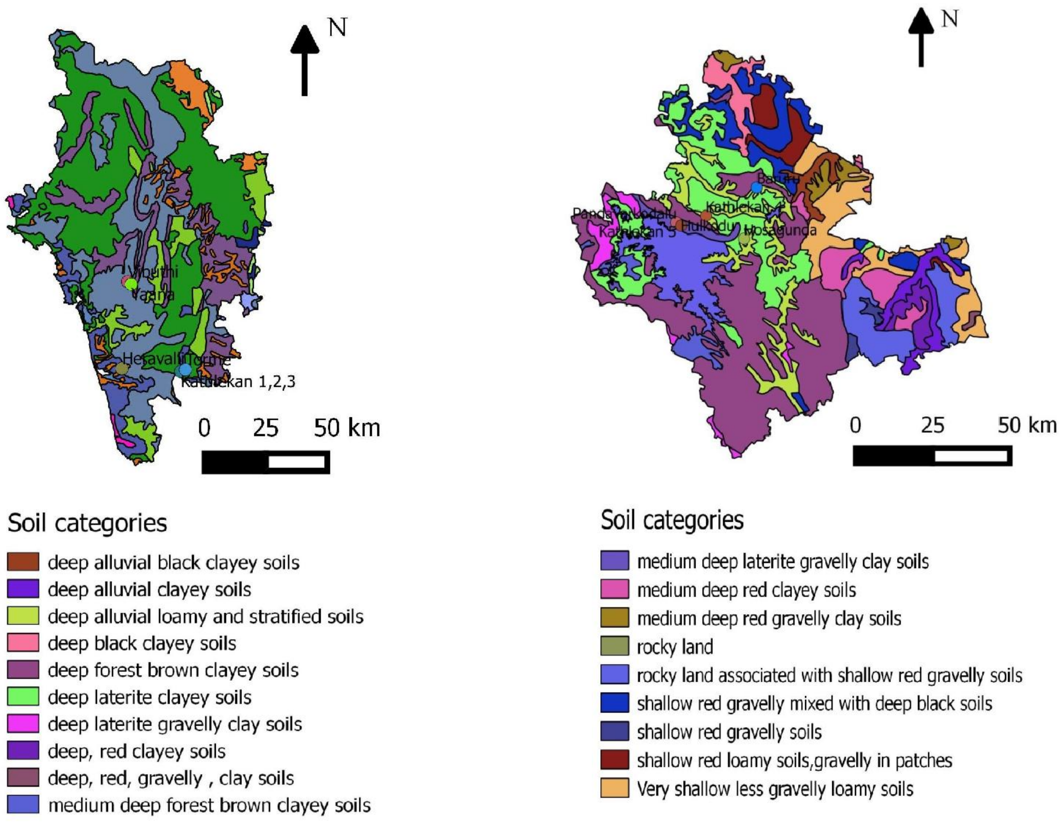

Figure 2:Laterite, Black, Red and Alluvial Soil Classification of Uttar Kannada & Shimoga districts. (Traditional Soil Classification Map source: NBSS LUP).

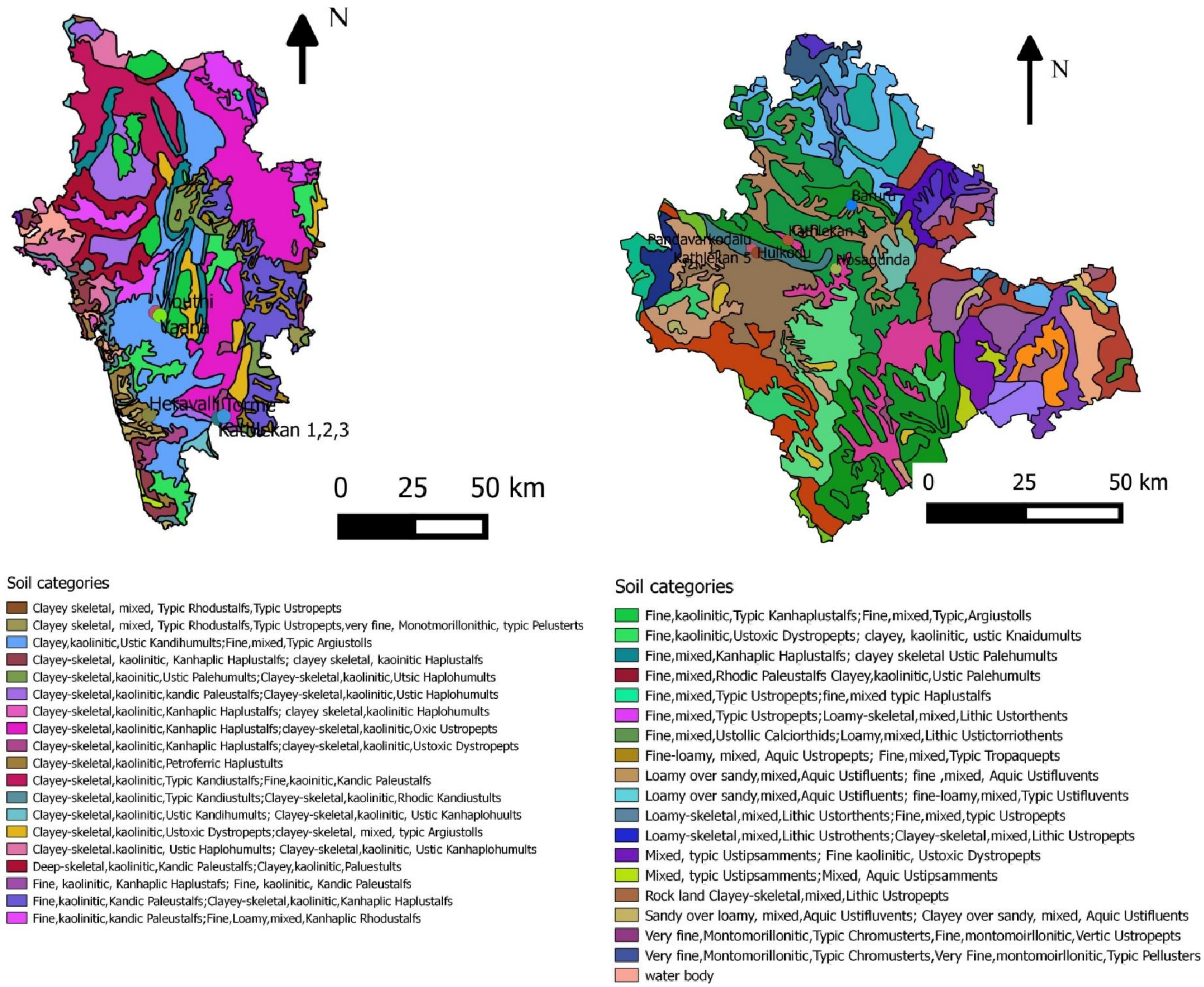

Figure 3: Soil Classification Map of Uttar Kannada and Shimoga districts(based on parent material)

(Taxonomical Soil Map source: NBSS LUP)

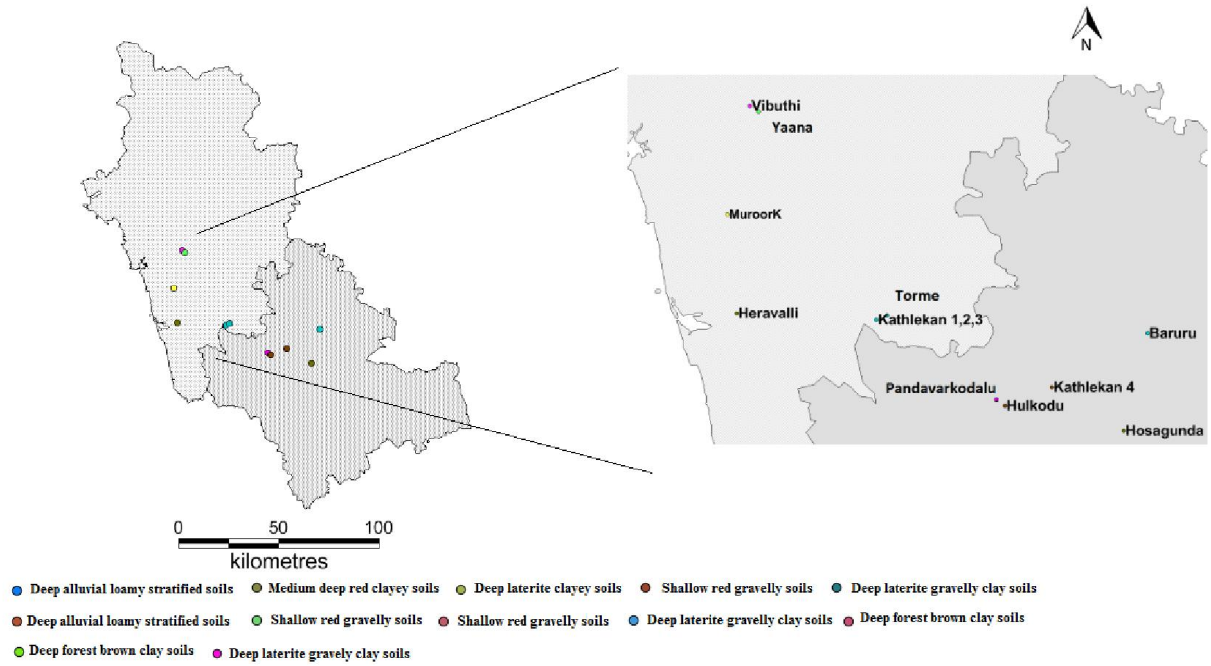

Figure 4: Laterite, Black, Red and Alluvial Soil Classification across study sites.

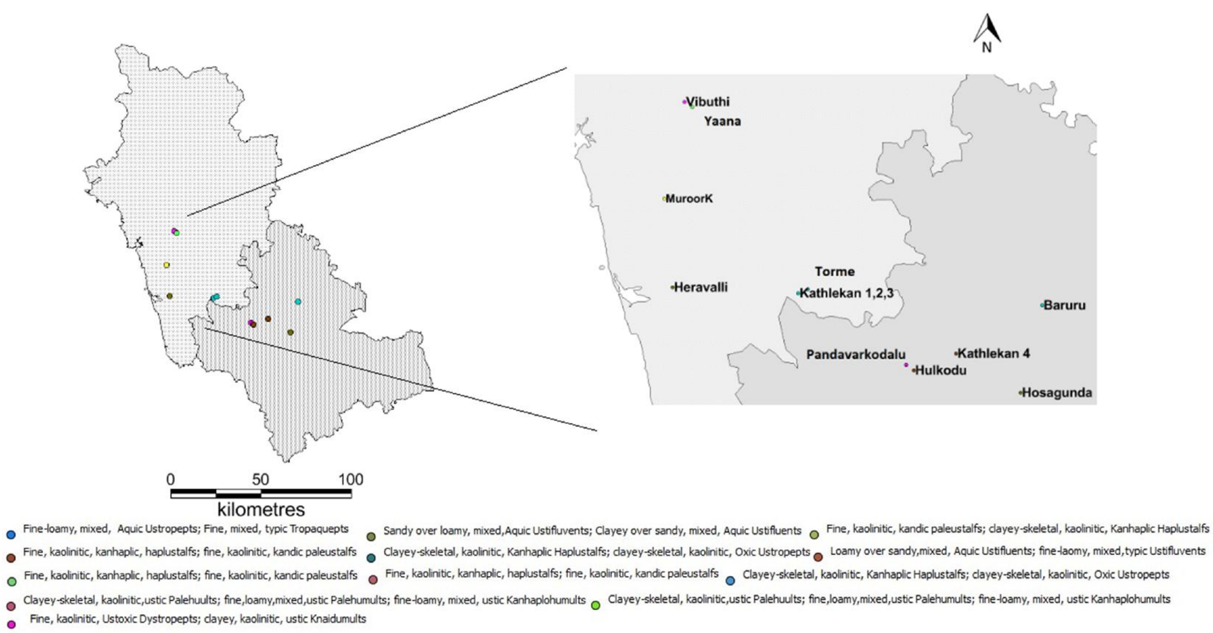

Figure 5: Parent Material based Classfication across Study sites.

METHOD

In order to carry out physico chemical and biological analysis of soils, various landscapes such as sacred groves, non sacred groves, agricultural fields (paddy, horticulture etc) and areca nut plantations were chosen in the Uttar Kannada and Shimoga districts of Karnataka. Preliminary reconnaissance survey was conducted in the forest area, familiarizing with the terrain, various types of vegetation, water bodies and fauna. Soil samples were collected from identified sample plots considering type of land cover, topography, altitude, etc. Stratified Random Sampling procedure was adopted for sampling the forest soil. Sampling plots are at a distance of minimum 250 m and soil samples are collected in transects at an interval of 80-100m. In order to establish soil sampling plots in agricultural fields and plantations, initial reconnaissance survey was done and sub samples were taken by random sampling, depending on the area of each field. Soil subsamples are taken from each representative site and then mixed properly to get a representative sample of soil from each site. Random sampling method is adopted for collecting subsamples. GPS points of all sampling spots are taken at the time of sampling (this helps in the collection of samples from the same locations in all three seasons: monsoon, post monsoon and pre-monsoon). Soil samples for soil nutrient and physico chemical parameter analyses are taken at a depth of 15cm from the surface as the soil microbial activity and biomass concentration will be highest in that region The samples collected are taken with a soil augur so as to get a comparatively less disturbed pedon of soil, the soil samples are then transferred into air tight polythene bags. Separate undisturbed samples for moisture content analysis and bulk density analysis are taken in a GI core of 20mm diameter and 18cm length and carefully transferred into air tight polythene covers and analyzed in the laboratory. Standard protocols are used for the physico chemical and nutrient analyses. The soil samples for moisture content and bulk density are collected separately in GI cores of 20mm diameter and are transferred into air tight polythene covers for further analysis. Moisture content and bulk density are calculated in the laboratory by gravimetric method. The available Potassium and Sodium in the soil samples were analyzed by extracting the Potassium and Sodium ions in the soil samples using neutral ammonium acetate solution and quantifying the concentration of Potassium and Sodium ions using Flame Photometer.

RESULTS AND DISCUSSION

A total of 16 sacred grove patches, 10 non sacred grove patches, 10 cultivation lands adjacent to sacred groves and 11 cultivation lands adjacent to non sacred groves were sampled and analyzed for physico chemical parameters. The pH of the forest soils was mostly acidic to near neutral whereas that of the agricultural and plantation fields gave neutral values. The Electrolytic conductivity did not show any pattern, it varied from as low as 44µS/cm in the agriculture field adjacent to Vibuthi non *kan* to as high as 301µS/cm at Baruru non *kan* forest. The high value of Electrolytic conductivity in Vibuthi area may be due to the soil type which is clayey. Baruru region on the other hand has deep loamy alluvial stratified soil. The moisture content was very high in all samples. This may be due to the sampling time which was during the heavy monsoon rains. The moisture content and bulk density of the forest samples were related such that higher moisture content gave lower values of bulk density and vice versa. The bulk density values increase with decreasing organic matter content (Johan 1998). The bulk densities values are higher in Shimoga non *kans* when compared with the kans in Shimoga and Uttar Kannada. The soils in the non *kans* in Uttar Kannada show a bulk density which is close to that of the kans. This may be due to the extreme clayey nature of soils in that area. Porosity is the fraction of soil which is not occupied by soil particles; it also refers to the percentage of voids which is present in the soil to permit infiltration of water through it. Considering the ground water recharge capability of the soils in the study area, porosity of the soils were also calculated. The porosity of the *kans* in Uttar Kannada were found to be varying from medium to high values with Torme having maximum porous soil. The non *kans* in Shimoga consisted of soils with less porosity. The soil in Hosagunda non *kan* showed extremely low porosity. The available Potassium and soil Sodium content in the *kans* in Uttar Kannada varied from higher values in Vibuthi area to relatively lesser values in Kattalekan, Torme areas. Kattalekan region gets higher rainfall compared to the other study sites due to the large expanse of uninterrupted thick forest cover. The available Potassium content and Soil Sodium content in the soils were found to be in trace amounts in all sites except at Kattalekan where the Soil Sodium was 14.31meq/100g and the Available Potassium at Hosagunda *kan* was 12.61 meq/100g.

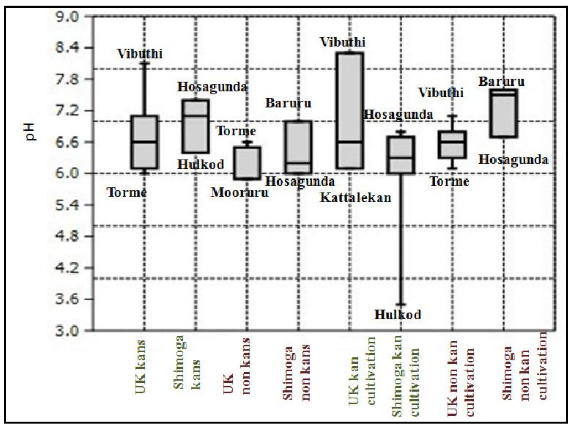

Figure 6: pH variability in study area

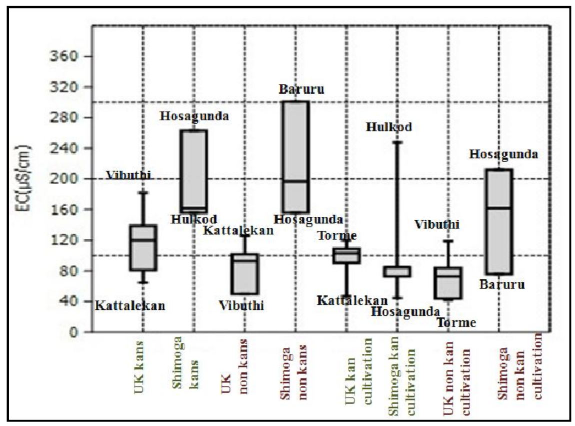

Figure 7: EC variability in study area

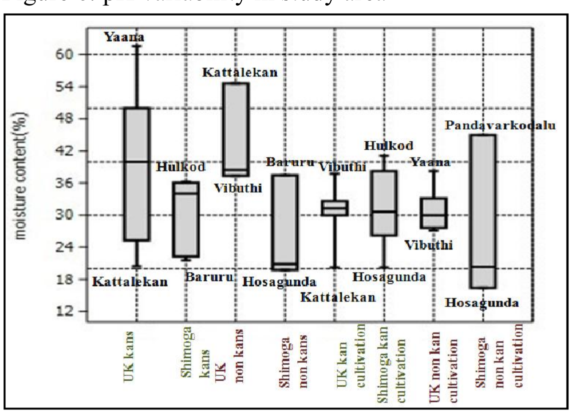

Figure 8: Moisture content variability in study area

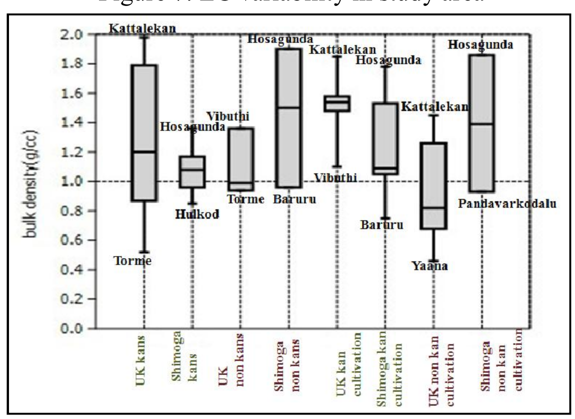

Figure 9: Bulk density variability in study area

CONCLUSION: The soil properties in the various landscapes varied with the inherent soil type of the region, the climatic condition at the time of sampling and the landscape element to which it belonged. There was not much difference in the physical properties of sacred and non sacred groves as most of the physical properties depend on the inherent soil material, amount of rainfall received, and location of the area. All the sacred and corresponding non sacred groves fell in the same soil type in all study areas. However sacred groves and less disturbed non sacred groves had high values of porosity and lesser values of bulk density. The porosity and bulk density values were inversely proportional in most of the sites except in areas of extreme clayey soil content. This may be due to the rich organic matter in this region. The values of Electrical conductivity were high in all sites, confirming the presence of ions such as Calcium, Magnesium, Chloride and Sulphates. The moisture content in the samples varies inversely with the Electrolytic Conductivity of the soil samples. This may be due to the excessive leaching of cations due to heavy rainfall. The variations in the Soil Sodium and Available Potassium values indicate that the chemical properties of the soils would throw more light on the organic content, mineral content and other variations in the soil properties. Further analysis with regard to Cation Exchange Capacity, Total Nitrogen, Total Phosphorous, heavy metal analysis etc would give a clear picture of the chemical status of the soils in the study sites. A thorough study on the biological parameters would also strengthen the facts about the actual status of the soils in the sacred and non sacred grove forests.

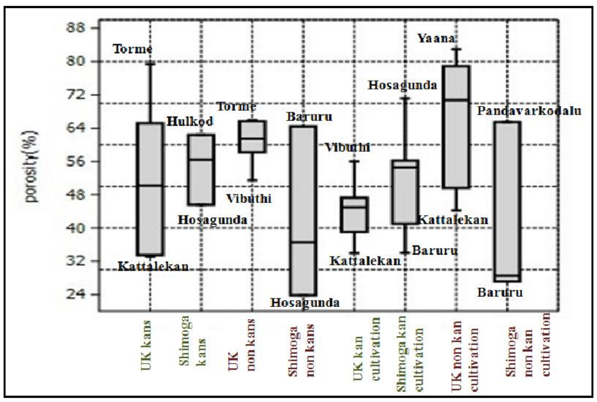

Figure 10: Porosity variability in study area

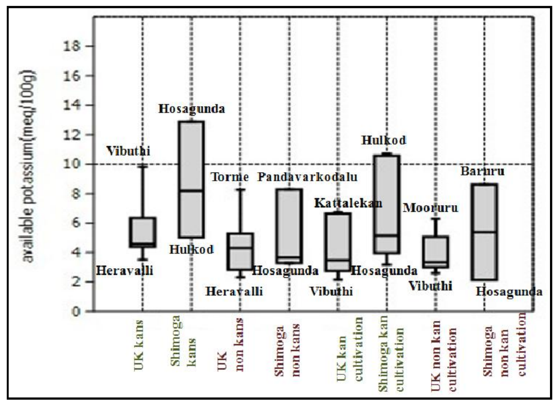

Figure 11: Available Potassium variability in study area

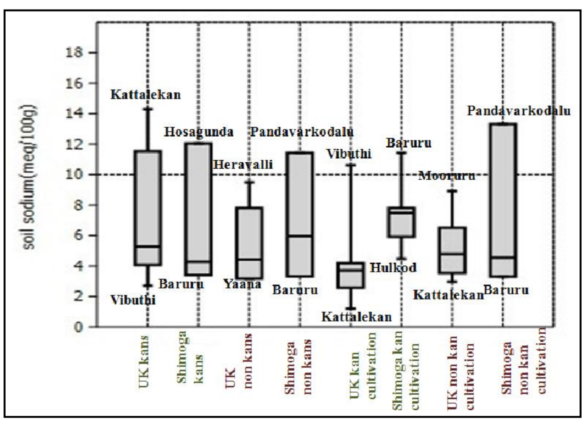

Figure 12: Soil Sodium variability in study area

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