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CHAPTER 9

ASSESSMENT OF WATER QUALITY VARIATIONS IN ANALYSIS OF PHYSICO-CHEMICAL AND BIOLOGICAL PROPERTIES OF SOILS AT AYIRAVILLI SACRED GROVE IN KOLLAM, KERALA

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ABSTRACT

Sacred Grove persisted in Kerala are the repositories of primeval biodiversity. The present study was conducted to analyse the soil properties in *Ayiravill*i Sacred Grove at Kollam District. The soil physical, chemical and biological properties were analysed and their influence in the distribution of sacred Grove of that area was assessed. For the present study soil samples were collected from five sample plots randomly selected in the Grove. The soil samples were collected from the sample plots in such a way that a pit of 30cm was made using a spade. The physical properties include soil pH, Electrical Conductivity whereas chemical analysis were carried out to detect the presence of organic carbon content, available phosphorus, Potassium, Calcium, Sulphur, iron, zinc, manganese, copper, boron, and magnesium levels of the soil. Percentage of root colonization of VAM fungi were also studied. The topsoil have high electrical Conductivity than down soil. The percentage of organic carbon content in the soil shows top layer having maximum percent than the down layer of soil. The phosphorus content is higher in top layer than down layer. It is same as in the case of available potassium, calcium. Magnesium has higher in top layer whereas Sulphur content shows variation in top layer and down layer. Iron and zinc content is higher in down layer whereas manganese content is higher in top layer. Copper content shows variations in top layer and down layer. Boron content is higher in top layer compared to down layer. The present study helps to understand the properties of soil in the Aravalli Sacred Grove, Paravoor, Kollam.

Key words: Sacred grove, VAM, Micronutrients, Physical properties

Introduction

Patches of vegetation protected on the basis of religious faith are called sacred groves. The sacred groves or sacred forest are protected areas of forest because of religious belief and an important aspect of the cultural life of various communities throughout the world (Hughes, 1997; Chandrasekharan and Sankar, 1998). It is an old tradition of preserving small patches of old growth forest as part of their culture and religious belief. Indigenous people who respect the groves with belief in nature worship inherited from their ancestor (Upadyay *et al.,* 2003). Since time immemorial conservation of natural resource has been an integral part of diverse cultures in different ways. Physically, it is a piece of forest land, but culturally, it is associated with deities, rituals and taboos. Sacred groves provide the inextricable link between present society to the past in terms of biodiversity, culture, religious and ethnic heritage. In the present day society, there are several endogamous populations that continue to practice many forms of nature worship.

Experts believe that the total number of sacred groves in India is between 100,00 to

15,000 (Malhotra, 1998). The total area under sacred groves in India has been estimated to be 33,000 hectares which come to 0.01 percent of the total area of the country (Gokhale *et al.,*1998). In India sacred groves are mainly distributed in the states of Andrapradhesh, Chattisgar, Haryana, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Tamilnadu etc. The sacred groves of Kerala are locally known as *Ayyappan kavu* or *Sastham kavu*, *Bhaghavathi kavu*, *Ammen kavu*, *Vanadhevadha kavu*, etc, depending upon the deities to whom these groves are dedicated. 644 sacred groves have been seen documented in the State. Serpent worship is an important feature of sacred grove in the state, as nearly all *kaavus* have images of snake.

In the floor of the Groove, the thick litter cover and channels created by soil macro fauna together enhances water retention, root system development, gaseous exchange, and heat conductance. The soil quality parameters vary across various landscapes based on the variation in parent material, climatic variations, topography and type of vegetation. The present work is being proposed in the above contest. In the present investigation with following objectives, proposed to understand the relationship of soil properties and microclimate at *Ayiravilli* Sacred grove region and passing the scientific information gathered from the study will influence the concerned regarding the importance to conserving the existing sacred groves for future ecosystem balance

Materials and Method

Study area: The *Ayiravalli Kavu* located 3 km from Paravoor, Kollam District has been hailed for its religious as well as geographical significance. The total area spans around 4.5 acres and includes a Temple and its associated buildings. The Temple worships Lord Shiva (Ayiravillan). The Sacred Grove forest surrounding the temple has an area of 2.5 acres. There is a *Sarpakavu* (Abode of Snake) inside the dense sacred grove rarely opens for the public. The Temple has a history that dates back to 150 years. One can find numerous small and big ponds in the Kavu whose point of end is Paravoor *Kayal*. Rare variety of trees are also present. The *Kavu* is also known for the abundance of Ayurvedic and Medicinal plants like *Kurunthotti, Vathamkolli, Thakara, Ponthakara*, etc. Water birds are also found in this region. There are numerous institutions like a school, technical education institute and an auditorium that makes the spot quite popular among the public.

For the present study soil samples were collected from sample plots, which are marked randomly within the Grove area. Five sample plots were marked with a dimension of 2m x 2m. From each sample plots three samples were randomly collected. The soil samples were collected in such a way that a pit of 30cm was made using a spade. Soil samples from the pits were collected from 0-15 cm from the top layer and 15-30cm from the bottom layer. About 500g of soil from the layer was collected and labelled and bring to the laboratory for further studies. In the laboratory the soil samples were processed in such a way that the soil was mixed well. Stones, roots and other debris were separated from the soil. The sample thus obtained was further made in to working samples of 10 g each and utilized for soil physical and chemical analysis and isolation of VAM fungal spores. Standard methods are adopted to determine the soil pH, Electrical conductivity etc. The percentage of organic carbon in the soil sample was determined by taking oven dried 10g working soil sample is transferred to a 500ml conical flask and add 10 ml 1N potassium dichromate ($K_2Cr_2O_7$) solution and 20ml concentrated Sulphuric acid (H_2SO_4) and mixed it by gentle

stirring. Keep the flask to react the mixtures for 30 minutes. After the reaction is over dilute the content with distilled water and add 10 ml of phosphoric acid and followed by 1ml of Diphenyl amine as indicator. Then titrate the sample against 0.4 N Ferrous ammonium sulphate. At the end point colour changes to brilliant green was noted. Percentage of Organic Carbon can be calculated by the formula :

Percentage of organic matter present in the soil = 10(1- T/S) X 1.34

Available phosphate was estimated by taking 3g , of soil dissolved in 200 ml of $0.02NH_2SO_4$ in a conical flask for half an hour for dissolution of the soil. After half an hour, filter the sample, take 10 ml of sample and add 5ml of Ammonium Molybdate solution followed by 2-3 drops of Stannous Chloride solution was added. A blue colour was appeared and read it within 5 minute in 690nm on a Spectrophotometer using distilled water blank. The percentage of available phospherous was calculated using the formula:

$$\text{Percentage of available phosphorus P} = \frac{\text{Mg p/r soil solution} \times 4 \times 1000}{1.724}$$

Determining the available Sulphur, 10 g dried, processed soil with 50 ml 0.15% $CaCl_2$ solution in a 250 ml conical flask for 30 minutes. Filter the extract through Whitman No 42 filter paper and estimated the sulphate content by turbidimetric procedure. To detect the available Fe, Mn and Cu, 10 g soil with 20 ml DTPA for 2 hours. Filter through Whatman No:42 filter paper. Collect the filtrate and estimate the contents of Fe, Mn, Zn, and Cu using an atomic absorption spectrophotometer.

Amount of micronutrient =Concentration from the instrument ×10.

To detect the available Boron, 20 g air dried processed soil in a 250 ml quartz or other boron free conical flask and add 40 ml distilled water. Add 0.5 g activated charcoal and boil for 5 minutes on a hot plate, filter immediately through Whatman No. 42 filter paper. Cool the content to room temperature and transfer 1ml sample solution into 10ml polypropylene tubes. Add 2ml buffer and mix. Add 2ml azomethine-H reagent, mix after 30 minutes. Read the absorbance at 420nm on spectrophotometer. Prepare a standard curve, B concentration on x-axis and absorbance on Y axis.

Available Ca and Mg are determined by taking 5 g of soil with 25ml neutral normal ammonium acetate for 5 minutes and filter immediately through Whatman No. 42 filter paper. Available K was determine by take 5 g soil with 25 ml neutral normal ammonium acetate for 5 minutes and filter immediately through Whatman No. 42 filter paper. First few ml of the filtrate may be discarded. Potassium concentration in the extract is determined using flame photometer after necessary setting and calibration of the instrument.

Root Colonisation studies were carried out to detect the presence of VAM fungi in the sample plots in the Grove. For that plants root samples of less than 0.2 mm thick are thoroughly washed in tap water to remove soil particles. Selected and cleaned roots were cut into 1cm in length by sterile blade. The root pieces were placed in a small beaker with 10%KOHL solution for about 60 minutes. A more recently developed staining method was uses ink and acetic acid (Vierheilig,*et al*.,1998). The staining solution contains 5% diluted in 5%acetic acid. Staining with Pelikan Blue (blue ink)was adopted for the present study. Keep the root in the stain for few days. Stained root becomes clearer after destaining with

50%glycerol. The percentage of root colonization was calculated with the formula:

Percentage of root colonization =

$$\frac{\text{Number of root bits with infection}}{\text{Total number of root bits examined}} \times 100$$

Results and Discussion

The soil samples collected from five different plots of the *Ayiravalli* Sacred Grove was subjected to analyse soil pH. Soil pH is a measure of acidity and basicity of soil. The pH of soil samples shows acidic in nature (Fig.1). The average pH of top soil is 5.1 and average pH of subsoil is 4.6.This shows that subsoil in all plot is slightly more acidic than that of topsoil. Some researchers found soil pH ranging from 2.87-6.40 (Khan *et al*, 1993). The result show soil is slightly acidic in nature. Soil electrical conductivity is a measurement that correlates with soil properties that affect crop productivity including soil texture, carbon exchange capacity (CEC), drainage conditions, organic matter level, salinity and sub soil characteristics.

In plot 1 top soil shows more electrical conductivity (0.2mmhos) and least by subsoil which is about (0.16 mmhos). In plot two the top soil show more electrical conductivity (0.12mmhos) and least by sub soil (0.11mmhos). The present study shows that plot 1 has more electrical conductivity than that of 2 3 4 and 5. Organic carbon is the carbon stored in soil organic matter. It is the main source of energy for soil microorganisms. In the present study it was found that the organic carbon content is higher in top soil of average 2.88% and that of subsoil is 2.24%.It is an essential nutrient both plant structure component and as a catalyst in numerous key biological reactions in plants. It captures sun's energy into useful plant components. In the present study, at site 1 the highest phosphorus content is seen in topsoil, 306kg/ha and least by subsoil 304% shows slight variation in the phosphorus content in plot 1.In site 2, 306kg/ha of phosphorus is seen in topsoil and least percent is shown in its subsoil, which is 284 kg/ha.

Pottassium is an essential plant nutrient and is required for proper growth and reproduction of plant. In plot 1 highest potassium content is shown by top soil, which is about 542 kg/ha and least by subsoil, 278kg/ha. Thus the present study shows highest potassium content is seen in topsoil of plot 1 and lowest is seen in down soil of plot 3 While, Calcium is essential nutrient for cell division and elongation, cell wall development and helps in starch metabolism. In site one, highest calcium content is seen in rhizosphere top soil (985 ppm) and least in non rhizosphere down soil (870ppm). The magnesium plays an important role in photosynthesis and building block of chlorophyll. In site one, highest magnesium content is seen in rhizosphere top soil, which is about 352.5ppm. and least by non -rhizosphere down soil, 209ppm. In site two high magnesium content is seen in non rhizosphere down soil which is about, 377.5ppm and least by rhizosphere top soil which is about 252.5ppm

Sulphure is an essential protein ingredient and helps in maintaining green colour of leaves. In site one, high sulphur content is shown by rhizosphere top soil, 31.59ppm and least sulphur content is shown by non - rhizosphere down soil, 28.82 ppm. Available Boron helps in cell wall formation and stability and maintains structural and functional integrity of biological membrane. In site one, highest boron content is seen in rhizosphere top soil, which is about 0.626ppm and least boron content is seen in non-rhizosphere down soil, 0.614ppm.In site two, high boron content is seen in rhizosphere top soil, 0.5ppm and least

content is shown in non rhizosphere down soil, which is about 0.485ppm respectively (Fig. 1).

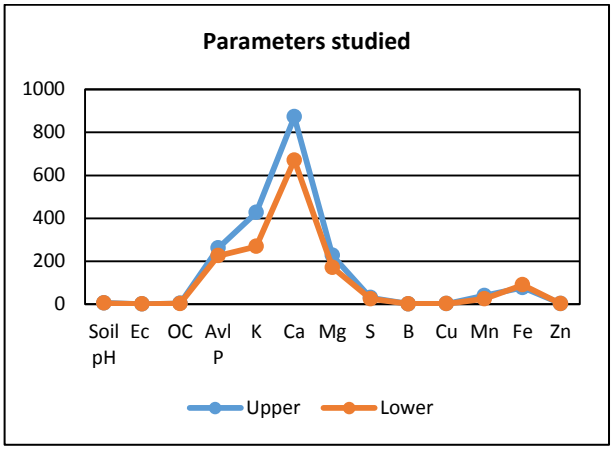

Fig.1. Comparative account of the soil parameters studied from upper and lower layer of soils at the sacred grove

Copper is an important nutrient for plant metabolism and facilities respiration and photosynthesis. In site one, highest copper content is seen in non rhizosphere down soil, which is about 1.7ppm.And least content is shown by rhizosphere top soil, 1.3ppm respectively. In plot two, high copper content is shown by non rhizosphere down soil which is about 1.9ppm and least content is shown by topsoil which is about 1.2ppm respectively. Manganese is an important plant mineral nutrient playing a role in several physiological processes, mainly photosynthesis. In site one, high manganese content is seen in rhizosphere top soil which is about 18 ppm and least manganese content is seen in non rhizosphere subsoil, which is about 13ppm respectively (Fig. 1).

Iron is an important content for the development and function of chlorophyll and range of enzymes and proteins. In site one , highest iron content is seen in non rhizosphere subsoil which is about 92ppm and least iron contents seen in non rhizosphere down soil which is about 53ppm. Zinc is an important nutrient for the formation of auxin. From the study, in site one, highest zinc content is seen in rhizosphere topsoil which is about 3.3ppm and least zinc content is seen in non rhizosphere down soil which is about 1.9ppm respectively (Fig. 1).

A correlation analysis was done on the base of the values obtained from the soil physical and chemical properties. It is depicted in the Correlation matrix (table 2). It is clear that among the parameters studied Copper and Iron showing negative correlation. While, Zn showing negative correlation with B, Cu and Fe. All other parameters are positively correlated.

The root samples were processed for VAM fungal identification. The following are the results. The presence or absence of Vesicles and Arbuscules in the root bits in each plot is represented in Table 1.

Table 1. Root colonisation by VAM fungi producing Vesicules and Arbuscules

VAM	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Vesicles	+	_	+	_	_	_	_	+	+	+
Arbuscules	_	_	_	_	_	_	_	+	+	_

The present study shows maximum percentage of root colonization was observed in plot 5 of Airavalli sacred Grove Paravoor, where both vesicles and arbuscules are seen in the top layer of soil. In down soil contains only vesicles. In plot 3, no root colonization was observed. In plot 1 and 2, vesicles are only seen in top soil. In plot 4, vesicles and arbuscules are seen in down soil only. The above study revealed that the top layer of rhizosphere soil shows highest percentage of root colonization

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