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Nutrient status of soil samples of few sacred groves from arid region of Sangli district, Maharashtra, India

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ABSTRACT

Sacred groves are a feature of the mythological landscape and the cultural practice all over the world. These Sacred groves are protected by local community through social traditions and taboos that incorporate spiritual and ecological values. These groves are rich in biodiversity and harbor many rare species of the plants and animals. These groves vary considerable in size from few acres to hundred acres. In many sacred groves, villagers perform annual rituals and ceremonies to appease the presiding deities and to ensure the well-being of the community. In the present study six sacred groves viz., Sagareshwar, Shukacharya, Aarewadi, Banali, Raywadi and Dandoba located in arid region of Sangli District in Maharashtra are analyzed for their nutrient status in soil. The present study indicates that the water holding capacity ranges between 38 to 49 %. The soil shows mostly alkaline pH. The NPK statuses as well as secondary elements were analyzed. The study indicates that the soil is deficit in major nutrients. The soil substratum is hard. These sacred groves shows presence of many herbs, shrubs and ground vegetation covered with grasses. It forms typical plant diversity within these sacred groves.

Keywords: Sacred Groves, Nutrient status, Soil, Sangli.

INTRODUCTION

Sacred groves were a feature of the mythological landscape and the cultural practice of many parts in the globe. In India, sacred groves are scattered all over the country and do not have any federal legislation. Each sacred grove is associated with presiding deity and the groves are referred to by different names in different parts of India. They were maintained by local communities with hunting and logging strictly prohibited within these patches. Sacred groves occur in variety of places like scrub forests in the Thar desert of Rajasthan to tropical rain forest of Kerala in Western Ghats. In Maharashtra there are about 2820 sacred groves found in tribal as well as non-tribal areas

forming an important landscape feature in the deforested hill ranges of the Western Ghats dedicated to various deities viz., Mhasoba, Biroba, Maruti, Vaghoba, Ekvira, Mahadev, Khandoba and Shirkai (Deshmukh, 1999; Ghate, 2014 and Amirthalingam, 2016).

The study of soils microbial function can provide important information when evaluating soil remediation. Soil represents heterogeneous habitat in which the environmental conditions can differ markedly from one microhabitat to the next. These microhabitats in the soil correspond to a large number of ecological niches.

The agriculturalists were quiet conscious about the nature of the soils and its relation to the production of specific crops (Raychaudhari, 1975; Velayutham and Pal, 2004) physical condition and chemical characteristics of soil play an important role in determining the environment in which biological processes took take place and can be defined at different spatial and temporal scales (De Vos et al., 1994).

It can be also started as, sacred grove is a small or large, isolated area that has escaped the extreme changes undergone by the surrounding area, as during a period of glaciations, allowing the survival of plants and animals from an earlier period. Each sacred grove has its own flora and fauna. Similarly, the soils substratum varies with physico-chemical parameters and composition of living organisms. The physico-chemical properties determine the suitability of a soil for production of different crop plants (Brady, 1995). Sacred groves play a crucial role in soil conservation. Soil erosion is prevented because of water retention capacity and the soil binding nature of trees. The root mat prevents the nutrients from leaching out. They also play an important role in soil and water conservation and are often the only source of water for many animals and birds (Amirthalingam, 2016).

The present paper deals with the investigation of nutrient status of seven different sacred groves viz., Aarewadi, Banali, Dandoba, Raywadi, Sagareshwar and Shukacharya from arid region of Sangli District.

METHODOLOGY

During the present investigation six different sacred groves viz., Aarewadi, Banali, Dandoba, Raywadi, Sagareshwar and Shukacharya from arid region of Sangli District were visited regularly from May 2014 to April 2016. Similarly data on status, deities, trust etc. was collected from local inhabitants by personal discussion as well as visits which are given in Table1.

The soil sample was collected from 3-4 different spots at depth of 0 to 30 cm from 50 meter circumference of the temple site. The collected soil was well mixed, sun dried and used for granulometry as well as analysis of physico -chemical parameters of the soil. The granulometry was carried out by using sieve sets of Jayant Make having different pore size. The other physico-chemical parameters were analyzed by using standard methods mentionned by Trivedy, Goel and Trisal (1997).

Study area

Sangli District is located in southern-western part of Maharashtra State having area 8522 Sq.km. geographical area which is situated between 16° 4′ to 17° 1′ North latitude and 73° 43′ to 75° 00′ East longitude. This district consists of 11 Tahsils with total 723 villages. The district is divided into two major regions viz., Western area along Krishna river basin with abundant water supply and arid region includes drought prone zone along Eastern part. The arid region includes Kadegaon, Khanapur, Atpadi, Tasgaon, Jath, and Kavathe-Mahankal Tahsil and Eastern part of Miraj Tahsil. The average rain fall is about 620 mm per year due to South-West Monsoon. The average temperature of this area ranges from 13^{O}C to 45^{O}C.

The present sacred groves under study viz., Aarewadi, Banali, Dandoba, Raywadi, Sagareshwar and Shukacharya are reported from scarcity zone or drought prone zone with uncertainty of rains from Sangli district of Maharashtra State (Table 1.).

RESULTS AND DISCUSSION

Sacred groves are protected areas of forest because of religious beliefs and constitute an important aspect of the cultural life of various communities throughout the world. The biodiversity keeps the ecological processes in balanced state, which is necessary for human survival. Therefore, the biodiversity rich sacred groves are of immense ecological significance. The soil substratum plays an important role in the conservation of flora and fauna. Vishwanath and Ukil (1993) classified 4 major climatic zones (arid, semi-arid, humid and prehumid) based on soil map prepared in 1943. Indian arid zone

receives low rainfall (100-400mm), which is highly erratic in both spatial and temporal distribution. This area receives average rainfall of about 400-500 mm well distributed from June to October every year. Due to drought situation during last two years, the area shows extreme temperature variations from 8^0C (during winter) to 45^0C (during summer). This makes the area water deficit zones. Soil on the basis of different particle size distribution, pH, cation exchange capacity or organic matter content, thus can affect microbial community structure either directly i.e. by providing a specific habitat that selects specific microorganisms or indirectly i.e. by affecting plant root functioning and exudation in a soil specific manner.

The physical condition and chemical characteristics of soil play an important role in determining the environment in which biological processes take place and can be defined at different spatial and temporal scales (De Vos et al., 1994). Similarly, the physico-chemical properties can determine the suitability of a soil for production of different crop plants (Brady, 1995).

The physico-chemical characteristics of soils can directly influence the structure, spatial distribution and activity of microbial population and enzymes in soils, which are potential early indicator of soil health and quality (Schnurer et al., 1985; Dick, 1994). Jenkinson and Powlson (1976), Ayanaba et al. (1976), Anderson and Domsch (1978) and Brookes et al. (1982) reported that recognition of the importance of soil microorganisms in the functioning of ecosystem has led to an increased interest in measuring the nutrients held in soil biomass. There are various processes that are capable of producing different types of clay minerals. Pal et.al. (2003) demonstrated that the main soil forming processes were clay illuviation and deposition of pedogenic $CaCO_3$.

Table 1: Salient features of the sacred groves from arid region of Sangli district.

S.No.	Name of the Grove	Deity	Area (Acres)	Tahsil
1	Aarewadi	Biroba	350.00	Kavathe Mahankal
2	Banali	Banshankari	27.00	Jath
3	Dandoba	Dandnath	200.00	Miraj
4	Raywadi	Shiva	20.00	KavatheMahankal
5	Sagareshwar	Lord Shiva	12.34	Kadegaon
6	Shukacharya	Shukdev	500.00	Khanpur-Atpadi

Table 2: Granulometry and water holding capacity of soil samples of 6 sacred groves from arid region of Sangli district.

S.No.	Name of the grove	Gravel %	Fine sand %	Silt %	Clay %	Water holding capacity %
1	Aarewadi	18.65	65.67	14.99	0.69	45
2	Banali	9.33	45.75	43.00	1.92	41
3	Dandoba	28.17	58.15	13.53	00.15	38
4	Raywadi	33.05	53.34	13.40	0.21	39
5	Sagareshwar	24.37	50.37	24.50	0.72	49
6	Shukacharya	27.87	56.21	15.21	10.56	44

Table 3: Chemical parameters of soil samples from 6 sacred groves from arid region of Sangli district.

S.No.	Name of the grove	pH	E.C.	Organic Carbon %	$CaCO_3$ %
1	Aarewadi	8.02	0.269	0.87	10.50
2	Banali	7.32	0.79	1.03	2.0
3	Dandoba	6.58	1.653	0.99	2.25
4	Raywadi	8.12	0.292	0.91	9.50
5	Sagareshwar	7.72	0.286	0.89	5.00
6	Shukacharya	7.81	0.227	0.97	3.75

Table 2 gives the analysis of soil components and water holding capacity of the soil. It is clear from the table that in all six sacred groves under study soil is mainly composed of gravel and fine sand particles. It leads to low water holding capacity, which ranges from 38 % to 49 %. The water is received only during rainy season. The surface ran off is more and hence low water table is noticed in this area of sacred groves under study. Recent studies were conducted in sacred groves of Meghalaya have focused on the existence of such forests, their spread in the state and extent, current status, biology content and cultural ethos associated with them (Tiwari et al., 1999). Different tree species tend to establish in different soil. But trees themselves also affect the chemical and microbial properties of soil.

The normal range of soil pH values is from 4 to 10. However, most plants prefer conditions between pH 6.5 and 7.5. Some specialized plants tolerate values outside this range (Dexter and Zoebisch, 2006). The pH of the soil in studied areas is mostly alkaline except Dandoba (6.58) which ranges from 7.32 to 8.12. It indicates more carbonates in the soil (Table3).The physico-chemical characteristics are potential indicator of soil health and quality (Dick, 1994). Juo et al. (1995) reported that when forest land was cleared there was no change in soil pH, at least until 13 years of bush re-growth. Different tree species tend to establish in different soils, but trees themselves also affect the chemical and microbial properties of soil. Spruce species have been shown to decrease the soil pH and slow down the cycling of nutrients, leading to the formation of more humus (Micola, 1985). Whereas birch species may raise the pH, enhance the cycling of nutrients and lead to mull humus. (Miles and Young 1980; Bradley and Fyles, 1995).

The chemical characteristics make a significant contribution in determining the quality and may even determine the maximum quality of a particular soil (Hassink, 1997).

The soil nutrients play an important role in the development of different plant species. The nutrient status of natural soil is dependent upon the added organic soil is dependent upon the added organic matter. During the nutrients of the soil, samples from 6 different groves were analyzed. Soil microbial populations may act as early indicators of changes in soil quality as they can respond much rapidly than soil C or N (Kennedy and Papendick, 1995). It contributes to the maintenance of soil quality through decomposition, nutrient cycling and availability and soil aggregation. For growth of plants and animals, macronutrients like nitrogen (N), phosphorus (P), potassium (K), sodium (Na), sulfur (S), magnesium (Mg), and calcium (Ca), and micronutrients like boron (B), molybdenum (Mo), chlorine (Cl), iron (Fe), manganese (Mn), and others are essential (Klik, 2004).

Table 4: Nutrient status of the soil samples from 6 different sacred groves from arid region Sangli District.

S. No.	Name of the Sacred Grove	Primary Elements (PPM)			Secondary Elements (PPM)				
		N	P	K	Ca	Mg	S	Cl	Na
1	Aarewadi	132	14	282	8946	202	23	142	49
2	Banali	135	23	288	1561	217	26	227	57
3	Dandoba	210	27	524	2508	410	21	539	167
4	Raywadi	138	15	301	7163	219	27	156	74
5	Sagareshwar	139	18	298	3204	70	27	199	47
6	Shukacharya	123	19	264	1988	205	23	227	61

Table 5: Micronutrients (ppm) from soil sample from 6 sacred groves from arid region of Sangli District.

S. No.	Name of the grove	Iron	Zinc	Copper	Manganese	Boron	Molybdenum
1	Aarewadi	3.08	0.45	0.53	3.26	0.24	0.31
2	Banali	5.62	0.92	0.61	5.12	0.27	0.25
3	Dandoba	5.21	1.16	0.91	5.37	0.31	0.20
4	Raywadi	3.29	0.32	0.54	3.40	0.19	0.15
5	Sagareshwar	4.88	0.84	0.58	5.01	0.22	0.30
6	Shukacharya	5.04	0.98	0.87	4.80	0.17	0.28

Table 4 indicates that the soil is deficit in major nutrients like nitrogen, phosphorus and potassium. Nitrogen ranges from 123 ppm to 210 ppm. The lowest value 123 ppm is recorded at Shukacharya while Dandoba records highest value of 210 ppm. The Phosphorus content of rocks is commonly between 500 and 1400 µg P/g depending on the parent rock type. Of the igneous rocks basalts are usually at the upper end of this range, while granites and most sedimentary rocks are at the lower end. Above this range are rock phosphates, some limestones and some basic volcanic lava. Typical total P contents in soils range from 150 to 700 µg P/g (Wild 1988). During present study phosphorus ranges from 14 ppm to 27 ppm. The most of the soil is in almost equal range for phosphorus. Nutrients in soil exist mostly in organic and inorganic form, both of which are important source of plant and microbial uptake (Lyons et al., 1998). The soil Phosphorus availability is controlled by environmental conditions such as soil organic matter, moisture content and aeration, which influence microbial activity and eventually transformations of phosphorus (Hedley and Stewart, 1982; Bloom et al., 1985; Read, 1991).

Potassium ranges from 264 ppm to 524 ppm. The average range recorded is upto 301 ppm. In most the soil samples the range is 264 to 301 ppm except Dandoba where it is 924 ppm. According to Brookes et al. (1985) microbial biomass in soil is a relatively large and a labile component of organic matter containing important plant nutrients, especially N and P.

An increase in the size of the microbial biomass is considered essential for the improvement of soil because the larger the amount of biomass, the greater will be the potential availability to higher plants (Stevenson, 1986). Calcium, Magnesium, Chlorides shows variation. Calcium and Magnesium together constitutes hardness and the soil substratum is hard.The micronutrients like iron, manganese, zinc, copper, boron, molybdenum were also analyzed (Table 5). The micronutrients like iron and manganese are below to the level of 6 ppm while other micronutrients like zinc, copper, boron and molybdenum are trace elements in the present investigations as they are occurring in soil at concentrations less than 100 µg/g (Logan, 2000).

Boron plays a key role in seed production. Generally, Boron becomes less available to plants with increasing soil pH and higher quantities of available B are generally found in fine-textured than in coarse-textured soils (Chatterjee et al. 1987; Gupta and MacLeod, 2004).

According to Gupta and Macleod (2004) coarse-textured loams and silty loams are low in organic matter, as well as severely eroded and /or heavily weathered soils are particularly low in Molybdenum. Molybdenum deficiencies are common in many countries where soils are acidic and coarse in texture. Our results are also same. Deficiency symptoms for most micronutrients appear on the young leaves at the top of the plant, because most micronutrients are not readily translocated. Molybdenum is an exception in that it is readily translocated, and its deficiency symptoms generally appear as yellowing of the whole plant. Symptoms associated with Mo deficiency are closely related to N metabolism.

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CONCLUSION

The present study concludes as below-

1. The soil of arid region is either sandy or rocky or gravelly and shallow.
2. These soils have low moisture poor nutrients and low water holding capacity. The substratum is hard made up of calcareous soils. Similar type of condition is noticed in all six-grove area.
3. The soil is deficit in major nutrients like nitrogen, phosphorus and potassium and Calcium, Magnesium, Chlorides shows variation.
4. The natural vegetation under such edaphic and climatic conditions is obviously sparse and stunted, spiny and bushy. It mainly shows xerophytic plants. The forests of the area can be classified as Dry deciduous, thorn scrub type forest.

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REFERENCES

Amirthalingam M (2016) Sacred Groves of India – An Overview. *Int. J. Curr. Res. Biosci. Plant Biol*., 3(4): 64-74

Anderson JPE, Domsch KH (1978) A physiological method for the quantitative measurement of microbial biomass in soil. *Soil Biol. Biochem.*, 10: 215–221.

Ayanaba A, Tuckwell SB and Jenkinson DS (1976) The effects of clearing and croping on the organic reserves and biomass of tropical forest soils. Soil *Biol. Biochem*., 8:519–525.

Bloom AJ, Chapin FS and Mooney HA (1985) Resource limitation in plants an economic analogy. *An. Rev., Eco Systematics*, 16: 363-393.

Bradley RL, Fyles JW (1995) Growth of paper birch {Betula papyrifera) seedlings increases soil available, C and microbial acquisition of soil nutrients. *Soil Biol. Biochem*., 21: 1565-1571.

Brady, NC (1995) The Nature and Properties of Soils. Prentice-Hall of India Pvt. Ltd., New Delhi. 621.

Brookes PC, Powlson DS and Jenkinson DS (1982) Measurement of microbial biomass phosphorus in soil. *Soil Biol. Biochem*., 14:319-329.

Brookes PC, Powlson DS and Jenkinson DS (1984) Phosphorus in the soil microbial biomass. *Soil Biol. Biochem*., 16: 169-175.

Chatterjee C, Sinha P, Nautiyal N, Agarwala SC, Sharma CP (1987) Metabolic changes associated with boron-calcium interaction in maize. *Soil Sci. Plant Nur.*, 33:607–617.

Deshmukh S (1999) Conservation and Development of Sacred Groves in Maharashtra – Final Report of the world Bank Aided Maharashtra Forestry Project, BNHS, Mumbai. 1-289.

De Vos JA, Raats PAC, Vos EC (1994) Microscopic soil physical processes considered within an agronomical and a soil biological context. *Agric. Ecosyst. Environment* 5: 43-73.

Dexter AR and Zoebisch MA (2006) Degradation: Critical Limits of Soil Properties and Irreversible Degradation. *In Encyclopedia of Soil Science Ed. Marcel Dekker, New York.* 381-385.

Dick RP (1994) Soil enzyme activities as indicators of soil quality. In: Defining soil quality for a sustainable environment, Eds. Doran J.W, et al.,. Minneapolis Soil Science Society of America, (SSSA Special Publication, 35). 107-124.

Ghate V (2014) Maharashtra: Unique plant diversity of sacred groves. In: Sacred Groves of India-A Compendium. Eds. Nanditha Krishna, Amirthalingam, M., C.P.R. Environmental Education Centre, Chennai. 283–293.

Gupta UC and MacLeod JA (2006) Boron and Molybdenum. *In Encyclopedia of Soil Science, Marcel Dekker, New York*. 107-199.

Hassink J and Whitmore AP (1997) A model of the physical protection of organic matter in soils. *Soil Sci. Soc. American J*., 61: 131-139.

Hedley MJ, Stewart JWB and Chauhan BS (1982). Changes in inorganic soil phosphorus fractions induced by cultivation practices and laboratory incubations. *Soil Sci. Soc. American J*., 46: 970-976

Jenkinson DS and Powlson DS (1976) The effect of biocidal treatments on metabolism in soil –V. A method for measuring soil biomass. *Soil Biol. Biochem*. 8:209–213.

Juo ASR, Franziuebbers K, Dabiri A, Ikhile B (1995) Changes in soil properties during long term fallow and continuous cultivation after forest clearing in Nigeria. Agric. Ecosyst. Environment, 56: 9-18

Kennedy AC, and Smith KL (1995) Soil microbial diversity and the sustainability of agricultural soils. In The significance and regulation of soil biodiversity Eds. Kluwer Dordrecht, pp: 75–86.

Klik A (2004) Erosion and water Quality. In Encyclopedia of Soil Science. Ed. Marcel Dekker, New York, 498-505.

Logan TJ (2000) Soils and environmental quality. In Handbook of Soil Science, Eds. Sumner ME. CRC Press: Boca Raton, 155-163.

Lysons JB, Gorres, JH and Amator JA (1998) Spatial and temporal variability of phosphorus retention in a riparian forest soil. J. Environ. Quel., 27: 895-903.

Micola P (1985) The effect of tree species on the biological properties of forest soil. Nat. Swed. Environ Prot Board., 3017:1-29.

Miles J, Young WF (1980) The effect of heathland and moorland soil in Scotland and northern England following colonization by birch (Betula spp.). Bulletin Ecology, 11: 233-242.

Pal DK, Srivastava P and Bhattacharya T (2003) Clay illuvation in calcareous soils of the semi-arid parts of the Indo-Gangetic Plains, India. Geoderma., 115:177-192

Raychaudhari SP (1975) Evolution of classification of solis of India. Indian Agriac.19:163-173.

Read D. (1991) Mycorrhizas in ecosystems. Experientia, 47: 376–391.

Schnürer J, Clarholm M, Rosswall T (1985) Microbial biomass and activity in an Agricultural soil with different organic matter. *Soil Biol. Biochem*. 17: 611–618.

Stevenson FJ (1986) Cycles of Soil. *Wiley, New York*.

Tiwari BK, Barik SK and Tripathi RS (1998) Biodiversity value, status and strategies for conservation of sacred groves of Meghalaya, India. *Ecosystem Health,* 4(1): 20-32.

Trivedy RK, Goel, PK and Trisal CL (1987) Practical Methods in Ecology and Environmental Science. *Enviro Media Publications, Karad*. 340.

Velayutham M and Pal DK (2006) Soil classification, India. *In Encyclopedia of Soil Science, Ed. Marcel Dekker, New York*, 1–3.

Vishwanath B and Ukil AC (1993) Soil map of India. *Indian Agriculture Research Institute, New Delhi.*

Wild A (1988) Russell's Soil Conditions and Plant Growth. Longman Scientific and Technical, Harlow.