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HYDROGEOLOGICAL CONTROL FOR TEAK AND SAL VEGETATION IN PARTS OF MAHARASHTRA AND MADHYA PRADESH

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ABSTRACT

Study of the area within the latitudes $19^{\circ} 15'$ and $19^{\circ} 35'$ N and longitudes $80^{\circ} 00'$ and $80^{\circ} 20'$ E in Chandrapur District, Maharashtra, indicates good growth of teak utilising ground-water from the pyroxene gneisses associated with quartz schists and cherty quartz breccias.

Such study in the area within the latitudes $23^{\circ} 10'$ and $23^{\circ} 30'$ and longitudes $83^{\circ} 0'$ and $83^{\circ} 15'$ in Surguja District, M.P., reveals relationship between the growth of *Shorea robusta* and the hydrogeology of Barakar sandstones which suits the vegetation. Similarly, *sal* can grow well on Jagdalpur shales in Bastar District of M.P.

Such orientation in the survey of "vegetation cartography" will be of great utility in afforestation schemes.

INTRODUCTION

HYDROGEOLOGICAL studies in Archaean gneisses and schists relating to the sustenance of teak were initiated in 1969 in Chandrapur District, Maharashtra, in an area between the north latitudes $19^{\circ} 15'$ and $19^{\circ} 35'$ and the east longitudes $80^{\circ} 00'$ and $80^{\circ} 20'$.

Similar studies were carried out in the Barakar formation (Lower Gondwana) of Surguja District in Madhya Pradesh for *sal*. The area forms part of the Bishrampur coal field and is situated about 200 km north of Raigarh. It lies within the north latitudes $23^{\circ} 10'$ and $23^{\circ} 30'$ and the east longitudes $83^{\circ} 00'$ and $83^{\circ} 15'$. The Jagdalpur shale of the Purana System in Bastar District of Madhya Pradesh has also been examined for growth of *sal*. The area lies within the north latitudes $19^{\circ} 00'$ and $19^{\circ} 15'$ and the east longitudes $82^{\circ} 00'$ and $82^{\circ} 15'$.

Tectona grandis (TEAK)

The teak bearing area in Chandrapur District of Maharashtra forms the undulating country with an average elevation of about 140 m above M.S.L. with low ridges rising to an elevation of 170 m.

The area has a tropical climate with a mean minimum temperature of 4°C and a maximum of 47°C and receives an average annual rainfall of about 132 cm. The area consists of pyroxene gneisses with linear patches, of sericite-quartz-schist associated with quartz breccias. Two sets of joints, trending ENE-WSW and NNW-SSE and about 0.2 to 2 m apart are prevalent. The schists are sheared with the presence of cherty quartz breccias, which have very closely spaced joints. The weathered zone in the above rocks are discernible to a depth of about 6 m, with development of cavities in place of cherty material. The above openings are indeed the venues for groundwater circulation. The soil is sandy with an admixture of clay and ferruginous material with minor amounts of alumina, magnesia and traces of phosphorus and alkalies. Groundwater occurs under water-table conditions. The wells indicate water levels of 2 to 6 m below ground level (b.g.l.) in winter and 7 to 10 m b.g.l. in summer. The groundwater contains 620 ppm of total dissolved solids, 120 ppm of sodium and less than 1 ppm each of potassium and boron, these being good for sensitive vegetation. Teak forests are prevalent in

the area, where the tree attains a height upto 50 m and a diameter of about 1.2 m; the maximum growth is localised in schists and associated breccias. Laurie (1931) has expressed the possibility of lime being associated with the growth of teak in Burma. His studies in the teak area of Palakadavu valley of Annamalai Hills of Tamil Nadu show that the soil contains 0.1 to 0.385% of CaO, 0.071 to 0.088% of P_2O_5 and 0.219 to 0.258% of K_2O . The rocks in the area are charnockites very much similar to the rocks of Chanda area.

According to Kulkarni (1951) majority of the rocks of the Gondwana System comprising fresh water sedimentary deposits do not bear teak (*Tectona grandis*), but the basaltic rocks are ideally suited for it. Amongst the Gondwana rocks, the younger sequence comprising Jabalpur and Pachmarhi sandstones are devoid of teak, while the older ones like the Talchirs, the Barakars, the Bagras, etc., do bear fragmentary forests of teak. Best teak is, however, reported from the Kamthi Sandstones and the Vindhyan Sandstones. Teak is largely confined to soils with a pH range of 6.5 to 7.5; and when pH value is below 6.0 teak is practically absent from natural forests. Presence of excessive alkalis or alkaline earths (pH value of 8.5 and more) is definitely toxic for teak growth. Hewetson (1941) has found similar relationship of teak with the soil geology in Madhya Pradesh. Good teak occurs on metamorphic rocks when not capped with laterite. According to Kadambi (1954) while teak is also associated with charnockite bands in Mysore, it is typically associated with the trap country; thus the teak belt in Mysore occupies the slopes and top of hills. Bhatia (1954) in his study of the teak in Madhya Pradesh has found that calcium is very essential for luxuriant growth of teak. With this criterion in view he has reported that Bagra conglomerates amongst the Gondwanas are the ones where teak flourishes well. Puri has observed that all massive outcrops in basaltic hills bear teak, with various proportions of *Terminalias*, *Lagerstroemias*, *Diospyros*, etc., but the vesicular units are almost devoid of it. He has suggested that the growth of teak depends very much on the content of calcium and phosphorus in the rock body.

From what has been indicated above, three facts emerge out very clearly. Firstly, not the rock alone but its mineral composition is the controlling factor for teak under the monsoonic condition of climate; and that lime and magnesia bearing

minerals with alumina and phosphate are rather essential in the rock for luxuriant growth of teak. Secondly, there should not be stagnation or accumulation of water under shallow water-table condition, and to that extent hill slopes and undulating topography are ideally suited for the purpose. Thirdly, the soils should be either neutral or with only slightly acidic or alkaline tendency.

Shorea robusta (SAL)

Sal (*Shorea robusta* Gaertn) on the contrary requires almost the opposite type of soil and geological features. While teak grows well on the lime-rich rocks, *sal* usually avoids them.

The *sal* bearing area in Bishrampur coal field of Surguja District is a flat country with an average elevation of about 535 m above M.S.L. The area has a tropical climate with a mean minimum temperature of 2.5° C and a maximum of 45° C, and receives an average annual rainfall of 150 cm. The Barakar formation occurring over an area of about 800 sq.km consists mainly of sandstones with a basal conglomeratic horizon. The rocks comprise quartz and quartzite with minor amounts of jasper in a matrix of kaolinitic clay. Coal seams occur at depths of about 3 m. The Barakars have very low northerly dips upto 5°. The rocks are fine to very coarse grained and pebbly with subangular to subrounded grains. The joints are trending E-W and N-S and about 0.2 to a metre apart. The depth of weathering is traceable to 5 m. The soil is sandy with a little admixture of clay and lateritic gravel. The rocks and the weathered materials are thus permeable. Groundwater occurs under water-table conditions in the weathered zone. Open wells reveal that the water levels range between 1 and 6 m b.g.l. in winter and between 3 and 9 m in summer. Mixed forests are prevalent with *sal* as the main vegetation. *Sal* trees attain a height upto 40 m with a diameter of about a metre. Thus *sal* draws water from the water-table not lowering below 10 m. The groundwater in the Barakar formation contains 500 ppm of total dissolved solids, 14 ppm of sodium and less than 1 ppm of potassium and boron, thus being good for sensitive vegetation.

The *sal* bearing area in Jagdalpur *tahsil* of Bastar District is also a flat terrain with an average elevation of about 565 m above M.S.L. The climate is tropical with a mean minimum temperature of 18.2° C and a maximum of 30.9° C. The average annual rainfall is about 161 cm in Jagdalpur shales of the Indravati Series. The

shale is ferruginous and silty. It is further interbedded with lenses of magnesian limestone. The shale in the form of lenses and bands have a thickness upto 0.2 m. The formation has further two sets of well-defined joints trending NNW-SSE and ENE-WSW, and about 0.05 to 0.2 m apart. Further the contact between shales and limestones is marked by solution channels. The soil is silty with small patches of lateritic material. Groundwater occurs under water-table condition. Open wells in the area suggest water levels between 0.6 to 15 m b.g.l. in winter and 2 to 16.5 m b.g.l. in summer. There are patches of *sal* vegetation in the area, where individual trees attain heights upto 40 m with a diameter of 1.2 m, which often depends on the groundwater. The groundwater in the area analysed upto 490 ppm of total dissolved solids, 26 ppm of sodium, 17 ppm of potassium and less than 0.1 ppm of boron, thus being good for sensitive vegetation.

Summarising the available data Troup (1921) and Champion (1933) have recorded that *sal* has definite requirement of soil, though occurring on a variety of rock types. Based on his work in Mayurbhanj District of Orissa, Nair (1944) observed that *sal* grows well in heavy but well-drained soil derived from acidic rocks. Iron is beneficial to it with a better development in the area, if water is available on the spot. Mooney (1941) from his report in Kalahandi District of Orissa recorded the occurrence of *sal* forest in association with *Xylia xylocarpus* on red soils derived from the identical basic igneous rocks like the hornblende schist and the epidiorite; it thus thrives well on the flat lateritic country. According to Hewetson (1952) and Waheed Khan (1953) acidic rocks like gneisses, quartzites, etc., are more suitable for the growth of *sal*. Puri (1955) in his observation in Balaghat, Bilaspur and Mandla Districts of M.P. stated that the best quality of *sal* is grown on the non-calcareous and acidic rocks with a low pH value. According to him ferruginous, acidic, base deficient soil is ideally suited for preponderant growth of *sal*.

A few facts thus emerge out very clearly. Firstly, ferruginous base is very essential for *sal* tree be it in the form of a basaltic rock or the hornblende-schist or epidiorite, or simply the laterite

as the end product of alteration under typically monsoonic condition. Secondly, the *sal* tree is a water loving phreatophytic species, and it is very essential that the groundwater is rich and shallow with well-drained soils. From this point of view best results can be achieved in the arenaceous sedimentary rocks and in flat lateritic terrain. Thirdly, the soils should be distinctly acidic with low pH values.

CONCLUSIONS

It has been observed that the Barakar sandstones and Jagdalpur shales rich in groundwater are well suited for the growth of *sal* (*Shorea robusta*) in Madhya Pradesh. The pyroxene gneisses and the associated quartz schist with breccias with sustained groundwater are on the contrary very suitable for teak (*Tectona grandis*) growth. Such results can be suitably utilised in the afforestation programme elsewhere.

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