TERMITE MOUNDS AS HYDROLOGIC INDICATORS – SOME CASE STUDIES FROM PARTS OF PALLADAM, POLLACHI AND UDUMALPET TALUKS OF COIMBATORE DISTRICT, TAMIL NADU.

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PRELUDE: In hard rock areas, it is generally difficult to explore ground water due to its complex hydrogeological conditions. While carrying out exploration, some indirect natural methods, which indicate the presence of ground water, namely geobotanical and termite mounds can be used as tool for locating ground water potential zones since they have been referred in the ancient Sanskrit works such as Rig and Atharvana vedhas. Varahamihira, a versatile astrologer, astronomer and hydrologist, during the 6th century in his magnum opus **BRAHAT SAMHITA,** described termite mounds and some plants as a good tool for ground water exploration. Termites popularly known as white ants, are an integral part of the extensive fauna of all the warmer countries, cause great damage to the structural timbers, wood, paper and plantations. They also play a prominent role in the welfare of the mankind. Their nest ie, the mound is considered to be a good indicator of ground water. Modern scientific studies reveal interesting facts authenticating these beliefs. Dr.E.R.V.Prasad, retired professor of Geology, S.V.University, Tirupathi, has done extensive field works based on Varahamihira's work on ground water and published a monograph [MASSLIT SERIES]. Since it has been scientifically proved that termite mounds are good hydrologic indicators, some detailed geological, hydrogeological and geoelectrical investigations have been carried out for agricultural purposes to explore ground water in some parts of Palladam, Pollachi and Udumalpet taluks of the old Coimbatore district which are generally drought prone areas. 24 bore wells have been drilled based on the old findings and as well as following the new techniques. Out of 24 bore wells drilled, except three bore wells all the 21 wells have discharged good yield in the range of 130 to 5oo LPM, which is a good success rate as far as hard rock terrain is concerned.

INTRODUCTION: Varahamihira [AD 505 – 587] belongs to the galaxy of Indian scientists that include Dhanvanthri, Aryabhata and Baskaracharya. Varahamihira's greatest work , ***Brahat Samhita*** deals with astonishing variety of subjects covering

astronomy, architecture, botany, zoology, medicine and hydrology. The art of exploring underground water in India goes back to antiquity and Varahamihira expounds on this subject and called the art as Dakargala or Udakargala which evidently refers to the presence of ground water. Brahat Samhita happens to be the only source of information about the state of hydrological knowledge in ancient India. Varahamihira describes the possibility of water where ant hills are present near tender bamboo. The termites in Sanskrit literature have been described as UPAJICA. Modern scientific studies reveal interesting facts authenticating the beliefs. In order to understand the significance of termite mound, a brief description of termites and its mounds, is a prerequisite.

TERMITES AND TERMITE MOUNDS: The termites consist of 6 families. The 6^{th} family Termitidae is the largest which includes about 75 % of all the known termite species. It is known as the higher termites and the other 5 families are lower termites. The termites live in 4 types of nest. One such type is the Epigeous nest ie, the nest built on the ground surface. All the termites are not mound builders and the only genus Copoterms of the family Rhinotermitidae build mounds. The epigeous nest is of importance for ground water exploration. High humidity is essential for the very survival of the species in arid and semi arid tracts. To maintain high humidity the termites have constant touch with ground water however deep it may be. The chief mechanism of the termites that contribute to humidity control is the active transport of water from the water table how deep it may be.

STRUCTURE OF THE TERMITE MOUNDS: The termite mounds exhibit greatest complexity with wide variation in size and shape. The construction materials are sandy particles cemented with a mixture of clay and saliva. The color, texture of the soil and architecture of the mound widely vary depending upon the nature of soil, climate and rainfall. They occur as small mounds of few inches to several feet height either as conical or elongated [Figures-1 & 2]... They may exist as individual mound or as an assemblage and are commonly located at the base of the trees. When a mound is razed to the ground level, a number of holes are observed with a dia in the range of 1 to 5'' [Fig-3].. A number of chambers occur with inter connecting galleries, [Fig- 4]. Which provide ventilation with in the mound where Termite Queen and King are lodged? The chambers surrounding the royal cell are populated by worker and soldier termites. They prefer to

live in the confined environment of their nest which is humid. The termite mound functions mainly to maintain a constant high humidity. Hence it is the only mound type of termite nest which serve as indicator of ground water.

Fig- 1, Termite Mound.

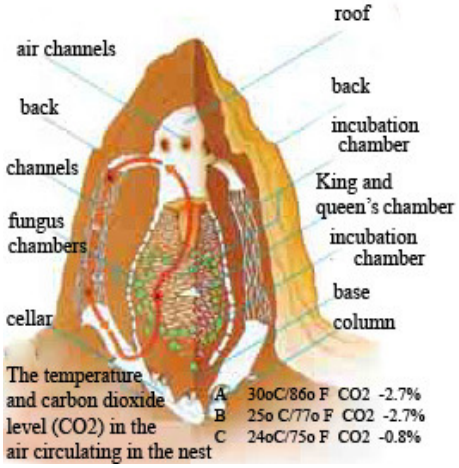

Fig-2, Inside of mound.

Fig-3, Mound with conduits.

Fig- 4, Gallery & Chambers.

STRUCTURE BENEATH THE TERMITE MOUNDS: An adult mound is connected with a very important system of under ground galleries called PERIERIA. From one of the subterranean galleries at some distance from the mound, a vertical shaft descends until it reaches the water table. In some cases the vertical shaft may occur right beneath the mound so that water occurs beneath the mound. Each mound is an assemblage termed a calic. The termite nest is termed polycalic when a group of mound or calics are associated with a single termite colony.

TERMITE MOUNDS AND THE WATER TABLE: The termite mounds function primarily to maintain a constant high humidity. The termites have the capacity to transport water from the water table however deep it may be. So water is very vital for the survival of the insects. The vertical shaft of the termite mounds subsurface structure is very significant since it only reaches the water table. Varahamihira's concept that the termite mound is a hydrologic indicator to locate sources of ground water has been amply substantiated by observations made in several modern researches.

PREFERRED ORIENTATION OF THE TERMITE MOUND STRUCTURE: The most conspicuous features revealed from the Varahamihira's work, is that the direction of occurrence of termite mound at the base of trees and occurrence of aquifers with respect to the termite mound, are most commonly north-south, east-west. If the mounds are elongated, the direction of elongation is always found to be in one of these four cardinal directions. The development of the vertical shaft of the mound is hydrotropic under the influence of earth's magnetic field.

TERMITE MOUNDS AND VEGETATION: [GEOBOTANICAL INDICATORS]:
The vegetation developed on the mound exhibits whiteness and glossy nature which are the responses occurring due to high relative humidity. The termite mounds occur adjacent to or surrounding the base of a phreatophyte which has a relatively shallow system of lateral roots with primary roots descending to the water table. The termite mounds associated with palm trees and neem trees are good hydrologic indicators.

CASE STUDIES : Extensive hydrogeological and geoelectrical investigations have been carried out near the termite mounds in some parts of Palladam, Pollachi and Udumalpet taluks of Coimbatore district [Old], Tamilnadu .[Fig-5].

GEOLOGY AND HYDROGEOLOGY OF COIMBATORE DISTRICT: The district lies between N. latitudes 10° 12' and 11° 25' and E.longitudes 76° 39' & 77° 31'. The major rock types are Charnockite, hornbende-biotite gneiss, granites and granite gneiss of Archean age which are intruded by pegmatites, quartz veins and basic intrusives. The regional trend of foliation being north-east-south west & dipping towards south east. Ground water occurs under semi confined to unconfined conditions along the foliation planes and weathered zones, joints and mainly along deep-seated fractures [Lineaments].

HYDRO GEOELECTRICAL INVESTIGATION: Geoelectrical investigation using resistivity profiling and vertical electrical sounding techniques [VES], using DC resistivity meter, adopting Schlumberger array, have been carried out extensively in the study areas. The VES data have been qualitatively and quantitatively analyzed. The geoelectrical sections have been prepared using Inverse slope method. Based on the termite mound indications, hydrogeological conditions and hydrogeoelectrical investigations, 24 bore well points were recommended. 24 bore wells were drilled engaging DTH rig. Some bore wells have been drilled on mounds and some near the mounds. The bore well details are furnished in the table-1.

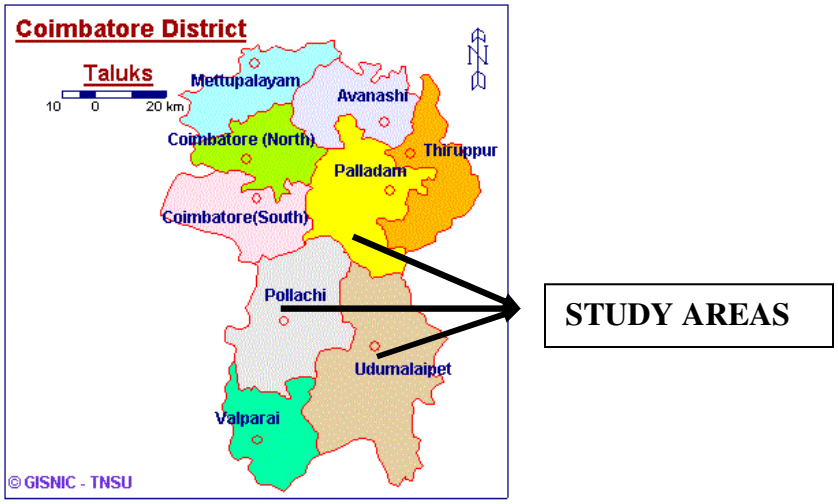

Fig-5, Coimbatore distrct [Old], Taluks.

TABLE- 1, BORE WELL DETAILS-- CASE STUDIES RESULTS.

SL. NO.	VILLAGE / CLIENT'S NAME	TALUK	DIA.OF BORE IN MM	DEPTH DRILLED IN M	YIELD IN LPM	REMARKS
01	SANUPPAPATTI C.THIRUMALAISAMY	UDUMALPET	150	117	370	Bore drilled near a t.m of 4' height & 2' dia. Plunging syncline-shear zone.
02	S.VALLAKONDAPURAM MADHUSUDHANAN	---DO-----	110	91.5	85	Small T.M + palm tree
03	S.NALLUR. GVG PAPER MILL-PUMP HOUSE	--DO----	150	61	190	Bore drilled near a T.M-quartz & pegma. Boulders
04	G.KALIAPURAM K.PONNUSAMY. [ETTIMARATHU KADU]	POLLACHI	163	170.5	500	Small T.M + palm tree.@ 310' coarse sand +shells
05	SEELAKKAMPATTI MOUNAGURUSAMY.	--DO----	110	104	190	Drilled on a small T.M of 1 ½' height, no vents.
06	SETHUMADAI VADIVELU	--DO--	110	98	190	Drilled in bet. 2 closely spaced T.M
07	PUKKULAM J.SUKUMAR CHETTITHOTTAM	UDUMALPET	163	170	460	Bore drilled near a big T.M-pukkulam-venasapatti lineament
08	--DO---- MOTTAICHULIKADU	--DO----	163	164	400	Bore west of T.M
09	------DO-------- EXTREME NORTH	--DO----	163	183	500	Near a big T.M
10	--DO----- SOUTHERN SIDE	--DO----	163	220	130	Bore near a T.M + Palm tree
11	PUKKULAM ANADHAMURUGAN	--DO---	163	152	130	Bore near a big T.M
12	--DO------	--DO--	163	158.5	370	Drilled very close to a T.M
13	--DO-----	--DO--	163	137	190	Bore near west of T.M
14	--DO-----	--DO---	163	213	85	Bore near a T.M of 3' height
15	V.VELUR VAJRAVEL	--DO---	163	122.5	130	Bore near a big T.M of 3' height-black soil

SL. NO.	VILLAGE / CLIENT'S NAME	TALUK	DIA.OF BORE IN MM	DEPTH DRILLED IN M	YIELD IN LPM	REMARKS
16	BOMMANAICKENPATTI R.MURUGESAN	--DO---	110	92	85	Bore near a T.M of 2' ht.only one T.M-razed & drilled
17	VADUGAPALAYAM DURAISAMY	--DO---	163	155.5	130	Bore near a T.M of 2' height.
18	PUKKULAM RATHNAKUMAR	--DO---	163	187.5	370	Bore drilled 10 m west of a T.M-yield @-560'
19	KARUMATHAMPATTI TERREN TELLA, P. LTD.	PALLADAM	163	195	85	Bore drilled very near to t.m-
20	PUKKULAM DR.PRABAKAR	UDUMALPET	163	219.5	370	Bore drilled on a big T.M of 3' height-
21	PUKKULAM DR. PRABAKAR	UDUMALPET	163	253	130	Bore drilled –T.M strike
22	PUKKULAM ARJUNAN	--DO----	163	206	130	Bore in bet. 2 T.M of 2' height
23	JALLIPATTI SUBRAMANIAM	--DO----	163	165	260	Bore drilled razing big T.M of 2 ½' ht-yield @-335' & 460'
24	SELLAMUTHU SADAYAGOUNDENPUDUR	--DO---	163	155	370	Bore near very small T.M of 1' ht,

CONCLUSION: From the bore well results of the case studies, it is revealed that out of 24 bore wells drilled, only three bore wells have yielded 85 LPM and all other 21 bore wells have yielded copious yields in the range of 130 to 500 LPM., which is a good success in hard rock terrain that too in a drought prone area. It is obvious that the termite mound method can be a good tool for ground water exploration and they have served as good hydrologic indicators. In Pukkulam and S.Vallakondapuram areas of Gudimangalam union of Udumalpet taluk, the termites mounds are found to be located & oriented along the major lineaments. Huge concentrations of mounds are well observed in the structurally disturbed areas of both Pollachi & Udumalpet taluks. But mere presence of termite mounds can not be blindly taken as a potential zone. Systematic investigations

must be carried out near the mounds. From the termite mound studies, an interesting fact was observed that, the mounds having vents or conduits gave very good result. The closed type mounds may not be fruit full. The active ones ie, where mound building activities are still going on, are more encouraging than the inactive ones. In some of the bore wells drilled at Pukkulam, electrical well logging has been conducted to study the fracture systems, which has confirmed the presence of good fractures. Termite mounds can be positively taken as a tool for ground water prospecting especially in the hard rock areas where there is no well or lithology of the area is not known. Geobotanical indicators in association with termite mounds also serve the purpose with good encouraging results. Since the termite mounds throw light on ground water table conditions, the Nature's gift namely the termite mound is of much use not only to the hydrogeologists, but also to the Mineralogists prospecting for ores & minerals.

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