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Plants As Indicators of Water: Revealing Positive Science From Brihat Samhita

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Abstract: Varahamihira (6th century AD.) authored Sanskrit treatise *viz*., Brihat Samhita. He was one of the nine jewels in the court of a legendary king Vikramaditya. His approach was multidisciplinary, inclusive of geo-botanical study. The present author scrutinized it with major emphasis on plant science and especially plant species as indicators of underground water. As many as 39 plant species pertaining to 35 genera and 27 families on angiosperms are informed as underground water indicators. The dicotyledons and particularly tree species appeared playing role in the said science. Varahamihira also pointed out close associations of animal species, features of soil, distance and depth of water veins or sources, certain unusual plant characteristics, apart from quality and quantity of underground water. His approach is thus obviously multidisciplinary even in the ancient period. It is noteworthy that the ancient Sanskrit literary sources are gold mine of positive science and still need to be unearthed as a crying need of the hour in India.

Key Words: Plants, Water Indicators, Brihat Samhita.

Introduction

Brihat samhita is authored by Varahmihira (also known as Varaha or Mihira) (505-587 AD). He was as astrologer, astronomer and mathematician. He was one of the nine Ratanas (jewels) in the court of king Vikramaditya. Varahamihira was a son of Adityadasa of Ujjain in Madhya Pradesh. Apart from his 'Pancha-Siddhantika' (a treatise on the five astronomical canons), his significant and valuable contribution is Brihat Samhita which contains 4000 verses (slokas) under 105 chapters in Deonagari script. He dealt with a variety of scientific discourses. One of the interesting chapter in Brihat Samhita is 'Dakargalam' which emphasized on ground water exploration on various surface features. This term connotes water exploration (Daka means water, derived from Sanskrit word 'Udaka', and Argalam means a discipline of science regarding water). This chapter includes plant species as indicators of ground water. Varahamihira used bio-indicators to locate sources of ground water. These bio-indicators included plant species, apart from animal species, termite mounds, soil structure and

geophysical features (Prasad, 1980; Jain *et al.*, 2007; Joshi *et al.* 2013; Zha, 1988). The present author recorded Sanskrit plant names in the verses which are underground water indicators. An attempt has been made to tap down and limelight positive science out of it. The results of this investigation are communicated in this article.

Methodology Adapted

To tap down and limelight positive science from Brihat Samhita by Varahamihira (6th century AD), the treatise authored by Zha (1998), Kern (1913) and Sastri and Bhat (1947) are consulted. The common Sanskrit plant names are noted from the verses and equated with the recent botanical (Latin) names. They are assigned to their respective families. The positive science with particular emphasis on water indicating plant species is elaborately explained. However, it is essential to know ancient terminology used by Varahamihira e.g. (i) Cubit means length of forearm from elbow to the middle finger. (ii) Purusa means about 07 ft. to measure depth of water vein or source. I followed these measures in verbatim.

Systematic Enumeration:

1. *Calamus viminalis* Willd. (Arecaceae)
   S.N.: Vesta
   Observation: When a Vesta plant grows in a place devoid of water, it is certain that after digging the ground at a distance of 03 cubits to its west, water is present half a purusa beneath the earth.
2. *Sysygium jambos* (L.) Alston (Myrtaceae)
   (Syn.Eugenia jambos L.)
   S.N.: Jambu
   Observation: (a) If you dig a hole 02 purusas deep and 03 cubits to the north of Jambu tree, one will find water in a vein westward. (b) If an ant-hill is close to the east of Jambu tree, certainly one will find sweet water in a pit when dug 02 purusas and 03 cubits to its South.
3. *Ficus racemosa* L. (Moraceae)
   S.N.: Udumbara
   Observation: One will note sweet water flowing in a vein in a pit when dug 2.5 purusas, 03 cubits to the west of Udumbara tree.
4. *Terminalia cuneata* Roth. (Combretaceae) [Syn.T.arjuna (Roxb.) Wight & Arn.]
   S.N.: Arjuna
   Observation: (a) When an ant-hill is present to the north of Arjuna tree, one can find water 3.5 purusas under the earth at a distance of 03 cubits to its west. (b) If an ant-hill is present to the east of Arjuna tree, one may note a vein of water at a cubit's distance to the west by digging 14 purusas.

5. *Vitex negundo* L. (Verbenaceae)
   S.N.: Nirgundi
   Observation: If a Nirgundi tree is associated with an ant-hill, one will find tasty water in a pit at 02 purusas and 03 cubits toward the south of it.

6. *Ziziphus jujuba* Miller (Rhamnaceae)
   S.N.: Vadari (Badari)
   Observation: One can guess water if an ant-hill is present to the east of Badari tree to its west at 03 purusas.

7. (i) *Ziziphus jujuba* Miller (Rhamnaceae)
   S.N.: Vadari
   (ii) *Butea monosperma* (Lam.) Taub. (Papilionaceae)
   S.N.: Palasa
   Observation: If these two tree species grow together in a place, one will find water at 03 purusas, and 03 cubits to the west of Vadari under the earth.

8. (i) *Aegle marmelos* (L.) Corr. (Rutaceae)
   S.N.: Vilva
   (ii) *Ficus racemosa* L. (Moraceae)
   S.N. Udumbara
   Observation: If these two tree species flourish close to each other, one can find water at 3.5 purusas under the earth surface at a distance of 03 cubits from them.

9. *Mallotus philippensis* (Lam.) Muell.-Arg. (Euphorbiaceae)
   S.N.: Kampilla
   Observation: When Kampilla tree grows in a place devoid of water, a southern veins run at a distance of 03 cubits to its west.

10. *Terminalia bellirica* (Gaertn.) Roxb. (Combretaceae)
    S.N.: Bibhitaka
    Observation: When an ant-hill is found close to this tree, one will record vein on its west side at 1.5 purusa beneath the earth surface.

11. *Bauhinia purpurea* L. (Caesalpiniaceae)
    S.N.: Kovidara
    Observation: If a white ant-hill alongwith Durva grass [*Cynodon dactylon* (L.) Pers.] to the north-east of this tree, water can be located between them at 5.5 purusas under the earth surface.

12. *Madhuca indica* J.F. Gmel. (Sapotaceae)
    S.N.: Madhuka

Observation: When an ant-hill is inhabited by a snake to the north of this tree, one can find water at a distance of 05 cubits from it.

13. (i) *Borassus flabellifer* L. (Arecaceae)
S.N.: Tal.
(ii) *Cocos nucifera* L. (Arecaceae)
S.N.: Narikel
Observation: If any of these trees grow close to anti-hill, one will find vein of good water flowing at a distance of 06 cubits to their west and at 04 purusas under the ground.

14. *Symplocos racemosa* Roxb. (Symplocaceae)
S.N.: Tilaka
Observation: When a smooth ant-hill with bent sacrificial grass are found to the south of this tree, an eastern vein will be located in a westerly direction at 05 purusas.

15. *Santalum album* L. (Santalaceae)
S.N.: Chandan
Observation: If a Chandan tree grows to the left side of an ant-hill (northwards), water will be located at 03 cubits to the east from these at 5.75 purusas.

16. (i) *Symplocos racemosa* Roxb. (Symplocceae)
S.N.: Tilaka
(ii) *Spondias pinnata* (L.*f.*) Kurz. (Anacardiaceae)
S.N.: Amrataka
(iii) *Crataeva religiosa* G. Forst. (Capparidaceae)
S.N.: Varunaka, Varuna
(iv) *Semecarpus anacardium* L.*f.* (Anacardiaceae)
S.N.: Bhallataka
(v) *Aegle marmelos* (L.) Corr. (Rutaceae)
S.N.: Vilva
(vi) *Diosyros embryoteris* Pers. (Ebenaceae)
S.N.: Tinduka, Tinduki
(vii) *Alangium salvifolium* (L.*f.*) Wangerin (Alangiaceae)
S.N.: Ankola
(viii) *Punica granatum* L. (Puncaceae)
S.N.: Pindara, Pindira
(ix) *Albizia lebbeck* (L.) Benth. (Mimosaceae)
S.N.: Siri, Sirisa
(ix) *Terminalia cuneata* Roth (Combretaceae)

[Syn. T.arjuna (Roxb.) Wight & Arn.]

S.N.: Arjuna

(xi) *Grewia asiatica* L. (Tiliaceae)

S.N.: Parusaka

(xii) *Calamus rotang* L. (Arecaceae)

S.N.: Vanjula

(xiii) *Sida rhombifolia* L. (Malvaceae)

S.N.: Antibala

Observation: If these trees or plant species are surrounded by ant-hills, then water will be found 4.5 below the ground at a distance of 03 cubits.

17. *Solanum virginianum* L. (Solanaceae)

[Syn.S.jacquini Miq.]

S.N.: Kantakarika

Observation: If this plant bears white flowers and without thorns or spineless, water is then found under it at a depth of 3.5 purusas.

18. *Areca catechu* L. (Mimosaceae)

S.N.: Khadira

Observation: If a tree of Khadira tree grows in region which is devoid of water, one will find water on its west side at 03 purusas.

19. *Butea monosperma* (Lam.) Taulb. (Papilionaceae)

S.N.:

Observation: If this tree bears white flowers, then one will find water at 02 cubits to the south at 03 purusas.

20. *Salvadora persica* L. (Salvadoraceae)

S.N.: Pilu

Observation: (a) If an ant-hill is present north-east to a Pilu tree, one will note water to the west of the depth of 05 purusas. (b) If an ant-hill is on the eastern side of Pilu tree, one can find water in a southerly direction at 07 purusas at a distance of 4.5 cubits.

21. *Capparis decidua* (Forssk.) Edgew. (Capparidaceae)

S.N.: Karira, Karil

Observation: If an abode of a snake present to the north of Karira tree, one can predict sweet water southward of 10 purusas.

22. (i) *Ziziphus jujuba* Miller (Rhamnaceae)

S.N.: Vadari

(ii) *Salvadora persica* L. (Salvadoraceae)

S.N.: Pilu

Observation: One will predict water if on the east side of Vadari tree grows a Pilu tree at 20 purusas.

23. (i) *Terminalia cuneata* Roth (Combretaceae)
[Syn.T.arjuna (Roxb.) Wight & Arn.]
S.N.: Arjuna
(ii) *Capparis decidua* (Forssk.) Edgew (Capparidaceae)
S.N.: Karira
(iii) *Aegle marmelos* (L.) Corr. (Rutaceae)
S.N.: Bilva
Observation: If Arjuna and Karira or Bilva trees grow conjointly, one will find water at 02 cubits further off in the west at 25 purusas.

24. *Neolarckia cadamba* (Roxb.) Bosser (Rubiaceae)
S.N.: Kadamba
Observation: If a bent grass grows on an ant-hill close to a Kadamba tree, one will find water at a distance of 03 cubits to the south at 25 purusas.

25. *Prosopis cineraria* (L.) Druce (Mimosaceae)
S.N.: Sami
Observation: If a knotty Sami tree growing near an ant-hill on its northern side, one can find water at a distance of 05 cubits in a westerly direction from the spot at 50 purusas.

26. (i) *Prosopis cineraria* (L.) Druce (Mimosaceae)
S.N.: Sami
(ii) *Butea monosperma* (Lam.) Taub. (Papilionaceae)
S.N.: Palasa
Observation: If a Sami tree inhabits near Palasa tree, one can predict water on the west side at 60 purusas.

27. (i) *Ficus benghalensis* L. (Moraceae)
S.N.: Vata
(ii) *Butea monosperma* (Lam.) Taub. (Papilionaceae)
S.N.: Palasa
(iii) *Firus racemosa* L. (Moraceae)
S.N.: Udumbara
Observation: If these trees grow conjointly, one can find water at 03 purusas.

28. (i) *Ficus benghalensis* L. (Moraceae)
S.N.: Vata

(ii) *Ficus religiosa* L. (Moraceae)

S.N.: Asvattha, Pippala

Observation: If these two trees grow conjointly, one will denote water in close connection.

29. *Aganosma heynei* (Spreng.) I.M.Turner (Apocynaceae)

[Syn. A.caryophyllata L. (Roxb. ex Sims) G.Don; Echites caryophyllata Roxb.]

S.N.: Malati

Observation: If this climber is surrounded by ant-hills, one can predict water to its north at 5 m.

30. *Pongamia pinnata* (L.) Pierre (Papilionaceae)

S.N.: Karanj

Observation: If abode of a snake is present south of a Karaj tree, there can be water vein in the south at 02 cubits and 3.5 m depth.

31. (i) *Theobroma cacao* L. (Sterculiaceae)

S.N. Rasalaphala, Madhuragoliki

(ii) *Borsassus flabellifer* L. (Arecaceae)

S.N.: Tal

Observation: If these trees are surrounded by ant-hills, then one will find water vein at 06 cubits to their west or a southern water vein at 04 m.

32. *Limonia acidissima* L.(Rutaceae)

S.N.: Kapittha

Observation: If snakes abode found on west of this tree, one will find water at 07 cubits by digging at 05 m.

33. *Andropogon serratus* Miq.

S.N.: Devtada

Observation: If this grass inhabits on the ant-hill, one will find water 03 cubits on its south at 25 m.

Results & Discussion

Historical footprints about hydrologic knowledge can be traced back through ages to the Harappan period (3000 BC-1500 BC) and also Vedic era (1500-500 BC). It is needless to state that water is intimately connected to existence of mankind and has remained the source of cultural development, rituals, religious beliefs and traditions. The past civilization clearly indicates that mankind was always associated and settled near water sources, rivers, lakes, etc. Thus human societies established permanent settlements with water sources. Varahmihira pointed out bio-indicators and even earmarked the depth and distances of ground-water from such indicators. He found associated termite mounds, symbiotic relationships of various plant or tree species, some plant features, animal species and their colours, colours of soil constituents etc.

There is hardly any ancient Sanskrit literary source such as Vedas, Samhitas, Nighantus, Epics, etc. which do not entell about hydrologic Indian history. They are gold mines of knowledge about hydrology. We must, however, regret that judicious research has not been extended in the past. These treasures are still preserved even after domination of foreign cultures and rulers in India. Thus hydrologic investigations remained unexplored largely to date. Hydrologic investigations have certainly become a crying necessity of the hour in India. At this backdrop, it is vital to tap down ancient Sanskrit scriptures revealing hidden positive science from these literary sources. Varahamihira's Brihat Samhita is one such rich heritage of India worth unearthing.

A closure scrutiny of the Sanskrit verses (slokas) of Brihat Samhita revealed a total of 39 plant species pertaining to 35 genera 27 angiospermic families. Of these, the dicotyledonous taxa played a major role (33 species, 30 genera and 25 families), whereas the monoctyledons have minor role (06 species, 05 genera and 02 families). Majority of them are tree species (37 species). A single grass and a climber are also recorded. Moreover, majority plant species are wild in nature (26 species), whereas some species are found under cultivation (13 species). Additionally, a grass *viz.*, *Cynodon dactylon* is also mentioned in such surrounding.

Varahamihira has made geo-botanical observations. He paid attention to the associated animal species, soil structure, distance and depth of water sources from such water indicator plant species, apart from characteristics of water, its quantity and directions of availability. He noticed animals especially Rohita fish, House-lizard, Brown-lizard, White scorpion, Mouse of water-lily colour, Tortoise, Gold-ting frog, Pale-yellow frog, Yellowish-green frog, Snakes which are half-white and half black, spotted ones, fish with smell of he-goat, etc. These are additional indicators of water, besides the plant species. He made in-depth observations regarding soil or clay. He noted soil colours such as black, yellow, white, red, red-brown, etc. The stones or gravel in such surrounding are also reported with their characteristics e.g. Saffron-hued stone or the colour of frog, yellowish-green stone, stone of the color of dolichos, grey stone, apart from soil mixed with sand or gravel. All these features of the surrounding aided to locate water sources.

Some interesting and unusual plant characteristics were also emphasized by Varahamihira. These were, however, indicative of negative or positive presence of underground water. He recorded the negative indicative plant features such as: (i) sappy trees, (ii) long or dwarf branches, (iii) very spreading branches, (iv) unhealthy leaves, (v) thorn-less and thorny trees species together. Positive indicators noted are knotty trees, plant of white flower instead of its usual colour and many thorns. He also paid attention to water availability, quality, taste and its colour e.g. immense or plenty water, water for long time, foaming water, inexhaustible water, cold water, delicious water, sweet water, little blackish water, etc. He also laid emphasis on some interesting features e.g. trees growing conjointly, association with ant-hills, distance from the indicator plant species, depth of water vein or source, etc.

Conclusively, it can be said that Varahamihira not only emphasized botanical science but also paid attention to animal science, besides ecological, edaphic factors, etc. He thus made an all-pervasive examination of the task handled to indicate underground water sources.

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