CHANGING FACE OF PRAKASAM POND IN RELATION TO WATER RESOURCES' DEVELOPMENT IN AND AROUND SRI VENKATESWARA UNIVERSITY, CHITTOOR DISTRICT, ANDHRA PRADESH, INDIA

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Abstract: This paper describes how Prakasam pond in Sri Venkateswara University (SVU), Tirupati in Chittoor District, Andhra Pradesh, India which the SVU Geology Department converted from a cattle pond to percolation pond in 1973, got changed into aquaculture pond, dry pond, sewage pond and back to dry pond due to anthropogenic causes. It also describes how the Tirumala-Tirupati-Devasthanam's (TTD) Haritha Project has led to sustainable development of deep groundwater of high quantity and quality all along a 12-km stretch of the Seshachala Hills between Srivarimettu on the west and Prakasam Pond on the east.

Keywords: Prakasam Pond, Cattle Pond, Recharge Pond, Aquaculture Pond, Dry Pond, Sewage Pond, TTD's Haritha Project, Groundwater Development

PURPOSE OF OUR WORK

Apart from studying the changing face of Prakasam pond over the last five decades as a cattle pond, recharge pond, aquaculture pond, dry pond and sewage pond, the primary purpose of our work is to review the works of Jagadiswara Rao (1974, 2016), Jagadiswara Rao et al (1978), Krishna Reddy (1982), Obul Reddy (1981), Rangarajan (2016) and Venkateswarlu et al (2020) to establish the development of high-quality deep groundwater in very large amounts within fracture openings in hard granite along the foothills between Srivarimettu and Prakasam pond created by the Tirumala Tirupati Devasthanams (TTD's) Haritha Project executed during 1999-2002. A method of tapping this water in very large amounts without getting mixed up with contaminated surface- and shallow ground- waters has been evolved. By this strategy, the water requirements along this entire tract could be obtained without the need to import piped water from Kalyani dam and Telugu Ganga Project involving import of Krishna River waters at high recurring expenditure.

DESCRIPTION OF THE STUDY AREA

Prakasam pond (Latitude N 13^0 37'54" & Longitude E 79^0 23'36") is located in the northwest corner of Sri Venkateswara University (SVU) established in 1954 in a 1000 acre-land in Tirupati, Chittoor District, Andhra Pradesh, India. Fig 1 shows a portion of Sri Venkateswara University including Prakasam Pond.

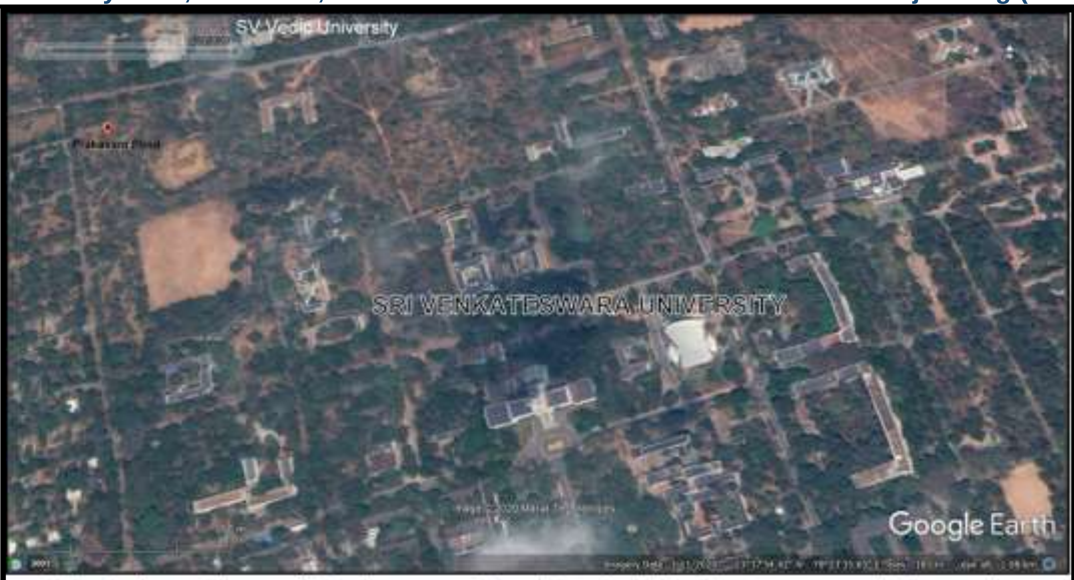

Fig 1: Location of Prakasam Pond in Sri Venkateswara University

The area is occupied by 2100-million year old Archaean rocks comprising of granites, gneisses and dolerite dykes overlain a little north outside SVU to form the east-west extending Tirumala Hills reaching an elevation of 976 m (3202 feet). The hills carry 1600-million year old Proterozoic Nagari Quartzite of Cuddapah Supergroup. The SVU located in the foot hills is occupied essentially by granitic rocks overlain by red loamy soils mixed with boulders and cobbles underlain by pervious sandy soils for a depth of around 40 feet (12 m). Weathering and fracturing of these rocks resulted in soft disintegrated rock (SDR), hard disintegrated rock (HDR), and impervious sheet rock with isolated thin gaps carrying artesian water in varying amounts. The foot hills between Srivarimettu on the west and Prakasam Pond on the east for a stretch of about 12 km are drained by a large number of south-flowing hill streams. Most land in the SVU abuts the University Valley developed within the Tirumala Hills in a southeast direction. Being covered by boulders, cobbles, and sand formed by crushing of quartzite overlain by red soil, surface runoff along this valley is minimal throughout the year.

The climate is tropical sub-humid to semiarid with maximum and minimum air temperatures of about 40°C and 28°C in May, and 29°C and 20°C in December. Rainfall is both in the South-West (SW) Monsoon from June to September and in the North-East (NE) monsoon from October to December. The average annual rainfall is around 1126 mm with November usually recording a maximum of 249 mm and February a minimum of 5 mm. Floods are due to cyclonic storms in the Bay of Bengal particularly during NE monsoon.

Google Earth Pro public domain shows for any part of the globe several Historical Imageries captured on a number of dates. As far as Prakasam pond area is concerned, we could capture and study sixteen multi-dated imageries as on 23 Jun 2001, 31 Aug 2002, 11 Oct 2012, 2 Sep 2013, 26 Nov 2013, 12 May 2014, 14 Apr 2016, 21 Apr 2016, 25 Oct 2016, 21 Dec 2016, 13 Mar 2017, 7 Mar 2018, 3 Jan 2019, 3 Mar 2019, 9 May 2019, and 11 Mar 2020. As these imageries could be freely downloaded, we find their use highly cost effective and at the same time highly useful. As no Historical Imageries were available prior to 2001, we couldn’t however use them to study Prakasam pond as cattle pond or aquaculture pond. Pictures of six of the historical imageries generated are shown in this paper.

PRAKASAM POND AS CATTLE POND

Although most water bodies in and around SVU are ephemeral, Prakasam pond was perennial serving the water needs of cattle and humans round the year. Its perennial nature was because of being fed by springs emanating from the Tirumala Hills. The SVU Engineering Department approached the SVU Geology Department in 1973 on the feasibility of using it as a source of water supply. Exploratory boring with an indigenous hand boring set in the pond bed revealed 3-feet deep water, clayey soil from 3 to 10 feet, water-bearing sand from 10 to 13 feet, stiff clay from 13 to 19 feet, and soft disintegrated rock (SDR) thereafter. It was felt that the best way would be to convert the cattle pond into an artificial recharge pond for boosting the yields of the SVU's large-diameter dug wells, later discarded in favour of bore wells.

PRAKASAM POND AS RECHARGE POND

This work was executed by the Geology Department with funds provided by the Chittoor District Collector A. Valliappan under the Crash Scheme for Rural Employment (CSRE) of the 4th Five-Year Plan in 1973-74 (Jagadiswara Rao, 1974). By just constructing 20-feet deep and 6-feet diameter recharge well in the pond using Reinforced Concrete Cement (RCC) Rings, the whole pond water disappeared into the underlying sand bed. The size of the pond was enhanced to around 0.54 acre (0.22 hectare) by constructing a masonry check dam-cum-earth dam with a masonry surplus weir across an adjacent ephemeral hill stream descending from Tirumala Hills.

With the SVU entering into a deal with the Tirupati Municipal Corporation (TMC) to obtain piped surface water from a gravity masonry reservoir constructed across Kalyani River in the Swarnamukhi river basin in 1977 and later from Telugu Ganga Project (TGP) involving import of Krishna River water, the SVU lost interest in the upkeep of the Prakasam percolation pond.

PRAKASAM POND AS AN AQUACULTURE POND

In 1979, when the SVU Zoology Department was looking for a perennial pond for aquaculture research, the Geology Department helped to transform the Prakasam recharge pond into a perennial pond by effectively sealing the recharge well to prevent any infiltration. With abundant entry of water during flash floods in the hill stream, Prakasam pond became an excellent aquaculture farm. The pond used to be then full to the brim with large-scale surplusing of flood waters downstream. The severity of these flows could be gauged from the drowning of a teenage son of a local Geology Professor.

PRAKASAM POND AS A DRY POND

One unusual thing that happened to Prakasam Pond in 2001 was its becoming suddenly a dry pond. This could be seen from the Google Earth Pro image captured on 23 Jun 2001 (Fig 2) as per which the flow in the hill stream was too meagre to fill the pond; while even the hill stream couldn't be seen in the image captured on 31 Aug 2002 (Fig 3). Such a phenomenon is normally explained by the environmentalists as a consequence of the worldwide climate change which brought drastic reduction in rainfall in the catchment feeding Prakasam pond. But, we traced the real reason for this happening to the TTD's Haritha Project.

Fig 2: Google Earth Pro Image of Prakasam Pond as on 23 Jun 2001

Fig 3: Google Earth Pro Image as on 31 Aug 2002

TTD's HARITHA PROJECT

In 1999, the Forest Wing of the Tirumala Tirupati Devasthanams (TTD) took up a 3-year Haritha Project for massive afforestation and rainwater harvesting through construction of a large number of cement check dams, gabion check dams, rock-fill dams, contour trenches, masonry embankments and percolation tanks all around the Seshachala Hills between Srivarimettu and Karakambadi villages towards south, Karakambadi-Mamanduru area, along important highways and various educational institutions in Tirupati including the Tirupati International Airport. Over 65 lakh seedlings such as those of red sanders, margosa, teak, sampangi, tamarind, gooseberry and blackberry and over 40 tonnes of seeds of margosa, tamarind and blackberry were planted.

The A. P. State Ground Water Department (APSGWD) estimated the Haritha Project to have generated 3.155 million cu m/year (111.4 million cft/year) of additional groundwater in 2000. This got enhanced to 6.59 million cu m (233 million cft/year) in 2001.

The little-known negative side of the Haritha Project is that a number of hill streams from the Tirumala Hills flowing in a southerly direction between Srivarimettu on the west and Prakasam pond on the east for a stretch of about 12 km along the second Tirupati-Tirumala ghat road including the one adjoining the Prakasam pond became completely dry (Figs 2 and 3).

Among other ponds affected, Peruru Tank and many ponds fed by it in the downstream such as Tummalagunta and Avilala Tanks, Tirupati Big Tank and Tirupati sewage pond at the RTC Bus Depot are important.

Another havoc created by the Haritha project along the same stretch is the frequent disruption of traffic along the 2nd ghat road to Tirumala during cloudburst rains, triggering landslides and rock-falls caused because of obstruction to free flow of rainwater by the Haritha project. This problem is experienced almost every year at one place or other of the ghat road during almost every year.

Fig 4 shows how the vehicles proceeding along the Tirupati-Tirumala 2nd ghat road providentially escaped disaster because of sudden landslides and rock falls under the influence of a cloudburst rain.

Fig 5 shows the timely action taken by the TTD Task Force to clear the debris and restore the traffic in record time.

Fig 4: Landslide in the Tirumala Second Ghat Road

Fig 5: Clearing Debris to Restore Traffic

PRAKASAM POND AS A SEWAGE POND

With the establishment of Sri Venkateswara Vedic University as an integral part of the TTD in 2006, the Engineering Wing of the TTD has been looking after all construction activities in the campus. One such work undertaken relates to creation of On-Site Sewage Facility (OSSF) to treat and dispose the entire effluent generated in the campus. Construction of such systems is a standard practice all over the world where large drain fields are available and where it is not practicable to connect the drain water to the main sewage pipe lines of the standard sewage treatment plants. Such plants of adequate size when constructed properly with good design and maintained properly would lead to minimal groundwater contamination and no release of drain water at surface. Despite availability of large space available in the campus, the work was not designed and executed properly. As a result, the entire drain water was let into a stream adjoining the septic system in the campus to flow freely for around 76 m (250’) towards south to join the SVU’s Prakasam pond.

Fig 6: Septic System in S V Vedic University

Fig 7: Untreated Sewage Water Joining Prakasam Pond via Adjoining Stream

Fig 6 is the septic system installed in the western extremity of S V Vedic University with untreated sewage let into a stream abutting it towards west (Fig 7).

Figs 8, 9 and 10 are the Google Earth Pro images captured on 12 Nov 2011, 26 Nov 2013 and 21 Apr 2016 showing Prakasam pond as a sewage pond. The differences shown by the three images reflect the influence of rainfall on the vegetation growth of the region. The one shown in Fig 8 reflects conditions after moderate rains; Fig 9 conditions after heavy rains; and Fig 10 under extreme aridity in summer. Fig 9 particularly highlights the greenbelt development with teakwood plantations grown under the Haritha project. Fig 11 is a photo of Prakasam pond taken almost around the same time of capturing the image shown in Fig 10, showing the blue-green algal scums floating on the pond water.

Fig 8: Google Earth Pro Image of Prakasam Pond as on 12 Nov 2011

Fig 9: Google Earth Pro Image of Prakasam Pond as on 26 Nov 2013

Apart from the pond serving as a breeding ground for mosquitoes, surplus drain water from the pond flows downstream by gravity flow causing further environmental pollution and groundwater contamination.

Fig 10: Google Earth Pro Image of Prakasam Pond as on 21 Apr 2016

Fig 11: Prakasam Pond as Sewage Pond

PRAKASAM POND AS A DRY POND

The appeal made by Jagadiswara Rao (2016) through print media (Rangarajan, 2016) led the Engineering wing of the TTD to promptly suspend conveyance of untreated sewage water into the Prakasam pond. Instead a pipeline carrying untreated sewage water was laid by the side of the pond to convey the sewage water outside the SVU into a stream flowing to the Tirupati Sewage Treatment Plant (STP) located close to the Tirupati International Airport (Venkateswarlu et al, 2020).

As a result of this work, the Prakasam pond became once again a dry pond as shown in the image captured on 11 Mar 2020 (Fig 12). Although the pond looks dry in summer, it gets filled up with rainwater in the rainy season as per Figs 13 and 14. The environmental damage already caused in and around Prakasam pond by way of letting untreated sewage into it since 1996 remains still unanswered.

Fig 12: Google Earth Pro Image of Prakasam Pond as on 11 Mar 2020

Fig 13: Southwest Portion of Prakasam Pond with Rainwater

Fig 14: Southwest Portion of Prakasam Pond with Rainwater

HARNESSING DEEP GROUNDWATER

Our studies indicate that the TTD's Haritha project has led to almost entire rainwater all along the 12-km strip between Srivarimettu on the west and Prakasam pond on the east of the Seshachala Hills along the second Tirupati-Tirumala ghat road to get forced into deep underground to flow downstream and get accumulated into the narrow openings within sheetrock of granite at depth. The quantum of water so getting accumulated is enormous in view of minimal evapotranspiration losses. The chemical quality of these waters is excellent in view of both quartzite and granite rocks contributing little soluble salts.

The conventional methods of drilling in vogue in the area are such that both contaminated surface water and shallow groundwater enter into the bore wells in large amounts. Fig 15 shows one such bore well constructed in the vicinity of Prakasam pond. The only way the deep bore wells could provide good-quality water is to use a drilling technology using blank casing for sufficient length together with properly sealed annulus that prevents entry of any surface water and shallow groundwater. Fig 16 shows the various precautions to be taken in maintaining a good wellhead protection, which include (a) no surface water at base any time, (b) no cracks or holes in casing, (c) extending casing at least 12 inches above ground, (d) keeping cap secure, and (e) effective screening of vent pipe.

The methodology described to pinpoint the best well site location and determine the maximum depth of drilling by Venkateswarlu et al (2020) can be used to harness deep groundwater in large quantities.

Fig 15: Bore well in SVU with Improper Wellhead Protection

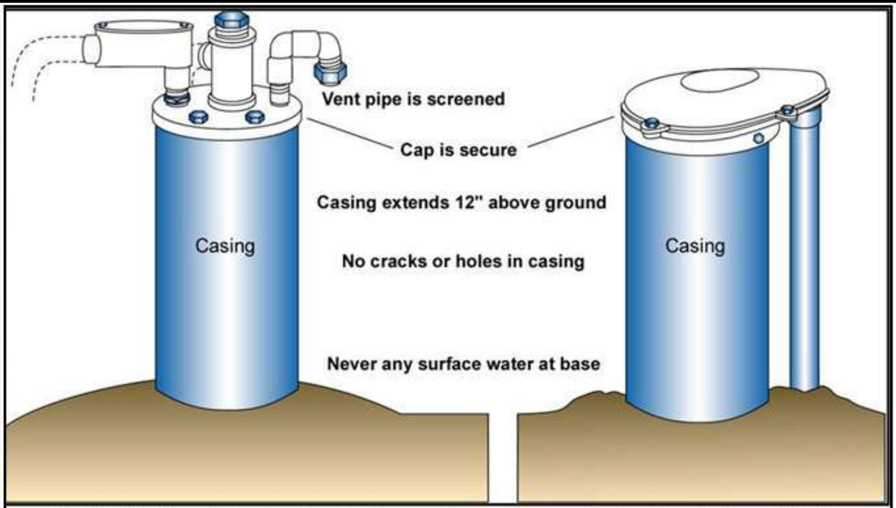

Fig 16: Wellhead Protection to Ensure Groundwater Protection in Bore Wells

CONCLUSION

This Paper describes how TTD's Haritha project has led to sustainable development of deep groundwater of high quantity and quality all along a 12-km stretch of the Seshachala Hills between Srivarimettu on the west and Prakasam Pond on the east. This water could be tapped in large quantities through a large number of high-yielding deep bore wells by using the methodology we described to pinpoint well sites to optimum depth. The water so tapped maintains its high quality by adopting the drilling technology described using blank casing of requisite length and properly sealed annulus against entry of contaminated surface water and shallow groundwater.

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