
Pradeep Raj, Ground Water Department, 37 LIC Colony, Opp Indira Park, Lower Tank-bund Road, Hyderabad - 500 080, comments

I have read with interest the above article which gives a good account of water balance in percolation ponds. The percolation tank near Kalwakurthi referred by authors is in Thimmarapalli village (they could have mentioned the name of the village instead of saying as near Kalwakurthi and possibly shown it on a location map too). The State Ground Water Department had established a hydro-meteorological station just upstream of the tank-bed. Officers of the Department had invented, all the wells and monitored water levels in the wells around the tank for 8 or 9 years. This programme was given up due to resource constraints. I was part of the team of the officers from State Department involved in these studies for sometime. I would appreciate if the authors can clarify/further elaborate the following points:

1. The authors state that “the water in two open wells close to the dam rose close to the ground surface which never happened prior to the construction of percolation tank”. I would like to state that the percolation tank referred is not a new tank but just a conversion of old minor irrigation tank. The sluice of the old tank was permanently closed, breach plugged, and that the bund was strengthened somewhat to convert it from an irrigation tank to percolation pond. The wells close to the dam, especially on the right bank (of the small streamlet across which the bund was made many many years ago) always had the water in the brim whenever the tank had some water. The other well did not react as fast. I do not know if the authors have noticed a dolerite dyke that may be influencing the flow direction of groundwater or at least affecting the rate of flow. There is no mention of this dyke in their paper.

2. They state that soil characteristics of the tank-bed as well as the ayacut are equally important, but why? They have not elaborated on the reasons as to how the soils in ayacut influence the efficacy of percolation tanks.

3. The percolation from tank is calculated as ~20,000 m³, which is hardly equal to groundwater draft from two wells. This is a rather negligible quantum. This volume can irrigate less than 2 hectares of paddy. Does it not suggest that percolation tanks are not effective?

4. In fact I was convinced after this tank was converted to percolation pond that there is no need for such an exercise. Simple irrigation tanks serve the purpose of recharge and do not only from the tank bed but also from irrigated area. In case of paddy cultivation, about
40% seeps as percolation. The availability of groundwater in the ayacut (command area of the tank) appears to have decreased after the conversion of the tank to percolation pond. All the wells that were functioning prior to conversion were functioning after the conversion, but all of them had lesser water by about 20 to 30%

5. The authors mention that they did not have the specific yield values to convert the water table fluctuation to volumetric terms. What prevented them from obtaining these values, especially as large numbers of wells are already there in the area? Approximate values can be easily obtained.

6. The authors state that storage capacity of percolation tanks is less than half a million cubic meters. I think the authors are wrong by an order of magnitude as most percolation tanks have a capacity of about 50,000 and not 500,000 m³. However, some big percolation tanks have capacities up to 200,000 m³.

7. Efficacy of a percolation tank may depend upon the downstream use of groundwater, but in the cases cited (Singaram and Kalwakurthi), it is due to the difference in hydrogeological conditions only and based on the data presented, this conclusion cannot be drawn. The fact that downstream use of groundwater is high in Kalwakurthi is mainly due to good hydrogeological conditions in the downstream area. The fact that downstream use of groundwater is low in Singaram is due to poor hydrogeological conditions in the downstream area.

B.S. Sukhija, D.V. Reddy, P. Nagabhushanam and M.V. Nandakumar, National Geophysical Research Institute, Hyderabad - 500 007 reply

We appreciate the interest and involvement of Dr. Pradeep Raj in artificial recharge studies and his comments on our paper. Our reply to his comments pointwise is as follows:

1. Regarding his comment on water levels in open wells, we would like to point out that our study of the Kalwakurthy tank refers only for the period from conversion of irrigation tank to percolation tank with breach plugged. During this period (1989 onwards), maximum water level rose to the brink of open wells no. 1 and 2 during 1991 and not before when the tank was in a breached state. We have made use of the data given by the A.P. State Groundwater Board in the "Status report on Timmarasipally percolation tank, Kalwakurthy Mandal, Mahbubnagar district", which we have acknowledged in our paper. Further, we have utilized the observations of the villagers regarding the conditions of the wells prior to the conversion of the irrigation tank to a percolation tank.

Further, we did notice the dolerite dyke in the area. Though such dykes can be important and influence groundwater conditions in general, our emphasis in the paper is on the study of the effect of percolation tanks on the groundwater system. Hence, we did not mention the dyke specifically. However, it is made clear that, without impounding the water in a percolation tank, enhanced recharge estimated by us would not have been possible.

2. Soil characteristics are important for infiltration and percolation of tank water, and the return flow in the downstream (ayacut) which in turn affects the efficacy of the percolation tank.

3. Percolation from the tank is estimated as 45% of the stored water. A quantum of 20,000 m³ water recharged is for a particular year, when the rainfall is below normal and storage in the tank is less than one third of its total storage. However, even during such extreme arid conditions such artificial recharge structures are useful.

4. Dr. Pradeep Raj has raised a fundamental question of use of irrigation tanks vs. percolation tanks. Advantages of percolation tanks are well known and need not be repeated here. Dr. Pradeep Raj should refer to recent literature on percolation ponds (references cited in the paper). On the contrary, in order to prove his point, he should provide a quantitative and comparative assessment of artificial recharge from irrigation tanks and percolation ponds with cost benefit ratio.

5. It is well known that specific yield can vary from 0.5-14% in the granites (Karanth, K.R., 1987, Groundwater Assessment, Development and Management Tata McGraw Hill) and the use of such values would have introduced large errors in the estimate of artificial recharge.

6. We have mentioned about the storage capacity of a typical percolation tank irrespective of its location in Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu, Karnataka etc. Dr. Pradeep Raj is perhaps referring to the specific context of Andhra Pradesh alone.

7. It is quite well known that efficacy of a percolation tank in general depends on hydrogeological conditions. In our paper, we were in particular referring to "capture recharge" which depends upon the downstream use of groundwater. It is quite understandable that by higher...
extraction of groundwater downstream one can create higher hydraulic potential difference between the percolation tank and water table, which in turn is responsible for greater percolation. Favourable conditions exist at Kalwakurthy in contrast to Singaram because of greater number of wells downstream of the Kalwakurthy tank thereby enhancing the efficiency of the tank as explained above.


V.S. Krishnaswamy, 409, S. Lexington Avenue, White Plains, NY-10606, USA comments:

The authors of the paper have once again demonstrated that modern tools of enquiry and ways of thinking can be useful in evaluating the ancient environments and long bygone events that have been so faithfully portrayed in the Sanskrit literature of India. However, I am unable to grasp the validity of certain of the observations and some of the conclusions presented in the paper, without some clarifications by the authors on the following points:

2. Three sets of evidences have been put forward by the authors in support of their conclusions on the location of Ur-Dwaraka and Ur-Prabhasa. However, they have not put forward any argument as to why the currently held views of archaeologists, like Sankhalia, S.R. Rao and other young scientists, all of whom accept the position as shown close to the western boundary of the Saurashtra peninsula, should be discarded. In this connection, the evidence and arguments put forward by Rao (1999, 2001) which are quite convincing, are very relevant to the current discussion. In particular, the illustrations portraying the sub-tidal and sub-marine finds of the ancient harbour lying close to the island of Bet Dwaraka offer in my view, impressive support to the existing opinion on the location of Dwaraka.

3. It appears to me that the three sets of evidences as put forward by the authors, are not unequivocal in support of the proposed new locations. The evidences cited appear to be equally applicable to the old locations as accepted by the archaeologists; hence, the need for changing the old in favor of the new locations is not clear. Also, using the new locations as suggested by the authors, the events, as portrayed in the Bhagavatha Maha Purana (referred to, hereafter, as BMP) do not seem to be as well supported by the description of the events as recorded in the Sanskrit texts as the old locations, as, for example, the descriptions given when Krishna ordered the immediate evacuation of the city of Dwaraka in the 2nd millennium B.C. because he felt that Dwaraka was going to be threatened by an impending holocaust (vide BMP; Bk11: ch.30: vc.4-5: pp.660). The high ground of Sankhodara, as mentioned in the BMP, fits well with the Sankhodara of the present day, located in the Bet Dwaraka area. On the contrary, the Ur-Dwaraka, as now suggested for consideration by the authors, does not have a higher ground called Sankhodara, to the best of my knowledge. The Ur-Prabhasa location, referred to in the ancient/Sanskrit text, is also on higher ground, to which Krishna had gone after he had abandoned Dwaraka, which is not the case at the location as suggested now. Lastly, it is relevant to recognize that while a submerged city’s remains have been discovered underwater, close to Bet Dwaraka, such a find in support of the new location in the Cambay basin, although this area has also been archaeologically explored.

4. It is not clear from the presentation made by the authors whether or not the new locations suggested in Fig.2 have been adjudged necessary because of the comparative nearness of these locations to Hastinapur (close to present-day Delhi) in relation to the currently accepted locations, that lie further westwards. If so, this argument does not seem to be very strong, because, the route as shown by the authors on Fig.2 has to negotiate the high hills such as at Mt. Abu and probably also some part of the Thar desert, with no significant relay or support facilities available en route, for Krishna’s entourage. This had a large number of chariots, palanquins and baskets, men, camels, horses, elephants and a contingent of soldiers for protection.