**Title: Replenishing traditional irrigation tanks with river waters: Does timing it matters?**

**Author Name:** Venkata Ramamohan Ramachandrula

**Authors Affiliation and Address:**

Executive Director, Water and Livelihoods Foundation, 12-13-451, Street no.1, Tarnaka, Hyderabad 500017, India. E-mail: ramamohan.ramachandrula@gmail.com.

**ORCID No.:** 0000-0003-0741-3003

## Abstract

Replenishing traditional tanks with water from dams and lift irrigation schemes permits optimum utilization of available river water. In this, schemes like Handri Neeva Sujala Sravanthi (HNSS) and Kaleshwaram Lift Irrigation Project (KLIP) in the two Telugu States, Andhra Pradesh and Telangana in India, set examples to the others. However, timing the replenishment is the key to avoid unnecessary pumping costs and destruction to tank downstream areas during monsoon rains. Timing the replenishment has implications to the economic viability of these irrigation schemes and social wellbeing of people downstream of tanks. Filling tanks end of South- West (SW) monsoon is the best strategy for areas predominantly receiving SW monsoon rains.

**Keywords**

Traditional tanks, ponds, replenishment, river water

## Introduction

Irrigation tanks and ponds are traditional surface water harvesting structures that were built centuries ago in India. While an irrigation tank will have a demarcated command area, a pond does not provide direct irrigation but stores rainwater as well as recharges to groundwater. Over recent decades, many of the irrigation tanks were converted as storage ponds by closing their irrigation sluices. Therefore, the hydrological differences between these two are blurring in recent years. As a pond is also contributing indirectly to the irrigation by augmenting the groundwater, henceforth 'tank' or 'irrigation tanks' is used to refer to both a pond and a tank.

As per the 5$^{th}$ Minor Irrigation Census conducted in 2013-14, there are 241,715 smaller and bigger tanks in India (GoI 2017). Andhra Pradesh and Telangana have 38,946 and 30,826 irrigation tanks respectively. These traditional structures are primarily of two kinds with respect to the nature of water inflow into them. Some are independent tanks having standalone catchment areas with no direct linkage with any other tank in the region. The second kind is the system tanks that are part of a cascade of tanks. In this case, surplus water from the upstream tanks also flows into the downstream tanks through the link channels, in addition to the run-off from rainfall in their catchment areas. The return flows from the upstream command areas also gets into the downstream tanks.

Of late, many of the irrigation tanks got dried up and do not get enough inflows during rainy season. Land use changes in their catchment areas; recurring droughts and deficit rainfall; silting up and drastic loss of storage capacity; and human encroachments are often found as the major reasons for this situation (Palanisami and Thangavel 2020). On the other hand, the techno-economic perspective in planning irrigation projects drastically changed in recent decades. The project designs once considered to be much complicated to manage and expensive to build are now easily pushed through the approval authorities as potential options. Lifting water to great heights using huge quantities of electricity was once not a viable proposition, but is now a heroic venture. Submergence of huge swaths of land and habitations is no more a deterrent.

Linking modern major and medium irrigation projects with the cascades of traditional tanks is an approach existed in India for quite some time. The earliest efforts towards this are found in Tamil Nadu, wherein North-East monsoon during October-December is the predominant rainy season. The South-West monsoon run-off during June-September that is tapped by dams like Mettur, Siruvani and Periyar is used to fill tanks and make water available for farming early (India Today 2019; ToI 2020). There is also the practice of filling the tanks during and after the North-East monsoon based on the storage available in dams, such as, Pilavakkal Periyar, Kovilar and Sasthakoil in western ghats and the Vaigai in Madurai district (News Minute 2019; Hindu 2020). This approach to utilize the traditional tanks to store river water gained traction in recent years, especially in recently started large-scale irrigation projects in Andhra Pradesh and Telangana states. There are two major motivating factors towards this approach, viz., (i) need for circumventing deficit rainfall and dwindling run-off in tank catchment areas and (ii) shift towards lift irrigation projects without significant reservoir storage.

**Circumventing droughts and deficit run-off in tank catchments**

Many tanks dried up with recurring droughts and deficit run-off in their catchments. Also, the run-off drastically reduced due to encroachment of feeder channels; land-use changes in the catchment areas and losses to soil moisture replenishment. Reduced storage space in the tanks due to the deposition of silt from their catchments further affected the total days of water retention and availability in a year. This has seriously impacted the water availability to crops in their command areas. Groundwater exploitation through open and bore wells increased in their command areas but recharge to the same diminished. Exponential proliferation of bore wells in the tank command areas and depletion of groundwater that occurred in the last two decades rendered the problem more acute.

The irrigation officials found a way of circumventing this crisis when new irrigation projects and their canals came up in different areas. The irrigation tanks enroute the canals are filled with the surface water carried by canals. Once a policy decision is made in favour of this approach, local political pressures played out to include as many tanks as possible from every village enroute the canals. A good example is the Handri Neeva Sujala Sravanthi (HNSS) lift project that is permitted to draw nearly 40 tmcft of flood waters annually from Srisailam reservoir on Krishna River in Andhra Pradesh. This project with a network of lifts and reservoirs enroute the 550 km long main canal provides irrigation and drinking water to four districts of Andhra Pradesh, together widely known as Rayalaseema region. Many remote villages in this region, once parched for water, are now brimming with water in their tanks (The Hans India 2018; Best Projects in India 2018). This also revived their dried up open and bore wells, a situation that makes farmers happiest and shower all the praise on the initiative.

## Evolution of lift irrigation schemes without significant water storage facility

Earlier efforts to utilize the river waters by building dams preferred creating larger storage reservoirs behind the high-raise gravity dams. The water thus stored is planned to flow by gravity to its command areas through a network of canals. If possible, some extent of hydel power generation used to be an integral part of the project. Thus, those projects were planned as net producers of electricity as well. But the new-age irrigation projects, such as the HNSS and the most recent Kaleshwaram Lift Irrigation Project (KLIP) across Godavari River in Telangana involve lifting water against high elevations using considerable amount of electricity. The KLIP, which was partly operationalized in the year 2019, is known as the world’s largest multi-stage lift irrigation scheme tapping around 240 tmcft of river water (Wikipedia 2021). The KLIP uses 25 small and big barrages to take water far and wide through 1800 km long canal networks.

These lift-based projects do not have considerable storage space as they raise low-head barrages across the source river. They are net electricity consumers on account of pumping water to higher elevations and longer distances. This lack of significant storage in these recent projects prompted the irrigation engineers and the political leaders to link the existing tanks with such pumping schemes. It is also beyond doubt that such a ‘politically calculated’ move also mints larger public support and votes for the ruling governments.

## Justification to time the replenishment of tanks

This debate on when to fill the traditional tanks with canal water may sound unnecessary at first instance. But it is true that the benefits of such a tank replenishment program are directly related to how best we synchronize the ‘local water’ (run-off from the tank’s own catchment) with the topping up of ‘external water’ (canal water from the modern lift projects). Though the replenishment of irrigation tanks enroute the canals is a measure with good intention, the timing of it makes all the difference. The beneficial effects of such replenishment are highly dependent on the time of the year chosen for such replenishment. There could be unintended negative effects when the replenishment is ill-timed.

The HNSS is restricted to lift water from Srisailam reservoir only after water level in it reaches 830 ft (253 m) above mean sea level. Thus, most of the time, the filling of tanks from the HNSS canal takes place end of the South-West monsoon season, after the Srisailam reservoir has surplus water. But, take the case of KLIS. Before, the irrigation tanks in around 75 villages enroute the Sri Ram Sagar Project (SRSP) Flood Flow Canal (FFC) used to get water filling after September every year. After the start of reverse pumping of water by KLIS to SRSP, the release of water to tanks got advanced to July in the year 2020 (NIE 2020). Giving strength to this approach, the Chief Minister of Telangana directed the irrigation officials to replenish the ponds, reservoirs and tanks enroute the canals of KLIP right from the beginning of monsoon in June 2021(CMO 2021).

The best time to fill the tanks is when the rainfall in their catchment is delayed or in deficit and when the water is in acute shortage in its command area for agricultural operations. If we know beforehand about rainfall patterns, we could plan the replenishment of tanks accordingly. However, it is not technically possible to forecast precisely whether it is going to rain in the micro catchment areas of these tanks in coming weeks ahead of time.

Theoretically speaking, three distinct approaches may be considered for analysis of merits and demerits. One obvious choice is to fill tanks early in June-July in the event of South-West monsoon gets delayed or in deficit in the tank catchments. This helps the timely start of agricultural operations by farmers. Second logical choice is to wait for the end of monsoon season to top up the unfilled storage space in the tanks. This will optimally utilize the run-off from the tanks' catchments and tremendously help in irrigating the winter crops sown by farmers. There is a third option that involves topping up of depleted tank storage intermittently, several times, using the canal water.

Filling tanks early at the beginning of the South-West monsoon facilitates early availability of water to farmers and helps in timely start of farming operations. But there is a risk of anytime flooding and tank breach due to copious run-off from its catchment during the ensuring monsoon season. The costs of pumping of canal water for filling tanks is not worth if a good rainfall follows in tank catchment area. Second option is filling tanks end of the rainy season, i.e., during and after September. In this option, monsoon rains in the tank catchment are fully tapped without involving any electricity use and associated pumping costs. Water thus filled in the tank is available for an assured winter crop. But there is the risk of failure of rainy season crops if it turns out to be a deficit or delayed monsoon in the catchment area.

The third option is to do several intermittent fillings of a tank but always leaving freeboard for absorbing possible floods from its catchment area. This is a more sophisticated, dynamic and real-time system that optimizes water replenishment, energy use for pumping and the associated costs. By design, the tanks with less catchment areas and tanks that are in low rainfall regions get deserving attention in this system. But it required more calibrated efforts and regular monitoring of tank storages across a large geographical area.

As explained already, these three options have their merits and demerits. A combinatorial approach may also be used by following more than one of them in a given rainy season. These three options assume that there is enough surplus water in the reservoir or canal for replenishing the irrigation tanks. Further, there may be a need for fine-tuning the strategy to suit system tanks and independent tanks. Tanks may also be segregated based on the amount of rainfall in their catchment areas. Tanks in low rainfall catchments may be given priority to replenish with canal water than those in high rainfall areas. The relative extent of catchment area of a tank in comparison to the water storage area of the tank is also an important consideration. Tank with a catchment area much less compared to its water storage area, especially in low rainfall areas, obviously deserves a priority in allocating canal water.

However, second and third have more merits than demerits compared to the first option. In absence of a sophisticated system to monitor tank storages dynamically during the monsoon period, the second option is more appropriate. Especially when the previous year was a normal or surplus monsoon year leaving comfortable groundwater reserves for use till the beginning of next monsoon. Thus, the crops could be saved using the groundwater even a deficit monsoon situation arises.

## Conclusion

Filling tanks with run-off from their catchments is a natural and inexpensive mechanism. But, artificial replenishment of tanks with river water from far-off places involve electricity use for pumping. These costs are further magnified by the seepage and evaporation losses in water conveyance through canals. Early filling of tanks could pose the risk of unintended harm, in the form of breaching of bunds and flooding of downstream areas.

Therefore, instead of an ad hoc approach to the replenishment of tanks whenever canal water is available, a more strategic approach is highly desirable. Such an approach shall stress on maximum use of 'local water' and optimize the replenishment with 'external water'.

Several intermittent filling of irrigation tanks based on the storage space available, deficit rainfall in their catchments and crop water needs in their command areas is the first best option. However, it requires a more nuanced water balancing between canal water and tank storage on a continuous basis. In absence of this wherewithal, as is the case now, replenishment of tanks end of the South-West monsoon season shall be the preferred option. This is the next best option for all those areas, except the ones like Tamil Nadu where North-East monsoon is predominant.

## Acknowledgements

The author thanks the Trustees of Water and Livelihoods Foundation for encouraging to study and write this article that critically analyses the emerging practices in irrigation sector in Telangana and Andhra Pradesh states in India in recent years.

## Declaration

The authors report there are no competing interests to declare.

## References

Best Projects in India (2018): "HNSS (HANDRI NEEVA SUJALA SRAVANTHI) Irrigation Project", *Best Projects in India*. https://www.bestprojectsinindia.com/article/95/hnss-irrigation-project (accessed on 15 July 2022).

CMO (2021): "CM reviewed the status of irrigation projects. May 26, 2021", *Office of the Chief Minister, Government of Telangana*. https://cm.telangana.gov.in/2021/05/cm-reviewed-the-status-of-irrigation-projects/ (accessed on 15 July 2022).

GoI (2017): "Report of 5$^{th}$ census of minor irrigation schemes", Ministry of Water Resources, New Delhi: Government of India. http://164.100.229.38/sites/default/files/5th-MICensusReport.pdf (accessed on 15 July 2022).

Hindu (2020): "Water released from dams", *Hindu*, 5 Nov. https://www.thehindu.com/news/cities/Madurai/water/article33032387.ece.

India Today (2019): "Tamil Nadu: Water from Mettur dam to be released on Tuesday", *India Today*, 12 Aug. https://www.indiatoday.in/india/story/tamil-nadu-water-from-mettur-dam-to-be-released-on-tuesday-1580165-2019-08-12.

NIE (2020): "Farmers rejoice as water fills Telangana's Sri Ram Sagar Project canal", *New Indian Express*, 16 July.

https://www.newindianexpress.com/states/telangana/2020/jul/16/farmers-rejoice-as-water-fills-telanganas-sri-ram-sagar-project-canal-2170391.html.

News Minute (2019): "Water from Vaigai dam released, Madurai's Mariamman teppakulam to be filled", *News Minute*, 10 Nov. https://www.thenewsminute.com/article/water-vaigai-dam-released-madurais-mariamman-teppakulam-be-filled-112052.

Palanisami, Kuppannan and Thangavel, Mohanasundari. (2020). 5 Sustaining tank irrigation in south India through time-tested measures. In *Sustainable Development in India: Groundwater Irrigation, Energy Use, and Food Production*. Ed. Koichi Fujita and Tsukasa Mizushima, New York: Routledge.

The Hans India (2018): "Handri Neeva Sujala Sravanti water to fill 300 irrigation tanks", *The Hans India*, 31 May. https://www.thehansindia.com/posts/index/Andhra-Pradesh/2018-05-31/Handri-Neeva-Sujala-Sravanti-water-to-fill-300-irrigation-tanks/385545.

ToI (2020): "Water released from Chithirai Chavadi anaicut for irrigation", *Times of India*, 8 July.
http://timesofindia.indiatimes.com/articleshow/76843097.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.

Wikipedia (2021): "Kaleshwaram Lift Irrigation Project". *Wikipedia, The Free Encyclopedia*, 25 May.
https://en.wikipedia.org/w/index.php?title=Kaleshwaram_Lift_Irrigation_Project&oldid=1025022131(Accessed on 15 July 2022).