J. Ind. Geophys. Union (October 2015)
v.19, no.4, pp:481-487

An over view of Irrigation Tanks Rehabilitation in semi arid hard rock terrain

P.R.Reddy
Former Scientist G & Emeritus Scientist, CSIR-NGRI, Hyderabad-500 007
e-mail: parvatarreddy@gmail.com

ABSTRACT
Tank rehabilitation presently in vogue, in many states of India and neighbouring Sri Lanka, needs a holistic approach involving scientific planning and execution and people`s participation to save the tank and meet basic objective of providing water for irrigation. The article brings into focus the essential inputs to make the initiative successful. The main inputs include specialists' reports on successful and failed initiatives in Karnataka, Tamilnadu, Pondicherry states and Sri Lanka. Needed procedural changes are also outlined to make tank rehabilitation under Mission Kakatiya Project, Telangana state effective and long lasting..

INTRODUCTION

The hydrological characteristic of the Indian monsoon necessitated creating storage facilities to hold the monsoon rainwater and utilize it later. It is necessary to create the storages - both ground water storage in aquifers and surface water storage to tap the excess/surplus water flows (runoff) during the rainy season and store to the maximum extent using in-situ methods - traditional tanks (if available and abandoned) and farm ponds, check-weirs/dams, percolation tanks. With extraordinary engineering, managerial, and social skills, an extensive system of rainwater harvesting structures comprising tanks and ponds had been built and maintained by the people for centuries. Many of these multiple use structures were the nerve centres for sustenance and livelihood of the rural communities. After independence the tanks capacities are on a decline. This decline is both in the form of decrease in the relative importance of tanks vis-à-vis other modes of irrigation and a decline in the actual area irrigated by tanks. Many reasons such as silting of feeder channels, encroachments in the tank bed, interruption in the catchment, poor maintenance, and development of well irrigation in tank commands are attributed for the decline in the tank-irrigated area. One of the most important reasons for the decline in tank irrigation is the disappearance of village institutions that were managing the tanks. The village level organizations have undergone changes because of a vast increase in the number of irrigators, shift in land control from a small to a large number of landowners, changes in the attitude of farmers, and the spread of well irrigation in the tank command. Today, tanks are viewed more as an "open access resource"; tank communities have lost their capacity and the will to mobilize resource and labour to undertake regular maintenance activity to enforce norms and obligations. Other important reasons attributed are:

*The construction of large canal systems has led to the displacement of traditional tank systems. After Independence, the canal irrigation was developed in a massive way that subsumed the tank-irrigated areas. Water resources development has been carried out through successive 5-year plans since 1951. Millions of rupees were invested in creating major, medium, and minor irrigation systems with extensive canal network. This resulted in substantial increase of irrigated area. The central Government, even under its 5-year plans, had not given due attention or resources to keep the tanks in good state. While the area under irrigation increased substantially after the beginning of the 5-year plans at the rate of more than 1 million ha per year, the percentage of tank-irrigated areas to total irrigated areas showed a steady decline.

*The groundwater exploitation got a lift with availability of institutional finance for acquiring infrastructure and procurement of heavily subsidized electric and diesel pumps for pumping ground water at will. This resulted in financially better-off farmers to go in for bore well irrigation in the tank command. Realizing the importance of tanks, South Indian states have started rehabilitating the tanks in the mid-1980s under state funds as well as under external assistance (however, nothing of substantial dimensions have been implemented in erstwhile Andhra Pradesh). The number of tanks modernized to date is negligible compared with the total number of tanks in the country. The general belief is that the tanks are in a vicious cycle of "poor maintenance–decline in condition–rehabilitation–poor maintenance." On the other hand, proponents argue that tank rehabilitation is a must around which livelihood options of the rural poor are to be built in view of the multiple use of tank water (Sakthivadivel, 2005). With ground water depletion and inadequate monsoon rains there is a perceptible change in irrigation options. Under minor irrigation sector, tank rehabilitation has been initiated in recent times, on a large scale, in Telangana and Andhra Pradesh. It is propagated that if properly executed the rehabilitation initiatives can not only enhance tank irrigation but also ground water utilisation. To make these large scale initiatives successful it is necessary to follow some structured execution norms in rehabilitation of tanks. To make this write up of use not only to interested researchers but also to those associated with tank rehabilitation process some fundamentals are included. This write up, mainly structured using hitherto experiences from Tamilnadu, Karnataka, Pondicherry and Sri Lanka, can be used as an introductory procedure. For comprehensive rehabilitation process it is necessary to have area specific norms and execution policies.

What is a Tank and basic importance of minor irrigation tanks?

A tank is a low, earthen bund constructed across a shallow valley to hold rainfall runoff from catchment area. A lake/tank is formed when water flow is intercepted by an obstruction i.e., a rock outcrop or dyke. People recognizing the obstruction constructed a stop dam to raise water level in the natural flow path. When the bund assumes certain length, the impounded water looks like a pond/ tank. Tanks may be either isolated or in cascades. In a cascade, when the upper tank gets filled, the surplus weir flows spill into the tanks in the downstream one below the other as a cascade until the last tank spills into a drain or a river. The configuration of the physical system of tank cascade in a particular watershed has to be considered as a link system of Tank rehabilitation index for prioritization of tanks in semi arid regions.

The objective of Improvement of Minor Irrigation tank component is to enhance the physical condition and operational performance of selected tank systems through a range of interventions identified and executed in partnership with the respective tank users. In executing these interventions steps are taken to secure safety of the tank structures, improve on-farm water management and water use efficiency. However, as most of the tanks presently operate below their designed capacity, it is necessary to revive these tanks for ensuring optimum use.

What are the functions of irrigation tanks?

India, a tropical country, has historical evidences of human interventions in the management of water for agriculture from village water bodies. One such intervention is an irrigation tank. Minor water reservoirs located behind earthen dams are known as irrigation tanks as they are generally used for ensuring protective irrigation to crops. A tank is a simple rainwater harvesting structure designed by people using indigenous wisdom and strengthened with generous support of native rulers and chieftains. There are 500,000 irrigation tanks in the country, of which 150,000 tanks are located in the semi arid region of Deccan plateau. They are located in hydrologically favourable sites, some of them in sequential chains or cascades, effectively capturing the rainfall and serving multiple uses with irrigation having the major share. Tank irrigation systems are simple but fragile structures. They have to be constantly maintained, monitored and conserved. Even more difficult is sharing the scarce water amongst its consumers, particularly farmers. And yet, people across the country have devised a variety of mechanisms to share the water and maintain their tanks (Shanmugham et al, 2007). The tank system has four different functions in irrigated agriculture viz.,soil and water conservation, flood control, drought mitigation and protection of environment of surrounding area. Likewise, development of tank irrigation has to be taken up in the four phases, viz., water acquisition or harvesting, storage, disposal of surplus water, distribution and management of water in the command area by an institution. The tank area comprises the catchment area, the feeder channel, tank bund, water spread area, sluice outlets, command area, field distributaries (water courses) and surplus weir. While the South and East Indian tanks are known for their antiquity and are created essentially as a source for providing supplementary irrigation during monsoon season, innumerable small water holding structures called ponds have been in existence in many North Indian states and some were constructed even after Independence for multiple uses including irrigated agriculture. Although many of these ponds are primarily meant for inland fresh water aquaculture, they have also been used for multiple purposes like irrigated agriculture, livestock and other domestic uses. Tank irrigation has thus a rich heritage on account of long historical antecedents in various regions of India (Shanmugham, 2007).

Tank Rehabilitation—needed approach:

In spite of extensive usage of tanks for irrigation for centuries, a marked decline was noticed post independence and it became almost defunct by 1980s. In such a scenario of tank degeneration, and tank use and management, the major deficiencies noticed in the tank complexes are: a) lack of community involvement in tank management and maintenance; b) inadequate and unreliable water supply to the tank; c) absence of local institutions for management; d) large-scale infestation of weeds and loss of grazing land in the tank bed; e) encroachment of tank bed and supply channel by the government, public, and private people; f) silting of tank water spread and supply channels; g) choked or leaky sluices and damaged weirs; h) sluices with missing shutters ; i) dilapidated and weak or cut-down tank bunds; j) meagre resource allocations for maintenance; k) urbanization and extinction of tanks; l) non sustainable large-scale groundwater development and decline in gravity flow in tank-fed irrigated area (Sakthivadivel, 2005).

During the past 2 to 3decades, some of the states in south India have started rehabilitating the tanks. The European Economic Community (EEC), now European Union (EU), the National Bank for Agriculture and Rural Development (NABARD), and the World Bank provided financial assistance for tank rehabilitation in these states. Besides this, the governments of Tamil Nadu and Karnataka carried out repairs to the tanks from their own funding either directly or with support from nongovernment organizations (NGOs). The objectives and the model used for tank rehabilitation projects, their process and lessons learned are discussed in the study carried out under International Water Management Institute (IWMI). IWMI-Tata Water Policy Programme during 2003–2005 documented reasons for the best performance of tank institutions and the sustainability level of rehabilitation carried out by different governments, funding agencies, and NGOs in different states. From these studies, recommendations for sustaining tank institution and tank rehabilitations were made.

A study under the IWMI-Tata Water Policy Programme in 2004–2005 examined various livelihood options in tank irrigation under different scenarios and gender-related issues in tank rehabilitation in 40 rehabilitated tanks under different models in three states—Tamil Nadu, Karnataka, and Pondicherry. The study concluded that in tank rehabilitation works, augmenting tank water and increasing tank storage have greater impact on the livelihood options of the landless and marginal farmers. There are three types of tank institutions: traditional institutions, government-sponsored institutions, and NGO-sponsored institutions. Traditional tank institutions have several advantages with respect to water allocation and maintenance. In most tank systems, the tank users have the most intimate knowledge about their own physical and social environments. Their proximity to the resource use area enables them to utilize their knowledge effectively and to act quickly in solving problems. Individuals who have lived together for a long time are able to develop various social networks and reciprocal relationships with one another. Finally, rules adopted by farmers are more relevant to local circumstances because farmers who decide to adopt the rules have to bear the consequences of their own decision. The government-sponsored institutions are created essentially to meet the conditions of funding agencies. Hence, the organizations disappear once the project is completed. Government officials entrusted with mobilizing farmers and forming an organization do not have the required outlook or capacity to interact with the community. Organizations formed by experienced NGOs are sustainable and vibrant. NGOs perceive the tank as a component of a watershed or a cascade of tanks. Hence, the planning and rehabilitation cover the entire watershed as a whole. The first activity of the NGOs is motivating and mobilizing people and building organizations at habitat, cascade in watershed levels. All development works are planned and implemented through the users' group. NGOs work at grassroots level to enable communities to build upon their skills, initiatives, resources, and entitlements rather than delivering services or solutions to them.

After detailed experimentation in different parts of Tamilnadu, Karnatka and Pondicherry the following criteria were considered for selecting a tank as a candidate.:1) enthusiasm of majority of farmers ; 2) hydrological features with the dependable water yield for storage; 3) soil fertility status and scope for diversity of crops; 4) conjunctive use of surface and groundwater in the command; 5) incremental benefits that are likely to occur; 6) number of villages served ; 7) population and its distribution in case of more than one village or hamlet with less disparity and 8) size and distribution pattern of landholdings. These norms are applicable for any tank rehabilitation exercise. However, as number of socio-economic issues are involved in making a tank rehabilitation programme successful, especially in semi arid hard rock terrain the following additional guidelines are needed to ensure success:

1) To have an effective rehabilitation and continued sustainability, farmers should be consulted before planning and involved in the rehabilitation process; 2) The yield from catchment and inflows from supply channels are to be assessed more accurately and, wherever possible, measurements are made and recorded. 3) Provision for forming and strengthening of water users' associations (WUAs) ; 4) The cost of rehabilitation provided needs to be fixed taking area specific changes ; 5) Selected lining of field channel should be carried out against complete lining; 6) More emphasis on training of officials and farmers; 7) Community organizers (COs) are to be deployed to mobilize farmers. 8) Catchment treatment and community wells are to be included as components and 9) Crop demonstration to motivate diversification of crops (Sakthivadivel, 2005).

The Government of India had given guidelines for tank rejuvenation projects. Based on appraisal of the guidelines, a set of additional recommendations on policy, institutional, and legal issues have been made. India has thousands of tanks and ponds which, if rejuvenated, will contribute significantly not only for increasing food production but also providing a variety of livelihood options to the rural poor, especially women. This appears to be the best cost-effective option than creating new irrigation works. The tank rehabilitation had been aimed to increase agricultural production. The IWMI-Tata water policy program concluded that in view of the increased benefits and from equity consideration, improving the livelihood of the rural community through increasing the gross tank product should be the objective of future tank rehabilitation and rejuvenation projects.

Tank rehabilitation will not be successful, if technical aspects pertaining to **river basins** are not considered. Irrigation system rehabilitation planning must take place within a basin context. That is, the impacts of system improvements on other users in the basin must be assessed to avoid creating or aggravating discord over water and to ensure that investments in water resources development give the expected benefits. However, in many places the needed hydrologic database for each basin does not exist, or not periodically updated. This needs to be given due importance.

Planning Small Tank Rehabilitation

When planning small tank rehabilitation, there are three basic considerations. First, the types of investment that can be permitted must be specified. Second, since development funds are limited, the tank must be selected for investment based on relevant criteria. Third, for any selected candidate, the particular works to be carried out must be identified. A procedure is suggested for determining the cascade water surplus including holding participatory planning sessions with farmers. One output of this process is a set of proposals for rehabilitation works, including proposals for both individual tank systems and augmenting cascade tank systems. Planning then consists largely of deciding which proposals should be accepted.

The alternative and more common planning process involves experts visiting each candidate tank system and working out the rehabilitation proposals themselves, sometimes in consultation with farmers. When there is little detailed knowledge of the tank cascades, the participatory planning approach has several major advantages over planning by experts. One is that having the farmers make their own plans gives them ownership of the plans and makes their cooperation more likely and more effective. Since small tank rehabilitation projects generally require farmer input in the form of labour or cash, such cooperation is essential. Another advantage relates to the impact of tank augmentation or capacity expansion can have on the tank systems downstream in the cascade. When farmers of the cascade are involved in planning, they can anticipate these impacts based on their combined knowledge of cascade hydrology. Also, as part of participatory planning, farmers can be asked to prioritize the proposed interventions. If resources are not sufficient for all of the proposed investments, selecting investments using the farmers' priorities is likely to be more politically acceptable than using other criteria. It is noticed from rehabilitation operations in Sri Lanka, Tamilnadu, Karnataka and Pondicherry that farmers are quite capable of applying their detailed local knowledge to prioritize the proposed interventions. Finally, since participation of the farmers is essential to gather data needed for each cascade, involving farmers in participatory planning is very efficient. Various options can be considered when planning small tank rehabilitation, such as: Repairs to the tank bund, sluice, weir, and spillway, to the main, secondary, and tertiary canals and their control structures, and to the drains. The other option relates to management improvements to upgrade information sources and management skills of the farmers. These improvements may include installing measurement devices, training managers, creating management organizations, devising new rules, etc. They also include training farmers in more efficient application of water to crops and in other means of improving water use efficiency.

Mission Kakatiya-needed initiatives

The Government of Telangana has taken up a massive programme of Restoration of all Minor Irrigation Tanks numbering 46531, under MISSION KAKATIYA (Mana Ooru – Mana Cheruvu) in a decentralised manner through community involvement. The objective of Mission Kakatiya is to enhance the development of Minor Irrigation infrastructure, strengthening community based irrigation management, adopting a comprehensive programme for restoration of tanks. While appreciating the initiative, it is advisable for implementing agencies to take note of gathered data from different tank rehabilitation exercises carried out in Karnataka, Pondicherry, Tamilnadu and Sri Lanka.

It is heartening to learn that Telangana government has started rehabilitation exercise, to ensure reasonable amount of water in segments of the state where there are no assured supply of water through river flows. The author advocated way back in 1983 (as Scientific Adviser of APSIDC) the need for saving tanks and ponds in the erstwhile united Andhra Pradesh, after witnessing large scale encroachments in drought hit segments of Telangana and Rayalaseema. Unfortunately, no concrete steps have been taken by different governments leading to almost 60 % of tanks losing their capacity to store water. In 2003-2004 Jayathi Ghosh committee clearly stated in its report that tank rehabilitation should be given top priority to ensure better irrigation facility.

Since Telangana government has taken up rehabilitation of tanks in a large scale and as majority of the tanks are located in hard rock terrain and as monsoon variability has increased considerably in the last 10 to 15 years, it is suggested that a proper technical/ scientific approach is introduced in executing rehabilitation. It is good that needed rules have been framed and efforts are being made to ensure proper execution of stipulated procedures. However, as the quantum of work is enormous, one has to ensure that adhoc time bound routine de-siltation process, extending catchment area etc, in a large scale do not replace quality procedures. Some suggestions are made below to remind the government channels the necessity to have people's participatory approach, in letter and deed, in this venture. For that, area specific steps are to be taken, by properly considering various socio-economic factors and technical execution mechanism based on hydrogeological features.

Tank construction is made when a segment of land has requisite topographic features to allow upstream waters to flow in to a catchment zone. When the tank bund assumes certain length, the impounded water looks like a pond/tank. Most of the benefits by obstructing the flow path will be received by upstream of the tank rather than downstream areas. However, in some instances, the low permeability obstructed formation may allow from its sides some flow of groundwater through its end points. Thus most of the interventions planned by government channels (in Karnataka, Pondicherry and Tamilnadu), for conversion of a tank into a percolation tank have not improved the envisaged water yield in bore wells in the downstream. During Neeru-Meeru programme execution, considerable set backs were encountered due to non implementation of stipulated rules and well articulated regulations. Neeru-Meeru programme failed, as importance was given to amount of money spent in constructing upstream interventions (check dams, sub surface dykes and contour bunding) within a limited time span, without peoples participation. In the present mission mode venture, in spite of presence of quality control mechanism for silt removing, bund strengthening and removal of obstructions for free flow of runoff water in to the tank catchment zone and tank bed received some setbacks at places as quality norms have been diluted in the name of time bound execution mechanism. The farming community invariably use pesticides and fertilizers for sustenance of crops. Majority of them have no knowledge regarding migration of these chemicals and their impact on environment and water sources. Since success of this project is paramount to strengthen irrigation practices in drought prone semi arid tracts of Telangana, it is essential to note that in hard rock terrain considerable storage volume loss could be noticed as evaporation from soil. This happens as more lateral area is covered with meagre column of water and the silts get saturated from the tank water storage and during shrinkage of water spread area. In this process soil surfaces are exposed and percolated moisture is lost through evaporation from soil. Collectively, 60-70 % of harvested water is lost without any utility by any tank system in SAT region. It is therefore desirable to utilize water collected by a tank system at the earliest for irrigation purposes to minimise the losses. One of the rejuvenation strategies is to restrict the lateral spread area and increase the height of column of water to be stored. Through this approach, though one may not be able to avoid evaporation one can minimize it (Muralidharan and Nair, 1998). The deepening of the sediments from the tank bed may help gain the hold capacity of runoff water. It is recommended to have additional water flows in the upstream areas to draw benefits from impounded water in the tank. It is rarely noticed that outcrop areas in the tank beds are connected to deeper aquifer. If that was the case, water would not get impounded in the tank. It is noticed in different segments of hard rock terrain that water percolates towards downstream enriching the groundwater. Thus, it is suggested to deepen tanks for increasing surface water holding capacity in view of likely receipt of high intensity rainfall of short duration under the climate change phenomenon. But, the potential for groundwater development would be very small from such interventions, particularly in highly pervious (having infiltration characteristics) red soils of granitic terrain of Telangana state. As such, it is suggested to go for small contour trenches of 10-15 cm, which will enhance the soil moisture in the soil zone on which all living plants grow/ depend by drawing available moisture. Unfortunately, soil moisture holding capacity is 60-90mm/m thickness only in the soil zone of red soils in Telangana region. Once the soil moisture in the soil zone exceeds field capacity i.e., 60-70 mm/m in Telangana region, possibility of deep percolation to groundwater could be expected. Such a phenomenon is recognized by farmers by seeing immediate rise in groundwater level after an intense storm rainfall of about 80 mm. All these features are plenty on ridge part of the watershed. Due to this, any attempt to enhance infiltration in the valley parts, which mostly host the ponds/ tanks, may not yield desired results. Moreover, the valley parts are enriched with fine silt/clay sediments, which impede vertical infiltration of the rainfall. To overcome this problem it is suggested to carry out water harvesting on the ridgelines of the watershed to reap benefits of direct rainfall infiltration to the deep water table. Further in the shallow water table condition of the valley regions the potential groundwater recharge may be leaving as rejected recharge resulting in enhancement of stream flows in the downstream areas in the watershed. As pointed out earlier (from acquired knowledge through organised rehabilitation works in Karnataka, Tamilnadu and Pondicherry) it is essential to take into consideration basin hydrogeologic dynamics in evaluating a tank`s working capacity. In other words in a basin, mini basin or a micro basin where cascade of tanks present one should have a reasonable knowledge of quantum of water entering a basin, water retained in the basin and water leaving the basin both as surface runoff and interactions with the subsurface. In the absence of such information one finds it difficult to distribute waters into chain of tanks, leading to conflicts and ultimate failure of the initiative. As it is advocated that Mission Kakatiya's main objective is to restore chain of tanks built in different parts of the state during Kakatiya dynasty, it is essential to understand the hydrological features of such cascade of tanks. Small tanks in a tank cascade are hydrologically interlinked and if the hydrology of one or a few tanks is altered by increasing its storage capacity or expanding the irrigated command area or by diverting water elsewhere from the cascade, the entire hydrology of the cascade may be changed. If the cascade is well endowed with water, the resulting effect may not be very significant, but if water is limited in relation to total demand, there may be serious implications in terms of water availability for downstream users. This means the hydrology of an entire cascade needs to be assessed and understood in order to make the best use of available water resources within the cascade. It is essential to recognize this before any intervention to any individual tank in the cascade is contemplated.

Rock and water interaction results in different types of chemical reactions. These reactions result in water and soil quality changes in a tank. When farmers are given permission to extract silt from tank bed and spread it in their agriculture lands government mainly took into consideration economic advantages to the government and probable benefit to the farmers. While executing rehabilitation of cascades of tanks, with in a stipulated time span, usually not much importance is given in carrying out chemical analysis of both the silt and water. In the absence of such an exercise inadvertently execution authorities may introduce quality change in agriculture lands, especially in endemic areas for fluoride. The fluoride problem has assumed significant proportions in Nalgonda and parts of Ranga Reddy, Nizamabad, Warangal, Medak and Mahaboobnagar districts of Telangana state. In many locales due to poor recharge to the groundwater through rainfall and absence of even the secondary recharge to the aquifer by surface water flow in the streams and dry irrigation tank bed condition on the upstream of the tank, the groundwater fluoride content is found to increase linearly (Muralidharan et al, 2009). As pointed out earlier, the silt accumulation in tanks has been one of the main causes attributable to the decline in the utility of tank system. In general majority of the tanks, presently being rehabilitated, are silted over the years. In fluoride rich regions invariably silts are contaminated by high fluoride minerals. One of the strategies followed on reviving the defunct or dilapidated irrigation tank is to de-silt the tank. A safe disposal of silt laden with high fluoride is to be formulated, instead of allowing random extraction and usage of silts by the farmers. So, in a nutshell the rehabilitation exercise on a large scale needs continuous monitoring by experts to ensure success of the project. Rehabilitation does not end with one time removal of silt and cleaning path ways to ensure free flow of water on the tank bed. This is only a part of the total process. Irrigation increases the possibility of pesticides and fertilisers migrating to groundwater and surface water. Irrigating saturated soils or irrigating at a rate that exceeds infiltration rate of soil promotes runoff that can carry pesticides and fertilisers with it. Irrigation that promotes the frequent downward movement of water beyond the root zone of plants also promotes the leaching of substances, including pesticides and fertilizers, to groundwater. This is of particular concern in areas where frequent irrigation is necessary because of coarse-textured red soils. Proper irrigation management is critical to minimize the risk of pesticides and fertilizers moving into the groundwater. This aspect needs to be given due importance, as an integral part of Mission Kakatiya. As rehabilitation is carried out to help the farmers, it is essential to identify probable sources of pollution to individual and cascade of tanks. To start with one has to identify the type of polluting source, namely, point source, linear source and radially distributed multiple sources. Such segregation requires a proper on spot data collection. Impact of pollution varies depending on dimensions of a surface water body, volume of water in a tank/ pond and presence of varied types of geomorphologic features in and around the tank. If not all at least one tank in a micro basin needs to be studied to understand pollution dynamics and fix up a standard for the said micro basin as a single unit.Sustainability of tank irrigated agriculture necessitates the proper maintenance of tank system. Studies in Karnataka, Pondicherry and Sri Lanka demonstrated the utility and effectiveness of spatial technologies in mapping the various problems of tank irrigation system. The agriculture information system developed by NRSC and premier research organisations provides information to develop the management strategies for effective use of agricultural resources by different user groups. Such agriculture information system has to be developed for all the tanks being covered under Mission Kakatiya, as an important protective measure. Use of Spatial technologies and Best Agricultural Practices, such as Precision Farming, Smart Irrigation System and Agro-Social Entrepreneurship in an integrated manner may lead to increased water and crop productivity and subsequent socio-economic development of the region.

One can proclaim that the mission has achieved success, only when agriculture practices result in sustainable development for a minimum of 5 years (irrespective of monsoon vagaries) from the time water is first released to the beneficiaries. Success also depends on a holistic approach in implementing various components of farming practices, starting from tilling till marketing. In spite of some teething problems, all of us wish to see a successfully completed initiative. For such a success multiple technical operations and socio-economic initiatives need to be initiated and completed following an integrated approach. We do hope learned advisers, competent administrators and political big wigs would make use of knowledge base on rehabilitation of tanks in Karnataka, Tamilnadu, Pondicherry and Sri Lanka and ensure proper implementation of suggestions, following a well structured strategy, instead of following a random path.

CONCLUSIONS AND RECOMMENDATIONS:

From past experiences it is well established that any developmental work involving large volume of work components, result in dilution of quality, as standards are fixed in a gross way, without giving importance to area specific changes/ variations. As such it is advisable to select three to four clusters, based on varied topography, soil characteristics, water availability, socio-economic norms, farmers' response etc. These experimental studies would bring out pros and cons of different rehabilitation works and help in narrowing down the deficiencies while actually implementing works in bigger clusters. These aspects need to be given due importance in executing tank rehabilitation works, on a large scale in Telangana, under "Mission Kakatiya" Project.

ACKNOWLEDGEMENTS:

I am thankful to Mr. V.V.S. Gurunadha Rao (Ex-Chief Scientist, CSIR-NGRI) for useful inputs.

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