In search of ways for improving the tank Irrigation systems

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ABSTRACT:
In this paper an attempt is made to explore the ways for improving the performance of our traditional tank systems duly recognizing their features and services as well as the inherited local knowledge. Our Irrigation tanks have been formed as water harvesting structures to offset the vagaries of monsoon with ingenuity by our ancestors many centuries ago. These tanks constitute an inland – wetland ecosystem and provide important ecological services other than the overt economical services which are not legitimately valued now.

Being numerous, of varying sizes and spread over thousands of villages, they lend themselves to decentralized management with better water use efficiency than the canal irrigation systems. As the tanks are formed as chains akin to cascades, our tank systems are proved to be superior because of the synergized hydrologic efficiency of the linkage between the tanks. Such marvelous and widespread rural life supporting tank systems are getting deteriorated in the recent past due to poor maintenance by the government agencies and lack of interest among the users.

Realising the declining trend of tanks, the governments of the tank intensive States like Andhra Pradesh, Karnataka and Tamilnadu have started rehabilitating the tank systems. Though these rehabilitation programmes are well conceived, the implementation lacks certain pre-requisites needed for sustainable performance of tank systems. With the lesions learnt from such tank rehabilitation programmes implemented in the recent past, a few suggestions are made for sustainable performance of tank irrigation systems after their rehabilitation. The suggestions include sub-basin level water-balance study to ascertain the availability of enough water for each tank as a pre-requisite for tank rehabilitation, encroachment eviction, people's participation with commitment to engage common paid irrigators, involving Gram Panchayats (Rural Primary Local Governments) by amending the 73rd Constitutional Amendment Act 1992 so as to ensure real devolution of powers from State Governments to the Panchayats to facilitate people's participation in the tank rehabilitation programme and need for research to attain improved water use efficiency by bringing out the obscured ecological services.

1. INTRODUCTION

India has a long history of human intervention in the management of water for agriculture, because of the country's distinctive climate – intense monsoons followed by protracted droughts. Though there are about 45,000 larger dams in the World, India has only 4291 numbers (9%), against China having 22,000 numbers (46%) and USA having 6575 numbers (16.5%). Larger reservoirs in India account for a total storage capacity of 138.40 BCM (Billion Cubic Meter) only. But there are about 2, 70,000 small, medium and big water harvesting structures called "tanks" (earthen bunded small storage reservoirs formed in the natural depressions of the land), ingeniously designed by our ancient native rulers and chieftains over the past several centuries with the total storage capacity of about 29.00 BCM. The southern Peninsular India alone has about 1, 50,000 tanks mostly in Tamil Nadu, Andhra Pradesh, and Karnataka States(Vaidyanathan,2001). Being numerous, of varying sizes and spread over thousands of villages, they lend themselves to decentralized management with better water use efficiency than the canal irrigation systems. As the tanks are formed as chains akin to cascades, our tank system is proved to be superior because of the synergized hydrologic efficiency of the linkage between the tanks. As one of the still surviving, man-made and large common property resources, they constitute a basic life supporting system in most parts of South India. Such marvelous and widespread rural life supporting tank systems are getting deteriorated in the recent past due to poor maintenance by the Government agencies and lack of interest among the users.

There is much scope for improving the performance of our tank systems through rehabilitation using inherited local knowledge and improved management duly recognizing their features, services and the dynamic environment. There are ways for accomplishing this with our will.

Though the significance of our tank systems, their declining status and the causes have been well elucidated in the past by many scholars in this field, it is concisely re-presented in Sections 2 & 3 below mainly to emphasize the importance of considering the suggestions made in the Section 4 to bring back the glory of our tank systems through effective implementation of holistic rehabilitation programme.

2. SIGNIFICANCE OF IRRIGATION TANKS, THEIR MULTIPLE USES AND SERVICES

The undulating topography of the Deccan plateau provided a good base for these innovative but simple water harvesting structures – tanks and ponds – which the early settlers developed with their indigenous skill and technical advice from local craftsmen. These tanks also catch and hold the nutrient-rich top soil eroded from their catchment areas due to run-off caused by intermittent spells of heavy rainfall during the monsoons so that it can be transported back to the needy crop lands for filling up the eroded patches of farm lands and as manure to crops. Thus, these tanks serve the vital purpose of conserving both the prime natural resources namely, the soil and water which in turn facilitate their multiple uses such as irrigation, flood control, drought mitigation, ground water recharging in addition to other socio-economic and ecosystem services.

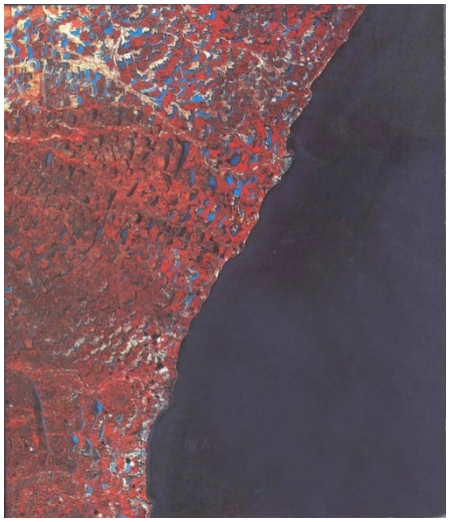


Figure1.*Panoramic Remote Sensing Map of Cascades of Irrigation Tanks in Eastern Tamilnadu*

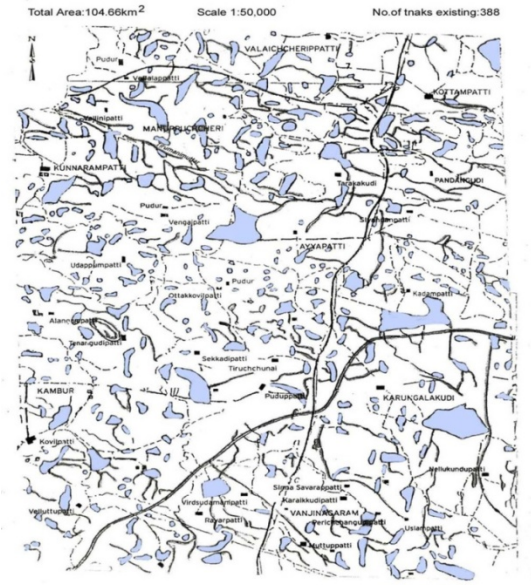


Figure 2. Toposheet showing the Tank population, 388 Tanks in an Area of 104.66 sq.km in Madurai Dt.

Figure 3.A view of a small tank with one sluice for irrigation in Tamilnadu, India

A tank is not a single entity. It is a cybernetic system with internal interference, external influence and change of goals. It is not merely a physical structure for storage of water. It is an integral part of the village society. It is an institution by itself. It has religious, historical, archaeological and cultural value. The tank is woven thickly into the social fabric of the rural community. Tanks are unique structures and potent instruments playing a very important role in poverty alleviation, social transformation and development of rural areas. Thus, the tanks and ponds play a crucial role for the rural masses as they promote their health, livelihood and economic prospects. Their sector-wise multiple uses can be categorized as under:

1.	Agricultural	:	Irrigation, tank bed agriculture, aquatic plant cultivation
2.	Non- agricultural	:	Fishing, Duck rearing, Tree planting, Silt collection
3.	Domestic	:	Drinking, bathing, washing
4.	Livestock	:	Drinking, washing, tank bed grazing
5.	Recreational	:	Resting, Boating, Swimming, Playing
6.	Environmental	:	Groundwater recharge, Support biodiversity, Flood control, microclimate modification
7.	Social	:	Meeting spot

2.1 Importance of Tank Eco-system services

In accordance with the proceedings of the Ramsar Convention, tanks and ponds come under “man-made inland -wetland ecosystem” based on their origin, vegetation, nutrient status and thermal characteristics. Although these water harvesting systems provide multiple services, they are valued mainly for their agricultural, domestic and livestock uses. The various services rendered by the tank eco system are as:

i. *Provisioning services* such as freshwater, food fiber, fuel and medicinal plants.
ii. *Regulating services* such as climate regulation, water regulation (ground water recharge/discharge), water purification(retention and removal of excess pollutants, diluting the toxicants), erosion regulation, natural hazard regulation(flood control, drought mitigation) and pollination (habitat for pollinators),

iii. *Cultural services* such as spiritual & inspirational, recreational, aesthetic & educational, and
iv. *Supporting services* such as soil formation (sediment retention and accumulation of organic matter) and nutrient cycling.

Even while demands for tank ecosystem services are growing, human actions are at the same time diminishing the capability of the tank ecosystem. One of the reasons for this normally could be that people are unaware of important ecological services other than the overt economical services provided by the tank ecosystems. This may probably be due to the absence of relevant research to bring out the values of ecosystem services holistically. It will be pertinent here to focus on the following quote:

> *"Because National Accounts are based on financial transactions, they account nothing for Nature, to which we don't owe anything in terms of payments but to which we owe everything in terms of livelihood."--Bertrand de Jouvenel, 1968*

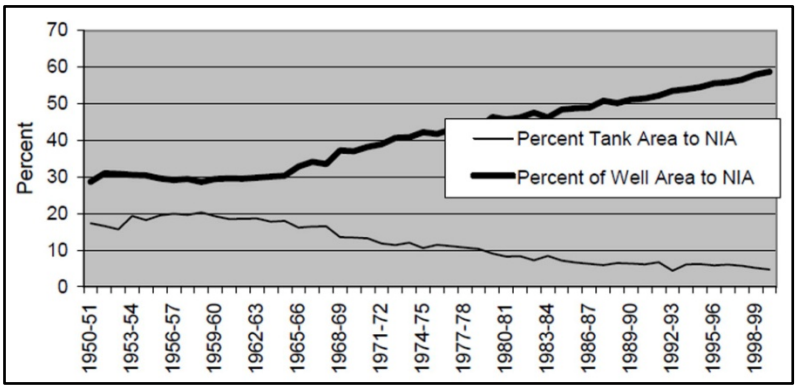
3. DECLINING STATUS OF TANK SYSTEMS

Tanks once owned by the local community were made as the property of the Government during the British rule and the users were made responsible for maintaining the tanks by "Kudimaramathu" (maintenance by community). After independence, the Government was keen on creating major irrigation schemes, leaving the maintenance of the existing age old tank systems to the users. Since agriculture became non-remunerative, farmers also lost interest in maintaining the tanks after 1960's. Since the State Governments have not paid adequate attention in maintaining their own tank systems till late 1980s, development works and encroachments caused delinking of tanks in many places.

This situation prompted the affluent farmers to sink open wells / bore wells of their own in the tank command areas reinforcing the heterogeneity among the tank users in their collective action for maintaining the tank system. The deterioration got accelerated due to lack of interest among the users on the maintenance of tank systems, caused by:

- The tanks are not able to catch and store the designed quantity of water due to siltation, physiographic changes in the catchment, encroachments in the water spread area and along the supply channels, etc.
- Agriculture is not found to be remunerative
- Since the tanks are small scale water resources spread over a large geographical area, Govt. could not pay effective attention on their maintenance due to paucity of funds.

The share of the tank irrigated area in India has declined from 16.51% in 1952-53 to 5.18% in 1999-2000, whereas the share of ground water irrigation has increased from 30.17% to 55.36% during this period. This is graphically represented in **Figure 4.** In the last 25 years, about 1.7 million hectares of net area under tank irrigation has been lost, amounting to a capital loss of about Rs.51,000 million (Palanisami et.al. 2000).



Source: Palanisami.K (Economics of Tank Irrigation – warning signals)

Figure 4. The trend of change in Tank and Well Irrigated Area to Net Irrigated Area (NIA), India

A note dated 24th September 1999 of the Planning Commission, Government of India on "Status of tank irrigation in India" attributes the following reasons for the decline of tank irrigation in India. "Partly due to ageing over the centuries, and partly due to inadequate and indifferent maintenance, the tank systems have gone into bad repair and require special attention. The common features noticed in the tank system which impair their services include silting of tank bed reducing the storage capacity, large scale encroachments, weed infestation and structural decay". All these indicate poor governance of tank systems serving millions of rural people. It will be pertinent here to note that the de- silting of these tanks can ameliorate 5.6million ha of dry land while creating additional storage capacity of 1.4 BCM. The declining status of tank irrigation in Tamilnadu compared to national figures is furnished in the Table 1 below:

Table1. ShareofdifferentsourcesofirrigationinIndiaandTamilNadu(%)

	Source	1960-61	1970-71	1980-81	1990-91	1999-2000
India	Canals	42.05	41.28	39.40	35.63	31.29
	Tanks	18.50	13.22	8.24	6.84	5.18
	Wells	29.56	38.22	45.70	51.04	57.81
	Others	9.89	7.28	6.66	6.49	5.73
	All	100	100	100	100	100
Tamil Nadu	Canals	35.80	33.90	32.70	32.40	27.58
	Tanks	38.00	34.50	32.10	22.38	19.47
	Wells	24.20	29.80	33.80	44.61	52.88
	Others	2.00	1.80	1.40	0.61	0.37
	All	100	100	100	100	100

Source:TamilNadu-AnEconomicAppraisal(Variousissues).

The declining status of tank irrigated area during the period from 1993-94 to 2004-05 in the tank intensive Southern States is brought out in the Table 2 below.

Table2. Declining trend of tank irrigated area in the tank intensive Southern States

State	1993-94		2004-05	
	Tank irrigated area	% of NIA	Tank irrigated area	% of NIA
Tamilnadu	668	23.9	465	17.6
Andhra Pradesh	633	16.3	477	12.3
Karnataka	273	11.7	177	6.3

Source: FAI, 1994; DACNET, NIC, 2006

Since the tanks are managed by different agencies with varying technical skills depending upon their sizes, it will be better to know about the size distribution of tanks. For instance the tanks having command area of more than 40 hectares along with the system tanks irrespective of their sizes are managed by Irrigation Department. Other small tanks occupying more than 75% of the total number of tanks are managed by Rural Development & Panchayat Raj Department through its district level and block level staff. The size distribution of tanks in the tank intensive States are furnished in the Tables 3a and 3b below:

Table 3a. Size distribution of tanks (by Numbers)

Size Class (Hectares)	Andhra Pradesh		Karnataka		Tamil Nadu		Total	
	No	%	No	%	No	%	No	%
<40	70474	86.3	35235	92.4	30263	77.2	**135972**	**85.5**
40-200	10252	12.6	2605	6.8	8405	21.4	**21262**	**13.4**
>200	961	1.2	288	0.8	534	1.4	**1783**	**1.1**
Total	**81687**	**100**	**38128**	**100**	**39202**	**100**	**159017**	**100**

Source: Koteswara Rao (1992), Nadkarni (1979) and PWD - GoTN – (1977)

Table 3b. Size distribution of tanks (by command area)

Size Class (Hectares)	Andhra Pradesh		Karnataka		Tamil Nadu		Total	
	Ayacut	%	Ayacut	%	Ayacut	%	Ayacut	%
<40	610	32.9	266	42.2	261	25.8	**1137**	**32.5**
40-200	833	44.9	253	40.1	495	48.9	**1581**	**45.2**
>200	411	22.2	112	17.7	256	25.3	**779**	**22.3**
Total	**1854**	**100**	**631**	**100**	**1012**	**100**	**3497**	**100**

Source: Koteswara Rao (1992), Nadkarni (1979) and PWD-GoTN – (1977)

4. WAYS FOR IMPROVING THE PERFORMANCE OF TANK IRRIGATION SYSTEMS

Knowing fully well about the significant importance of our tank systems as explained above, we cannot afford to be a silent witness to the disintegration of such a dynamic system due to indifference, negligence and greed. The disappearance of tank systems will aggravate rural poverty and spell the start of destruction of the village society. In turn it may adversely impact on urban society also.

Realizing the need for improving the performance of tank irrigation systems, Government of Tamilnadu has undertaken modernization of tank irrigation systems with EEC aid in two phases during 1987-2000to cover about 500 tanks,each irrigating more than 40 hectares. Also, tank systems are being improved now with World Bank aid under IAMWARM project to improve irrigation service delivery and productivity of irrigated agriculture with effective integrated water resources management in a river basin / sub-basin frame work in Tamilnadu in selected 63 Sub-Basins. Similarly the Government of Karnataka has taken up the modernization of their tank systems under Jala Samvardhane Yojana Sangha (JSYS) to improve rural livelihoods and reduce poverty by developing and strengthening community-based approaches to manage selected tank systems during the period from 2003-04 to 2010-11. The Government of Andhra Pradesh has taken up Andhra Pradesh Community Based Tank Management Project (APCBTMP) for rehabilitating and restoring about 3000 minor irrigation tanks for agriculture improvement and livelihood enhancement during the period from 2007-2012. All such rehabilitation programmes covered only the big tanks managed by the Minor Irrigation Department of the respective State. Now, the Government of Tamilnadu has contemplated a proposal to improve the performance of all the 25000 minor irrigation tanks which are under the management of Rural Development & Panchayat Raj Department (RD&PR) with people's participation and basin approach within three years commencing from 2012-13.

The author having associated with the evaluation of EEC assisted tank modernization in Tamilnadu taken up by CWR, Anna University during 1988-1992 and in the implementation of JSYS and APCBTMP in Karnataka and Andhra Pradesh through DHAN Foundation, Madurai during 2005-2012, could see that all these programmes have been planned well with sound concepts; but while implementation, high priority has been given mainly to protective measures with the cost intensive structural improvements (Anna University, CWR, 1992). The attentions paid to the works needed for acquiring enough water to the tanks, actions for securing desired people's participation for future maintenance and management, measures for avoiding / controlling the recurrence of the past ills to the tank, etc., were found neither adequate nor effective. The following suggestions made based on experience for sustainable performance of our tank systems, especially the large number of small tanks which are not directly managed by the RD&PR Department could be considered in addition to the structural improvements under tank rehabilitation programmes. Nevertheless, these suggestions also hold good for the rehabilitation of big tanks managed by the technically skilled staff of irrigation department.

4.1 Sub-basin level water balance study to ascertain the availability of enough water for each tank prior to rehabilitation

Every tank has its own free and intercepted catchments, which have undergone many physiographical changes later due to population pressure affecting the anticipated flow into the tanks

which have been formed centuries ago. Presently, thousands of farm ponds and percolation ponds are formed under various watershed development programmes with the slogan “Catch and use the rain where it falls”. Similarly hundreds of check dams have been constructed across the drainage streams as water harvesting structures with the slogan “When water runs, make it to walk; when it walks, make it to stop”. In addition to this, roads and other development works have been undertaken in the rural areas by inadvertently closing many water ways linking the tanks. Many such changes happened in the tank catchment areas. Hence, water balance study becomes essential in each sub basin to verify the adequacy of inflow in to each tank existing in the sub basin as a pre-requisite for the rehabilitation programme. Preference should be given to the tanks ensured with adequate inflow for taking up rehabilitation. Tanks found to have insufficient water resource have to be dealt separately for treatment. In respect of irrigated agriculture under the tanks without adequate water resource, the loss due to risk will be more than that in rainfed agriculture. Hence it is suggested for re-localizing the command area for the non-preferred tanks in accordance with the ensured inflow. Also it may be thought of closing the high level sluices in such tanks to lessen the area irrigated by the tank. Dry land horticulture which is more suited to the land under such plugged sluices need to be promoted for the benefit of farmers who had to lose the right of direct irrigation from the tank.

4.2 Encroachment eviction and ensuring safeguards for the future

For the tank selected for rehabilitation, all measures needed for conveying its entire share of inflow and for storing it fully in the tank should be taken up. In this regard, the first step would be to evict all the encroachments in the inflow channels and tank water spread area after ensuring the link without any block and no unauthorized diversion in the upstream side before taking up the required de-silting works in the supply channel and tank bed. To avoid future encroachments in the tank bed, lines should be marked to represent FTL (Full Tank Level) and MWL (Maximum Water Level) in the tank foreshore. Vegetative fencing with trees and bushes is to be established in between these lines which would not only protect the water spread area from future encroachments but also promote biodiversity and additional income to the community.

4.3 People’s participation with commitment to engage common paid irrigators

Since our tank systems have been better managed and maintained for centuries by our farmers, they can do it now also with their inherited knowledge and experience gained in their tank systems. They can be organized to form their own Tank Association with a good leadership capable of motivating the fellow farmers towards unity in diversity by projecting the common objective to achieve their individual objectives. By creating awareness about the importance of ecological services rendered by their tank systems other than their economical services, it is possible to secure their real participation in the rehabilitation, management and maintenance of their tank systems. But, extraordinary efforts are needed for this task due to the complexity associated with the human relations.

4.3.1. Organizing people – Intrinsic issues

Generally, people can be organized to form an association and work for a common objective if it results in increasing their individual gains. If it functions effectively with good leadership, the members will stay together as a social need, even if the individual gain is not in commensuration with the effort and contribution made. Otherwise, group effort will vanish slowly. Experiences have shown that it is not very difficult to organize people around a profitable activity like maintenance and management of common property resource for a while; but sustaining of such interest over a long period has been difficult. It is important to distinguish between people’s cooperation and people’s participation with involvement. Most of the people’s institutions are formed mainly by their cooperation and many will be short lived after the withdrawal of the project staff. In ground reality, most of them are of fragile nature. But evidences are also there to show that the people’s organizations emerged on their own out of necessity without any external support are functioning well for many decades, irrespective of the quantum of individual gains, as it has become a way of life for them. Hence more efforts and mechanisms with incentives are needed for forming sustainable Farmer’s Associations, taking a cue from the weak and strong organizations existing now and the problems encountered by them. (Venkatasamy, 2012) Without ensuring such sustainable Tank Associations, we cannot expect sustainable performance of our tank systems.

4.3.2. Commitment for engaging common paid irrigators

People should be motivated to commit for practicing traditional irrigation distribution by engaging

common paid irrigators who would be the “water managers” for the tank command. When such method is adopted, there will be need based irrigation in every field and thus minimizing the wastage of available water. Further, by engaging common paid irrigators,it is possible to restrict the irrigated area as per an agreed ratio during bad years of rainfall, so as to maximize the crop production during good years and to minimize the production loss during the bad years.

4.4 Involving Panchayats for facilitating peoples participation

Indian villagers have had a rich tradition of self-governance and participatory management of community resources. The 73rd Constitutional Amendment Act 1992 gave a fillip to the Panchayat Raj system conferring constitutional status on it by considering the Panchayats as Institutes of Self-governance. But studies have pointed out that, despite their legal power, the Panchayats are not able to effectively enforce any regulation on the use and management of such resources or ensure peoples participation. The Panchayats have failed now due to many reasons. A study conducted in Tamilnadu concludes that the tank users rely more on their Associations than the Panchayat for maintaining their tank systems (Raghupathy, 2004). But it is necessary to involve Panchayats in the maintenance of tank systems duly recognizing their constitutional rights and to avoid conflicts with the Tank Associations.

The Panchayat Raj Institutions, as rural local governments in India, are self-governing and participatory institutions as per the Act. So, the tanks in the rural areas must be under the integrated management of Panchayats on watershed basis. The usufructs rights of the tank system are to be with the Panchayats which ensure the management of the tanks through the Tank Associations.

For making the Panchayats, as the true rural local government to perform their roles, the 73rd Constitutional Amendment Act 1992 is to be amended further to ensure real devolution of power from the State Government to the Panchayats.

4.5 Research needs for improving water use efficiency

As a measure of helping the distressed tank farmers, generally Government agencies advice the farmers to adopt some techniques of irrigation water management evolved by Research Institutes so as to improve the crop productivity with available water; but with less success.

Any new technique advocated should be adoptable as well as acceptable to the users. Farmer oriented Action Research becomes essential before recommending any irrigation management technology evolved by Research Institutes (in controlled conditions) for mass scale adoption in a tank system, recognizing the fact that farmers and others are using the common resource for individual gains with the influence of social, economical and environmental factors. In irrigation management, more research is done on conveyance efficiency, evapo-transpiration, crop water requirement, etc., which may be useful to the canal managers and not to the farmers who cannot comprehend them with proper perspective. But, many of the research findings are propagated without conducting any farmer oriented action research resulting in failures. In the name of modernization, the traditional leak proof plug and rod shutters are replaced by high cost leaky paddle shutters against the wish of farmers. Farmers are also skeptical about the technologies recommended by the researchers as they are not consistent over a period of time.

While conducting Farmers Participatory Action Research Programme on “Introduction of micro irrigation technique in a small tank command area” sanctioned by the Ministry of Water Resources, Government of India, the author noticed that the sprinklers installed for irrigating paddy crop could not function satisfactorily due to high turbidity of tank water in-spite of trying with different types of filters available in the market. So, there is a need for evolving suitable sprinklers or filters for operating the system with tank water, if micro irrigation techniques are to be adopted in tank irrigation. Likewise, farmers expressed their difficulties in raising irrigated dry crops in the place of water intensive paddy crop because of seepage from the tank during the monsoon crop season.

Although the people who live in and around the tank ecosystem know better than others about its physical degradation, they do not know the magnitude of the losses incurred by them due to the declined ecosystem services. Hence there is a strong need to create awareness about the magnitude of losses on ecosystem services due to degradation by bringing out an effective evidence base along

with the details of potential services rendered by the tank ecosystem. So, appropriate research is needed to generate new knowledge on the obscured services of tank ecosystem.

It was found that there is no reliable account of tanks available in our country. Realizing the importance of the services provided by the tanks, there is an imperative need to take tank census for appropriate planning for their development.

5. CONCLUSIONS AND WAY FORWARD

The essence is that the effect of implementing the suggestions made in Section-4 above in their true sense along with the seemingly big rehabilitation of tank's structural components would be far-reaching on the sustainability of the results of tank rehabilitation programme.

Further discussions may be needed on these suggestions to transform them as "non-negotiable" for the ongoing tank rehabilitation programmes and for formulating a trans-disciplinary approach to accomplish them.

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