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Tank Rehabilitation in Chennai Peri-Urban Area

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Abstract*: Urban cities rely on surface water resources such as lakes, rivers for their survival, anthropogenic activities, rapid urbanization and industrialization had put thrust on such water bodies in major cities across India. Bountiful research works conducted also proves that such resources are rapidly depleting, and it also conveys that very few reasons contribute to major deterioration of lakes. Two major parameters that contribute to this deterioration include discharge of sewage into the water bodies and unplanned encroachments along the banks. This study aimed as a sustainable water resource management technique to rehabilitate a highly deteriorated tank in Kovilambakkam village, Peri- urban in Chennai city, India. The tank which is one of the primary sources of water for the area is affected highly due to urbanization and the natural ecosystem is disturbed. A best possible solution for rehabilitation is suggested using Socio-Economic method utilizing qualitative analysis like a PRA tools (Transect Walk, Focus group Discussion, Key Informant Interview, Resource map, Semi-Structured Interview), measures to improve and safe guard the lake were taken. To analyze the performance of the work water quality analysis was done to verify physical, chemical and biological parameters, both before and after rehabilitation is done, it is found that the performance with reference to biological parameters such as MPN index. Promising results were obtained in this study restoring the lake to its original condition which started serving the indigenous people proving the effectiveness of the suggested method.

Keywords: Urban City, Rehabilitation, PRA Tools, Capacity building, Drinking water, Participatory approach.

I. INTRODUCTION

Based on the renewable water resources available in our country (India), we are ranked 7th in the world and 3rd among all the other Asian countries. More over based on ground water recharge it stands in 5th position among the world and 2nd among Asian countries (Sakthivadivel et al., 2016). It is stated that many rural areas in the country entirely depend upon the surface water resources for many purposes as agriculture, households and more.

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Ground water availability increases the chances in agriculture.(Suba, 2014).

In the last few decades raising human population have made the supply of natural water limited owing to rapid depletion of ground water quality and quantity thus creating water stress. Demand for pure water resource increases day by day in urban cities of India which is not supported by the disastrous rainfall pattern India faces during the last two decades (Reddy, 2015; Ramachandraiah and Sheela Prasad, 2004). Urban infrastructure is unable to bare this burden and affecting the urban dwellers with limited water resources. It is a great challenge for administrators of any state to manage its water resources to supply water to its rapidly developing urban cities (Anuradha et al., 2009). Indian kings who ruled ancient India had constructed numerous tradition surface storage systems named as - ponds / lakes / talab / cheruvu / aari (regional names of tanks) (Nagarajan, 2013; Palanisami and Ruth Meinzen, 2001).

For the past 2000 years they helped in sustaining the agriculture even in many dry areas of the country. This includes dry zones of India as well as South East Asia. The number of tanks availble in India are about 2.1 million. And nearly 120,000 are existed in southern peninsula of the country, covering many important states as Andhra Pradesh, Karnataka, Tamil Nadu and union territory of Pondicherry which takes into account 60% of tank based irrigation (Vaidyanathan, 2001). Tanks that are well connected supported the effective usage of water in arid and semi-arid regions and certain management practices were implemented at improving effective usage of water during drought situations (Tennakoon, 1986;Frederick, 2008). But recently there is a decline in the usage of traditional tanks owing to alternation source availability such as reservoir, canal, lift irrigation(Morun, 2007). Also there occurred a paradigm shift towards usage of modern irrigation systems, construction of artificial and larger reservoirs, dams, river valley projects have considerable impact on usage of tanks and they become a low key issue (Balasubramanian and Bromley, 2002).

1.1 Tanks and their impact on irrigation

A tank by definition is an earthen bund that may be constructed across a shallow valley or between two land mass to sustain the rainfall runoff from its catchment area, they may be isolated or cascading type in which the primary surplus fills the next tank and it goes on until the last tank gets filled in (Anuradha and Ambujam, 2012). Always in Tamil Nadu are the main sources of irrigation covering huge irrigation area from time immemorial, Figure 1. depicts the area covered by tanks and other water bodies.(Asian Development Bank,2006) and table 1 covers the information about amount of tanks present in various districts of Tamil Nadu

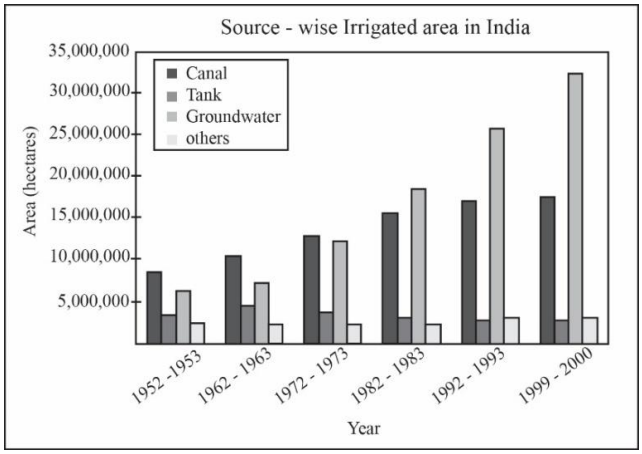

Figure 1: Source – wise Irrigated Area in India

Source: Water and related statistics, Central Water Commission, 2002.

Table 1: District wise Distribution of Rural Tanks in Tamil Nadu during 2010 – 2011

S.No	Name of the District	Total no. of tanks	Total ayacut (in hec)	Category
1	Kanyakumari	2593	15516	TID
2	North Arcot	1355	15074	TID
3	Thirunelveli	2170	57276	TID
4	Chengalpattu	3628	112993	TID
5	Salem	829	4924	NTID
6	Thiruvannamalai	1791	39606	TID
7	Nilgris	004	NA	-
8	Virudunagar	997	32316	NTID
9	Dindigul	2880	16607	TID
10	Tiruchirappalli	2629	20882	TID
11	Coimbatore	78	2532	NTID
12	Thoothukudi	628	22900	NTID
13	Nagapattinam	NA	NA	-
14	Thanjavur	428	9140	NTID
15	South Arcot	2977	50121	TID
16	Ramanathapuram	1830	61310	TID
17	Pudukottai	4929	79969	TID
18	Dharmapuri	2332	16817	TID
19	Erode	52	211	NTID
20	Sivagangai	4597	82663	TID
21	Madurai	2415	27276	TID
	Total	**39202**	**727448**	

Note: TID – Tank Intensive Districts (60% cultivated land by tanks irrigated area) NTID – Non Tank Intensive Districts (15 – 20 % area irrigated).

Sources: MIDS, Chennai

Rainfall in India is erratic during any period and also the country faces extreme climate within its 329 million hectares of geographical area and hence tanks become primary source of water for many areas supplying for agricultural and for drinking purpose too (Benedetti et al., 2008; Naomi et al., 1997). According to Dhan "throughout South India there are small tanks that are a major source of drinking water for rural communities and supplementing irrigation, but often become defunct due to disuse or lack of maintenance". Tanks also play a major role in recharging the ground water in the locality and are the source of supporting many livelihood options (Tiberghien et al., 2011; Tu, 2007). The water and land spaces of the tank serve several sections of village communities. Figure 2 shows the environmental issues in tank.Water resources become more and more scarce in India owing to the rapid depletion of surface water resources, rainfall plays spoil sport in this with its erratic distribution, table 2 shows the variation of area served by tanks in terms of rainfall.

Table 2. Source – Wise Net Irrigated Area, 1960-1961 to 2002- 2003 at 5 – year Intervals

(Area in '000 hectare)

Year	Normal R.F. mm	Actual R.F. mm	TANK		WELL		CANAL		Others		Total area
			Area	%	Area	%	Area	%	Area	%	
2002 - 2003	964	731	422.3	18.4	1,262.80	54.6	614.1	26.6	10.7	0.4	2,309.90
2000 – 2001	979	785	588.6	20.4	1,449.50	50.2	833.1	28.8	16.3	0.6	2,887.60
1995 – 1996	923	722	512.3	19.5	1,326.50	50.5	771.1	29.4	14.6	0.6	2,624.50
1990 – 1991	925	715	530.9	22.4	1,058.50	44.6	769.4	32.4	13.9	0.6	2,372.80
1985 - 1986	943	951	671.7	26.9	1,029.50	41.1	774.4	31	25.1	1	2,500.80
1980 – 1981	943	669	590.1	23..0	1,067.40	41.5	889.1	34.6	23.9	0.9	2,570.50
1975 – 1976	946	857	749.8	29.2	869.6	33.9	910.4	35.5	35.3	1.4	2,565.10
1970 – 1971	946	918	897.9	34.6	774.6	29.9	883.7	34.1	35.6	1.4	2,591.80
1965 – 1966	947	870	902.5	37.6	902.5	37.6	799.2	33.3	37.7	1.6	2,398.60
1960 - 1961	925	855	936.4	38	597.9	24.3	881.8	35.8	46.2	1.9	2,462.30

RF = Rainfall, mm = millimeter

Source: Department of Statistics, Government of Tamil Nadu.

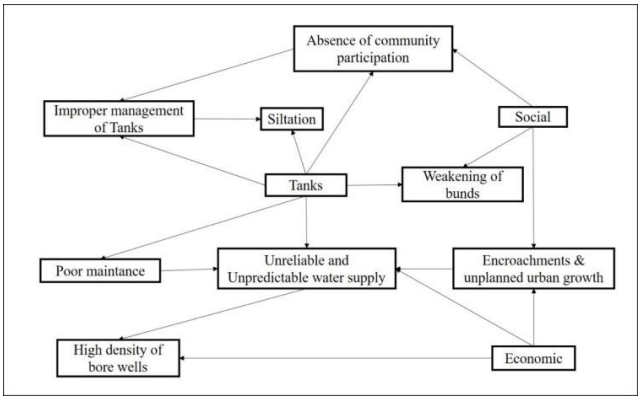

Figure 2: Environmental issues in Tanks

1.2 Tank rehabilitation

Water level in Chennai city becomes alarmingly low in the dry season thus putting pressure on increasing the naturally available water resources and also to protect them by all means, the cities increasing population needs to be served which needs more water via tanks (Rogers and Calvo, 2015).Tank systems that are developed ingeniously and managed over several centuries of human existence have provided support to the human kind during severe and floods, changes in monsoon, recurring floods and offered the mostly required livelihood security to the poor people living in semi-arid regions. Data also shows that the count of rehabilitated tanks is very minute compared to the existed tanks count. The need for rehabilitation is very much increased with the changes in the ther conditions and increasing water scarcity in many parts of the country (Siderius et al., 2015). Thus in all ways managing the available tanks is becoming the key issue policy makers face in modern days and this work focus on one such study conducted in Kovilambakkam Village, Peri- Urban in Chennai, Tamil Nadu, India.

II. MATERIALS AND METHODS

2.1. Study area details

This study area Kancheepuram is having coordinates as 11°00' to 12°00' NORTH and 77° 28' to78° east. The district has a total geographical area of 4400 km^2 and have a coastline of 57 kilometers. The city is famous for its temples, for administrative reasons its bifurcated into 10 taluks with 1137 revenue villages covering 13 development blocks and 648 village panchayats, Figure 3 shows thestudy area map.Kancheepuram district possess a population of nearly 3.8 million and it amounts to nearly 7% of the state's population, the area is about 4394 km^2. Kancheepuram district depends mainly on seasonal rains, failure of rain force the agriculture into peril, North-East and South-West monsoon supports the district showering 54% and 36% of the annual water demand, normal rainfall over the area is 1213.3 mm and the actual rainfall is 1133.0 mm. Considering the surface water, river Palar is the major river in the district running through it, major source of water for the district utilisation is served only through the tanks.

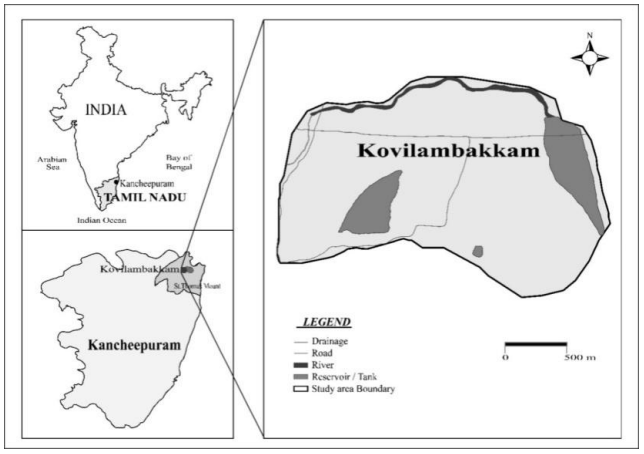

Figure 3.Study area map.

Kovilambakkam tank is a panchayat level tank. This tank lies in Kovilambakkam village of Tambaram Taluk, Kanchipuram District. This tank is lovated on two sides of a 200 feet road, this area is having a fifteen acre lake in Pallikaranai, which is considered as the oldest water bodies in that sub urban areas. Moreover due to developments in constructions, unplanned residential buildings there are a very little place for this water body to thrive. When the residential area increases automatically all sorts of pollutions increases in that particular area. The regular works of people like washing clothes, disposal of domestic sewage from the nearby habitation and also wastes are dumped around the water body. Due to this water quality of the tank gets deteriorated and the tank has lost its water storage capacity. This tank is used for irrigation and ground water recharge. The cultivated area by this tank is about 349 sq.m in 2009, 554 sq.m in 2010 and 543.4 sq.m in 2011 (Saravanan and Gobinath, 2015).The encroachment in this tank includes government buildings, private buildings and other resident buildings. Out of 19.455 acres about 3.455 acres were encroached. And out of which 0.755 acres have been evicted except the remaining encroached areas which are owned by government.

2.2. Methodology

The present study was carried by using PRA (Participatory Rural Appraisal)tools such as transect walk, social resource mapping, semi-structured interview, focus group discussion is to be done. The transect walk and social resource map was taken up to know the important resources. With it, the most important places were like tank, water taps, labels, wells, Over Head tanks (OHT), school, canals, residents and locals were identified to understand the interaction of the people and resources. By practising these PRA tools people's preference about the source of drinking water can be identified and the merits and demerits they face is also identified. PRA tools even though seeming to be cumbersome, it provides productive results in community engagement, understanding the crux of the problem they face and also to motivate them to be a major stake holder in the tank rehabilitation work.

2.3. Spatial variation

Land use changes in Kovilambakkamvillage were found out by getting the spatial variation of the area for three years 1970, 1990 and 2010. Figure 4. Shows the land use and land cover pattern of the Kovilambakkam village during the year 1970, 1990 and 2010.The total area of kovilambakkam has 274.76 hectare. The land use change from 1970 to 1990, 49.9788 ha had been converted into Cropland to residential, 47.3543 ha converted into fallow land to crop land and 177.425 ha has been no changes. Similarly, in 1990 to 2010 crop land has been converted into Residential, Industrial or Institutional, Fallow land, Scrubland and open/ vacant land as 52.17, 2.20, 55.27, 21.00 and 10.55 Hectare. 125.51 ha land has been No changed during 1990 to 2010.

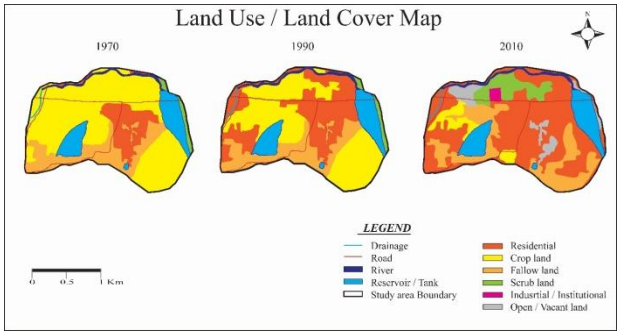

Figure 4: The land use / Land cover Map of the

Kovilambakkam village for the year 1970, 1990and 2010 Kovilambakkamvillage has a total population of 45000 with 8500 houses according to the 2011 census, which was only about 9270(3000 Houses) in 2001 indicating the high rate of urbanization in this area. This increase has had its impact on farm land, grasslands, increased water use, increased energy consumption, social fragmentation, water pollution etc. Thespatial variation can be identifiedfrom rapid urbanization cause disorganised and unplanned growth of town and cities. A symmetrical growth of urban centres consumes agricultural adjacent land, resulting in lower agricultural productivity has happened in Kovilambakkamvillage. Increase in population causes pollution to Kovilamabakkamtank as it affects the quality of water. There are various sources of pollution in this tank such as sewage intrusion, open defecation, waste dumping, cattle grazing, cleaning and washing.

So that, disposal of domestic sewage from the nearby habitation and alsogarbage'sis dumped inand around the tank. The sewage intrusion into the lake that was coming from the surplus channel. Due to this,the nature oftank water quality gets deteriorated and the tank loss for water storage capacity. It also increases the environments hazards greatly in that place. Because of these hazards the peoples are prone to serious health effects. The panchayat is supplyingwater to the people from OHT (Over Head Tank) by bore wells. But these bore wells are located around the tanks. Due to all these reasons, the tank water is contaminated.

2.4. Key Informative Interview

Key Informants interviews are qualitative, in-depth interview of people were selected in 700 (out of 9270) simple random sample for their knowledge. Key informant interview were conducted with the Kovilambakkam Village President, various department officials and community members. Figure 5. shows the interviews conducted during this study to understand various aspects involved in tank rehabilitation works. From the interviews with the key informants it is clearly evident that Kovilambakkam tank was getting polluted a lot and pollution abatement was necessary. The data obtained clearly conveyed that the encroachments in the tank have been evicted except the government buildings including the government higher secondary school which occupies a large ground.

Figure 5. Key Informant Interview

The surplus course from Medavakkamtank which has to serve as the storm water drainage to is now carrying the sewage water from the residents and is draining into the Kovilambakkam tank. It also mentioned that a part of the tank (around 60% of the tank area) has been deepened due to which the tanks storage capacity has been increased. So that, the petition was given to necessary stakeholders and policy makers for initiating actions to stop the sewage entering the tank from the surplus course which the quality of the water can be protected from deterioration. But there is no response regarding this. And also there is no water quality monitoring system in this village. The locals and the officials said that the sewage intrusion in the water body is the major issue in the contamination of water. This sewage is coming from the residents through the storm water drain and getting mixed with the lake. Strom water drain is being flooded with sewage as there is no underground drainage system in this village, so all the residents and the commercial buildings are letting the sewage into this.

III. RESULTS AND DISCUSSION

2.5. Awareness Creation

People do lot of things without having enough knowledge about the upcoming factors or the side effects. Later when awareness is created among the people then we can expect to minimise the side effects successfully. A community participation was held taking the venue as Govt Hr. Sec School IN Kovilambakkam Village. Around 700 members attended the meeting, which involve the locals, Self Help group (SHGs) members, NSS Student of 70 members from Anna University, 600 workers under the MREGS (Mahatma Gandhi National Rural Employment Guarantee scheme), Scheme, Village President, Secretary and joint secretary of Panchayat Level Federation. Awareness were created for the community people and focussed on appropriate about tank rehabilitation and it is important. Figure 6Shows the awareness created in Kovilambakkamwith the help of panchayat presidents.

Figure 6.During the Awareness Program

The existing water quality problems in the Kovilambakkam lake and the risk factors involved in accessing the supplied and other drinking water sources were explained to the community people. They were also informed about the hygiene and its importance related to managing quality of water and its consumption purpose.

2.6. Cleaning the tank

For the tank rehabilitation process, initially the NSS students were trained to undertake studies related to understanding the importance of sanitation, hygiene and the consequences of during contaminated water. Then were instructed to perform the cleaning operation of the tank systematically. This involved coordinating with local MREGS members and cleaning the tank. Simultaneously MREGS members were also trained to clean up the tank. Figure 7.Shows the work progress of community people during the tank rehabilitation.

Figure: Workprogress of community people during the tank rehabilitation.

With the successful coordination of all the tank was cleaned that enhanced the water storage capacity. Village people understood the importance of tanks and its uses. Tank is rehabilitated by removing the bushes from in and around the tank bund, debris inside the tank, cloth materials, plastic bags, covers, unwanted domestic wastages, vegetation's in and around were removed from the tank.

Drainage inlet points were obstructed to entering into the tank. Finally left the tank free from all contamination of biological and physical components, so it led to storing large capacity of water in the tank. It greatly influenced the maximum recharging capacity of ground water from the tank bed, it also induced the rise of water table in that area during pre and post – monsoons.Figure 8. shows the after the tank rehabilitation. Above all now there is an increasing commitment and realization found among the community members to safe guard their water resources for resolving their drinking water problem.

Figure 8.After tank rehabilitation.

Water quality test were carried out for four samples collected before and after rehabilitation of the tank in both surface and subsurface water. The physical, chemical and biological parameters were analysed with reference to BIS Drinking Water-specification (2009), (second revision of IS 10500). Table 3. Shows the water quality parameters before and after rehabilitation of the tank.

Table 3: Water quality Analysis in before and after rehabilitation of tank

SAMPLE	Desirable limit	Permissible limit	Ground Water(before)	Ground Water(after)	Surface Water(before)	Surface Water (after)
pH	6.5-8.5	no relaxation	8.04	**7.02**	8.26	**7.29**
TDS (mg/l)	500	2000	598	**409.6**	614.4	**449.3**
Alkalinity (mg/l)	200	600	488	**125**	244	**157**
Hardness (mg/l)	200	600	49	**23**	47	**45**
Calcium (mg/l)	75	200	40	**10**	40	**10**
Magnesium (mg/l)	30	no relaxation	35	**5**	38	**12**
Sodium (mg/l)	20	200	16.3	**9.8**	15.2	**10.5**
Potassium (mg/l)	20	200	3.9	**2.3**	4.6	**2.8**
Chloride (mg/l)	250	1000	74.97	**19.98**	62.48	**22.48**
Total Microbial count cfu/ml	-	20	108	**14**	140	**16**
E.coli /ml	-	-	71	**0**	98	**0**
Total coliform bacteria (MPN)/ml	-	-	121	**0**	167	**0**
Faecal coliform bacteria (MPN)/ml	-	-	14	**0**	43	**0**
FeacalStreptocci/ml	-	-	56	**0**	140	**0**

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Before rehabilitation of the tank the biological harmfulness is bit high and its drastically reduced after the rehabilitation, making the water bit more potable, and it assures that with slight preliminary treatment this water can be consumed by the society.

IV. CONCLUSIONS

Through this work authors found that utilisation of indigenous people and all stakeholders who may get benefitted directly and indirectly for the tank rehabilitation prove to be a viable alternative measure, rather than approaching through government agencies and policy makers. Community participation in resource management, in particular water resources management will prove to be a good alternative, in spite of the challenges that may emerge while employing them. The community is to be mobilized by means of conducting key informant interview and focus group discussion with the community people, government officials, Non - government organization to make them understand the tank rehabilitation on drinking water safety, effects on due to encroachment over the water body, awareness were to be given to safeguard the fresh water sources and some policy recommendations are to be given to turn the people back to the old practice of drinking cheaper and cost effective fresh water by means of creating the public private partnership to improve and safe guard the water resources were taken.

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