FORFEITED TREASURE

A study on the status of Irrigation Tanks in Karnataka

S.T. Somashekhar Reddy

The system of conservation of water was so meticulously followed that no river basin favourable for the construction of tanks was spared, especially the river basins of south India are exploited to an extent ranging from 51.75 percent of the river to hundred percent (Table 1.3). Due to this exploitation and conservation of rainfall in the river basins, it was"....observed that of the 29,455 sq.miles covered by the then State (Karnataka) nearly 60 percent had covered by the patient industry of its inhabitants been brought under tank system". (H. Rao, 1929). By 1881 there were, in all, 24,896 tanks or, on an average, there was one tank for every 15 of a sq. mile in the then State of Karnataka irrigating 7,66,314 acres and the total revenue from such sources was about Rs. 40 lakhs.

Due to the ingenuity made evident by various civilizations in developing tanks, today Karnataka proudly owns 43,474 tanks of various capacities. Majority of the tanks (15,713) irrigate less than ten acres. About 21,398 tanks irrigate areas ranging from 10 to 50 acres. There are 3326 tanks which irrigate between 50 to 100 acres. Of the rest, 2701 tanks irrigate between 100 to 500 acres. Only 336 tanks irrigate above 500 acres (Table 1.4)

A majority of the big tanks with a capability to irrigate above 500 acres are located in the low rainfall districts like Tumkur (47), Bangalore (39), Dharwar (34), Mysore (31), Chitradurga (29), Belgaum (23), and Kolar district (22). The smaller tanks with capabilities to irrigate 10 to 50 acres are mostly located in high rainfall districts like Shimoga (3206), Hassan (2792), western parts of Dharwar (1639). North Kanara (1261) and Chikkamagalur districts (1054). The only exception is Kolar district, which even with a low rainfall possesses, 1912 tanks which are small in size, due to the natural terrain it has.

The tank systems were always managed by the beneficiaries. Only major repairs were attended to by the rulers. In many places irrespective of the size of the command area, beneficiaries used to organize into a panchayat not only of varying sizes and composition but also rules and regulations were framed for judicious use of water taking into consideration social-economic factors of the benificaries and their requirement. Such collective will, organised in the form of panchayat used to control and distribute water on an equitable basis. Nowhere water was allowed to be wasted or be misused. Any one who wastes or misuses was punished, as every drop of water in low rainfall region was precious as it contributed to save a crop.

With the annexation by the Britishers, who had a revenue motive (Arthur Cotton), the system of tanks was neglected. The royal patronage available till then for the upkeep of the system was withdrawn. As a consequence, many tanks perished. Further, the introduction of Zamindari and Ryotwari systems brought about the supremacy of the rights of an individual than that of the community which lead to the weakening of panchayats managing the tank system. Pained by such a state of affairs, Arthur Cotton wrote, *"The old public works of irrigation now existing show plainly that at some previous time and in some places, natives have had some idea that there were things of more importance than collecting revenue; but so low the Europeans sunk, that they have not been roused by the sight of these valuable works, so far as to make it a point to keep them in repair"*, (emphasis added). Even then, by 1900 nearly nineteen and odd million acres were irrigated by these public works (Campbell).

The negligent attitude of the administration towards the tank system continued even in the post-Independent era, due to the dominance of big dam' construction for irrigational purposes. During the plan period, the allocation to the sector 'minor' irrigation plus where tanks happen to dominate was always very low.

In the first five year plan, the total allocation for minor irrigation (Table 1.5), was only 76 crores against 380 crores for major and medium irrigation. In the Second Five year plan, the plan outlay on minor irrigation was 142 crores and institutional outlay was 19 crores. In the third five year plan outlay increased to 328 crores and the institutional outlay increased to 115 crores. Major projects are those that can irrigate a command area of above 10,000 hectares; medium projects irrigate less than 10,000 hectares and above 2000 hectares and minor projects irrigate less than 2,000 hectares. Comparatively, the outlay on major and medium project was 581 crores. If 15434 crores was invested on major and medium projects, in the annual plans 686 crores was invested on minor irrigation. These differences were more apparent in the budget allocated of State Government. In Karnataka, except in Third Five Year plan, the investment on minor irrigation was less than 15 percent of what is spent on major and medium projects. Sometimes it was even less than 25 percent of the outlay on major and medium projects (Table 1.6). At the end of the Sixth Five Year plan only 220 crores was spent on minor irrigation, whereas 1238 crores was spent on major and medium projects.

The low budget allocation for minor irrigation was due to the national commitment to bigger dams. This investment on major and medium projects was treated as commercial and the investment on minor irrigation was treated as non-commercial (Government of Karnataka, 1987). This consideration on commercial lines has biased the allocation and working expenses. The working expenses on major and medium projects has increased from Rs. 0.18 crores to Rs. 20 crores between 1956-57 and 1986-87. When compared to this, the working expenses on minor irrigation for the same, period has increased from Rs. 0.21 crores to Rs. 12.8 crores. This discrimination in the total investment and working expenses has affected the tank system to a great extent. The discrimination shown towards minor irrigation projects hides more than what it reveals. The concept 'minor irrigation' refers to tanks, wells and lift irrigation schemes. Which hides within its womb, one of the inimical factors for development of tanks, privatisation of water resource in the form of wells. As a result of such a confusing term, the discrimination shown towards tanks or, to that extent, any indigenous system of irrigation is concealed. Nowhere the investment break-up made on minor irrigation projects is provided according to various categories. Therefore, it is rather difficult to estimate the investment on tanks. A way to discern the prejudice is to examine the relative area brought under irrigation by various categories within the concept of minor irrigation.

The most important facet of financial discrimination is the proportion of area irrigated by tanks in Karnataka which is declining continuously from the dominant position of 46.8 percent in 1954-56 to 34.8 percent in 1964-66 and then to 29.8 percent in 1973-75, and by 1982-83 it accounted for only 20 percent. This reduction is explained as a consequence of the increase in the area irrigated by major and medium irrigation projects. However, there are districts in Karnataka such as Kolar, Bangalore and Tumkur where no major and medium irrigation projects are carried out. In these districts also, the area irrigated by tanks is decreasing (table 1.7). In comparison the area irrigated by wells has increased tremendously. In Karnataka, the area under well irrigation has increased from 1,29,000 hectares in 1949-50 t0 3,64,000 by 1980-81. Comparatively, the area irrigated by tanks has decreased from 3,22,000 hectares in 1954-55 to 3,04,000 hectares by 1980-81. The decrease in the area irrigated by tanks calls for an enquiry to find out whether the decrease is due to the decrease in the capacity of the tanks to hold water or due to any other factors.

Since the catchment area to a tank is the major source of flow into the tank, that area has to play a greater role not only in maintaing a steady flow into the tank but also in conserving the scanty rainfall. Any physical changes or transformations in the catchment or source of water can decrease or increase the flow of water into the tank. Therefore, the tank is a composite system of catchment and reservoir with organic linkages. Further the term catchment area goes beyond the physical term, in most of the cases the catchment area will be normally a community managed pasture land or a forest area. Once again each aspect may not be separate. They can be simultaneously all in one. Hence, any study of tank system has to be a study of both catchment and the tank-site.

Apart from the tank-site and its catchment, the command area also forms a part of the physical structure of the tank. The poor state of the components of the command area like distributories and canals can be detrimental to the physical capabilities of a tank, and so they have to be treated as an integral part of the tank. If the physical aspects of a tank represent to be the technology for efficient distribution of water, the way beneficiaries organise either to maintain or to distribute water also constitutes part of the entire tank system.

The Public Accounts Committee of 1980 appointed by the Legislature of Karnataka States that nearly 12,000 tanks have silted up (Gatti Chandrasekhar). The Programme Evaluation Wing of the Planning Commission, in a study of minor irrigation works has come to a conclusion that nearly 50 percent of the tanks in Karnataka have silted up. This figure appears to be realistic, if one goes by the estimation of the life of a tank by the Public Works Department (PWD) Minor Irrigation Manual, 1974). According to the PWD, the life of a tank is only 50 years. Going by such an estimation and the negligence shown towards from last two hundred years, it is but natural to expect many more tanks to be silted up. But the figures given by the Directorate of Economics and Statistics does not show the loss of tanks to be of such a great magnitude. Even today, according to the Directorate, the number of tanks in each district remains to be the same, unless new ones are constructed. This reporting brings in the predicament of choosing to trust: the engineers or the statisticians. Probably, the statistics appears to be true as the number of tanks in each district does not show any decrease. In fact, it shows an increase in the number of tanks, as few tanks were constructed by the Government of Karnataka. The acceptance of the fact that tanks have not gone out of use totally calls for an examination of the present status of tanks, from the point of view of their present day utilization and the mechanisms that have contributed to their survival. An attempt is made in this study, to examine how far age old tanks are surviving and what are the mechanisms that have contributed to their survival. If by any chance any tank has gone out of use, the cause for such obliteration will also be examined.

Tanks being primarily used for irrigation in Karnataka, the changes that have taken place in the cropping patterns will also be examined. This appears to be essential, as it is not the quantum of water that determines the crop but the crop determines the quantum of water required. If changes have taken place, how far such changes are responsible for the decrease in the area irrigated by tanks will also examined.

Table 1.1
Percentage Distribution of Net Sown Area in Different Rainfall Regions

States	High Rainfall (1150mm) & above	Medium Rainfall (upto750) to 1150mm)	Low Rain fall (upto 750mm	Percent of Net sown Area Irrigated
Dry (Low Irrigation/ Low rainfall) Region				
1. Karnataka	9.2	24.0	66.8	11.2
2. Maharashtra	21.4	42.3	36.3	7.8
3. Gujarat	8.1	24.9	67.0	12.0
4. Rajasthan	—	11.6	88.4	15.7
Wet (high rainfall) Region				
5. West Bengal	100.00	—	—	26.5
6. Bihar	80.00	20.00	—	27.2
7. Orissa	100.00	—	—	16.9
8. Kerala	100.00	—	—	19.5
9. Others (Including Assam & Himachal Pradesh	76.0	20.00	4.0	26.1
Wet (high irrigation) Region:				
10. Punjab & Haryana	—	11.3	88.7	56.0
11. Tamil Nadu	16.8	83.2	—	41.3
Mixed Region:				
12. Andhra Pradesh	—	64.1	35.9	27.7
13. Madhya Pradesh	55.7	39.6	4.7	7.8
14. Uttar Pradesh	10.9	74.9	14.2	39.0
15. All India	30.2	35.0	—	—

Source: Indian Agriculture in Brief

Table -1.2: Net Area under Irrigation (Modes of Irrigation)

(000 hectares)

States	1959-60 Canals Govt.	1959-60 Canals Private	1959-60 Tanks	1959-60 Wells	1959-60 Other Source	1959-60 Total	1983-84 Canals Govt.	1983-84 Canals Private	1983-84 Tanks	1983-84 Wells	1983-84 Other Source	1983-84 Total
Andhra Pradesh	125	13	1255	297	115	2949	1839	NIL	1087	838	114	3878
Assam	72	292	NIL	NIL	257	621	71	291	NIL	NIL	216	572
Bihar	441	155	297	260	653	1807	1609	NIL	98	956	454	2517
Gujarat / Maharashtra	278	30	204	1076	57	1645	819	24	324	2815	132	4204
Jammu & Kashmir	63	226	NIL	3	9	301	132	172	3	3	11	321
Kerala	153	30	32	14	127	356	100	04	36	31	95	226
Madhya Pradesh	428	4	135	321	38	926	1209	03	149	1192	219	2772

(Contd. in page 13)

States	1959-60 Canals Govt.	1959-60 Canals Private	1959-60 Tanks	1959-60 Wells	1959-60 Other Sources	1959-60 Total	1983-84 Canals Govt.	1983-84 Canals Private	1983-84 Tanks	1983-84 Wells	1983-84 Other Sources	1983-84 Total
Tamil Nadu	841	2	833	564	39	2279	864	01	807	926	20	2618
Karnataka	207	5	3439	122	123	806	661	NIL	317	436	176	1590
Orissa	197	28	495	38	219	977	1187	NIL	314	344	NIL	1845
Punjab	1961	53	3	948	33	2998	1478	NIL	NIL	2122	09	3609
Rajasthan	31	NIL	313	787	14	1445	1119	NIL	214	1906	37	3276
Uttar Pradesh	2013	12	419	2419	290	5153	3330	NIL	152	6081	316	9879
West Bengal	391	387	368	16	189	1351	724	NIL	278	717	261	1980

Table 1.3: Exploitation of River Basins for Irrigational Purpose

Sl. No. River System	Total Length of the main rivers with their principal affluents within Karnataka (miles)	Area over which the drainage is intercepted by tanks (sq. miles)	Total Area of each catchment basin (sq.miles)	Percentage of whole area under tank system
1. Tungabadhra	611	6217	11696	56.47
2. Palar	47	1036	1115	100.00
3. North Pennar	167	1946	2628	85.35
4. South Pennar	32	1319	1424	85.80
5. Cauvery	646	5769	11340	51.75
6. Sharavathy &	103	-----	1252	------
Total	1606	16287	29455	56.16

Source: C. Hayavadana Rao: 1929. Mysore Gazzetter: Vol. 3 , Govt. of Mysore.

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TABLE: 1.4: District-wise abstract of Irrigation Tanks In Karnataka (In Acres)

District	< 10 No.	< 10 Achkat	10 to 50 No.	10 to 50 Atchkat	50 to 100 No.	50 to 100 Atchkat	100 to 500 No.	100 to 500 Atchkat	above 500 No.	above 500 Atchkat
Bangalore	593	3085	979	23947	234	16366	195	38492	39	17714
Kolar	1408	7568	1912	45999	350	24681	255	47580	22	19407
Tumkur	326	1784	733	19338	340	21969	331	63973	47	43989
Chitradurga	13	63	87	2902	98	6427	181	34779	29	27826
Chikkamagalur	1326	6962	1054	22864	127	6591	87	13833	12	14666
Hassan	2983	14371	2792	59339	360	25539	184	22971	4	5076
Shimoga	2984	14378	3206	71864	625	43369	401	69811	12	9458
South Kanara	116	1160	181	3678	24	1578	11	1940	-	-
Coorg	338	1895	580	15583	69	4711	13	1904	-	-
Mysore	446	2472	567	13069	202	7700	124	26168	31	38744
Mandya	223	1151	384	10751	97	6623	102	20219	11	13905
Dharwar	1400	7631	1639	35982	316	20917	344	77102	34	26369
North Kanara	2813	11155	1261	26642	140	9658	81	13401	3	1856
Belgaum	361	1780	344	8563	128	9254	146	29310	23	22314
Bijapur	1	4	7	1291	5	404	51	10584	22	23053
Bellary	12	86	69	1889	59	4207	51	10584	6	6956
Gulbarga	71	380	200	5116	89	6327	66	12103	17	13986
Raichur	298	1488	249	5086	54	4103	47	10389	11	10124
Bidar	1	1	13	495	11	881	31	8021	13	8705
Total	**15713**	**7744**	**16257**	**372698**	**3328**	**219305**	**2701**	**515378**	**336**	**304178**

TABLE 1.5: PROGRESS OF IRRIGATION IN VARIOUS PLANS

PLANS	Government Outlay (Rs. in Crores)			Cumulative Irrigation Pot. created (Mill. ha)		
	Major & Medium	Minor	Total	Major & Medium	Minor	Total
Pre-Plan	NA	NA	NA	9.70	12.90	22.60
First Plan (1951-56)	380	76	456	2.20	14.06	26.26
Second Plan (1956-61)	380	142	522	14.30	14.79	29.09
Third Plan (1961-66)	581	328	909	60.60	17.01	33.61
Annual Plans (1966-69)	434	326	760	18.10	19.00	37.10
Fourth Plans (1969-74)	1237	513	1750	20.70	23.50	44.20
Fifth Plan (1974-79)	3399	868	4267	25.86	28.60	54.46
Annual Plan (1979-80)	1079	260	1339	26.50	30.00	56.50
Sixth Plan (1980-85)	7614	1741	9255	30.85	37.01	67.86

TABLE 1.6: Plan-wise Investment in Irrigation in Karnataka (Rs. in Crores)

Period	Major & Medium Irrigation Out lay	Minor Irrigation works out lay	Total
1. Pre-Plan & First Five Year Plan (1951-1956)	37.27	4.15	41.42
2. Second Plan (1956-1961)	29.82	5.08	34.90
3. Third Plan (1961-1966)	33.99	15.79	49.78
4. Annual Plans (1966-1969)	33.74	13.78	46.92
5. Fourth Plan (1969-1974)	139.00	23.03	162.03
6. Fifth Plan (1974-1978)	188.36	37.21	225.57
7. Annual Plan (1978-79)	90.18	13.89	104.07
8. Annual Plan (1979-80)	101.86	16.82	118.68
9. Sixth Plan (1980-85)	583.78	91.22	675.00
Total	**1238.00**	**220.37**	**1458.37**

Source: Irrigation Projects in Karnataka, 1985. Issued by Irrigation Department (Major and Medium).

Table 1.7: AREA IRRIGATED BY VARIOUS SOURCES IN SELECTED DISTRICTS

DISTRICTS	AREA IRRIGATED (HECTARES) 1970-71 Canals	1970-71 Tanks	1970-71 Wells	1970-71 Other Sources	1983-84 Canals	1983-84 Tanks	1983-84 Wells
Bangalore	3760	38434	46450	1509	3707	26502	37074
Tumkur	694	31835	45031	304	338	30609	28319
Kolar	---	36275	67391	1268	----	24623	49671

Chapter 2

IRRIGATION IN INDIA: DAMS vs. TANKS

WHAT IS IRRIGATION?

Irrigation is the process of providing water artificially to a crop in an area where the rainfall falls short of requirement for the crop that is grown. This process involves collecting, impounding and supply of rain water to the crop. But harvesting of rainwater for a crop is classified as rainfed cultivation and only where the rainwater stored by harvesting the surface run-off and the same is utilised for feeding a crop the word 'irrigation' is being used. Broadly it refers to surface water irrigation and ground water irrigation. The surface water irrigation is further classified with construction of major dams, as irrigation by dams and by tanks.

Evolution of Irrigation

It is believed that the most ancient irrigation system existed on the banks of the rivers Nile and Eupharates. But a few scholars credit the Aryans with the establishment of the earliest irrigation system. Irrespective of the claims, ancient irrigation systems were by diverting river water to the crop. This was succeeded by irrigation on the fringes of river banks by utilizing the floods in the river.

It is believed that the need for irrigation was due to the increase in human population and succeeding inability to produce sufficient foodgrains during rainy season to feed the entire population. As the population increased, irrigation was shifted from the banks of a river to a place away from the river. River water was diverted by erecting a cut in the river bank. Soon it was experienced that flow of water from the river to the crop has to be regulated and this brought in a regulator. It was also realized that there is a need to bund the river for impounding water, if the river water has to be tapped at low levels and if the same has to be carried to a distance from the river. Even today, in many river basins, the diversions of water from rivers do exist and they are called by various names such as bandharas, nalas, kaluves, etc.

Simultaneously, with the expansion of civilization to low rainfall regions far away from the river, the need to impound surface run-offs from a particular area or region was felt and when it was transferred into action,one of the crudest structures that must have emerged must have been the tank system .Tanks helped in impounding rain water for various purposes like drinking, washing and irrigation, even in adverse conditions.

History of Tanks

In India, utilization of river water for irrigating crops dates back to Vedic times. If Rigveda speaks about four sources to tap water for irrigation purposes, Yajurveda denotes big lakes and reservoirs as. Atharvaveda provides the description of stages of digging wells and canals. Kaushika-Sutra explains the rituals of letting water into canals.

The epics, Smrutis, Panchatantras and Jatakas also abound in references to the existence of dams, canals and wells. Even during the Mauryan period references occur in Dharmapada about aqua-ducts and canals. The notable minister, Kautilya of King Chandragupta mentions in his book 'Arthashastra' about the tax to be levied based on various sources utilized for irrigational purposes. The kings of Mauryan dynasty have to their credit the construction of Sudharshan lake near Kathiawar. But the topography and snow-fed rivers came in the way of the efforts of the royal dynasties of North India in building diversions, canals and tanks.

Among the several royal dynasties that ruled South India, the Cholas,the Hoysalas and the Vijayanagar kings have a special place in the history of irrigation. The credit of constructing massive tanks in Southern India goes to the Chola kings even though they confined themselves, to a great extent, to the present domain of Tamil Nadu. The tanks such as Uttaramiyur, Kaveripakkam, Parameshvara tank of Conjeevaram, Tandalam tank, Solapuram, Chittramega, Nagavaram and Chikkaballapur tank in Kolar district of Karnataka which are functional even today were built by the Cholas. (GOI, Central Board of Irrigation and Power; 1954).

The Pallavas, Gangas and Kadambas also constructed tanks in several parts of South India. It was the Hoysalas, who ruled Karnataka from 11th to 14th Century, who made a notable contribution by constructing nearly 204 new tanks and by renovating about 50 tanks. Various epigraphical records make references to 114 tanks during the regime of Hoysalas (G.R. Kuppuswamy, 1983).

After the Hoysala's rule, it was the Vijayanagar Kings who enriched the Southern peninsula by constructing large number of tanks. Existing big tanks like Haridara tank, Narasambudhi, Nagalapura, Paragi, Vyasaraya Samudra tanks in Andhra Pradesh and Donnanayakana Kere, Dorji, Kamalapura, etc., in Karnataka owe their existence to Vijayanagar Kings. It was during Vijayanagar Kings that a large-scale attempt was made to draw canals from rivers especially from Tungabhadra and Palar. Even today nearly 14,000 hectares of land is irrigated by such canals in Bellary district. During this period, a special officer was maintained in the Court of Vijayanagar Kings to supervise irrigation works.

With the establishment of British power, as an imperialist power the objective being resource extraction and generation of resources for their own industrial power, tanks being community owned and managed by the beneficaries through an organisation for the imperialist power it would have been difficult to utilise them for production such crops which were helpful in enhancing the revenue or the crops that would helped to supply raw materials for their industries. Therefore the Britishers neither favoured either the construction of new tanks nor the maintenance of them on a large scale. Further , as the land revenue from each village wasa assured through well-developed Ryotwari and Zamindari systems, Britishers knew that construction of tanks would not enhance revenue. Therefore, Britishers did not prefer tanks as alternatives to large scale irrigation projects. Even though there was appreciation for irrigation works like tanks, on the whole the indigenous system was neglected in favour of large scale irrigation projects such as the Punjab canals, Deccan canals, water works on deltas, etc. At the beginning of 19th century in India, nineteen and half million acres were irrigated by tanks built indigenously (Lady Hope). The oppression was systematically carried out, on the one hand, by denying patronage that was provided earlier by the royal dynasties and, on the other, by concentrating largely on large scale projects for diverting and impounding river water.

Irrigation in Independent India

Even in post-Independent era, till the end of the second five year plan, tanks were not recognized as a major source of irrigation. The financial allocation was very low. Later on, even though equal importance was not given to tanks, the financial allocation saw a progressive enhancement with every Five Year Plan. This is very clear if one examines the allocations made for minor irrigation over the plan periods (Table 1.6). In the First Five Year Plan, the total allocatrion for minor irrigation (Table 1.5) was only 76 crores against 380 crores for major and medium irrigation. In the Second Five Year Plan, the plan outlay on minor irrigation was 142 crores and institutional outlay on minor irrigation was 19 crores. In the Third Five Year Plan outlay increased to 328 crores and the institutional outlay increased to 115 crores. Comparatively, the outlay on major and medium project was 581 crores. In the annual plans, if 15134 crores was invested on major and medium projects, 686 crores was invested on minor irrigation. These differences were more apparent in the budget allocated by State Governemnts.In Karnataka, except in the Third Five Year Plan, the investment on minor irrigation was less than 15 per cent of the outlay on major and medium projects. Sometimes it was even less than 25 per cent of the outlay on major and medium projects. At the end of the Sixth Five Year Plan (Table 1.6) only 220 crores was spent on minor irrigation, whereas 1238 crores was spent on major and medium projects.

DAMS VS. TANKS

The major reason for such a poor allocation to minor irrigation was the dominant trend of building big dams. The big dams were considered as ideal technological products which can meet the demand for power by the growing industrial sector and water for irrigational purposes by the agricultural sector. Commissioning the 226 metre high dam at Bhakra, the then Indian Prime Minister, Jawaharlal Nehru identified the big dams as "Temples of Modern India". These new resources of irrigation unlike in the past were providing water for irrigation and also for producing power to advance industrial growth. These saw an investment of 1238 crores by 1979, for constructing more than 1500 dams classified as major and medium projects. Through these projects, India was able to meet 33 per cent of its power requirements and was able to create an additional potentiality of 20 million hectares.

The over enthusiasm shown in the construction of 'Modern Temples' everywhere has been opposed presently in the entire country. Beginning with 'Silent Valley' in Kerala, it has spread to every corner of the country and presently construction of dams like 'Tehri' in Gerhwal and many dams on Narmada river are being opposed by the entire populace of the country. This widespread opposition is bringing out the ecological consequences of these dams. Each criticism, either on the front of submergence of forests or displacement of villagers or centralised pockets of development do establish the merits of tanks as the best systems of irrigation. In the recent experience of Karnataka, even when it has built 79 tanks, in no case forest has been submerged. There is no displacement of any village. Each of these 79 tanks are in different location.

The large dams are recently being criticized as not only financially non-viable but also as economically disastrous. The submergence of huge tracts of lands by large dams is another point of criticism against them. In fact, in Karnataka one of the large dams - Linganamakki - has submerged 154 villages and about 31,600 hectares. The criticism of financial non-viability is due to the prolonged gestation period and low revenue. In case of large dams, the gestation period is quite prolonged at two stages - one at the construction level and another at achieving the total potentiality. As the construction of large dams spread over decades, the outlay on the raw materials will have the escalation of cost.

For the Srisailam project in Andhra Pradesh,the original estimation was Rs.384.7 million, but due to inordinate delays, the total cost went upto Rs.4.2 billion, nearly a 12-fold over that of original cost (Fact Finding Committee, 1984). Compared to such schemes, the escalation of cost of material will not be high in case of tanks.

One of the tanks in Karnataka 'obichoodnahalli' was to cost Rs.11.75 lakhs when it was originally estimated in 1963, (Bhargava, 1980). When it was finally completed in 1980 due to litigation between the contractor and the department, the total cost was 28 lakhs. Which is just above two-fold. In actuality, the cost of escalation per acre increased from Rs. 2024.74 to Rs.22105.26, in case of Srisailam Dam and in case of the tank the escalation was from Rs. 1021.28 per acre to Rs. 2382.99, in 15 years. Whereas in the case of the dam, it was in eight years.

The rise in cost of materials, due to prolonged gestation, increases investment capital which has to be recovered from farmers. Understanding the possible financial burden by such enhanced capital cost on the farmers, the Irrigation Commission, had recommended recovery of only 30 per cent of capital cost from the farmer in the form of betterment levy. About rest of the issues it said nothing. As a result, the annual financial loss from large dams worked out to be Rs. 150 crores (B.B. Vohra, 1976). On an average, the States are losing more than Rs. 4270 million per year. By the end of 1987-88, the State governments put the deficit substantially higher at Rs. 1500 crores (CMIE,1987).

A SUNK CAPITAL

If the remaining 70 per cent of the capital cost is added on to the working expenses for determining the water rate, even a hundred per cent mopping up of the net benefit from irrigation may fall short of the requirement. "At best receipts from the betterment levy may be set-off against capital costs... but not the objective of recovering any pre-determined proportion of capital costs." (Planning Department Gok) Added to this, the Sixth Finance Commission had suggested to States not to step up water rate to increase the receipts to meet

FORFEITED TREASURE

A study on the status of Irrigation Tanks in Karnataka

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the working expenses. Analysing such an opinion of the Finance Commission, a report of Government of Karnataka opines that *"it is unfortunate that the Finance Commission should take such a view. This would, in fact, mean the entire capital outlay on irrigation projects should be treated as sunk capital...It will amount to saying that investment in irrigation is sunk capital and at best a social overhead expenditure"*, (Emphasis added).

Loss In Potentiality

Another major criticism levelled against large dams is that they have not been able to irrigate the total potential area. Out of the created potentiality of 56 million hectares, the gap at the end of Fourth Five Year Plan period was 2.5 million. This increased to 4 million hectares by 1979-80. by 1987-88 it was about eight million hectares. This increasing gap in achieving the created potentiality is exclusive of loss of 13 million hectares of land due to waterlogging. The cause attributed for both the problems is the prolonged gestation period required by the large dams to irrigate its total potentiality, within the time required to achieve the total potentiality, the farmers at the top reach are fed with available surplus water. The availability of surplus water to the farmer at the initial stages after commissioning of a project encourages them in growing perennial and semi-perennial crops which on the one hand, develop waterlogging inthe years to come and on the other hand, create shortage of water for tail-enders.

PROBLEM OF WATERLOGGING

The problem of waterlogging is very acute even in those projects like Upper Krishna Project (UKP), Tungabadhra (TB), etc., where black cotton soils are predominantly found in the command areas. The attempts made to impose semi-dry cropping patterns in such command areas have not shown favourable results. On the other hand, the experience of Malaprabha and Ghataprabha has showen that inspite of imposing semi-dry crops from the beginning, the occurrence of waterlogging on a large scale could not be controlled.

Compared to the large dams, small tanks appear to be a better way of extending irrigation to areas predominated by black cotton soils, as the scale of operations are handy, factors like prolonged gestation period, wastage of water, etc., can be controlled. In Bellary district, where the Tungabhadra dam is irrigating 1,16,070 hectares, tanks are also irrigating 90,340 hectares. In some taluks like Bellary, Hospet and Siruguppa, tanks irrigate more or less the same area as that of the dam (Table 2.1). The low level canal (LLC) of the Tungabhadra dam irrigate Bellary, Hospet and Siruguppa taluks. The total waterlogged area in these taluks is 33,000 hectares. But such a situation is not reported in the command areas of any tank. Few tanks like Kamalapura and Dorji are fed by the LLC, even then waterlogging is not reported in the command areas of either Kamalapur, Dorji or in any other tanks fed by LLC.

In the Chitradurga district the, Badhra project irrigates 51,807 hectares. Out of which, nearly 14,176 hectares is waterlogged and 13,065 hectares is affected by salinity. Comparatively, even though tanks do irrigate 10,687 hectares in Chitradurga district, the problem of waterlogging is not reported in the command areas irrigated by tanks. This amply proves that tanks are a better source to prevent waterlogging.

In the command areas of large dams, the benefits accrued go to big farmers whereas in case of tanks it goes to small and marginal farmers. In the case of Bellary district, if one examines the area operated by various categories of farmers (Table 2.2), it is evident that the size of bigger farmers is highest in the areas irrigated by canals drawn from the dam. The only exception is Hospet taluk. If the entire section of beneficiaries are grouped into two: a) poor; holding below 2 hectares; and b) rich; those who hold above 2 hectares, once again, except in Hospet taluk, it is the rich farmers who hold large holdings than the poor in the irrigated areas by dam. In the taluks which are not benefited by the dam but benefited by tanks, either they are equal or a slight advantage may be there for the rich. From the point of view of equitable distribution of developmental efforts, tanks appear to be a better proposition than the dams. This conclusion is also well supported by the findings of Agricultural Census of 1971 (Table 2.3).

Tanks as Common Property Resources

Historically, tanks even though constructed as a product of generosity by an individual, is the property entirely owned by the community. It need not be specifically by those who are benefited but by all those who reside in that village. In certain cases, wherever zamindari system of revenue collection was imposed by Britishers , tanks might be owned by an individual who collected the revenue. However, the right is limited to the tank bed but not the water collected in it. Even today, in few villages of Devedurga taluk of Raichur district such system of ownership is continued.

The produce available in any form from the tank was also regarded as a property belonging to entire community. The trees grown either on the bund or in the foreshore area and the produce from such tree lots were the property of entire community. Unless the community decides to restrict the usage for a general benefit, the produce could have been utilised by any individual. Such wood lots were beneficial for the poor in providing green manure, fuel, fodder and timber.

As the water in the tank receded, the tank bed was used for grazing by the entire community.To facilitate good growth of grass the community had the rights to ban collection of dung from the tank bed.

Above all tank, as a reservoir of water, was utilised by every member in the community. Every one had a right to utilise other then irrigation for any purpose they like. Such purposes ranged from washing, bathing, drinking water for animals to that of few religious activities. The silt available within the tank bed was a prperty of the community and every one had a right to utilize it. Such uses included brick making, potterymaking, soil to the roof tops,etc.

Wells as Inimical Factor to Tank

Excessive financial encouragement provided to construction of wells has in a way affected tanks. Wells being individual water resources, the owners of such resources were liberated from their dependencies on community for water. Further being exclusive owners of a resource for irrigation were no more to comply the communities compulsions to contribute labour for the physical maintenance of tank, or had to grow a crop in the way community wishes to. Such liberties extended by the wells as private resource, made them withdraw from such activities which will be required to maintain tank as a community owned resource for irrigation. Such withdrawals compelled the rest either to contribute more or disband the communitys hold on the tank.

Liberties extended by the private resource and the liberal finances extended in the form of subsidies (World Bank aided such programmes in Karnataka) expanded the area irrigated by such private resources. Traditionally wells were located within the command area and were used to supplement purposes in summer month. Of late these wells are not only dug outside the command area but are also operated throughout the year. As a consequence, these wells do draw water stored in the tank. In few cases, such as Bodampalli of Chantamani taluk and in Tallaker of Challekere taluk the community land restricted drafting of water from the wells. However due to heavy encouragement provided by the government the hold of community on well owners has vanished. On the other hand a, large number of those who benefited by the tank are shifting to well irrigation. In Karnataka the area irrigated by such resources enhanced from 1,22,000 hectares in 1959-60 to 4,36,000 hectares by 1983-84. This enhancement was at the cost of tank as a common property resource. The extensive proliferation of wells has sucked in the water collected in the tank. In several villages of Kolar and Bangalore districts, farmers complain how the storage in the tank will not last long with individual owned resources sucking it off. Few villages like Hanabe in Bangalore district and Muthur in Kolar district have almost disbanded the tanks, as the tank water collected in them do not last beyond few months.

Table 2.1: Area Irrigated by Dams and Tanks in Bellary District

Taluks	Net Area Irrigated	
	Canals (dams)	Tanks
Bellary	59,622	58,384
Hadagali	4,806	-----
Harappanahalli	4,866	2,112
Hospet	17,667	15,303
Hagaribommanahalli	8,707	2,112
Kudligi	4,407	-----
Sandur	3,068	445
Siruguppa	12,927	11,928
Total	**116,070**	**90,340**

SOURCE: Govt. of Karnataka : Bellary zilla Anki-Amsha gala Nota:1983-84; District Statistical officer, Bellary.

Table 2.2: Agricultural Operation Holding Classification in Bellary District

Taluk	MARGINAL Below 1 hectare	SMALL 1 to 2 hectares	MEDIUM 2 to 4 hectares	BIG 4 to 10 hectares	10 & above
Bellary	6215	6258	7922	7962	2836
Hadagali	3959	4847	5722	2203	1015
Harappanahalli	7628	8363	9099	5678	1174
Hagaribommanahalli	3591	3895	4777	3857	995
Hospet	10169	5678	4267	1986	311
Kudligi	7526	7417	8757	4767	1283
Sandur	4663	3994	3408	1930	351
Siruguppa	7806	5982	6001	4632	2318

SOURCE: Govt. of Karnataka : Bellary zilla Anki-Amsha gala Nota:1983-84; District Statistical officer, Bellary.

Table 2.3: State of Holding and Area Irrigated Source-wise in Karnataka State

Size/Class (Ha)	Total No.	Holding Area	Canals	Tanks	Wells	Tube Wells	Rivers	Others Sources
Below 0.5	527,105	136,753	15,754	18,333	5,296	2	13	2,915
0.5 to 1.0	554,174	412,085	36,411	31,362	9,978	2	62	7,711
1.0 to 2.0	839,591	1,220,807	72,565	60,198	23,673	8	106	17,931
2.0 to 3.0	491,047	1,185,961	60,198	47,315	41,960	9	75	15,211
3.0 to 4.0	297,423	1,019,334	45,919	33,927	17,864	2	69	11,091
4.0 to 5.0	201,998	892,970	37,093	26,440	14,831	7	45	8,681
5.0 to 10.0	420,867	2,899,084	101,461	64,706	46,835	10	132	23,497
10.0 to 20.0	175,641	2,343,999	66,215	32,374	36,583	-	76	14,342
20.0 to 30.0	30,776	725,681	18,556	7,554	11,509	---	22	4,045
30.0 to 40.0	8,264	279,653	7,230	2,857	4,506	---	---	1,308
40.0 to 50.0	2,426	106,007	2,354	1,099	1,538	---	-	610
50.0 and above	2,018	145,476	2,407	1,390	2,081	---	-	875
Total	**3,551,230**	**11,367,825**	**466,1853**	**27,555**	**196,654**	**40**	**600**	**108,217**

SOURCE: Govt. of India: All India Report on Agricultural Census-1970-71 Ministry of Agriculture and Irrigation.

Chapter 3

TANK: PEOPLE'S TECHNOLOGY FOR CONSERVATION OF WATER

Need for a new Definition

One of the popular definitions of a tank can be stated as a "small water reservoir created by throwing an embankment of earth across the flow of water". (Sharma) Such an embankment of earth may be between two rising grounds or in a concave form, where the extremities of the embankment are stretched sufficiently to retain the depth of water required in the belly of the curve. But such a definition limits the scope of tank to a description of a part of the system. That is waterstored and the common area. The consequence of such a limitation is that tank will be identified as a resource that is much to do with irrigation. Which in turn identifies tanks as a source owned by a particular class of land owners and fails to explain it as a resource owned by the community as a whole. If it has to be a resource owned by the community then the definition of tanks has to take into consideration the system as a whole. Wherein the tank does not remain as a reservoir or the area of waterspread, but extends beyond the water spread area into the catchment and the structures that are part of water harvesting mechanisms available within the catchment area. The definition has to comprehend all those mechanism for tanks which are constructed exclusively for percolation purposes. Such a comprehensive definition is required to understand the role of tank not only from the point of view of irrigation, which is certainly one of the aspects, but as a source for water conservation for greater ecological reasons. The utilitarian aspect should not dominate the role of conservation. Tanks are built in a succession, where the size predominantly determine the order of succession. In such a case, the embankment and its size becomes insignificant, along with the utilitarian aspects.

Beyond Tanks

Tanks are predominantly found in those parts of India where rainfall has to be conserved within the soil for the purpose of raising crops. In areas where rainfall is below 760 mm, every drop conserved is a step towards conservation of crops. Tanks in such a situation are the conservors of rain water and the ability to irrigate is chiefly a function when the conservation is beyond the optimum level required for conservation of water in the soil. When conservation of water within the catchment is below the optimum level, the ability of tank tends to be low or totally absent. Such factors do determine the structures that were purely for perlocation and to check the velocity of surface run-off before it reaches the tanks. Insuch areas where high erosion is a possibility, these structures exclusively meant for conservation do act as silt traps.These structures that do not directly lend to irrgation but aspects incorporated into the system are called by various names in Southern India. In Tamil Nadu they are called Pallam, Madavu and Cheri. In Kannada speaking areas of Karnataka they are called Kunte, Katte and Kere. In Telugu speaking areas of Andhra Pradesh they are called Kunta, Katta, and Cheruvoo. The Telugu, Tamil and Kannada terms are almost equivalent. Though the terms are Kunte, Kunta and Kuttai are different. Kunte literally means a dug out pit to hold water flowing from few fields. Several of these, when overflooded, lead to a single Katte, or Katta, or Madavu. Unlike the kunte or kunta occasionally, these irrigate few acres. Even today many of the kattes in the drought prone districts of Raichur district in Karnataka irrigate hundreds of acres. Several of these kattes by over flowing led into a particular tank, which was called Cheruvo, kere, kuttai or cheri. Thus, these structures were points of conservation of water at different levels in the given catchment area to hold back the run-off at every given point to protect the soil from erosion and to infiltrate water into the soil. Therefore, any attempt to define tanks has to take into consideration the role of conservation, than merely the utilitarian aspects of the tank. If so, the tank can be defined as a technology for the conservation and utilisation of run-off water.

The utilitarian function of kuntes, kattes, and keres is not restricted

FOREWORD

I congratulate the Members of 'PRARAMBHA' for producing this book on matters relating to irrigation. The material contained therein should be of great value to persons interested in the subject.

It has to be realised that tanks have historically played an important role in a very big way. Till the craze for construction of large irrigation works took the fancy of the powers that be, it was only the tanks which were the major source of irrigation. Excavating tanks, like construction of Temples was considered as a meritorious Act. A majority of the tanks in Karnataka were built during the pre-British days, and the British Rule, in fact, resulted in their neglect as a result of the traditional institutions and arrangements which took care of the tanks having been relegated to the back-ground.

In the Book, the author has explained, after an in-depth study of statistics, the harm caused to the tanks themselves and to the environment by rapid siltation of tanks. Suggestions made for rehabilitation of the tanks are interesting and should be studied by those who are charged with the maintenance of tanks.

'Prarambha' is a purely non-official voluntary organisation, whose members are engaged in study of various subjects of far reaching importance and deserve all encouragement.

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to the conservation of water. Though it may be a major function, the other objective is to prevent soil erosion and flow of silt into bigger tanks. As kuntes were located at very strategic points in between fields or in the catchment, water never had a chance to flow as a single course for a long distance. For every periodic distance Kuntes were located to check the free flow of water. Such obstructions placed in the form of kunte, used to check the velocity of flow and the possible consequences of erosion Run-off water was made to overflow the kuntes after settling and shedding all the sediment it had carried with it. Kattes also play a similar role, the chances for run-off water to carry huge quantities of silt and possible erosion was checked. The inbuilt process to shed silt at various strategic points was helpful in desilting, as the quantum collected at every point was small and within the capabilities of few farmers to desilt without investing too many mandays on this. Such regular and repeated activities kept these mechanisms in operation over a long period of time.

Tank: An integrated unit

The tank if taken as a physical unit should include the embankment inclusive of all mechanisms of drawing water for irrigational purposes and provision for surplus water to flow out the water spread area, the catchment and the command area. In this, all categories that may lead to a succession are inclusive. The embankment is the physical structure that withholds the water in the water spread area. The size and shape of the embankment do differ according to the type of soil, the topography and the order of that tank in the series.* For those which are very small and perform only conservation activity in the case of <u>katte</u> the embankment will be semi-circle in shape, facing the water. It may be a few feet in height. The embankment will have no stone revetment on the side facing water. A few plants or shrubs of proven ability to hold soil against the standing water might have been planted on that side of the bund facing water. In few cases the katte, may own on embankment which will be once again a semi-circle and possess stone revetment on the side facing the water. If the water impounded is beyond the optimum level of conservation, water may be drawn to irrigate a few acres of land. Then the sluice of appropriate size and shape may be provided at a convenient point where water stored can be drawn out. Even in the kere the embankment will have stone rivetment and sluice. The number of sluices provided depends on the quantum of water stored and . Life of their command area.

Embankment: Not only to impound

The shape of the embankment in tanks will be normally designed to withstand the pressure that a source of water can put on the embankment. Further, the height and breadth of standing water may determine the structure of embankment. The terminal tanks, for a series, the embankment will be two-storied. The lower one will be very broad and the upper storey will be smaller one, almost sitting on the top of lower storey . The shape of embankment in such tanks will be normally crooked to dissipate the pressure at various points. In the medium tanks the shape of the embankment may be less crooked and may be a single solid structure, without any storeys.

The succession of tanks from smaller sizes to bigger ones are, hereafter termed as series. It is not synonymous to system tanks.

The shape of stone rivetment will depend on the size and location of tank in the series. In the terminal tanks huge stone boulders will be used. In the medium and smaller tanks, the size of stones used for rivetment will be relatively smaller. The stone layer will be normally placed one upon another to obtain a flight of stairs. No cement or mortar is used to bind one to another. In between, small broken stones are inserted to fill the gaps in order to prevent seepage and this also lends firmness to the whole structure. To provide additional strength and to obtain rigidity, binding stones will be placed in such an order to obtain a series of steps. Each binding stone nearer to the free board provide steps on to the left or right. This way, these binding stones do obtain an orderliness. No cement was used to fill the space. Only at the waste weir that too in very big tanks, mortar was used.

The embankment on the opposite of water spread area will be unrivetted, but will inevitably have a grass and tree cover. The idea of grass and tree cover is to protect soil from erosion and add strength to the embankment. At the bottom of the embankment, a small canal will run upto the sluice carrying the seepage water from the bund. If the embankment, as in the case of a terminal tank, is broad enough at the top to accumulate rain water on its own, then separate water course were run downwards to carry the water collected on the top of the embankment.

Sluice: An indigenous technology

The sluice is the mechanism to draw water from the tank for irrigational purposes. These sluices have an opening towards the water spread area. Normally, such an opening will be protruding into the water spread area. There will be a stone slab connecting the sluice and the embankment. The opening portion of the sluice works as an inlet. This inlet will be of two divisions, the upper one and the lower one. The upper one will be operated when the tank is filled to its capacity. The lower one will be operated when there is little water remaining on the bed of the tank or it is used to tap what is called 'dead storage' At the inlet, especially the upper one is controlled by a mechanism called plug and pole. The plug being a wooden piece in conical shape will be exactly shaped to sit into the top inlet (Photo 1). Depending upon the quantum of water to be drawn, the plug will be raised up through a pole or rod. Normally this pole or rod will be the only iron piece that can be found in the entire construction of the tank. To withhold the plug at a particular level, the pole or rod will have holes, by piercing a stick, rod or a club, the rod will be made to rest on a stone slab supported by two vertical stone pillars on either side of the sluice. In a few tanks, there will be a mechanism to lock the rod at a particular height. The stone pillars on either side of the sluice, on certain occasions, may have some engraving either indicating the level of water in the tank or the number of days on which water may be drawn from the tank (Photo 2). The outlet at the lower level is to top the dead water storage. Normally the flow in this outlet will not be controlled. Further, in such tanks in which it is silted up, this outlet may be out of operation.

Foreshore Area: To check flow of silt

The foreshore area of the tank will not only slope gently towards the centre of the tank but also will have certain mechanisms built into it to prevent silt flowing into the tank. One of the normal mechanisms that have been adopted for checking flow of silt is by providing a tree cover, which can withstand submersion either partially or fully. In few cases,as in Raichur district there will be pits of various sizes provided in succession. These are silt traps to prevent the flow of silt into the tank. If the flow of water into the tank is from various directions then at each point such mechanisms were provided to the tank. The number of trees and silt traps in a foreshore area depended on the size and location of the particular tank in the series. Normally, the one at the beginning of the series had many. Yet, as each tank had an independent catchment apart from the feeding it has from the tanks in the upstream, depending upon the size of independent catchment, the mechanisms to trap silt was provided. In Kolar district to prevent the movement of silt towards the sluice, and rivetd bund at right angle to sluice will be in existence. In black cotton soils, the number of silt traps in the form of pits were large in number, but even in the independent catchment of each tank, silt traps were provided at every point of convenience. If the catchment was cultivated, for every field silt traps were provided as the quantum of silt carried by run-off water was high. Further, at a convenient point, kuntes and kattes were built not onlyas a mechanism to trap silt but also to infiltrate water into the soil.

The Social Aspects of Tanks

Each technological device utilized to constuct tanks had a role in fulfilling certain social needs of the community living in proximity to the tanks. Though the embankment was to impound water, it had

to provide access to water for drinking and washing purposes. The tanks, were the drinking water source for the weaker sections, as the sources within the village were private sources owned on the basis of caste. The flight of stairs in the structure of bund was helpful for the womenfolk and children to collect drinking water from the tank.

For the entire community, the flight of stairs facilitated washing of clothes, sqatting on the stairs. Even today washing clothes is done in tanks by every community. For the poorest who had no means to have separate bath-rooms, tanks acted as a bath-plce for both men and women and for such functions the flight of stairs was useful.

Embankment : a grazing Spot

The unrivetted sideof embankment was in a way a source for generation of resources required by the farming community, to carry on its agriculture in the command area. The trees planted on the embankment were a mix of manure, fruit and fodder yielding. Such trees which were good yielders of green manure were planted on the embankment. Normally, it was pongamia glabra or neem trees, Mangoes, Jamoon, date-palm, etc. As none of these trees were owned individually, every farmer had an access to these resources, especially the poor.

The green grass on the embankment was conserved up to the harvest season and in that season, the cattle belonging to the families including the labourers harvesting the crop in the command area were given the priority to graze. Once the harvesting season was completed it was open to everyone to graze their cattle on the embankment. The receding waters in the water spread area enabled the cattle to graze the newly sprouting grass. It is a common practice for the poorest even today to make use of the bed for grazing purposes. To conserve grass for such purposes collection of dung was prohibited. In certain cases the poorest may be allowed to collect the dung from the foreshore area to enrich their manurial resources. Similarly, the banks of channels and distributories provided green grass for the entire community.

Tank bed and droughts

In extreme drought conditions, the bed of the tank was ploughed to grow food grains. Depending on the severity of the drought, the nature of crops to be grown was determined. During mild drought, to meet the shortages, if few pulse crops were grown, during severe drought conditions, food grains were irrigated on the bed of the tank by exploiting the ground water resources within the bed. Many times, the poorest of the poor, used to dig tubers grown in the bed for their food requirements. Almost all these activities, especially growing crops on the bed was carried out by the entire community, no individual was allowed to exploit the resources for individual benefit. Individual fishermen were allowed to fish in the channels and distributories. The fish grown in the tank was the property of the entire community and by auctioning th fish in the tank, money was raised for the maintenance of the tank. Any individual can catch crabs in any part of the command area or in between stones in the embankment. After the harvest those who consume field rats were free to catch rats in any part of command area. The only condition is that such people should remake the bunds in between the fields, if they dig it up. Many rat catching families used to collect sufficient quantity of grains stored by rats in their hideouts.

All yields from the trees in the foreshore area of the tank was the property of the community. Every individual within the community had a right to utilize the yield without damaging the capital stock. The dead and fallen trees were auctioned off by the community to raise funds for the maintenance of tank. The trees in the foreshore provided shade to the animals grazing on the bed especially in summer months.

Tanks: An integral part of culture

The tanks also had a role in the cultural activities of the community. Every time the tank filled up to its capacity, there used to be a celebration. If the tank failed to receive sufficient water in time, a celebration called ' Mallaraya festival' (festival for rain god) was celebrated. In this festival, young boys carrying an idol of rain god made from the clay in the tank, go from house to house praying to god to save the drying crops. Each household not only pours a measure of water on the god and the boy carrying it, but also donate foodgrains. From such collected foodgrains a feast will be made on the bed to appease the rain god. The belief is that by the closing time of the feast, it should rain. When the tank overflows also, the entire community celebrates it as a floating festival, wherein the woman-folk who have brought lamps, are taken around the brimming tank on a float. In a few places animal sacrifices are also offered. It was a practice for the village officials to offer a saree, kumkum, turmeric powder and few bangles to the water in tank, identified as 'Gowri' wife of Shiva. This was done on behalf of the entire village. Normally, the floating festival is a joyous occasion wherein near and far relatives are summoned to share the happiness. After the conclusion of harvesting season and before the commencement of summer season, it was a practice of those who own land in the command area to offer an animal and cook food in the value of a god called 'Muneswara' who will be normally identified as a resident of a huge tree on the tank bund. Every life cycle activity of human beings will have an occasion to worship water in the tank either at the beginning or at the end of the rituals. After the birth of a child, mother offers a worship to the tank. After the death ceremonies are completed for a dead person, the relatives offer a prayer to the tank. Even marriages among certain communities, commences with bringing of what is called 'holy water' from the tank. Thus, tank was a community resource being an integral part of all social activities.

Classification of Tanks

Tanks are classified on the basis of capability to irrigate its command area. The classification is minor, medium and major tanks. A tank is classified as a minor one when it commands an area is within 50 acres. A medium-sized tank commands an area between 50 acres to 100 acres. Those tanks that irrigate above 100 acres are called major tanks. Apart from these, there are tanks which can irrigate above 500 acres, such tanks are called big tanks or terminal tanks and for all operational purposes treated as a small reservoir.

The above classification is done for operational purposes like tax collection, restoration, maintenance, etc., but in actuality the tanks can be broadly divided as those that are with an independent catchment and are isolated and those tanks that have small independent catchment but run in a series. The capability of an isolated tank is directly proportional to its catchment, whereas for a tank within a series of tanks, found in a valley, that can be irrigated is determined by the flow from the upstream and the space in between that tank. In certain cases, like Savanur, Chikkanahalli and Hanabe tanks in Doddaballapur taluk and Chandragiri and Hosakere of Devadurga taluk, Baylakundi and Donnanayakanakere in Hospet taluk, the area to be irrigated between two tanks is very much limited due to location of tanks closer to one another and the tank in the upstream will be a feeder tank to the one in the downstream. The purpose of having two tanks close to one another is to check the velocity of flow of water and siltation to the tanks in downstream. Usually, to have such an advantage the minor tanks are located at the beginning of the series. Therefore, from the point of total utility of a tank, the minor tanks are silt catching tanks, rather than for irrigation tanks.

The catchment area of these minor tanks will be very small, as they will be, in normal circumstances, constructed at the end of a pan at the beginning of a halla or gorge. The medium tanks are those that are in the middle order of the series of tanks. These middle order tanks usually have a good catchment area of a few square miles. These tanks help in preventing downward flow of silt and in the conservation of water. Usually, such middle order tanks irrigate an area ranging from 50 to 100 acres.

Major tanks are located at the terminus of a gorge or a hall into a rivulet or stream. These serve irrigational purposes than siltation, as flow of silt is prevented by the minor and middle order tanks in its catchment. These major tanks have a capability to irrigate between 100 to 500 acres. Several of these tanks lead to major tanks which are located at the terminus of each valley. These terminal tanks command bigger command areas ranging from 500 acres to several thousand acres. Several of these terminal tanks lead ultimately to a very big tank at the terminus of several valleys into a single valley or beginning of a river or just before joining a river. The Hoskote tank near Bangalore for example gives birth to South Pennar, the Hesaraghatta tank to Arakavathi river. Kerebudur tank in Raichur joins Tungabadhra river. The Varthur tank near Bangalore joins Pennar and Devanganapalli tank in Siddlaghatta taluk joins Kumudavathi river.

From the point of location of a tank in the series, the tanks can be classified as small tanks that are at the beginning of the series or the beginners, the middle order tanks and the terminal tanks. This type of classification helps in understanding the role of a tank in a given geographical area since in the series, each tank is linked to one another in a chain. Any problematic situation at a particular tank has a linkage with the other tanks in the upstream.

Physical Capability of a Tank

A tank is formed by throwing an embankment of earth either across the gorge betwee two rising grounds, or in a concave form of sloping surface, the extremities carried sufficienly up the rise to retain the depth of water required in the belly of the curve.

The physical capability of a tank is determined by the size of bund, area of catchment, extent of tank bed and length of the command areas. These physical aspects forming one integral part determines the status of a tank in its utilitarian aspects. Even though each individual element can be separated from one another, for an indepth analysis of tanks, each element should be examined in relation to the other. The flow from the catchment area of a tank determines the sizes of the bunds by determining the quantum of water to be impounded. The nature of the tank bed and the bund together determine the quantum of water that can be stored. The condition of sluices determine how long the water stored can be efficiently and effectively used for utilitarian purposes. Similarly, the physical condition of distributories determines the effective use of water and wastage of water. Hence, an examination of the role of each element constituting the physical structure of tank, is required to understand the total functioning of a tank.

The physical structure of a tank is dependent on various factors like nature and type of tank, purpose, location and the geographical area. There are three types of tanks; storage tanks, spring tanks and percolation tanks. The storage tanks are those which are meant to impound water for irrigational purpose. These consist of earthern bunds thrown across streams or halla so as to impound water for irrigation. The area irrigated under storage tanks varies from a few acres to several hundreds of acres. The other type of tanks are "Spring Tanks" which are generally formed due to occurrence of natural springs within the bed from which water is drawn for irrigation. The spring is the source of supply which is sometimes perennial and sometimes lasts for a few months in the summer. The perlocation tanks are, as the name indicates, mainly for perlocation of water, to recharge ground water but they will also be used occasionally for irrigation.

The type of tanks constructed in any region depends upon the geographical conditions in which it is constructed. Geographically, Karnataka is divided into three regions, Malnad or Western Ghats section, southern Maidan and Northern Maidan. In the hilly terrain of Malnad or western ghats, the type of tanks that are constructed are usually storage tanks. In Malnad region sometimes the rainfall ranges from 900 mm upto 5000 mm per year. The nature of rainfall is confined to downpour spreading over few months in a year and totally absent in rest of the year. Therefore, there is a need to store water for the rainless days. To conserve water, when it downpours in every micro-catchment, the rain water is impounded in smaller tanks leading to a bigger tank in the plains. Due to this reason, the Malnad districts like the ghat sections of Shimoga, Hassan and Chikkamagalur have the highest number of those tanks that can irrigate less than 10 acres. The eastern parts of these districts being plains and rain shadow regions possess tanks which can irrigate even beyond 500 acres. These three districts have the highest number of tanks which can irrigate between 10 to 100 acres and very few tanks which can irrigate beyond 100 to 500 acres. None of these districts have many tanks which can irrigate above 500 acres. In few areas of Malnad, several tanks does not have sluices at all. It is by effective utilization of seepage that irrigation is carried out in such areas.

The Western part of Malnad region does not possess many tanks due to very heavy rainfall and also due to innumerable streams. In

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this region spring tanks dominate. Of the districts in this region, Dakshina Kannada possesses large number of spring tanks.

The Sourthern maidan of Karnataka is characterised by a low rainfall ranging from 380 to 777 mm in a year. The soils in the region being dominantly favourable to irrigation, every available valley and terrain is utilized for impounding the surface run-off as it is a scarce resource in the dry and hot seasons. In almost all the districts of southern Maidan, tanks are the major source of irrigation. Therefore, in these districts almost all tanks are storage tanks, but in a few districts like Kolar and Bangalore, tanks also facilitate percolation. In a couple of other districts (like Tumkur and Kolar) which have hilly terrain, springs tanks do prevail. But the spring within the tank bed is used for irrigation only during summer season, that too, when the impounded water is exhausted. In these districts of the southern maidan the number of tanks with a capability to irrigate above 500 acres do predominate.

In the northern Maidan region, especially in the eastern districts, where black soils of various depth predominate, the need for a large number of tanks is not felt over time. Further, the landscape being plain, it has been found difficult to have a good site for a tank where submergence of land will be less than the land to be irrigated. Wherever soils permit, irrigation tanks occur and most of these are storage tanks.

The Bund

The physical characteristics of a tank varies according to the category. The bunds, sluices, waste weir, tank bed, etc., are all directly related to the category to which the tank belongs to.

The bund is the structure that is constructed across a gorge,valley or halla, to impound water. This bund actually defines the tank. No tank can be without a bund. The size, shape, length, height and breadth of a bund is defined by the category to which it belongs. Most of the tanks that are called beginners will have bunds of a small size.The beginners like Chandranakere of Deodurga taluk or Savanur of Doddaballapur taluk have a size (Table 3.1) which differ from that of middle order tanks like Talaku and Hebbalagere. These once again differ from that of terminal tanks like Kunigal Doddakere and Parashuramapura. The reason being that the holding capacity of each of these tanks differ from category to category.

The shape of the bund plays a very important role in withholding the water. The shape provided will be denoting the pressure it has to withstand. The bund provided to the beginners will be somewhat straight but curved at its extremes, as the depth and quantum of water impounded is comparatively small. Whereas in the middle order tanks the bund will be in a outward facing horsehoe shape to diversify the force of standing water. The shape of terminal tanks will be usually curved. The curve in the bund of terminal tanks may be repeated many times, to disperse the force of standing water.

To provide strength to the bund and prevent erosion of the same, the bund that is facing the water will be stone revetted. The revetment once again differs from category to category. In the very small tanks irrigation less than ten acres, instead of stone revetment, the erosion is prevented by planting the foot of inner slope with some of the various common plants, which will be grown thickly and well in water. Among such plants crow bamboo, the screw pine, the common bulrush, the smaller varieties of bamboos, canes or rattans and the lunka or dignatic feathergrass (Greenway), are well-known.

In the major tanks the stones will be pitched at right angels to the slope, resting on a foundation benched into the earth at the foot about three feet in depth and with a backing of ballast gravel and quarrv rubbish.

While placing the stones, if they are not dressed, they are placed in such a manner to acquire the shape of stairs. This will accommodate the various level of pressure that water transfer onto the bund. If the stones are dressed, they will be laid horizontally, underlapping each other like a flight of steps. This method is very essential if the material of the bank itself happens to be of gravel.

The bund in any tank, except small tanks at the beginning of the series, should never be less than 4 1/2 feet higher than the surface of the water in the tank at the fullest, and in terminal tanks that should be from 6 to 12 feet above that level in proportion to the extent of water spread, and consequent size of the waves which a strong breeze may raise upon it.

The top width of the bund may vary from 3 ft. in the smaller tank to 12 ft. in very large terminal tanks. The slopes of the bund vary with the soil it is composed of. In the stiffest earths, the inner slopes (that faces water) will be not less than 1 1/2 base to 2 of height and the outer slope will be not less than 1 to 1. In loose fragile earth or which have high affinity for water, greater inclinations of 5 to 6 to 1 is given.

The bund at the bottom of the outer surface is provided with trees to support the bund and to prevent slipping. In many tanks pongamia trees are grown to provide the above benefits and also to supply green manure to the irrigated fields.

Waste weir

Every tank irrespective of its size will be provided with waste weir. It will be usually at or near one end of the bund, from where the natural fall of the ground will be easiest to enable the surplus water to find its way into the nearest stream or water course. The waste weirs should discharge the anticipated maximum flood without any damage to the bund.

The waste weirs, according to their locations, are classified as: a) Flank weirs - at the immediate flank and continuation of the bund, and b) Saddle weir - separated from the bund by high ground. Flank weirs may damage the bund during heavy discharge to prevent this, wing walls are usually provided on the upstream side of weir and a lining wall on the down stream of weir. Wing walls should be at an angle of about forty degrees with the body wall.

Sluices

Sluice is a mechanism through which water from the tank is drawn for irrigational purposes. Each tank is provided with sluices to provide sufficient water for irrigation. Depending on this shape and size of command area, the number of sluices in a tank is determined. The sluice will be located at the most suitable site along the centre line of the bund in such a way that it can easily water to the expected command area. The most preferred positions are : (1) at the saddle of depression across the centre line of bund; and (2) near the flank of the bund which is the one having a waste weir, so that crossing the waste weir passage or gorge is avoided.

There are two types of sluices: (1) pipe sluices and (2) masonary culverts or barrels. The first one is not usually preferred if the depth of the water standing is above eight feet, as it will be difficult to repair the pipes that have been broken. In such cases, the second one, that is culverts made of masonary or stones or concrete is ideal. The opening will be proportion to the requirement of water for the crops grown in the area commanded by the sluice.

To control the inflow of water into the sluice, there are two methods: plug and pole and the shutter system. The shutter system is a relatively a new phenomenon. In the plug and pole method, a plug made of wood is fixed to one end of an iron pole which sits exactly into a whole in the stone slab at the entrance of a sluice or orifice (Photo 3). These plugs will be of standard sizes ranging from 4 inches to 12 inches. By lifting the plug to desired lengths desired quantum of water is released for irrigational purposes. In a few tanks in Chitradurga, Bangalore and Tumkur districts there are two holes in the stone slabs at the entrance of water into sluice. One of these holes, is to tap the normal standing water and the one at the bottom of the sluice is to tap the dead water storage in times of contingency. In a few tanks where water has to be strictly regulated, locking mechanism is found. Usually the 6-inch plug hold will discharge one cusec of water.

In the shutter system, the entry of water into orifice or sluice is regulated by placing a sheet of iron sliding over a frame. This shutter is regulated at the top of the sluice by a screw mechanism. Usually, this method is ideal for very big tank at the terminals or at the reservoirs.The operation and maintenance of these shutters requires skilled personnel. In the shutter system, there are two types, one where an iron plate is glided down over iron rails an another, where the sides of iron plate is lined with rubber. Being recent additions to the tank system and that too where only the Pulbic Works Department maintains these operations, the system is yet to become popular.

DistributorySystem

The canals are those that receive water from the tank for onward conveyance to the fields. Thes canals are categorized into major canals, main distributories and field channels. Major canals are those that convey water from the tank to the entire length of the command area. The main distributories are those that receive water from the major canals and convey water into interior parts of the command area. The field channels are those that receive water from the distributories and convey it to the fields.

Major canals being the receivers of water directly from the tank have to withstand the velocity of discharge. To this extent, usually in the traditional tanks, a box like formation will be provided at the point of discharge. The size of the box will be determined, depending on the maximum discharge capability of the sluice. This box being constructed from stones will have no outlet directly facing the sluice (Photo 4). The outlet will be at right angles to the discharge from the sluice and this will, in a way, redue the velocity of water entering the major canals, as the discharged water collide against the construction and then on its way back is received by the canals. In the newly constructed tanks this system is absent and the water is directly let into the canals. In such situations, canals inevitably need lining to withstand the velocity. The lining is necessary only in such cases where soils are pervious and have a crumbling character. These canals will be normally shaped as a semi-circle, unless they have been shaped into trapezoidal shape in some soil to provide lining. When it is in trapezoidal shape the slope has to be 1 to 1 but due to crumbling and siltation it can gain a slope of 1.5 to 1.

The main canals will move according to the contour and take curves gradually. Usually, only one side of the canal's area will be irrigated. These canals usually avoid hallas or gorges in traditional tanks. In the modern ones they will be crossing the gorge or halla through an aqueduct or siphon . In siphoning, the chances of fast siltation is high even with one or two flows, as in the case of Chikkalingadahalli of Gulbarga district. Therefore, the best means will be an aqueduct to transport water across a gorge or halla.

The velocity of flow in these main canals will depend on the physical conditions in which they are maintained. In the tanks that are already serving, in the unlined canals, the growth of weeds will reduce the velocity as a result the banks may be damaged due to overflow. The accumulation of silt also reduces the carrying capacity of these canals. Therefore, it is essential that these canals are desilted every year.The silted up canals will disrupt the flow and help the water to stand in the canals. In such canals, the seepage losses will be high.

The distributories are the other type of canals that are important in the supply of water to the fields. In actuality as these distributories are planned for flow of water at the low velocity and low quantum of water, the chances of these distributories silting up are high. Further, the equitable distribution of water is highly dependent on the location of distributories, their size, the slope and the capacity. If the location is not suitable to provide water to all the field channels the farmer on the field channels may disturb the shape and size of distributory to supply more water for their fields. The situation may arise if the size and capacity of distributory is not according to the area it is going to supply water.

The field channel are those that draw water from the distributories to supply water to the fields. Usually, these fields channels are to supply one cubic foot of water per second, but in reality the situation will be different in such tanks where farmers themselves operate the flow of water. These channels, unlike the others are not damaged by cross drains. But there could be a damage if they are not properly located, so as to distribute water equally to the entire field.

In any command area, apart from the canal the other important structure is the drain. Drains are essential to remove surplus water from the fields. If surplus water is not removed, initially, the standing crop may be affected but in the long run it may lead to salinity, alkalinity and then waterlogging. Therefore, these drains have to be located in such a way they can easily drain all the fields within their reach. Depending upon the soil conditions and their ability to drain surplus water, the number of drains in a command area has to be decided. In poor and problematic soils like black cotton soils, the need for drains are high. In such cases, the drains should have higher depth and slope than the canals to provide greater velocity for the water to prevent impact of such drained water on the neighboring fields. In a few ancient tanks these drains may be used for irrigational purposes, if the water it collects is not acidic.

Table 3.1
Physical Measurements of Bunds in various Tanks
(In meters)

	Top Width	Rear Slope	Front Slope	Free Board	Length	Height
Tallaku	1.2	1:1.5	1.5:1	1.8	7.60	6.7
Hebbalagere	1.2	1:1	1.5:1	1.0	1350	7.0
Chandankere	1.8	1.5:1	1:1	1.22	450	15

[illegible] The distributaries [illegible] the other type of canals that are important [illegible]

[illegible] capacity of distributory is [illegible] according to the area it is going to supply water.

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Chapter 4

WATER MANAGEMENT

Tanks being conservors of rain water especially in low rainfall regions, their efficiency depends on how the impounded water is managed for irrigational purposes. Water management involves an "integrated process of diversion, conveyance, regulation, measurement, distribution and application of a rational amount of water at the appropriate time." This process in its operational aspects can be divided into two parts: 'on the farm' water management and 'off the farm' water management.

Water management on the farm involves the following; the nature and type of distribution network; location of fields, soils to be irrigated, shape of land, location and level of the field to be irrigated. Off the field wate: management involves two aspects; institutional and social framework available for the beneficiaries or officials incharge of water distribution to coordinate with each other and the infrastractural facilities available to efficiently execute the decisions of the coordinated body.

Finally the efficiency of water management in irrigation is evaluated in terms of water utilization for raising a crop even under adverse drought conditions. Therefore, water management ultimately aims at producing the maximum by utilizing the available resources, which may be a scarce resource at a given time in the calendar of an agricultural season.

The existence of tanks has from time immemorial helped farmers of Karnataka to develop various systems of water management based on the capacity of the tank, size of the command area, number of villagers benefited, soil conditions and above all on the basis of rainfall pattern in a particular region. As a consequence, the systems of water management differ from one agro-climatic zone to another, since each agro-climatic zone differs from the other.

In general, the prevalent water management in Karnataka can be classified for comparative purposes as: water management in department-managed tanks; and water management by farmers This classification in a way, takes into consideration the extent of area irrigated by tanks. In Karnataka, such of those tanks which have a capability to irrigate more than 500 acres are managed by the minor irrigation wing of Public Works Department (PWD). Those tanks that irrigate between 100 acres and 500 acres are managed by the PWD, but such management does not extend to water management. It extends to the physical maintenance of the tank only. It is the beneficiaries of such tanks who have to manage the available water. Similarly, for other types of tanks which irrigate less than 100 acres, the physical maintenance is managed by the PWD whereas the water is managed by the beneficiaries. If a tank irrigates less than ten acres, then the physical management of the tank is by the Taluk Development Board (TDB), and once again water management is by the beneficiaries themselves.

Traditionally,in the tank rich State of Karnataka, water management was taken care of by two social institutions namely, 'Panchayats' and 'Nirgantis'. These are classified on the basis of water management as off the field and on the field respectively. The institutions which managed water off the field was called 'Panchayat' and the one that managed water on the field was 'Nirgantis'. Even though they are institutionally separate, functionally they are complimentary to each other. Hierarchically, the Panchayat was superior to the Nirganti.

The Panchayat was a social institution constituted by the beneficiaries in the command area of a tank. It is an off the field institution responsible for the management of physical structure of tank, canals and distributories. It had a linkage to water management on the field in allocating the quantum of water impounded in the tank equally to all the beneficiaries, irrespective of the location of one's holding in the command area. Depending on the water available in the tank, the quantum of water to be distributed was determined. Such decisions were usually based on the crops grown, if all the farmers have grown the same crop. If not, the water was distributed on the basis of area or time. The time was determined earlier on the length of a song, now it can be an alarm clock. This responsibility of allocating the water gave a right also to supervis the Nirgantis in

CHAPTER 1

INTRODUCTION

The present decade in India is characterised by the damage caused by scarcity of rainfall on the one hand and by flash floods due to heavy rainfall on the other. "As soon as monsoon is over, springs and streams start drying up and water scarcity haunts what was once the wettest spot on earth. When river catchments lose their hydrological function, floods occur immediately following rain even when the rainfall is not heavy leading to water scarcity during the rest of the year. (J. Bandyopadhaya, 1987)". The scarcity of water for all purposes is threatening all the so called developmental works. With every passing year the budgetary allocation for meeting the drought situation is increasing. Such an increase is retarding other developmental activities on various fronts.

In India the distribution of normal annual and monthly rainfall is largely determined by the physical features of the terrain; the trend of mountains and pleateaus; the magnitude and time of the burst of the monsoon. The very heavy rainfall zones are confined to the windward side of the western ghats, in the Brahmaputra valley and on the hills of Assam. A few areas such as Bengal basin, Orissa, eastern extremes of Madhya Pradesh and south-eastern regions are receivers of heavy rainfall ranging between 750 mm and 1000 mm. The western parts of Rajasthan adjoining the desert receive only 350 mm of rainfall.

More than 75 to 90 percent of rainfall occurs during four months, that is, June to September and the same is compressed in a few rain-hours during 25 to 60 rainy days (Jasbir Singh, 1974). Therefore, for communities which are living in the low rainfall regions, there is a need to conserve rain water for the rest of the year.

executing their decision.

The Panchayats were also appellate bodies that heard and decided the complaints of beneficiaries; to punish those beneficiaries who interfere in the implementation of their decision and also those who do not contribute labour or finance in the demanded form for the physical maintenance of tank and its canal system.

Though these Panchayats were constituted by the beneficiaries within the command area, the size, structure and composition differed from one to another depending on the command area irrigated by each tank. Tanks located at the beginning of a series, due to their small command area had panchayats of a loose structure without a formal head and without a formal meeting. The small number of beneficiaries and the feasible interaction between each other enabled the beneficiaries to afford a loosely knit informal panchayat. In case of complaints or any litigation, the beneficiary holding highest acreage within the command area played the role of formal headman.

In those tanks that irrigate below five hundred acres or such tanks which are terminals for a series, as the command areas used to be vast and the beneficiaries were spread over many villagers, the structure of the Panchayats used to be different from that of other smaller tanks. There used to be an executive body either selected on the basis of canals or on the basis of area irrigated or one representative from each village benefited by the tank. Such constituted executive body had a head or a presiding officer. In villages which were under zamindari system, the zamindar used to be the presiding officer and in those villages which had 'ryotwari' system, the officials incharge of revenue collections such as 'shanubag' and 'patel' were the presiding officers. Each member of the panchayat also presided over another committee, constituted by the executive body or was presiding over the panchayat constituted by the beneficiaries of his village or canal or in the area he represents. Normally the composition was based on the land held in the command area. Each caste group was not only represented but were assigned with certain activities. In most of the cases the brahmin who happened to be the 'Shanubag' or tax collector was responsible for maintenance of accounts. The 'Patel' who normally hailed from the dominant peasant caste was responsible for getting the physical work accomplished. It was the duty of 'Nirganti' who happened to be most of the times, a scheduled caste person to be responsible in getting the benificaries assembled, collection of fines and excuting the levies or punishments.

No one knows exactly when these committees were constituted or their formal procedures. Yet, by way of custom, these panchayats have developed a system of rules and procedures. Much of such rules are practices, handed down through generations. These practices have gained customary status in the case of some tanks. Because of such status, a few Panchayats have still survived. One of the major causes for the disappearance of these panchayats is the abolition of the offices of zamindar, patel and shanubag; secondly, the superseding of such panchayats by PWD at terminal tanks and, thirdly, the loss of implementing agency such as Nirganti..

The Panchayats were responsible for the physical maintenance of canals and distributories. The normal procedure followed is two-fold. Firstly, by eliciting physical labour from the beneficiaries of all the canals and distributories in the command area to desilt or to repair them as per the requirement. Secondly, requesting all the beneficiaries to desilt the part of the canal or distributory that is situated next to one's own field.The work was entrusted to the Nirganti in both the methods for the remaining part of desiltation.

On a particular day, every beneficiary will be summoned through an announcement by the Nirganti to collectively contribute labour to desilt or repair the entire length or a portion of a canal or a distributory. The usual procedure followed to elicit work from every land holder in the command area was to demand one labourer per acre of holding. Here part of an acre was counted always as one. The gathered group was set to desilt or repair the entire canal at morning hours, without hampering the daily routine activities of any participant. Those who contributed less or abstained without permission of the presiding officers were identified and fined

It is in the low rainfall regions that human survival is highly threatened today due to scarcity of water. In such regions, the number of drought prone villages where even drinking water is scarce, are increasing every year. For example, in Uttar Pradesh during the 1960s, 17,300 villages were without water for drinking purpose. By 1972 this had increased to 35,000 and by 1985, nearly 70,000 villages are facing shortage of water for drinking purpose. Similarly, in Maharashtra 23,000 villages were facing scarcity of water in 1984. In Gujarat, the number was 64,565 in 1985. In Karnataka where the programme to provide drinking water facilities to every village was taken up on a war-footing since 1984, there are 655 villages, even today, without water for drinking. This shortage is attributed to depleting ground water levels in the low rainfall regions. In Maharashtra the ground water level has receded from 0.25 meters in 1982 to 4 metres by 1986. Similarly in Gujarat, the ground water levels have receded from 2 meters in 1976 to 5 meters by 1986. In Karnataka the recession is from one meter in 1980 to five meters by 1986. Therefore, there is a dire need to understand various factors that are contributing to the depletion of ground water and scarcity of drinking water.

India is endowed with different rainfall regions both in the quantity and pattern. The windward parts of the western Ghats and the Himalaya receive rainfall ranging between 3000-5000 mm within three months during the monsoon. Such a heavy quantum would be equal to the total rainfall on the city of London over five years (Jayal, N. D). Even this heavy quantum of rainfall in three months falls in heavy lumps spread over few hours. Such intensified conditions of rainfall imply seasonality of the input of water resources to ecosystems. If plant, animal and human life have to survive during the rest of the seasons, water that is localised during the few months in monsoon period must be conserved. Conservation of water for dry seasons involves two simultaneous processes.

In the plateaus of Deccan and Malwa, the great plains of North India, and the plains of Karnataka the rainfall is moderate ranging between 750 and 100 mms. Once rainfall is distributed over four months and several hours, the pattern is so varied that much of the annual rainfall may fall only in two to three months of a year.

Firstly, reduction of instant surface run-off when it rains during monsoon season and secondly, increase in infiltration and percolation/ensure availability of water even during dry seasons, as the water is localized by the above two processes. With the reduction in the instant run-off, the rate of infiltration the soil moisture and ground water gets enhanced. The enhancement of surface moisture and ground water assures perennial yield from the catchments, which, in turn assures perennial surface flow. This entire process is very essential to reduce the surface run-off and to recharge the soil moisture and ground water. By such a process, tanks ensured conditions for the survival of plant, animal and human life, even during drought-like conditions.

In India 69.8 percent of the net sown area lies within the rainfall of 1150 mm. Of this, more than fifty percent of the area is in an area where annual rainfall will be 750 mm (Table 1.1) (C.H.H.Rao, 1976). Therefore, it is very essential to conserve rainfall in these regions, if productivity in agriculture has to sustain plant, animal and human life. The appropriate technology that has been developed and maintained over the centuries are the 'tanks'. The percentage of area irrigated by tanks shows (Table 1.2) that they are dominating in those States where the annual average rainfall is below 1150 mm, especially in Karnataka they are highly prevalent in those districts or parts of districts where the rainfall is below 700 mm and are declared as drought prone.

At what particular period the tank system attained its full development, is now impossible to say, but by judging from the necessary conditions of its growth, the progress could have been extremely slow and most probably it expanded with the natural increase in population. It may be conjunctured that the first civilized inhabitants taking possession of the higher grounds, constructed the small tanks on the minor rivulets, and then step by step followed these down to the larger streams arresting and impounding the water at every convenient site by throwing earthen bunds across the valley (Hayavadana Rao, 1929). According to this plan, steady flow downwards from the watersheds of various streams to their extremities feeds a single series of several hundred reservoirs, linked together and forms a continue chain of works such that very little water falling on the catchments is lost in seasons of drought.

Green Way, a British engineer, notes that tanks were constructed by "....Rajahs or wealthy natives, are magnificent works, on a gigantic scale, furnished with cut-stone facings or revetment walls with enormous sluices, rich and adorned with sculpture, and with a mass of earth for an embankment, which almost be mistaken for a natural hill. These were evidently got up regardless of expense, as their originators had for object the attainment of religious merit by the execution of such works, quite as much as the acquisition of grain by the profits of improved cultivation they were, of course, lavish of ornament, and careful to ensure such solid work as should hand down their names to the latest posterity". (Green Way, 1986). These factors like religious merit and cause for posterity had led to the construction activity of tanks "....... to such an extent has the principle of storage been followed, that it would now require some ingenuity to discover a site for a new tank. While restoration are, of course, feasible, any new works of this description would within the area be almost certainly found to cut-off supply of another lower down and to interfere in fact with vested interests" (Sankey).