STATUS PAPER ON

Small Scale water Resources in Tamil Nadu

Problems and Perspectives

Nirmal Sengupta

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1
INTRODUCTION

In the case of Tamil Nadu it is difficult to differentiate between small and large systems. This state stands out from the rest by extensive bottom up approach in water resource development. Some of the modern systems had started as small-scale systems and have been developed over the years into large systems. Since we are also interested to learn how the small systems can be developed we must include those integrated systems too. Cauvery system is traditionally, a large-scale water appropriation system. But it has many tanks that must find mention in this paper. Even exclusion of groundwater from this study is not without practical problems. The interaction between surface and ground water sources concerns us. Besides, along the seacoast, small water bodies serve as protection against salt-water intrusion. Those too are included.

TYPES OF WATER BODIES

Streams/waterway

Small streams are tapped by various means, from collection of water in buckets to manual lifts. In recent years energised water pumps have replaced manual lifts.

Diversion structures/ anicut/ flood channel/ kal

Another method of appropriating flowing water in streams and natural drains is through diversion. Diversion structures vary from small checks – sometimes, just a few pebbles thrown along hilly streams, to large temporary obstructions (korambo) and permanent weirs (anicuts). When water flows through these streams those are diverted through channels to suitable spots. In perennial rivers such structures divert the regular flow. In non-perennial rivers only the high flows are diverted. The channels are then called flood channels. Irrigation may be effected directly from channels, indirectly through tanks, or by both together.

Springs channels and Springhead channels

These are diversion channels for appropriation of water from sandy river beds, which are quite common in northern parts of the State. Spring channels are channels dug in the beds of rivers to tap the seepage. They run long distances along the rivers but are not made as deep as the adjacent river bed. As a result water in the channels gradually rise above the river and ultimately reach the ground level being able to provide gravity irrigation. Springhead channels are formed in sandy soil connected underground with the seepage of rivers. A long pond, called kasam, is excavated in such soil below the level of the riverbed. River water percolates and fills up the pond. This is then taken through spring channels. Both of these are temporary channels and are filled up after flood flow in the river.

Tanks (Eri/Kulam/Kanmai)

The most common, and most well known of small water bodies in Tamil Nadu is of course the tanks. Tanks are three-sided semi-circular above-surface storage works. The peculiar geographical feature of Tamil Nadu permits construction of this kind of storage structure. The landmass has a gentle slope from the western hilly region to the coast. Rainwater escapes rapidly down the sloping terrain. This is arrested by constructing an embankment across the line of drainage, with two side embankments making a storage. The side embankments gradually lose their height because of the land gradient. Thus, the fourth side, the upper reach, may be left open for the run-off to enter while still retaining storage ability. From outlets located in the main embankment, water is drawn and directed through channels to irrigate the plots at lower levels. The difference between the gravity tanks and the dug out pond has mostly been overlooked. Ponds necessitate lifting of water, tanks do not.

System tanks

Sometimes the channels carrying water from diversion of rivers are so designed that they supply water to certain tanks. Such tanks, receiving water from river diversions, are called ‘system tanks’. The feeder canals too are used extensively for irrigation.

Chain Tanks

Feeder channels may also originate from tanks. Many tanks are so located that the surplus water of one flows down to be the source of supply of the next tank at a lower level. These are called chain tanks.

Temple Ponds

In Tamil Nadu each temple contains a tank. At the centre of each such tank there is a temple. But temple tanks are very different from irrigation tanks. These are four sided tanks. Unlike irrigation tanks, the fourth side is not left open. Instead, storm water courses, from catchments or to any other water source, are used to feed these tanks. All temple tanks have wells located in them, which connect them to the aquifers.

Ooranis/ Kuttai,

In some areas, where groundwater is saline, drinking water need cannot be met by wells. Surface water sources like tanks do not provide safe drinking water. Ooranis are found there. These are small ponds used specifically for storing drinking water. Some ooranis collect runoff water like tanks. But generally these are deep requiring lifting of water. Quite often a draw well is sunk in one corner of the oorani. Considerable care is taken for keeping the stored water clean. Some ooranis are protected by fencing. To keep the quality of water high separate ooranis are made for use of cattle. Ooranis for use of cattle are sometimes called kuttai.

Farm Ponds

Surplus runoff and groundwater is sometimes collected by constructing small ponds in the lowest point of the terrain. These are called farm ponds and are used for irrigation. Being privately owned farm ponds do not require community participation. But whether they can provide as much services as the tanks and checkdams is open to question.

Percolation Ponds

These are shallow ponds constructed across small streams or depressions to store the runoff water long enough to facilitate percolation and recharge of groundwater. They also act as silt traps, peak flood moderators and provide drinking water to the cattle. Sandy or rocky soil, which has good permeability, provides favourable conditions for the success of percolation tanks. They charge wells within a distance of 3 to 5 kms.

Silt detention tanks

These are smaller than percolation tanks and are used to retain silt.

Subsurface dam

An underground wall is constructed between two mounds, situated above or under the ground, at the bottom of as sloping field. Here surface and underground water is collected and may be used in various ways.

Swamps

Rainwater flowing to the sea often finds natural lowlands and form swamps. There are quite a few fresh water swamps near the sea although these are not as extensive in the eastern coast as in the western coast. Seawater may enter during tides. That can be prevented by constructing regulators at the gate of the creeks. Fresh water is retained in the wetland for a few months during monsoon. After the monsoon salt water may eneter from adjacent estuaries. These are leached out during the next monsoon. Vedaranyam Swamp is one of the most famous. Several others exist, some are known as tanks. Swamps are very suitable for aquaculture-agriculture purpose. Famous Kole, Khazan and Khar lands of the west coast are known for such practices. These are also the habitats for several birds and animal species.

HISTORY

Water control works must have started as small water bodies. In course of time they developed and became extensive. We know a little of the history of these smaller works, like tanks, anicuts and diversion works. Numerous prehistoric megaliths are usually found close to currently existing tanks, which suggests close association between them. Megaliths are dated to some 3500 years before present. So tanks must be as old as that. Sangam works like Purananuru used the name *kulam* for tanks. Later, from 7^{th} to the 9^{th} centuries, the name *eri* began to be used for tanks in Tamil literature (e.g. Nalayira Thiya Prabantham). In her poem 'Varappuyara' Avvaiyar sang praises of tanks. Inscriptions suggest that sophisticated tank and anicut construction were going on during the times of Pallava, Pandya and Cholas. In the Pandya region, major irrigation projects were carried out during the seventh and eighth centuries. The ninth century was characterized by the use of granite in place of mud and laterite in the construction of bunds, sluices, wells, troughs etc. Most records of the period, which deal with irrigation works, refer to the rebuilding or remodelling of bunds and sluices with stone. Certain improvements in the technical aspect of stonework in the case of construction of embankments and sluices of reservoirs are indicated by a few records of that period (Gurukkal, 1986). The use of chiselled blocks of stone instead of rubble and of a string line to set the stone precisely are the two notable improvements . The position and the depth of sluices demonstrate adequate knowledge of choosing the most suitable points and ascertaining the correct sill level. Aqueducts were used as in Pandian Kal. Great works like Grand Anicut and Gangaikonda Cholapuram tanks speak of the tremendous development.

Considerable development occurred during the later period. Nayakas improved water supply to many tanks by integrating them and rivers to construct system tanks. Sir Arthur Cotton, the most famous engineer of the eighteenth century wrote: "The natives have constructed tens of thousands of tanks in almost every kind of soil with earthen bunds without the puddle bank which English engineers have fancied necessary …". (viz. Mukundan, 1988 p. 7). Some other British officials felt there was no further spot where a tank could be made with advantage. Nevertheless, modern engineering knowledge brought by the British , found other spheres for further improvement. Modern technology could build larger dams, wider canals and stronger sluices. Extension occurred in areas where old technology could not succeed. Rivers were trained and system tanks extended. Even interbasin transfer of water could be attained with modern technology. But unfortunately, the potential of modern technology was not matched by compatible development of management. As a result it has brought more problems for the small scale water bodies.

2
STRUCTUARL FEATURES And CONTRIBUTIONS

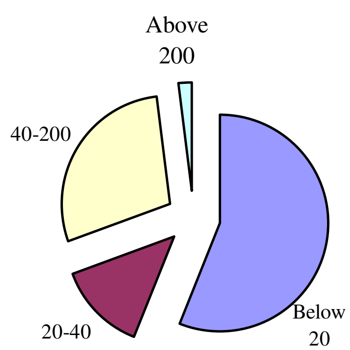
In this chapter we will discuss only the tanks, including the system tanks. This is because, tanks and feeder channels have been studied to some extent. Knowledge of other small water bodies is still very limited. An intensive discussion of one technique may help us to identify the many different dimensions of other techniques that should be brought out.

STRUCTUARL FEATURES

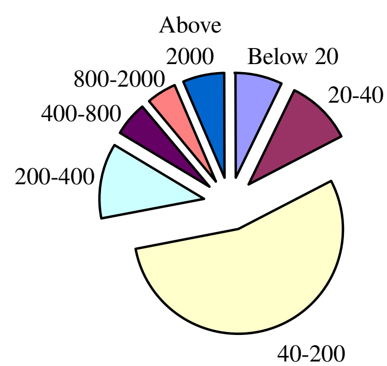
A tank comprises of: (a) catchment area, (b) feeder channels, (c) waterspread area (tank bed), (d) embankments, (e) outlets structures (sluices), (f) flood disposal structure, (surplus weir), (g) drainage channel, (h) command area.

Size Variations

As per PWD statistics there are above 39,000 tanks in Tamil Nadu. The ex-zamin tanks account for 25 per cent in number but only 10 per cent of irrigated area. Size distribution of these tanks is not available. The rest of the tanks have the following size distribution (by size-class of hectares irrigated, e.g. 40-200 ha.):



By Number



By Area Irrigated

Near the hills only small tanks are possible since a large embankment may easily collapse before the brute force of rushing water after a heavy rainfall. As one proceeds eastward towards the coast, the gradient of the land reduces. In these plains with gentler gradients there is much less danger of embankments collapsing. Bigger tanks are therefore, found closer to the coastline.

Embankments

Tank construction requires considerable technological knowledge about the topography, rainfall pattern and hydrological characteristics of the area. The curvatures of the tank bunds do not follow any random configuration but are designed to be concave to give maximum strength to the embankment. The wave action is the most dangerous sources of erosion and damage to the bunds. Stone facing on the inner wall as to minimize the wave action usually protects the bunds. Surplus water must be drained out. For this purpose, every tank has a surplus weir. Surplus weir structures are absolutely crucial to the safety of storage structures, including tanks.

In Bihar, many tanks have additional embankments dividing the tank beds in several compartments. Openings in these embankments permit flow of water from one compartment to the other. If the tank breaches the villagers rush to close the openings of the partitions. This prevents the complete draining of water, and also moderates the force of flood due to a tank breach.

Surplus Weirs

For disposing the flood flows in different geo-climatic conditions different types of waste weirs were used in tank structures. Those range from the natural ground escape to the multi-functional calingula type of weir. The calingula type of weir is one wherein cut stones (Dam Stone) are fitted at closer intervals on a masonry body wall. During the receding floods, the local communities close the calingula up to the Dam Stone level and are able to store water to the maximum extent in the tank. The advantage of the calingula type of weir is to store maximum water in the tank without affecting the safety of the tank. It serves (a) as surplus weir, (b) water sharing device in the case of chain or group of tanks and (c) a flood moderation structure at time of heavy rains. Even today viable alternatives could not be thought of for sluice plugs and calingulas (following Kallapiran and.Ratnavel, 1995). However, the success of this type of surplus regulation arrangements depends much on the community's participation and timely action taken by them in opening and closing the calingula to the required level at the appropriate time. In many places calingula type of weirs has been converted into high co-efficient weirs.

Outlets

Sluice designs vary from open cut Palmyra spouts sluices to masonry barrels with lime mortar covered with cut stone slabs, to the present R.C.C. hume pipe sluice barrels for sluice conduits. Regulating mechanism for drawing of water through the sluice barrels are also many. This includes open cut systems where water is drawn in an uncontrolled fashion. Subsequent to the masonry sluice barrels two types of control mechanisms are seen.

One is for the high level sluices where depth of water is less. In these sluices a masonry head wall is constructed in the tank side with a cut stone with three holes. The holes in the cut stone are manually closed by wooden plugs. The three holes in the cut stone look like that of a tiger's eye. It is commonly known as *Pulikan Madai*. When more water is required three holes are opened. At other times, only some of the holes are opened. In the case of deep sluices, the sluice barrels are extended to the deepest bed of the water spread to ensure maximum drawal of storage.

The other type consists of a rectangular cistern divided into two parts. The rear half is fitted with a cut stone with circular and rectangular vents. The rear half of the cistern is also closed by vertical cut stones. In other words, the rear half of the cistern is a closed chamber while the front half is an open one. The sluice barrel takes off from the rear cistern. It would be a problem to locate such sluice when the tank is full. As a remedy, stone pillars were erected by the sides of the rear portion of the cistern, with a guide stone across the holes. The operator was to swim to these pillars from the bank and to operate the sluice opening or closing with a help of plug and plug rod. The top shaped plug (Pambaram) provides an annular ring opening for partial lift and is capable of allowing varying discharges in accordance with the fluctuations in water level in the tank as well as for varying water demand. The present paddle shutters could not replace such facilities. The present tower head sluices with plug rod arrangement are an improvement of this kind of sluice. The tower head has been shifted close to the bund. Providing a leading barrel in front of the Tower head for sufficient length ensures the drawal of adequate water from the deep bed of tank (following Kallapiran and.Ratnavel, 1995).

Traditional sluices found in the tanks of Tamil Nadu can be classified in five types: 1) *mada*i, 2) *kumili*, 3) *mathagu*, 4) *thumpu and 5) kuyavan thal*. Farmers use these names to identify the different types of sluices available today. These names are still associated with irrigation related matters. For instance, irrigation workers-*niranis*- attached with *madais* and *mathagus* are known as *madai kudumban* and *mathagukaran* in parts of Ramanathapuram and Pudukkottai districts. In such a way, the local deities worshiped around *madai* are popularly called as *madai Karuppu* and *madai Muni*. *Kumili thulaval* is a well known phrase for clearing the accumulated silt in the *kumili* during last irrigation periods[1]. These ancient sluices are outstanding example of the engineering ability of Indian builders. A Sri Lankan expert had suggested that the ancient sluices be preserved just as any priceless artefacts of the ancient times are, and that international agencies be not permitted to intervene and destroy these marvellous structures and replace them with crude cement substitutes (cited by Mukundan, 1988).

Water Level Indicators

In many tanks there are excellent management methods for systematic distribution of water in years of shortage. All beneficiaries of the tank-in-short-supply decide together how much of the area cultivated can be successfully irrigated by the available water. By suitable organisational arrangement they irrigate only a part of their crops. In order to pursue such an efficient distribution method the users must have a good idea about the volume of water stored in the tank. In many cases this is now done by eye estimates. But in some tanks an old system of measurement still persists. Quite often the supporting pillars of the sluices were used also as water level indicators. These were marked with various types of symbols, indicative of the quantum of water collected.

Diversion Structures

These vary from spring channel and kasam types, to temporary korambos, checkdams and anicuts. Anicuts have found a place in the list of modern technologies and the technique has been greatly improved. But the purpose of different shapes and variations of traditional anicuts are not yet clear.

Channel constructions too have wide varieties. Channels are constructed in hills with arrangements for silt control, as resistant to flood flows, for smooth flow of water and with aqueducts apart from meeting purposes like equitable distribution. Channels were constructed to tanks, as feeder channels, and from tanks as distribution channels. Channels also provided direct irrigation.

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[1] Personal communications with Manimohan.

Division Boxes

Division boxes, determining shares of different rights holders in common supply channels is an important issue of irrigation management. Old types were mostly made of stones. Some of those have been replaced by modern regulators. The sizes of the openings of many distribution boxes are determined by judicial awards, following cases of conflicts and litigation.

Supplementary Wells

Although tanks provide gravity irrigation, much of the stored water percolates down. The water thus stored in aquifers is not lost in evaporation. During the time of water shortage farmers use this water to save crops. For this purpose farmers construct wells within the ayacuts. Palanisami et. al. (p. 26) in their sample study found that in most areas there are 60-140 wells per 100 ha. of command area. In the commands of functioning PWD tanks in the tank-intensive areas the density is low – about 30 per 100 ha. Another study (Vaidyanathan ed. P. 39) reports that well density in command areas of Periyar-Vaigai system tanks is even lower, 18 per 100 hectares on an average, but ranging from 2 to 75 per 100 ha. The study of Palar Basin (ibid, pp86-88) reports an average of about 50 wells per 100 ha. of commands of both system and non-system tanks. But the range varied from no well to above 100.

Integrated Designs

Conjunctive use of surface and groundwater is of considerable interest now. Conjunctive use of different techniques of surface water appropriation is also widespread in Tamil Nadu. Most of the traditional water appropriation systems are only apparently small. In reality, they constitute vast networks of smaller systems whose aggregate effects are comparable to modern major irrigation systems. Thousands of tanks together store as much water as a large dam. But those are constructed over a much wider area, and protect land not suitable for large dams.

A tank with an independent catchment is called 'isolated tank'. Chain tanks are a series of tanks located at different elevations which divide among themselves the entire run-off of a watershed. Often, each tank is so located that it receives surplus water of more than one tank instead of being totally dependent on one. Rivers and streams are diverted through canals for feeding tanks (system tanks). In those regions where the network of tanks is well developed, it is difficult to find an isolated tank which belongs neither to a chain nor to a system. This network has been developed slowly, over the years, by using advancement of technology in different periods. In case of the Tambraparani system tanks for example, the last anicut was built in the nineteenth century, and three reservoirs and two hydropower stations were added in the twentieth century. This unique system shows how imaginative use can succeed in a bottom up approach to achieve conjunctive use of small and large dams, of tank irrigation and hydel power generation. In general, modern dams and canals have been built without ever considering whether the existing traditional systems could have been developed.

In general, in centralised canal systems farmers do not always receive water when they need. This reduces crop yield. In contrast, farmers know how much water is available in their tanks well in advance to plan their crop practice, and can release water exactly when the palnts need. The system canals retain this feature, but enhance the supply by using modern technology. In fact, it has been suggested that productivity of modern canals, like the Bhakra canal, can be increased substantially by using the system tank principle (Mishra and Tyagi, 1989).

Duration of Storage

Most tanks contain water for about 3 months, some even less. Some of these retains water up to 9 months a year. The large tanks, with considerable depth can retain water for a longer time because they have less surface area per unit volume, and suffers less from evaporation. These are usually double cropped. However, even after drying up the tank beds contain sufficient subsoil moisture, worth cultivation of cash crops and vegetables. This is why there is so great interest in encroachment.

CONTRIBUTIONS

Cropping Pattern

Apart from rainfall regions the state can be divided into three regions by soil types: black cotton soil of southern districts, red-soil, gravely area of central region, and sandy tracts of coastal districts with laterite soils. There are differences in cropping seasons and patterns between these regions. Irrigated dry crop s predominated in rain-fed tanks in the black cotton area of the south. Long-duration crops were cultivated in the northern districts. *Sornavari* and *samba* are the cropping seasons in the northern districts, *kar* and *pisanam* in the southern districts. In rain-fed tank agriculture in black cotton area the crops grown are less water demanding crops like ragi, maize, kambu supplemented by cash crops like cotton, chillies and coriander. But these are slowly being replaced by short-duration HYV paddy, which has created stress in water supply. Also, water-intensive crops such as sugarcane, banana and turmeric are being grown with well supplementation. This has caused greater water shortage.

Productivity

Palanisami et. al (p. 116) estimates the rice yield of a sample of cases of tank irrigation in the state as:

Productivity of Rice (tonnes/ha)

Type	Head reach	Tail end
Pachayat Union tank	3.9	3.7
PWD tank	4.3	4.0

According to the Central Water Commission (CWC) statistics the average of yield of rice in irrigated land in different states of India varies between 1.5 to 3.5 t/ha. Average productivity of foodgrains in India in 1993-94 was 2.33 t/ha in irrigated land and 1.00 t/ha in rainfed land. Evidently, tank irrigation, though classified as rainfed cultivation techniques, has productivity higher than all India average of irrigated land. In fact, the data compares well with some of the best rice producing countries: with Vietnam or Indonesia (about 4.0 t/ha.), though less than that of countries like China, Japan or U.S.A. (more than 6.0 t/ha.)

Palanisami et. al. (1997: 8) estimated the relationship between rainfall and area irrigated by tanks. They did not find any significant correlation (correlation coefficient: 0.2-0.3), which means that irrigation performance of tanks depends on other factors, not on rainfall. This is significant since tanks are primarily dependent on rain and are rainwater harvesting structures.

Drinking Water

Scarcity of potable drinking water is acute in most parts of the state. Although groundwater is being used extensively for drinking pupose, surface water still accounts for a large part. Sourcewise data is not available. Major cities like Chennai use water stored in some tanks. Villagers often use well water for drinking which are replenished by tanks. The population in Ramanathapuram district of Tamil Nadu State (India) faces potable water scarcity throughout the year in general and acute drinking water problems in lean periods of the year. For them surface water is the major source. For safe drinking water ooranis are used. In coastal areas, groundwater has become saline in many parts.

Drinking water is essential for cattle and poultry too. These are almost always met by surface water sources.

Groundwater Recharge

As per the standards used by the Central Groundwater Board direct rainfall infiltration rate in most parts of the state is between 5 to 15 per cent of normal rainfall. This means that only about 5-15 cms. of water percolate in a normal year. This is augmented by the vegetation covers and the numerous surface storage works, big and small. As per the Board seepage from tanks is 44-60 cms. per year over the total waterspread area. Augmentation methods have increased utilisable groundwater potential of Tamil Nadu by about 50 per cent. Small water bodies contribute about a half of it.

The seepage from percolation ponds is higher than that of tanks. However, a study of percolation ponds in Coimbatore district conducted by TNAU shows that their performances have not been satisfactory, largely because of improper site selection. As much as 73 per cent of the state is hard rock area where percolation needs very careful site selection. Subsurface dykes for artificial recharge is being explored in Villupuram district.

Protection of saline water intrusion in coastal zone

Reversal of saltwater intrusion is virtually impossible. It would be more sensible to adopt preventive measures now. Water desalinisation is not a sustainable practice since it requires a lot of energy and can meet the needs of only a few – certainly not the needs of plants and wildlife. Small fresh water bodies like tanks and swamps for a protective barrier against saltwater intrusion.

Fisheries and Forestry in bed

In Tamil Nadu the social forestry project was launched in 1981 with SIDA assistance. More than 80 per cent of social forestry has been established in tank foreshores and bunds and became integral part of the tank system in recent years. Rules have been set by government for selection, planting, maintenance, harvest and sharing of income from social forestry.

Fishery is an important water based resource of tank system since the past. Fish Farmers Development Agency (FFDA) was established in 1982.

Other uses

There are various other uses of small water bodies. Tanks are used for bathing and washing. Ducks are reared with the help of tanks. Silt is used for various puposes.

Religious and Ritual Significance

What are the tanks? To experts and scholars tanks are physical structures. To the farmers these are sources of irrigation and drinking water, for people and cattle alike. Tanks are essential for carrying out household chores like washing, bathing, and grazing of cattles. Besides, tanks recharge groundwater and meet the needs of thirsty soil, produce fish, fodder, wood and timber. Tank soil can be used as manure and for making bricks. Tank sand can be used to construct houses. Ducks and pigs can be raised with the aid of tanks. Summer vegetables can be grown because of tanks. In summer tank beds may be used as threshing floors. Children swim in the water when tank is full and play in the tank bed when it is dry. Tank bunds serve as pathways for people and carts. Cremations are done close to tank bunds.

Tanks are revered. In temple centred Tamil society temple tanks were the focal point of activities. These tanks are still used for religious rites. Festivals are held during the monsoon months. Temple tanks are not used for agriculture and irrigation. But many irrigation tanks have a temple built at one end of the tank bund. The belief is that the deity will protect the tanks and the villagers from flood damage. Villagers worship and organise *puja* before starting the works like tank renovation. Sluices have often distinct identities with names referring to physical features, deities or persons associated. Quite often these are associated with demon deities or inferior forms of Shiva. Funds generated from tank resources, like fishery and forestry, are frequently used for temple purposes, celebration of festivals and charitable feeding of people in public feasts.

Farmers begin their auspicious functions and festivals by sprinkling of tank water. Agricultural activities start with devotional offering to structures like the tank sluices. However, the reverence to irrigation tanks is distinctive[2]. Cremation grounds are located near the tanks. Some believe these are places of peyes and picacas. Women are advised not to go to tank bed in the night.

Tanks and small water bodies are important not only to human beings but to all living beings. They support the animal and plant life found in the village, the wells, agriculture, aquaculture, animal husbandry, social forestry, etc. Tanks are central to the whole ecosystem.

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[2] Personal communications with Bettina Weitz.

CBSR Sharma studied the wetland systems around 6 tanks and identified a total of 273 plants and 223 animal species. Each water body harboured 50 to 163 types of plant species and 86-187 animal species, the richer are the ones with remnants of natural vegetation. Many medicinal plants occur around the water bodies as well as other plants useful as hedges, soil binders, fuel, food, fodder, fertiliser, and thatching and weaving materials. Some of the tanks support 10-30 migratory bird species. Many butterflies and other fauna are supported by tanks.

3
CURRENT STATUS

Number

In the past there were about 132 spring channels feeding 5.6 thousand hectares and 101 Kasam channels irrigating of 2.4 thousand hectares in Palar basin.

There is no definite statistics about the number of tanks. The number reported by the PWD differs from that recorded by the Revenue Department. The data given by the Minor Irrigation Census for number and area irrigated are considerably less than the PWD figures.

Types of tanks	Ayacut size (ha)	Agency in Charge	Approx. No.	p.c. of total
System tanks	Any size	PWD	3,600	9
Rainfed tanks	above 40	PWD	5,300	14
	Above 20 below 40	Panchayat Union	3,900	10
	Below 20	Panchayat Union	16,500	42
Unclassified	Any size	Undecided (Ex-zamin tanks)	9,900	25
All	All sizes	Total	39,200	100

Typical villages of Ramnathapuram and Sivaganga have two ooranis each, one for cattle and washing, and the other exclusively for drinking.

For other small water bodies no compiled data is available.

Area Irrigated

Irrigation sources like streams, swamps or springs should be collected under the general head ‘irrigation from other sources’. But it is doubtful how many different categories were included and included consistently. In the sixties, above forty thousand hectares were shown irrigated by these sources. As much as 62 per cent of this was in the old North Arcot, South Arcot and Chengalpattu districts. Another 34 per cent was to be found in old Salem, Coimbatore, Tiruchirapalli and Madurai districts. In the northern districts, in old North Arcot, South Arcot and Chengalpattu, these sources have almost disappeared.

Tank irrigation now accounts for about 6.75 lakh hectares. System tanks are rare in Salem, Namakkal, Dharmapuri, Erode, Coimbatore, Ramnathapuram, Virudhnagar, Sivaganga, Kancheepuram and Thiruvallur. On the other extreme, most of the tank irrigated area in Thanjavur, Thiruvarur, Nagapattinam and Kanyakumari are from system tanks.

Canal irrigation is available over 8.38 lakh ha., more than a half of this is from the Cauvery system. But many other canals are small canals or parts of the system tanks. On a rough estimate they irrigate about 1.5 lakh hectares.

DECAY

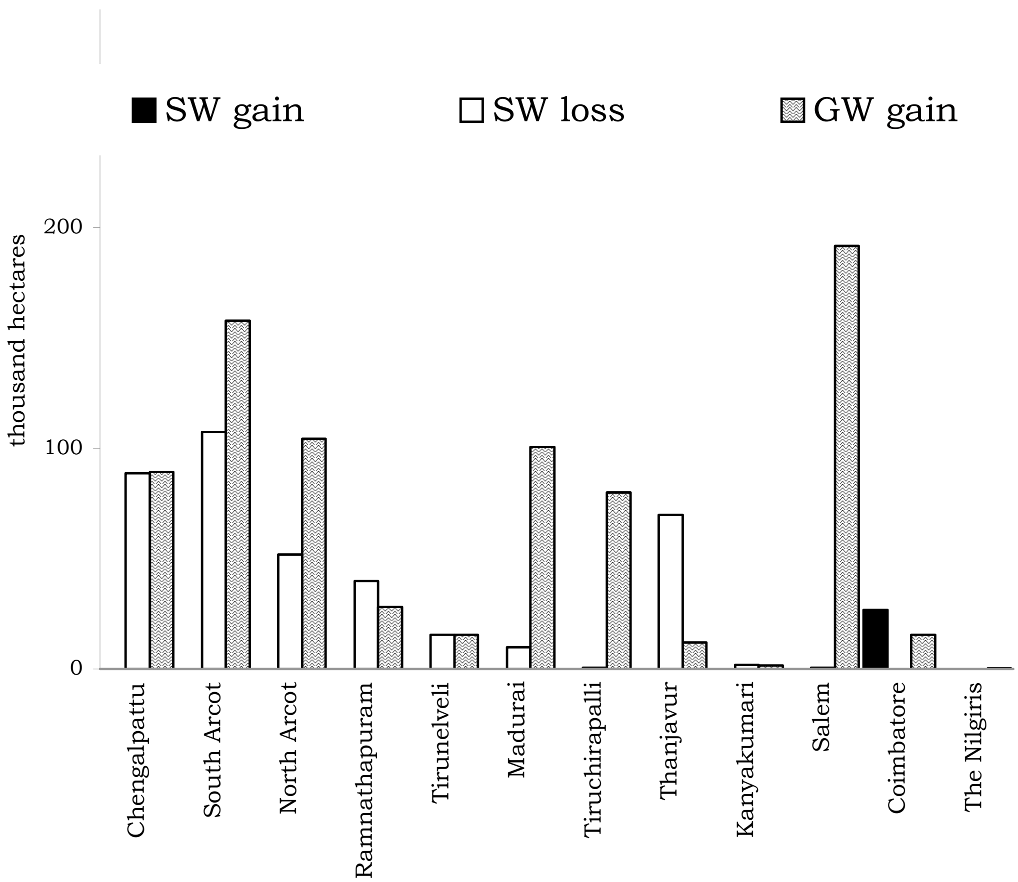
Most of spring channels and springhead channels have ceased to exist because of widespread pumping of river water. Most temple tanks are now short of supplies because of the decay of the supplying storm water drainages. The catchments have been occupied by settlers, whereupon sewage flows into the tanks. Most of these tanks are now filthy and human excreta covers the steps that lead to the water. Concretisation of the bed in some of the tanks has further hampered the seepage. Ooranis and kuttais have silted up.

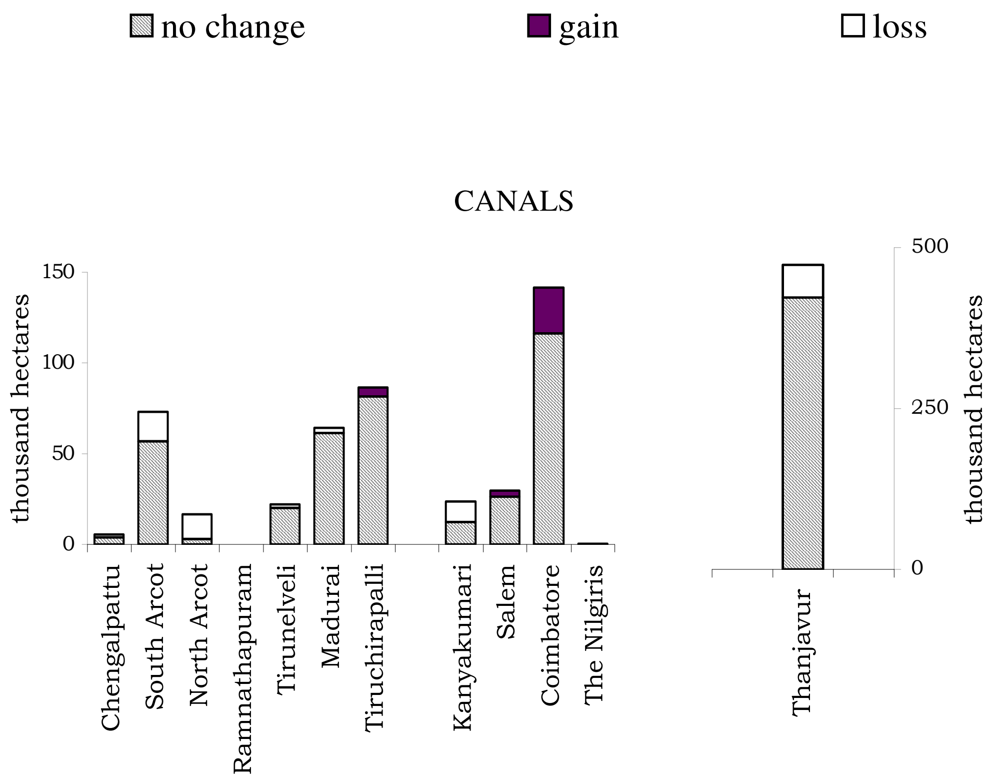
Reduction in Irrigated Area

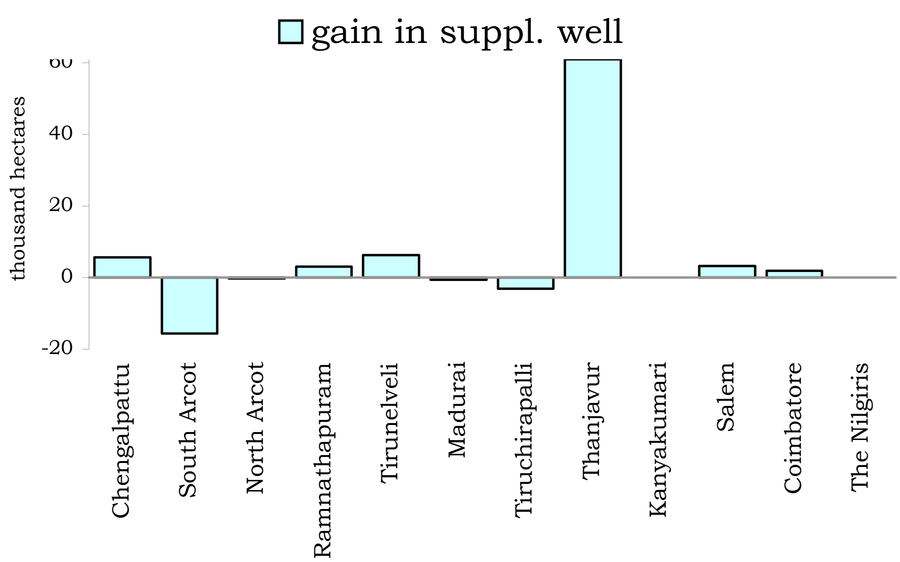
Surface water sources are decaying rapidly after the nineteen sixties. Data is available only for irrigation sources. For comparison, we have compiled the data by old district boundaries. As will be evident, only for old Coimbatore (present Coimbatore and Erode) district, total surface water irrigation has increased in this period. For some others, groundwater extraction has compensated the loss. The loss of canal irrigation facility in Cauvery system (old Thanjavur: present Thanjavur, Thiruvarur and Nagapattinam) has not been compensated by extension of groundwater irrigation. Instead, farmers have constructed numerous supplementary wells to meet uncertain supply of canal irrigation. Another region that has suffered is old Ramnathapuram (Ramnathapuram, Virudhnagar and Sivaganga). With diversion of Vaigai river tributaries for Periyar-Vaigai scheme the downstream supply of tanks in the tail-end region of the river basins have diminished. Since groundwater is saline over most parts of this region loss of surface water sources of irrigation has not been compensated by groundwater. The next set of figures show the source wise situations. The loss of canal irrigation shown by many districts is actually the loss of traditional surface canals. In tanks and other sources, most districts have suffered.

CHANGES IN IRRIGATION PATTERN BETWEEN 1962-63 AND 1997-98
BY 1962-63 DISTRICTS

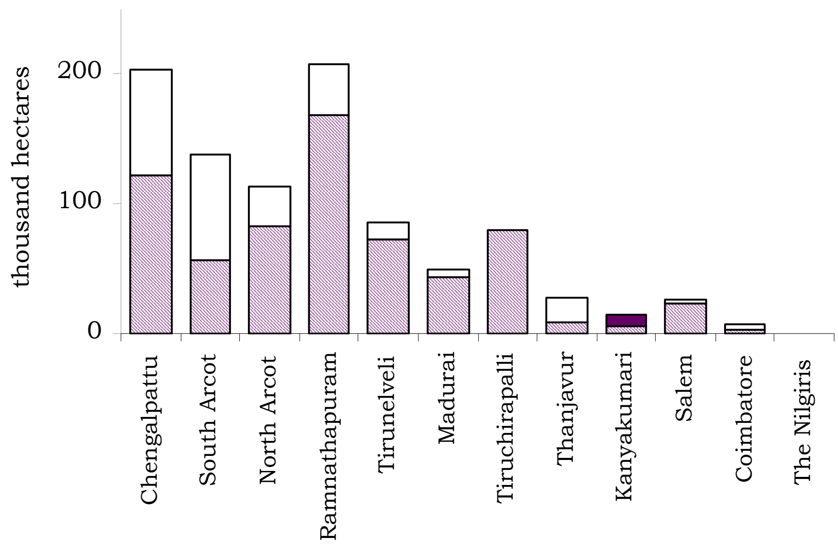
ALL SOURCES



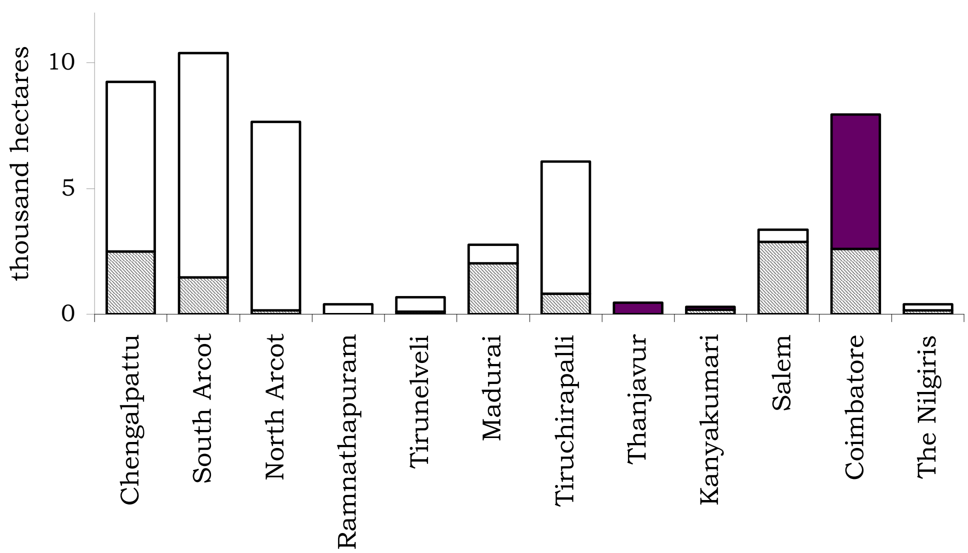

no change
gain
loss
CANALS
thousand hectares
150
100
50
0
Chengalpattu
South Arcot
North Arcot
Ramnathapuram
Tirunelveli
Madurai
Tiruchirapalli
Kanyakumari
Salem
Coimbatore
The Nilgiris
500
250
0
thousand hectares
Thanjavur


gain in suppl. well
thousand hectares
60
40
20
0
-20
Chengalpattu
South Arcot
North Arcot
Ramnathapuram
Tirunelveli
Madurai
Tiruchirapalli
Thanjavur
Kanyakumari
Salem
Coimbatore
The Nilgiris

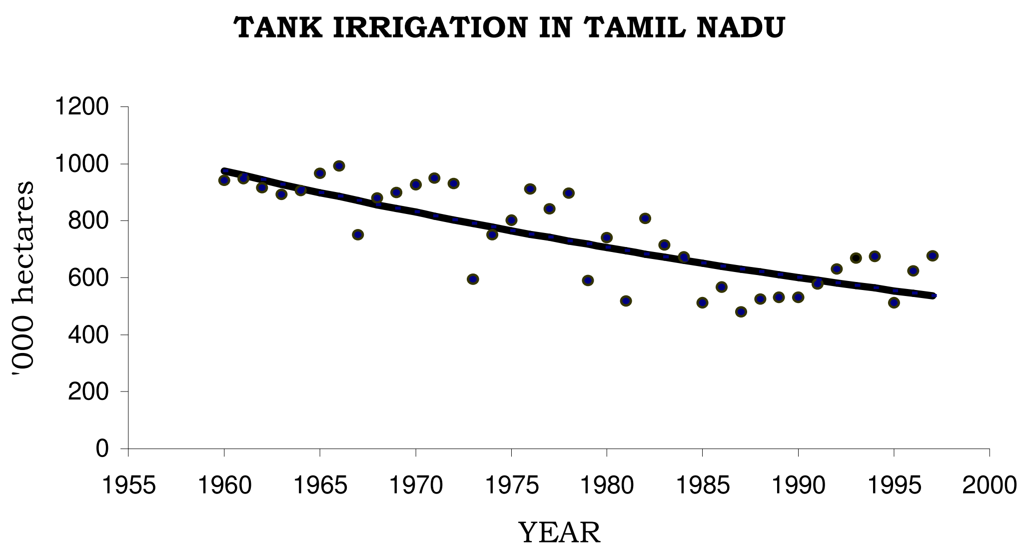
TANKS



OTHER SOURCES



The following graph shows the trend of tank irrigation in the state. On an average, area irrigated by tanks of Tamil Nadu is decreasing at the rate of 1.6% per year. At this rate its extent reduces to a half in each 43 years.



It is necessary to be warned of a possible pitfall. If from the macro- picture of reduction in area irrigated one expects to see the same pattern repeated in every local situation one may fail to appreciate farmers' abilities. In some places farmers have responded in ingenious ways to negate the rising problems. An increase in area irrigated in spite of reduction in water supply is possible, when farmers changed to well irrigation and less water-intensive crops, or use water judiciously. In several case studies Vaidyanathan (2001, p. 156) observed that a large section of the tanks studied had actual irrigation more than the registered ayacuts.

Defunct Tanks

Through a sample enumeration of tanks Palanisami et. al. (p. 27) estimated that 64-76 per cent of tanks in the districts where tank irrigation was not intensive, e.g. Coimbatore, Erode, Salem, Thanjavur, have become defunct. In the districts with intensive tank irrigation, e.g. Chengalpattu, North Arcot, Sivaganga or Tirunelveli, the picture is not so bleak, only about 1 or 2 per cent of tanks have suffered this fate. However, functioning tanks too working much below their capacities for various reasons. Only about 1500 tanks have become totally defunct in the state. This does not account for a substantial part of the reduction in area irrigated. Even the functional tanks have lost irrigation capacities due to various reasons like loss of water supply or reduction of storage capacity. Systematic data is not available for any of these issues. In the next section we will introduce these problems largely through descriptive accounts.

Tank breach and Flood

Reduction in irrigated area is only one indicator of decay. Poor maintenance of tanks is reflected in tank breach and consequent flood.

Drinking Water Facility

In many places surface water bodies still provide drinking water. But in many others it has been replaced by groundwater extraction. In Ramanathapuram district, where groundwater is saline, potable water scarcity persists throughout the year and drinking water problem becomes acute in lean periods of the year. The decay of surface water sources like the ooranis is the major reason.

Groundwater Decay

Spread of groundwater extraction might have compensated for loss of surface water sources. But its effect has not been very good. Excessive extraction of groundwater leads to aquifer depletion. Deterioration of surface storage facilities have reduces groundwater recharge. In most parts of Tamil Nadu the groundwater level has gone down. 14% of blocks in the state are over exploited (above 100%), 11% are dark blocks (85-100%). Efforts are being made to promote new small water bodies for groundwater recharge, like percolation ponds. Encouragement is being given to rainwater harvesting. But these are on a nominal scale, and with limited success.

Contamination and Pollution

This is a rising problem. The agriculture run off from the command area contains pesticides, herbicides and fertilizer residues, which affect the quality of all surface water sources. Industrial pollutions are restricted to some areas, but are severe there. Tanneries in Vellore district discharge effluent in Palar river and adjoining lands affecting 20,000 ha. of land. Tiruppur industries are discharging effluent in Noyyal river, and dyeing industries in Kalingarayan channel. And so on.

REASONS FOR DECAY

Loss of Supply including Water Theft

Various reasons like diversion of supply sources to other uses, contraction and deterioration of catchment area, or siltation and encroachment of supply lines have reduced supplies to several tanks. With every phase of planned improvement of the Periyar Vaigai system the farmers of Madurai, Virudhnagar, Sivaganga and Ramnathapuram are deprived of the supplies to their tanks received from time immemorial, through feeder canals from Vaigai and its tributaries. Political pulls often favour one channel at the cost of the rest. Availability of pumpsets has led to extensive use of water lifting. It has also given rise to unauthorised lifting. The spring channels of Palar basin have dried up largely because of indiscriminate pumping of river.

Urban Extension

The Chennai Metropolitan Area had 124 tanks, most of which were system tanks. Most of these tanks have been acquired for housing. In several parts of Chennai city salt water from sea has intruded to nearly a kilometre from the beach.

Siltation

In the 1950s Planning Commission, on the basis of a survey of 125 tanks, noted that 16 tanks had silted more than 50%, 51 tanks between 25-50%, 50 tanks between 10-20% and 8 less than 10%. Whether this is reliable or not, it gives an idea of the extent of siltation. Villagers are often conversant about the extent of siltation.

Encroachment

There is an incentive to encroach the fertile foreshores of waterspread area. Encroachment also occurs in supply channels, areas, tank beds, tank bunds and field channels. A survey of 62 tanks in old Ramnathapuram district in 1990 found that on an average 26-30 per cent of the tank water-spread area has been encroached by farmers (Palanisami, Meinzen-Dick and Svendsen, 1994: 131-2). The normal process of law serve more often to encourage, even legalise encroachment rather than prevent it. Indeed, the government legalised the cultivation of foreshore lands (lands on which there was standing water for less than 21 days) in 1971 and issued kulamkorvai pattas (foreshore land titles) where 'encroached' land has been cultivated for 15 years or more. As against this, illegal encroachments can be removed only after prolonged efforts and considerable expenses.

Evaporation losses

Evaporation loss is inevitable. But it can be reduced by various methods. Loss of depth of tanks due to siltation increases the surface area of water per unit volume. It increases evaporation loss. It is also possible that many tanks have lost green covers around them which would increase evaporation rate. However, social forestry programmes are carried out mostly on tank embankments.

Decay in Structure

It is now a common site to see a tank whose bunds are damaged or weak. In many tanks surplus weirs are damaged. Sluices and shutters often leak, in some those are altogether missing. Cultivation in tank foreshores commonly creates tension between upstream farmers concerned to protect their crops from inundation and downstream farmers aiming to maximise water storage in the tanks. Often the farmers of these flooded land surreptitiously open the downstream tank sluices at night, cut the tank bunds, or break overflow weirs in order to lower the water level, which often results into conflicts. Such conflicts often involve mediation by junior revenue officials to set standards of FTL. It is not unknown that the FTL was lowered to favour encroachers (Mosse, p. 47).

Loss of Tank bed cultivation

In addition to these known avenues of decay of tank irrigation another one, which happened probably a century back, need to be added. In Magadh region of Bihar tank foreshore is still used for producing a rice crop in kharif season and good cash crop in rabi season (Sengupta, 2001: 182). In monsoon seaseaon tall variety paddy is grown which rises over the water contained in tank bed. After monsoon good cash crops are produced in the tank bed rich in subsoil moisture. This is going on year after year, over an extensive area, without any fear of encroachment of foreshore area. In an ingenious method of property ownership the farmers ensure that the tank bed retains in primary function as storage and is not encroached by cultivating farmers. In Ramnathapuram district tank bed cultivation was extensive under the zaminadri system, which survived till the nineteen sixties. Adiceam (1966), who had studied these tanks at that point of time mentions that the tank beds in Ramnathapuram were cultivated using the sub-soil moisture remaining after the monsoon season. This practice was forcibly stopped by the PWD after it got involved in Ramnathapuram tanks, once those became ex-zamin tanks (for details see Sengupta, 1991: 111-113). It is possible that in other districts, where the PWD has been involved for long, this practice was stopped earlier. Considering that the tanks are shallow structures and a tank bed occupies just a little less area than the ayacut served by it, several lakh hectares of tank foreshore area have ceased to cultivated. Where foreshore area is cultivated, it is by encroachers, and the tank has lost its capacity in this case.

4
MANAGEMENT

Division of Responsibilities – Past and Present

When the British took over, they settled different parts of the state under different settlements. In zamindari settlement areas along with land, tanks and other common properties were settled with zamindars. The communal management of tanks survived in these areas behind the zamindars. After independence, these tanks have been taken over by the government and are known as 'ex-zamin tanks'. In several other regions The British introduced ryotwari system, a system of direct settlement with the farmers. The intermediaries being dispensed with, and in the absence of any modern notion about communal ownership systems, there was no other way but to assign the ownership of common properties to the government. This is how the government became the owner of the tanks and the likes. Ultimately this led to the formation of the Public Works Department. This does not mean that this alien system of management achieved any great success. But with the colonial power modern engineering inputs made their first inroads to tank system. Large new anicuts, which could not be built with the old technology, were made on Tambraparani, Palar etc. Reservoirs were added, even interbasin transfer was arranged. In contrast, in zaminadri areas, there was not much technical progress, but communal management survived to some extent.

Understandably, some examples of good management may be found from the old history of Ramnathapuram district or from ex-zamin tanks of other parts of the country. In Tamil Nadu in contrast, we have some excellent examples of achievements of modern technology in the spheres of tanks and anicuts. But this was not matched by thoughtful innovations in management. During the colonial days a division of responsibility had emerged between the PWD and the Revenue Department. It has been formalised in later days. The Water Resource Organization (WRO, formerly PWD) maintains system tanks and tanks with irrigable area above 40 ha. The Rural Development Department (RD) manages smaller tanks, by allocating maintenance grants to Panchayats. These are therefore, known as Panchayat tanks. Nearly 25 per cent of tanks were in the zamindari areas in the past. Their status is not yet decided. Village Panchayat are also responsible for maintenance of other small water sources like Ooranis or Kuttais.

People's Management

It follows that farmers themselves are required to manage substantial parts of the small scale water bodies. Even for WRO tanks, the departmental responsibilities end at the sluice level. Down the sluices all tasks are to be done by the beneficiaries. In some system tanks laskars are not found to carry out this task, farmers themselves operate the sluices. In other tanks and other small water bodies Panchayats have the statutory responsibility.

In this brief space it is not advisable to introduce farmers management, even in brief since that would tend to oversimplification. There are some excellent studies. In some areas farmers are well-organized, in some others they are not. It seems that organizations exist in most of the tanks which receive somewhat regular supply, it is weak or broken in those which do not receive water regularly. As for the forms of organization, Panchayats themselves often carry out the responsibilities. Some others have Farmers' Associations or Water Users Associations. Some of the water users associations have long tradition, like the Oppidi Sanghams of Thoothukudi (viz. Sengupta, 1991: 138-149). Lately, NGOs have started facilitating formation of farmers associations. DHAN Foundation in particular, has been working in this area for a long time and with considerable success.

Farmers' management of water bodies has a long tradition in Tamil Nadu and have a rich repository of imaginative and efficient management practices. To name a few, appointment of water distributors (neerpaichy, neerkatti, neerani) is a widespread practice. So is kudimarammath, or communal labour, for regular maintenance. There still exist equitable allocations systems during the times of scarcity, like the kandavettu system (Sengupta, 1991: 130-132, 141).

Exemplary Participatory Management

The system tanks are also modern canal systems. Lately, participatory management is being promoted for modern canals everywhere. In the bottom up approach adopted in development of system tanks in Tamil Nadu traditional farmers' organisations around tanks were never threatened. Instead, that had turned these canal systems into some earliest examples of participatory management cases. In the Tambraparani irrigation system, one of the earliest modernised systems, the joint management concept is in effect for almost a hundred years. It has registered some great achievements which are worth emulation. Detailed discussion is not possible here (see Sengupta, 1991). I will describe just one aspect showing the extent of participation.

This system, which was originally some isolated tanks, have been so very improved by imaginative use of advanced technologies in pre-colonial, colonial and very recent periods, that now it generates hydropower in its upper reaches. One of the major complaints of multipurpose projects is that the stored water is used to meet primarily, the need of power generation. So farmers do not get water when they need. But in Tambraparani system this problem has been eliminated by some excellent systems of information sharing, mutual responsibilities and accountability of both the administration and the farmers. The Tamil Nadu Electricity Board too releases some water during the summer season, from the two reservoirs for hydropower generation, the Papanasam and the Servalar reservoirs. But the farmers are informed well in advance. In turn, the farmers downstream in the command area have advanced the cropping season here by two months before the rainy season, in order to avail this water. The crop is therefore locally called 'advance kar' (Sengupta, 1991: 139).

Water Rights

(a) On Water Sources:
It is rather surprising that farmers spend substantial amount for construction of wells and tubewells, but rarely do so for common for surface water bodies. The reason is simple. Farmers do not enjoy any property rights on surface water sources. Investing in something that may be diverted, appropriated or declared illegal by the government is a foolish step. This is not an exaggeration. Recently, the Tarun Bharat Sangh was awarded the Magsaysay award for its tank-like constructions in Rajasthan. But the State Irrigation Department has engaged it in a legal battle declaring their constructions illegal. Thousands of tanks that received their supplies through feeder channels from Vaigai and its tributaries had no water

rights over those. They cannot contest the gradual improvement of Periyar Vaigai irrigation system, which is gradually depriving them of the supply they have been receiving for hundreds of years. The farmers do not have any legal right, in spite of such a long uninterrupted possession. The following story will enlighten how popular initiative has been curtailed here in a sustained manner.

In 1867 it was proposed to construct the eighth anicut on river Tambraparani. The potential beneficiaries had collected on their own Rs. 30,000 for aiding the construction. The government was facing financial problem and ultimately, could not construct the South Main Channel as originally planned because of dearth of fund. Yet, it did not use the fund donated by the farmer on the ground that in future, the beneficiaries might use this as a plea for reduction of rent. Instead, the fund was used to construct a road above the anicut (Sengupta, 1991: 138).

(b) Below Sluices:
For systems tanks or tanks benefiting several villages rights are defined below sluice levels. Many such tanks have rotational (murai) registers. In many cases sizes of division boxes are also protected by judicial awards. Rights have been granted after water bodies enter a village, although there is a hitch here. The Tamil Nadu Panchayat Act, 1958 had a provision by which small water bodies vested with the Panchayats. The Panchayat Act, 1994 has eliminated this provision. This is in spite of the fact that the Union 73rd Amendment added a special schedule (Eleventh Schedule) by which all common property resources, including these bodies, should vest with the Panchayats.

(c) Amongst Beneficiaries:
Within the villages the farmers' organisations determine the water rights. These may not have any legal sanction, but are often imaginative and equitable. For example, DHAN Foundation listed the following kinds of water rights existing in Ramnathapuram district:

a) water rights to all families, including landless families
b) water rights to command area farmers and sale to farmers outside command area
c) water rights only for command area farmers.

By using ingenious property rights arrangements farmers may even allow extensive tank bed cultivation without the fear of encroachment[3]. Probably, the practice of tank bed cultivation existed in Tamil Nadu before the government restricted it. In some parts it lasted until recently, like in Ramnathapuram district settled under the zamindari system. Every year the Revenue Department used to distribute temporary pattas for cultivation of tank beds. Government reports in the 1950s document official objections against continuation of this practice. After zamindari abolition the engineering wing of the PWD had taken over the tanks from the Revenue Dept. PWD was determined to stop tank bed cultivation on the plea that the department was not getting enough time for undertaking desilting work, which, they never did. For ten years there was a tug of war between the unrelenting farmers and the PWD. The Planning Commission recommended a high penalty tax. Finally the government succeeded. (Sengupta, 2000, pp. 157-8).

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[3] for details of the property rights system supporting this see Sengupta, 2001: pp. 192-193.

Water distribution

While a water right is merely recognition of who should get water, the distribution system realises the rights along with efficiency in water use. Wasteful field-to-field system is extremely rare in Tamil Nadu. Distribution is done mostly through channels. The wide variety of systems found is:

i. Open system: entire distribution network carries water and the farmers are free to use as much water as they need.
ii. Murai system or fixed-time turn.
iii. Oru Madai Paichal (single channel) system: rotation between channels.
iv. Pangu (share) system: In earlier days some priority rights were traditionally given to certain families in the village. Plots in one pangu were not necessarily contiguous. This results in loss of water. Now pangu on contiguous land is more popular.
v. Kandavettu system: practised during scarcity. Depending on water availability villagers decided that only a part of the ayacut could be successfully irrigated. Each farmer encloses proportionate part of his holding and the waterman irrigates.
vi. Irrigation from tail-end: Because of conveyance loss tail-enders do not get enough water even if all farmers are granted same quantity of water. It may be desirable to start from the tail end. Not known in Tamil Nadu.
vii. Night irrigation and equity: night irrigation is practised. But whether some are favoured by the day irrigation privileges is difficult to ascertain.
viii. Priority for drinking: in water scarcity: Some villages still have this custom. When there is very little water in the tank villagers decided to use it only for household works and cattle drinks, collectively refraining from irrigation use.

Water Market

Water market for surface water irrigation sources is restricted to lift irrigation (legal or illegal). In tanks, during scarcity periods, well owners sometimes sell water to farmers not having wells. Drinking water of course, has a large market in urban areas.

Increasing Reliance of groundwater

The overall strategy of development needs also to be taken note of. Since 1950s irrigation from private wells have been actively encouraged through subsidised institutional credit and free electricity for pumping. Treating tanks as sources of percolation to be used in conjunction with wells promised efficiencies in reduced evaporation and conveyance losses, flexibility and timeliness of water inputs and security in times of drought. But greater dependence on wells has not always matched with interest in upkeep of tanks as percolation storage. The reduction of replenishable groundwater due to deterioration of tanks and water bodies, coupled with intensive use of groundwater has already resulted in falling groundwater level. In water deficient villages where community control is not strong, farmers may lift tank water over ineffective and poorly maintained tank sluices or sink open wells into the tank beds.

Farmers using groundwater are not keen to maintain the tanks, or are willing to free ride expecting others to take care of the tanks. Indeed, in extreme cases, even conflicts over this issue are not unknown since well-users are interested in maximum percolation and tank users in maximising storage. However, there are conflicting observations. It has also been reported that well use often decreases in years of good rainfall when surface water is sufficient. Farmers too prefer muddy tank water containing silt than well water. Rajivan reported an increased interest in tank maintenance with extension of well irrigation (compiled by Mosse, pp. 50-52).

Tank Desilting

One of the major requirements is to restoration the existing tanks and other small water bodies to their full capacities. Desilting of ooranis of field channels is much easier, that of the tanks difficult for various reasons. Two methods have been tried for restoration of tanks: desilting of tanks beds and raising the full tank level (FTL). Desilting is not economically viable and has other problems. Raising the FTL is a better strategy for economic and environmental reasons, but cannot be used since adequate vacant space is rarely available in the foreshore. However, the government has banned this practice in the name of prevention of uncontrolled digging in the tanks.

Records and Documentation

When the colonial government became owners of the common properties as a consequence of ryotwari settlement it did not know where its properties were. In a sustained effort of more than fifty years, by the 1880's they could release a complete list (Madras, 1885) of nearly thirty two thousand tanks, existing in the raiyatwari areas. This list had a footnote, "In addition to the works included in this statement there are a large number of private tanks and zamindari tanks, with which the irrigation branch have no concern" (Madras, 1885; 406). But a mere list would not help technical works of maintenance and improvement. This led to the hundred years exercise of preparation of individual Tank Memoirs. This is the most detailed data source of tanks. Unfortunately, most of the information is outdated. Some updating has been done for tank modernisation schemes.

In addition, Agriculture Dept. collects Land Utilisation statistics on an annual basis. This shows source wise irrigation. But the only distinct category of small surface water bodies available in this data is that of tanks. Others are merged with different categories. Minor Irrigation Census was done more than a decade back. But its data is of very poor quality and content and is of little use. No compiled data is available on a regular basis for use of water bodies other than irrigation. For specific problems, small sample studies have been done. Detailed data has been collected for a few tanks under the Tank Modernisation schemes. Recently, some efforts are being made to use satellite data for small water bodies.

5
IMPROVEMENT

We will introduce only the agencies involved – it is not possible to summarise the numerous improvement efforts that are being made.

The bulk of the plan outlay in Tamil Nadu till the early 1980's was on the Special Minor Irrigation Program (SMIP). Apart from tanks this programme had specifically addressed the spring channels and flood channels, and also reclaiming of swamps. Minor irrigation works are now funded under several programmes – Irrigation, Integrated Tribal Area Programme, DPAP, Special Programmes for Scheduled castes and Scheduled Tribes, Tamil Nadu Water Supply and Drainage Board (TWAD), Watershed development programmes etc. NABARD has started extending financial support for community works. External Agency involvement started since 1980s, with EEC and Tank Modernisation programmes. World Bank and the Japanese Govt. have also been inducted. RD conducted a pilot program for tank rehabilitation in Dharmapuri district with ILO collaboration. However, there is little coordination between these plethora of activities. There is no clear policy about improvement of small water bodies. Although tanks account for substantial part of irrigation in the country there is no central or state policy. There is no master plan for the state working out how small and large, surface and ground water bodies can be developed together and in a balanced manner.

In addition to the government departments, IMTI, Anna University and DHAN Foundation are very active in development of small water bodies. The government does not provide much support for data collection, intensive studies or technical development of these sources. However, stray popular initiatives have by now, created a significantly rich corpus of knowledge, some of which have been culled in this paper. DHAN Foundation has started water literacy programs.

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