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A Rehabilitation of Irrigation Tank through Sustainable Agriculture Productivity – A Case Study in Bahour Commune at Puducherry Region

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Abstract

Tank irrigation systems of India are century old. Most of the tanks have, over time, degraded into open access resources due to weak property relations. About 2% of the tanks in the tank less intensive region and 67% of the tanks in the intensive region have become non-operational. The tank irrigation system have provided support for the livelihood of the rural communities and have to be restored and conserved as an economic assets, especially for the poor and marginalized communities in the under developed areas. The tank irrigation system has a special significance to the marginal and small-scale farmers who make a very large number essentially depending on tank irrigation system. Development of tank irrigation system not only increases the storage

capacity, it also protects and conserves the environment and contributes to village livelihood security.

The objective of this study is to improve tank irrigation and sustainable agriculture productivity and decrease the deep dependency of tupewells and thus the arrest the sea water intrusion. Hence this paper concludes that tank irrigation system is very much important for achieving long term sustainability of agriculture productivity.

Key words: Rehabilitation, Tank Irrigation, sustainability.

Tank irrigation system contributes significantly to agricultural production in the parts of South and Southeast Asia, especially in south India and Sri-Lanka. Tank irrigation system has a long history and many currently used tanks were constructed in the past centuries. In India, the largest concentration of tanks is found in the three southern states of Andhra Pradesh, Karnataka and Tamil Nadu and the Union territory of Pondicherry, which account for nearly 60% of India's tank-irrigated area. Tank irrigation system are the traditional irrigation common situated in many parts of Indian sub-continent to capture monsoon runoff in the arid and semi arid areas. Tank systems, developed ingeniously and maintained over the centuries, have provided. Insulation from recurring droughts, floods, vagaries of the monsoon, and offered the much needed livelihood security to the poor living in fragile semi-arid regions. Conserving the tank eco-systems for Minerals multiple uses such as irrigation, domestic and livestock use and groundwater recharge is a way to provide a safety net to protect the livelihood of millions in a semi-arid India. These tanks have many special features.

Tank irrigation system

An irrigation tank is a small reservoir constructed across the slope of a valley to catch and store water during rainy season and use it for irrigation during dry season. Tank irrigation systems also act as an alternative to pump projects, where energy availability, energy cost or Ground-water supplies are constraints for pumping. The distribution of tanks was quite dense in some areas. However, the tanks have helped in recharging groundwater, provided crucial irrigation for crop production, functioned as a source of multiple uses for the village community (drinking water, washing, bathing, water for livestock and wildlife, fishing, water for cultural and ritual purposes), and played a role in the maintenance of a good natural environment.

Because of these benefits, the Indian kings, Jagirdars, religious bodies and philanthropists built a large number of tanks all over their domains.

These rainwater-harvesting structures in various forms were known by different names in different parts of the country, e.g., kere in Karnataka, cheruvu in Andhra Pradesh, Erie in Tamil Nadu, johad and bund in Rajasthan, ahar and pyne in Bihar.

The tanks were meant not only for agriculture, but also served as a resource-base for many other activities such as the collection of fodder, fuel, the making of bricks, pots, baskets, etc, with women offering their assistance in these processes.

Tanks were also part of the socio-religious and economic system in villages. The location of the tank and its physical conditions were a matter of much significance to the people, particularly women, in carrying out their economic activities. The tank and its surroundings used to be the common property of the village and its people. The maintenance of natural resources through a continuous process of use and conservation meant not merely the assurance of livelihoods to the people of the village, but also the preservation of the ecological balance.

Objectives

1. To improve tank irrigation and sustainable agriculture productivity.
2. Decrease the dependency on deep tube wells and thus arrest sea water intrusion.

Pondicherry at a Glance

The Union Territory (U.T.) of Puducherry comprises of four interspersed geographical entities namely Puducherry, Karaikai, Mahe and Yanam. Puducherry region is the largest of the four and is situated on the coramandal Coast between 11 45' and 12 0' North Latitude and 79 37' and 79 50' East longitude.

Bahour commune is situated at a distance of 20.5 km South West of Puducherry (via Kirumampakkam). It is the headquarters of Bahour commune and also designated as a revenue village. Bahour Lake the second largest lake in Puducherry is situated on the Northern side of the Bahour commune. Bahour commune considered as the "rice bowl" of Puducherry was chosen for the present study.

This area is highly fertile with the conspicuous presence of a chain of irrigation tanks that were supplying water for agriculture allied activities, the technologies introduced in early 1970s have caused rapid decline of groundwater table and increasing salinization of aquifers in coastal regions. This has culminated in the decline in the growth and yield of paddy in the Bahour commune (35-50% yield reduction) and consequently decreased the income of resource poor farmers, due to increase in the water charges paid.

Bahour Lake, the second largest lake in Puducherry is situated towards the Northem side of the Bahour commune. The lake covers an area of 1374.30 Ha. It becomes dry In the month; of May. The feeding channel called Bangaru vaikkal, which takes off from Soranavur anicut about 16.8 km, north West from the tank. feeds the tank. Ponnaiyar is the exclusive source of water to the Bangaru vaikkal, which feeds the Bahour tank. The spring flow in the river is diverted into the Bangaru vaikkal by means of a korambu , kararnbu (temporary checkdam), the construction of which was governed by the convention of June 1910.

This convention was entered into agreement between the British and the French Government. The full supply depth in the rear of the old head sluice was fixed as 1.675m. After subsidence of flood, the channel would be cleared of silt and the korambu was formed again to draw off supplies in the next monsoon period. Thus, ryots had to incur expenditure from time to time.

The maintenances of the korambu was left to the care of the PWD since 1975. Matters took a turn for the worse with the construction of Krishnagiri and Sathanur reservoirs and as a consequence, the flow on the downstream fell considerably in quantity and duration. The present capacity of the tank is 5.38 MCM. It serves an anicut of 1,740 Ha (1,664 Ha in Puducherry and 76 Ha in Tamil Nadu).

The ayaeut under the Bahour tank is 1374 Ha accounting 10% for U.T. of Puducherry. But the tank feeds twelve other tanks whose ayacut also may indirectly be treated as under Bahour tank. Water from the tank is supplied by means of eight sluices situated around the periphery of the tank bund.

This study is based on 6 tanks that were selected on following rationale

1. Based on rehabilitated year (to represent different years of rehabilitation viz: Pilot, I, I1 batch and I11 batch of tank as control)
2. Tanks that are closer to sea (< 6 km) and that are away (> 6 krn)

Selected tanks based on the year of rehabilitation

Pilot tank (1999-2001)	I batch tank (2000-2002)	II batch tank (2001-2003)	III batch tank (2003-2005
Keezhparikalpet	Bahour sitheri Utchimedu	Seliamedu Kirumampakkam	Irulananchandai

*The years given in brackets indicate the duration of rehabilitation
*Each tank needs a minimum duration of two years to complete the rehabilitation process

In Bahour, all the 15 tanks have been rehabilitated, which holds a total ayacut area of 722.94 Ha and tank water spread area of 141.66 Ha.

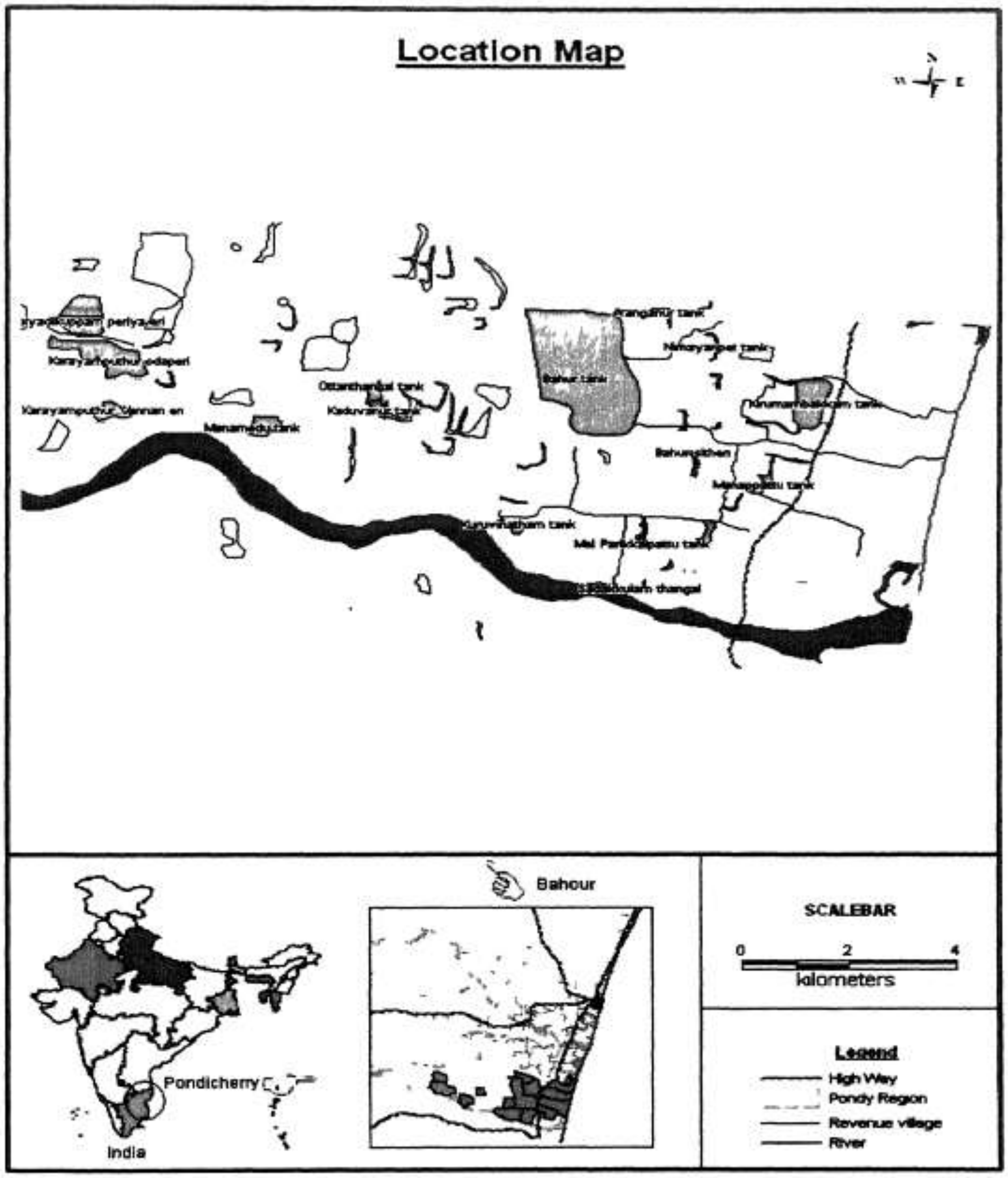

Location Map
Bahour tank
Bahour
Pondicherry
India
SCALEBAR
0
2
4
kilometers
Legend
High Way
Pondy Region
Revenue village
River

Fig. 5.3. Keezhparikkalpet Tank (Pilot tank)

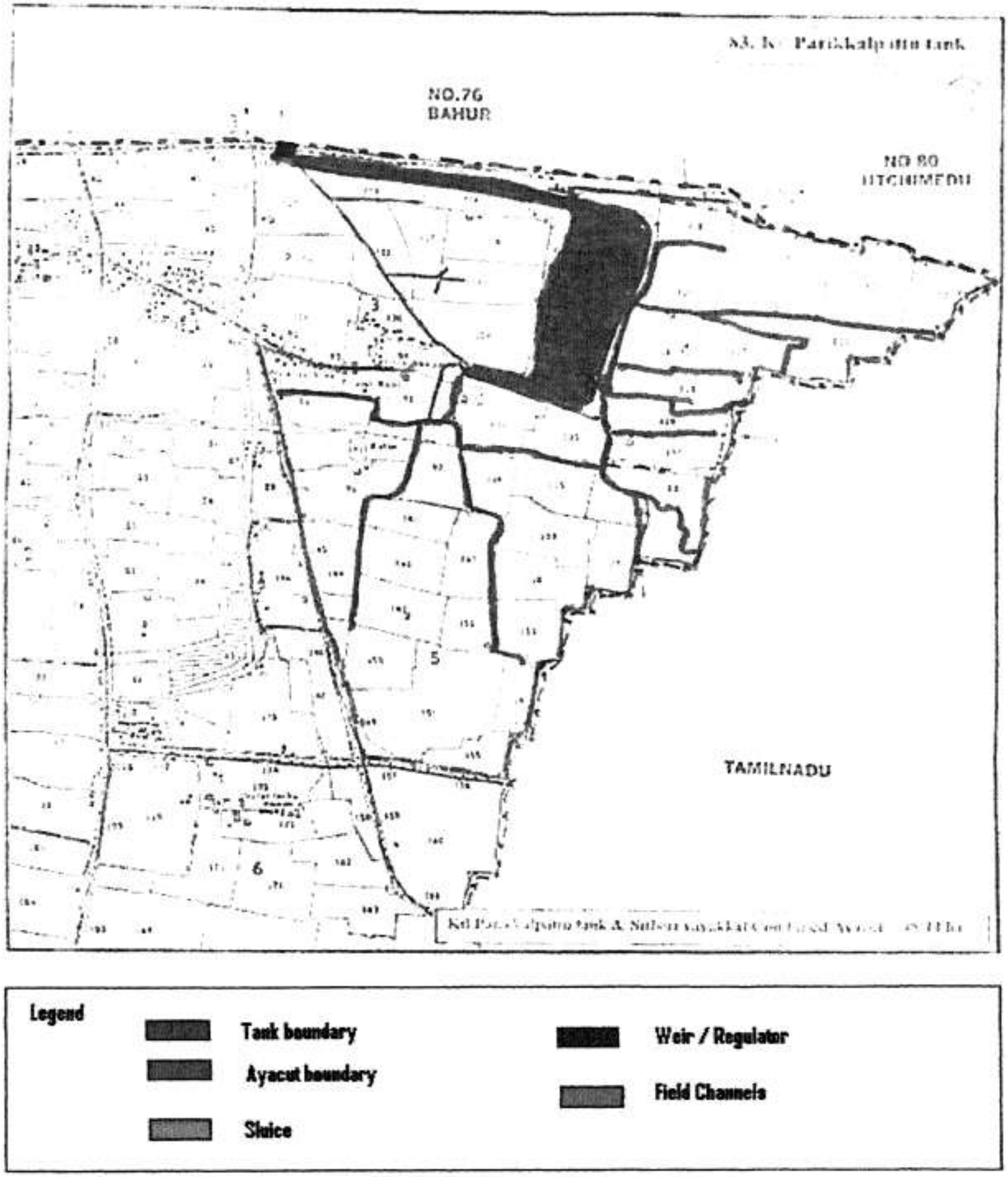


Fig. 5.4. Bahour Sitheri (First batch)

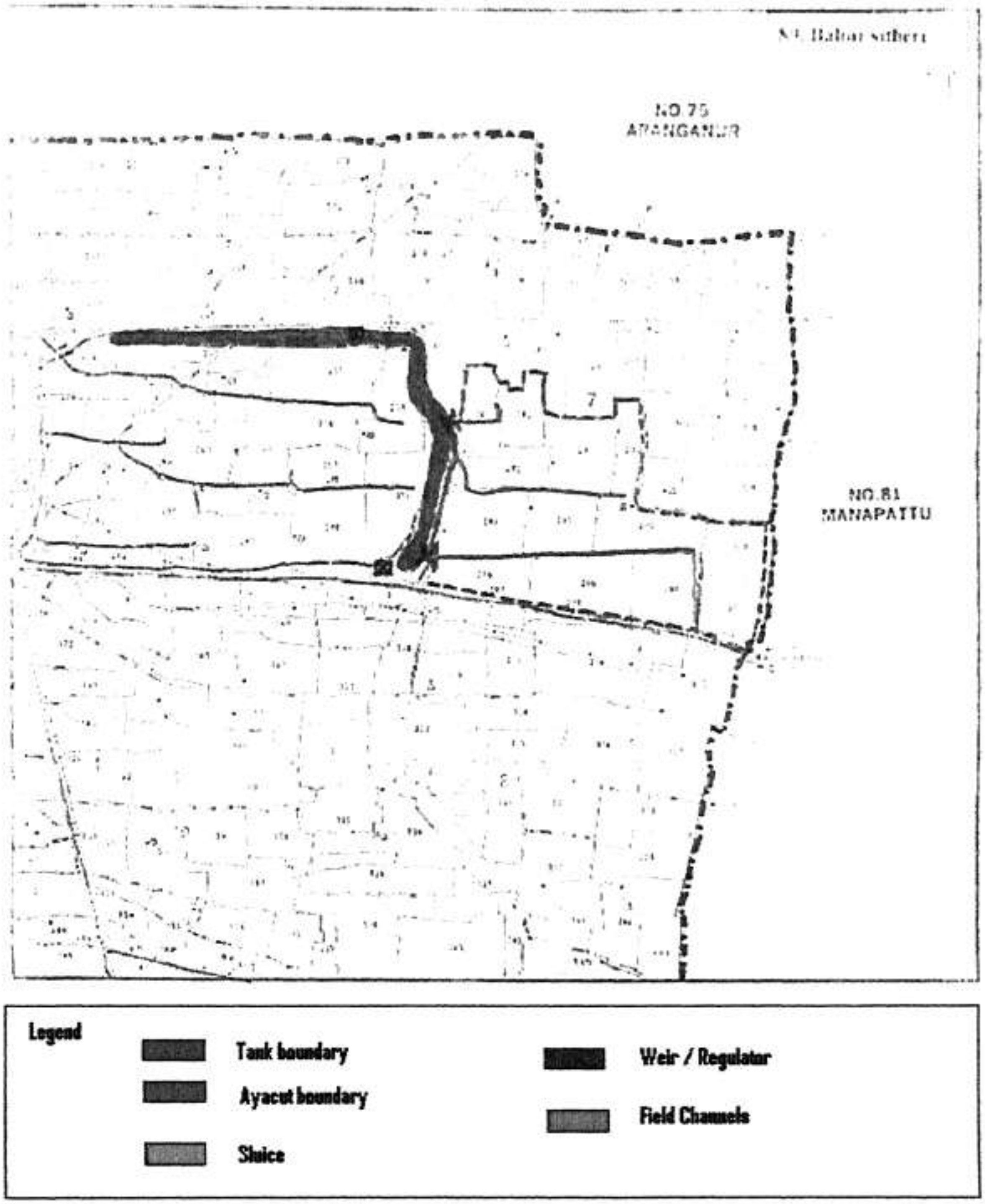


Fig. 5.5. Utchimedu Tank (First batch)

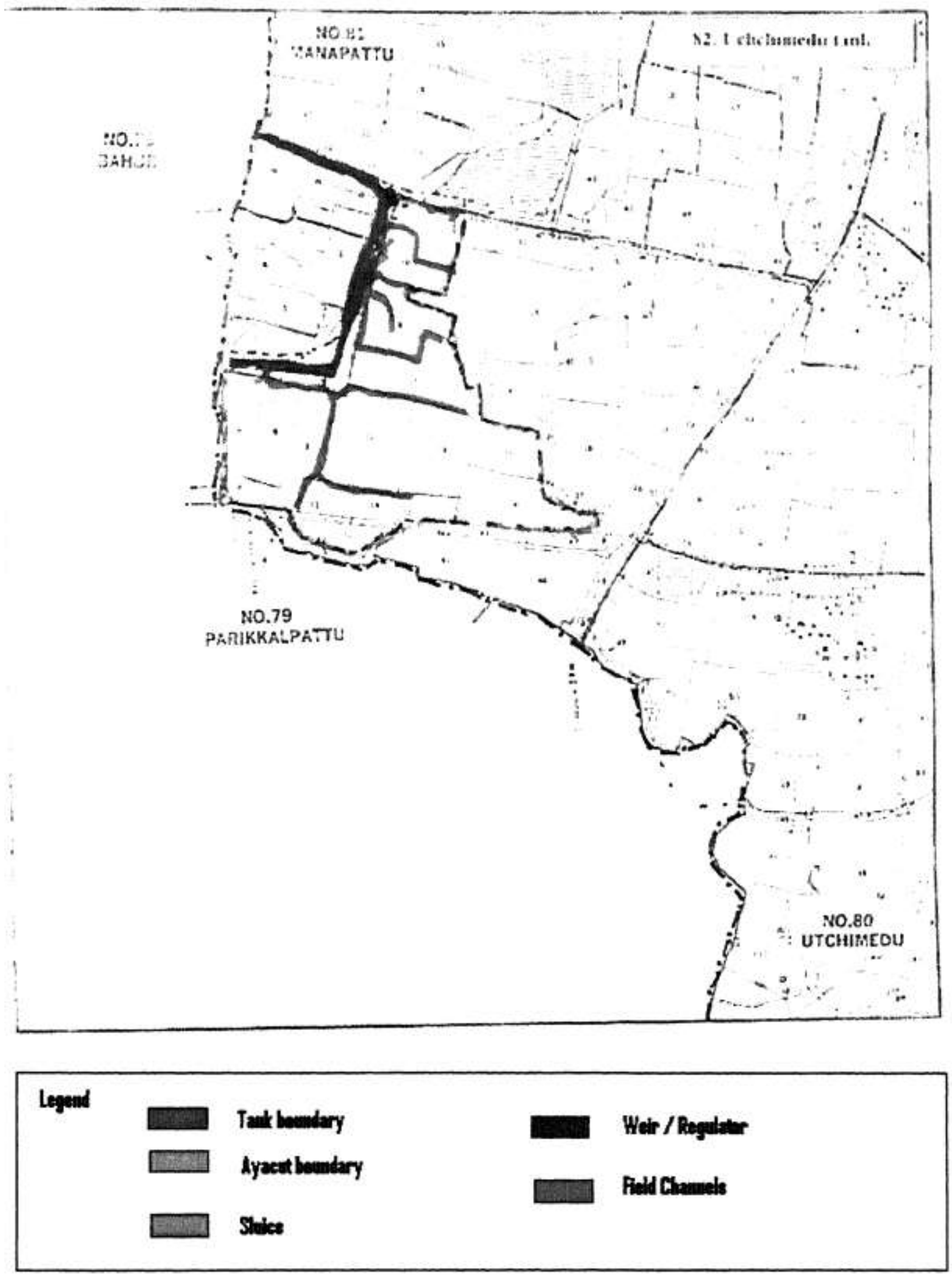


Fig. 5.6. Sellamedu Tank (Second batch)

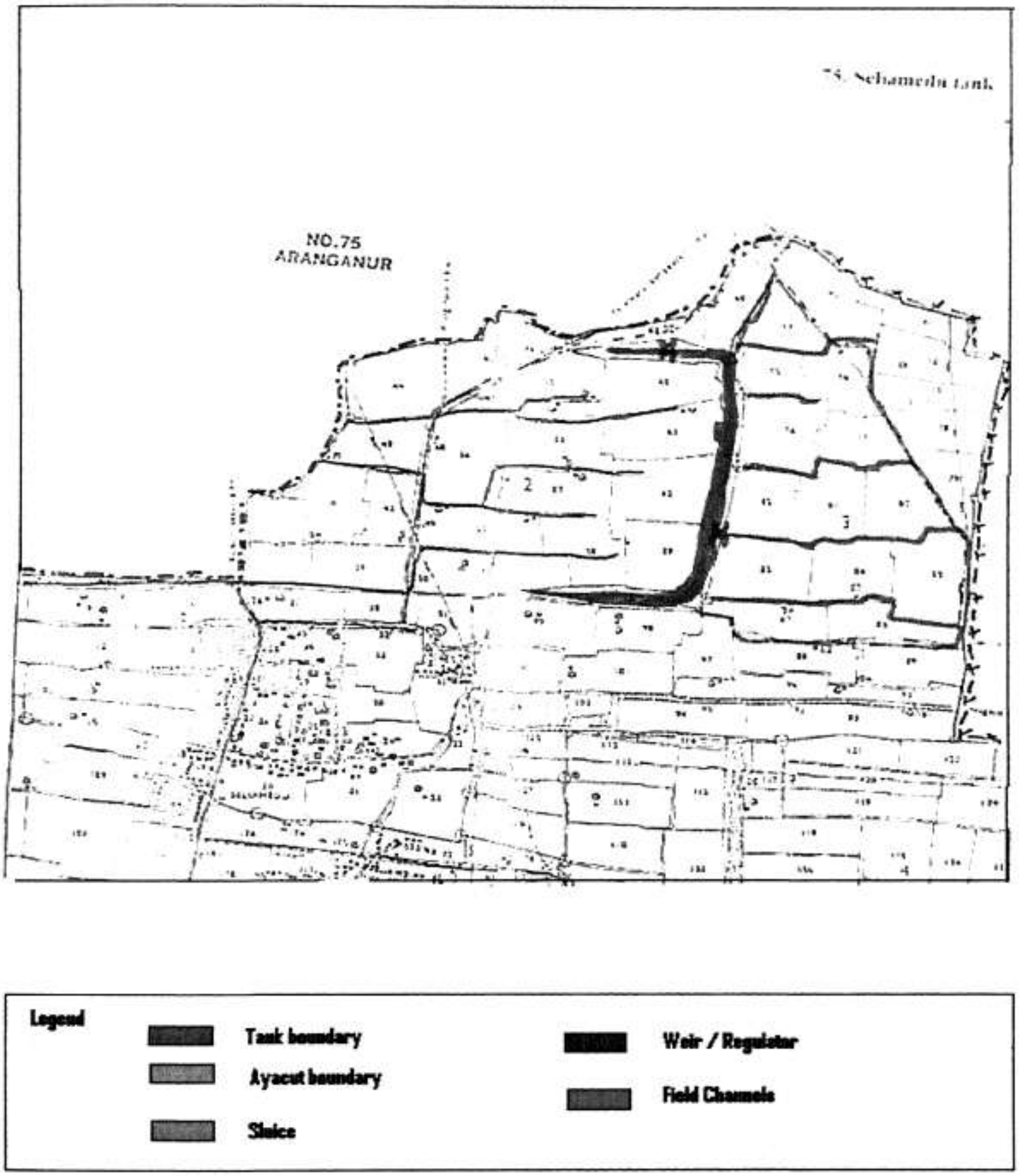


Fig. 5.7. Kirumampakkam Tank (Second batch)

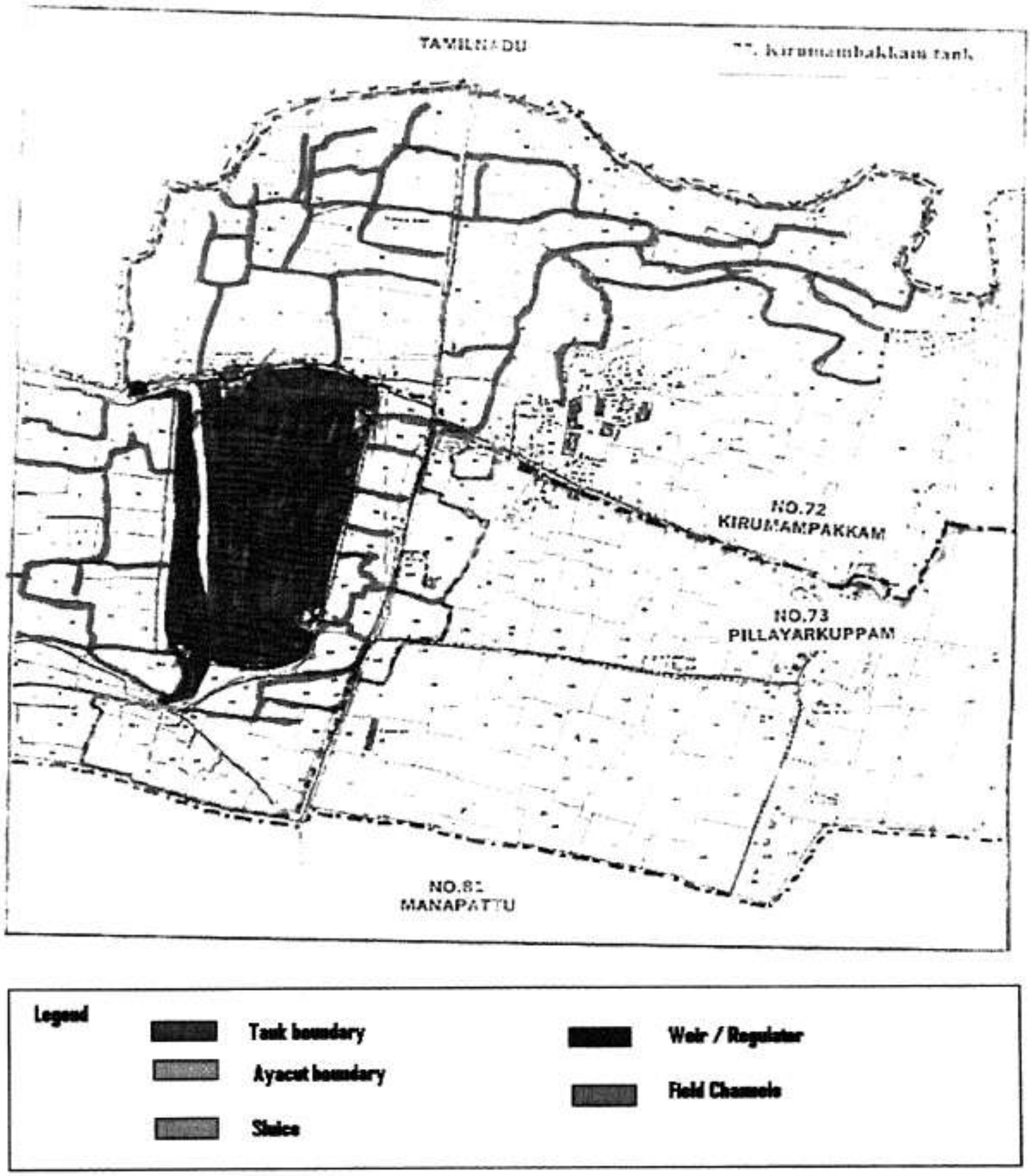
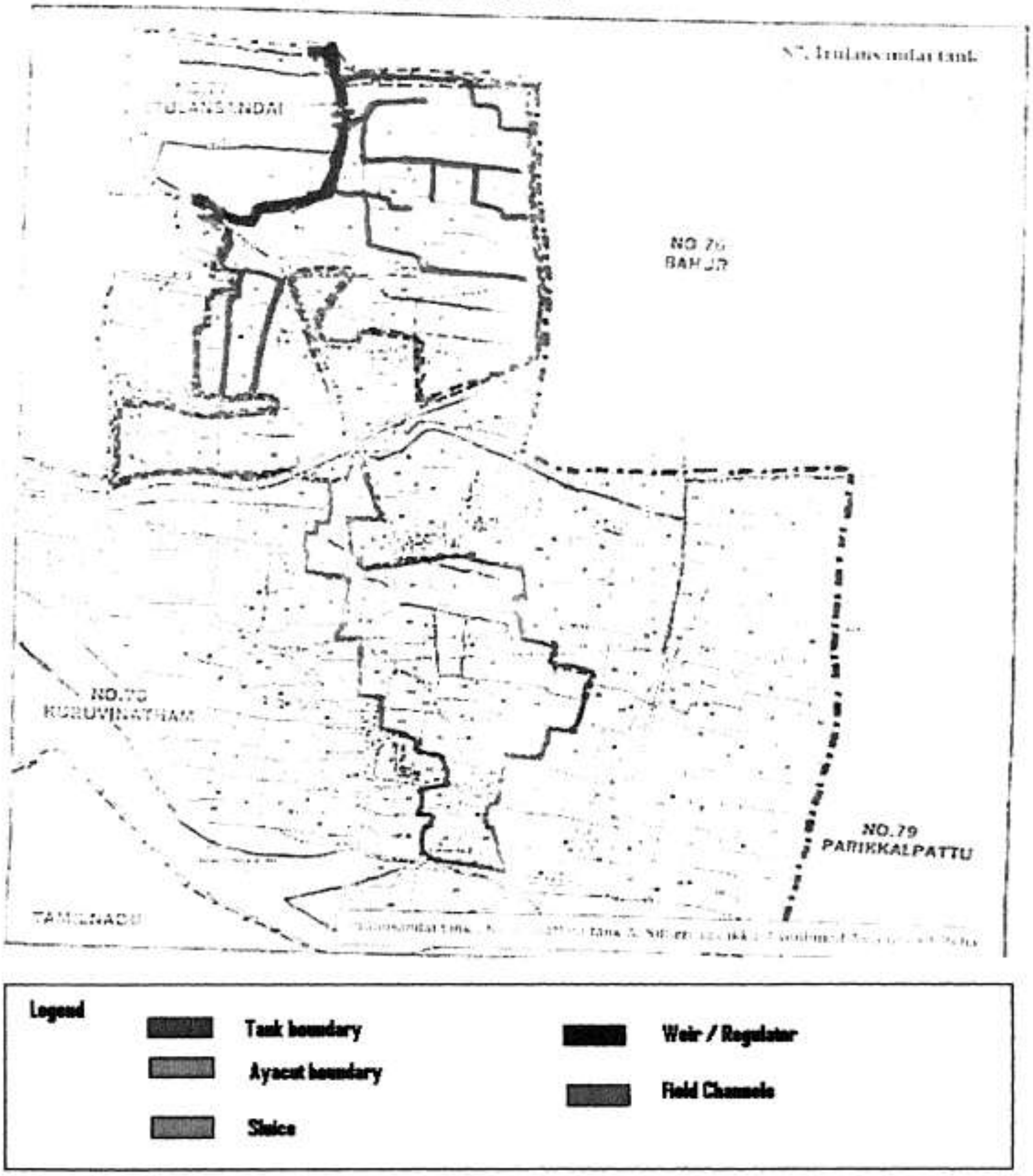


Fig. 5.8. Irulansanthai Tank (Central)



Encroachment Eviction of Keezhparikalpet Tank

Storage of Rain Water After Desilting Keezhparikalpet Tank

Before Desilting of Utchimedu Tank

Desilting Work in Progress in Utchimedu Tank

Rainfall pattern

During the North East monsoon seasons, depressions and storms from the Bay of Bengal bring heavy rains, thunderstorms, and gusty winds. The period December to January is the most pleasant and coolest part of the year. The dry period extends up to the end of August and then onwards-wet period starts and is at the peak during November. Relative humidity is generally high above 70%, during August to April.

The average annual rainfall in Puducherry is about 1270 mm. The maximum downpour is during October – November, 2005. The rainiest month is November, contributing to about 30% of the annual rainfall. The variability of rainfall is fairly large. There are on an average 55 rainy days per year.

Water Availability in Puducherry

The annual rainfall of the region replenishes the surface and ground water **Surface water.** The annual runoff for Puducheny are 59.5 million cubic meters (MCM), **41** MCM, and 25 MCM at 50 %. 75 % and 90 % dependability. The a m a l utilizable runoff is estimated to be 49.5 MCM. Much of this runoff can be stored in the **84** tanks that dot the landscape, in particular the Ousteri and Bahour tanks. There are 59 system tanks (i.e. tanks that are connected to river systems) and 25 non-system (rainfed) tanks, which irrigate about 6600 Ha of land.

The system tanks receive supply from the two rivers and three major tributaries. Water from the rivers and tributaries are conveyed to the tanks through feeder channels. Apart from the 25 non-system tanks there are nearly 500 ponds that can also hold rainwater. Over time, there has been neglect of the tanks, and the tank beds have been encroached. By sewing as percolation ponds, the tanks also recharge groundwater in the command areas. The rehabilitation of the tanks could increase the utilizable surface water potential to some extent. However, the surface water potential was assumed to be 49 MCM.

There are 84 small and medium tanks in Puducherry region of total capacity 46.36 MCM, which are serving about, 6764.6 Ha. The storage capacity of Ousteri and Bahour tank is 15.29 MCM and 5.60 MCM, which are serving about 1568.0 Ha and 388.7 Ha of agriculture land respectively.

The utilizable groundwater resources (at 85% of the gross recharge potential) were assessed at 151 MCM. Since alluvial aquifers cover about 90% of the Puducherry region, water level in the wells is fairly shallow ranging between 12 to 14 m below ground level. In the tank command areas alone there are 70-80 shallow wells and about 1000 tubewells. Overall. there were 8000 tubewells in the Puducherry region.

Ground Water depletion

The excessive extraction for all uses has caused a drop in the water table at a number of locations such as Katterikuppam, Krishnapuram, Bahour, Sorapet and Ariyur. The declining trend over 10 years is of the order of 15 to 30 m in the West and about 7 m in the Eastern part of Puducherry. Urban sprawl has also contributed to lower recharge through reduction of vegetation cover and wetlands. In the agricultural areas. open wells were replaced by tube wells from 1970 to 1985 with motor pumpsets and 1985 to till date with submersiblel/jet pump sets. Extraction has gone to 35-50 m and upto 100 m in some places. A secular decline in the water potential levels which shows that the ground water use exceeds recharge (i.e. there is unsustainable extraction of groundwater) and the banned area for construction of new and deepening of existing borewell in Bahour within 6 **km** range from the coast. This area covers about 60% of Bahour commune and only 32% of the study area, as the remaining fraction is beyond the 6 km range. Thid situation can be reversed only by ensuring either greater storage for recharge or by decreasing the amount abstracted.

Seawater Intrusion

In a coastal region like Puducherry, there is the added danger of the ingress of seawater. In 10 to 15 villages of Bahour, where groundwater has become saline, the villagers are supplied water through tankers from commune headquarters, the shallow aquifers along the coast show signs of salinity. Due to over pumping, there has been a reversal of gradient in certain areas like Kalapet, Muthialpet, Mudallarpet, Kirumambakkam. and Panithittu. Salt water has intruded up to a distance of 5 to 7 km from the coast. Any further extraction of groundwater has to be done only beyond this distance.

Future Directions

Tank irrigation system development programmes not only protect and conserve the environment, but also contribute to livelihood security. All the beneficiaries should be involved at various stages of project activities, planning and implementation with the ultimate objective of sustainability. In addition, strengthening of community organizations within the Tank irrigation system, implementation of the planned Tank irrigation system management activities, encouraging linkages with other institutions and initiating groups towards formation of apex bodies will help motivate the people and make it a peoples' movement.

Summary

The present study was carried out in the Bahour commune of the Union Territory of Puducherry with a prime objective to improve tank irrigation and sustainable agriculture productivity and decrease the deep dependency of tupewells and thus the arrest the sea water intrusion. of analyzing the potentials and constraints for community based strategies for tank rehabilitation, efficacy of tank rehabilitation and to compare the sustainability of revived tank based irrigation and conventional bore well irrigation. Other objectives include characterizing the ground waters of Bahour commune, to assess the efficacy of preventing seawater intrusion with the recharge of ground water and to evolve design elements for successful community based strategies for tank rehabilitation and irrigation management. All the above-mentioned objectives are achieved.

However, the process of adopting the traditional irrigation strategies is not very simple since there has been lot of changes in governance systems both at the macro and micro levels, as well as the changing cultures and traditions over a period of time. Hence we have to identify and incorporate elements of success from the traditional irrigation systems into community based tank rehabilitation strategies and at the same time should not hesitate to integrate the recent advances in migration technologies as long as they are appropriate to the given situation in terms of economic feasibility and cultural acceptability. Here are a few problems that are faced by farmers in the last three decades that are common to all. Head and tail end conflicts **a** Political interference in irrigation scheduling **o** Encroachment of feeder canals Revolution in bore well technologies coupled with power subsidies for irrigation pump sets, marginalizing the importance of surface water bodies.

CONCLUSION

- Today tank irrigation system management has become the main intervention for water resource management and rural development due to sustainable agriculture crop production.
- Tank irrigation system development program not only protect and conserve the environment, but also contribute to livelihood security.

- Tank irrigation development activities have significant impact on groundwater recharge, access to groundwater and hence the expansion in irrigated area. Tank irrigation development activities have been found to alter crop pattern, increase crop yields and crop diversification and thereby provide enhanced employment and farm income.

The alternative farming system combining agricultural crops, trees and livestock components with comparable profit should be evolved and demonstrated to the farmers.

- Once the groundwater is available, high water-intensive crops may be introduced.
- Hence, appropriate water saving technologies like drip is introduced without affecting farmers' choice of crops.
- The various rural development programmes in and around the tank irrigation could be ensured to promote holistic development of tank irrigation system. For its continued success, the programme should be economically efficient, financially viable, technically feasible and socially acceptable while ensuring equity.
- The Bahour region has witnessed a range of irrigation organizations - CC-SA-
- PWD-CP- EU - PWD (from 1859 to till date). Though the problems faced by each one of these organizations were found to vary, there are a few problems that are faced by farmers in the last three decades that are common to all these organizations.
- Head and tail end conflicts
- Revolution in bore well technologies coupled with power subsidies for irrigation pump sets, marginalizing the importance of surface water bodies.

Benefits gained by farmers

The farmers manage the systems and will be real managers; The farmers of the area understand more clearly about the irrigation systems, so they can properly support the protection of the system; Operation are managed safely; maintenance and repairs are done in time; Consumption of electricity 30% and water is reduced; ayacut area is irrigated (before, it could irrigate only 50-60% and the rest is irrigated by bore well water); Pumping expenses are reduced (Rs.3000 per year due absence in periodical deepening of bore well) (working time of the farmer reduced to introduction of water managers); Crop yields have increased; Water conflicts between big and small farmer is reduced considerably; Farmers are trained for more understanding about the maintenance, their skills and techniques are improved, they are involved in discussions on expenditure and revenue, and they elect the representatives to carry out the management; Due to the proper in-time irrigation, the farmer is ready to pay the contribution and corpus fund regularly;

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Appendix
Physical characteristics of Tanks Studied

Details	Keezhparikal pet	Bahour Sitheri	Utchimedu	Seliamedu	Kirumampakkam	Irulansanthai
Tank Type	System	System	System	System	System	System
Village and Commune	Parikkalpattu/ Bahour	Bahour/ Bahour	Utchimedu/ Bahour	Seliamedu/ Bahour	Pillayarkuppam/ Bahour	Irilansanthai/ Bahour

Components of Tanks

Details	Keezhparikal pet	Bahour Sitheri	Utchimedu	Seliamedu	Kirumampakkam	Irulansanthai
Ayacut (Ha)	69.49	23.48	26.37	27.56	203.39	135.13
Cultivable ayacut area (Ha)	69.49	23.48	21.40	27.56	153.48	133.35
Storage Capacity (MCM)	0.158	0.034	0.425	0.228	1.220	0.779
No. of Sluices	2	2	3	2	6	3
No. of Weirs and type	1	1	2	1	1	1
Bund length (M)	1150	1170	730	1140	4330	950
Maximum water depth (M)	1.15	1.75	1.10	1.0	1.75	1.20

Water resources of Tanks Studied

Details	Keezhpa	Bahour	Utchi	Seliamedu	Kirumam	Irulansant

	rikalpet	Sitheri	medu		pakkam	hai
Canal water (%)	30	40	20	30	10	10
Navarai (%)						
Tank water	20	20	20	20	30	20
Ground water	60	60	70	70	60	70
Canal water	20	20	10	10	10	10
Sornavari (%)						
Tank water	10	10	10	10	10	10
Ground water	70	80	90	80	80	70
Canal water	20	10	No	10	10	20
No. of wells in the ayacut	21	6	3	5	39	50

Source: Computed

Types of Soil

Details	Keezhpa rikalpet	Bahour Sitheri	Utchimedu	Seliamedu	Kirumam pakkam	Irulansa nthai
Ground water Problem	Salinity	Salinity	Salinity	Salinity	Salinity	Salinity problem
Soil type	Clay	Clay (alkalinity problem)	Clay (alkalinity problem)	Clay	Clay (alkalinity problem)	Sandy Clay
Depth of Wells (m)	20-60	40-180	45-260	45-80	10-55	45-150

Source: Computed
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