Mapping and Study of
Coastal Water Bodies in Nagapattinam District

Commissioned by

NGO Co-ordination and Resource Centre (NCRC)

Nagapattinam

Supported by

Concern Worldwide

By

Dr.R.K. Sivanappan & Associates

April 2007

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NCRC has great pleasure in publishing this study on the "**Mapping and Study of Coastal Water Bodies in Nagapattinam District**". This has been the culmination of the natural progression from relief to rehabilitation and then to development through disaster- proofing of agriculture. It is an attempt to leave behind a legacy that, despite being of the very limited mandate of disaster response, will have a larger role to play in not only restoring agriculture to its immediate pre- tsunami status but also starting a process that will hopefully reinstate agriculture to its former stature of being the life- line of the food security of the State.

NCRC takes this opportunity to gratefully acknowledge the financial, technical and moral support provided by Concern Worldwide who partnered us every step of this journey, especially Mr. Prabhakaran and Mr. Pattabhiraman.

NCRC gratefully acknowledges the "open-door policy" and the support of the Nagapattinam District Collector, Sri Tenkasi S. Jawahar, IAS, and his staff to NCRC.

NCRC also states its indebtedness to Mr. Nalluswamy, CE WRO/PWD- Trichy, Mr. Ganesan, SE WRO/PWD - Thanjavur, Mr. Murthy and Mr. Kannan EEs WRO/PWD, Mr. Bhaskaran AE/WRO/PWD, Thiruvarur, Mr. Rajendran AE/ Thanjavur, Mr. Senthil, EE, AED- Nagapattinam, Mr. N. Varadaraj R.D., CGWB, Chennai, and all their staff for their unstinted support and guidance all through the study.

This Report would have been grossly deficient if not for the experience, expertise and perspectives shared by the farming communities either directly or through their representatives. NCRC gratefully acknowledges their valuable inputs.

This Study has gained immensely from the rich experience and sectoral understanding of Dr. R K Sivanappan, erstwhile member of the State Planning Commission and former Dean of Agriculture Engineering College, Coimbatore, who agreed not only to lead this Study but also voluntarily walked the extra mile to enrich the study.

NCRC gratefully thanks CCD, CEE, TOFARM, Kudumbam and Venture Trust for collaborating with us on this Study and providing us with their staff despite the exigencies on their time.

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NCRC has the proud privilege of dedicating this report to the farmers of Cauvery Delta Region.

The NCRC Team

PREFACE

The NGO Coordination and Resource Centre (NCRC) Nagapattinam entrusted me with the task of mapping the coastal water bodies including ground water in Nagapattinam district. Though it was a challenging task to cover the full length of 145 km of the east coast, I agreed since I have been involved in studying the various problems encountered in the coastal area, especially the water logging and drainage problems which affect agricultural production and thereby livelihood of the population. I organized an international seminar on Land drainage in deltaic regions in 1984 at Kattuthottam, near Thanjavur and many experts in this field from England, Philippines and top scientists from India attended the seminar and shared their experiences.

The study relates not only mapping the coastal water bodies but also how to use the flood/rain water for agriculture and drinking water supply; and recharging the ground water. This will help solving the twin problems of flooding and betterment of the poor people living in areas that are regularly affected during the north east monsoon.

The data required for mapping were collected by the five NGOs deputing two persons by each NGO and with the help of the staff working in the Agricultural sector of NCRC. The data relate to the number of channels, the ayacut, length, width, depth of both irrigation and drainage channels, encroachments, siltation, bund damages, flooding, weed in the water bodies / bund damages and the damages to the various structures. They were gathered by walking and studying the entire study area with the help of WRO/PWD, Agricultural Engineering, Agriculture and Groundwater officials. Similarly the data for the other bodies like ponds, lakes, tanks, farm ponds, *alams*, wells, details of crops grown, yield obtained and the problem etc, were collected with the cooperation with VAO/SHG/WUA and other public in the study area. Further, in order to store the floods/rain water, the existing structures and the proposed structures were identified and details were gathered. I also traveled the study area to get first hand information and discussed with farmers, officials of various Departments, NGOs etc. After analyzing the data, the report was prepared in a short period.

I specially thank Ms Annie George, CEO and Mr. Chandramohan, Agricultural sector head, NCRC for their confidence in entrusting this job to me. I thank Mr. Ramesh Pandian and Mr. Perumal who have helped to collect the data and other details in the field including preparing the figure and tables with the support of 5 NGOs namely: 1) Covenant Centre for Development, Poompuhar 2) Centre for Environmental Education, Karaikal 3) Tamil Nadu Organic Farmers Trust, Nagapattinam 4) Kudumbam, Trichy & 5) Venture Trust, Pudukottai.

I also thank Mr. Raghunathan and Mr. Balakrishnan of CMS, Bangalore for their computer work and their suggestions.

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Finally I thank the donors who have provided funds for taking up the study.

(R.K. SIVANAPPAN)

EXECUTIVE SUMMARY

- Nagapattinam is one of the coastal districts in Tamil Nadu and is a part of the Cauvery river basin and delta. The Cauvery delta begins from the Grand Anicut near Tiruchirapalli, constructed more than 1800 years ago by King Karikalacholan. The main direction of the flow of the River Cauvery is east and the delta spreads northwards and southwards from Grand Anicut. The distributaries originating from the Cauvery finally discharge their waters into the Bay of Bengal.

- Being at the tail end of the Cauvery delta, Nagapattinam is at the mercy of the water flow from the Mettur dam. Located on the Bay of Bengal coast, it is also frequently hit by cyclones that bring in large quantities of rain in short spells. Alternate periods of water scarcity and flooding have resulted in frequent crop losses and a steady decline of cropping area under paddy, the main crop of this region. The 2004 tsunami was, therefore, only another disaster to contend with for the farmers of Nagapattinam.

- While working on the rehabilitation of farmers affected by the tsunami, it became apparent that the malaise went much deeper. NCRC, supported by Concern Worldwide, commissioned a study to understand the different vulnerabilities faced by the farmers, belonging mostly to the marginal farmers group, of Nagapattinam. This study highlighted, inter-alia other findings, the high degree of sensitivity of the area to flooding or drought- like conditions and to the poor status of the irrigation and drainage mechanisms prevailing in the area. Successful post- tsunami interventions, by some NGOs, in correcting such identified flaws in small pockets, only validated this finding.

- Based on this understanding, NCRC, again strongly supported by Concern Worldwide, followed up with another study with the following objectives:

1. *Collectively address the issues of identifying, prioritizing and planning the course of action to improve the irrigation and drainage infrastructure, including the canals and all water bodies, that have been neglected leading to frequent flooding and salination.*

2. *Influence the Government / NGOs and farmers to maintain these life support systems of agriculture as the quickest means of disaster proofing of agriculture in the district.*

- The study area was spread in all the taluks of the district except Mayiladuthurai and worked out to about 92,851 ha out of the total geographical area of 2,71,583 ha of the district, covering 148 revenue villages including 779 hamlets. The irrigated area studied (31,500 ha) is 28% of the total irrigated area of the district. Five NGOs were involved in the study, each covering one taluk.

- A Co-ordinator from NCRC facilitated the entire process. Dr. R.K. Sivanappan, erstwhile member of the State Planning Commission and former Dean of the Agriculture Engineering College, Coimbatore, who is also an Expert in Water Resources Development was the Team Leader for the Study. Apart from NGOs, the study was a collaborative effort with the involvement of personnel from PWD, AED, Ground Water Department (both Central & State), TWAD Board and other line departments. The farming community was involved throughout the study at various stages.

- Irrigation channels and drainage channels at various levels, standing water bodies such as ponds, tanks, *ooranis* and *alams* and different kinds of groundwater sources such as wells and bore wells were mapped. There are 1141 irrigation channels running up to 1324 km with an ayacut of 25509 Ha while there are 180 drainage channels with a total length of 346 km. 1075 village ponds, 652 farm ponds, 6437 wells, 4 irrigation tanks and 6 *alams* were also found in the study area apart from the Vedaranyam Canal and the Buckingham Canal.

- Siltation, damages to bunds and other structures like shutters and notches, deliberate encroachment for cultivation, aquafarming, habitation and weed infestation were the common adverse conditions found across most of the water bodies; more so in the drainage channels than the irrigation canals.

- The Study estimates a total amount of Rs. 125 Cr. for desilting, weeding, repairs and maintenance and construction of some additional structures in the total area of the 14 TERs studied. This is designed to not only restore the efficiency of the irrigation and drainage channels and other water bodies but also improve their potential for additional storage of fresh water.

- Irrigation Channels:
  - ☞ ***Damages***: 526 of the 1141 irrigation channels showed siltation to the extent of 6.7 lakh m^3. 147 of channels had bund damages requiring 1.67 lakh m^3 of earth work. 35 ha of channel area showed high levels of weed infestation. 147 sluices require various levels of repairs and 107 shutters need to be repaired/ replaced.

  - ☞ ***Estimate for repair/ maintenance/ new construction*: ** The total cost of repairs, maintenance and additional construction in the irrigation channels is estimated at Rs.264.88 lakhs. Desilting of the irrigation channels is estimated at Rs. 122 lakhs, repairs of the damaged bunds at Rs. 28.34 lakhs, weed removal at Rs. 13.86 lakhs, repairs of shutters/ sluices and other structures at Rs. 86.35 lakhs and construction of additional structures at Rs. 13.69 lakhs.

- Drainage Channels:
  - ☞ ***Damages*:** 138 of the 181 channels show siltation to the extent of 34. 3 lakh cubic mtrs. 6.36 lakh cubic mtrs. of earth work is required to repair the bund damages seen in 99 of the channels. 27.6 ha of the drainage channel area are seen to be heavily weed infested.

  - ☞ ***Estimate for repair/ maintenance/ new construction*:** The total cost of repairs, maintenance and additional construction in the drainage channels is estimated at Rs.887.08 lakhs. Desilting of the drainage channels is estimated at Rs. 751.91 lakhs, repairs of the damaged bunds at Rs. 114.36 lakhs, weed removal at Rs. 11 lakhs, and repairs of other structures at Rs. 9.8 lakhs

- Positioning of the TERs at long distances from the confluence of the river and the sea, coupled with the low slope gradient has resulted in high levels of salination of the water as well as farm lands leading to conversion of cultivable land to either fallow land or shrimp farms. This Study has highlighted the need for additional regulators closer to the sea for effective blocking of ingress of sea-water during high tides and to increase the potential of fresh water storage. Construction of additional regulators is estimated to cost Rs. 1956 lakhs.

- The total estimate also includes Rs. 1500 lakhs for restoration of the Vedaranyam Canal, construction of additional ponds at Rs. 3972 lakhs and a detailed study of Buckingham Canal.

- This intervention is estimated to restore and improve the production and productivity of 30000 ha of cultivable land. For this intervention to be sustainable, the Study also recommends a "Participatory Irrigation Management "approach with the farming user community taking the responsibility of the continued operation and maintenance of these water bodies.

Chapter One

Introduction

Nagapattinam is one of the coastal districts in Tamil Nadu. It was carved out of the Thanjavur district in 1997. Located between 10^0 15' to 11^0 30'N and 79^0 30' to 79^0 55' E, it stretches from River Coleroon in the north to Kodikarai in the south.(Fig 1.1).

The district forms part of the Cauvery river basin and delta. For administrative purposes, the district is divided into seven taluks namely Sirkali, Mayiladuthurai, Tharangambadi, Nagapattinam, Kilvelur, Thirukkuvalai and Vedaranyam (Fig-1.2). These are further divided into 11 blocks namely Mayiladuthurai, Kuttalam, Sembanarkoil, Sirkali, Kollidam, Vedaranyam, Thalainayar, Nagapattinam, Keeliyur, Kilvelur and Thirumarugal (Fig-1.3). The district has a coastline stretching to 190 km.

Physical description of the delta

The Cauvery delta begins from the Grand Anicut near Tiruchirapalli. It was constructed more than 1800 years ago by King Karikalcholan (Fig-1.4). The gross area irrigated by the rivers and canals commencing from this point is nearly 5.60 lakh ha spread over the erstwhile Thanjavur district (currently split into Thanjavur, Tiruvarur and Nagapattinam Districts) and a portion of Pudukottai district. Most of the area in Pudukottai district has been brought under irrigation only after the construction in 1934 of the Mettur dam/Grand Anicut canal (hence known as the new delta).

The main direction of the flow of the River Cauvery is east and the delta spreads northwards and southwards from Grand Anicut. The distributaries originating from the Cauvery finally discharge their waters into the Bay of Bengal. The distance from the Grand Anicut to the Bay of Bengal is about 110 kms and the north-south spread of the delta along the coast is about 145 kms. The total geographic area of this region is 8.21 lakh ha, out of which 5.22 lakh ha is cultivated[1].

The delta has a very gentle slope of about 1 in 2000 to the east and south towards the Bay of Bengal. Thirty seven river systems traverse over the area adding up to about 1600 kms in length. There are 1505 main channels called as 'A' class channels running to about 5600 kms but their branches and sub-branches number adding up to as many as 28376 run to more than 18,000 kms. There are twenty two major drains totaling up to a length of 800 kms and over 600 minor drains.

Climate

The climate is sub-tropical humid. The average maximum temperature is about 32.5^0C and minimum is about 24.75^0C . The climatological parameters are given in Table-1.1.

Rainfall

The annual average rainfall in the delta ranges from 950 mm (Thanjavur) to 1500 mm (Nagapattinam). Most of the rainfall is received between October and December under the influence of Northeast monsoon. Rainfall is higher in the coastal areas and progressively decreases inland. The average rainfall figures do not reveal as much about the actual situation as do the number of rainy days and the maximum rainfall received during a day (Fig 1.5).

Geology and Soils

Clayey, clayey loamy, silty clay, sandy clay, loamy, sandy loam and sandy are the predominant soil texture in the Cauvery delta. Clayey and clayey loam in the middle of the delta, sand fraction associated clay more towards the sea coast, loamy nature in new delta area and sandy loam in the western parts of the delta are the most prevalent textures[2].

Broadly, the soils in the delta area are characterized by very high clay content, low nitrogen and phosphorus and high potassium and lime content. Along the east coast, for a width of 3-5 km, the soils are predominantly sandy loam in texture on the surface grading to sandy clay loam below. They are generally high in sodium and poorly drained. The nutrient status of the soil is low. In the extreme southeast corner of the region is an area of about 50,000 ha of low lying swamp subject to inundation by the sea at high tide with poor

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[1] International Seminar on Land Drainage in Deltaic Regions of Tamil Nadu, Thanjavur, 1984

[2] Cauvery Delta Zone: Status Paper. TNAU 2004, http://www.tnau.ac.in/dr/zonepdf/CauveryDeltaZone.pdf accessed 15 April 2007

natural surface drainage. The soil is typically stratified with heavy alluvial clay overlaid by fine sand which may be from few centimetres to several metres in depth.

In Nagapattinam district, 15 soil series excluding sand (2.03%), swamp (1.28%) and reserve forest (2.00%) have been identified. The major soil series are Kolathur, Adhanur, Kilvelur, and Meelkadu. Kilvelur soil series consist of dark yellow- brown, very deep, heavy textured, slightly saline alluvial soils. Melkadu soil series are dark brown, very deep, sandy, calcareous coastal alluvial soils[3].

The hydrological soil group 'A' with good infiltration and low runoff potential is widespread in Keeliyur, Talainayar, Vedaranyam and Nagapattinam blocks. The hydrological soil group 'B' with moderate infiltration and moderate runoff potential is seen extensively in Vedaranyam, Kollidam, Mayiladuthurai and Keeliyur blocks. The hydrological soil group 'C' with slow infiltration and moderate runoff potential is found in greater proportion in Kuttalam, Sembanarkoil, Thirumarugal, Sirkali, Nagapattinam and Kollidam blocks. The hydrological soil group 'D' with very slow infiltration and high runoff potential is present in many areas in Kilvelur, Mayiladuthurai, Thirumarugal, Thalainayar blocks[4] (Fig-1.6).

Geo-morphology

Since the district is underlined by sedimentary formations, the major land forms that occur are natural levees near Mayiladuthurai coastal- plain covering almost the entire district with beaches, beach ridges, mud flats, swamps, and back waters along the coastal stretch. The deltaic plains are found near the confluence of River Coleroon with sea in the east and also in the south. Flood plain deposits are observed along the river courses.

Hydrogeology

The sedimentary formations in the district are represented by Miocene, Pliocene and Quaternary formations. Ground water occurs in these formations and is extracted by filter point wells, tube wells, shallow bore wells and infiltration wells, especially from the sandy aquifers.

The Pliocene and Quaternary shallow aquifers are represented by sand, gravel and clay. The aquifer is more clayey towards east and south eastern part of the district except the

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3 Development Proposal for Flood Control and Water Conservation in Cauvery Delta Zone, TRRI, TNAU, 2006

4 Identification of Recharge Areas using Remote Sensing and GIS in Tamil Nadu, IRS, Anna University, Chennai,1998-99.

coastal stretch where the beach sands occur. The depth of the aquifers varies between 3m and 35m and deep aquifers to an extent of 80m to 100m are found in the blocks of Kilvelur and Keeliyur (Fig- 1.7).

An analysis of water level data of WRO/PWD for 9 wells along with rainfall data from 1971 to 1998 indicated that there was no appreciable declining trend in water levels indicating that the discharge and recharge are equal in almost all the blocks of the district. The maximum and minimum water levels were observed to be 1m and 7m respectively. The pre monsoon declining trends are compensated by subsequent monsoon recharge. However, there has been no later data to substantiate this and there may have been changes in this scenario over the last ten years. During summer, water level goes down 6-7m below ground level. When water level drops below 7-10m during summer months, the quality deteriorates (becoming more brackish) resulting in acute scarcity of potable water in the district.

Groundwater quality:

A proper appraisal of ground water quality is necessary for any Ground Water (GW) development programme. Electrical conductivity (EC) and levels of nitrate, iron and fluoride (F) are the important parameters that decide water quality. The EC of the water in the district ranges from 0.750 millimhos / cm to 4.98 millimhos /cm. In the cultivated fields, iron (Fe) content is higher in some parts of Mayiladuthurai, Kollidam, Sirkali, Sembanarkoil, Nagapattinam, Keeliyur and Talainayar blocks. Salinity or high TDS is observed in the entire Vedaranyam block. The GW quality is poor in most part of the district except in the north[5] (Fig-1.8).

[5] ibid

Figure 1

Location Map of Nagapattinam District

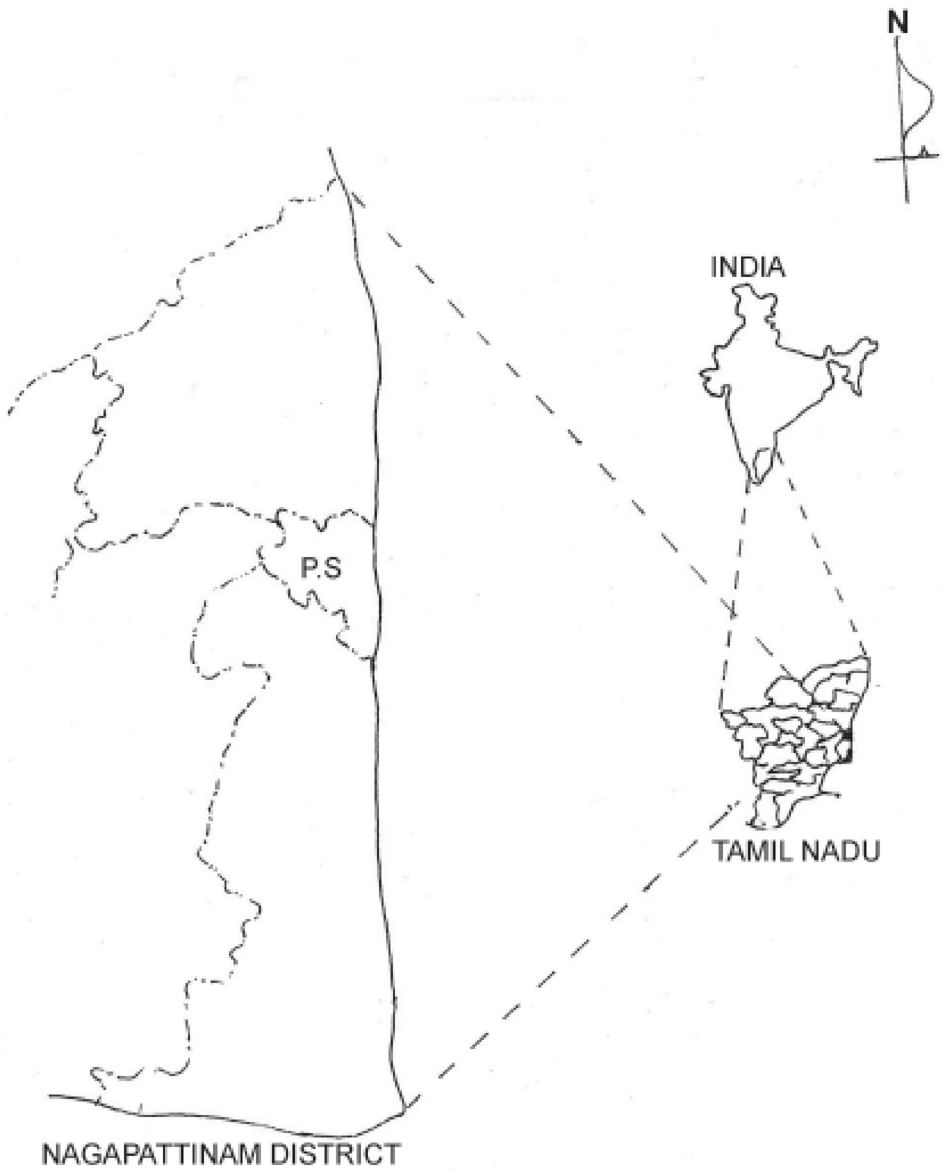


Figure 2

Nagapattinam District - Taluks

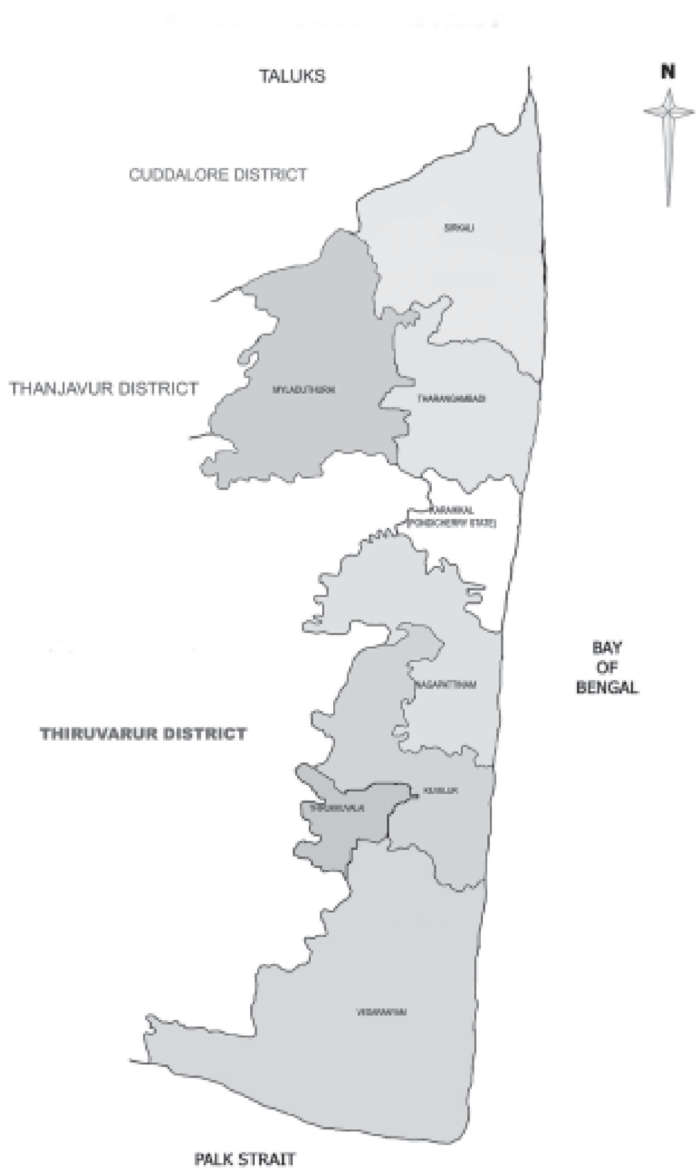


Figure 3
Nagapattinam District - Blocks

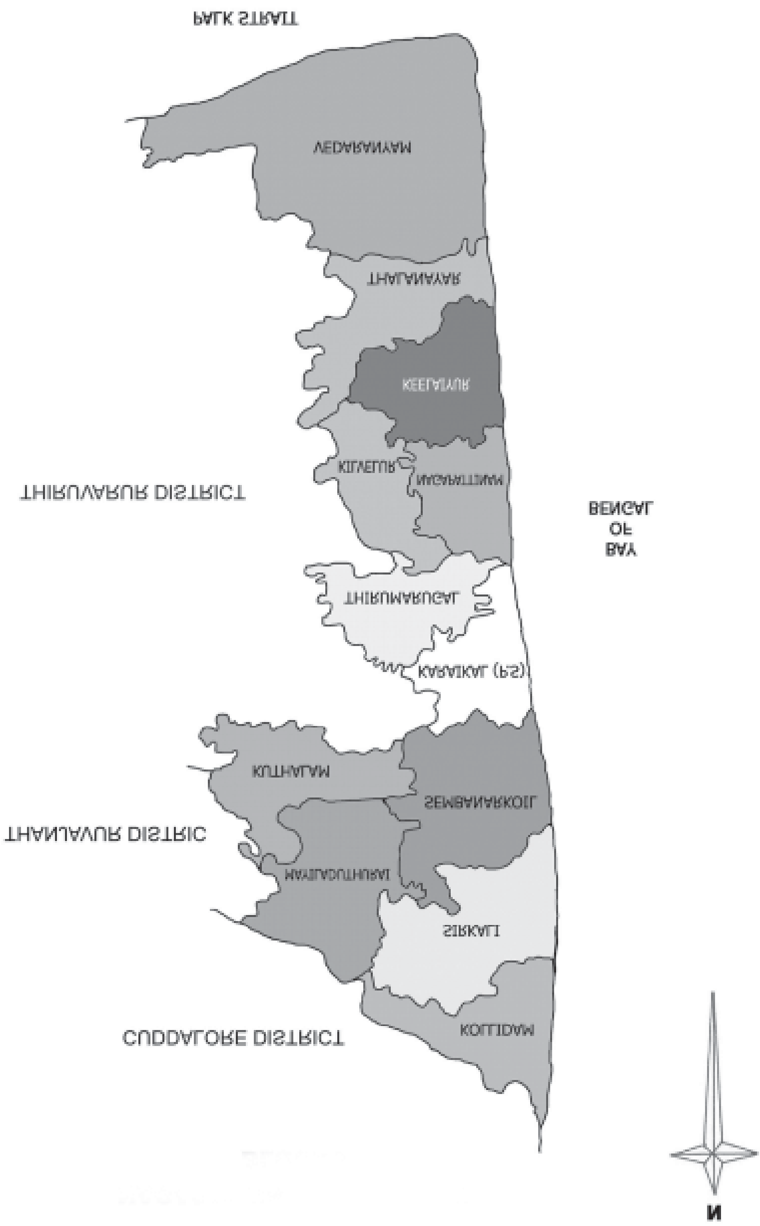


Figure 4
Cauvery Delta

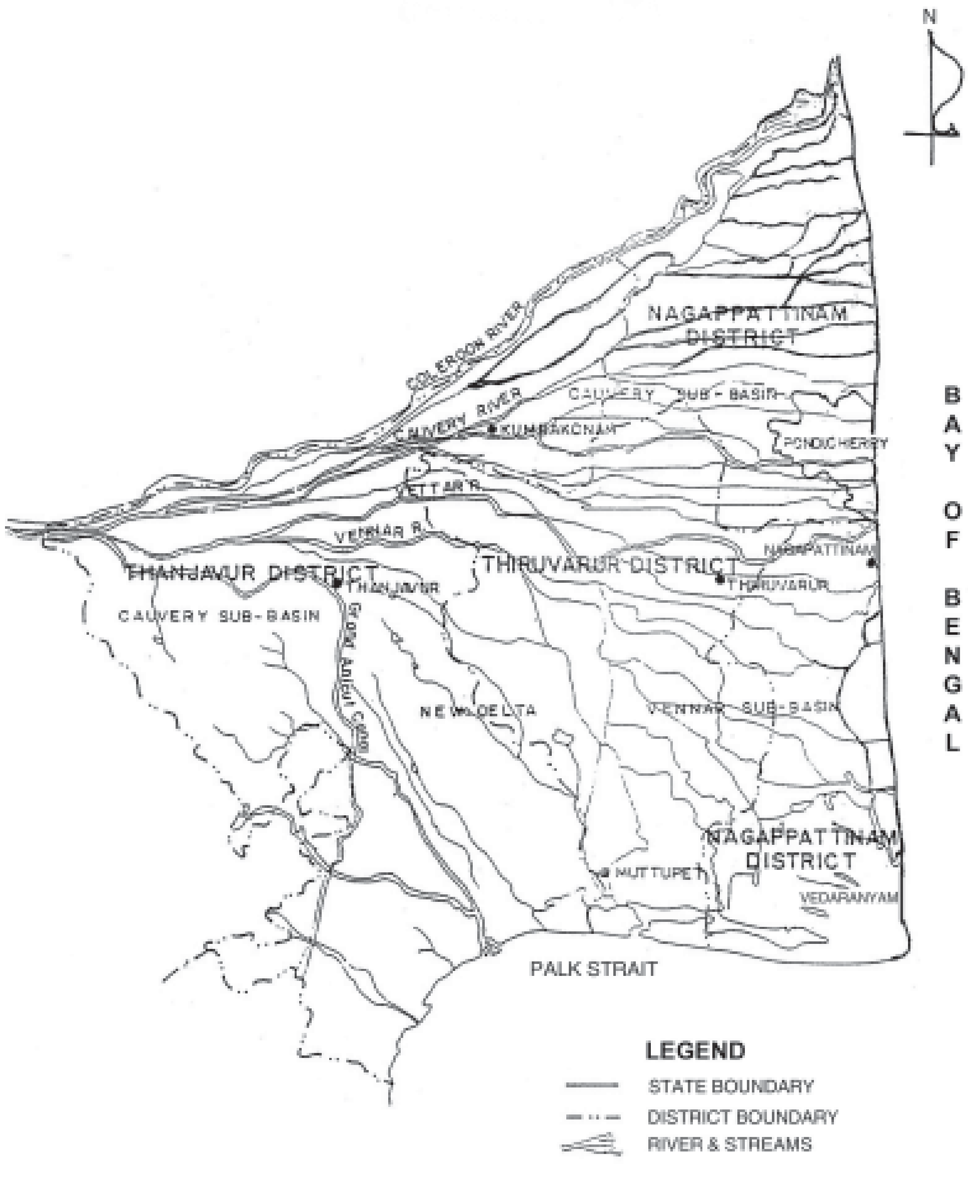


Table 1.1

Climatological parameters of Nagapattinam District

Sl.No	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Total Evaporation observed (mm)	84.7	85.3	132.7	182.9	200.4	18.42	178.8	173.3	187.4	159.2	91.1	104.1
2	Total rain fall (mm)	12.2	124	-	2	26.5	-	39.5	39	25	85	32.15	46
3	Average maximum temparature (ºc)	30.85	32.67	36.83	38.72	40.2	38.1	37.07	36.54	37.02	33.67	29.66	29.13
4	Average minimum temparature (ºc)	21.72	22.15	23.37	26.68	27.48	27.17	26.36	25.44	25.17	24.43	22.34	29.97
5	Average mean temparature (ºc)	26.29	27.41	30.1	32.7	33.84	32.63	31.71	30.99	31.1	29.05	26	24.55
6	Average relative humidity (%)	80.98	78.75	71.95	66.68	62.91	61.28	61.4	63.71	63.46	77.69	86.55	91.03
7	Average sunshine hour per day	7.17	6.47	8.52	9.18	9.88	7.84	6.19	5.96	7.32	5.16	2.55	6.88
8	Monthly bright sunshine hours (%)	59.75	53.92	71	76.15	82.33	65.33	51.52	49.67	61	43	21.25	55.7
9	Average wind velocity (month / 24 hrs / km / hr)	2	1.48	1.59	1.95	3.63	5.73	4.89	3.34	2.32	1.49	1.26	1.91
10	average monthly wind velocity (Day time) km / hr	4.09	3.21	3.45	3.69	6.52	9.07	8.24	5.59	3.76	2.96	2.49	3.26
11	Average monthly wind velocity (Night time) km / hr	0.7	0.45	0.48	0.93	2.06	3.69	2.82	1.9	1.36	0.59	0.53	0.77

Source: Office of the Chief Engineer, P.W.D., (Ground water) Govt of Tamil Nadu, Chennai

Figure 1.5
Rain Fall - Cauvery Delta

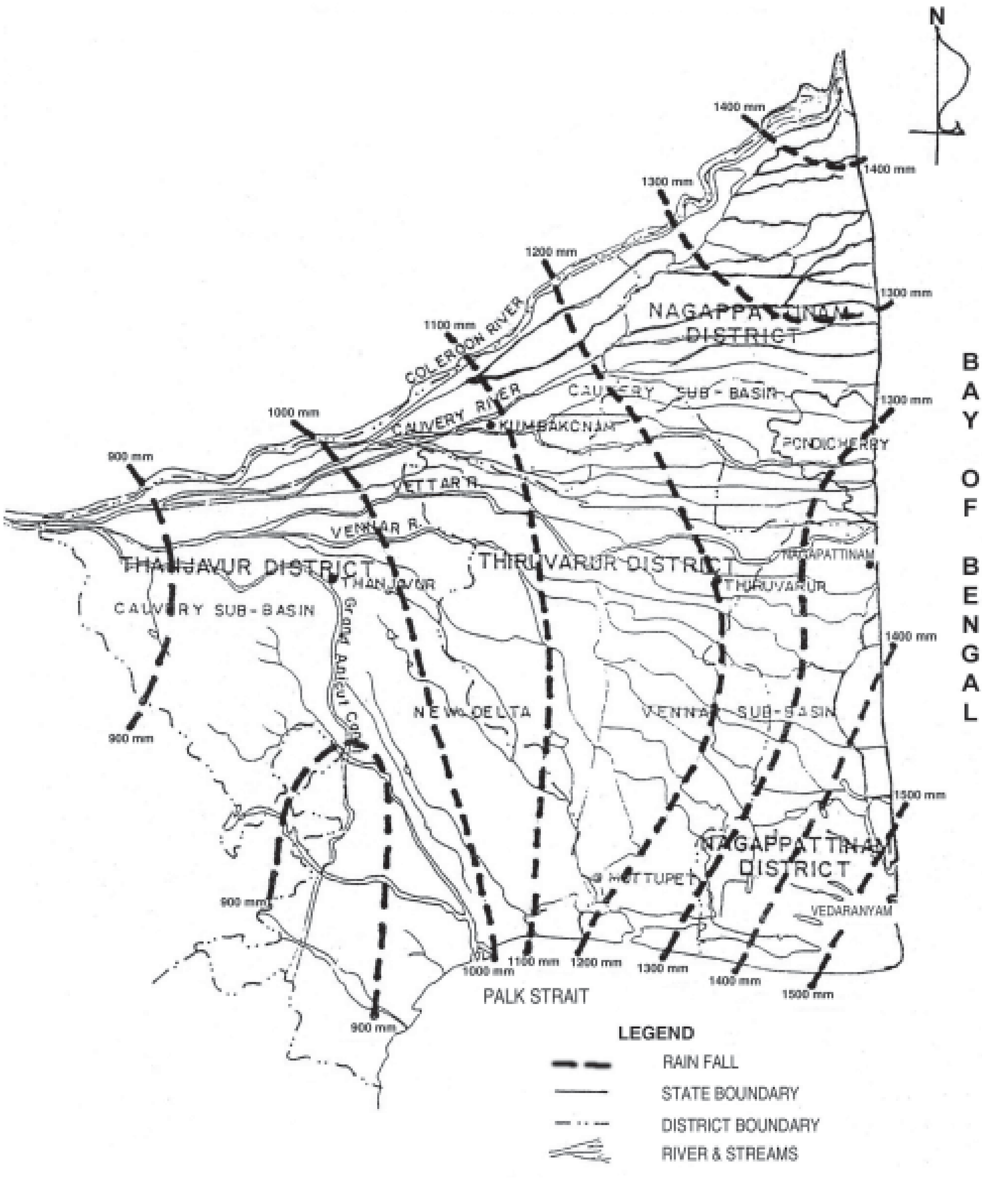


Figure 1. 6

Soil Map of Nagapattinam District

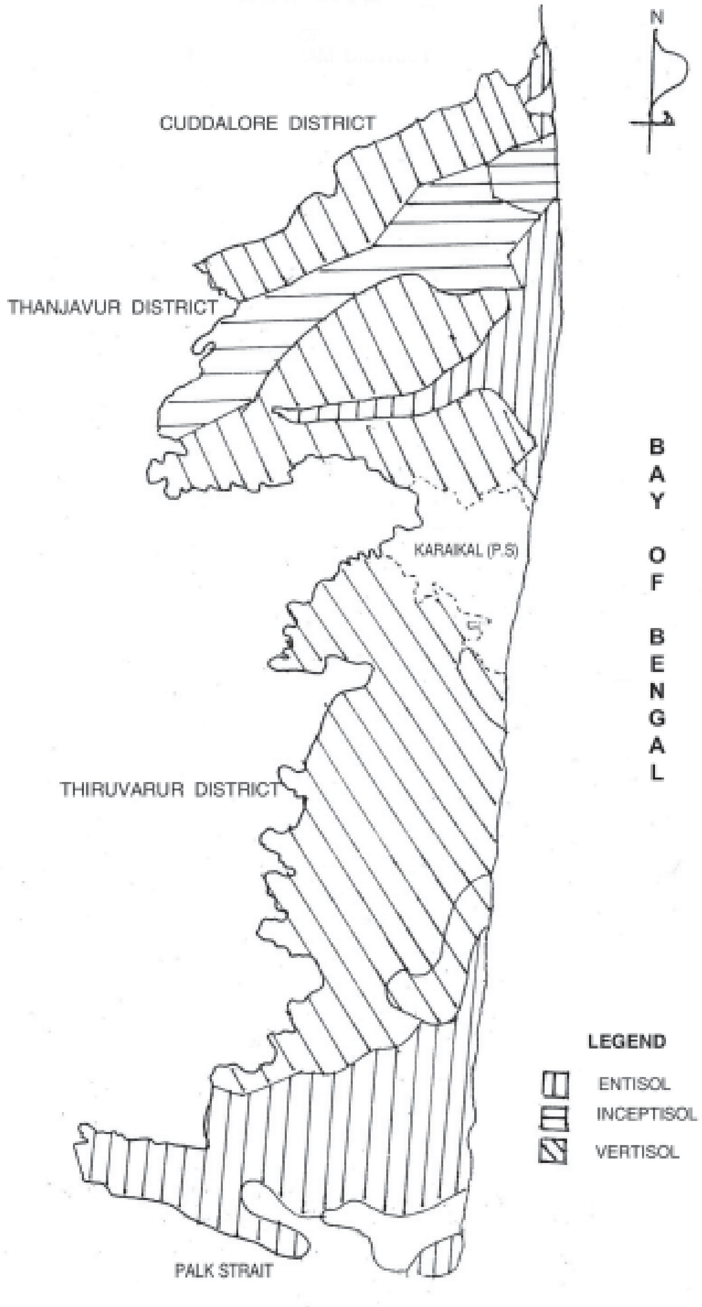


Figure 1. 7
Hydrogeological Map

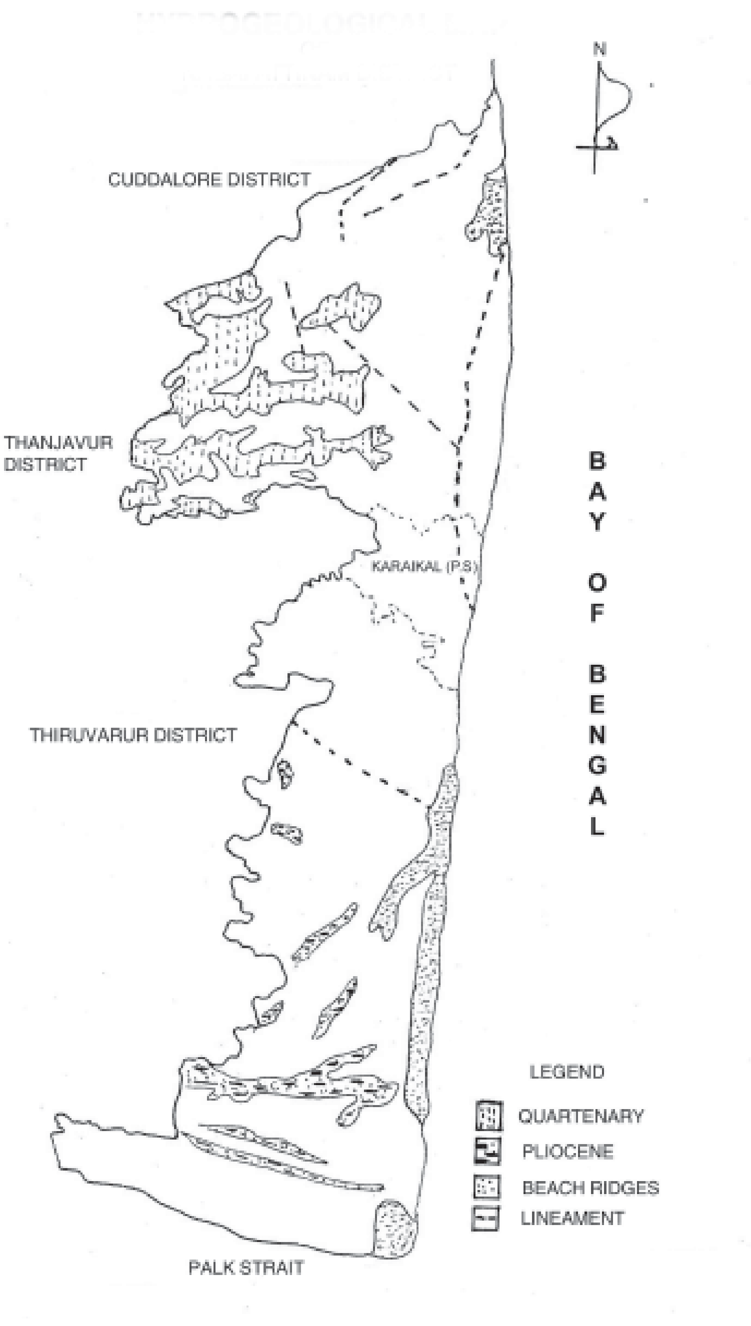
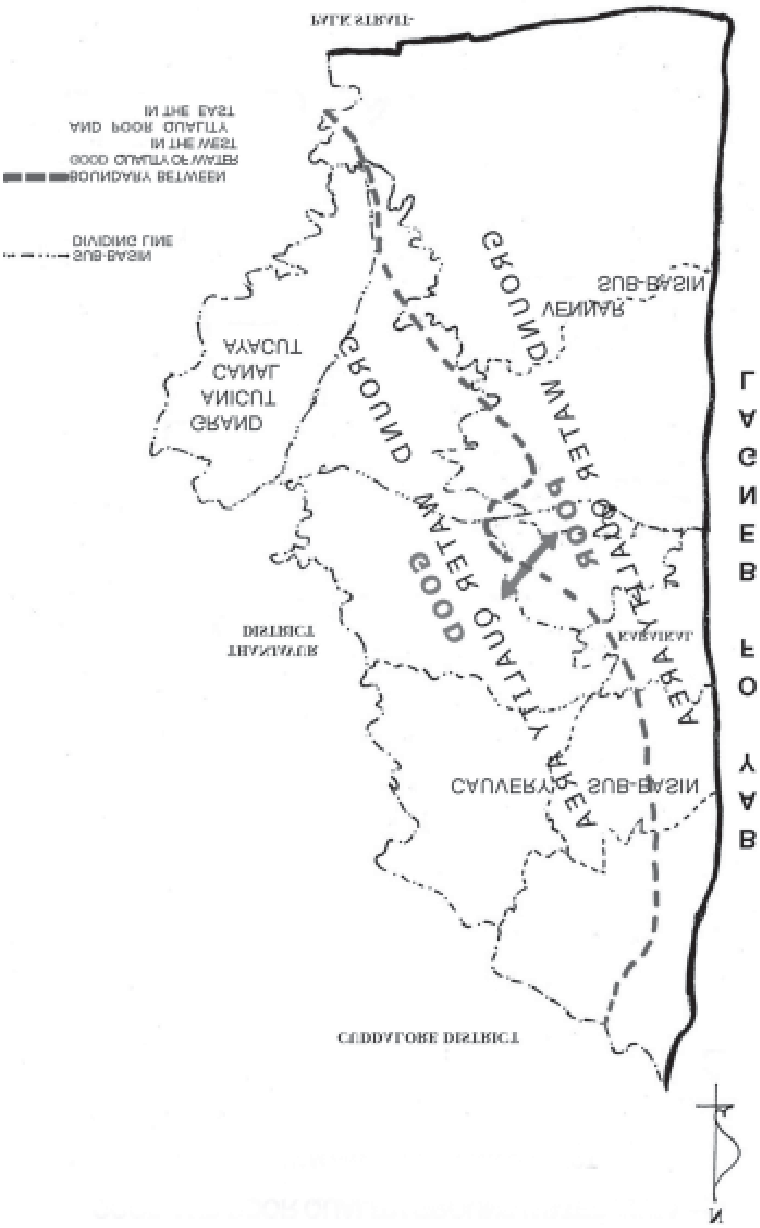


Figure 1. 8

Good and Poor Quality Ground Water Area



Chapter Two

Agriculture in Nagapattinam

Agricultural Profile of Nagapattinam District

Agriculture is the major means of livelihood for the people of this district. Located in the delta of the Cauvery River and crisscrossed by rivers and canals, the area is known for paddy cultivation though a number of other crops are also grown here.

The traditional cropping pattern of cultivation in the three districts of the Cauvery delta is: *Kuruvai* as the first crop of paddy (June-September) followed by *Thaladi* as the second crop of paddy in the double crop lands (October-January/ February). In the single crop land/ area, *Samba* paddy is grown from September to January. The farmers raise a pulse crop after *Samba/Thaladi* paddy using the residual moisture in the paddy field. In addition, wherever groundwater is available especially in Cauvery sub-basin, farmers grow sugarcane, banana, cotton, vegetables and other dry crops (Table 2.1).

Table 2.1

Important crops grown with area of cultivation and yield

Name of crops	Area in Ha	Yield in Ton/Ha	State average yield in T/Ha
Paddy	138945	3 to 3.25 *	4.25
Sugarcane	3000	92	100
Cotton	1000	0.33	0.375
Ground nut	3000	1.4	1.5
Fruits &vegetables	3100	-	-
Pulses	70000	-	-

Source: Economic Appraisal of Tamil Nadu, GoTN, 2003-04 & 2004-05

* as per our study

The Net and Gross sown area and Irrigated area of Nagapattinam District are given in Table 2.2.

Table 2.2

Sown and irrigated area in Nagapattinam district

Year	Net area sown in Ha	Gross area sown in Ha	Net area Irrigated in Ha	Gross area irrigated in Ha
1998-99	149706	252462	128749	157270
2003-04	131890	197890	104594	126428

(Source: Source: Economic Appraisal of Tamil Nadu, GoTN,, 1988-89)

The intensity of cultivation is 160% compared to intensity of 117% in the entire state of Tamil Nadu and the intensity of irrigation is about 124% compared to the state average of 120%.The area under *Kuruvai* and *Thaladi* are around 30,000 Ha whereas the area under *Samba* cultivation varies from 75,000 Ha to 1.00 lakh Ha.

Due to poor rainfall and non-availability of water from Mettur reservoir, the area under paddy in Cauvery delta is coming down. Among the three districts that are located in the Cauvery delta zone, Nagapattinam is the most affected by shortage of water. This is due to the fact that the water position in Mettur reservoir is frequently insufficient to allow enough outflow to all water to reach the tail end of the delta. However, when there is higher rainfall in the coastal areas due to cyclone / depression in the Bay of Bengal, many areas of Nagapattinam district get flooded and water logging takes place. In both situations, agriculture is affected.

Irrigation

Irrigation is done mostly from canals and to some extent, by wells. There are not many irrigation tanks in the district. The irrigation water is drawn from Cauvery, Vennar and Vettar rivers. The total length of canals is about 550 km[6] and there are about 6368 open wells. Table 2.3 gives the area under irrigation in the last three years.

In normal years, the water is released from Mettur dam on 12th June and flows till the end of January of the following year. During rainy days in the delta, the gates are closed at Mettur dam. The dam is situated about 200 km away from the Grand Anicut. It takes three days for water from the Mettur dam to reach the Grand Anicut and another three days to the tail end especially to the areas in Nagapattinam district.

[6] *Source: Economic Appraisal of Tamil Nadu, Government of Tamil Nadu, 2003-04 an 2004-05*

Table 2.3
Area under irrigation

Sl.No	Details	2001-02 (Area in ha)	2002-03 (Area in ha)	2003-04 (Area in ha)
1	Net area irrigated	125602	110113	104594
2	Gross area irrigated	160522	131322	126428
3	Food crops	157668	128476	121917
4	Non food crops	2854	2846	4511

Drainage

The delta slopes very gently (1 in 2000) towards east and south. The hydraulic head available for gravity flow into the fields from the irrigation channels that take off from the rivers is often negligible and in many cases, it is negative. Therefore irrigation is done under such situations by blocking the channel flow and building up a "Head". Under these conditions the same channels play a twin role serving for irrigation as well as drainage.

Floods and droughts

The Cauvery delta is known for floods and droughts in the same year. For example, in 1983-84, the South West monsoon was very weak and consequently the rainfall was low. The inflow into Mettur reservoir was minimal with no outflow and consequently there were drought conditions from July to October 1983 in the delta when the farmers were

Table 2.4
Floods and Droughts

Year	Flood/Drought
1966-67	Drought
1971-72	Floods
1978-79	Floods
1980-81	Drought
1982-83	Drought
1983-84	Floods
1995-96	Drought
2001-02	Drought
2002-03	Drought
2004-05	Floods / Tsunami
2005	Floods

unable to raise any crop. With the onset of North East monsoon in October-November 1983, paddy was planted. In December 1983-January 1984 there was heavy rain in the delta leading to unprecedented floods in low lying areas especially in Nagapattinam district. Many villages were marooned for weeks. Table 2.4 gives an idea of the frequency of floods and droughts in the district.

Thrusts in Agricultural Development

More than 80% of the water available is used for agriculture in Tamil Nadu. Hence it is essential that the available water be used efficiently, and economically. The main thrusts in Agricultural Development are as follows.

1. Increase the availability of surface and ground water
2. Increase the water use efficiency in canal, tank irrigation and in well irrigation.
3. Increase the yield per unit of water, land and time.
4. Introduce advanced method of irrigation in paddy cultivation (SRI method) and drip and sprinkler methods in well irrigation.
5. Bridge the yield gap in various crops grown in the district.
6. Change crop and cropping pattern based on the availability of water - introduce more areas under horticulture crops like growing fruit trees and vegetables in areas irrigated by groundwater.
7. Increase the fertility of soils and reduce the soil salinity.
8. It will also be worthwhile to start an attempt by pumping saline water from nearby canals on both sides into the canals and recharging them through flood/rain water, which will result in reducing salinity in aquifers in the long run.

Chapter Three

Brief on Vulnerability Study

Impact of tsunami on water resources and agriculture

The tsunami of 26th December 2004 impacted the coast of Tamil Nadu, Kerala and Andhra Pradesh on the Indian mainland, with the tsunami waters exerting their damaging effects up to 2 km from the coastline. Nagapattinam district was the worst affected district in Tamil Nadu. While the impact on the fishing community was most obvious, over 8460 Ha of agricultural land was also affected by the tsunami, of which over 4650 Ha was in Nagapattinam district according to official reports[6]. Apart from the waves that inundated lands close to the shore, the inflow of water through the channels and backwaters in the area resulted in the inundation of fields up to a distance of 7 km from the coast, causing extensive damage.

The agricultural land and water bodies were affected in the following manner due to the tsunami:

- Drying and scorching of the standing crop
- Spreading of debris to a distance of up to 1km
- Deposition of sand over the agriculture lands to depths varying from 3-15 inches
- Formation of sand mounds in some places
- Deposition of sea mud / saline soil up to 3 inches deep in some places
- Siltation of skimming wells with sea sand
- Contamination of water bodies with seawater
- Formation of gullies (channels developed due to erosion) in some areas

[6] "Tiding over Tsunami", p16. Government of Tamil Nadu, December 2005

Study on vulnerability of agricultural communities by NCRC

While working on the surveying to understand the impact of the tsunami on the agricultural sector, it became apparent that the tsunami had only brought into the limelight the vulnerable status of the agricultural community that had been reeling under the impact of alternate floods and droughts of increasing frequency and impact in recent times. NCRC felt relevant to understand these from communities' point of view, and identify focus areas to prepare communities to face future disasters. The first step in this direction was to undertake a systematic study, as grass-root level data on these issues were not readily available for planning. Subsequently, a sample study was conducted by NCRC in the district, to understand vulnerabilities of agricultural communities to frequent disasters and also their coping mechanisms. The outputs of the study were presented in the "National Workshop on Disaster Preparedness in Agriculture" in August 2006. Some of the relevant aspects of the study are described below.

A large number of coastal habitations are dependent on agriculture for their livelihoods; with higher proportion of families in Southern Region. In most habitations, large proportion of farmers have very small land holding, with large proportion of houses being thatched or government colonies, reflecting the poor economic status of most families living in these habitations.

The important immediate impact of the various disasters affecting agriculture has been reduced or total loss of production from the particular season, and reduced productivity of land due to salination (during floods) or lack of irrigation (during droughts). However, the effects of disasters are much wider than just loss to physical or tangible assets (such as land) and have been found to affect different profiles of communities in different ways. The responses to these disasters from government and other agencies seem to be asset based and reactive. There has been very little or no effort to mitigate these disasters or to help communities to prepare themselves to face and manage future disasters.

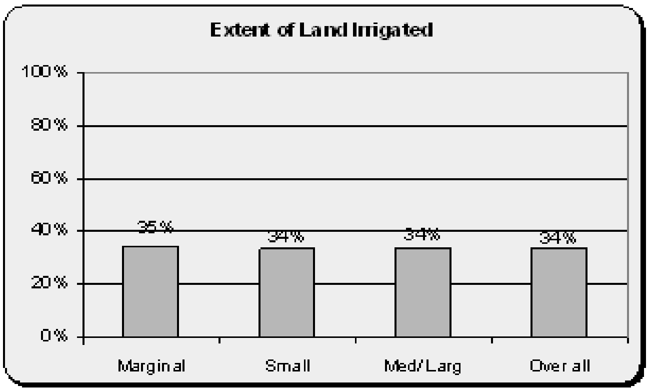
Coping mechanisms

The coping mechanisms adopted by farmers have been on individual household's ability to access financial and other support. Most of the marginal farmers shift to construction labour or even migrate due to loss of livelihood. They rarely get technical or financial support to return back to normalcy. This trend has been continuing over a long time thereby not allowing these communities to move out of a vicious poverty cycle. There are no safety nets for these farmers and their families to fall back on. Even normal or good yield gained from some years are wiped out in just one disaster.

The coping mechanisms adopted by the farmers were studied in two areas – with respect to land and crop, and with respect to managing their household chores. More than a third of marginal farmers quoted that they did not do anything to improve the situation during flood situations. About half of these farmers tried to drain excess water. In terms of running the family, 43% marginal go to informal sources for credit (with high interest rates) and 28% take up labour work either within the village or migrate. The proportion of small and medium/ large farmers taking up labour work is limited. A large proportion (57%) of medium/ large farmers managed these with their own money (savings).

Irrigation practices

From the study, it was learnt that about 34% of the land is irrigated, with about 35% of the marginal farmers' land under irrigation (which is marginally higher than small and medium/ larger farmers). Farm ponds are the main source of irrigation (53%) closely followed by the canal irrigation (43%) for the farmers as seen in coastal villages of the study area. A small percentage used bore wells as a source of water. At the habitation level too, of the 34 habitations covered, 56% of the land is irrigated through farm ponds followed by 41% area through canals. In terms of type of irrigation practice followed, 99% of the farmers reported using the method surface irrigation – flooding, as the regular practice.



Even though the data related to irrigation shows reasonable acreage of land being irrigated (which is good for agriculture), the proximity of these lands to these canals and sea is an important vulnerability factor in this delta region. With higher proportion of land of marginal farmers as 'wet land' (and canal irrigated), their lands are more prone to floods and cyclones.

It is this vulnerability that NCRC thought could be crucial to the continuing existence of farming in Nagapattinam district. Disaster-proofing of agriculture in Nagapattinam district necessarily meant that the status of the irrigation and drainage mechanisms, that should allow the excess water to safely drain out into the sea, be studied in greater detail and strengthened, wherever found necessary, to protect farms from flooding and salination.

Chapter Four

Need for the Study

Water management in agriculture is an increasingly important matter. Nagapattinam district, though located in the Cauvery delta, is at the tail end of the delta, which means that if there is not enough water in the Mettur dam, water does not reach the agricultural fields situated in Nagapattinam district resulting in drought like conditions leading to crop failure.

Nagapattinam is also a coastal district and affected by tidal influx through the many confluences of the Delta Rivers and canals. Large tracts of land get flooded with saline water during tidal influxes and this has resulted in increased salination of the land as well as waterbodies making them unfit for agricultural use especially those close to the coast. In addition, the coastal areas are lashed by cyclones, which frequent the Bay of Bengal, bringing in very heavy rainfall within very short periods of time. This causes extensive flooding.

The tsunami was only another disaster for the farmers of Nagapattinam district who were reeling under the impact of alternate floods and droughts in the region. As part of trying to understand the problems of the agricultural community in Nagapattinam district, studies were carried out which indicate that more than 80% of the farmers are marginal and small farmers and many of the problems faced by them could be traced to issues of drainage. Post tsunami, some NGOs worked at the field level and put in a lot of effort to improve drainage, at least locally. Their efforts paid off when later that year (2005), heavy rains led to flooding and crop losses in large areas but in areas where the drainage issue had been worked on, most of the crop could be saved.

While the drainage issue has been tackled in a few instances, it is generally localized and it is only when a holistic picture is made available and comprehensive solutions found that there can be improvement in the status of agriculture. Hence NCRC commissioned a study with the following objectives:

1. Collectively address the issues of identifying, prioritizing and planning the course of action to improve the irrigation and drainage infrastructure including the canals and all water bodies that have been neglected and lead to frequent flooding and salination.

2. Influence the Government / NGOs and farmers to maintain these life support systems of agriculture as the quickest means of disaster proofing of agriculture in the district.

The expected outcome of the study includes the mapping of the entire infrastructure, which are useful for agriculture in Nagapattinam district. This includes all the water bodies like irrigation canals, drainage channels, tanks, ponds, *ooranis*, temple tanks, farm ponds, percolation ponds, wells, check dams and other water storage structures in the study area.

Chapter Five

Methodology

Choice of Study area:

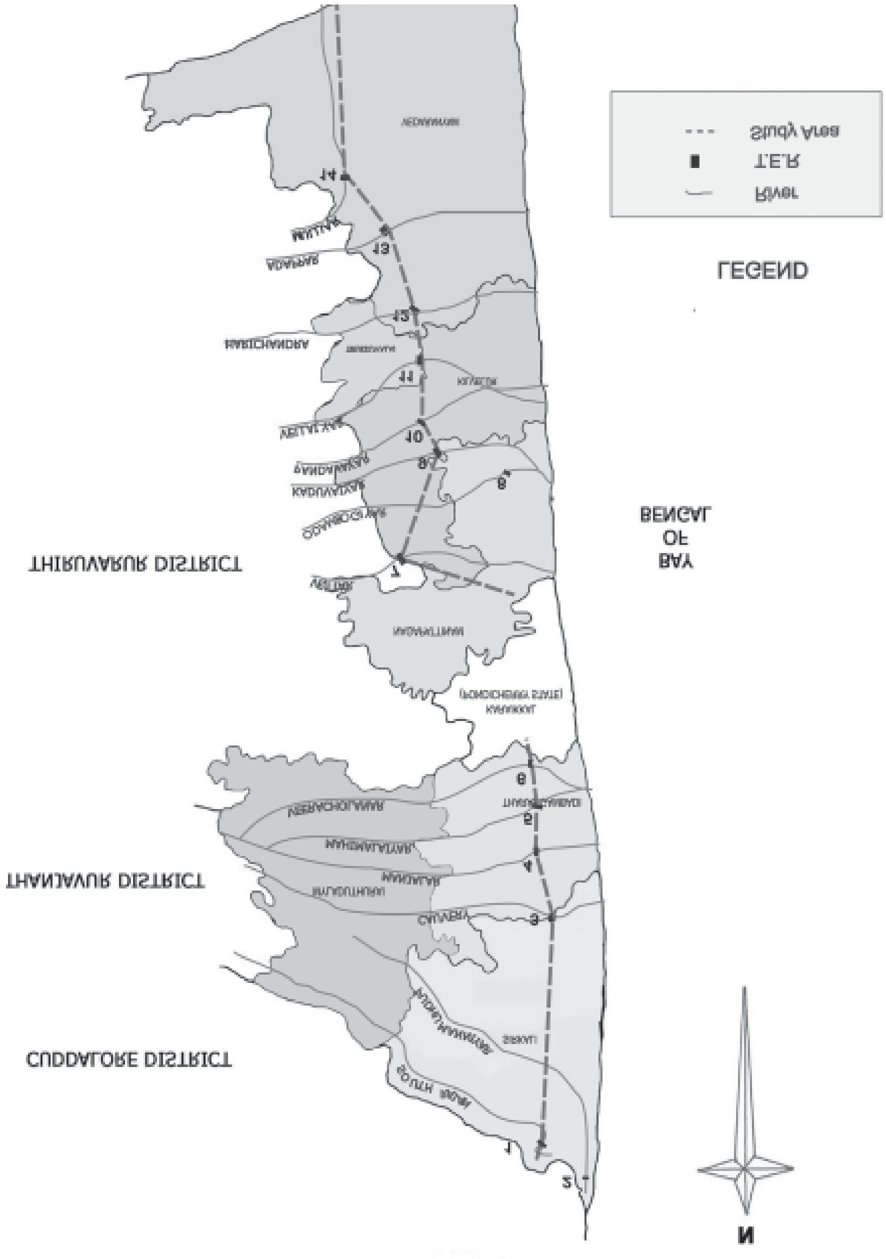
The tail end of Cauvery delta covers the entire Nagapattinam district from Sirkali taluk (River Coleroon) in the north to Vedaranyam taluk (swampy area) in the south for a distance of 145 Km. There are about 20 rivers/channels/drains in this stretch which flow into the Bay of Bengal. Of these, six channels/drains are in the Karaikal region of Puducherry state and fourteen are in Nagapatttinam district.

Tail End Regulators (TER) are provided at appropriate points towards the tail end of the river, from which main irrigation channels (A class) are drawn on one or both sides. These TERs are used to maintain the command level in the rivers to help the channels (A class or main channels) taking off above the regulators. From the A class channels, sub mains, distributaries, field booths (B,C,D class channels) are seen branching off and used for irrigation. After the TER, the river channel acts only as a drain and joins the sea. The TERs are situated about 5 to 20 km west of the coastline.

Being an impossible task to cover the entire Nagapattinam district in the short period during which the study was to be done, consultations were held with the officials of the WRO/PWD, Department of Agricultural Engineering, Agriculture, Horticulture and others to identify a suitable area. WRO/PWD suggested that the points where the TER are located in all the river channels could be taken as the boundary on the western side. The area between the boundary of the TER points in the west and coastline in the east was taken as the study area. This was considered reasonable and could be covered by the team in 3 to 4 months. The area comes to about 33% of the total area of Nagapattinam district (Fig-5.1).

The study area thus selected was spread in all the taluks of the district except Mayiladuthurai and worked out about 92,851ha out of the total geographical area of 2,71,583 ha of the district. The irrigated area is about 31,500 ha (25,500 + 6,000) which is about 28% of the

Figure 5.1
River-TER Study Area



total irrigated area of the district. 148 revenue villages were covered in the study area including 779 hamlets.

The location of TERs and other details are given in Table 5.1. A map showing the study area and the tsunami affected area is given in Fig 5.2.

Table 5.1

Location of River – Tail End Regulators

No	Taluk	River	TER.No	Location Village	Revenue Village
1	Sirkali	South Rajan	1	Pillpadugai	Alagudi
2		Pudhumaniyar	2	Pudhupattinam	Pudhupattinam
3		Cauvery	3	Melaiyur	Melaiyur
1	Tharangambadi	Manjalar	4	Annappanpettai	Udayaurpathu
2		Mahimalaiyar	5	KannappaMulai	Kaliyappanallur
3		Veeracholanar	6	Thevanur	Kattucherry
1	Nagapattinam	Vettar	7	Odacherry	Odacherry
2		Odambogiyar	8	Nariyangudi	Pappakoil
3		Kaduvaiyar	9	Vadugacherry	Vadugacherry
1	Kilvelur	Pandavayar	10	Eravangudi	Eravangudi
1	Thirukuvalai	Vallaiyar	11	Earvakkadu	Melavalakkari
1	Vedaranyam	Harichandra Nathi	12	Brinjimulai	Brinjimulai
2		Adappar	13	Unbalacherry	Unbalacherry
3		Mulliyar	14	Thanikkottagam	Thanikkottagam

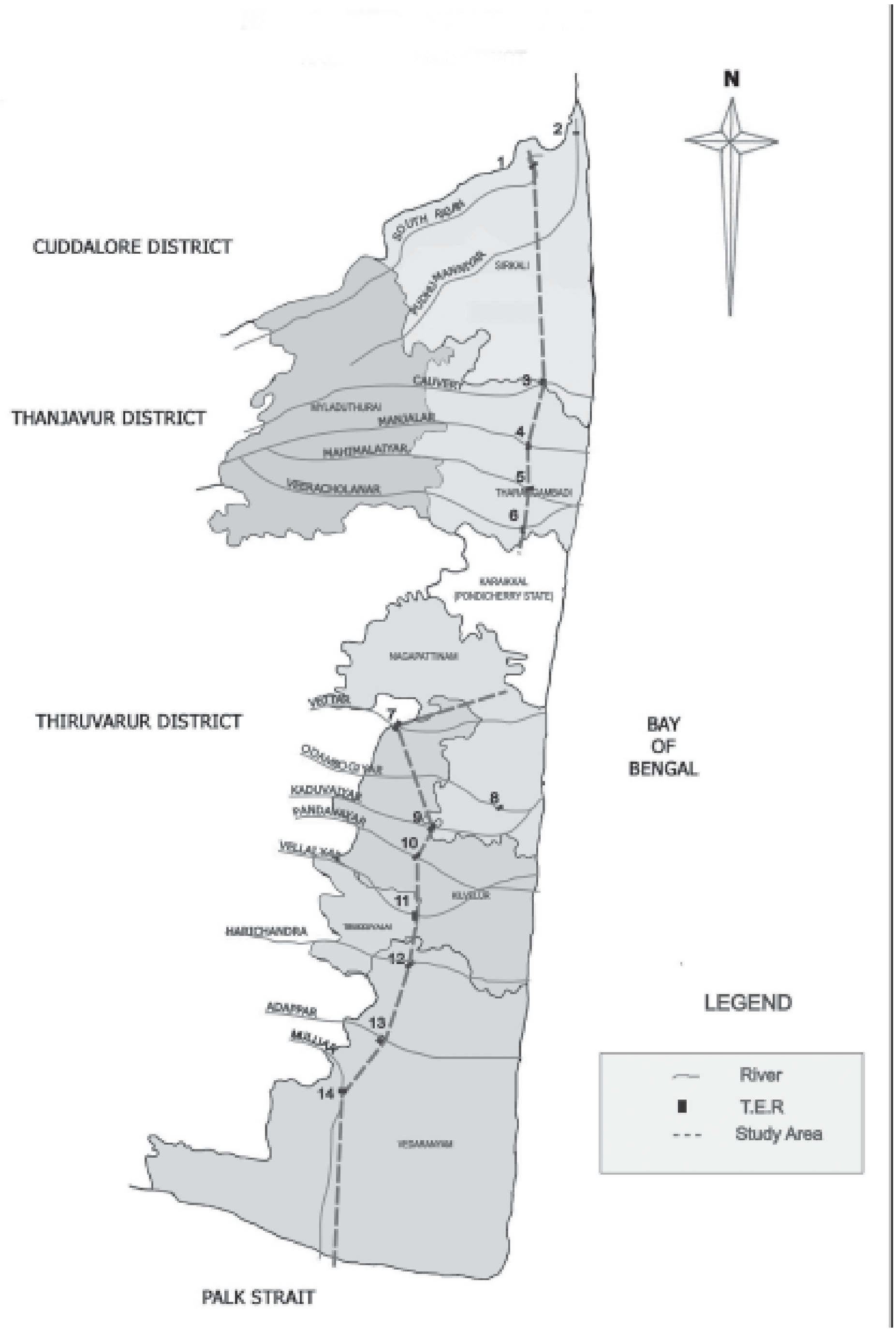
Study Team

Five NGOs were involved in the study, each covering one taluk as follows:

- Covenant Centre for Development (CCD), Poompuhar - Sirkali taluk,
- Centre for Environment Education(CEE), Karaikal - Tharangambadi taluk,
- Tamil Nadu Organic Farmers Movement (TOFARM), Nagapattinam - Nagapattinam taluk,
- Kudumbam, Trichy - Kilvelur/Tirukuvalai taluks, and
- Venture Trust, Pudukottai - Vedaranyam Taluk.

Figure 5.2

Study area with Tsunami affected area



Two staff members from each NGO were involved in the study process on a full time basis for a period of three months. A study co-ordinator from NCRC facilitated the entire process. Dr. R.K. Sivanappan, Senior Consultant and Expert in Water Resources Development, erstwhile State Planning Board member and former Dean of Agriculture Engineering College, Coimbatore, was the Team Leader for the Study.

Stakeholders involved

Apart from NGOs, the study was a collaborative effort with the involvement of personnel from PWD, AED, Ground Water Department (both Central & State), TWAD Board and other line departments. The farming community was involved throughout the study at various stages. Catalyst Management Services (CMS), Bangalore did the data management.

Capacity Building of the study team:

1. Orientation programme

After conceptualizing the study, a "pilot study cum orientation programme" was organized covering one full river system (TER) visiting all irrigation (A, B, C, D class) / drainage channels (main/sub) and 'other water bodies' (village ponds, tanks, farm ponds, open/bore wells etc.) with PWD officials. Sessions on information/data formats were organized periodically.

2. Review & Planning

- Meetings were organized with the NGO field staff on a weekly basis during the entire study period. These meetings helped in a large way to review, assess and plan; and to discuss problems/issues in the field.

- A few meetings were held with the NGOs along with the PWD personnel initially to plan the study and identify the study area, and later to collectively work on location of TERs, irrigation/drainage channels etc.

- Meetings from time to time were held with Sub-Divisional Officers (SDOs) and Assistant Engineers (AEs) of PWD in their respective offices as well as in NCRC office in order to map out all the irrigation / drainage channels and other water bodies.

Sampling

As each river system is unique and the off-take of channels from the main river varies from one TER to another, it was felt necessary to study the entire network of irrigation / drainage channels. The study, hence, covers all the channels including A, B, C, D class under irrigation and the river, main, sub drainage channels under the given TER.

Owing to the nature of 'other water bodies', it was felt necessary to study them only on a revenue village- wise basis. The time constraint of the study coupled with huge number of 'other water bodies' permitted sampling only in 25% of the total revenue villages in the study area on a random selection basis. The information thus collected is to be extrapolated to the entire study area.

Primary and Secondary Information collection

The methodology of data collection in the field includes the following.

- Transect walk along the river system with key informants (farmers), taking measurements and making observations.
- Focus Group Discussions with farmers / Self Help Groups / Water User Associations in the villages.
- Discussions with representative farmers at district level.
- Discussions with personnel of PWD, AED, Department of Agriculture (DoA), Central Groundwater Board and other line departments.

Apart from the above departments, secondary data was also collected from Revenue department (Taluk office, Village Administrative Officer), Statistics department, Tamil Nadu Rice Research Institute (TRRI) and other institutions. Secondary as well as supportive information has been taken from annual reports of departments / institutions, workshop reports and other papers.

Historical information on the Vedaranyam and Buckingham canals as well as on *Alams*, irrigation tanks and sand ridges / sand dunes was collected.

Damage Assessment and status of water bodies

The NGO representatives surveyed the area covered under the TER and collected the flow chart for the TER from the concerned section officer in charge of the River Channel. The flow chart contains the irrigation and drainage channels under the TER. With this map, and with the help and guidance of the key informants (VAO/Farmer/WUA member/SHG member) the field investigators walked along the A class channel (Fig-5.3) and all other branch channels to study the existing conditions of the channels, problems in the channels and what is to be done for increasing the flow, and methods of control and regulation for efficient use of water.

The data and details collected with detailed measurements for all the channels under each TER / channel wise are as follows:

- Number of irrigation channels
- Area irrigated (ayacut)
- Length, average width and average depth of channels
- Number of abandoned/used channels
- Number of channels encroached, total area encroached and type of encroachment
- Details of vegetation/weeds obstructing flow
- No of channels silted and extent of siltation
- Damage to channel bund and volume of earth required for strengthening the bund to the original condition
- Sluices and other structures damaged and extent of damage

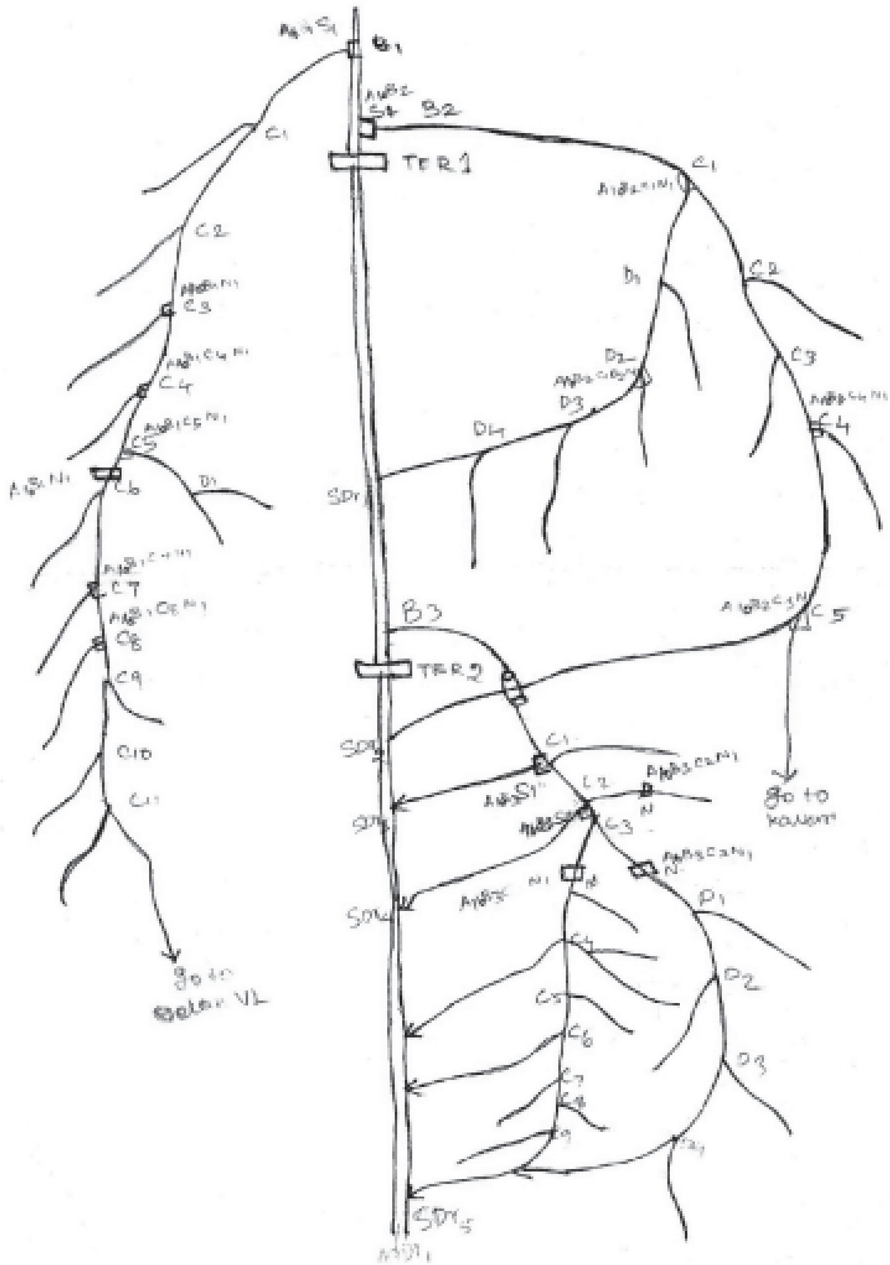
The time line with respect to status of water bodies was studied to know the trend over years in terms of maintenance, regulation and other mechanisms. Information on the community's involvement in management of water bodies over the years was also collected.

Basic village and agricultural information (crops, trees, horticulture, animal husbandry-related) were collected as primary information from villages. The issues in agriculture as felt by farmers were also collected.

Data Analysis

Primary data collected has also been triangulated with secondary data available, wherever possible, to minimize discrepancies. The primary data (both quantitative & qualitative) in prescribed formats were then analyzed using the services of CMS. Interpretations were made based on data analysis.

RAJENDREN CHENNEL (CAUVERY)



Chapter Six

Observations - Water Bodies

6a: Water bodies

Two different kinds of water bodies can be distinguished - flowing water and standing water. In the former are included rivers, their distributaries and the various canals and channels that have been carved out of the rivers for irrigation/drainage. Standing water bodies include both natural and artificial structures formed mainly by collection of water in low lying areas. Some of these are fed by rivers/channels, others are transient structures which are mainly rain-fed. There are also various kinds of wells that are used to harvest groundwater. In this study focusing on the irrigation systems prevailing in the areas, as a representative sample, one quarter of the villages in the study area were surveyed for their water bodies.

Channels that are cut directly from the river for irrigation purposes are called 'A' class channels. From these, sub channels are sourced and are classified as 'B', 'C' and 'D' class channels. There are also channels that carry the excess irrigation water from the fields. In some cases, irrigation channels may also serve as drainage channels. The river after the TER serves only as a drain. The total length of irrigation channels in the study area is 1324 km compared to the 346 km of drainage channels. The total number of irrigation channels is 1141 against 180 drainage channels.

The tail end regulators are used to maintain command level in the rivers to help the A class channels taking off above this regulator. The TERs are constructed at appropriate locations that permit water taken from the sluices (in the A class channel) to irrigate all the lands below the TER up to the sea. There are 14 TERs in the study area. The TERs are constructed about 3 to 20 km from the confluence of the river and sea depending on the terrain and located suitably so as to irrigate all the command area up to the seashore. TER No 7 in the

River Vettar is at the furthest distance from the confluence. TER 2 on the river Pudumanniar River is located closest to the sea at about 200 m from the point where the river joins the sea.

The TERs serve not only to divert water for irrigation and collect excess water from the fields but also help prevent seawater ingress.

Table 5.1 (Chapter 5) gives a list of the 14 TER and the villages in which they are located.

6b: Irrigation

Number of Channels

The total number of different channels is 1141. Of these, 26 channels are abandoned due to various reasons. The total ayacut in the study area under all the TERs is 25,509 ha. Table 6.1 gives the numbers and lengths of the various kinds of irrigation channels.

Table 6.1

Irrigation Channels in the study area

Type of channel	Number	Length in kms	Average width (in metres)	Average depth (in metres)
A	119	329	3	1.2
B	397	522	1.8	0.9
C	483	402	1.2	0.7
D	135	72	1	0.7
E	7	0.6	1.2	0.9

The detailed basic data TER wise and Channel wise are tabulated and given in Tables 6.2 and 6.3

Siltation

526 channels out of 1141 channels are badly affected by siltation in the study area. The locations of siltation in each channel were identified and the length, average width and depth of siltation were measured to assess the volume of silt accumulated in the entire study area. The total siltation is more in the Vellaiyar river system (TER 11). The number of channels affected and the channel-wise quantum of siltation are given in Table 6.4.

Table 6.2

Irrigation Channels - No of Channels and Ayacut area

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Class	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Total
A	12	50	19	4	2	4	1	2	2	2	5	10	2	4	119
B	7	10	50	39	39	22	8	4	20	6	61	83	38	10	397
C			86	35	45	33	29	12	54	1	77	62	49		483
D			14	6	1	25	37	1	18		22	11			135
E							7								7
Total No	19	60	169	84	87	84	82	19	94	9	165	166	89	14	1141
Ayacut Area (Ha)	489	1377	3243	619	1344	391	1830	202	4194	475	3731	3935	2355	1324	25509

Table 6.3

Irrigation Channels - Length (metre)

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Class	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Total (m)	Total (km)
A	22550	50550	72200	13000	11500	6000	23000	8200	15500	6200	29900	38618	14100	17500	328818	328.8
B	9000	3020	70300	41075	43400	17750	37700	6500	61850	10900	99973	59385	30710	30000	521563	521.6
C			52500	36830	28650	18900	37020	5145	55978	2000	87285	31805	45500		401613	401.6
D			6000	2500	400	8900	13575	600	20750		14640	4215			71580	71.6
E							620								620	0.6
Total (m)	31550	53570	201000	93405	83950	51550	111915	20445	154078	19100	231798	134023	90310	47500	1324194	
Total (km)	31.55	53.57	201.00	93.41	83.95	51.55	111.92	20.45	154.08	19.10	231.80	134.02	90.31	47.50		1324

Table 6.4
Siltation quanta

Type of channels	Total No. of channels	No. of channels silted	Quantum in m3
A	119	74	1,98,684
B	397	205	2,89,258
C	483	170	1,04,388
D	135	70	14,584
E	7	7	159
Total	1141	526	6,07,073

The details of siltation TER-wise and channel-wise volume of siltation are given in the Table 6.5.

Bund damages

Bunds of 147 channels out of 1141 are affected due to various kinds of damage that have accumulated over the years because of non-maintenance. The damages are due to carrying materials for farming operations, animal / human crossings, breaches during heavy rains/ floods, and because of soils loosened by not giving proper slope. In some cases, there have also been deliberate damages to the bunds for easy access of water for aquaculture. The length, average breadth and depth of the damaged portions of the bunds were measured to calculate the volume of earthwork needed to bring the bunds to the designed condition. The maximum damages are noticed in Vettar river system (TER 7). The number of channels affected and the volume of earthwork involved / needed are given in Table 6.6.

The TER wise and channel-wise details of damaged bunds, and volume of earth work damaged are given in Table 6.7.

Encroachment

The total area of encroachment in the entire study area works out to 11.67 ha out of 368 ha. The encroached land is used for the following purposes.

- Cultivation
- Aquaculture, pisciculture
- House construction
- Planting of trees

Table 6.5

Irrigation channel - Siltation volume (in m^3)

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Volume of silt (m^3)
Class	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	
A	776	885	13870	720	4800	1000	399	6363	2790	11160	88968	54531	2288	10134	198684
B			2050	2374	5237	820	7403	2898	6630	7349	174301	48476	19481	12240	289258
C			1369	2238	248	12	6024	1938		1200	79807	2133	9420		104388
D				64			2764	300	1980		9110	367			14584
E							159								159
Total	776	885	17289	5396	10285	1832	16748	11498	11400	19709	352186	105507	31189	22374	607073

Table 6.6

Earthwork Requirements

Channel Type	Total Number	Channels affected	Volume of earthwork damaged (in m^3)
A	119	65	1,07,039
B	397	37	43,573
C	483	44	13,081
D	135	1	263
E	7	-	-
Total	1141	147	1,63,956

The TER-wise and channel-wise detailed information about different encroachments are given in the Table 6.8.

Weed Infestation

Water hyacinth is found growing in most of the channels in the study area. In some locations, the entire cross section area is occupied by this weed, which obstructs easy flow of water especially during the rainy season. The total area covered by this weed in all the channels in the study area is about 3,50,000 square metres or 35 ha. The channel-wise area covered by weeds is given in Table 6.9.

Other structures

The structures in the channels are old and not maintained properly. Many are damaged and some are not in use at all. Out of 258 sluices within the study area, 214 are in working condition (though being used with difficulty). All need to be reconstructed or repaired. The channel-wise damage details in the sluices are given in Table 6.10.

The information regarding the reasons for abandoning the sluices like impact of tsunami, theft, flood, not maintaining the structures properly etc, were gathered.

The extent of damages to sluices is given in the Table 6.11.

The other structures like bed dam, culvert, pipes, etc in the systems, about 278 in number, require replacement/repair to various extents. The damages were classified into three categories for estimation purposes.

Table 6.7

Irrigation channel - Bund Damage volume (in m^3)

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Volume of Bund Damage (m^3)
Class	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	
A	4194	2168	613	1477	144	50	26291	4670	14443	706	22724	117	28500	945	107039
B			1091		48		22504	5359	10019	768	1321		165	2299	43573
C							9133	2913	971	64					13081
D								263							263
Total	4194	2168	1704	1477	192	50	57927	13205	25433	1537	24045	117	28665	3244	163956

Table 6.8

Irrigation Channels - Encroachment area (in acres)

TER No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Encroched Area (acres)				Total Area (Ha)
	Class	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Agri land	Aqua farm	Houses	Trees	
A	Agri land		0.90	0.03	0.08			0.88	0.31		0.03	0.01	2.96			5.18				
	Aqua farm	0.98					0.25						0.16				1.39			
	Houses							0.01		0.01	0.64	2.41	0.90		0.01			3.97		
	Trees												0.10	0.50	2.66				3.26	
	Total	0.98	0.90	0.03	0.08	0.00	0.25	0.88	0.31	0.01	0.66	2.42	4.12	0.5	2.67					5.59
B	Agri land							0.50	0.065	0.01		2.24	1.30		3.67	7.79				
	Aqua farm						0.65					0.13	0.83	1			2.61			
	Houses							0.04		0.01		0.02	1.07					1.13		
	Trees													0.55					0.55	
	Total	0.00	0.00	0.00	0.00	0.00	0.65	0.54	0.07	0.02	0.00	2.38	3.20	1.55	3.67					4.89
C	Agri land							1.67				0.05				1.71				
	Aqua farm			0.55			0.54					0.15					1.24			
	Houses																	0.00		
	Trees																		0.00	
	Total	0.00	0.00	0.55	0.00	0.00	0.54	1.67	0.00	0.00	0.00	0.20	0.00	0.00	0.00					1.19
Total (acres)		0.98	0.90	0.57	0.08	0.00	1.44	3.09	0.38	0.03	0.66	4.99	7.32	2.05	6.34	14.69	5.23	5.10	3.81	
Grand Total (Ha)		0.40	0.36	0.23	0.03	0.00	0.58	1.25	0.15	0.01	0.27	2.02	2.96	0.83	2.57	5.95	2.12	2.07	1.54	11.67

Table 6.9

Extent of weed infestation

Channel	Area covered in square metres
A channel	1,60,000
B channel	1,40,000
C channel	46,000
D channel	4,000

Table 6.10

Damage to other structures

No.	Channel	Masonry (in numbers)	Shutter (in numbers)
1	A	56	37
2	B	58	48
3	C	22	22
4	D	1	-
5	E	1	-

The other structures like bed dam, culvert, pipes, etc in the systems, about 278 in number, require replacement/repair to various extents. The damages were classified into three categories for estimation purposes.

Table 6.11

Irrigation channel - Condition of Sluices

a) Masonry

Class	TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	No. Of Sluices	
Class	Masonry condition	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Good	Damaged
A	Good	-		4	3				-		1	1	2	2	4	17	
	25% Damage	-	6	9	1	1	1	2	-			1	8			-	29
	50% Damage	-		9			2	3	-	3		5				-	22
	100% Damage	-						1	-		1	3				-	5
B	Good Condition	-		3	4	1			-			9	6	18	9	50	
	50% Damage	-		4		3		4	-	3		18	6			-	38
	100% Damage	-						2	-	3	4	20	1			-	30
C	50% Damage	-							-				1			-	1
	100% Damage	-							-			21				-	21
D	100% Damage	-							-	1						-	1

b) Shutter

Class	TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	No. Of Sluices	
Class	Shutter Condition	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Good	Damaged
A	Good	-	5	11	4	1	2		-	3		2	2	2	4	36	-
	50% Damage	-	1	11			1	6	-		2	5	8			-	34
	100% Damage	-							-			3				-	3
B	Good	-		5	4	4			-	3	4	17	8	18	9	72	
	50% Damage	-		2				4	-	1		17	5			-	29
	100% Damage	-						2	-	2		13				-	17
C	100% Damage	-							-			21	1			-	22
D	Good									1						1	

6c Drainage Channels

Types of channels

Drainage channels are classified into 1) River drains, 2) Main drains and 3) Sub drains.

1. **River drainage:** The river serves for irrigation and drainage purposes, but after the tail end regulators (TER), the river channel does the function only of drainage and hence is called as river drainage. There are 14 river drainages in the study area corresponding to the 14 TER. Out of these, two river drainages split into two branches each before joining the sea.

2. **Main drains**: Just above the TER, A class channels are drawn from one or both sides of the rivers. From these, branches are further cut resulting in the B,C and D class channels. When water is released in all the channels for irrigation and during rains, the excess water and seepage/percolation water from channels are collected in a channel which joins the river drainage. Such drains with a width of more than 5m were classified as "main drain" for the study. In addition, the channels that originate between two TERs, run parallel to the river drainage and join the sea directly are also classified as "Main drain" for the purpose of this study.

3. **Sub drains:** Drains of the above type but of width lesser than 5m were classified as "sub drain" for the study.

In the district map all the River Drainage and Main Drains are marked for the study area (Fig-6.1). The conditions of these (drainage) channels were studied in depth and measurements are taken in order to work out the estimation for rehabilitation. Since drainage / water logging is the major problem in the coastal area especially in southeast and southern part of Nagapattinam district, and the main intention of this study was understanding the means to disaster- proofing of agriculture, there was considerable focus on the drainage systems. Discussions with the farmers and PWD officials indicated that that about two third of the paddy land in the study area is badly affected / inundated due to insufficient drainage.

Number of Channels

The total number of different type of drainage channels is 180 having a total length of 346 km. The number, length of the channels are given in Table 6.12.

Figure 6.1

Drainages in the Study Area

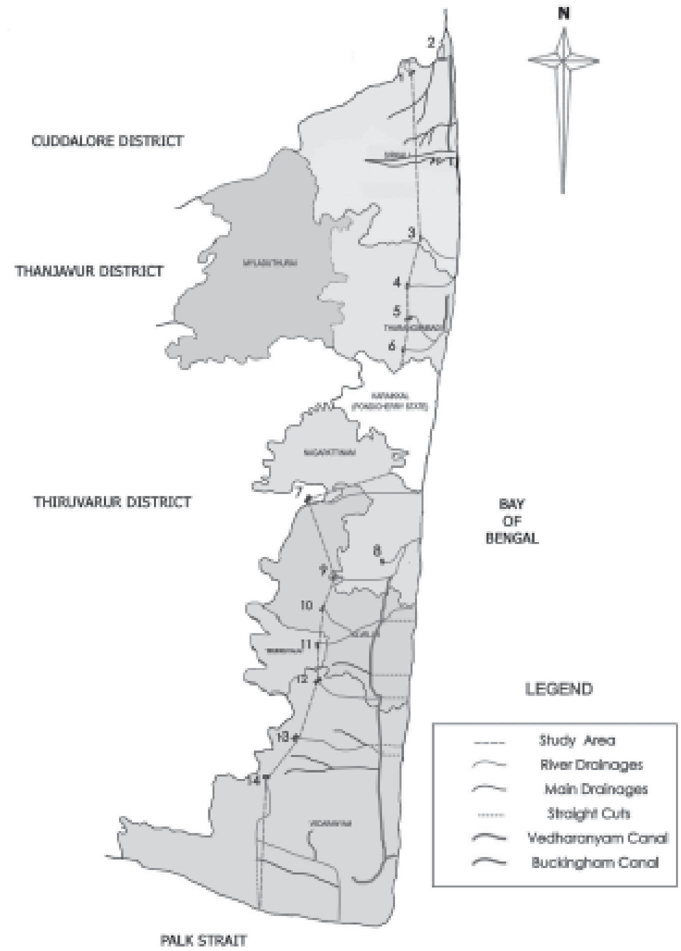


Table 6.12

Drainage channels in the study area

Sl.No	Category of channel	Number	Length in km
1	River drainage	16	116
2	Main drainage	67	170
3	Sub drainage	97	60
	Total	**180**	**346**

Table 6.13

Drainage channel - No of Channels

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Type	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Total
River Drainage	1	1	1	1	1	1	1	1	1	1	2	1	1	2	16
Main Drainage	2	4	7	1	4	3	17	1	5	3	3	5	10	2	67
Sub Drainage	1		21	7	8	10	35	2	11	2					97
Total	4	5	29	9	13	14	53	4	17	6	5	6	11	4	180

Table 6.14

Drainage channel - Length (metre)

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Type	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Total (m)	Total (km)
River Drainage	2000	200	5800	6000	1000	1200	22000	4000	9000	4000	21000	5000	13000	21500	115700	115.70
Main Drainage	8200	10500	14700	1500	6100	1800	26350	2000	6700	10000	7200	14280	51800	9000	170130	170.13
Sub Drainage	1200		11500	2400	4900	7400	23890	550	1580	6500					59920	59.92
Total (m)	11400	10700	32000	9900	12000	10400	72240	6550	17280	20500	28200	19280	64800	30500	345750	
Total (km)	11.4	10.7	32	9.9	12	10.4	72.24	6.55	17.28	20.5	28.2	19.28	64.8	30.5		346

Siltation

Out of 180 channels, 138 channels are affected very badly by siltation. The total siltation is more in the Vettar River system (TER 7). The number of channels affected by siltation and the estimated quantum of silt are given in Table 6.15.

Table 6.15

Siltation quanta

Sl. No.	Type of channels / drainage	Total number	No of channels silted	Quantity of silt in m^3
1	River drainage	16	21	21,54,420
2	Main drainage	67	55	12,55,054
3	Sub drainage	97	62	19,369
	Total	180	138	34,28,843

The details of siltation category-wise, TER-wise and volume of siltation are given in Table 6.16

Table 6.16

Drainage Channel - Siltation volume (in m^3)

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Volume of silt (m^3)
Type	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	
River Drainage	750	10320	31750	33790	59200	22680	660000	29400		72000	300530	610000	160000	164000	2154420
Main Drainage	10800	145500	124980		12130	571	14337.6	1435	3885	42075	27540	551300	208500	112000	1255053.6
Sub Drainage			4012	382.5	960	120	11883.6	1207.5	803.42						19369.02
Total Volume (m^3)	11550	155820	160742	34173	72290	23371	686221	32043	4688	114075	328070	1161300	368500	276000	3428843

Bund damages

Poor maintenance of bunds has resulted in reduction in carrying capacity of the channels. Also, the soil is sandy, the bunds are formed with loose soil and without giving proper slope. The length, average width and depth are measured to calculate the volume of earthwork needed to bring the bund in good condition. 99 channels are found affected out of 180. The maximum bund damages are noticed in Adappar river system (TER 13). The damages are more in the main drains, which are flowing parallel to river drainage. The number of channels affected and the volume of earth work involved is given in Table 6.17.

Table 6.17

Earthwork Requirements

Sl.No	Channel / Category	Total number	Channels affected	Volume of earth needed (in m^3)
1	River drainage	16	16	3,70,572
2	Main drainage	67	43	2,59,695
3	Sub drainage	97	40	5,692
	Total	180	99	6,35,959

The details of damaged bunds category wise, TER wise and volume of earth work needed are in Table 6.18.

Table 6.18

Drainage Channel - Bund Damage volume (in m^3)

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Volume of Bund Damage (m^3)
Type	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	
River Drainage	131		450	5540	40050	45506	66000	13475	4500	60480	81725	43714	9000		370572
Main Drainage	1063	5063	5300		8800		14840	604	1214	27420	11632	49761	134000		259695
Sub Drainage					168		5112	412							5692
Total volume (m^3)	1194	5063	5750	5540	49018	45506	85952	14491	5714	87900	93357	93475	143000	-	635959

Encroachment

The total area of encroachment in the drainage channels in the study area is about 16.6 Ha. The encroachment area is used for the following purposes.

- Cultivation
- Aqua farm
- Constructing houses
- Growing trees

The detailed information about different encroachment, category-wise and TER wise are given in Table 6.19.

Table 6.19

Drainage channel - Encroachment area (in acres)

TER No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Encroched Area (acres)				Total Area (Ha)
Type		South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Agri land	Aqua farm	Houses	Others	
River Drainage	Agri land			0.75										0		0.75				
	Aqua farm								0.02								0.02			
	Houses												0.29	3.75	0.20			4.24		
	Others												0.03		0.17				0.20	
Total		0.00	0.00	0.75	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.32	3.75	0.37					2.11
Main Drainage	Agri land	0.68								0.027				4.25	3.00	7.95				
	Aqua farm							1.25	0.01								1.26			
	Houses										3.75	3.04		1.13	4.00			11.91		
	Others							0.19					7.63						7.81	
Total		0.68	0	0	0	0	0	1.44	0.01	0.027	3.75	3.04	7.63	5.38	7.00					11.72
Sub Drainage	Agri land	0.28						0.03	0.01							0.31				
	Aqua farm			0.72			2.18										2.90			
	Houses											2.81						2.81		
	Others			0.15				0.69											0.84	
Total		0.28	0	0.87	0	0	2.18	0.71	0.01	0	0	2.81	0	0	0					2.78
Total (acres)		0.96	0.00	1.62	0.00	0.00	2.18	2.15	0.03	0.03	3.75	5.85	7.94	9.13	7.37	9.01	4.17	18.96	8.85	
Grand Total (Ha)		0.39	0.00	0.66	0.00	0.00	0.88	0.87	0.01	0.01	1.52	2.37	3.22	3.69	2.98	3.65	1.69	7.68	3.58	16.60

Weed Infestation

Water hyacinth is seen growing extensively in many channels. Area covered by weeds in all different channels is about 27.6 Ha (276000 sqm). The channel wise area covered is given below

River drainage	13.4 Ha	134000 m^2
Main drainage	14.2 Ha	142000 m^2

Other Structures

There are totally eight structures/sluices noticed in the entire drainage system of which one sluice is completely damaged and abandoned. There are five structures in Vellaiyar river system and two in Pandavaiyar river system. All the structures / sluices require repair to masonry and shutters. The sluices in the drainage channels are provided to prevent salt/back water entering into the field.

6d: Other Water bodies (Ponds, *ooranis,* Tanks, wells)

A variety of water bodies are in use in the district. These include *ooranis*, village ponds, temple tanks, *alams*, irrigation tanks, farm ponds, traditional dug-wells, skimming wells, tube/bore wells. Since the study area is extensive, information was collected from 37 out of 148 villages, representing a fourth of the study area. Secondary data were collected from the line departments as well as the TNAU to counter-check and support the documentation process.

1. Village ponds, **ooranis***, temple tanks:*

There are about 1075 village ponds (including temple tanks) in the selected villages. Out of these 56 are abandoned and 1019 are in use (Table 6.20). The size of these ponds range from about 40m x20m x 1m to 90m x30m x 2m.

Table 6.20

Village ponds / *ooranis* in the study area

Sl.No	Taluk	In sample villages			In Study area		
		No.of ponds	Abandonent	Normal	No.of ponds	Abandonent	Normal
1	Sirkali	142	8	134	568	32	536
2	Tharangambadi	160	8	152	640	32	608
3	Nagapattinam	256	17	239	1024	68	956
4	Kilvelur	186	15	171	744	60	684
5	Thirukuvalai	22	2	20	88	8	80
6	Vedarnayam	309	6	303	1236	24	1212
	Total	1075	56	1019	4300	224	4076

The problems identified in these water bodies are siltation, bund damage and encroachment in supply channels and drains. Table 6.21 gives taluk wise average size, storage capacity, encroachments, siltation volume and bund damage to these structures.

Table 6.21

Average Capacity, Siltation, Bund damage etc of Village ponds/ *ooranis* - Taluk wise in Study Area

Taluk wise	Avg.Size (in m^2)	Avg.Storage Capacity (in m^3)	Avg.Encroached area (in m^2)	Avg.Siltation Volume (in m^3)	Avg.Bund Damage volume (in m^3)	Increased in Capacity (in %)
Sirkazhi	2258	5812	512	2458	78	42%
Tharangambadi	1628	3066	636	1822	156	59%
Nagapattinam	3158	9505	146	3488	115	37%
Kilvelur	1774	3893	335	1252	142	32%
Thirukkuvalai	1088	2665	199	645	102	24%
Vedaraniyam	2876	9035	223	4466	91	49%
Average in Study Area	2253	6082	375	2697	114	44%

2. Farm Ponds:

These have been constructed by the Department of Agricultural Engineering since 2002 with a 90% subsidy (the balance 10% being the farmer's contribution). They serve two purposes: a) supplementary irrigation when the supply is either not sufficient or not available, b) if there is water available after paddy is harvested, farmer can grow a short duration pulse/vegetable in a small area using this water. The cost of farm ponds constructed through the government is about Rs. 30,000/pond and the dimensions are 30m by 30m 1.5m = 135 m^3 in about 900 m^2 area (22 cents).

The number of farm ponds constructed in the study area is 652.

3. Wells

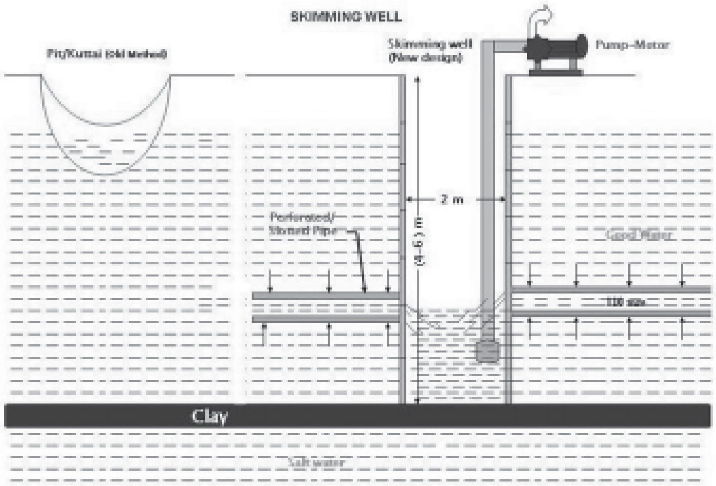
Ground water is tapped by providing or constructing the following types of wells

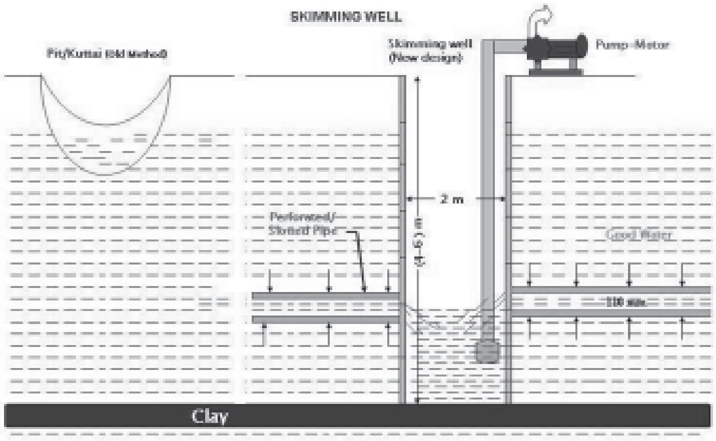
- Open wells – masonry /earth (*kutcha*)
- Pits – shallow depth / *kuttai*
- Skimming wells
- Bore wells.

Kuttais are seen near the sea coast (upto 3-4 km from sea shore) from Nagapattinam to Vedaranyam. The depth varies from 2 - 3 m based on the aquifer and salt water intrusion in the area. All villages having kuttais come under sample villages.

Open wells and bore wells are constructed by the farmers mainly for supplementary irrigation and if water is available, the same is used for summer cultivation from the wells and raising early nursery for *Kuruvai* crop. The filter point (tube/bore) wells are mostly in Sirkali and Mayiladuthurai Taluks. The skimming well concept was recently developed by the TNAU. In the skimming well, water is drawn from the larger area by providing perforated pipes in all the four directions (Fig 6.2). There are only a few such wells in this area by which farmers are irrigating 1-2 acres.

Figure 6.2
Skimming Well





The number of wells in the sample villages are given in Table 6.22.

Table 6.22

Wells in the sample villages

Type of wells	Sample area
Open wells	590
Kuttai /pits for pumping water	5130
Bore wells	717

4. Irrigation tanks/*alams*

a) Tanks: There are four irrigation tanks in the study area belonging to the PWD/WRO. Of these, one is a system tank fed by water from river/channels in Sirkali Taluk. The other three are rainfed tanks located in the Nagapattinam and Keeliyar blocks. These tanks require renovation and repairing.

b) Alams: These are shallow tanks formed in low lying land without any bund. The area ranges from 50 ha to 600 ha and depth is about 0.60 to 1.50 m. There are 6 *alams* in the study area and all are in the southern part of the district

5. Vedaranyam and Buckingham Canals

The Vedaranyam canal was constructed in the nineteenth century under famine relief work for a length of 57 km and used for navigation (Fig 6.3). This channel running from Nagapattinam down South up to Vedaranyam intercepts all the east running drains and this, in turn, is connected to sea through five straight cuts namely Vellaiyar straight cut, Chakkillian Vaikkal straight cut, Lawford straight cut, Nallar straight cut and Adappar straight cut apart from Vellaiyar river course (Fig 6.4). As these channels and straight cuts are not maintained properly, this area with paddy fields around the Vedaranyam canal gets flooded with salt water when the sea is rough and at high tide.

Buckingham canal (BC) was constructed during British rule from Kakinada in Andhra Pradesh up to Tharangambadi in Nagapattinam district, Tamil Nadu, mainly for navigation. The canal has been encroached upon in several places and siltation due to non maintenance of the canal in some lengths is also seen. This canal is in two segments in Nagapattinam district, a 13 km stretch in Sirkali Taluk and another length of 2.3 km in Tharangambadi Taluk (Fig 6.5). The BC runs parallel to the coast about 500 – 750 m inland. The northern part of the BC starts from the right bank of Kollidam in Pazhaiyar village and traverses a length of 13 km and joins with Vellapallam Uppanar drain in Thirumulaivasal village. The canal is used to carry waste water and has become a source of pollution to the surrounding areas.

Figure 6.3
Vedaranyam Canal Location

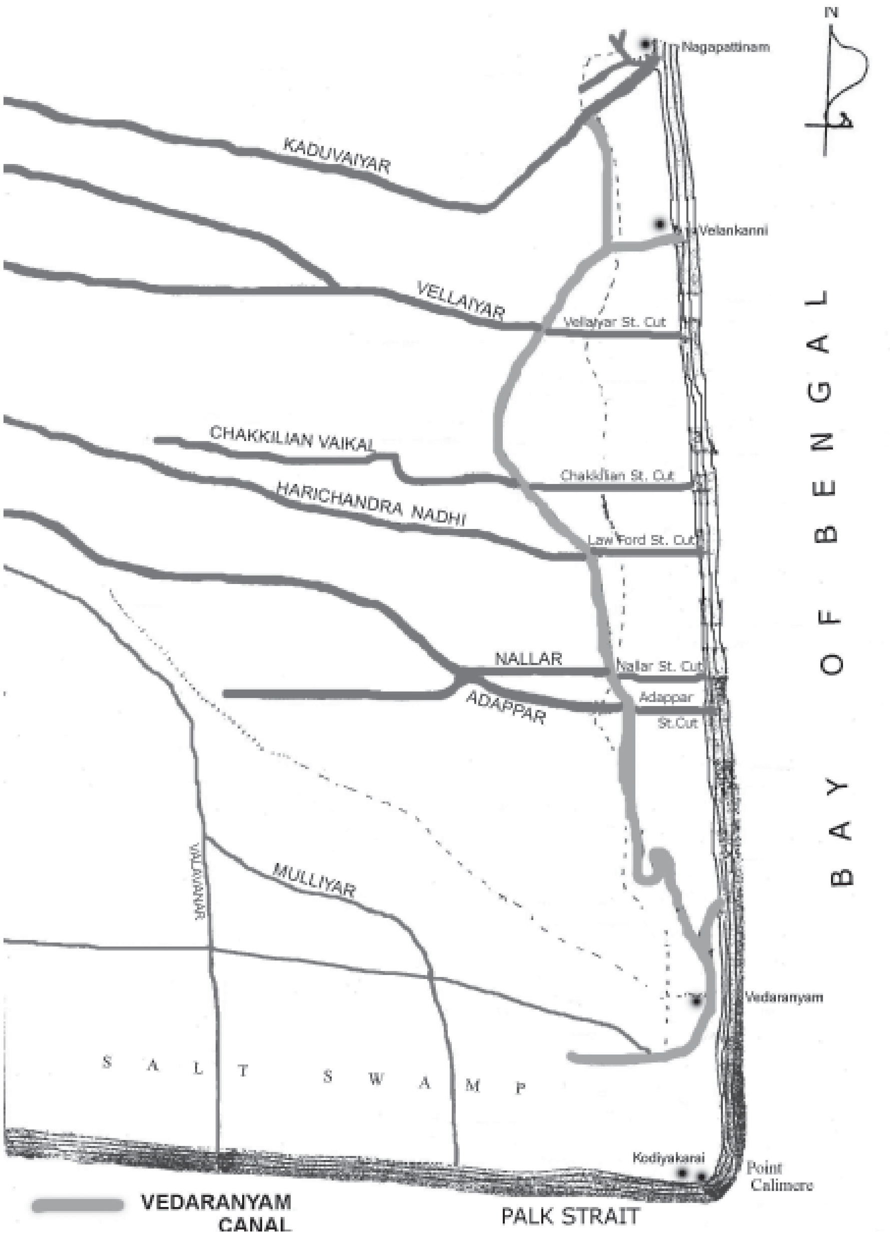


Figure 6.4

Vedaranyam Canal Straight Cuts

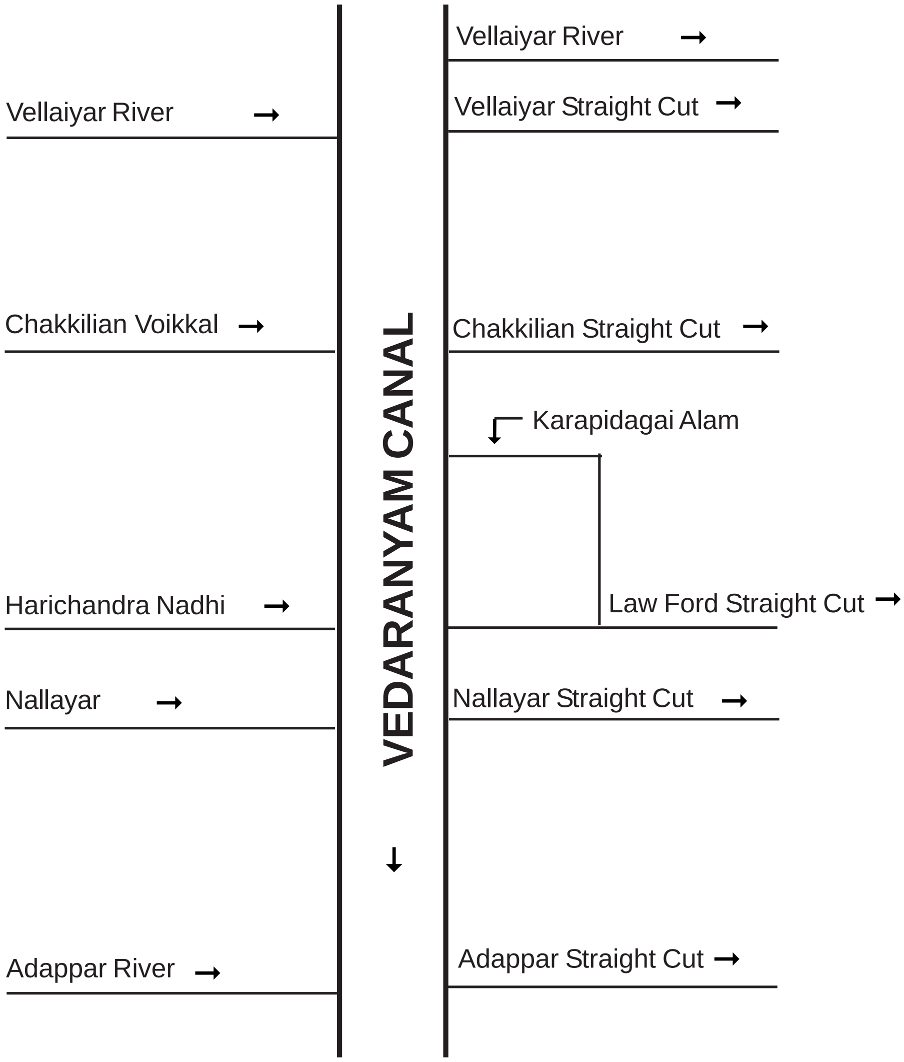
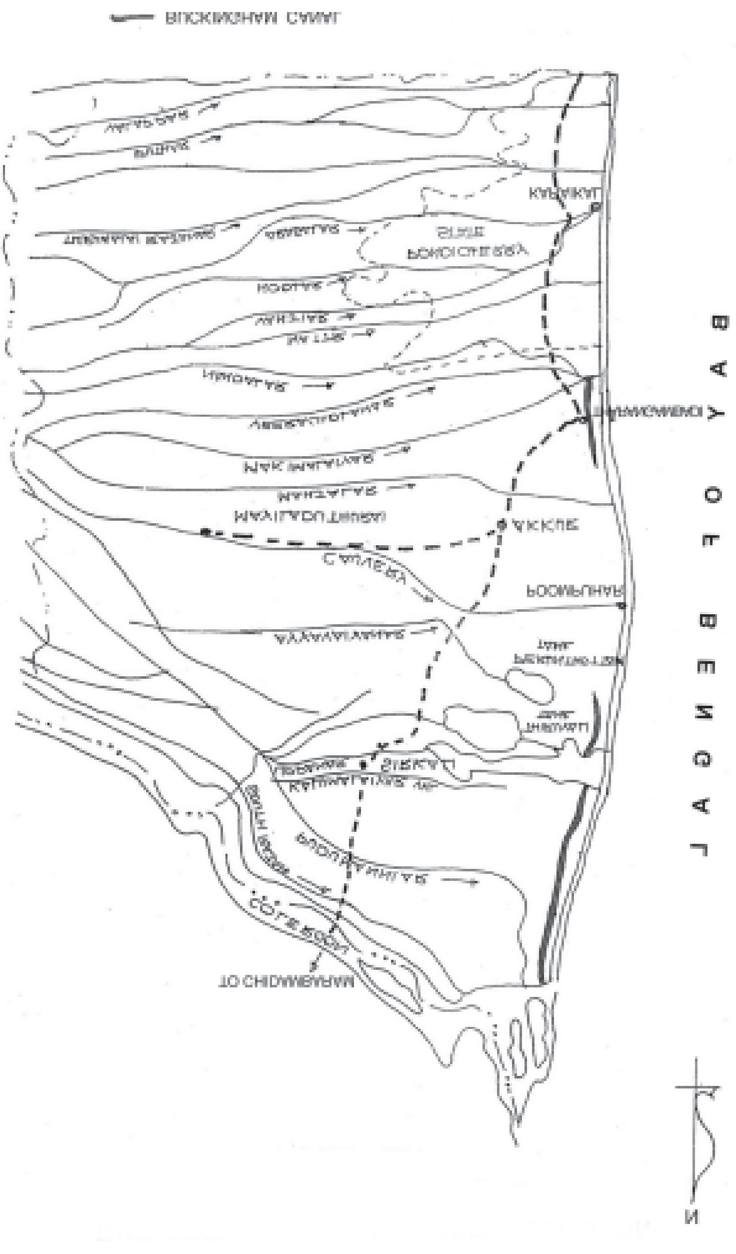


Figure 6.5
Buckingham Canal Cauvery Sub-basin



Chapter Seven

TER-based Observations and Estimates

There are 14 rivers entering Nagapattinam district from which irrigation channels are drawn which irrigate about 30,000 Ha of agricultural land before draining into the sea. Tail End Regulators (TER) are placed at appropriate points of the river, just before which, the river is channelized into irrigation canals. After the point where the TERs are placed, the river acts as drainage. The irrigation canal is generally classified as "A" class and the further sub- divisions classified as "B", "C" and "D". Similarly, the drainage system is also classified as river drain, main drains and sub- drains. The main drains and sub drains are defined based on the width of the channel for the purpose of this study. Generally, a TER with its network of irrigation and drainage channels is commonly referred to by the name of the river on which it is located, for eg., South Rajan TER. There are 14 TERs in the study area referring to the 14 exclusive irrigation and drainage networks.

TER 1 : South Rajan

As is seen by the name, this TER is on the South Rajan River, which enters through Sirkali Taluk. The network of channels under this TER passes through Mahendrapalli, Kattur, Semmangadu, Naanal Padugai, Vettathangarai, Rettaikulam, Thaithan, Reghunathapuram and Nanal padugai before finally draining into the sea. The main revenue villages covered are Mahendrapalli and Kattur. The Tail End Regulator is placed at Pilpadugai, at a distance of 2 kms from the confluence with River Coleroon, which runs for 3 km before draining into the sea. The large numbers of shrimp farms that have come up in this area indicate the extent of tidal ingress of sea-water. This network of channels is 42.95 kms long, of which, 31.55 kms are for irrigation and 11.4 kms are for drainage.

The irrigation network covers approximately 489 Ha of ayacut and has 12 "A" class and seven "B" class channels. These channels show some amount of siltation and bund damages. There is also encroachment in these areas, mainly by the shrimp farms.

The drainage network consists of one river drain, two main drains and one sub-drain. There is considerable siltation and bund damage in these channels. There is also agricultural encroachment in this area, mainly by the local farmers.

A profiling of the farmers in this area shows 39% of the farmers being dependant on rain-fed cropping and the rest as having access to surface water irrigation. Of the total, 64% are marginal farmers, 32% are small farmers and the remaining 4% are medium farmers. There are no large farmers in this area. An in-depth study of one village in this area identified 10 private ponds and 12 common ponds in this village, apart from the channel running through this village. However, there were no shallow wells or bore wells seen as being utilized for agriculture. The major crop cultivated in this village is paddy. Water is available only during *samba* season. Although mangoes and cashews are cultivated in other villages of the same block, this village has only coconuts as its major horticultural crop.

The community, Panchayat and the PWD have jointly desilted the irrigation channel and repaired the damaged shutters last in 1996. The community stated that damages to the shutters were due to corrosion and that PWD should restore the old wooden structures rather than going in for iron shutters. No maintenance work has been done after 1996 and thereafter they claimed a general lack of interest due to non- availability of water in these channels. The community also requested that shutters be put in all channels to reduce salination due to backwaters.

There are no formal water user groups in this area although the community did acknowledge the need for one. However, they also feel that operation, management, repairs and maintenance of these were the responsibility of the PWD.

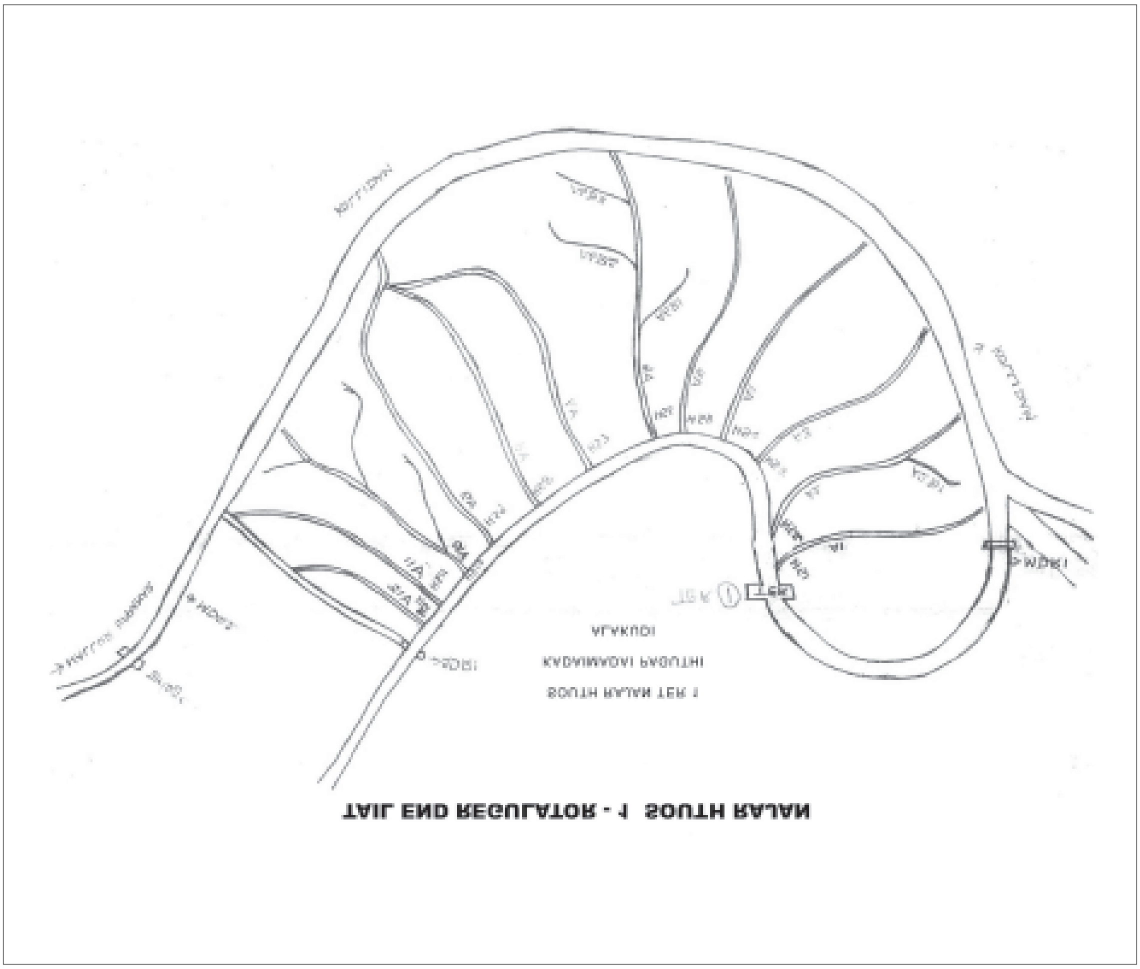
The details of the damages as well as estimates for repair are shown in Table 7.1.

The estimated costs for desilting and repairing the bund damages is estimated to be about Rs. 90,000 in the agriculture channels and a little over Rs. 2 lakhs in the drainage channels, totaling to about Rs 3 lakhs as the overall estimate for the complete repairs and maintenance works. This works out to about Rs. 600/ Ha of ayacut.

Table: 7.1

TER1 Basic details, Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

Class/Category	Basics details			Types of Encrochment Area(m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs.)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage (m^3)	Estimate for Strenthening of Bunds (Rs.)	
IRRIGATION Channels														
A	489	12	22.55	3920						776	12416	4194	75483	87899
B	-	7	9											0
C	-													0
D	-													0
E	-													0
Total	489	19	31.55	3920	0	0	0	0	0	776	12416	4194	75483	87899
DRAINAGE Channels														
River drainage		1	2							750	12000	131	2363	14363
Main drainage		2	8.2		2720					10800	172800	1063	19125	191925
Sub drainage		1	1.2		1120									0
Total		4	11.4	0	3840	0	0	0	0	11550	184800	1194	21488	206288
Grand Total		23	42.95	3920	3840	0	0	0	0	12326	197216	5388	96971	294187



TER 2: Puthumanniyar

River Puthumaniyar enters through Sirkali taluk and the network of channels under this TER pass through Thandavankulam, Palaiyapalayam, Madhanam, Pudupattinam and Tharkas. The Tail End Regulator on this river is located at Puthupattinam, at a distance of just 0.2 kms from the sea. The length of the network under this TER is 64.27 kms, of which, 53.57 kms is for irrigation purposes and 10.7 kms for drainage. The irrigation network, which has 50 "A" class and 10 "B" class channels has a fairly large ayacut of 1377 Ha.

The drainage network consists of one river drain and four main drains. Siltation, bund damages and encroachment have reduced the efficiency of both the irrigation and the drainage channels. The details including the estimates for repair are as shown in the Table 7.2.

Table: 7.2

TER 2 Basic details, Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

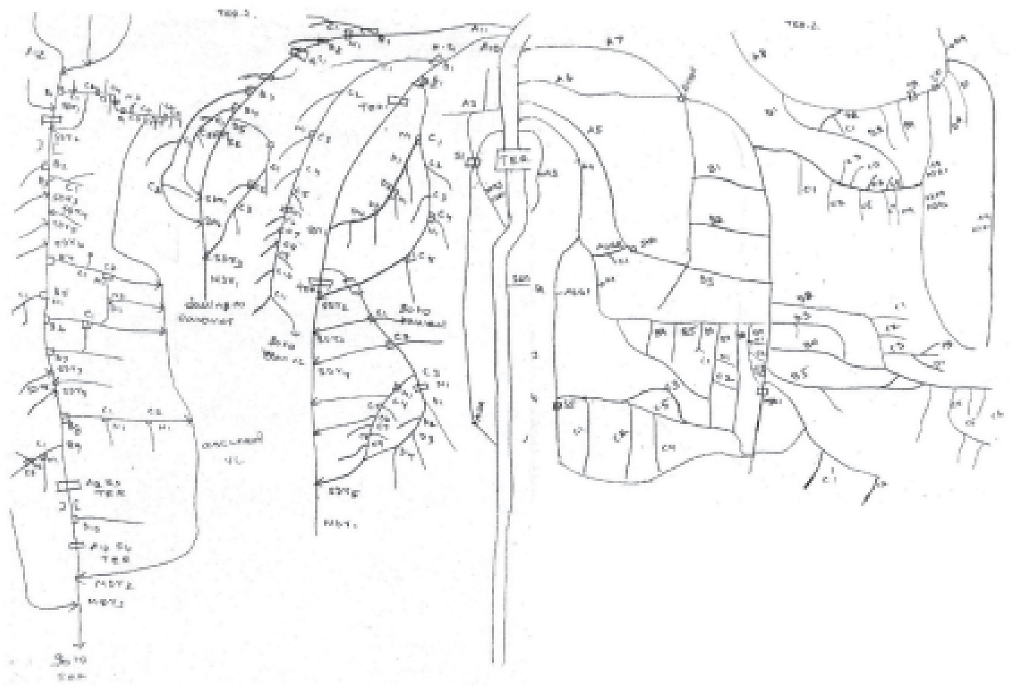
Class/Category	Basics details			Types of Encrochment Area (m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs.)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/ others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage (m^3)	Estimate for Strenthen ing of Bunds (Rs.)	
IRRIGATION Channels														
A	1377	50	50.55		3600			0.02	600	885	14160	2168	39024	53784
B		10	3.02											0
C														0
D														0
E														0
Total	1377	60	53.57	0	3600	0	0	0.02	600	885	14160	2168	39024	53784
DRAINAGE Channels														
River drainage		1	0.2							10320	227040			227040
Main drainage		4	10.5							145500	3201000	5063	91125	3292125
Sub drainage														0
Total		5	10.7	0	0	0	0	0	0	155820	3428040	5063	91125	3519165
Grand Total		65	64.27	0	3600	0	0	0.02	600	156705	3442200	7231	130149	3572949

A profiling of the farmers in this TER shows that 56% are dry land farmers and the rest have access to surface water from the irrigation channels or ponds. 61% of the total farming community are marginal farmers, 28% are small farmers and 11% are medium farmers. Five private ponds and 14 common ponds were identified in a sample village taken for in-depth analysis, apart from the irrigation channel. Despite this, water was available only during the *samba* period. Paddy is the main agricultural crop cultivated in this village and there is also some area under cashew and coconut cultivation. However, the lack of water has seriously affected the horticultural crops.

The farmers did some desilting activities in one of the main channels a few years ago but have not continued the practice. There are no formal water user groups or farmers' associations here. The community feels that operation, repairs and maintenance of these channels should be the responsibility of the PWD.

The estimated costs for desilting and repair of bunds is about Rs. 55,000/- for the irrigation channels and about Rs. 35,000/- for the drainage channels. Apart from this, six sluices have to be repaired which will cost an additional Rs. 1.7 lakhs. Thus the overall cost of repairs to revitalise this network adds up to almost Rs. 38 lakhs for a total ayacut of 1377 Ha and works out to Rs. 2718/ Ha of ayacut.

TAIL END REGULATOR - 2 PUDUMANIYARU



TER 3: Cauvery

River Cauvery enters through Sirkali taluk and passes through Ayyanarkoil, Kidayakattalai, Samba Katalai Theru, Melaiyur, Palaiyagaram, Veerameturuppu, Dharmakulam, Manigramam, Neithavasal, Pudukuppam, Thiruvenkadu, Mandakarai, Maanthankadu, Yerampalayam, Melaperumpallam, Keelaperumpallam, Vanagiri, Nettaveli, Maruthampallam, Kidangal, Mamakudi, Chidambarampakkam and Seethambadi. With a length of 233 kms, this is the longest network of irrigation and drainage channels in the district. Of this, 201 kms comes under irrigation and 32 kms under drainage. This is the fourth largest TER in terms of ayacut area covered, with a total ayacut area of 3243 Ha. The Tail End Regulator is placed at Melaiyur, which is 5.8 kms away from the sea.

The distance of the placement of the regulator from the sea has resulted in ingress of sea-water during high tides through the drainage channels. Shrimp farms have come up in this area due to the easy access to the seawater through these channels and the bunds have been deliberately damaged at many points for easy access to this water. About 5080 m^2 of land has been encroached within the channel area for shrimp farming.

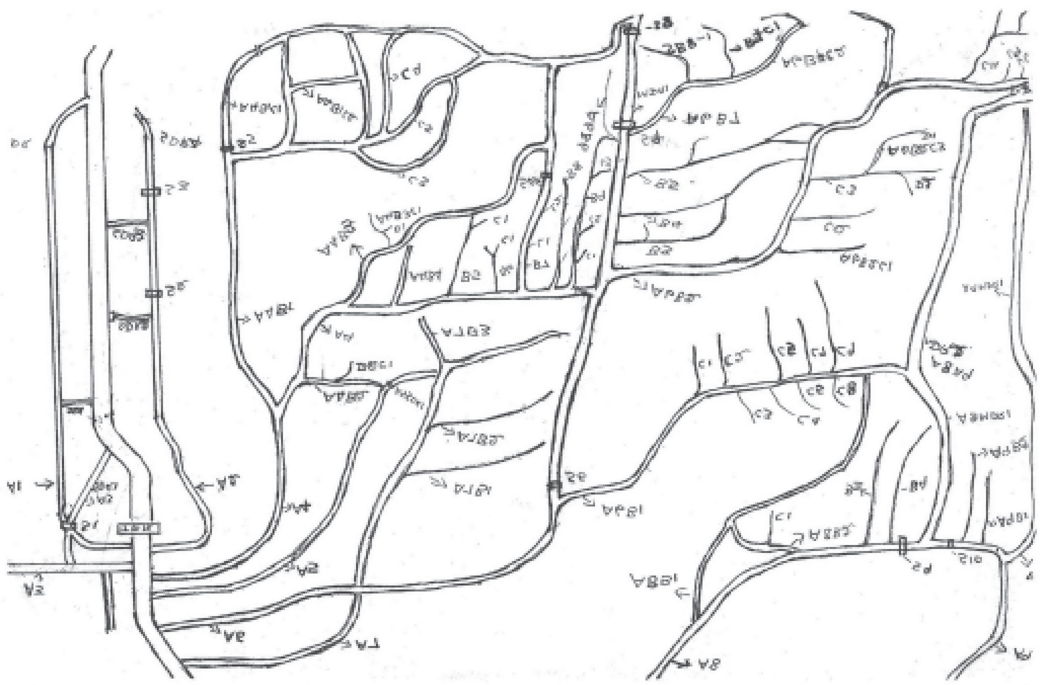
The irrigation channels have 19 "A" class, 50 "B" class, 86 "C" class and 14 "D" class channels of which heavy siltation is seen in "A" class channels and bund damages in "B" class channels. "C" class channels also show some siltation but no bund damages in the irrigation network. There are also 18 sluices in "A" and 4 sluices in "B" channels that require repairs.

The 32 km long drainage channels include one river drain, seven main drains and 21 sub- drains. Despite being only 16% of the total system, the volume of damages is almost 10 times that of the irrigation network. The details of the damages are as given in the Table 7.3.

Of the total farming community, only about 17.6% of the farmers fully depend on the rain fed farming. All the rest have access to surface water sources, though only seasonally. 64% of the farmers are marginal farmers, 30% are small, 5% are medium and about 1% are large farmers. There are seven irrigation/drainage channels running through this area and hence, dependence on ponds seems to be much lower. A study of three villages in this area showed the presence of a total of seven private ponds and five borewells. Paddy is the major agriculture crop in this area. There is also horticulture with coconut, mango and vegetable cultivation. Water, from all sources, was available only during *samba*.

The community and the Panchayat have, together, desilted and repaired the bunds at Melayur, Vanagiri and Thenampattinam. Shutters have also been repaired in all three places and notches have been repaired in Thenampattinam where the Panchayat has also desilted the common ponds. Post-tsunami, some of the NGOs have also supported the desilting of some of the channels. However, all three villages studied said that they require further maintenance support for drainage channels and for construction of additional shutters and bed dams. The Panchayat was supportive enough to agree to use the NREG scheme for desilting and small maintenance works. Although a formal water user group was set up only in Thenampattinam, both the other villages were interested in setting up the same provided they had some more information and support for the setting up process.

The estimate for the desilting and bund repairs in the irrigation channels is about Rs. 3.1 lakhs and Rs. 3.6 lakhs for the drainage channels. Apart from this, 18 sluices in "A" channel and four sluices in "B" channels need to be repaired at a cost of about Rs. 10 lakhs. Considering the large ayacut area this channel is feeding, this total cost of Rs. 50 lakhs works out to Rs. 1550/- per Ha.



TAIL END REGULATOR - 3 CAUVERY

Table: 7.3

TER 3 Basic details Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

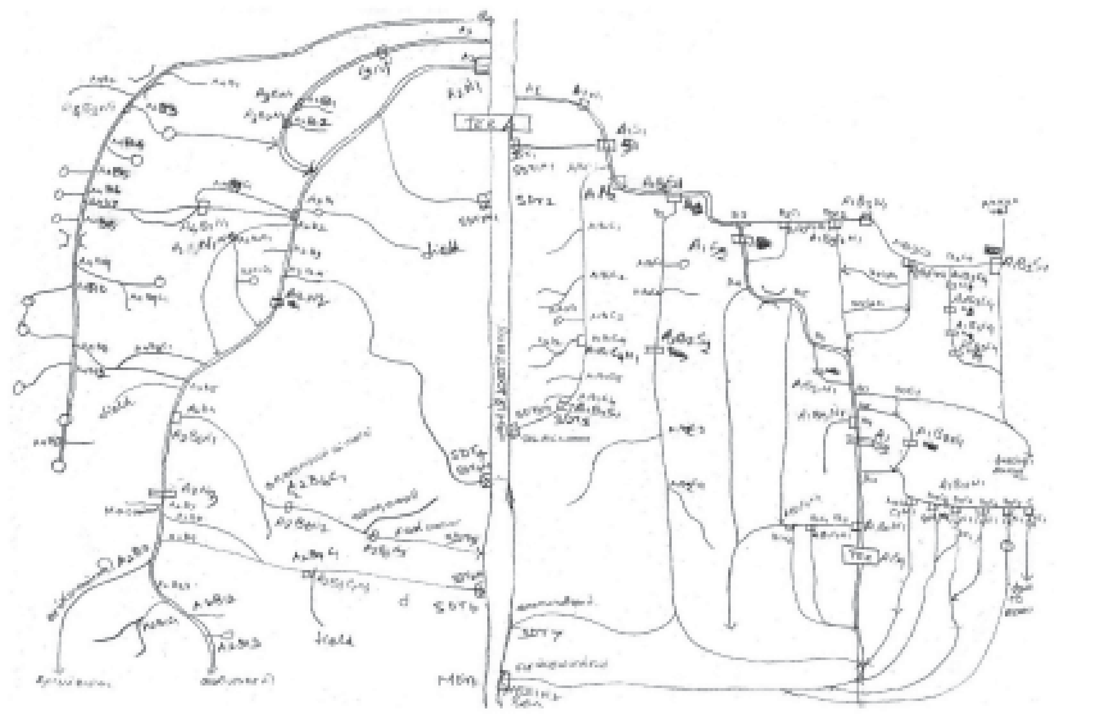
Class/Category	Basics details			Types of Encrochment Area (m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs.)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/ others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage (m^3)	Estimate for Strengtheni ng of Bunds (Rs.)	
IRRIGATION Channels														
A	3243	19	72.2		120			0.28	11000	13870	221920	613	11025	243945
B		50	70.3							2050	32800	1091	17456	50256
C		86	52.5	2200						1369	21904			21904
D		14	6											0
E														0
Total	3243	169	201	2200	120	0	0	0.28	11000	17289	276624	1704	28481	316105
DRAINAGE Channels														
River drainage		1	5.8		3000					31750	698500	450	8100	706600
Main drainage		7	14.7							124980	2740560	5300	95400	2835960
Sub drainage		21	11.5	2880			600	0.13	5000	4012	70192			75192
Total		29	32	2880	3000	0	600	0.13	5000	160742	3509252	5750	103500	3617752
Grand Total		198	233	5080	3120	0	600	0.41	16000	178031	3785876	7454	131981	3933857

TER 4: Manjalar

The river Manjalar enters through the Tharangambadi taluk. The Tail End Regulator is placed at Annappanpettai, which is about 6 kms away from the sea. The network under this TER has a total length of 103.31 kms and passes through Annappanpettai, Kidangal, Veppancherri, Thirukadaiyur, Radhanallur, Kumarakudi, Sembarambakkam, Sanghendi, Ootukattalai, Vadakattalai, Mamakudi, Kalamanallur and Thirumanjanam. Of its total length, 93.41 kms is for irrigation purposes and just 9.9 kms for drainage. The ayacut is 619 Ha. Despite the proximity of the TER to the sea, this does not seem to have any threat, in terms of encroachment, from the shrimp farms.

Only 11% of the farmers of here are dry land farmers and the rest have access to surface water. 75% of the farmers here are marginal farmers, 21% small farmers and 4% medium farmers. Although there was access to 6 irrigation/drainage channels, there was also a high prevalence of ponds, both private and common, and borewells. In the four villages studied in detail in this area, 19 private ponds, 8 common ponds and 344 borewells were identified. Water was available in the channels and ponds only during *samba* season but was available during *samba* and *kuruvai* in the borewells. Paddy is the main agricultural crop grown in this region. Mangoes and coconuts are also seen in some areas.

TAIL END REGULATOR - 4 MANJALARU



The irrigation channels include four "A"class channels, 39 "B" class channels, 35 "C" class channels and six "D" class channels. Similarly, the 9.9 km long drainage channels include one river drain, one main drain and seven sub-drains. Although the bund damages are not very high, siltation is quite high in both the irrigation and the drainage channels. There are other structures also, like the sluices and the notches that require repairs.

Although there are no formal farmer groups or water user groups, the community, along with the Panchayat and the NGOs desilted "C" and "D" class channels as well as the affected ponds in 2005. Clearing the irrigation and drainage channels of weeds was another activity taken up regularly even pre-tsunami. The community stated their need for an additional regulator one km away from the sea and new bed dams on Manjalar. Almost all the panchayats, within the area of this network, were interested in sustainable interventions for maintenance of these structures and were willing to use the NREG and other similar schemes for regular maintenance works.

The estimate for desilting of irrigation and drainage channels in this TER is over Rs. 8 lakhs of which, only 10% of it is towards desilting the irrigation network. The bund repairs, for both together, are estimated at about Rs. 1.3 lakhs. Apart from this, the repair to the other structures is estimated at Rs. 35,000/- bringing the total budget for this TER to a little short of Rs. 10 lakhs, which works out to Rs. 1606/ Ha. The details of damages as well as repair cost estimates are shown in Table 7.4.

Table : 7.4

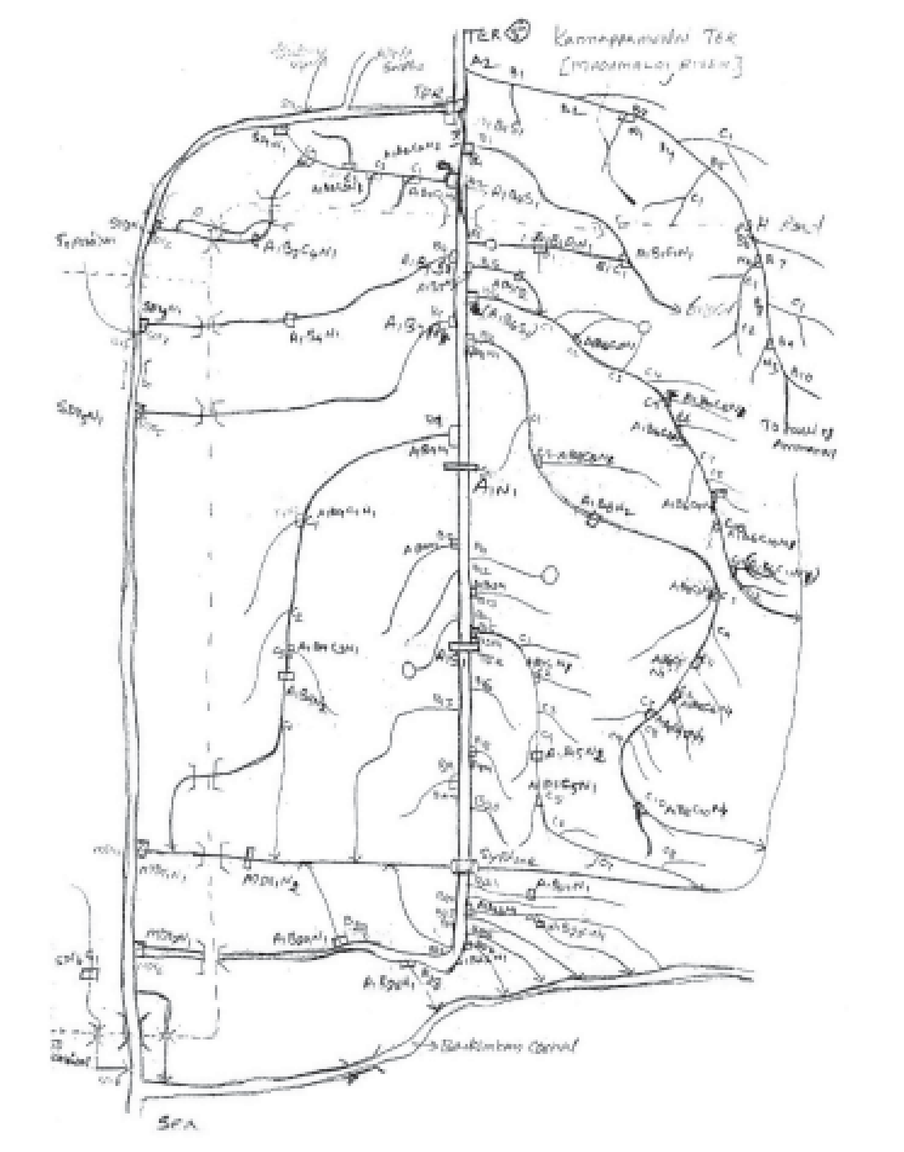
TER 4 Basic details Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

Class/Category	Basics details			Types of Encrochment Area (m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage (m3)	Estimate for Strenthening of Bunds (Rs.)	
IRRIGATION Channels														
A	619	4	13		320					720	11520	1477	26582	38102
B		39	41.08							2374	37984			37984
C		35	36.83							2238	35808			35808
D		6	2.5							64	1024			1024
E														0
Total	619	84	93.41	0	320	0	0	0	0	5396	86336	1477	26582	112918
DRAINAGE Channels														
River drainage		1	6							33790	740020	5540	99720	839740
Main drainage		1	1.5											0
Sub drainage		7	2.4							383	6645			6645
Total		9	9.9	0	0	0	0	0	0	34173	746665	5540	99720	846385
Grand Total		93	103.31	0	320	0	0	0	0	39569	833001	7017	126302	959303

TER 5: Mahimalaiyar

River Mahimalaiyar passes through Anandamanagalam, Olugaimangalam, Kattanchavadi, Kannappamoolai, Manickapangu, Kuttiyandiyur, Velipalayam, Perumalkattalai, Anaikoil, Erukattancheri and Tharangambadi. The Tail End Regulator is placed at Kannapamoolai, a mere one kilometre away from the sea. The network under this TER is about 96 kms of which, 83.95 kms falls under irrigation and 12 kms falls under drainage. This covers a total ayacut area of 1344 ha.

TAIL END REGULATOR - 5 MAGIMALAIYARU



The irrigation channels consist of two "A" class, 39 "B" class, 45 "C" class and nine "D" class channels. The drainage channels include one river drain, four main drains and eight sub-drains.

There is a high level of siltation in both the irrigation and the drainage systems with a lesser level of damage to the bunds. As is the case with the other TERs, the damages are much lesser in the irrigation network than in the drainage network. While there is only a 10,285 m^3 of siltation in irrigation channels, it is 82,575 m^3 in the drainage channels. Damage to the bunds is only 192 m^3 of irrigation channels while it is 49,018 m^3 in the drainage channels.

An in- depth study of one of the villages in this TER showed that only 8% of the farmers were fully dependant on rain fed farming. All others had access to surface water and/ or ground water. There were four private ponds, four common ponds, two irrigation/ drainage channels and six borewells available in this one village. Some of the ponds and the borewells provided water both during *samba* and *kuruvai* seasons. Paddy was the main crop and there were also horticultural crops like mangoes and coconut, and flower cultivation was also practiced.

The community, with the Panchayat, have desilted and repaired bunds in some of the channels. However, both were very interested in a complete survey of the channels and increasing the width wherever felt necessary. They also requested for the strengthening of bunds. Although there is no formal water user group, both the Panchayat and the community were interested in starting a functional group to maintain these structures.

The desilting of the irrigation channels is estimated to cost almost Rs.2 lakhs and almost Rs.16 lakhs for the drainage channels. Including the repairs of other structures, the total estimate for TER 5 is about Rs. 27.8 lakhs which works out to be Rs. Rs. 2070/ Ha of ayacut area. The details of damages as well as repair estimates are given in Table 7.5.

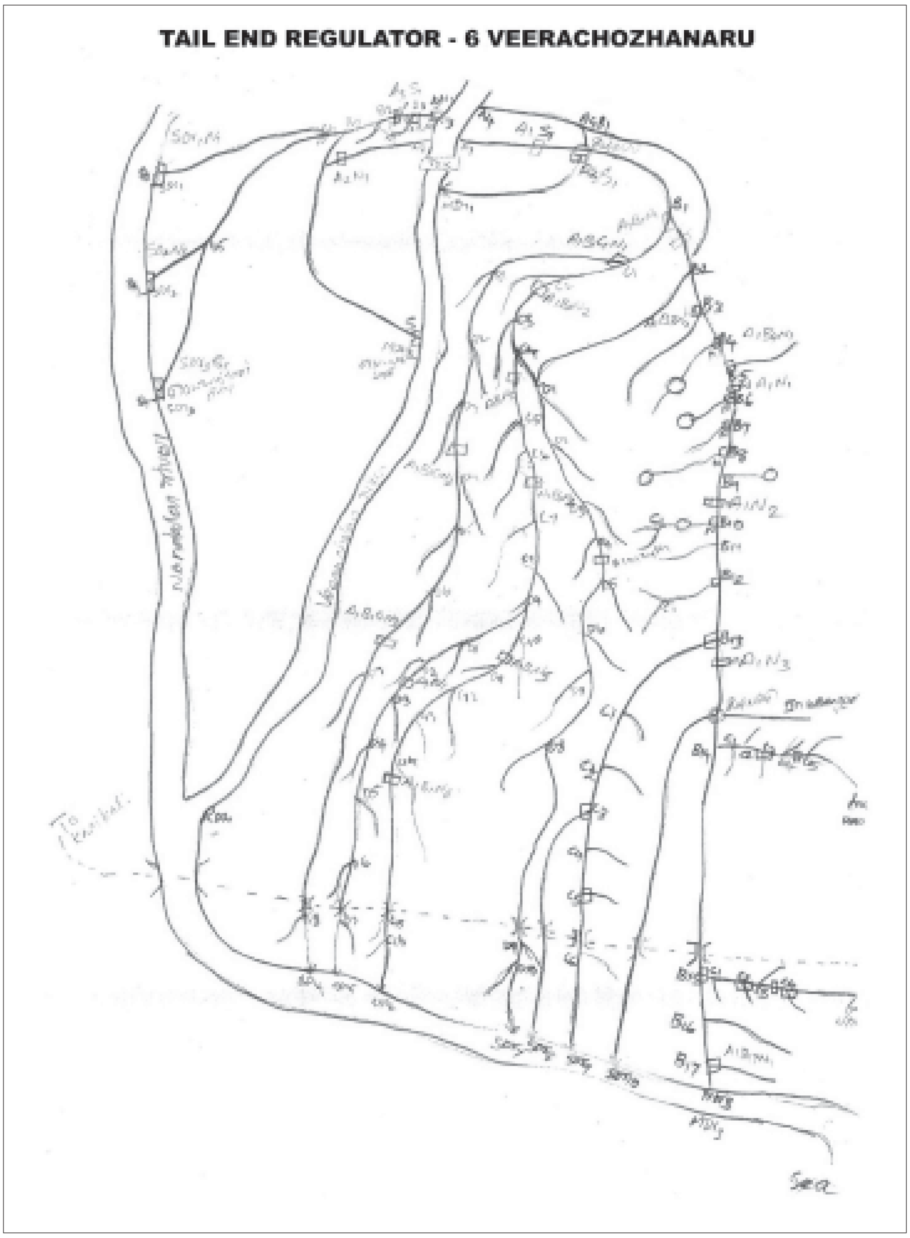
Table: 7.5

TER 5 Basic details, Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

Class/Category	Basics details			Types of Encrochment Area(m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/ others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage (m^3)	Estimate for Strenthening of Bunds (Rs.)	
IRRIGATION Channels														
A	1344	2	11.5					0.15	6000	4800	105600	144	2592	114192
B		39	43.4					0.2	7800	5237	87612	48	773	96185
C		45	28.65							248	3974			3974
D		1	0.4											0
E														0
Total	1344	87	83.95	0	0	0	0	0.35	13800	10285	197186	192	3365	214351
DRAINAGE Channels														
River drainage		1	1							59200	1302400	40050	720900	2023300
Main drainage		4	6.1							12130	263800	8800	158400	422200
Sub drainage		8	4.9							960	15360	168	2688	18048
Total		13	12	0	0	0	0	0	0	72290	1581560	49018	881988	2463548
Grand Total		100	95.95	0	0	0	0	0.35	13800	82575	1778746	49210	885353	2677899

TER 6: Veeracholanar

River Veeracholanar passes through Rajivpuram, Devanoor, Poraiyar and Tharangambadi. The total length of the irrigation and drainage network is about 61.95 kms, of which, 51.55 kms falls under irrigation channels and 10.4 kms under drainage. The Tail End Regulator is placed at Devanoor, about 1.5 kms away from the sea.



The irrigation network consists of four “A” class, 22 “B” class, 33 “C” class and 25 “D” class channels and the ayacut area is 391 ha. The drainage channels include one river drainage, three main drainages and ten sub-drainages.

A profile of the villages surveyed under this TER showed that only 10% of the farmers were totally dependant on rain fed farming. The others had access to some source of water- either surface water or groundwater. 82% of the farmers were marginal farmers, 16% were small farmers and less than 2 % were medium farmers. There were no large farmers in this area.

There is some siltation in both the types of channels, predictably the siltation in the drainage channel being about 22 times that of the irrigation channel (1832 m^3 in irrigation and 23371 m^3 in drainage). However, the bunds of the river drainage are badly affected.

Although there are no formal water user groups here, the community and the Panchayat have jointly carried out some desilting and weed clearing work in the “B”, “C” and “D” channels. However, the bunds, made of sand are weak and need revetment, which they expect the government/ PWD to provide. The community is also desirous of having Buckingham Canal desilted and strengthened as they say that is a major source of flooding.

The desilting in the irrigation and the drainage channels together is estimated to cost about Rs. 13. 6 lakhs. Including the repairs of the other structures, the total estimate for rejuvenating this TER is about Rs. 15 lakhs which works out to Rs. 3874/ ha of ayacut area. The detailed estimates are given in Table 7.6.

Table: 7.6

TER 6 Basic details, Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

Class/Category	Basics details			Types of Encrochment Area (m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs.)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/ others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage (m3)	Estimate for Strengthening of Bunds (Rs.)	
IRRIGATION Channels														
A	391	4	6	1000				0.16	6400	1000	16000	50	900	23300
B		22	17.75	2600						820	13120			13120
C		33	18.9	2160						12	192			192
D		25	8.9											0
E														0
Total	391	84	51.55	5760	0	0	0	0.16	6400	1832	29312	50	900	36612
DRAINAGE Channels														
River drainage		1	1.2							22680	498960	45506	819113	1318073
Main drainage		3	1.8							571	9136			9136
Sub drainage		10	7.4	8720						120	1920			1920
Total		14	10.4	8720	0	0	0	0	0	23371	510016	45506	819113	1329129
Grand Total		98	61.95	14480	0	0	0	0.16	6400	25203	539328	45556	820013	1365741

TER 7: Vettar

The River Vettar enters through Nagapattinam taluk and the network of channels under this TER passes through Elankadambanoor, Mudikondan, Perunkadambanoor, Palaiyur, Vadapathi, Vairavanirruppu, Palakad, Vadakudi, Sellur, Keelapaliyur, Odacherry, Theethumattal, Ellumkadambanur, Palur, Theethampattai, Thenkarai, Vankaramavadi, Melaveli, Thetti, Elusiam, Velipalayam,Karumarangudi, Puliyur, Keelapuliyur, Poothangudi, Amoor, Orugudy, Villampakkam, Okur, Narimanam, Muttam, Poolangudi, Thennangudi, Vadagudi, Kottur, Villampakkam and Sirunankai. At 184.16 kms, this is the second longest network of irrigation and drainage channels in the district. This covers a total ayacut area of 1830 Ha. The Tail End Regulator is sited in Odacherry, which is 22 kms from the sea, the farthest inland TER among all 14 TERs.

The irrigation channels which add up to 111.92 kms, consists of one "A" class, 8 "B" class, 29 "C" class 37 "D" class and 7 "E" class channels. The drainage channels, 72.24 kms long in all, consist of one river drain, 17 main drains and 35 sub- drains.

The profile of the farming community showed that only 6% of the farmers were totally dependant on rain fed farming. 65% of the farmers were marginal farmers, 23% small farmers, 10% medium farmers and barely 2% were large farmers. An in- depth study of four villages in this TER showed a high degree of access to surface water through irrigation and drainage channels and ponds, as well as ground water through open wells and bore wells. There were a total of 22 private ponds, 42 common ponds, 12 irrigation/ drainage channels, 21 open wells and eight borewells. However, the community claimed that water was available only during *kuruvai* season. Dry and wet-land paddy cultivation is the main agricultural practice, although there is also land under horticulture- coconuts, mangoes, flowers and vegetables.

The community has cleaned up most of the tanks and ponds in their area with the help of the Panchayat and NGOs. Interestingly, the community also seems to be more interested in having additional ponds rather than repairing the irrigation channels.

There is extensive damage in this network and necessitates an intensive collaborative effort from both the government and the community to successfully restore this TER. 16,749 m^3 of siltation is seen in the irrigation channels and 6,86, 222m^3 in the drainage channels. Apart from this, there is almost 58,000 m^3 of bund damage in the irrigation channels and 86,000 m^3 of bund damage in the drainage channels. Nine sluices and 119 other structures have been seen as damaged and there is a requirement for thirteen new structures. Apart from this, about 9 ha are covered with weeds, mainly water hyacinth.

In all, the estimate for desiltation is about Rs. 1.5 lakhs and for repairs to bund damages is almost Rs. 23 lakhs. Including the cost of repairs of other structures and construction of new structures, the total estimate for making this TER totally functional comes to Rs. 1.9 crore, which works out to Rs. 10, 390/ Ha of ayacut. The details are as given in Table 7.7.

TAIL END REGULATOR VETTAR

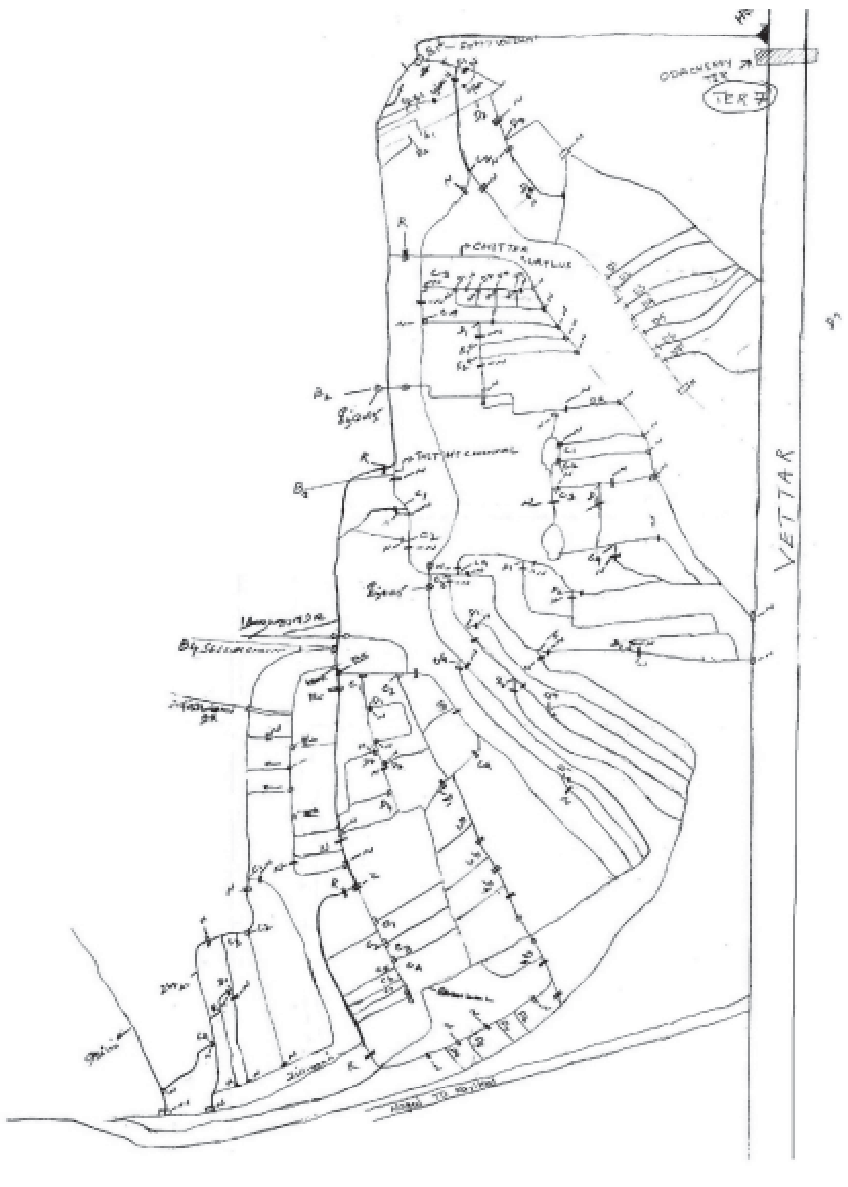


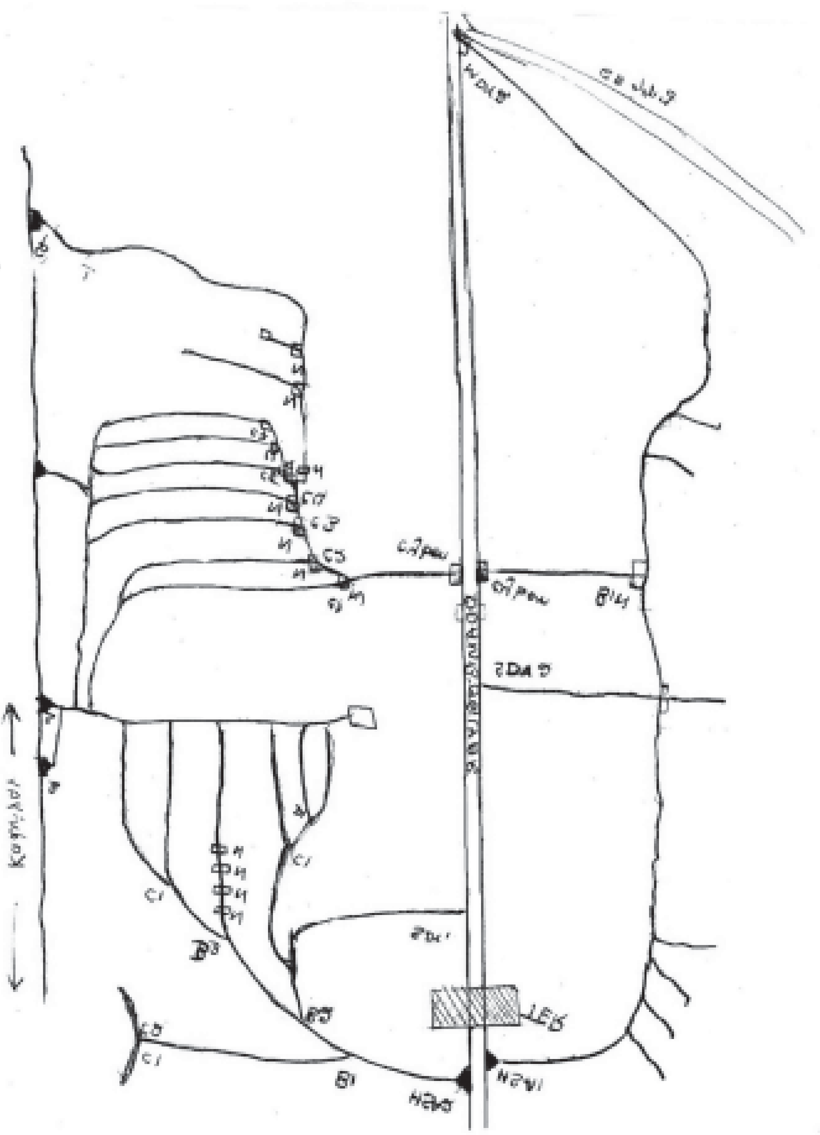
Table :7.7

TER 7 Basic details, Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

Class/Category	Basics details			Types of Encrochment Area (m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs.)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage(m^3)	Estimate for Strengthening of Bunds (Rs.)	
IRRIGATION Channels														
A	1830	1	23		3520	40		4	160000	399	8328	26291	473229	641557
B		8	37.7		2000	160		1.63	65000	7403	118448	22504	360060	543508
C		29	37.02		6680			3.5	139800	6024	96377	9133	146125	382302
D		37	13.58							2764	44220			44220
E		7	0.62							159	2542			2542
Total	1830	82	111.92	0	12200	200	0	9.13	364800	16749	269915	57928	979414	1614129
DRAINAGE Channels														
River drainage		1	22							660000	14500000	66000	1188000	15688000
Main drainage		17	26.35	5000			760			14338	274701	14840	26120	300821
Sub drainage		35	23.89		120		2720			11884	190138	5112	81792	271930
Total		53	72.24	5000	120	0	3480	0	0	686222	14964839	85952	1295912	16260751
Grand Total		135	184.16	5000	12320	200	3480	9.13	364800	702971	15234754	143880	2275326	17874880

TER 8: Odambogiyar

Odambogiyar river enters Nagapattinam district through Nagapattinam taluk. The network of channels under this passes through Karuveli, Narauyangudi, Pappakoil, Andhanupettai and Akkaraipettai. The Tail End Regulator is sited in Pappakoil and is 4 kms from the sea. This is the smallest network under a TER - of just 27 kms, of which, 20.45 kms is for irrigation and 6.55 kms is for drainage purposes.



TAIL END REGULATOR - 8 ODAMPOGIYARU

All farmers seem to have access to water for irrigation purposes. 80% of the farmers are marginal farmers, 16.5% are small, 2% are medium and 1% large farmers. An in-depth study of one of the villages showed a high prevalence of water sources - 6 private ponds, 21 common ponds, 11 open wells and 8 canals- though water availability was only during *kuruvai* at all these sources. Paddy is the main agricultural crop and coconut, the main horticultural crop.

As seems to be the practice in Nagapattinam block, in this village also, most of the community-based efforts were on desilting and clearing of ponds and tanks and they also evinced an interest in adding to the number of ponds and tanks rather than for the maintenance of the channels.

The damages in this TER network are also considerable with 43,542 m^3 of siltation and 27,700 m^3 of damage to bunds. There has also been considerable damage to the other structures like shutters and notches. The estimate for desilting is about Rs. 8.84 lakhs and repairs Rs. 4.8 lakhs. Including the repairs to the other structures, the total for revitalising this TER comes to around Rs. 16.6 lakhs, which works out to Rs. 8220/ Ha of ayacut. The damages and detailed estimates are given in Table 7.8.

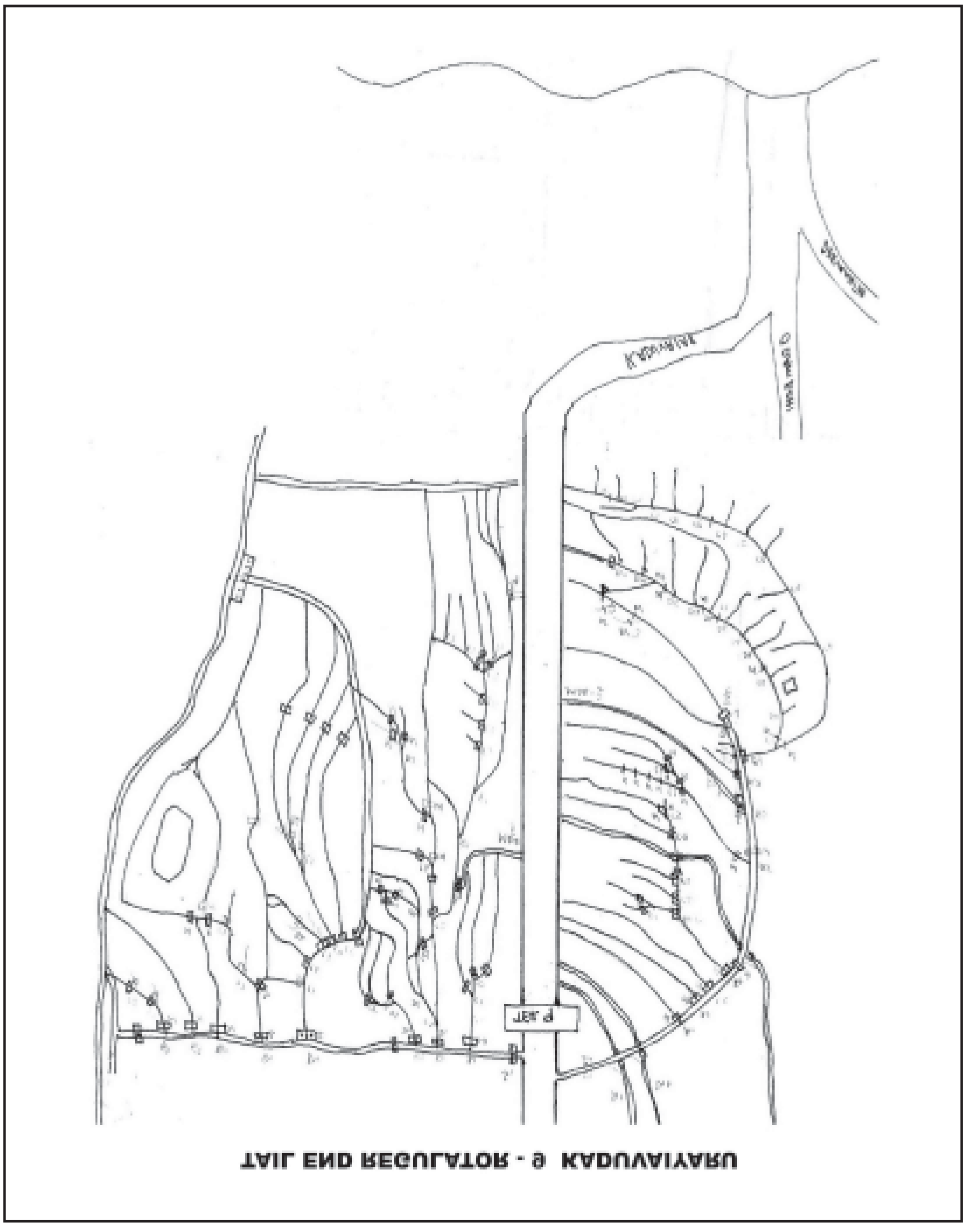
Table:7.8

TER 8 Basic details, Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

Class/Category	Basics details			Types of Encrochment Area (m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs.)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage (m^3)	Estimate for Strengthening of Bunds (Rs.)	
IRRIGATION Channels														
A	202	2	8.2		1240			0.03	1380	6363	105150	4670	84060	190590
B		4	6.5		280			0.02	840	2898	46360	5359	85744	132944
C		12	5.15							1938	31000	2913	46607	77607
D		1	0.6							300	4800	263	4208	9008
E														0
Total	202	19	20.45	0	1520	0	0	0.05	2220	11499	187310	13205	220619	410149
DRAINAGE Channels														
River drainage		1	4	880				0.004	150	29400	646800	13475	242550	889500
Main drainage		1	2	40						1435	25330	604	10868	36198
Sub drainage		2	0.55		40			0.015	600	1208	24885	412	6592	32077
Total		4	6.55	920	40	0	0	0.019	750	32043	697015	14491	260010	957775
Grand Total		23	27	920	1560	0	0	0.069	2970	43542	884325	27696	480629	1367924

TER 9: Kaduvaiyar

River Kaduvaiyar enters Nagapattinam district through Nagapattinam Taluk. The network of channels under the TER located on this river pass through Palakurichi, Ootathatai, Aayamalai, Radhamangalam, Kalasabadi, Ooratur, Nariankeisal, Vadugacheri, Sengamalanayakipuram, Sirachi, Sukanoor, Pappakoil and Chetticherri. The Tail End Regulator on this river is placed at Vadugacherry, 9 kms away from the sea. There is high



level of salt -water ingress through the backwaters in this area. The encroachment in this area is mainly through construction of houses. As this is in the urban area of Nagapattinam block, pressure on land may be one of the reasons for this kind of encroachment. There are about 80 houses constructed on the bunds of "A" and "B" channels.

This network has a total length of 171.36 kms and is the third largest in the district. Of this, 154 kms is used for irrigation and 17.28 for drainage. The irrigation network comprises of two "A" class, 20 "B" class, 54 "C" class and 18 "D" class channels. The drainage network comprises of one river drainage, five main drains and eleven sub-drains. This covers a total ayacut of 4,194 Ha and has the largest coverage among all the TERs.

Despite a high level of access to water sources, 36% of the farmers seem to be doing only rain- fed farming. A study of four villages in this area showed that 55% of the farmers were marginal farmers, 32% were small, 9% were medium and 3% were large farmers. Paddy is the major crop cultivated. There were 87 private ponds, 102 common ponds, 30 bore wells and 43 open wells apart from 11 irrigation and drainage channels.

One of the villages had constituted a water user committee but it had not worked well. But in all villages, some attempts have been made to desilt ponds and repair bunds. All the villages showed a keen interest in constituting community level mechanisms for repairs and maintenance of these structures; some even suggested having the women SHGs take control of operation and maintenance, including repairs.

The dependence on ponds and wells rather than the irrigation channels, seems to have reduced the interest of the users in the basic upkeep of these structures. Apart from encroachment, there are about 6.7 Ha of weed coverage, 16088 m^3 of silting and 31147m^3 of damages to bunds. Six sluices are partially damaged and three fully damaged. 95 of the 104 other structures like shutters and notches have also been damaged. The estimate for weed removal and desilting comes to about Rs. 5.43 lakhs and the bund repairs is estimated at Rs. 5.8 lakhs. The total estimate for reviving this TER comes to Rs. 18.75 lakhs, which is about Rs. 447/ Ha of ayacut, making this the most cost-beneficial TER to take up for immediate repairs. The damages and estimates for repair are given in Table 7.9.

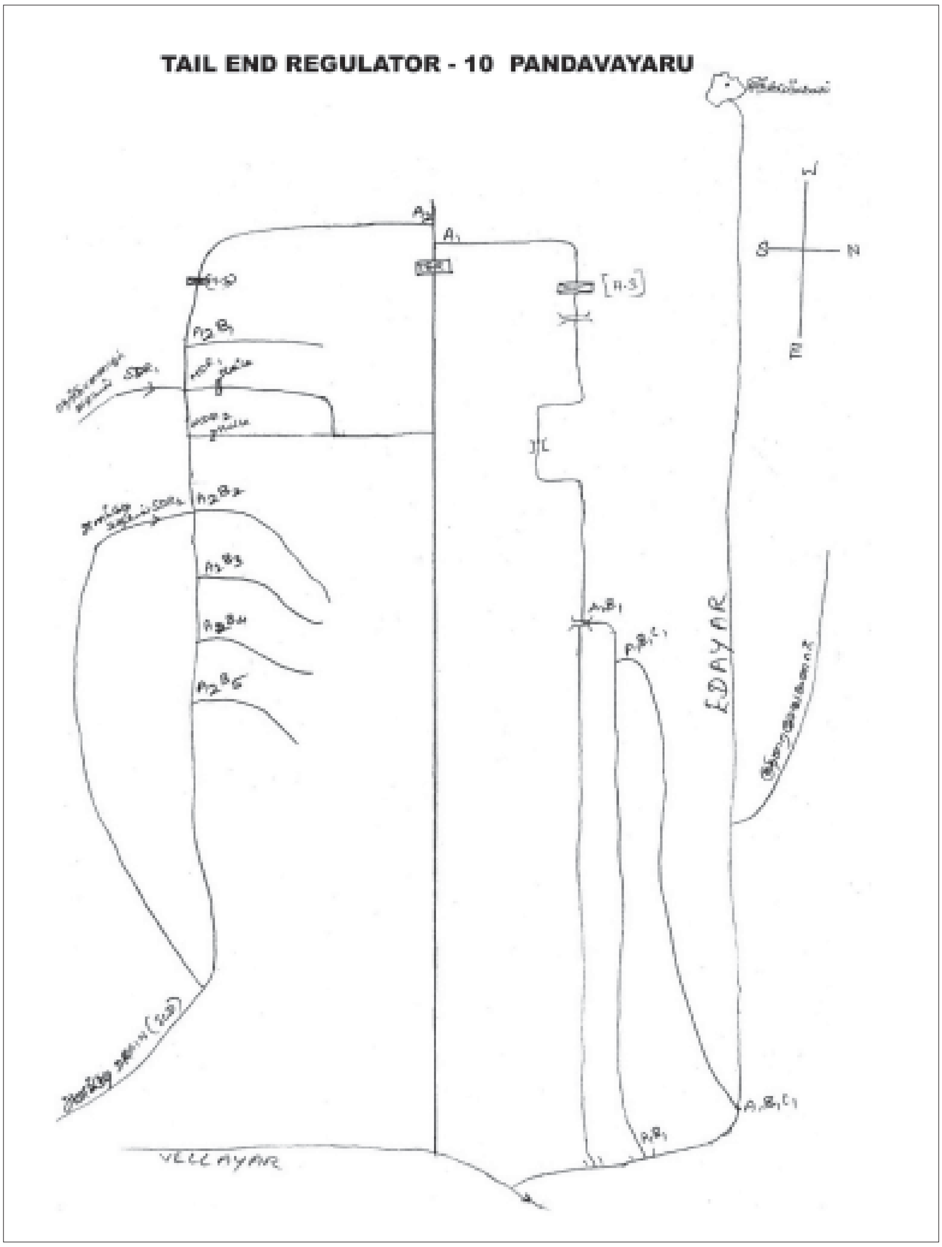
Table: 7.9

TER 9 Basic details, Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

Class/Category	Basics details			Types of Encrochment Area (m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs.)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/ others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage(m3)	Estimate for Strenthening of Bunds (Rs.)	
IRRIGATION Channels														
A	4194	2	15.5			40		3.5	140000	2790	44640	14443	259965	444605
B		20	61.85		40	40		2.96	118200	6630	106080	10019	160300	384580
C		54	55.98					0.24	9600			971	15540	25140
D		18	20.75							1980	31680			31680
E														0
Total	4194	94	154.08	0	40	80	0	6.7	267800	11400	182400	25433	435805	886005
DRAINAGE Channels														
River drainage		1	9									4500	81000	81000
Main drainage		5	6.7		120					3885	81450	1214	21848	103298
Sub drainage		11	1.58							803	12855			12855
Total		17	17.28	0	120	0	0	0	0	4688	94305	5714	102848	197153
Grand Total		111	171.36	0	160	80	0	6.7	267800	16088	276705	31147	538653	1083158

TER 10: Pandavaiyar

River Panadavaiyar enters Nagapattinam district through Kilvelur taluk and the network of channels under this TER pass through Erayangudi, Elavathadi, Vallamkottam and Periyathidal. The Tail End regulator is sited at Erayangudi, at a distance of 4 kms from the sea. This network has a total length of 39.6 kms, of which only 19.1 kms are for irrigation and the remaining 20.5 kms, for drainage. The total ayacut is 475 Ha.



The irrigation network has two "A" class channels, six "B" class channels and one "C" class channel. The drainage network comprises of one river drain, three main drains and two sub-drains. About 17,520 houses have come up on the bunds of both the irrigation and the drainage channels, though the number on the drainage channels is much higher.

Only about 8% of the farmers seem to be totally dependant on rain. In the village studied, there were eight private ponds, 16 common ponds, two open wells and nine irrigation/ drainage canals. About 45% of the farmers are marginal farmers, 26% small, 23% medium and 6% large farmers. The farming community seems to have generally followed the decisions of the grama sabha in cleaning and desilting activities. However, there is a strong discontent among the farmers on the encroachments and they opined that the illegal encroachment should be removed. They also recommended the repair of the sluices/ regulators and strengthening of the bunds.

There is a fairly high level of siltation in the channels with 19709 m^3 in the irrigation channels and 1, 14,075 m^3 in the drainage channels. Bund damages are also high with a total of 89438 m^3 of bund area being damaged, mainly in the drainage network. The estimate for desilting and repairing the damages to the bunds is approximately Rs. 45. 47 lakhs and including the repairs to other structures will total up to Rs. 49. 27 lakhs, which works out to be Rs. 10, 373 / ha of ayacut. The details of the damages as well as estimates for repair are given in Table 7.10.

Table:7.10

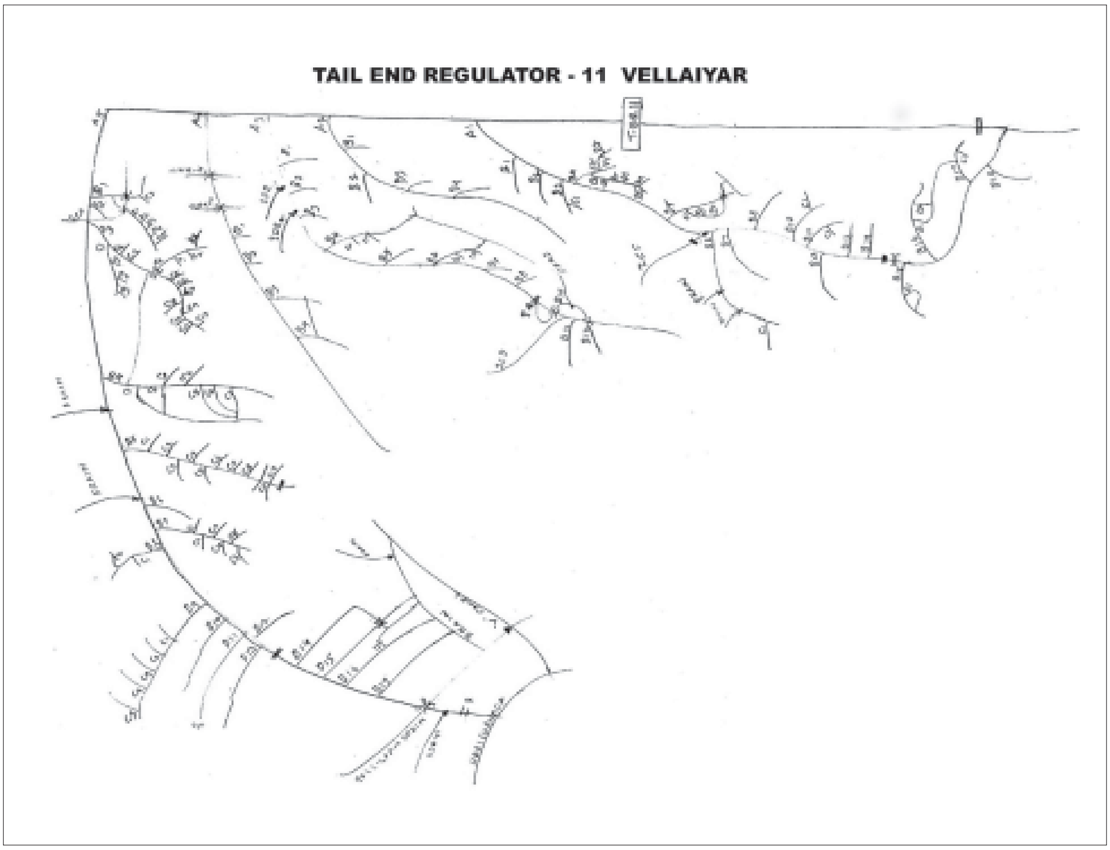
TER 10 Basic details, Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

Class/Category	Basics details			Types of Encrochment Area (m2)				Weed Coverage		Siltation		Bund Damages		Total Estimat (Rs.)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/ others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage (m^3)	Estimate for Strenthening of Bunds (Rs.)	
IRRIGATION Channels														
A	475	2	6.2		120	2520				11160	245520	706	12701	258221
B		6	10.9							7349	157729	768	12288	170017
C		1	2							1200	26400	64	1020	27420
D														0
E														0
Total	475	9	19.1	0	120	2520	0	0	0	19709	429649	1538	26009	455658
DRAINAGE Channels														
River drainage		1	4							72000	1584000	60480	1088640	2672640
Main drainage		3	10			15000				42075	925650	27420	493560	1419210
Sub drainage		2	6.5											0
Total		6	20.5	0	0	15000	0	0	0	114075	2509650	87900	1582200	4091850
Grand Total		15	39.6	0	120	17520	0	0	0	133784	2939299	89438	1608209	4547508

TER 11: Vellaiyar

River Vellaiyar enters Nagapattinam district through Thirukkuvalai Taluk. The network of channels under this TER pass through Thirupoondi, Karunkanni, Melavazhakarai, Venmanachery, Keezaiyur, Kalathidal Karai, Seeravattam, Earvakaadu, Ramankottagam and Keezhapidagai. The Tail End Regulator has been constructed across the river at Eravakkadu at a distance of 21 kms from the sea. The total length of channels in this network is 58.1 kms, of which 29.9 kms is utilized for irrigation purposes and 28.2 kms for drainage. This covers a total ayacut of 3731 ha. The irrigation network comprises of five "A" class channels, 61 "B" class, 77 "C" class and 22 "D" class channels. The drainage system comprises of two river drains and three main drains.

The four villages studied in the area of this TER showed a profile of 60.8% of farmers depending totally on rain fed cultivation. 59% of the farmers are marginal farmers, 34% small, 4.6% medium and about 2.4% are large scale farmers. There were 717 private ponds, 121 common ponds, 18 open wells and 15 irrigation and drainage channels in these four villages but all of them, other than the irrigation channels, provide water only for one season.



Of the four villages studied in depth, one village, Karunganni, had two water user associations, both of which were functioning well and working closely with the Panchayat. Another village, P R Puram, had already done some desilting and maintenance work under the SYGS in 2005. They wanted their tanks to be desilted, and check dams and retaining walls built to prevent flooding. In Karunganni, the shrimp farmers had deliberately damaged the bund in three locations for easier access to the backwater flow of saline water during high tides. The Panchayat and the User Groups were also helpless against the encroachment for construction of houses and were ready to back any initiative to remove these encroachments. Apart from the mechanisms to prevent flooding, the water user groups also had suggestions for repairing shutters and deepening the lake, which would provide them with additional storage capacity for fresh water, thereby increasing the cultivation potential of about 1000 acres in the vicinity.

The estimate for weed removal, desilting and repairing of bunds in both the irrigation and the drainage network is Rs. 1.73 crores and repairs to the other structures like shutters and construction of new structures like additional regulators, small dykes for improving the water storage work out to Rs. 42. 5 lakhs, bringing the total estimate to Rs. 2.16 Crores, which works out to Rs 5785/ ha of ayacut. The detailed information on damages as well as estimates for repair are given in Table 7.11.

Table : 7.11

TER 11 Basic details, Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

Class/Category	Basics details			Types of Encrochment Area (m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs.)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/ others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage (m^3)	Estimate for Strenthening of Bunds (Rs.)	
IRRIGATION Channels														
A	3731	5	29.9		40	9600		6.77	270720	88968	1957296	22724	409023	2637039
B		61		520	8960	80		8.32	332800	174301	3724167	1321	21136	4078103
C		77		560	200			0.63	25200	79807	1543959			1569159
D		22								9110	148162			148162
E														0
Total	3731	165	29.9	1080	9200	9680	0	15.72	628720	352186	7373584	24045	430159	8432463
DRAINAGE Channels														
River drainage		2	21							300530	6611660	81725	1471050	8082710
Main drainage		3	7.2			12160				27540	605880	11632	209376	815256
Sub drainage						11240								0
Total		5	28.2	0	0	23400	0	0	0	328070	7217540	93357	1680426	8897966
Grand Total		170	58.1	1080	9200	33080	0	15.72	628720	680256	14591124	117402	2110585	17330429

TER 12 Harichandra

The River Harichandra enters Nagapattinam district through Vedaranyam Taluk. The Tail End Regulator on this river is sited at Brinjimoolai, 5 Kms away from the sea. The network of canals 153.3 km long pass through Thalainayar, Brinjimoolai, Sadaiyanchi, Thennanchi, Palayatrankarai, Umbalachery, Kaadanthethi, Manakudi, Sadaiyankottugai, Pudupalli, Vettaikaranirruppu, Venmanacherri, Thirumalam, Sadaiyamkottagam, Mudulaiyappankandi, Eagarajapuram, Aaradiyambalam and Vattagudi. This is the third longest system in the district and has the second largest ayacut at 3935 Ha.

The irrigation network is 134.02 kms long and comprises of 10 "A" class, 83 "B" class, 62 "C" class and 11 "D" class channels. The drainage network is 19.28 kms long and has one river drain and five main drains.

The population is almost evenly divided between farmers and fishers. Sometimes the farmers also fish in the straight cuts of the drainage channels, mainly using poles and nets, which block the free flow of water. 38.43% of the farmers are marginal farmers, 45.7 small farmers, 13.4% medium farmers and 2.5% large farmers. A study done in four of the villages in this area showed a large presence of water bodies- 929 private ponds, 80 common ponds, 14 open wells and eight irrigation/ drainage channels. Although paddy is the single major agricultural crop, there is also considerable area under cultivation of horticultural crops like mangoes, cashew, coconut, vegetables and flowers. Water is stated to be available in the ponds during both *samba* and *kuruvai*, which is probably the reason for the lush greenery of Vedaranyam.

However, due to very low gradient differential, even a small increase in the water levels leads to flooding of some of the areas coming under this network. The community states that desilting was done about 15 years ago. This low gradient also encourages ingress of sea- water during the high tides, favouring prawn cultivation. Some of the farmers have converted some area of their agricultural land into shrimp farms. About 3960 m^2 of the channel land has been encroached upon by the shrimp farms. This network has the most complex encroachments including shrimp farms, houses (about 9000), agricultural purposes (about 17000 m^2) and for horticultural purposes (about 31000 m^2). Most of the encroachment for cultivation has been done by influential farmers from that locality itself; and the others are unable to evict them.

Probably due to the high dependence on other water sources, not much attention has been paid to the maintenance of the channels. There is a large volume, 12.67 lakh m^3, of siltation in both types of channels and will require immense financial resources for desiltation.

Two of the villages surveyed stated that they had registered a farmer's association about ten years earlier. One of these associations has been active in desilting some of the channels.

They are interested in strengthening and continuing their activities and have sought help, especially for eviction of encroachers.

Just desilting of these channels is estimated to cost Rs. 13.68 crores. The repairs to the bunds are estimated at Rs. 16.84 lakhs, and repairs to other structures at Rs. 7.4 lakhs. The total estimate for the entire network is Rs 13.95 crores, which works out to Rs 35,440/ha of ayacut, the highest among all the networks. The details are provided in Table 7.12**.**

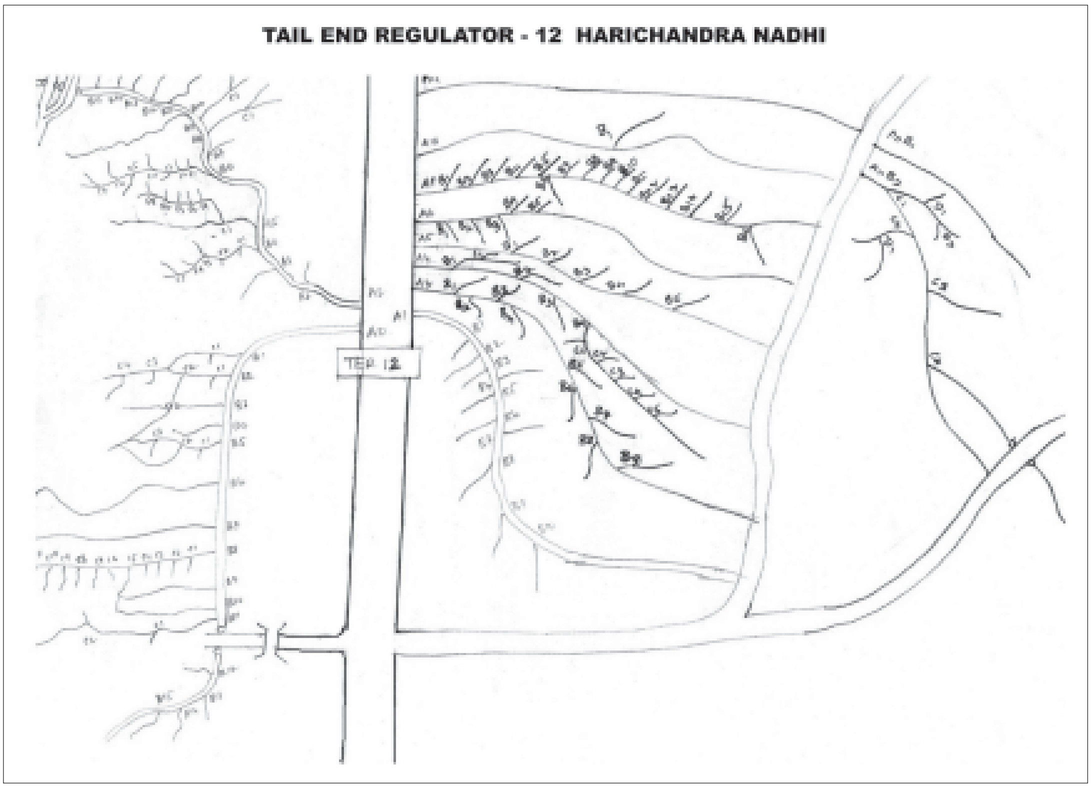


Table: 7.12

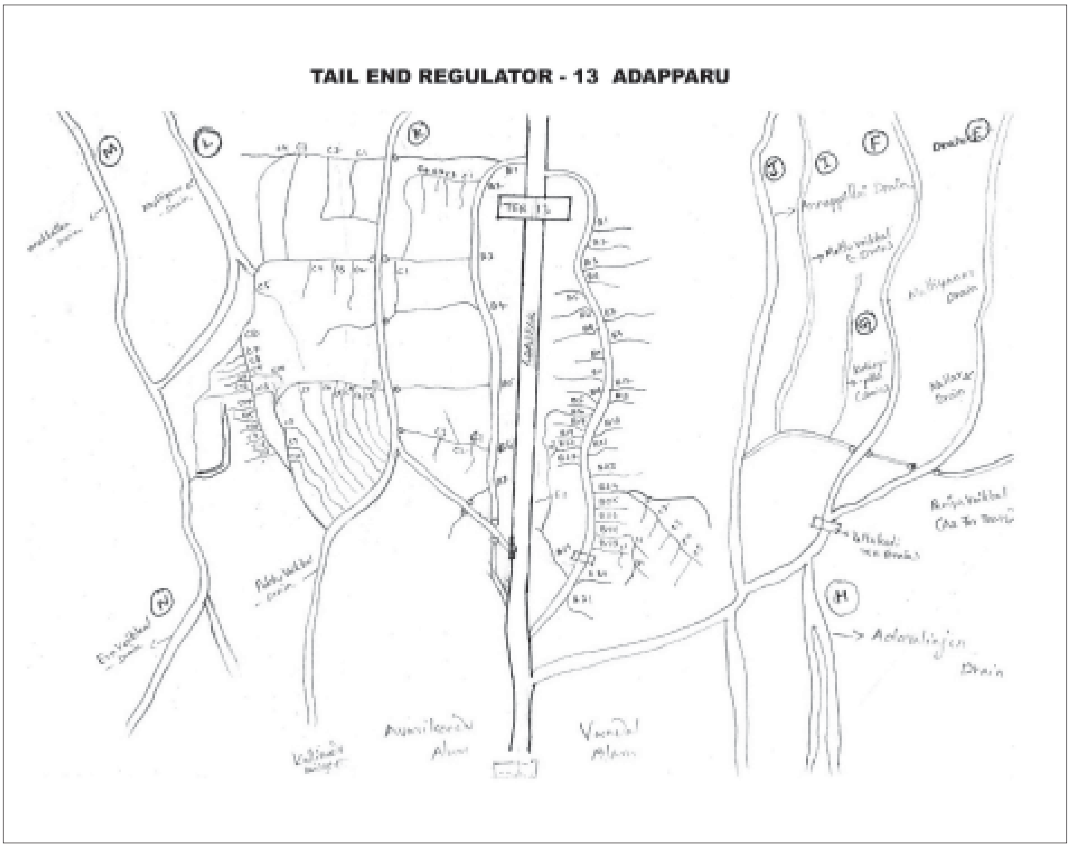
TER 12 Basic details, Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

Class/Category	Basics details			Types of Encrochment Area (m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs.)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/ others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage (m^3)	Estimate for Strenthening of Bunds (Rs.)	
IRRIGATION Channels														
A	3935	10	38.62	640	11840	3600	400	1.03	41382	54531	1174263	117	2106	1217751
B		83	59.39	3320	5200	4280		0.55	21870	48476	886881			908751
C		62	31.8					0.12	4772	2133	41201			45973
D		11	4.21					0.02	652	367	6602			7254
E														0
Total	3935	166	134.02	3960	17040	7880	400	1.72	68676	105507	2108947	117	2106	2179729
DRAINAGE Channels														
River drainage		1	5			1120	120			610000	13420000	43714	786852	14206852
Main drainage		5	14.28				30520	3.98	159200	551300	121286000	49761	895692	122340892
Sub drainage														0
Total		6	19.28	0	0	1120	30640	3.98	159200	1161300	134706000	93475	1682544	136547744
Grand Total		172	153.3	3960	17040	9000	31040	5.7	227876	1266807	136814947	93592	1684650	138727473

TER 13: Adappar

The Adappar river also enters Nagapattinam district through the Vedaranyam Taluk and passes through Umbalacherri, Chettikulam, Thalainayur, Andagathurai, Kariyapattinam, Aavarikaadu, Maruthur and Nagakudiyan. The Tail End Regulator on this river is sited at Umbalacherri, about 13 kms from the sea. This is a 108.49 km long network with an ayacut of 2355 Ha.

The 90.31 km long irrigation network consists of two "A" class, 38 "B" class and 49 "C" class channels. The 18.18 km long drainage network consists of a river drainage, and ten main drainages. Bound by the TERs 12 and 14 on either side, the area under this 100 year old network is always flooded from the spillover from both the sides. Apart from this, the iron shutters that were provided have completely been eroded and the community prefers the old wooden shutters that were prevailing earlier. There is a marked difference in the agriculture patterns dating from about 20 years back, when apparently the change in the shutters took place. Due to constant flooding, the farmers have given up some of their former practices.



77% of the farmers here are marginal farmers, 21% small, about 2% medium and barely 0.5% are large farmers. There was a heavy dependence on wells numbering 3975, seen in the three villages surveyed in this area. Due to the high volume of seawater ingress through the backwaters, some of the farmers themselves have started converting their land into shrimp farms. So, even if the farmers at the top end desire shutters blocking ingress closer to the sea, the farmers at the tail end who access the sea water for shrimp cultivation oppose it. There are functional registered water user associations in at least two of the villages surveyed and they have been active in desilting and controlling damage to the bunds. However, the bund walls, being made of sand, are weak and constantly vulnerable to damages. They have requested for stronger bund walls.

About 4000 m^2 of the channel area has been taken over for shrimp farming. Apart from this, an estimated 4 lakh m^3 of siltation and 1.75 lakh m^3 of bund damages were observed. The estimate for desilting of these channels is Rs. 87.26 lakhs and repairs to bunds is slated at Rs. 30.9 lakhs. The total estimate for reviving this network is Rs. 1.18 crores, which works out to Rs 5027/ Ha of ayacut. The details are as shown in Table 7.13.

Table: 7.13

TER 13 Basic details, Encroachment, Siltation ,Bund damage, Sluices and other structures - Irrigation / Drainage Channels

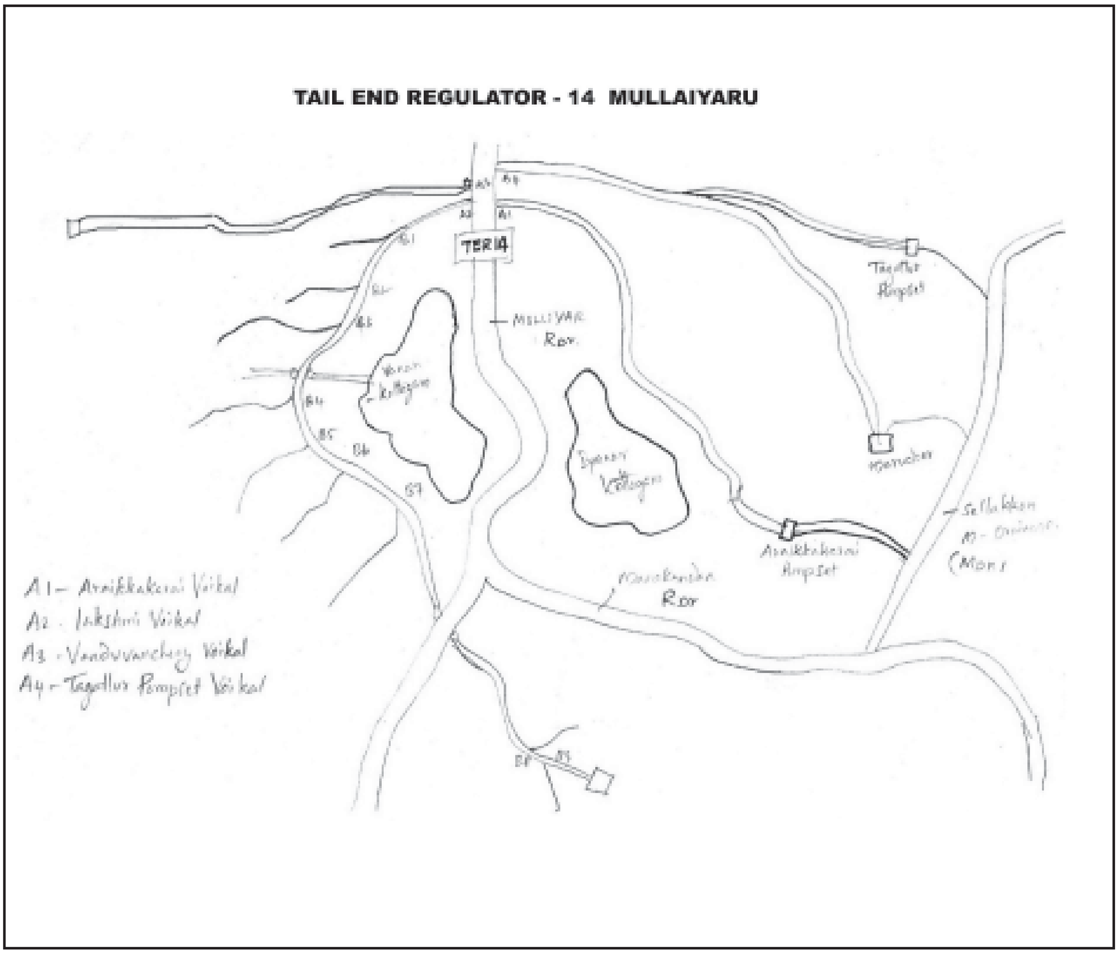
Class/Category	Basics details			Types of Encrochment Area(m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs.)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/ others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage(m^3)	Estimate for Strenthening of Bunds (Rs.)	
IRRIGATION Channels														
A	2355	2	14.1				2000	0.2	8000	2288	50336	28500	513000	571336
B		38	30.71	4000				0.35	14000	19481	418796	165	2640	435436
C		49	45.5							9420	150720			150720
D														0
E														0
Total	2355	89	90.31	4000	0	0	2000	0.55	22000	31189	619852	28665	515640	1157492
DRAINAGE Channels														
River drainage		1	13			15000				160000	3520000	9000	162000	3682000
Main drainage		10	5.18		17000	4520				208500	4587000	134000	2412000	6999000
Sub drainage														0
Total		11	18.18	0	17000	19520	0	0	0	368500	8107000	143000	2574000	10681000
Grand Total		100	108.49	4000	17000	19520	2000	0.55	22000	399689	8726852	171665	3089640	11838492

TER 14: Mullaiyar

The River Mullaiyar enters Nagapattinam district through Vedaranyam taluk and passes through Pethachikaadu, Vellikidanku, Vaaimedu, Panchanathi, Naduthittu, Karuvapallam, Avaikkakarai, Thanikottagam, Thagattur, Govindagadu, Aayakkaranpuram, Maruthur and Karuvapuram. The Tail End regulator of this river is sited at Thanikkotagam, 21.5 kms away from the sea. The 78 km long network under this TER has an ayacut of 1324 Ha.

The 47.5 km long irrigation network comprises of four “A” class and 10 “B” class channels. The 30.5 km long drainage network consists of two river drains and 2 main drains.

60% of the farmers here are marginal farmers, 31% small and 9% medium. There are no large farmers. There is a high dependence on ponds with five private ponds and 110 common



ponds in the two villages surveyed in this area. There are only two water channels available and the poor availability of water sources is probably the reason why 100% of the farmers here were totally dependant on the rain for their agriculture. Although paddy still continues to be an important crop, the farmers here have started cultivating casuarina and tobacco where the per-acre returns are seen to be higher than from paddy. There is also jasmine cultivation in this area. The other reason for switching from paddy is also the non-availability of sufficient water which has been vitiated by the height of a retaining wall built in Thannikottai, eight to ten years ago, which prevents water from irrigating the farms nearby. Although there are three pumping stations set up by the government about 20 years ago, none of these are functional as there was no water and the mechanism became non- functional.

Although the Panchayat and the community had attempted at clearing the channels of weeds, their disposal was stated as a problem. Dumping of the water hyacinth on the bunds did not eradicate the problem, which just started all over again with the next rains due to the slipping of the spores back into the water. The meeting of two drainage channels towards the south of the block and the lack of a gradient has made the surrounding areas swampy and no cultivation can be done in these areas. There were informal water user groups, which met at the behest of the Panchayat and followed the decisions taken by them.

The damage in this network is more through siltation, encroachment and weed coverage rather than damages to the bund. Siltation is to the tune of 2.98 lakh m^2 and about 27000 m^2 of land is encroached for agricultural purposes. The estimate for desilting the entire network is Rs. 64.54 lakhs and for weeding Rs. 9.36 lakhs. Including repairs, the total estimate for revitalising this network is Rs. 74.40 lakhs, which works out to Rs. 5620/ ha of ayacut. The details are as shown in Table 7.14.

Table: 7.14

TER 14 Basic details, Encroachment, Siltation, Bund damage, Sluices and other structures - Irrigation / Drainage Channels

Class/Category	Basics details			Types of Encrochment Area (m^2)				Weed Coverage		Siltation		Bund Damages		Total Estimate (Rs)
	Ayacut (Ha)	Count	Length (km)	Aqua farm	Agri land	Houses	Trees/ others	Area (Ha)	Estimate for Removal (Rs.)	Volume of Silt (m^3)	Estimate for desilting (Rs.)	Volume of Bund damage (m^3)	Estimate for Strenthening of Bunds (Rs.)	
IRRIGATION Channels														
A	1324	4	17.5			40	10640			10134	186444	945	13931	200375
B		10	30		14680					12240	195840	2299	36776	232616
C														0
D														0
E														0
Total	1324	14	47.5	0	14680	40	10640	0	0	22374	382284	3244	50707	432991
DRAINAGE Channels														
River drainage		2	21.5			800	680	13.3	532000	164000	3608000			4140000
Main drainage		2	9		12000	16000		10.1	404000	112000	2464000			2868000
Sub drainage														0
Total		4	30.5	0	12000	16800	680	23.4	936000	276000	6072000	0	0	7008000
Grand Total		18	78	0	26680	16840	11320	23.4	936000	298374	6454284	3244	50707	7440991

Chapter Eight

Recommendations

8A: For improving efficiency of existing structures

8 a1: Irrigation Channels

In addition to counting the number of each kind of channel and its status (siltation, encroachment, weed-infestation), discussions were also held with the farmers, WUA/SHG and other local people to get ideas regarding need and method for restoring water flow in these structures. Estimations were also made on the funds that would be necessary to carry out the repair and rehabilitation works. The problems and possible solutions and costs are discussed below.

Desilting: Siltation is more in A, B, C class channels and is estimated to be about $6x10^5$ m^3. The rates for the removal of siltation (earthwork) were obtained from WRO/PWD and depend on the width of the silted area varying from Rs. 16 to Rs. 22 per m^3. The total cost for removal of silt works out about Rs. 122 lakhs. Table 8.1 gives the TER-wise cost for desilting of channels.

Strengthening bunds: Poor and improper maintenance has resulted in extensive damage to bunds in 147 locations in the channel and to bring the bunds to the designed condition, the earthwork required is about 1,64,000 m^3. The rates for estimation for rectification were obtained from the WRO/PWD and work out to about Rs. 18/m^3 for A class channels and Rs. 16/m^3 for B, C and D class channels. The total cost for repairing bunds works out Rs. 28,34,000. The channel-wise and TER-wise details are given in Table 8.2.

Table 8.1

Irrigation Channels - Estimate for Desilting(Rs.) (Upto 3 m width–Rs.16/m^3, (3-4)m width–Rs.18/ m^3 and above 4m width–Rs.22/ m^3)

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Volume of Earthwork (m^ 3)	Estimate for Desilting (Rs.)
Class	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar		
A	12416	14160	221920	11520	105600	16000	8328	105150	44640	245520	1957296	1174263	50336	186444	198684	4153593
B			32800	37984	87612	13120	118448	46360	106080	157729	3724166.66	886881	418796	195840	289258	5825816
C			21904	35808	3974	192	96377	31000		26400	1543959.09	41201	150720		104388	1951535
D				1024			44220	4800	31680		148161.6	6602			14584	236487
E							2542								159	2542
Total (Rs.)	12416	14160	276624	86336	197186	29312	269914	187310	182400	429649	7373583	2108947	619852	382284	607073	12169974

Note: i) The rates dpend upon the width of the channels

Table 8.2

Irrigation Channels - Estimate for Strengthening of Bunds (Rs.)

(For A channel-Rs.18/ m^3, BCDE channels- Rs.16/ m^3)

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Volume of Earthwork (m^3)	Estimate for Strengthening of Bund (Rs.)
Class	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar		
A	75483	39024	11025	26582	2592	900	473229	84060	259965	12701	409023	2106	513000	13931.1	107039	1923621
B			17456		772.8		360060	85744	160300	12288	21136		2640	36776	43573	697173
C							146125	46607	15540	1020					13081	209292
D								4208							263	4208
Total (Rs.)	75483	39024	28481	26582	3365	900	979414	220619	435805	26009	430159	2106	515640	50707	163956	2834295

Note: i) The rates dpend upon the top width of the bunds

Encroachment: This is an important and difficult problem as eviction of encroachers is possible only by the Revenue Department. The WRO/PWD does not have the authority to remove encroachments even when it directly affects water flow in channels. The High Court has advised the State Government to take action to evict the encroachers in all the water bodies, but the implementation is not progressing well.

Weed Infestation: Water hyacinth growing in the channels is a problem as it reduces the flow during rains and hence results in flooding. The cost for removal of this vegetation is about Rs. 4/m^2 or Rs. 40,000/ ha. The total cost for removing this weed in all the irrigation channels may be about Rs. 13,86,000. Table 8.3 gives the area in each channel affected by the weed and the cost for removing and destroying the weed.

Other structures: There are about 258 sluices in the entire study area of which 44 are abandoned. The areas that were under the abandoned sluices are now irrigated through nearby sluices.

The different types of damages noticed in the sluices are in masonry and in shutters. To get an idea of repair costs, the damaged masonry structures were classified into three categories based on the extent of damage (25%, 50%, and 100%). For each category, approximate repair costs were obtained from WRO/PWD. Accordingly, about 147 sluices require various levels of repairing/rehabilitation. The total cost for repairing the masonry damages works out to Rs. 53,35,000. Similarly, the damages to the shutters were also studied and classified into 2 categories namely 50% and 100% damages. 107 out of 214 shutters were found damaged and the cost for repair and rehabilitation works out to about Rs. 23,00,000 (Table 8.4).

The cost for the repair and maintenance of the 14 TERs (as in actual structures) are not included in this report as the WRO/PWD has already submitted detailed estimates to the government for repairs and rehabilitation at a cost of Rs. 1637 lakhs. The works are expected to be taken up by the WRO/PWD as soon as the approval is given by the government.

Apart from sluices and regulators, other structures in the irrigation channels include bed dam, culverts, pipes and siphons. There are 284 structures of this type in the study area. The cost of the repairs and rehabilitation of these structures are given in Table 8.5. The total cost is Rs.11 lakhs to repair the existing structures and Rs. 13.70 lakhs for construction of new structures, totaling Rs 24.7 lakhs. It is also suggested that a series of regulators be provided in the main river channels to regulate the flow for irrigation. A number of small check dams may be constructed to store the flood water at appropriate places.

Table 8.3

Irrigation Channels - Estimate for Removal of water Hyacinth

(Rates @ Rs. 40000/ Ha-area)

TER No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Class		South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Weed Coverage area (Ha)	Estimated Amount (Rs.)
A	Area (Ha)		0.02	0.28	0.00	0.15	0.16	4.00	0.03	3.50	0.00	6.77	1.03	0.20	0.00	16.14	
	Amount (Rs.)	0	600	11000	0	6000	6400	160000	1380	140000	0	270720	41382	8000	0		645482
B	Area (Ha)	0	0.00	0.00	0.00	0.20	0.00	1.63	0.02	2.96	0.00	8.32	0.55	0.35	0.00	14.01	
	Amount (Rs.)	0	0	0	0	7800	0	65000	840	118200	0	332800	21870	14000	0		560510
C	Area (Ha)	0	0.00	0.00	0.00	0.00	0.00	3.50	0.00	0.24	0.00	0.63	0.12	0.00	0.00	4.48	
	Amount (Rs.)	0	0	0	0	0	0	139800	0	9600	0	25200	4772	0	0		179372
D	Area (Ha)	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02	
	Amount	0	0	0	0	0	0	0	0	0	0	0	652	0	0		652
Total Amount (Rs.)		0	600	11000	0	13800	6400	364800	2220	267800	0	628720	68676	22000	0	34.65	1386016

Table 8.4

Irrigation channel - Estimation for Rehabilitation of Sluices

a) Masonry																	
TER No.			1	2	3	4	5	6	7	8	9	10	11	12	13	14	Est for Masonry repair (Rs.)
Class	Masonry condition	Rates (Rs.)	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	
A	25% Damage	25000		150000	225000	25000	25000	25000	50000				25000	200000			725000
	50% Damage	50000			450000			100000	150000		150000		250000				1100000
	100% Damage	100000							100000			100000	300000				500000
A - Total																	2325000
B	50% Damage	25000			100000		75000		100000		75000		450000	150000			950000
	100% Damage	50000							100000		150000	200000	1000000	50000			1500000
B - Total																	2450000
C	50% Damage	10000												10000			10000
	100% Damage	25000											525000				525000
C - Total																	535000
D	100% Damage	25000									25000						25000
D - Total																	25000
Total Amount (Rs.)			0	150000	775000	25000	100000	125000	500000	0	400000	300000	2550000	410000	0	0	5335000

Contd.

Table 8.4

Irrigation channel - Estimation for Rehabilitation of Sluices (Cotd.)

b) Shutter

TER No.			1	2	3	4	5	6	7	8	9	10	11	12	13	14	Est for Shutter repair (Rs.)
Class	Shutter Condition	Rates (Rs.)	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	
A	50% Damage	20000		20000	220000			20000	120000			40000	100000	160000			680000
	100% Damage	30000											90000				90000
A - Total																	770000
B	50% Damage	20000			40000				80000		20000		340000	100000			580000
	100% Damage	30000							60000		60000		390000				510000
B - Total																	1090000
C	100% Damage	20000											420000	20000			440000
C - Total																	440000
Total Amount (Rs.)			0	20000	260000	0	0	20000	260000	0	80000	40000	1340000	280000	0	0	2300000

Note: i) The rates dpend upon the % of damages of Sluices

Table 8.5

Irrigation Channels - Estimate for Rehabilitation of Other structures (Notch, Pipe line culvert & Syphon)

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Other Structures - Damage	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Total
Notches	-	-	13	5	2	2	119	25	94	-	6	5	-	-	271
Pipe line culvert	-	-	-	-	-	-	-	-	-	-	11	0	-	-	11
Syphon	-	-	-	-	-	-	-	1	1	-	-	-	-	-	2
Estimate for Repair	-	-	40000	10000	4000	4000	304000	292000	312000	0	108000	20000	-	-	1094000
TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Other Structures Needed	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Total
Notches	-	-	3	-	-	-	13	-	-	-	3	4	-	-	23
Pipe line culvert	-	-	-	-	-	-	-	-	-	-	15	1	-	-	16
Syphon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Estimate for Install new one	-	-	15000	0	0	0	65000	0		0	165000	30000	0	0	275000
Grand Total	0	0	55000	10000	4000	4000	369000	292000	312000	0	273000	50,000	0	0	1369000

Note: i)The rates dpend upon the % of damages of Structures

8 a2: Drainage channels

The maintenance and upkeep of the drainage channels is very essential to dispose of excess irrigation water as well as to ensure that floodwaters are quickly and properly drained so that probability of salination of soil due to water logging is minimized.The problems encountered in the drainage channels are similar to those seen in the irrigation channels. There are relatively fewer masonry structures.

Desilting: The total volume of accumulated silt is estimated to be about 34 lakh m^3 which is about six times the quantity that has accumulated in all the irrigation channels put together. The approximate cost for removal of silt and to maintain the drainage channel in proper condition is estimated to be about Rs. 7.5 crores (Table 8.6). Siltation is more in the river drainage compared to other drains. Apart from this, the formation of sand bars/silt deposits in river mouths obstructs free outflow of flood water.

Strengthening bunds: Damages are noticed in 99 locations in the drainage channels and to bring the bunds to the designed condition, the earth work required is about 6,36,000 m^3 which is again more than five times the earth work required for all the irrigation channels. The total cost for rectification and rehabilitation works out about Rs. 1,14,36,000. The channel-wise and TER-wise details are given in Table 8.7.

Removing encroachments: 16.6 ha of 896 ha of the total area covered by the drainage channels have been encroached upon but it is difficult to remove the encroachments though the Revenue department is working on this.

Weeding: Infestation by water hyacinth is a serious problem. The area covered by the weed is about 27.5 Ha and the cost for removal of this weed from the canals may be about Rs. 11 lakhs. However, removal of the weed has to be done on a continuous basis as re-infestation can be rapid. Table 8.8 shows the area covered by the water hyacinth and the cost for removal.

Other structures: Only seven sluices are there, of which, one is abandoned. The total cost for repair and rehabilitation of the sluices is estimated at about Rs. 4,80,000 for masonry wall, shutter repair etc.(Table 8.9). Another Rs. 5 lakhs may be required to repair and maintain the two damaged siphons in the Vellaiyar river system.

Table 8.6

Drainage Channels - Estimate for Desilting

(Rates @ Upto 3 m width–Rs.16/m^{3}, (3 -4)m width–Rs.18/ m^3 and above 4m width–Rs.22/ m^3)

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Type	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Volume of Earthwork (m^3)	Estimate for Desilting (Rs.)
River Drainage	12000	227040	698500	740020	1302400	498960	14520000	646800		1584000	6611660	13420000	3520000	3608000	1255054	47389380
Main Drainage	172800	3201000	2740560		263800	9136	274701.6	25330	81450	925650	605880	12128600	4587000	2464000	2154420	27479908
Sub Drainage			70192	6645	15360	1920	190138	24885	12855						19369	321994
Total (Rs)	184800	3428040	3509252	746665	1581560	510016	14984839	697015	94305	2509650	7217540	25548600	8107000	6072000	3428843	75191282

Note: i) The rates dpend upon the width of the channels

Table 8.7

Drainage Channels - Estimate for Strengthening of Bunds
(Rates @ RDR & MDR- Rs.18/ m^3 SDR channel-Rs.16/ m^3)

TER No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Type	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Volume of Earthwork (m^3)	Estimate for Strengthening of Bund (Rs.)
River Drainage	2362.5		8100	99720	720900	819113	1188000	242550	81000	1088640	1471050	786852.29	162000		370572	6670287
Main Drainage	19125	91125	95400		158400		267120	10868	21848	493560	209376	895691.88	2412000		259695	4674513
Sub Drainage					2688		81792	6592							5692	91072
Total (Rs.)	21488	91125	103500	99720	881988	819113	1536912	260010	102848	1582200	1680426	1682544	2574000	0	635959	11435872

Note: i) The rates dpend upon the top width of the bunds

Table 8.8

Drainage Channels - Estimate for Removal of water Hyacinth
(Rates @ Rs. 40000/ Ha-area)

TER No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Category		South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Weed coverage area (Ha)	Estimated Amount (Rs.)
River Draingae	Area (Ha)	0	0	0	0	0	0	0	0.00375	0	0	0	0	0	13.3	13.30375	
	Amount (Rs.)	0	0	0	0	0	0	0	150	0	0	0	0	0	532000		532150
Main Drainage	Area (Ha)	0	0	0	0	0	0	0	0	0	0	0	3.98	0	10.1	14.08	
	Amount (Rs.)	0	0	0	0	0	0	0	0	0	0	0	159200	0	404000		563200
Sub Drainage	Area (Ha)	0	0	0.125	0	0	0	0	0.015	0	0	0	0	0	0	0.14	
	Amount (Rs.)	0	0	5000	0	0	0	0	600	0	0	0	0	0	0		5600
Total Amount (Rs.)		0	0	5000	0	0	0	0	750	0	0	0	159200	0	936000	27.52375	1100950

Table 8.9

Drainage Channels - Estimation for Rehabilitation of Sluices

a) Masonry

TER No.			1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Type	Masonry condition	Rates (Rs.)	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Est for Masonry repair (Rs.)
River Drainage	50% Damage	50000											100000				100000
	100% Damage	100000											100000				100000
River Drainage - Total																	200000
Main Drainage	50% Damage	25000											50000				50000
	100% Damage	50000										100000					100000
Main Drainage - Total																	150000
	Total Amount (Rs.)		0	0	0	0	0	0	0	0	0	100000	250000	0	0	0	350000

b) Shutter

TER No.			1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Type	Shutter Condition	Rates (Rs.)	South Rajan	Pudumanniyar	Cauvery	Manjalar	Mahimalaiyar	Veeracholanar	Vettar	Odambogiyar	Kaduvaiyar	Pandavayar	Vellaiyar	Harichandra	Adappar	Mulliyar	Est for Shutter repair (Rs.)
River Drainage	50% Damage	20000											40000				40000
	100% Damage	30000											30000				30000
River Drainage - Total																	70000
Main Damage	50% Damage	10000											20000				20000
	100% Damage	20000										40000					40000
Main Drainage - Total																	60000
	Total Amount (Rs.)		0	0	0	0	0	0	0	0	0	40000	90000	0	0	0	130000

Note : The rates depend upon to & of damages of sluices

New Regulators:

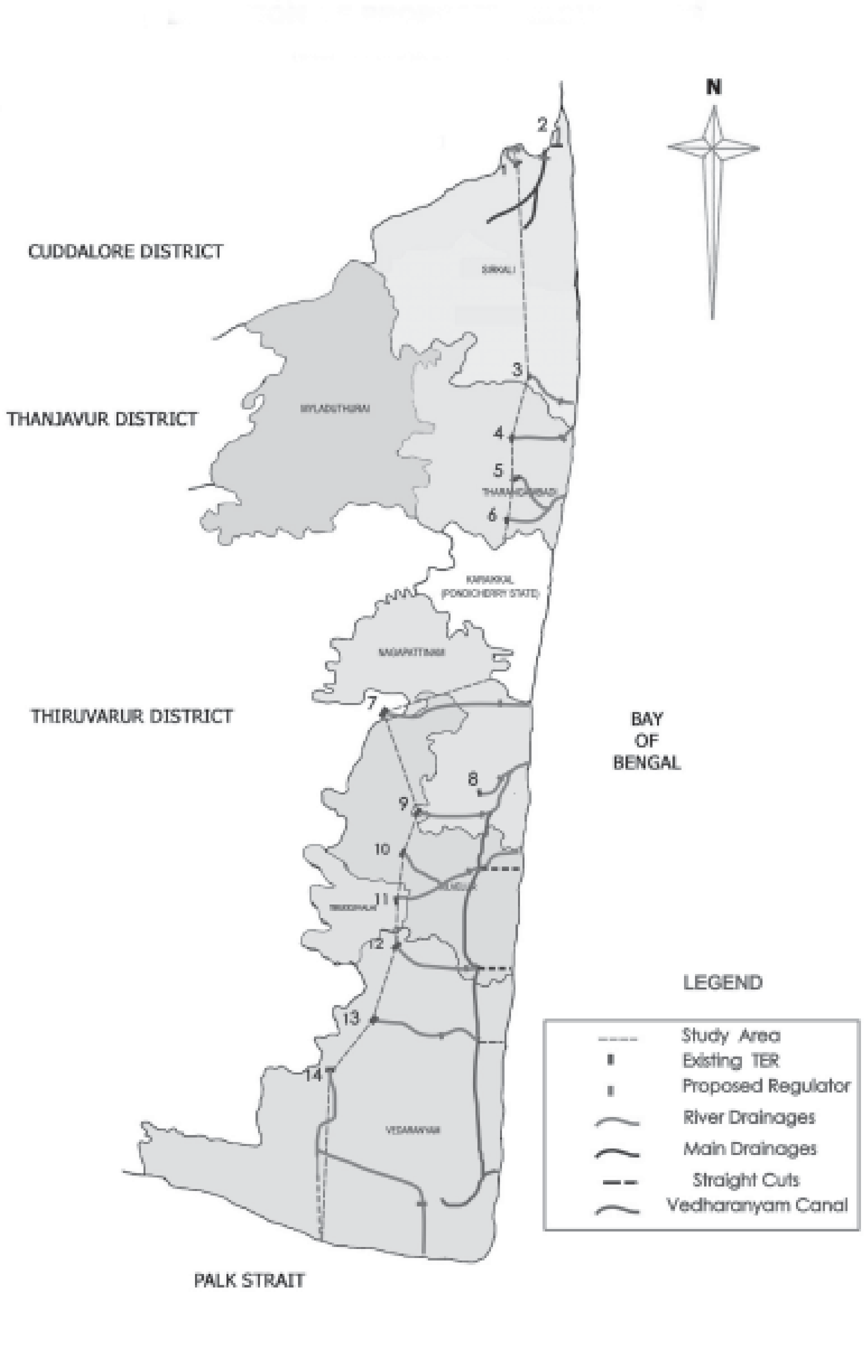
Currently, as the bunds of many drainage channels below the TERs are damaged and do not have the required/designed height, and because siltation has reduced the channel depth, the sea water over flows over the bunds and spreads on both sides of the channel into the paddy fields. This damages the standing crop apart from increasing soil salinity. This is more pronounced during cyclones/depressions in the Bay of Bengal that result in higher tides. When the distance of TER from the confluence is greater, the damage is likely to be higher. To overcome this, and also to use some length of the river channel for storing fresh water, a regulator in the drainage channel at a distance of 3-4 km from the confluence needs to be constructed. This is suggested for nine of the fourteen TERs. (Table 8.10 and Fig 8.1). The farmers of Sirkali Taluk have suggested an additional regulator be fixed in the Nallar main drainage to prevent the backwaters entering into the fields.

Table : 8.10

Distance between Existing TER and Proposed regulators

TER No	River	Distance of TER from the sea (km)	Distance of new regulator from the sea (km)	Distance between Proposed regulator & Existing TER (km)
1	South Rajan	2	0.5	1.5
2	Pudhumaniyar	0.2	-	-
3	Cauvery	5.8	1.8	4
4	Manjalar	6	3	3
5	Mahimalaiyar	1	-	-
6	Veeracholanar	1.2	-	-
7	Vettar	22	5	17
8	Odambogiyar	4	2	2
9	Kaduvaiyar	9	3	6
10	Pandavayar	4	-	-
11	Vellaiyar (River drainage + Straight cut)	21 (17 + 4)	4	13 (17 - 4)
12	Harichandra	5	2.5	2.5
13	Adappar	13	6	7
14	Mulliyar (Monakondan drain + Mulliyar drain)	21.5 (15 + 6.5)	4	9 (15 - 4)
15	Nallar drain	-	1 km (from cooleron)	-

Figure : 8.1
Location of Proposed Regulators



The approximate cost of the new regulators is expected to be about Rs. 1 - 1.25 lakhs each and the cost of desilting and strengthening of bund on either side may be about Rs.7 - 10 lakhs per kilometre. The quantity of stored water for one filling will be around 0.30 - 0.40 TMC. The stored water can be used for irrigation after the paddy (*Thaladi/samba*) is harvested. This stored water can also help to recharge the ground water to some extent and also can be used for fish culture by the WUA to obtain additional income. The cost for the construction of about 10 regulators including deepening the bed and strengthening bunds works out to approximately Rs. 21.75 crores (Table 8.11).

Table 8.11

Rough cost for the construction of regulators, deepening bed and strenthening of the bunds

TER.No	Cost for Regulator (Lakhs)	Cost for deepening Bed & Strenthening Bund (Lakhs)	Total cost (Lakhs)
1	100	1.5 x 8.0 = 12.00	112.00
2	-	-	-
3	100	4 x 7.00 = 28.00	128.00
4	120	3 x 8 = 24.00	144.00
5	-	-	-
6	-	-	-
7	350	17 x 10 = 170	520.00
8	120	2 x 8 = 16	136.00
9	120	6 x 9 = 54	174.00
10	-	-	-
11	160	17 x 10 = 170	330.00
12	100	2.5 x 12.0 = 30	130.00
13	100	7 x 7 = 49	149.00
14	100	9 x 7 = 63	163.00
Nallar Main drainage in Sirkali	100	50	150.00
	Total	-	2136.00
			or 21.50 cr

This type of work i.e., providing regulators below the TER has already been executed in Karaikal region of the delta in most of the river drainages to store fresh water for irrigation and drinking purposes and to prevent salt water ingress.

Storing the floods / fresh water below the tail end regulator of Vettar: The TER on the Vettar is located about 22 km from the sea. The average width of the river below the TER is about 40 – 50 m. A new TER can be installed at the place where the new East coast road crosses the river, about 4 km from the sea. The length of the drainage river from the TER to the proposed new regulator may be about 15 km. To store water in this drainage channel, it can be deepened to a depth of about 2 m and the earth can be used to strengthen and raise the river bunds and also the bunds of the main and sub drains that join in between the two regulators to avoid flooding the cultivated lands on both sides. The approximate storage capacity may be about 1.7 MM^3 or 60 Mcft. The approximate cost for taking up the work may be about Rs 5.20 crores (Regulator = 3.50 crores, desilting and strengthening bunds = Rs1.70 crores). The fresh water stored in the river will irrigate about 1000 acres for one filling.

8a 3 Other water bodies (ponds, *ooranis*, tanks, wells)

Village tanks / ponds: There are about 4000 village tanks. All the ponds are very old and have not been maintained regularly. The actions required to restore these ponds are desilting the ponds, strengthening of bunds, desilting the inlet and outlet channels, repairing bathing ghats etc. From the study and based on the experience gained by the Department of Agricultural Engineering, the total average cost for attending to the above said works may be about Rs. 1.0 lakh per tank. The detailed estimates are given in Table 8.12. If the tanks are all repaired, it is possible to increase the present capacity at least by 50 % and the additional water stored will be available for use by villagers throughout the year and also to recharge the ground water. The approximate cost may be around Rs 40 crores. The total capacity of all the tanks is 24.33 Mm^3 or 2433 Ha M.

8 a 4: Natural water bodies (*alams*, lagoons)

Irrigation tanks/*Alams*: In order to store larger quantities of flood water/fresh water, the existing irrigation tanks should be rehabilitated and strengthened. Similarly, the shallow *alams* in the study area should be modified to the extent necessary to store the fresh/flood water and prevent the salt water/sea water entering into it. All this will go a long way in preventing flood and inundation and mitigate water problems and also help increase the groundwater recharge.

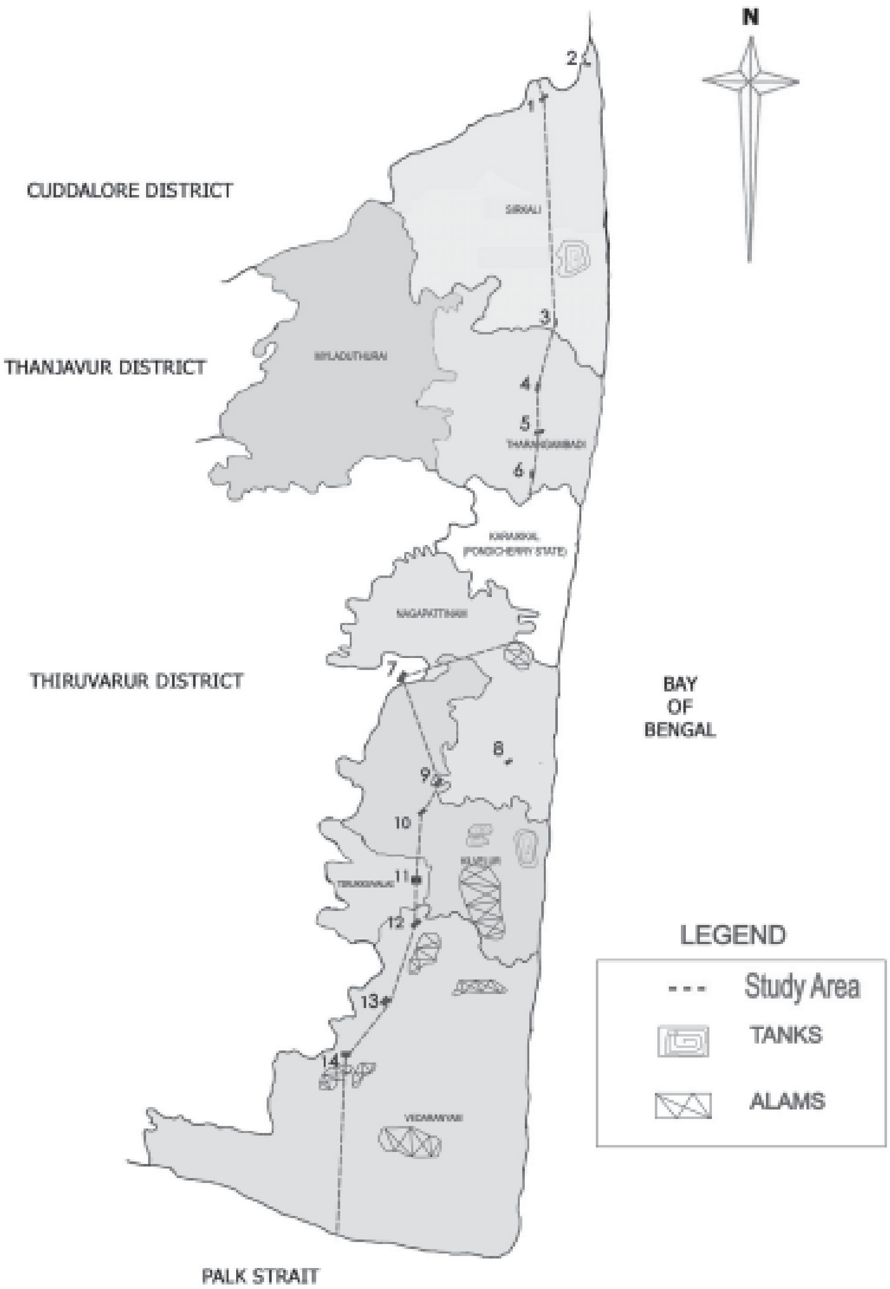
***Alams*:** There are six large *alams*, four in Vedaranyam taluk and one each in Kilvelur and Nagapattinam taluks (Figure 8.2). In one or two large *alams*, there is also saline water intrusion. The water spread of the *alams* varies from 20 Ha to 600 Ha. It is possible to increase their storage capacity by desilting, and deepening these structures and providing bunds and weirs. During heavy rains, flood waters can be diverted into these for storage.

Table 8.12

Estimate for Rehabilitation of Village pond / Ooranis in the Study Area

Sl.No	Taluk wise	No of Villagepond/ Ooranies in the study area	Average siltation volume in sample villages (m3)	Estimate for desilting @ Rs 22 / m3 (in lakhs)	Average Bund damage volume in sample villages (m^3)	Estimate for Strengthening bund @ Rs 20 /m3 (in lakhs)	Rehabilitation for Feeder /Drain canals @ Rs 0.3 laks /pond	Total Estimate Amount (in Lakhs)
1	Sirkali	536	2458	289.85	78	8.3616	160.80	459.01
2	Tharangambadi	608	1822	243.71	156	18.9696	182.40	445.08
3	Nagapattinam	956	3488	733.60	115	21.988	286.80	1042.38
4	Kilvelur	684	1252	188.40	142	19.4256	205.20	413.03
5	Thirukuvalai	80	645	11.35	102	1.632	24.00	36.98
6	Vedaranyam	1212	4466	1190.81	91	22.0584	363.60	1576.47
	Study Area	4076	2355	2657.72	114	92.44	1222.80	3972.96

Figure : 8.2
Tanks and Alams in the Study Area



The details of the alams and the improvements proposed are given below

a. Panangudi:

This is in Panangudi village of Nagapattinam Taluk, 5 km north-west of Nagapattinam on the Nagapattinam – Thittachery road. The tank is about 1.5 km long and 0.5 km wide with a depth varying from 2-6 m and a water spread of about 75 - 80 Ha. It has its own catchment area. Water drained from the nearby fields also accumulates in the depressions. The rain water stored in the *alam* is used by the farmers for irrigation by installing diesel pump sets. The stored water at present is available up to February/March. This *alam* can be strengthened by forming earthen bunds and providing a surplus weir and sluices. The approximate capacity of the tank may be about 2 Mm^3. This water can be used for irrigation or as a source of drinking water as well as to recharge groundwater. Flood waters can be stored (3 or 4 fillings) which will help to reduce the drainage congestion. It is expected that reconstruction of this tank as stated above may cost about Rs 250 lakhs (as estimated by WRO/PWD). The area irrigated from the water stored can be about 400 ha for one filling.

b. Karapidagai alam:

Karapidagai alam is near the tail end of the Harichandra nadhi in Thalainayar block of Nagapattinam district. It is bounded on the east by the Nagapattinam – Vedaranyam Road, on the south by the Law ford straight cut, on the west by the Vedaranyam canal and on the north by Chakkilian vaikkal straight cut. This *alam* has a water spread of about 600 ha. The maximum depth of the *alam* at present is only about 0.60m. Since the bund surrounding this *alam* is damaged, water enters the *alam* from the Vedaranyam canal and the two straight cuts in the southern and northern sides. The entire area is saline and hence water cannot be used. Fresh water can be stored in this *alam* after deepening it to 2 - 2.5 m and strengthening and raising the bunds when its capacity would be about 15 Mm^3 or 1500 ha m. Fresh water can be obtained from Harichandra nadhi and Chaklian vaikal during monsoon. This water can be used for recharging ground water and can be used for drinking and irrigation purposes. The WRO /PWD had prepared a rough estimate to restore this *alam* some years ago for Rs. 3 crores[7]. If this is implemented, the drainage congestion and salinity problem can be minimized in the area. (Fig 8.3). The water stored is sufficient to irrigate 3000 ha in summer for one filling.

[7] Personal communication

Figure 8.3
Karapidagai *Alam*

c. Alams in Vedaranyam taluk in Thalainayaru, Adhanoor,Thanikkottagam and Vandal villages:

The water spread area of these *alams* are about 480 ha, 160 ha, 20 ha and 80 ha respectively. All these four *alams* can be deepened and converted into tanks by providing sluices and weirs. The total water spread area is about 640 ha. The average depth of the tanks can be increased to 2-3 metres. If rain water / flood water is stored, it is possible to store about 1600 ha m or 16 Mm^3 of water. This water can be used for recharging ground water, drinking and irrigation purposes. The approximate cost for rehabilitating the four *alams* is about Rs. 3.0 Crores. The stored water will be sufficient to irrigate 3200 ha in summer for one filling.

8 a 5. Tanks

Improvements to the four major irrigation tanks:

There are four major irrigation tanks built and controlled by the PWD in the study area (Fig 8.2). The details of the four tanks are given in Table 8.13.

Table 8.13

Irrigation Tanks

Sl.No	Name of the tank	Ayacut area in acres	Type
1	Perunthottam	2020	System
2	Thidalari	219	Non system
3	Keeraneri	285	Non system
4	Chittery	142	Non system

The WRO / PWD has estimated that --the repair and rehabilitation (including sluice and weir) for the Perunthottam tank in Sirkali taluk would be about to Rs 100 lakhs. This will help to irrigate the entire ayacut and also carry over the excess water stored to allow a summer crop.

The other 3 tanks are in the south, located in the rainfed areas and receive water only from their own catchment areas. Since these tanks are non system tanks, routine minor maintenance like strengthening bunds and repairs to sluices is done. Hence for bringing these tanks in their original condition, it is estimated that about Rs 35 lakhs may be required for the 3 tanks (Keeraneri Rs 25 lakhs and Chittary and Thildalari Rs 5 lakhs each). By repairing all the tanks, the total ayacut of about 1000 Ha can be irrigated.

8 a 6 Vedaranyam Canal

Details about Vedaranyam Canal:
The effective length in which water can be stored in the Vedaranyam Canal is 50 km. The average width is about 20m with an average bed level of about 0.6m. Currently Vedaranyam canal is filled with sea water. This increases the salinity of groundwater and affects nearby land. At high tide, the water level in this area is about +0.6 m above MSL.

It is suggested that the canal is rehabilitated a) to store the monsoon/flood water – this can be made possible by widening and desilting the canal and providing shutters / regulators for closing at both the ends of the canal and in the straight cuts (Fig 8.4), and b) to serve as flood carrier to drain excess water into the sea which can be done by providing two more straight cuts with regulators in addition to the existing five straight cuts.

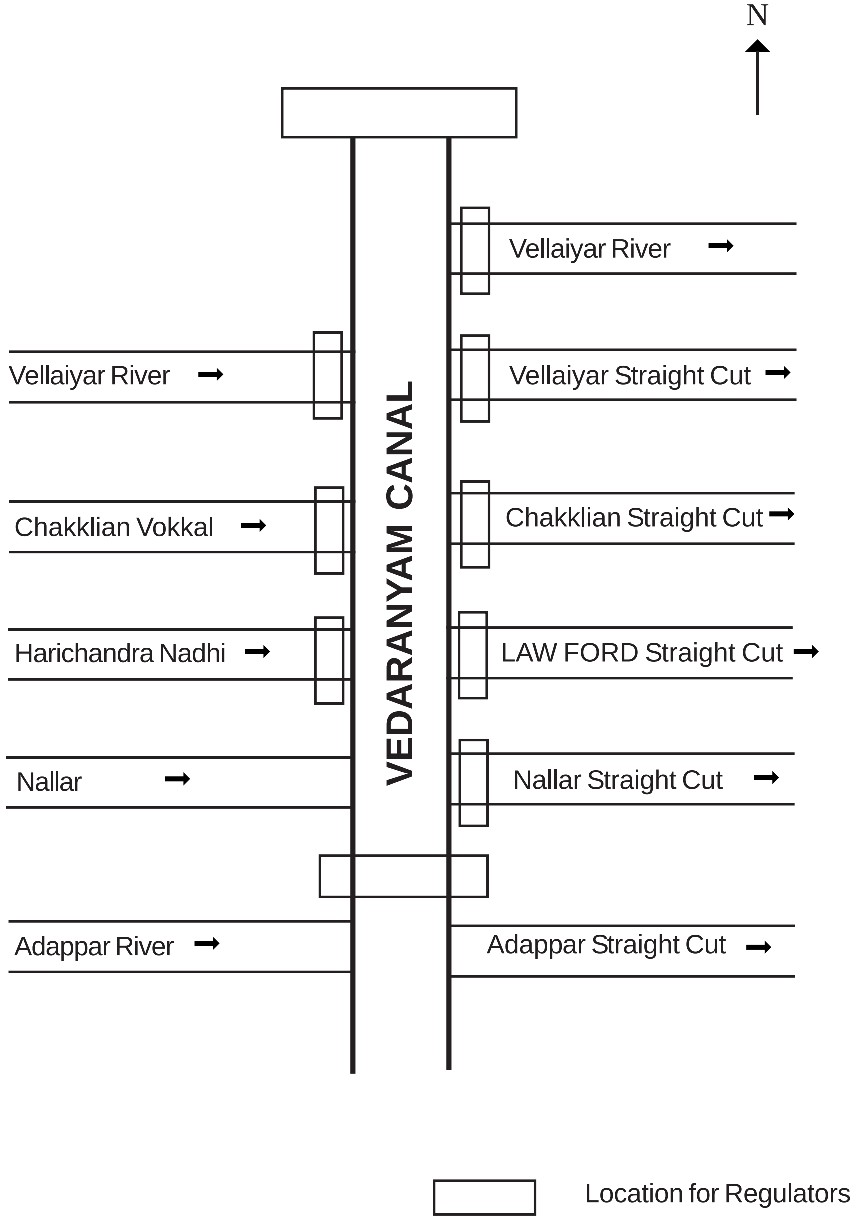
If VC is restored to its original width (20 m) and deepened to a depth of 2.50 m and both its mouths are cut off from the sea, it can definitely act as a storage structure by absorbing flood water entering into the canal. Since this canal runs parallel to the coast, the improved / rehabilitated VC can effectively act as a barrier to sea water intrusion. The bund of the canal will act as a protective barrier from the high sea waves.

Proposal details / modification for VC:
To carry out the above, sea water needs to be drained from Vedaranyam canal which then has to be filled with fresh water (flood and drainage from the delta rivers). The canal is to be restored to its original capacity with the depth increased to 2.5m. Existing inlets and outlets of the canal are to be regulated by providing suitable control structures. The bund should be made 1.0 m above MSL. This would result in the carrying capacity of the modified canal to be 3 Mm^3 or 0.10 TMC. Assuming number of fillings as equal to four, utilizable fresh water availability will be about 0.4 TMC which is sufficient to irrigate about 5,000 acres (dry crops). An operation rule has to be framed for effective functioning of the system.

Issues encountered in this proposal
Aquafarms now exist along the banks of Vedaranyam canal to its full stretch. The reasons for the recent development of aquafarms are due to non availability of sufficient water for irrigation especially during crucial periods in the tail end regions of the delta and the fact that sea water mixed with fresh water as now available in the existing Vedaranyam canal is conducive for aquaculture.

Figure 8.4

Proposed Regulators



Adverse effects due to the existence of these aqua farms are listed below[8].

1. Increased salinity of water in the canal due to letting out water of higher salinity into the canal from the Aqua farms.

2. Vast area of land are already affected. The concern is that the land will become totally unrecoverable

3. Farm labourers are reportedly affected due to the reduced agricultural activities and this has aggravated social problems in this area.

4. Water for both drinking and irrigation, already scarce, will be very scarce in this area in near future.

The approximate cost for all the works may be about Rs. 15 crores (as estimated by PWD). If this proposal is accepted and the Government of Tamil Nadu can take up the work, it will go a long way to solve many problems in the coastal district of Cauvery delta.

Recently the Tamil Nadu Government has sanctioned Rs. 70 lakhs for desilting, widening and strengthening bunds of the VC and another Rs. 25 lakhs for desilting and strengthening of the five straight cuts taken from the VC canal. The channel and straight cuts should be maintained periodically for quick disposal of flood water to the sea.

8 a 7 Buckingham Canal

The BC runs parallel to the coast about 500 – 750 m inland. The northern part of the BC starts from the right bank of Kollidam in Pazhaiyar village and traverses a length of 13 km and joins with Vellapallam Uppanar drain in Thirumulaivasal village. The canal is used to carry wastewater and has become a source of pollution to the surrounding areas.

Under Emergency Tsunami Rehabilitation Project the WRO / PWD has proposed to desilt and strengthen the bunds for both lengths at a cost of Rs 263 lakhs[9]. In order to store more water and to improve the drainage, it is suggested to extend the canal in both sectors. Rs Five lakhs may be required to make a detailed study for taking up the works.

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[8] Personal Communication from PWD

[9] Information from PWD

8b Additional Structures proposed

Joining Eravaikal to Manakondan drain:
At present Eravaikal is running towards east and joins the VC. During high rainfall in the north east monsoon, the flood waters in the VC prevent the Eravaikal water from entering the VC and hence the entire area is flooded. It is reported that the situation is very severe in disaster years. To avoid the water stagnation and flooding in the area, it is suggested that the Eravaikal can be diverted south to join Manakondan river which is flowing east and then turned right to drain into the swamp (Fig 8.5). The length of the new channel proposed is about 10 km. Poromboke / government land is available for this, except for about 2 km which will have to be aquired. The Eravaikal carries the drainage water from about 25 villages covering an area of 10, 000 Ha. During monsoon this land is submerged and farmers are unable to get any yield from their lands.. The approximate cost for the implementation may be about Rs. 250 lakhs. This work may be taken after a detailed study.

Construction of storage tanks in the locations where sub drain / main drains join the river drain below the TER and in other government vacant lands:

There are about 175 drains in the study area to carry excess irrigation water and flood water to the river drainage which in turn carries the water to the sea. Water stagnation is noticed in these small channels before they drain into the river. There is scope to construct a storage tank by deepening the area so that appreciable quantity of water can be stored. As there are many such channels in the area, it will help to ease the drainage congestion. Similarly there are small pockets of government poromboke lands/ panchayat waste lands and these uncultivated common lands (small pockets) can also be made into storage ponds wherever possible. This will also help to store the flood water. All these activities will help in recharging the ground water position in the area. A sum of about Rs 50 lakhs may be required to implement this.

Farm ponds: These have become acceptable to the farmer for the role they play during both droughts and floods. It is suggested that about 2500 farm ponds can be constructed in the next 5-7 years in the study area, i.e., one tank in a 10 ha field. The size of the tank can be 30m by 30m by 1.5m and the cost may be about Rs. 30,000/- per tank.

Wells: The type of wells suitable here are the *kuttai*, which are dug to a depth of 2 to 3 m and provided with oil engine[10] that can extract sufficient water to grow vegetables, ground nut and tree crops. An improved version of this is the skimming well which gets water

[10] Farmers refer to motors served with regular power as 'motors' and those powered by diesel as 'oil engines'

from large catchment and has the capacity to irrigate about 1 - 1 ½ acres compared to the *kuttai* that can irrigate only about ½ to ¾ of an acre. The cost of *kuttai* with oil engine may be about Rs. 15,000/- whereas the skimming well will cost about Rs. 60,000/- (including the cost of a pumpset). It is suggested that about 500 *kuttai* and about 1000 skimming wells can be provided in the next 5-7 years to improve water availability especially for the poor farmers.

The total cost for the 2 type of wells are as follows.

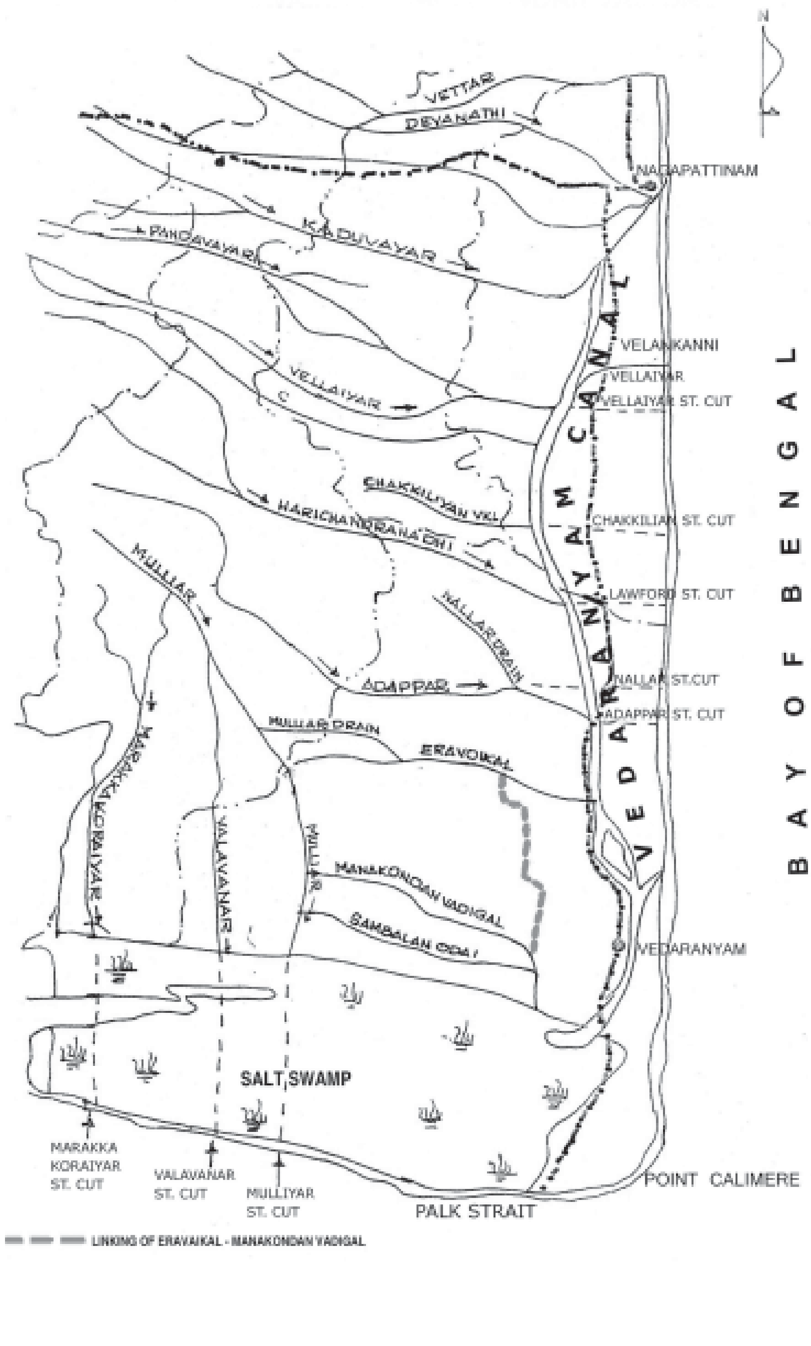
For 500 *kuttai* (pit type of well = 500 x 15,000 = 75,00,000 or Rs. 0.75 crores.

For 1000 skimming wells = 1000 x 60,000 = 6,00,00,000 or Rs. 6 crores.

In addition, deep bore well (>300 m deep) can be constructed 15 km from the sea shore, where the salinity level is only about 1.50 mmhos/cm and the extracted water can be distributed to the farmers during periods of water scarcity. Each well would probably cost Rs. 10 to 12 lakhs. If necessary this water can be used by mixing with fresh water or canal water.

To mitigate drainages problems and to store the rain/monsoon water, if these measures are implemented, farmers in the area will be benefited and food production can be increased.

Figure 8.5
Vennar Sub-basin Linking of Eravaikal Manakondan Vadiyal



Chapter Nine

Groundwater Recharge

Water, for most of the irrigation in the Cauvery delta, is obtained from the Mettur reservoir. However, groundwater also plays an important role during seasons of scarcity and also enables growing of crops in summer. At present, groundwater in the delta is used

- For raising seedlings for kuruvai crop
- To augment supply from Mettur dam when there is a shortfall during the regular season
- As a supplement at the fag end of samba and thaladi crops when the water supply from Mettur reservoir is either stopped or is in short supply.
- To raise a third crop during summer (February to April)

Ground water position

Two main aquifer systems present in the delta are a) Shallow aquifer consisting of 1) Quaternary and 2) Pliocene and b) Deep aquifer consisting of 1) Aquitanian termed as Oranthanadu aquifer and 2) Burdigalian termed as main flushing zone. In Tamil Nadu, groundwater levels are monitored by the PWD, TWAD Board and Central Groundwater Board. Water level and water quality are monitored during the post-monsoon and the pre-monsoon every year and the ground water level status reports are maintained. The water level and fluctuations for Nagapattinam district made by Central Groundwater board and TWAD board are given in Tables 9.1 and 9.2.

Table 9.1

Water level and Water Table fluctuations – CGWB

Station	Water level			W.T fluctuations (in mbgl [11])	
	2004 November	2005 May	2005 November	2004 November	2005 May
Mayiladuthurai	0.88	5.98	1.27	-0.39	4.71
Nagoor	1.65	2.8	1.56	0.09	1.24
Sirkali	2.45	4.35	1.1	1.35	3.25
Vedaranyam	0.26	1.74	1.15	-0.89	0.59
Velankanni	0.42	0.22	1.46	-1.04	-1.24

Table 9.2

Average water level and fluctuations –Block wise - TWAD Board

Water level in mbgl

Station	May-04	Jan-05	May-05	Jan-06	GW fluctuations in M	
					May-05 to Jan-06	Jan-05 to Jan-06
Keelayur	2.3	0.9	1.6	0.8	0.8	0.1
Kilvelur	2.8	1.9	2.8	1.3	1.5	0.6
Kollidam	2.1	1.7	2.4	0.9	1.5	0.8
Kuttalam	5.5	4.7	9.1	3.6	5.5	1.1
Mayiladuthurai	4.7	4.2	6.9	0.9	6	3.3
Nagapattinam	2.9	1.3	3.1	0.9	2.2	0.4
Sembanarkoil	4.6	4	6.5	3.2	3.3	0.7
Sirkali	2.8	2.6	4.2	1.7	2.6	0.9
Talainayur	2.3	1.3	2	1.1	0.8	0.2
Thirumangal	1.8	1.2	2	0.8	1.2	0.4
Vedaranyam	2.1	1.1	2	0.9	1	0.2

The working group on the estimation of ground water resource and irrigation potential from ground water in Tamil Nadu has estimated that the position in the district as given in Table 9.3.

[1] mbgl = metres below ground level

Table 9.3

Ground water potential, utilization, and % of development:

Sl. No.	Name of the Block	In hectare meters				Stage of GroundWater development (%) (1997)
		GW recharge	Utilizable ground water	Net ground water draft	Balance	
1	Sembanarkoil	3899	3314	6126	-2812	188
2	Kollidam	1090	926	3580	-2656	389
3	Kuthalam	2976	2530	7822	-5292	312
4	Sirkali	1652	1404	2285	-1881	237
5	Mayiladuthurai	10279	8729	12546	-3817	147
6	Nagapattinam	Saline area				
7	Keelaiyur					
8	Vedaranyam					
9	Thalainayar					
10	Kilvelur					
11	Thirumarugal					

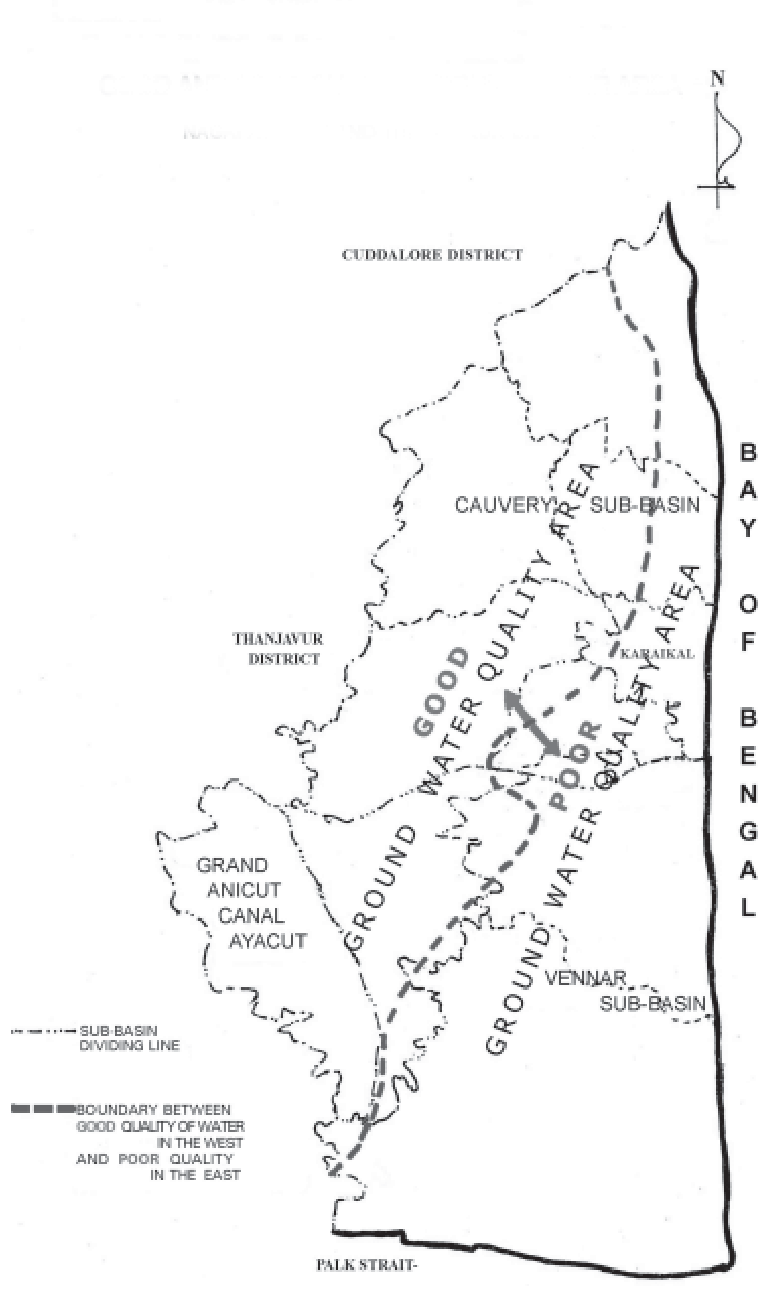
Source: Draft Report of the Work Group on the estimation of ground water resource and irrigation potential from ground water in Tamil Nadu, Chief Engineer, Ground Water, WRO / PWD / Chennai 1992

Groundwater quality

The UNDP has done extensive studies to identify the areas where good quality of groundwater is available. Fig.9.1 shows dividing line in the delta for the good and poor quality of water. From the figure it is seen that the groundwater quality along the entire length of the coast is poor. The width of this strip is less in the northern portion and more in the southern part of the district. A large quantity of saline water is available under pressure (artesian condition) in the deep aquifers but it cannot be used either for irrigation or drinking.

Nagapattinam district has 11 blocks, of which five are north of Karaikal (Puducherry UT). The groundwater in the six blocks south of Karaikal is categorized as saline (Table 9.3) . The five blocks in the north are over exploited at levels ranging from 150 to 400%. Though certain blocks are categorized as saline, there are a few potable pockets especially south of Nagapattinam up to Vedaranyam, in the sand ridge areas, which are used for drinking and irrigation purposes. The farmers also use skimming wells to harvest water in some areas. There are also a number of water supply schemes for coastal habitations which depends on the shallow and deep Pliocene and Miocene aquifers.

Figure 9.1
Good and poor quality ground water area



The coastal tracts in the southern part of the district contain fine clayey sand. Levees are absent in the areas. Close to sea shore, beach ridges (up to 2-4 km from shore) and sand dunes are seen. These beach ridges and sand dunes serve as filter point aquifers. Numerous wells have been dug here and due to over exploitation of ground water, in some places, sea water has intruded turning saline the fresh water in the wells.

Ground water availability

Anna University, Chennai has estimated the actual runoff on sub water shed wise for the entire district. Table 9.4 gives the quantity of harvestable surface water due to monsoon rains in the district.

Table 9.4

Harvestable surface water Mm^3

Sl. No.	Block (sub watershed)	Quantity (Mm^3)
1	Kollidam	62.14
2	Sirkazhi	23.05
3	Mayiladuthurai	55.99
4	Kuttlam	36.93
5	Sembanarkoil	35.17
6	Thirumarugal	30.12
7	Kilvelur	30.9
8	Nagapattinam	32.02
9	Keezaiyur	37.15
10	Thalainayar	47.23
11	Vedaranyam	141.08
Total		531.78
		Rounded off to 532

(Source: Identification of Recharge Areas using Remote Sensing and GIS in Tamil Nadu, Institute of Remote Sensing, Anna University, 1999)

However, this runoff water is available only during the north -east monsoon (October-December). It is suggested that a large number of farm ponds be provided in the fields to store substantial quantity of this water.

The shallow aquifers in the Cauvery sub-basin are almost fully recharged within two months after the water is released from Mettur dam and the extractable potential is about 27 TMC. In the Vennar sub-basin, the recharge takes place through river channels and irrigated fields but with a considerable time lag, and the extractable quantity is only about 1.8 TMC. The potential of deep aquifer is very low because of small recharge area and high clay content in the aquifer.

However, if a dynamic plan can be prepared such as pumping of water using low-head and high discharge pumps after storing the flood water in the low-level areas/*alams* in the coastal areas, it is possible to recharge large quantities of water and the same can be used for irrigation and other purposes.

There is no scope to bring more area under irrigation unless fresh water or flood water is stored and used to recharge shallow unconfined aquifers. Towards this, an effort has been made to locate appropriate sites.

The major problems in the study area are

- Floods during north-east monsoon (October – December),
- Non-availability of Mettur water in the lean season as this area is in the tail end of the delta, and
- Saline groundwater in most places except at shallow depths due to sand ridges in the coastal areas south of Nagapattinam.

Improvement of groundwater quality and availability

To look into possibilities of improving the groundwater potential, the area was visited along with Regional Director, Central Groundwater board followed by interactions with the geologists of TWAD board and Central Groundwater board. The following measures are suggested:

- Provision of a wide channel in the western side near the sand ridges area parallel to sea to store the rain/flood water.
- Identification of the numerous depressions in the sand dunes/ridges between the sea and Vedaranyam canal and developing them to store the flood water/ rain water
- Pumping out the mild saline groundwater on both the sides of the river channel and mixing with the canal water. This will improve availability of space in the underground aquifer to recharge the groundwater. The saline water in the aquifer can be slowly changed into sweet water over a period of time. .

· A detailed study can be undertaken to implement the above suggestions.

Prospects of Artificial Recharge

The uneven distribution of rainfall, erratic flow in canals in recent years and its shrinkage due to encroachment and siltation and poor quality of ground water necessitates augmentation of groundwater by recharging in this area. Drinking water has become a scarce commodity in eastern and south eastern part of the district. Indiscriminate pumping of groundwater will lead to depletion of water level and intrusion of sea water which is to be prevented.

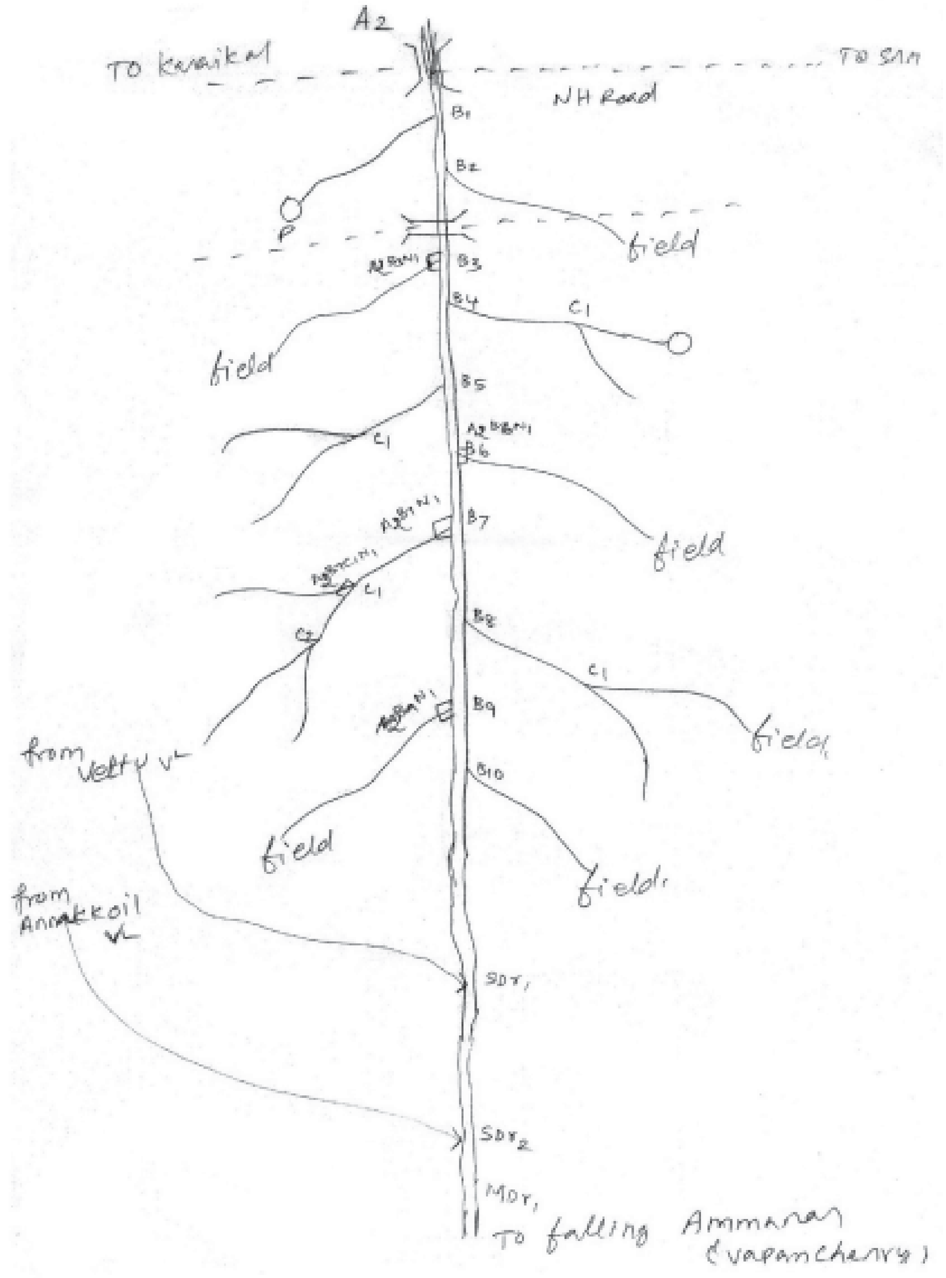
The physical requirements for undertaking artificial recharge for an area are:

1) Basin must be suitable from consideration of storage capacity and transmissibility of aquifer. For e.g., the transmissivity of Vennar sub-basin is only one-third of the value of the Cauvery basin.

2) Sufficient water should be available for recharge. Since adequate storage space is not available during the rainy season, the flood water is allowed to drain into the sea. The depth of water level ranges from 0.2 to 4 mbgl during the post-monsoon period whereas during the pre-monsoon period, it is from 1.56 to 8.65 mbgl. The deeper aquifers are in confined conditions with poor quality of water.

From the above, it is clear that the artificial recharge of groundwater is not an easy task in this area. More scientific studies are to be undertaken for the prevailing hydro-geological conditions.

RAMACHITHIRAN CHANNEL FROM MANJALARU



Chapter Ten

Community Based Water Resource Management

Introduction

In Tamil Nadu, most of the surface water potential was harvested even before the 1970s. The area of irrigation was about one third in each system viz canal, tank and well irrigation. The surface irrigation systems, namely the canals and tanks are under the control of the government. The maintenance has not been done periodically as required and hence many channels are silted up, bunds damaged, and encroachments are commonly seen in all water bodies. The effect of this has been the reduction in area of irrigation under canal and tank irrigation system, namely 29% in canal and 22% in tank system. The area irrigated using groundwater has increased from about 9 million Ha to 14 million Ha in this period.

In olden days, irrigation systems were maintained by stakeholders themselves by engaging staff called *Neer Katti*. The available water was distributed evenly to all, based on the land area, condition of the crop etc. Subsequently, the government took charge of the maintenance but it was not done every year to the extent needed. The net result was deterioration of the channel and sluices. The water distribution was also done by the Luskar, a government official.

A decision was taken by the Central / State Governments, in early 2000, to entrust the operations and maintenance of the irrigation systems to the stakeholders by forming Water Users Associations (WUA)/ or otherwise called participatory irrigation management groups.

The Central and State governments have accepted, in principle, the Participatory Irrigation Management (PIM) concept. The Tamil Nadu government has framed the Tamil Nadu

Farmers Management of Irrigation System Act, 2001 to provide legal support to the farmers. Necessary rules for implementation of the act were also framed in 2002. The Act has been brought into force in all the ayacut area.

The Act provides for the contribution of farmers organization comprising:

a. WUA at primary level.
b. Distributory Committee at secondary level.
c. Project committee at project level.

At present the primary level of the farmers' organization, namely WUAs, have been constituted in only about 6.0 lakh Ha out of 21 lakh Ha in the command area. In these areas, the next levels of farmers' organization, i.e., Distribution Committee (D.C) and Project Committee (P.C) are yet to be formed.

The National Water Policy (2002), of the Government of India has suggested the progressive involvement of farmers in the management of irrigation systems particularly in water distribution and collection of water rates. Separate guidelines have also been issued on farmers' participation in irrigation management. These include

- Setting up of WUAs on hydrological basis.
- Registration of the WUA.
- Signing MoU between WUA and WRO unit.
- WUAs assuming the responsibility of obtaining required water and distributing it among the members, i.e., the responsibility for the management of system.
- WUAs should be responsible of collecting the water cess (charge) from the members and remitting the same to the government.

The repair and maintenance of the irrigation system, i.e., canals and drains are be undertaken by the WUAs. The works which involve technical skill and major construction are to be taken up only by the WRO/PWD. Even here, the execution can be allotted to the WUAs. In the proposal based on the present study, many constructions especially the regulation below TER and major shutters in the VC are included. These are major components which require detailed survey and design of the system. This cannot be done by WUAs. However the design and preparation of estimate and floating tenders for these major works can be taken up by the WRO, but the execution of civil works should be given only to WUAs. The involvement of the WUA/farmers will help develop ownership of the structures/project.

Similarly, by giving the power of distribution of water, the users are likely to take more care to save water since the water thus saved will be used by them to grow one more crop.

This will increase the intensity of cultivation and irrigation. In turn, this will help them to get more income from their lands and enhance the employment opportunity in the villages.

Functions of farmers' associations

The WUA is expected to perform the following functions as per the Act passed in the assembly:

a. To prepare and implement an operational plan and rotational water supply to each irrigation system (*warabandhi)*, consistent with the operational plan, prepared by the distribution committee and the project committee, and based upon the enlistment, area, soil and cropping pattern as approved by the managing committee.

b. To prepare a plan for the maintenance of irrigation system in the area of its operation at the end of each crop season and carry out the maintenance works of both distributory systems, irrigation channels and field drains in its area of operation with the funds of the WUA from time to time.

c. To regulate the use of water among the various sluices under the area of operation according to rotational water supply.

d. To promote the economy in the use of water allotted.

e. To assist the authorities of the Revenue Department in the preparation and demand and collection of water charges.

f. To maintain a register of water users.

g. To monitor the flow of water for irrigation.

h. To resolve the disputes between the members of the WUA.

i. To raise resources.

j. To maintain accounts/audit accounts.

k. To assist and conduct elections/maintain the records.

l. To conduct GB meeting etc.

m. To remove the encroachments on canals, drains, and poromboke in the area of jurisdiction of the WUA.

From the above it is clear that the WUA has all the powers as per the Act to repair and maintain the irrigation and drainage channels/structures including levying and collecting the money from the users; and distribution of water to all the farmers based on the stage of the crop and the extent of area etc. The association is to be formed and the office bearers are to be elected according to the rules. Though the Act has been in vogue for nearly five years, in many places the WUA have not been constituted and office bearers have not been elected. The farmers should take action to see that the Act is implemented early for their own benefit.

Although such formally registered groups have been seen in the villages visited in the course of this study, not all of them have been active. Lack of water in these irrigation canals has been one of the most common reasons cited. There have also been informal groups in quite a few of the villages, formed due to common interest or at the behest of the elected Panchayat. Most of such groups have been involved in cleaning up activities and minor repairs. However, there is a feeling of futility as they recognize the fact that unless there is a unified and synchronized attempt by all the habitations along the length of the canal, such interventions in limited geographical areas, however well- intentioned, is not going to be useful.

In all the villages visited, both the farming community and the Panchayat were equivocal in the pressing need to repair and revitalize these canals. In one area, the farmers went to the extent of being thankful to the tsunami as it had at least brought the travails of the farmers to the fore. They were worried that their village would also have to be abandoned like their neighbouring village Keelakarai, near Madampattinam in Sirkali, where all the inhabitants have migrated to other places after the repeated failure of agriculture and salination of their lands.

The community and the Panchayat are willing to provide all support, through available schemes as well as through labour, to the Government or any other willing agency for the work to be carried out in these canals. They are also willing to formally take on the continuing operation and maintenance, provided they are given some back-stopping support by the PWD and the Administration.

Chapter Eleven

General Recommendations and Budget Estimates

The study is only on a small portion of the delta below the Grand Anicut from where the Cauvery water is diverted to the 2 sub basins namely Cauvery and Vennar and subsequently to the Grand Anicut canal system to irrigate a gross area of about 5.60 Lakh ha of agricultural land. Any water resources development should be tackled only on watershed basis. The rain water/runoff water coming from the catchment area from the south-west/right side of Grand Anicut and Thanjavur in addition to the rainfall in the command area of the delta is to be managed. The drainage problem is more where the rainfall is high and the soil is clayey and the slope of the terrain is nearly zero. This is true of the south eastern and southern part of the delta i.e., most of the study area.

The study area is limited to about 30,000 Ha in the tail end portion in a total watershed of about 800,000 ha, i.e., about 4% of the total watershed. It is believed that the mapping of the waterbodies and identifying ways in which their status can be improved as expounded in the report will enhance the efficiency of water use, production and productivity. The cost estimates for all the works contemplated are abstracted and given in Table 11.1. The total costs works out to Rs. 125 crores. However, before execution of all the works, detailed design and estimates for all works are to be prepared.

The repair, rehabilitation and improvements for all the irrigation and drainage channels, the construction of new structures, modernization of the existing ones and other works to store fresh / rain water and dispose of the flood water were estimated based on the requirements and assuming the rates as adopted by WRO/PWD. The implementing / execution of works can be undertaken by the WRO/PWD (Govt.) WUA / NGO (Public-Private Partnership), or by farmers depending on the nature of the works. Accordingly, suggestions on the works and the agencies that can implement them are given in Table 11.2.

Table 11.1
Abstracts of estimates of all works

Sl.No	Particulars of works	Amount (in Lakhs)	Total Amount (in Lakhs)
I	Irrigation Channels:		
	a) Water Hyacinth removal	13.86	
	b) Desilting	121.70	
	c) Strengthening of bund	28.34	
	d) Sluice damage Masonry	53.35	
	e) Shutter	23.00	
	f) Other structure - rehabilitation	10.94	
	g)New one	13.69	
	Sub total		264.88
II	Drainage channels:		
	a) Water Hyacinth removal	11.01	
	b) Desilting	751.91	
	c) Strengthening of bund	114.36	
	d) Sluice damage Masonry	3.50	
	e) Shutter	6.30	
	Sub total		887.08
III	Other water bodies :		
	a) village ponds (4076)		
	Rehabilitation i) Desilting	2657.72	
	ii) Strengthening bund	92.44	
	iii) Rehabilitation- feeder / drainage channels	1222.81	
	Sub total		3972.96
	b) Farm ponds (2500) New Construction	750.00	
	c) Kuttai (500)	75.00	
	d) Skimming well (1000)	600.00	
	Sub total		1425.00
IV	Storage Structures :-		
	a) Rehabilitation and Strengthening of Alams and Irrigation Tanks	985.00	
	b) Storage tank in Main and Sub drainages join the River drains	50.00	
	c) Provide parallel channel western side of the sand dune area	70.00	
	d) Deepening and strengthening of bunds in the existing depression points	100.00	
	e) Regulators below existing TERs, desilting and strengthening bund on either side	2150.00	
	Sub total		3355.00

Contd.

Sl.No	Particulars of works	Amount (in Lakhs)	Total Amount (in Lakhs)
V	Improvements to the Existing Structures :-		
	a) Improvements to V.C including Providing Shutters to prevent sea water entering the canal etc.	1500.00	
	b) To take a Study of BC to extend the Length	5.00	
	c) Linking Eravaikkal to Manakondan drain to drain the flood water	250.00	
	d) Dredging the river mouth for all drainage channels	200.00	
	e) Provide sand barrier and shelter belts along the coast	185.00	
	Sub total		2140.00
VI	Agriculture Development		
	a) Providing Drip and Sprinkler Irrigation Systems(500 +500) 1000 Ha	450.00	
	b) Training the Farmers on Water Mangement - Drip &Sprinkler and for demonstration	10.00	
	Sub total		460.00
	G .Total		12504.92 or 125 crores

Table 11.2
Works and Stakeholders

SL no	Particulars of Works	Implementing Agencies		
		Govt. Department	Public Private Partnership (PPP)	Farming Community
1	Irrigation Channels			
a	Water Hyacinth removal			
	i) A B class	✓	-	-
	ii) C D E class		✓	-
b	Desilting			
	i) A B class	✓	-	-
	ii) C D E class		✓	-
c	Strengthening of Bunds			
	i) A B class	✓	-	-
	ii) C D E class		✓	-
d	Sluice damages			
	i) Masonry	✓	-	-
	ii) Shutter	✓	-	-
e	Other structures			
	i) Rehabilitation	✓	-	-
	ii) New structures	✓	-	-
2	Drainages Channels			
a	Water Hyacinth removal			
	i) River drainages	✓	-	-
	ii) Main&Sub drainages		✓	-
b	Desilting			
	i) River drainages	✓	-	-
	ii) Main & Sub drainages		✓	-
c	Strengthening of Bunds			-
	i) River drainages	✓	-	-
	ii) Main & Sub drainages	-	✓	-
d	Sluice damages			
	i) Masonry	✓	-	-
	ii) Shutter	✓	-	-
	ii) Syphon rectification	✓	-	-

Contd.

SL no	Particulars of Works	Implementing Agencies		
		Govt. Department	Public Private Partnership (PPP)	Farming Community
3	Other water bodies			
a	Village (ponds/Ooranies/Tanks)	-	✓	-
b	Farm Ponds	-	-	✓
c	Pits / Kuttais			✓
d	Skimming wells			✓
4	Activities for Improvements			
a	*Storage Structures*			
	i) Alams & Irrgation tanks	✓	-	-
	ii) Storage tanks in the drains	✓	-	-
	iii) Parallel drains/western side of the sand dune	✓	-	-
	iv) Deepening and strengthening of bunds in the existing depression points			
	v) Regulaters below TER	✓	-	-
5	Improvements in Existing Canals			
a	Vedaranyam Canal	✓	-	-
b	Buckingham Canal	✓	-	-
c	Linking Eravaikal to Manakondan drain	✓	-	-
d	Dredging the River mouths	✓	-	-
e	Providing Sand barrier &Shelter belts	-	✓	-
6	Agriculture Development			
a	Drip&Sprinkler Irrigation Systems	-	-	✓
b	Training & Demonstration	-	-	✓

As mentioned earlier, the irrigation system of the Cauvery delta (Thanjavur delta) is more than 1800 years old and the life has been exceeded for most of the structures. For a sustainable/permanent solution, it is necessary to look at all problems of the delta in the long run. Considering all the points and after consultation / interaction with many stake holders like officials of the government from the various departments, NGOs, farmers and experts on this subject, the following recommendations are suggested to tackle various issues like flood/drought, increasing the agricultural production and income and enhancing the livelihood condition of the poor people living in the coastal district.

a. Bring the irrigation and drainage channels to the required/designed capacity by widening, desilting and strengthening bunds.

b. Construction and rehabilitation of various irrigation structures such as:-

i. Main regulators.
ii. Diversion weirs
iii. Sluices/vents
iv. Siphon arrangements
v. Series of regulators to control and distribute water
vi. Culverts / pipes
vii. Bed dam
viii. Check dams in the rivers
ix. Other structures.

c. The monsoon flood waters from the catchment in the upland tracts lying south west of delta must either be detained in the upland itself by watershed development works or the runoff must be diverted to areas other than the Vennar sub basin.

d. Provide linking of drains and providing proper location of in-fall points of minor drains into the main drain. This has to be done only after a careful study of the drains in the intended area.

e. Provide a number of straight cuts in Vedaranyam canal and in the salt swamp/ lagoons for easy / quick disposal of flood water.

f. Dredging all the river mouths

g. Recharging the ground water through construction of a number of deep bore wells at the appropriate place and pumping the water using pressure to push the salt water to the sea.

h. Reclaim the salt affected agricultural lands for bringing the land under normal production conditions.

i. Improve the fertility of the soil.

j. Water management including introducing advanced methods of irrigation etc.

To take up all the above said items of work and to have a permanent solution, rehabilitation and modernization of the entire delta is necessary. The approximate amount required for the works may be around Rs. 3000-3500 crores, which can be taken up and completed in a phased manner in 7-10 years. The cost was about Rs. 1000 crores in early 1980s and it is now increased threefold. Hence early action is recommended with respect to rehabilitation / modernization in a reasonable period.