CHAPTER 7 : VADAKKUPATTU TANK AREA

CHAPTER 7 VADAKKUPATTU TANK AREA

7.1 General

7.1.1 Location

Vadakkupattu Tank, which has a registered command area of 417.3 ha is located about 10 km west from the National Highway No. 45 (NH-45) along the road to Sriperumbudur as shown in Fig. 7.1.1. The tank is located west of the road. Administratively it belongs to Vadakkupattu Village in Sriperumbudur Taluk of Kanchipuram District.

The village area is surrounded by Chennakuppam and Oragadam villages in north side, Vattampakkam Reserved Forest, Bahadurvadi village and ChengalpattuTaluk in east and south sides, Poondi and Ezhichoor villages and Vadakkupattu Reserved Forest in west side.

7.1.2 Topography

Vadakkupattu Tank is located south of the Chengalpattu - Sriprumbudur road touching the northern end of tank to the road. Its waterspread area is measured as 1.0 km^2. The ayacut areas of 417.3 ha expand southward. The catchment area of the tank expands in the northern areas of the tank.

A bund of about 1.4 km runs from northeast to southwest along the southern and the southeastern edges of the tank. There are two (2) surplus arrangements on the northern end of the bund, and the surplus water flows southward. The surplus water is used for the irrigation of the downstream fields, and flows from plot to plot toward the downstream tank. Some supply channels are provided on the western section of the tank, and surplus water of the upstream flows into the tank.

There is an unpaved village road running southward at the center of village area from the Chengalpattu - Sriprumbudur road. The residential areas of the village are developed mainly along this village road and its branch roads.

The ayacut areas are generally flat with mild slope toward south and east, and the earthen main channels run generally southward, and their off-take channels flow eastward. There are 35 wells in the ayacut areas to take domestic and irrigation water.

7.1.3 Geology

This region has a crystalline rock of archean age as basement which is overland by Upper Gondwana formations. The Gondwana formations are covered by thin layer (about 4 m) of top soil. The archean crystalline rocks are mostly charnockites. The

overlying upper Gondwana in this region consists of compact clays and shales (Sriperumbudur Shales). The Sriperumbudur shales consists mainly of sandy shale, mudstone which are weathered at the top and also fractured at the bottom. The borehole drilled in the comment areas during the study indicated that the shales are located at a depth of about 5 m and extends more than 50 m. However, the charnockites are met at a depth of only 5 m and 14.5 m in the bore wells drilled in the tank area and bund, respectively.

7.1.4 Soils

The type of soil is mainly black silty clay and partly sandy silt both in the catchment and ayacut area.

7.1.5 Vegetation

The catchment area is mostly under social forest of eucalyptus trees are cut and sold every 10 years and 12 % of the gross revenue goes to the Panchayat. Other trees found in the catchment area are *Azadirachta Indica (Neem)*, *Borassus Flabellifer (Palmyrah)*, *Tamarindus Indica (Tamarind)* and Prosopis Juliflora. No tank bed plantation is seen in the waterspread area.

7.1.6 Objectives

Vadakkupattu Tank is categorized as a NR-4, which belongs to the Northern Study Area or annual rainfall more than 1,000 mm, and has an average cultivation area of less than 75 % of the registered ayacut area. This means that surface water and groundwater resources are rather rich, but it can only irrigate less than 3/4 of the registered ayacut area by some reasons.

According to the Baseline Survey, tanks in Kunnattur Panchayat Union show about 80 % of years have surplus water, and cultivation ratio is more 90 % with 17 % of total tank area cultivated more than twice a year.

The catchment area requires more than 2.7 times the registered ayacut area in the Northern Study Area under an irrigation efficiency at 60 %. In the tank inventory, the ratio between free catchment area and registered ayacut area of the tank is 1.54, and more than 95 % of registered ayacut area depends on the tank for water supply. Therefore the tank has less catchment area to irrigate all registered area.

Therefore, objectives of Vadakkupattu Tank rehabilitation program are 1) to extend the irrigable area by rehabilitation of tank facilities and maximize the irrigation efficiency by channel lining and proper operation of irrigation, 2) to select the water saving crops as a alternative of paddy cultivation, 3) to install the community irrigation wells for the supplemental water sources at important period of cultivation.

7.2 Meteo-hydrology

7.2.1 Climate

The climate prevailing over the tank area is sub-tropical. The basic and consolidated climatological data of temperature, relative humidity, sunshine, wind speed and evaporation data are available for Tirutani Meteorological Station located in the Nandi River basin maintained by the Ground Water Wing of the PWD. Since Vadakkupattu Tank belongs to the same North-eastern agro-climatic zone, the climatological data of Tirutani Meteorological Station also represents Vadakkupattu Tank. The coordinates and the monthly average climatological parametres of Tirutani Meteorological Station are presented in Section 3.2.1.

7.2.2 Rainfall

The rainfall in the catchment area of the tank varies with season and it receives considerable rainfall during the South-west and North-east monsoon seasons. For all rainfall computations, data recorded at the nearest Sriperumpudhur Rainfall Station, and maintained by the Revenue Department is used. The mean monthly rainfall data of this station for the last 25 years are shown as follows:

Mean Monthly Rainfall of the Vadakkupatu Catchment Area

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	17.6	12.5	3.1	13.2	36.4	54.2	117.4	125.6	138.4	248.2	322.5	146.0	1,234.9
Maximum	143.6	176.8	31.0	64.8	343.2	208.7	377.1	333.4	316.2	648.4	808.6	664.0	2,007.8
Minimum	0.0	0.0	0.0	0.0	0.0	3.0	7.1	0.0	0.0	58.0	46.0	0.0	629.1

The entire calendar year can be divided into four seasons with the following rainfall distribution.

-	Southwest Monsoon (June-September):	435.6 mm	(35.3 %)
-	Northeast Monsoon (October-December):	716.6 mm	(58.0 %)
-	Winter (January - February):	30.1 mm	(2.4 %)
-	Summer (March - May):	52.6 mm	(4.3 %)
-	Total:	1234.9 mm	(100 %)

The tank catchment receives its maximum rainfall in the North-east monsoon season while the lowest rainfall occurs during the winter months of January and February. The maximum average monthly rainfall is 322.5 mm in November, and the minimum rainfall 3.1 mm in March. The annual maximum rainfall of 2,007.8 mm occurred during 1976 while the minimum was 629.1 mm occurred in the year 1974.

7.2.3 Catchment Area

Vakakkupattu Tank is a non-system tank located in the Adayar River basin. In preparation for the field visits, the 1:50,000 map of the tank was obtained which

permitted an assessment of catchment and command area. Vadakkupatu Tank receives its runoff water from its free basin of 6.32 km^2 and an intercepted catchment of 4.66 km^2 hence the total catchment (free + intercepted) is 10.98 km^2 and the equivalent catchment (free + 1/5th of intercepted) is 7.252 km^2. As per the PWD norms, the catchment is classified as "average" having gentle slope and moderate vegetation. The registered ayacut of this tank is 417.24 ha, and hence the ratio between free catchment and registered ayacut is 1.51.

7.4.4 Hydrological Analysis

The hydrological analysis procedures are similar to that of Echur Tank. Rainfall - runoff computations have been carried out for the monsoon period (September - December) and annual basis (January - December) for a continuous period of 16 years by the Strange Tables. There is no hydrological gauging station in the tank catchment and command area.

Yield and Runoff from the Catchment Area of Vadakkupattu Tank

Year	September-December			January - December		
	Rainfall (cm)	Yield (cm)	Runoff (Mm^3)	Rainfall (cm)	Yield (cm)	Runoff (Mm^3)
1980	68.5	12.0	1.316	103.3	30.8	3.381
1981	80.6	16.5	1.815	130.1	49.6	5.442
1982	56.8	7.7	0.842	99.0	27.7	3.042
1983	82.5	18.6	2.039	95.1	25.2	2.768
1984	71.0	13.1	1.443	133.7	53.6	5.885
1985	133.9	52.9	5.808	176.3	88.2	9.681
1986	36.8	2.4	0.263	69.9	12.6	1.382
1987	73.1	14.2	1.564	107.8	32.9	3.611
1988	49.3	5.5	0.600	100.1	28.0	3.076
1989	63.6	10.2	1.118	111.7	35.7	3.923
1990	70.3	12.8	1.404	134.4	53.1	5.828
1991	81.7	17.6	1.929	126.4	46.8	5.135
1992	64.0	10.2	1.125	80.2	17.1	1.876
1993	118.5	40.9	4.490	141.1	59.3	6.507
1994	110.2	35.2	3.870	140.2	58.9	6.466
1995	50.4	5.8	0.636	154.3	72.5	7.965
Mean	75.7	17.2	1.891	119.0	43.2	4.748
Max.	133.9	52.9	5.808	176.3	88.2	9.681
Min.	36.8	2.4	0.263	69.9	12.6	1.382

During 1980 - 1995, the average annual yield was 43.2 cm with a maximum of 88.2 cm in 1985 and a minimum of 12.6 cm in 1986. The corresponding values of estimated annual runoff from the equivalent catchment area are 4.748 Mm^3, 9.681 Mm^3 and 1.382 Mm^3. The monsoon (September - December) yield and runoff values also have been estimated and are presented in the table above. The 16 year average monsoonal yield was 17.2 cm and that of runoff from the equivalent catchment was 1.891 Mm^3. On average, the monsoonal yield accounts for nearly 40 % of total annual yield.

The runoff calculated based on the daily rainfall data for the years 1986 - 1995 using the

dry-damp-wet method are presented in Table 3.5.4 and 3.5.5. The estimated runoff values vary from 2.082 Mm^3 to 7.573 Mm^3. The 10 year average runoff is 4.017 Mm^3, with a runoff ratio of 47 %. Similarly, the monsoon (September 16 - December 15) runoff values vary from 1.483 Mm^3 to 5.053 Mm^3, with an average value of 2.761 Mm^3. The average runoff ratio for the monsoon period increased to 52 %. Based on the annual runoff values surplus occurred only once in 10 years when the maximum rainfall was 1,543.4 mm in 1995.

7.3 Social Conditions

7.3.1 Present Social Conditions and Facilities

(1) Available Social Facilities in the Village

The piped drinking water supply system covers about 60 % of the villagers, and the rest of the villagers uses shallow and deep wells. The water quality of these sources is considered to be good. The electricity supply system is provided for 79 % of villagers.

There is no public facilities such as community halls in the village area, but a Health Sub-center (HSC) is available. There are a primary (Grade 1 to 5) and a higher (Grade 6 to 10) schools. There is a village road running from north to south at the center of village, and bus services for neighboring villages are available.

(2) Social Settings of the Ayacut Area

1) Land Holding and Relating Villages or Hamlets

There are 355 farmers in the ayacut areas of Vadakkupattu Tank, and their average land holding size is calculated to be about 1.18 ha. About 95 % of all farmers are marginal or small farmers. All the farmers in the ayacut areas live in the above-mentioned residential areas in Vadakkupattu Village. The most common is the marginal farmer who represents 80 % of total farmers. Most of SC farmers' lands are located at the tail end reaches of irrigation channels.

2) Caste Composition

The approximate caste composition of the farmers in the ayacut areas are as follows:

Caste Composition in Vadakkupattu Tank Ayacut Area

(Unit: %)

Others	BC	MBC	SC	ST	Total
10	28	20	40	2	100

The most predominant caste category is SC composed mainly of the group of Adidravida, but its share is 40 % of all the farmers in the ayacut area. The second predominant caste category is BC composed of Mutharayar and Yadavan sharing 28 %. MBC category shares about 20 % and they are Vanniar. The Other castes mainly composed of Brahmins shares 10 %. The least predominant category is ST composed of Irulla sharing only 2 %. In this ayacut area, all the categories of castes are available and the homogeneity in view of caste composition seems to be low.

3) Water Distribution and Decision Making Procedure

There is no registered organization for water distribution in the ayacut area, but they select the *Neerkatis* every year among the group of families which are traditionally assigned for gate operations. The *Neerkatis* control the opening and closing of sluices in consultation with the farmers. However, there is no rule for distributing irrigation water at present. Until the death of a leading farmer few years ago, the water distribution had been made under his directions. Recently eelected village president's participation in taking leadership for proper water distribution is expected by the farmers in the ayacut area.

4) Maintenance of Irrigation Facilities

No regular maintenance activity of the irrigation facilities is conducted in the ayacut area except for the emergency repair works of tank bund and the desilting works done at the initial stage of the every irrigation period. The removal of weeds and the desilting works of the sluice are carried out by the assigned *Neerkatis*.

5) Conflicts and Problems

According to the farmers in the ayacut areas, there is no conflict among either the caste groups or the farmers having advantage or disadvantage in receiving irrigation water. The marginal farmers' lands located at the tail end reaches are apt to be left abandoned during the drought periods, and they have to work as agricultural laborers or seek for their jobs out of the village.

6) Other Employment Opportunity

The nearest towns are Chengalpattu and Sriperumbudur located about 15 km away from the village. They usually work as construction laborers and helpers for weaving factories, etc. Some farmers have jobs in Chennai also because it is located within the distance in which they can attend daily.

7.3.2 Sociological Evaluation

Based on the criteria described in Section 2.5, the sociological conditions of Vakakkupattu Tank ayacut are evaluated as stated below.

Results of Social Scoring of Vadakkupattu Tank

Factors	Hamlets	Farm Size	Conflicts	WUA	Leader-ship	Resource Mobilization	Main-tenance	Overall Score
Scores	5	5	15	0	30	20	5	80

This results show that the ayacut area is average on social screening and the timing of community organizer for formulating WUA is 2 months prior to estimate preparation.

7.4 Agriculture

7.4.1 Present Agriculture

(1) Land Use

The registered command area is 471.3 ha of which irrigable area is 370.0 ha (78.5 % of the command area). In 1995-96, paddy was double cropped in the areas of 374.8 ha (89.8 % of the command area) as the 1st crop and 228.0 ha (54.6 %) as the 2nd crop, respectively. The total cultivated area was 602.8 ha and the crop intensity was 144.5 %. In normal year also, paddy is double cropped in the area. The area is 370 ha (78.5 %) for the 1st crop and 225.0 ha (47.7 %) for the 2nd crop with a total area of 595.0 ha (126.2 %).

(2) Soil and Land Capability

The type of soil in the ayacut area is mainly black silty clay and partly sandy silt which are suitable for wet and dry cultivation. No saline soils are found in the ayacut area. The present cultivation of those soils show that the soils are suitable for irrigation.

(3) Agricultural Production

1) Crop Production

In 1995 - 1996, 1,306.3 tons of paddy were produced in the rainy season and 862.8 tons in the dry season with a total amount of 2,168.9 tons. The average yield was 3, 485 kg/ha in the rainy season and 3,784 kg/ha in the dry season. In a normal year, the amount of paddy produced is 1,665 tons in the rainy season and 1,057.5 tons in the dry season with the total amount of 2,722.5 tons. The average yield is 4,500 kg/ha in the rainy season and 4,700 kg/ha in the dry season.

2) Irrigation Water

Tank water is available from September to April with an irrigable area of 602.0 ha in a normal year. On the other hand, there are 18 wells with an irrigable area of 18.0 ha on normal year.

3) Fertilizer Application

According to the data of farmers' interview survey, 76 kg/ha of N and 41 kg/ha of P_2O_5 and 21 kg/ha of K_2O were applied for paddy in 3 split applications of basal, top-1 and top-2 in 1995-96. These amounts applied are slightly less than the government recommendations (N: 120-150 kg/ha, P_2O_5: 38 - 50 kg/ha, and K_2O: 38 - 50 kg/ha) except the amount of N. The amount of N applied was around half of the recommendation.

4) Labor Input

According to the farmers' interview survey, the average labor input for paddy cultivation in the 10 Pilot Tank areas was about 200 man-day/ha in which 28 % was allotted to harvesting, 24 % to weeding and 21 % to transplanting. While the family agricultural labor in this tank area is 2.1 men/house, the potential agricultural labor is 5.1 men/house. The necessary staggering period in the area to accomplish the farm works of paddy cultivation by family labor is calculated based on the above data as 11 days, at least when the potential labor is used. The labor requirements for vegetable, sugarcane and groundnut cultivation are around 4.3 times, 2.3 times and 0.6 times of the paddy, respectively.

5) Livestock Breeding

This area is the most active area for breeding of livestock among the study areas. 1140 heads of cattle, 100 heads of goat, 200 heads of sheep, 30 heads of pig, 200 heads of chicken and 600 heads of duck have been raised in the area. The cattle was raised at a level of 19 heads on average by 17 % of the total farmers, the goat was raised at a level of 10 heads on average by 2.8 % of the total farmers, the sheep was raised 50 heads on average in 1.1 % of the total farmers, the pig was raised 8 heads on average by 1.1 % of the total farmers, chicken was raised at a level of 100 heads on average in 0.6 % of the total farmers and the duck was raised at a level of 120 heads on average by 1.4 % of the total farmers.

(4) Farm Size and Land Tenure

The number of farm holders in the area is 355 of which 5 % are farm holders of more than 2 ha, 15 % are farm holders of 1.0 to 2.0 ha and 80 % are farm holders of below 1.0 ha (marginal). The average farm size is 1.18 ha which belongs to the large group in holding size in the study areas.

7.4.2 Agricultural Development Plan

(1) Land Use

As shown in Table 3.4.1, the crop intensity is planned to be slightly increased from 126.2 % at present to 131.8 % in the plan by the introduction of high return crops in the dry season. The high return crops are banana (5.0 ha), turmeric (5.0 ha), tomato (8.0 ha) and ladies' finger (8.0 ha). These crops are grown by well water.

(2) Farming and Cropping Plan

The cropping plan was made as shown in Fig. 7.4.1. In the plan, present paddy area and the cropping season are kept as it is. While banana, turmeric, ladies' finger and tomato are introduced as high return crops during the dry season in the areas at an extend of 5.0 ha on banana, 5.0 ha on turmeric, 8.0 ha (4.0 ha as the 1st crop and 4.0 ha as the 2nd crop) each on ladies' finger and on tomato. These crops are cultivable by well water whose irrigable area is 18.0 ha in normal year.

(3) Crop Budget and Production Plan

The planned production amounts, the production costs and the net incomes of the cultivated crops are shown in Table 3.4.2. In the plan, the total net income of crops in the command area amounted to Rs.12,217,400 of which paddy, banana, turmeric, tomato and ladies' finger shared 89.1 %, 2.4 %, 3.1 %, 2.5 % and 2.9 % respectively. The total amount of net income in the area increased by 30 % than that of the present.

(4) Employment and Working Opportunity

The introduction of the cash crops for 26 ha in the dry season will bear a certain increase in employment and working opportunities throughout a year. The labor requirement is estimated at the amount corresponding to the labor requirement of about 104 ha in paddy cultivation.

(5) Farm Management and Farm Budget

1) Farm Management Plan

For Vadakkupattu Tank area, the average water capacity in tank through the year is considered to be rather good for making a possible double cropping of paddy. Based on this abundant water supply condition, the application of crop diversification is recommended in this tank area for higher farm income. The application of integrated agriculture at each farm is also recommended with the application of related documents for making local farmers obtaining this

knowledge.

From these basic concepts, after confirming the related feasibilities for realization, the proper plan for farm management for each individual farm should be further elaborated for each corresponding farm based on the following elements:

- Existing natural conditions for farming
- Local traditions in agriculture
- Periods of possible water supply from tank, groundwater etc.
- Available capital for investing in agricultural production
- Evaluation of possible crop budgets
- Preparations of farmland, inputs and related techniques
- Selection of crops for planting through the year
- Harvesting and marketing capabilities and proceedings
- Estimates on net farm revenues after all production costs
- Estimates on the balance after all family living expenses

2) Farm Budget Plan

The farm budget is recommended to be elaborated on the basis of crop budget analysis of possible cash crops to be introduced in the crop diversification plan for making a higher farm budget for small and marginal farms also.

Besides, as the integrated agriculture is observed being neglected in this tank area, the application of integrated agriculture should be also considered for increasing farm revenues, particularly on the aspects of raising livestock at farm basis and aquaculture in the tank through a cooperative scheme.

(6) Marketing Plan

Due to the remote location and the large scale in agricultural production for this tank area, the constant supply of agricultural inputs, particularly seeds and fertilizers, is recommended to be elaborated for an effective supply. Godowns for this purpose are recommended to be established in the framework of newly established farmers' organization.

Basic post-harvest treatment facilities and shops for selling materials applied to the integrated agriculture are also recommended to be established in the village.

Besides, some transport vans are subjected to be equipped for quick transportation of agricultural produces to village godowns and district markets.

7.4.3 Agricultural Supporting Services and Institutional Plan

(Same as notified in this part for Echur Tank)

7.5 Rehabilitation of Tank Irrigation System

7.5.1 Present Conditions

(1) Irrigation and Drainage System

The total registered ayacut area is 417 ha in the Tank Inventory List of PWD. It includes the ayacut area of Vadakkupattu Small Tank which is located about 750 m downstream of Vadakkupattu Big Tank, west of Vadakkupattu village. The eastern part of ayacut area was converted into campus area of an academic institute. Therefore, the actual ayacut area to be irrigated is estimated to be about 342 ha at present.

A district road connecting Sriperumbudur, Sennakupram, Vadakkupattu, Guruvanmedu and NH-45 at Singapperumalkovil runs along the toe of tank bund from east to west, it turns south at the north-eastern corner of the Vadakkupattu village in the Study Area.

There are 4 sluices, but No.1, 2 and 3 sluices are considered as one unit, their sill elevation differs more than 2.8m, therefore, the sluices are operated based on the water level in the tank, and their outlet channel are connected and two channels convey water to the paddy field. No. 4 sluice is located near to the surplus arrangement having the highest sill elevation among others.

No. 3 sluice channel runs along the district road and formulates the western border of the ayacut commanding about 60 ha. No.2 sluice channel is a main channel in the ayacut covering about 280 ha. 10 branch channel divert eastwards and most of them turn southwards at the middle of ayacut area. 3 branch channels are diverted from main channel southwards, 3 branch channel divert water westwards from the main channel. No. 1 sluice channel irrigates less than 10 ha at the north eastern corner of the ayacut area.

The tail of each irrigation channel drains surplus water into Kunmedu Tank, and tail reaches suffer the backwater during the high-water stage of Kunmedu Tank.

Branch channels sometimes disappear in the paddy fields and at the lower end of paddy fields channel appear again.

Surplus water of the tank flows into Kunmmedu Tank, and continue and it joint with the Palar River.

(2) Tank Bund

The existing dimensions of the tank bund are measured and soil mechanics properties are analyzed. The results are shown in Table 3.5.1 and Table 3.5.2. There is not serious damage to tank bund except for the followings:

- leakage from the bund foundation in high filling (about 5 m)
- soil erosion around the irrigation facilities

(3) Spillway (Surplus Arrangement)

1) Location

There are two (2) weirs of BC in this tank. Location of these weirs are shown in Fig. 7.5.1.

2) Existing Condition

In weir No. 2, some parts of the apron are broken by the force of excess water. It might be sue to the underestimation of design discharge. It is urgently necessary to repair the apron using cement mortar and stone.

(4) Intake Facilities (Sluices)

1) Location of the Sluice

Even though, the Tank Inventory List and tank memoir show four (4) sluices, sluice No. 4 is not confirmed during field inspection. Sluice No. 1 located at the end of the bund is of a head and wall type, others located in the center are Head Tower type. Location of these sluice are shown in Fig. 7.5.1.

2) Existing Condition

Sluices No. 1 and 2 are kept under normal conditions concerning both durability and intake functions, especially, Sluice No. 1 does not have any cracks due to being just established in 1993. Sluice No. 3 is not properly work as an intake facilities; it is urgently necessary to rehabilitate.

3) Water Supply Control Devices

The water control devices used in all sluices are plug and plug rod type, these devices are confirmed in sluice No. 2. However, this device is difficult to operate manually because rod length is so long (about 4.0 m).

(5) Groundwater Usage

Groundwater in this area is mainly used for domestic purposes. About 10 to 15 dug wells located in this area are used only for domestic purposes. Deep boreholes upto a depth of 65 m, fitted with hand pump are used to collect drinking water. Only two dug wells in the command area are being used for irrigation. Irrigation requirements are met only by tank water. The pump test carried out in this command area gave very low transmissivity and storativity values.

(6) Operation and Maintenance

No formal water users' association exist in the ayacut area. Traditional irrigation is practiced. No conflicts appears for the irrigation water distribution. Most of irrigation channels are cleaned and repaired at the beginning of the tank operation by farmers. Private channels from well are maintained properly by owners themselves.

7.5.2 Water Resources Development Plan

(1) Liability of Water

The Indian Meteorological Department's classification of drought based on monsoon rainfall is given in Section 3.5.2. Following the same classification, the probability of availability of water for Vadakkupattu Tank is presented in the following table.

Liability of Water Based on Rainfall

Classification	No. of Years	Total No. of Years	Probability (%)
Excess	7	25	28.00
Normal	6	25	24.00
Deficit	9	25	36.00
Scanty	3	25	12.00

Among the 25 years, 36 % of the years are classified as deficit followed by excess 28 %, normal 24.0 %, and scanty 12 %. Apart from this, as mentioned for the Echur tank, another important aspect is the occurrence of drought or flood based on the rain storm. For a five year return period (205 of provability), the drought monsoon rainfall is estimated as 1,225.9 mm The above figures make it necessary to rehabilitate the tank system facilities to harvest all the available rain water.

(2) Water Quality

Based on the field measurement of the Study Team, the water quality on its pH and EC in the tank areas indicate no salinity hazard for the crop cultivation. Tank remained water shows pH 7.6, and EC indicates less than 0.24 dS/m. While groundwater (shallow well) indicates pH 7.8 and EC between 0.42 to 0.68 dS/m.

The EC in lower reaches shows higher figures than head reaches.

(3) Irrigation Water Requirement

Paddy rice is the dominant crop in the 417.24 ha of the command area of the Vakakkupattu Tank. The gross irrigation requirement for the rice crop during the main rice growing season of September - December is calculated at 4.977 Mm^3 at the present level irrigation efficiency of 40 %. The estimation procedures are similar to that of Echur Tank and the comprehensive results are presented in Table 3.5.3. With canal lining, the irrigation efficiency is expected to increase to 75 % and at this level, the calculated gross irrigation requirement is 2.946 Mm^3. Thus there is a saving of 2.929 Mm^3 of water, which can be used to either increase the total tank irrigated area in the same season or raise second crop in the following season.

(4) Water Balance

By topographic survey, the capacity of Vadakkupattu Tank is determined as 2.538 Mm^3. As per the annual (January - December) water balance calculations for the years 1986 - 1995, (Table 3.5.4 and 3.5.5) under the present irrigation efficiency of 40 %, the irrigated area varies from 1 % to 54 % of the registered ayacut. In an average, the tank water could irrigate only 20 % of the registered ayacut. Among the last 9 years, spill-out occurred only in one year namely, 1995, when the rainfall was 1,543.4 mm. The average value of runoff - irrigation water requirement is 80 %. By canal lining it is possible to increase the irrigation efficiency to 75 %. In such a case, near 100 % irrigability could be achieved only one year and average irrigated area raises to 30 % of the ayacut. With the reduced water requirement, the runoff - irrigation ratio is increased to 135 %, implying that, if evaporation losses are controlled and tank capacity is improved, it is possible to irrigate the entire ayacut with tank water. The monsoon (September 16 - January 15) also shows the same trend, but little bit increased % of spill out and decreased runoff-irrigation ratio. However, in both cases, under improved irrigation efficiency also, 100 % achievement in irrigated area is not observed. Hence, along with canal lining, it becomes necessary to increase the tank storage by removing the sediment deposits from the bed of the waterspread area. Evaporation control measures are also needed to reduce the evaporation losses as they account for nearly 43 %.

(5) Drainage Water Requirements

The drainage water requirements of Vadakkupattu Tank is calculated by adopting procedures similar to that of Echur tank, and summarized in Table 3.5.6. Using the Ryve's formula the estimated maximum flood discharge is 32.93 m^3/s while that using the rational formula is 70.58 m^3/s. Hence a safe design discharge of 70.58 m^3/s can be adopted for designing the surplus arrangements. However, in such estimates, the seriousness of disaster, type of surplus weir and cost estimate need to be considered before making a final decision.

(6) Basin Water Management

Vadakkupattu Tank, located in the Adayar basin receives its water from its free catchment area of 6.32 km^2, and from an intercepted catchment area of 4.66 km^2 comprising two chain tanks and supplies its surplus to one down stream tank. Various basin ratios are calculated and presented in Table 3.2.1.

- Free catchment / command area: 1.51
- Intercepted catchment / command area: 1.11
- Waterspread area / command area: 0.34
- Tank storage capacity / command area: 0.006 Mm^3/ha
- Waterspread area / Tank storage capacity: 0.563 km^2/Mm^3

The surface water resources of Vadakkupattu chain tank basin consists of direct runoff from rainfall and flow in streams. However, irrigation is largely depend on available tank water and ground water. The total ground water recharge of Sriperumpudur block to which, Vadakkupattu Tank belongs was estimated to be 12,400 ha. Utilizable recharge is 10,540 ha.m, Net groundwater draft is 2,072 ha.m and the balance available is 8,468 ha.m. This balance of 80.3 % groundwater resources are readily available for exploitation, by digging out ground water wells. Likewise, the surface water resources of this basin can not be utilized fully due to natural, environmental and sociological conditions as already outlined in Section 3.5.2. Hence it becomes necessary to develop certain management strategies with conjunctive use of ground water and participatory approach by farming three level farmers' association viz. tank level, basin level and district level.

(7) Groundwater Development

The compacted clays and shales extending more than 50 m in the command area have very low transmissivity. However, groundwater potential in this region is comparatively higher than the tanks in the northern area. The groundwater table is generally 3 to 5 m below the ground level throughout the year. Further, as the balance available groundwater potential is very high in this region, more groundwater development is possible in this region. In order to extract large quantity of groundwater from disintegrated shales large, diameter wells have to be dug.

7.5.3 Tank Irrigation Facilities Rehabilitation Works

General layout of irrigation facilities is shown in Fig. 7.5.1, and required item for rehabilitation works are described in the following table.

Countermeasures for Rehabilitation of Vadakupattu Big Tank

Component	Rehabilitation works	Section for Rehabilitation works	
Tank Bund Improvement (Total bund length 1483m)	• Strengthening of the bund for reshaping to standard size.	1343m	
Intake works (Sluice)	• Modification of intake system using gearing shutter • Protection of back-fill for side slope.	Tower head type	2 units
Surplus arrangement	• Repairing of apron by clogging wet masonry.	B.C. weir	2 units-
Selective Lining for Field Channel including On-farm development	• Installation of lining canal • Provision of diversion boxes with paddle shutter for equal distribution. • Reshaping of existing canal. • Provision of incidental device such as cart, cattle, and canal/crossing.	7,480m as main 4,370m as branch	1 unit 7 units
Building for Farmers' Association	• Provision of community hall for WUA, local farmers and inhabitation.	50m²	1 Nos.

7.6 Farmers' Organization

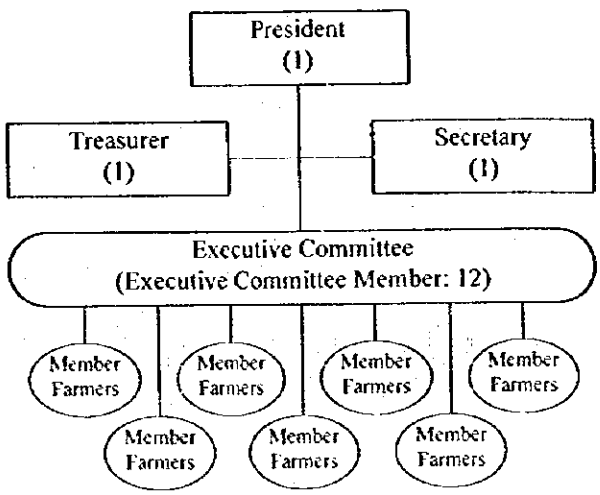
7.6.1 Present Situations of Farmers' Organization

There is no such registered organization as water users' association in the ayacut area as described in Sub-chapter 7.3.1. They have their informal society for water distribution appointing *Neerkatis* for monitoring water distribution.

7.6.2 Proposed Farmers' Organization

(1) Water Users' Association

Since there are 355 farmers in the ayacut areas, the number of the Executive Committee Member becomes 12 and the number of member farmers is 340 deducting the number of bearers from the total farmers. The functions of the proposed WUA for the Echur tank are described in Sub-section 4.3.4 of Volume II of the Report.



PROPOSED ORGANIZATION FOR WATER USERS' ASSOCIATION OF VADAKKUPATTU TANK

(2) Farmers' Organization for Agricultural Production

As explained in Sub-section 4.3.4 of Volume II of the Report, the sections which have the following functions are proposed to be attached to the WUA in Vadakkupattu Tank areas to realize sustainable agricultural development.

- Operation and maintenance technology for water-saving irrigation
- Agricultural technology extension services, crop diversification and value-added agriculture, etc.
- Various agricultural supporting services such as supply of agricultural input materials, marketing, including agricultural credit services

7.7 Project Evaluation

7.7.1 Project Costs and Benefits

(1) Project costs

Unit cost for rehabilitation works are estimated based on *the Standard schedule of Rates for Anna & M.G.R District* issued by PWD. At the 1997 price level, direct construction cost is estimated at Rs. 12,023,000, as shown in the table below.

Direct Construction Cost for Vadakupattu Tank

Description	Total Cost (Rs.)	Percentage	Unit Rates (Ayacut 417.21) (Rs./ha)
Tank Bund Improvements	149,000	1.24%	357
Sluices Improvement	327,000	2.72%	784
Surplus Improvement	552,000	4.59%	1,323
Tank Supply Channel Improvement	-	0.00%	-
Selective lining for Field Channel & OFD	10,865,000	90.36%	26,042
Building for Farmers' Association	130,000	1.08%	312
Community Well	-	0.00%	-
Direct Construction Cost	12,023,000	100.00%	

The Project cost consisting of direct cost, supervision charges, contingencies, preparation work cost and overhead charges is estimated at Rs.17,653,000.

Project Cost for rehabilitation Works in Vadakupattu Tank

Description	Total Cost (Rs.)
Direct Construction Cost	12,023,000
Petty Supervision Charges & Contingencies	1,924,000
Preparatio Cost (Govt. Share)	175,000
Overhead Charges	3,531,000
Total	17,653,000

Economic price for the economic analysis is estimated using the conversion factor (SCF, 0.8) for the direct construction cost.

(2) Project Benefits

The Project aims mainly at stabilizing the agricultural production through out the year in the large command area of about 417 ha by providing a better water supply from the tank and the introduction of proper agricultural production techniques for better farming system for higher farm revenues as well as improving living conditions of small and marginal farms after the rehabilitation works.

At present, though the whole command area is cropped with paddy for double crops in a year from August to April, but the cultivated area for the second paddy crop starting from January to April has been occurred in only a half part due to lack of water supply from tank. Besides, due to the main factor of unstable water supply in the first crop, the average unit yield of the first crop (4.5 t/ha) is observed to be lower than the unit yield in the second crop (4.7 t/ha).

With the Project implementation, major benefits of the Project, therefore, will come from two sources: 1) increases of crop benefits, and 2) value-added benefits from post-harvest treatments.

For the increases of crop benefits, the cropping pattern, detailed elaboration on water requirements, plan for land use, applied farming system including the cropping schedule, varieties as well as estimates on inputs and yields for projected crops etc. were carefully evaluated in order to obtain higher farm revenues. This resulted in an increase in the net production value of agriculture from presently Rs.9.4 million to more than Rs.11.2 million (Table 7.7.1).

Besides, with the establishment of various facilities for organizing farm management and improving treatments on storing, marketing etc., an estimated amount of value-added of about Rs.0.56 million as 5 % of the net agricultural production value "with Project" would be annually obtained. This is estimated on the basis of results from the Study Team's site surveys that with the application of some basic post harvest treatments such as storage and selling at markets only, will provide a profit margin of an average 10 % higher than selling at farm sites during harvesting periods.

7.7.2 Economic Evaluation

The economic evaluation is carried out to judge the project viability in terms of direct contribution to the national economy. The Project covers a command area of about 417 ha with a total number of 355 farms as beneficiaries.

For the economic analysis, the related EIRRs for Vadakkupattu Tank area are as follows:

i) EIRR under basic conditions : 7.4 %

ii) EIRR at 10% cost-increase: 5.7 %
iii) EIRR at 10% benefit-decrease: 5.1 %
iv) EIRR at 3-year benefit delay: 4.1 %

From these figures, the EIRR under basic conditions of 7.4 % shows the Project viability. The risk case of 3-year delay of benefits showed the lowest EIRR of 4.1 %.

7.7.3 Financial Evaluation

In this Project, the financial evaluation is for mainly dealing with the analysis of farm budget for the representative farms in both cases of "without project" and "with project". The related results are as follows:

- "Without Project" Net Income per Farm: Rs.26,404
- "With Project" Net Income per Farm: Rs.34,415
- "With Project" Value Add: Rs.1,721
- Incremental Net Farm Income: Rs.9,732

With the project implementation, the increase in annual net farm income for an average farm will be about Rs.9,700. However, in order to achieve these figures, proper supports on technical aspects as well as more investments in farm inputs should be made accordingly. This should be made in a new scheme of financial and technical supports for these farm categories in the newly established farmers' organization.

7.7.4 Labour Force Requirement

Monthly labor force requirement for the planned cropping schedule are shown in Table 3.7.3. The peak of labor requirement in the area comes August with the requirement of 27,291 man-day/ month. To meet this labor requirement amount, 15 days in staggering period is needed when the potential family labor is used. The potential family labor in the area is 1,811 man per day.

7.7.5 Farm Household Economy

With the Project implementation, the farm household economy of small and marginal farms will be largely improved accordingly. From the financial analysis on farm budgets of these farm categories, an average farm would obtain an increase in net agricultural production value of Rs.8,000 and a value added of about Rs.1,700 annually for a total amount of about Rs.9,700 per farm per year.

Besides, better conditions on water supply and supporting institutions for agricultural production in the project framework will support small and marginal farms to improve their living standards.

Even for landless farmers, apart from the proposed work scheme for landless people in

the farmers' organization as mentioned in the above, they would obtain more labour works from big and medium farms to support their living expenses. A legislative measure to make big and medium farms in the tank areas hiring on annual basis a quota of landless farmers i.e. 2 males or 1 male and 2 females per ha, if permissible, would be promoted for basically supporting their living conditions.

7.8 Environmental Issues

7.8.1 Present Environmental Conditions

(1) Health and Sanitary Conditions

Major diseases in this area are diarrhea, dysentery, common fever and eye disease. In relation to irrigation and drainage, neither waterborne nor mosquito-related diseases occur.

(2) Natural Environment

The tank area is generally flat land. Catchment area is covered by mostly social forest of eucalyptus. No aquatic weeds are found in the tank. Wildlife seen by the villagers are only natural birds.

(3) Surface Water and Groundwater

Quality of tank water, as measured by the study team, is found suitable for irrigation. Groundwater is utilized widely for irrigation in the dry season. There are 35 private open dug wells in the ayacut.

From the result of the water quality measurement, it can be stated that the groundwater will have no salinity problems for irrigation use.

7.8.2 Environmental Impact of The Project

As summarized in Table 7.8.1 and Table 7.8.2, the environmental impact study for Vadakkupattu Tank area was conducted through the field survey and in consideration of the Project components.

(1) Social Environmental Impact

1) Social Institutions and Customs

In regard to the introduction of a WUA under the Project, almost the same impact as stated in Section 3.8 for Echur tank area will be considered.

2) Health and Sanitary Issues

As to agrochemical aspects, the same situation as stated in Section 3.8 for Echur tank area can be expected. That is, the use of agro-chemicals will be increased in the future. For rural health and diseases the Project will not be a cause of any waterborne or mosquito-related diseases.

(2) Natural Environmental Impact

Groundwater with EC value of about 0.55 dS/m is suitable for irrigation, and groundwater in this area will still have development potential. Likely problems of groundwater induced by the groundwater development will be the changes of groundwater table. Large scale groundwater extraction will be a cause of lowering water tables.

7.8.3 Recommendations

As a result of the environmental impact study described above, it can be concluded that the Project will not induce any serious direct negative environmental impact. But, the development activities may induce some indirect impacts. Details are presented in Volume IV of the Report.

i) For the establishment of WUAs, it is recommended that an effective procedure involving NGOs with close cooperation among government agencies shall be provided.

ii) For the expansion of the irrigated agriculture, it is recommended that AD shall extend the guidance to the farmers on agrochemical use.

iii) For the groundwater development for irrigation, it is recommended that the scale of groundwater development shall be carefully planned.

Table 7.7.1 Calculation of Crop Economic Benefits for Vadakkupattu Tank

"Without Project":

Crop	Area (ha)	Production				Production Cost		Net Production Value (1000Rs)	Remarks
		Yield (T/ha)	Production (T)	Unit Price (Rs/T)	Value (1000Rs)	Unit Cost (Rs/ha)	Total Cost (1000Rs)		
1. Paddy (1st Crop)	370.0	4.50	1,665.0	4,736.0	7,885.4	5,008.0	1,853.0	6,032.5	
2. Paddy (2nd Crop)	225.0	4.70	1,057.5	4,736.0	5,008.3	7,200.0	1,620.0	3,388.3	
Total	595.0		2,722.5		12,893.8		3,473.0	9,420.8	

"With Project":

Crop	Area (ha)	Production				Production Cost		Net Production Value (1000Rs)	Remarks
		Yield (T/ha)	Production (T)	Unit Price (Rs/T)	Value (1000Rs)	Unit Cost (Rs/ha)	Total Cost (1000Rs)		
1. Paddy (1st Crop)	370.0	5.00	1,850.0	4,736.0	8,761.6	5,760.0	2,131.2	6,630.4	Aug-Dec
2. Paddy (2nd Crop)	225.0	5.00	1,125.0	4,736.0	5,328.0	8,280.0	1,863.0	3,465.0	Jan-Apr
3. Ladies Finger	8.0	15.00	120.0	3,600.0	432.0	18,800.0	150.4	281.6	
4. Tomato	8.0	15.00	120.0	3,200.0	384.0	17,200.0	137.6	246.4	
5. Banana (1 Year)	5.0	28.00	140.0	2,400.0	336.0	20,000.0	100.0	236.0	
6 Turmeric	5.0	25.00	125.0	3,200.0	400.0	20,100.0	100.5	299.5	
Total	621.0		3,480.0		15,641.6		4,482.7	11,158.9	

Incremental Crop Benefits:

"With Project" NPV:	11,158.9
"Without Project" NPV:	9,420.8
Incremental Crop Benefits:	1,738.1
Value Added (5%) :	557.9
Incremental Total:	2,296.0

Table 7.8.1 Possible Environmental Impacts for Vadakkupattu Tank Area

A : Significant environmental impact is unquestionably induced by the Project
B : Significant environmental impact is likely to be induced by the Project
C : There is no environmental impact likely to be induced by the Project
D : Not known or there likely to be no impact

Categories of Environmental Impact	Evaluation A	B	C	D	Evaluation Base
1. Planned residential settlement			x		No plan
2. Involuntary resettlement			x		No plan
3. Substantial changes in the way of life			x		Not expected
4. Conflict among communities and people		x			Conflict in water distribution may increase
5. Negative impact on native people			x		Positive impact by improvement of socio-economic conditions
6. Population increase			x		Not expected
7. Drastic change in population composition			x		Not expected
8. Changes in bases of economic activities			x		Not expected
9. Occupational change and loss of job opportunities			x		Positive impact by increase of seasonal employment in agriculture
10. Increase in income disparities			x		Not expected
11. Adjustment & regulation of water or fishing (repairing) rights		x			Establishment of WUAs needs new water sharing adjustment
12. Changes in social and institutional structures		x			Establishment of WUAs impacts on traditional community
13. Changes in existing institutions and customs		x			Traditional water sharing needs to be modernized
14. Increased use of agrochemicals				x	Agrochamicals application may increase under expansion of irrigated agriculture
15. Outbreak of endemic diseases			x		Not expected
16. Spreading of epidemic diseases			x		Not expected
17. Residual toxicity of agrochemicals			x		Not expected
18. Increase in domestic and other human wastes			x		Not expected
19. Impairment of historic remains and cultural assets			x		Not found in the area
20. Damage to aesthetic sites			x		Not expected
21. Impairment of buried assets			x		Not found in the area
22. Changes in vegetation			x		Not expected
23. Negative impact on important or indigenous fauna and flora			x		Not expected
24. Degradation of ecosystems with biological diversity			x		Not expected
25. Proliferation of exotic and/or hazardous species			x		Not expected
26. Destruction of wetlands and peatlands			x		No wetlands and peatlands in the area
27. Decrease of tropical rain forests and wildlands			x		No tropical rain forests in the area
28. Destruction or degradation of mangrove			x		No mangrove forests in the area
29. Degradation of coral reefs			x		No coral reefs in the area
30. Soil erosion			x		Not expected
31. Soil salinization			x		Not expected
32. Deterioration of soil fertility			x		Not expected
33. Soil contamination by agrochemicals and others				x	Intensive/improper application of agrochemicals may lead to soil
34. Devastation or desertification of land			x		Not expected
35. Devastation of hinterland			x		Not expected
36. Ground subsidence			x		Not expected
37. Change in surface water hydrology			x		Not expected
38. Change in ground water hydrology		x			Large scale development may lower the water table
39. Inundation and flooding			x		Not expected
40. Sedimentation			x		Not expected
41. Riverbed degradation			x		Not expected
42. Impediment of inland navigation			x		Not expected
43. Water contamination and deterioration of water quality				x	Excess use of agrochemicals may lead to water contamination
44. Water eutrophication			x		Not expected
45. Sea water intrusion			x		Not expected
46. Change in temperature of water			x		Not expected
47. Air pollution			x		Not expected

Table 7.8.2 Environmental Impacts (Irrigation) for Vadakkupattu Tank Area

	Check Items	Major	Small	None	Not Clear	Problems	Action and Countermeasures Planned	Remarks
Pollution	1. Air Pollution caused by spraying of agricultural chemicals			x		Not expected		
	2. Effect on aquatic organisms, fisheries, and other water utilization of change in the water system resulting from project construction			x		Not expected		
	3. Water pollution caused by effluent from irrigated fields		x		x	1. Excess and improper use of agrochemicals may lead to soil and water contamination. 2. Large scale groundwater development will lower water table.	1. Farmers training on proper use of agrochemicals is extended. 2. Appropriate development scale is planned with careful hydrological study.	
Natural Environment	1. Effect of construction and operation of the facilities on the ecology			x		Not expected		
	2. Effect on landscape			x		Not expected		
Human Environment	1. Effect of the project on historical and cultural heritage			x		Not found in the project area		
	2. Effect on existing infrastructure			x		Not expected		
	3. Relocation and effect on land-use			x		Not expected		
	4. Effect on other water use				x	1. Introduction of WUA may cause increase of friction and conflict on water sharing in the community.	1. Appropriate procedure is taken in preparation stage through farmers participation.	
Others	1. Effect on the environment during construction period			x		Not expected		
	2. Environmental Monitoring		x			1 Present monitoring activities are not sufficient.	1. Monitoring shall be conducted by relevant agencies.	

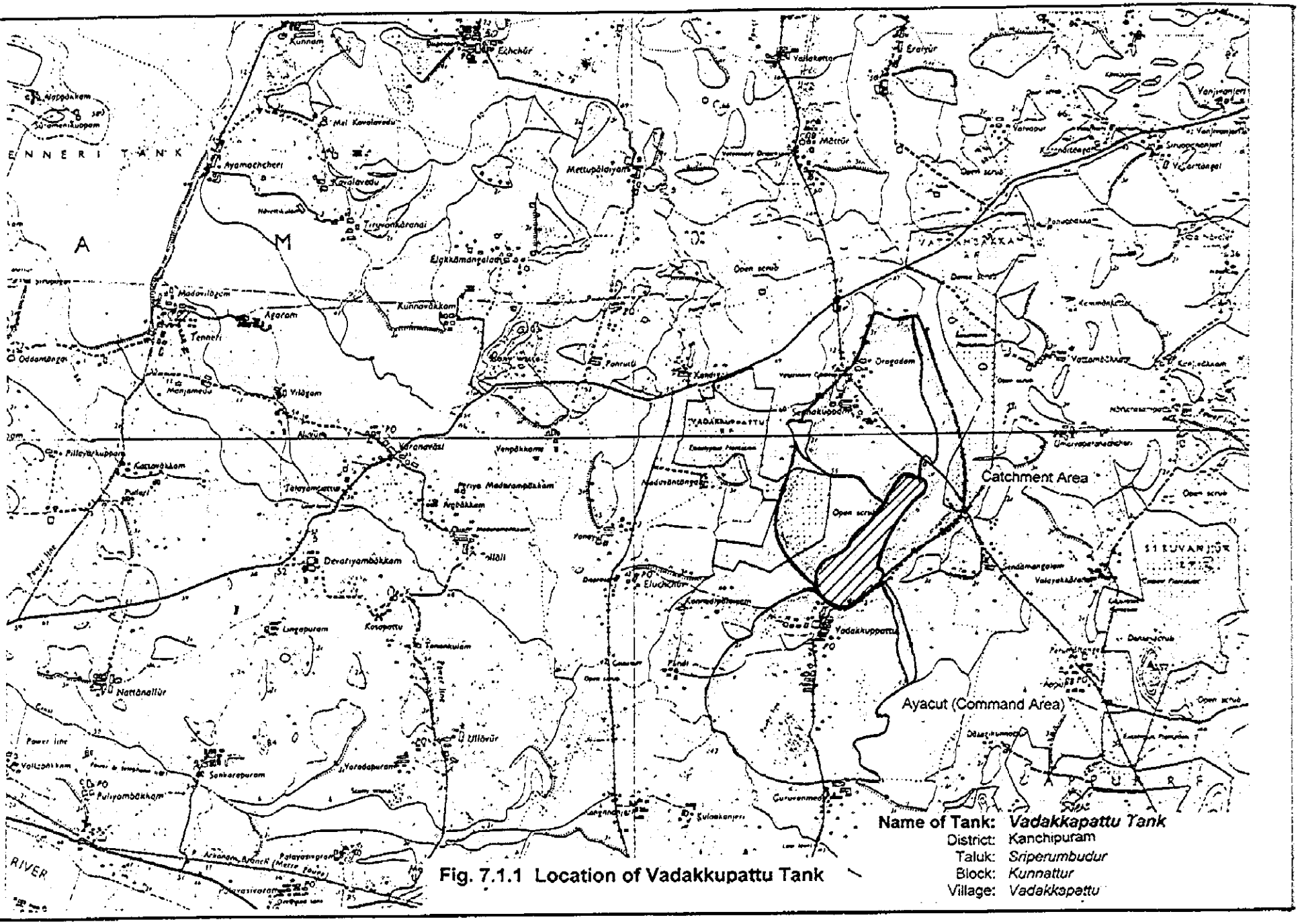


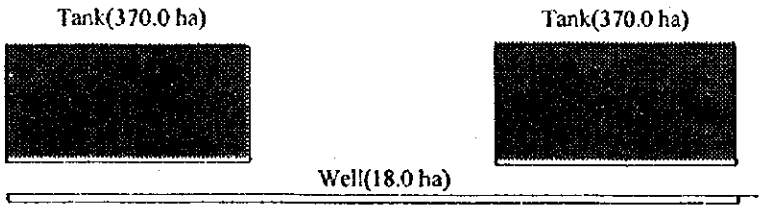
Fig. 7.1.1 Location of Vadakkupattu Tank

1 Name of Tank	VadakkupattuTank
2 Ayacut Area	417.3ha
3 Main Soil	Black soil: 87%, Red soil:5%,Red Sandysoil: 8%
4 Water pH,EC	pH: Tank 7.6, Groundwater 7.7 to 7.8, EC: Tank 0.233 to 0.239 dS/m, Groundwater 0.422 to 0.682 dS/m
5 No. of Farm Households	355 farm households
6 Self-Support Amount of Rice	710tons (355 x 2,000 kg/Household)
7 Geographical Irrigable Area	Normal year: 370.0 ha
7 Irrigable Area and Month by Tank	Normal year:602.0 ha(Sep-Apr)
9 No. of Wells and Irrigable Area	18 wells, 18.0 ha.
10 Average Rainfall(mm)	

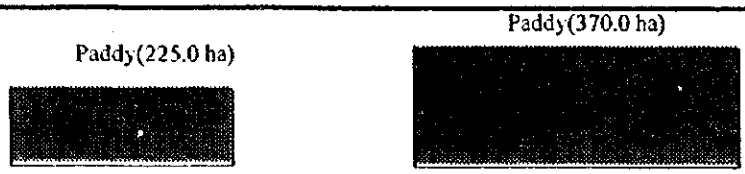
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
17.6	12.5	3.1	13.2	36.4	54.2	117.4	125.6	138.4	248.2	322.5	146.0	1,234.

11 Cropping

1) Irrigable Area and Period



2) Present Cropping Pattern

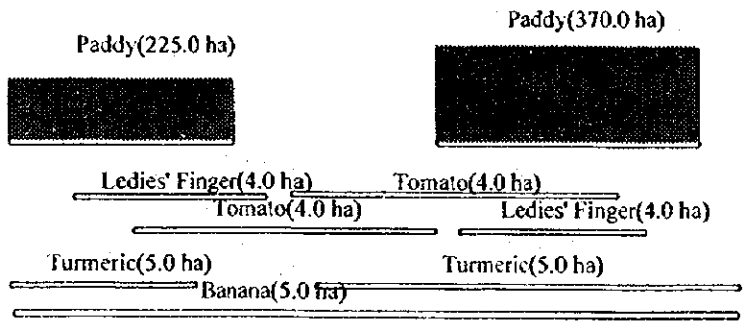


3) Cropping Plan

a) Paddy Area for Self-Support

142ha(710t/5t/ha)

b) Cropping Plan



c) Evaluation

	Crop Intensity(%)	Net Income(1000Rs)
Plan	131.8	12,217
Present	126.2	9,374
Plan/Presen	1.04	1.30

Fig. 7.4.1 Cropping Plan in Vadakkupattu Tank Area

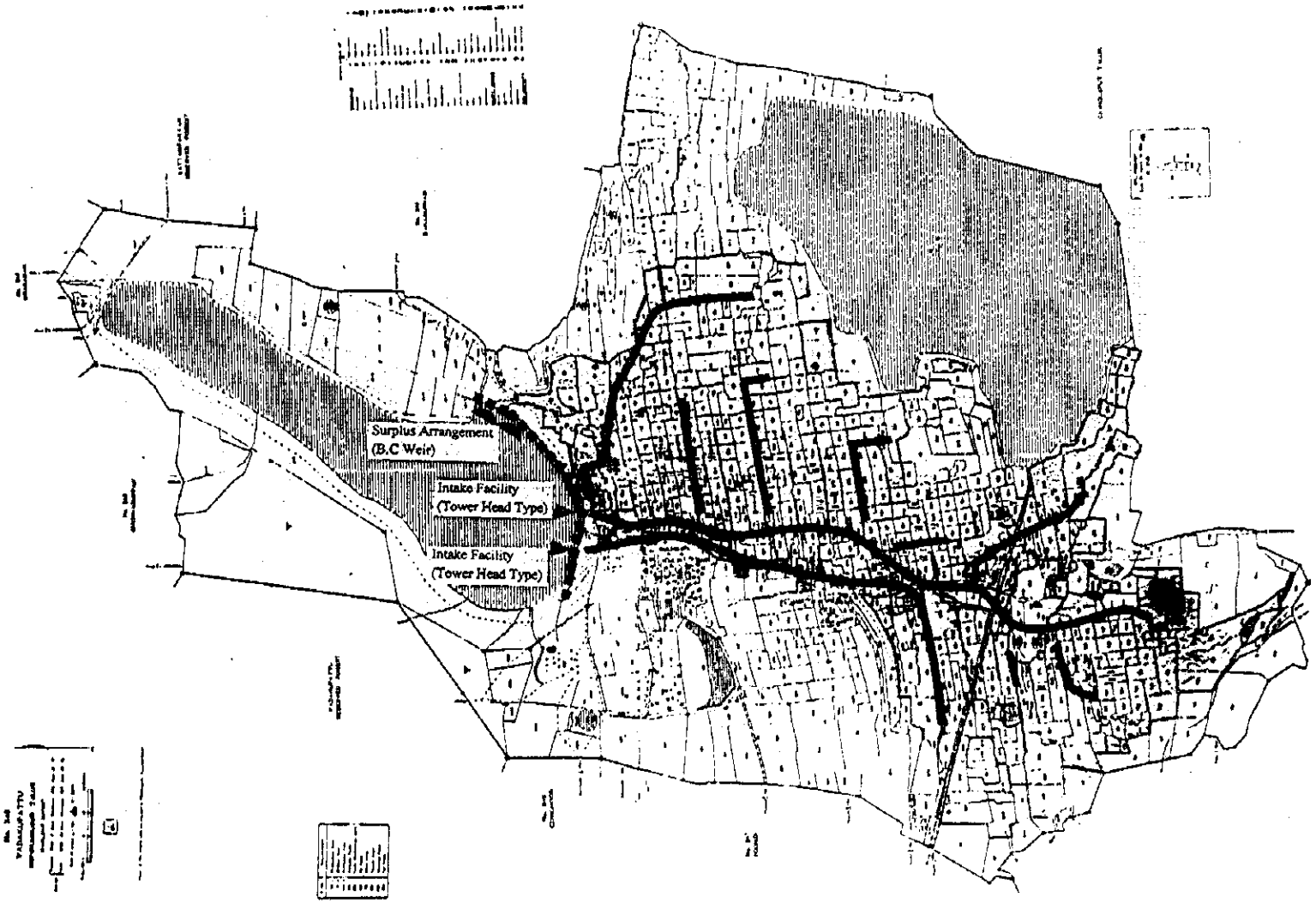


Fig. 7.5.1 General Layout of Irrigation Facilities in Vadakkupattu Tank

CHAPTER 8 : SIRUVALAI TANK AREA

CHAPTER 8 SIRUVALAI TANK AREA

8.1 General

8.1.1 Location

Siruvalai Tank, which has a registered command area of 53.2 ha, is located about 20 km northeast of Sivaganga as shown in Fig. 8.1.1. The tank is located north of the Sarugani River. The Paganeri village, to which the tank belongs is located about seven (7) km east of the Sivaganga - Tiruppattur road. The tank is located about one (1) km south to the center of the village. Administratively it belongs to Paganeri Village in Sivaganga Taluk of the Sivaganga District.

The village area is surrounded by the Kottappatti village in north side, the Tiruppattur taluk in east and south sides, and the Nagarampatti and the Kadaneri villages in west side.

8.1.2 Topography

Siruvalai Tank is located north of the Sarugani river flowing west to east. Its waterspread area is measured as 0.45 km^2. The ayacut areas of 53.2 ha expand in the southern area to the tank. The catchment area of the tank expands in the north areas of the tank.

A bund of about 2.3 km runs from the northeastern corner to the southwestern corner of the tank along the western and the southern edges of the tank. There is a surplus arrangement on the western end of the bund, and the surplus water flows southward into the Sarugani River. A supply channel is provided at the western end of the tank to draw the water from the Sarugani River.

Two (2) unpaved village roads are available; one runs from north to south connecting the village with the Southern Railway Line and the other runs from east to west for the Sivaganga - Tiruppattur road. The residential areas of the village are developed mainly around the junction of these village roads.

The ayacut areas are generally flat with mild slope toward south, and the earthen channels run generally southward. There is one (1) well in the ayacut area to supply domestic and irrigation water.

8.1.3 Geology

The geological formation met in this area is Archean basement complex represented mostly by charnokites. These formations are overlaid by thin top layer, whose thickness ranged from 3 m to 5 m. The crystalline basement rocks are highly massive and the

thickness of the weathered zone is very less, which generally about 7 m deep. The massive crystalline rock present below the weathered layer is devoid of any major fracture zones.

This is very week groundwater potential zone. In most of the wells, only one to two hour pumping is possible per day.

8.1.4 Soils

The type of soils is mainly black clay suitable for wet and dry cultivation both in the catchment and ayacut area.

8.1.5 Vegetation

A part of the catchment is covered by trees and shrubs such as eucalyptus, *Prosopis Juliflora*, *Ipomia Cornia* and other natural shrubs. No tank bed plantation is seen in the waterspread area.

8.1.6 Objectives

Siruvalai Tank is categorized as a SP-1, which belongs to the Southern Study Area (agro-climatic zone III) where annual rainfall less than 1,000 mm, and having the average cultivation area is more than 75 % of the registered ayacut area less than 55 ha. Additionally, the ratio between free catchment area and command area is less than 5.0. This means water resources is poor on its surface and groundwater.

Baseline Survey of Siruvalai Tank shows that about 80 % of years have surplus water, and average cultivation ratio is about 85 %. PWD rainfed tanks in the Kalayarkoil Panchayat Union are concerned, the surplus year is about 60 % and cultivation ratio is 86 % with 4 % of total tank area cultivated more than twice a year.

The catchment area requires more than 4.7 times of registered ayacut area in the Southern Study Area under the irrigation efficiency of 60 %. In the Tank Inventory List, the ratio between free catchment area and registered ayacut area of the tank is 6.31, but it is corrected to 2.87 based on the review of the Study Team. Then it might be difficult to irrigate whole registered command area of the tank.

Objectives of Siruvalai Tank rehabilitation program are: 1) maximize the tank water instead of groundwater; 2) distribute tank water in equity through the physical tank facility rehabilitation and channel lining, and 3) to install the community irrigation wells for the supplemental water sources at an important period of cultivation.

8.2 Meteo-hydrology

8.2.1 Climate

The climate prevailing over the tank area is sub-tropical. The basic and consolidated climatological data of temperature, relative humidity, sunshine, wind speed and evaporation data are available for Kavalur Meteorological Station located in the Vaippar River basin maintained by the Groundwater Wing of the PWD. Since, the Siruvalai, belongs to the same Southern agro-climatic zone, the climatological data of Kavalur Meteorological Station represents Siruvalai Tank also.

The coordinates of the Kavalur Station are:

- Latitude 9°34'20"N
- Longitude 77°54'00"E
- Altitude 110.180 m

All basic daily climatological data are compiled in a separate yearly records and are available from the Ground Water (GW) wing of the PWD. Monthly totals and averages are presented in the following table.

Monthly Averages of Climatological Parameters

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MEAN MONTHLY TEMPERATURE(°C)												
Mean	25.3	27.0	29.4	31.6	32.3	31.4	30.7	30.8	30.0	28.6	26.6	25.9
Maximum	23.9	25.9	28.3	30.0	29.8	30.5	29.2	28.6	28.8	26.9	24.1	24.2
Minimum	23.9	25.9	28.3	30.0	29.8	30.5	29.2	28.6	28.8	26.9	24.1	24.2
MEAN MONTHLY HUMIDITY (%)												
Average	63.1	58.9	56.6	58.6	58.2	55.5	56.6	55.3	62.9	68.3	72.5	69.0
Maximum	73.9	69.4	67.6	71.6	69.3	68.2	67.1	70.2	74.2	83.1	85.7	80.6
Minimum	52.0	46.9	49.6	50.9	43.2	45.4	45.9	44.8	55.5	60.0	62.0	58.5
AVERAGE MONTHLY EVAPORATION (mm)												
Mean	158.5	178.4	231.6	226.1	240.4	247.3	244.8	248.7	202.7	154.9	121.5	129.6
Maximum	197.0	225.0	289.5	294.0	292.1	308.8	323.8	325.5	244.2	238.5	170.8	191.7
Minimum	105.5	130.0	173.5	165.0	164.1	155.5	136.5	127.6	116.1	79.2	64.9	67.3
AVERAGE SUNSHINE (hours/day)												
Mean	8.4	9.4	9.1	8.7	8.1	6.5	5.9	6.5	6.5	6.2	6.2	6.8
Maximum	9.8	10.6	11.0	10.6	10.8	8.3	9.0	7.9	7.6	7.8	7.6	8.4
Minimum	5.3	5.1	7.8	7.2	6.2	3.6	4.1	4.7	5.1	3.9	4.1	4.4
AVERAGE WIND SPEED (km/hr)												
Mean	4.46	4.03	4.13	4.31	4.45	6.52	5.89	6.51	4.47	3.25	3.01	4.41
Maximum	8.13	7.53	6.36	6.51	7.79	9.62	9.23	10.87	6.43	4.80	4.80	9.42
Minimum	1.97	1.64	1.89	1.89	1.65	4.37	2.55	3.68	2.55	1.58	1.10	1.36

Temperature shows remarkably little/small variation. Mean annual temperature is 29.1 °C and North-east monsoon mean temperature is 27.0 °C. Relative humidity is influenced by the proximity to the coast of Bay of Bengal, which is nearly 100 km from the tank. Annual mean is relative humidity is 61.3 % with higher 85.7 % in November and the lowest 43.2 % in May.

Sunshine data are also available. Annual mean is 7.35 hrs/day, ranging from 6.4 hrs/day during the NE monsoon to 8.9 hrs/day between January and February. Similarly total

monthly evaporation fluctuates between 154.9 mm/month for October and 248.7 mm/month for August. As to be seen in the following section, agriculture in the tank area is seasonal unless irrigation is resorted to storage of rain water. November to February would be a pleasant cool and dry climate and from March to May would be hot and dry being summer, relatively free from rainfall.

8.2.2 Rainfall

The rainfall in the catchment area of Sirvalai Tank varies with season and it receives considerable rainfall both in South-west and North-east monsoon. For all rainfall computations, data recorded at the nearest Sivaganga Rainfall Station, maintained by the Revenue Department was used. The mean monthly rainfall data of this station of the last 60 years are shown as follows:.

Mean Monthly Rainfall of the Siruvalai Catchment Area

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	19.6	12.6	18.2	52.9	60.0	35.6	72.9	88.7	100.9	172.4	141.3	76.5	851.4
Maximum	208.4	135.1	120.8	220.7	158.0	127.3	306.2	242.3	275.3	394.1	529.5	339.8	1490.4
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.5	0.0	0.0	248.1

The entire calendar year can be divided into four seasons with the following rainfall distribution.

-	Southwest Monsoon (June-September):	298.0 mm	(35.0 %)
-	Northeast Monsoon (October-December):	390.2 mm	(45.8 %)
-	Winter (January - February):	32.2 mm	(3.8 %)
-	Summer (March - May):	131.1 mm	(15.5 %)
-	Total:	851.4 mm	(100 %)

The tank catchment receives its maximum rainfall in North-east monsoon while the lowest rainfall occurs during the winter months of January and February. The monthly maximum rainfall is 172.4 mm in October, and the minimum rainfall 12.6 mm in February. The annual maximum rainfall of 1,490.4 mm occurred during 1947 while the minimum of 248.2 mm occurred in the year 1976.

8.2.3 Catchment Area

Siruvalai tank is a semi non-system tank located in the Vaigai River basin. In preparation for the field visits the 1:50,000 map of the tank was obtained which permitted an assessment of catchment and command area. Siruvalai Tank receives its runoff water from its free basin of 1.415 km^2 and an intercepted catchment of 12.77 km^2 hence the total catchment (free + intercepted) is 14.19 km^2 and the equivalent catchment (free + 1/5th of intercepted) is 3.97 km^2. As per the PWD norms, the catchment is classified as "average" having gentle slope and moderate vegetation. The registered ayacut of this tank is 49.25 ha, and hence the ratio between free catchment and registered ayacut is 2.87.

8.2.4 Hydrological Analysis

The hydrological analysis procedures are similar to that of Echur tank. Rainfall - runoff computations have been carried out for monsoonal (September - December) and annual (January - December) for a continuous period of 16 years by Strange tables. There is no hydrological gauging station exist in the tank catchment and command area.

Yield and Runoff from the Catchment Area of Siruvalai Tank

Year	September - December			January - December		
	Rainfall (cm)	Yield (cm)	Runoff (Mm^3)	Rainfall (cm)	Yield (cm)	Runoff (Mm^3)
1980	86.4	20.3	0.805	111.9	37.5	1.488
1981	50.0	5.6	0.222	74.6	14.5	0.577
1982	56.7	7.6	0.304	94.6	26.3	1.044
1983	44.8	4.4	0.174	69.1	12.4	0.494
1984	85.4	20.1	0.797	147.7	64.3	2.550
1985	59.3	8.6	0.341	105.2	31.6	1.253
1986	49.1	5.5	0.218	96.6	25.9	1.027
1987	58.0	8.1	0.322	93.9	25.4	1.006
1988	37.8	3.1	0.123	80.3	17.5	0.695
1989	30.2	1.4	0.054	81.3	17.9	0.710
1990	34.1	2.0	0.081	59.1	8.6	0.340
1991	40.1	3.2	0.127	61.0	9.0	0.358
1992	49.9	5.6	0.222	74.9	14.2	0.562
1993	45.9	6.8	0.270	64.6	10.5	0.415
1994	32.1	1.6	0.065	46.8	4.7	0.186
1995	25.2	0.8	0.032	56.8	7.7	0.304
Mean	49.1	6.5	0.260	82.4	20.5	0.813
Maximum	86.4	20.3	0.805	147.7	64.3	2.550
Minimum	25.2	0.8	0.032	46.8	4.7	0.186

During 1980 - 1995, the average annual yield was 20.5 cm with a maximum of 64.3 cm in 1984 and a minimum of 4.7 cm in 1994. The corresponding values of estimated annual runoff from the equivalent catchment area are 0.813 Mm^3, 2.55 Mm^3 and 0.186 Mm^3. The monsoon (September - December) yield and runoff values also have been estimated and are presented in the table. The 16 year average monsoon yield is 6.5 cm and that of runoff from the equivalent catchment is 0.26 Mm^3. In an average the monsoon yield accounts for nearly 32 % of total annual yield.

The estimated runoff values based on the daily rainfall data for the years 1986 - 1995 using the dry-damp wet method is presented in Table 3.5.4 and 3.5.5. The annual runoff values vary from 0.665 Mm^3 to 2.210 Mm^3, with a 10 year average of 1.101 Mm^3. The average runoff ratio is 34 %. On the other hand, the seasonal (September-December), runoff values fluctuate from 0.332 Mm^3 to 1.839 Mm^3. The 10 year average monsoon runoff is 0.764 Mm^3, with an increased runoff ratio of 42 %. As per the monsoon rainfall records, the surplus from this tank occur four out of ten years accounting for 40 % of total years.

8.3 Social Conditions

8.3.1 Present Social Conditions and Facilities

(1) Available Social Facilities in the Village

The piped drinking water supply system is provided only for about 25 % of the villagers. The rest of them take water from deep and shallow wells, and some from the river also. The water quality of these sources is considered to be good. The electricity supply system is provided for 75 % of villagers.

Paganeri is a large village, and the public facilities in the village are shown in table:

Available Public Facilities in the Paganeri Village

Category	Facility
Education:	Primary School (Grade 1 - 5) High School (Grade 6 - 10) Higher Secondary School (Grade 6 - 12)
Health and Clinic:	Primary Health Center (PHC) Maternity Center
Others:	Community Hall Post Office

There are village roads for the Southern Railway Line and for the Sivaganga - Tiruppattur road, and bus services also available at the bus stop in the village.

(2) Social Settings of the Ayacut Area

1) Land Holding and Relating Villages or Hamlets

There are 106 farmers in the ayacut areas of Siruvalai Tank, and their average land holding size is calculated to be about 0.50 ha. About 96 % of the farmers is constituted by marginal and small farmers. All the farmers in the ayacut areas live in the Paganeri village. The most prevailing holder is marginal farmers sharing 77 %.

2) Caste Composition

The approximate caste composition of the farmers in the ayacut areas are as follows:

Caste Composition in Siruvalai Tank Ayacut Area

(Unit: %)

Others	BC	MBC	SC	ST	Total
10	12	73	5	0	100

The most predominant caste category is MBC composed mainly of the group of Kallar, its share is about 73 % of all the farmers in the ayacut area. The second predominant caste category is BC composed of Pillai and Konar sharing 12 %. The other category shares about 10 % and they are Chettiar. SC of Adidravidas shares only 5 % in the ayacut area. The Adidravidas and the Chettiar are muslim

and Christian, respectively. The others practice Hinduism.

3) Water Distribution and Decision Procedure

There is no registered organization for distributing water in the ayacut area. The farmers gather and discuss on the water distribution during the irrigation season, and during the drought period, a person is assigned for watching the water distribution. The watchman is paid by paddy according to the cultivated areas.

4) Maintenance of Irrigation Facilities

No regular maintenance activity of the irrigation facilities is conducted in the ayacut area except for the emergency repair works of tank bund.

5) Conflicts and Problems

There is no conflict among either the caste groups or the farmers having advantage or disadvantage in receiving irrigation water. The marginal farmers' lands located at the tail end portions are apt to be left abandoned during the drought periods, and they have to work as agricultural laborers.

6) Other Employment Opportunity

The nearest town is Sivaganga located about 17 km away from the village. They work usually as construction laborers.

8.3.2 Sociological Evaluation

Based on the criteria described in Section 2.5, the sociological conditions of Sirvalai Tank ayacut are evaluated as stated below.

Results of Social Scoring of the Sirvalai Tank

Factors	Hamlets	Farm Size	Conflicts	WUA	Leader-ship	Resource Mobilization	Main-tenance	Overall Score
Scores	5	5	15	8	35	20	5	93

This show the ayacut is good on social screening and the timing of community organizer placement for the formulating WUA should be at the commencement of estimate preparation.

8.4 Agriculture

8.4.1 Present Agriculture

(1) Land Use

The registered command area is 49.3 ha of which irrigable area is 49.3 ha (100 % of the command area). In 1995-96, only paddy was cropped in a area of 49.3 ha. In a normal year, the land use is the same as in 1995-96.

(2) Soil and Land Capability

The type of soil in the ayacut area is mainly black clay which is suitable for wet and dry cultivation. No saline soils are found in the ayacut area. The present cultivation of those soils show that the soils are suitable for irrigation.

(3) Agricultural Production

1) Crop Production

Paddy grown in the rainy season is the only crop cultivated in the area. In 1995 - 1996, the production was 167.6 tons with an average yield of 3,399 kg/ha. In normal year, the production amounts to 192.3 tons with the average yield of 3,900 kg/ha. The varieties used are CO43 and ADT38 which are tolerant to salinity.

2) Irrigation Water

Only tank water is available during the period from 25th of August to 25th of December with an irrigable area of 53.9 ha in normal year. Because of the saline water, there is no well in the area. According to the measurement of the groundwater conducted by JICA Study Team, the pH was 8.0 and the EC was 2.48 dS/m (can be assumed TDS is 1,587 ppm) which had the worst quality among the 10 study areas.

3) Fertilizer Application

According to the data of farmers' interview survey, 70 kg/ha of N and 76 kg/ha of P_2O_5 and 77 kg/ha of K_2O was applied in 3 split application for the paddy in the area in 1995-96. The amounts had proportionally unbalance, that is, less amount of N, more amounts of P and K in comparison with the recommended amounts (N: 120-150 kg/ha, P_2O_5: 38 - 50 kg/ha, and K_2O: 38 - 50 kg/ha).

4) Labor Input

According to the farmers' interview survey, the average labor input for paddy cultivation in the 10 Pilot Tank areas was about 200 man-day/ha in which 28 % was allotted to harvesting, 24 % to weeding and 21 % to transplanting. While the family agricultural labor in the area is 2.3 men/house and the potential agricultural labor is 5.2 men/house. The necessary staggering period in the area to accomplish the farm works of paddy cultivation by family labor is calculated based on the above data as 5.2 days at least when the potential labor is used. The labor requirements for vegetable, sugarcane and groundnut cultivation are around 4.3 times, 2.3 times and 0.6 times of the paddy, respectively.

5) Livestock Breeding

187 heads of cattle, 342 heads of goat, 320 heads of sheep have been raised in this area. The cattle which is mainly draft cattle was raised 3 heads on average in 63.2 % of the total farmers, the goat was raised as 16 heads on average in 20.8 % of the total farmers, the sheep was raised 53 heads on average by 5.7 % of the total farmers.

(4) Farm Size and Land Tenure

The number of farm holders in the area is 106 of which 4 % are farm holders of more than 2 ha, 19 % are farm holders of 1.0 to 2.0 ha and 77 % are farm holders of below 1 ha (marginal). The average farm size is 0.5 ha which corresponds to 54 % of the state average and 32 % of the national average.

8.4.2 Agricultural Development Plan

(1) Land Use

In the area, there is little scope for improvement of land use because of the very limited irrigation water. In the plan, paddy is grown in the area of 42.4 ha which is the necessary area for securing self-support crop in the area. Ladies' finger is grown in the remaining 6.9 ha during the period from September to December. The crop intensity is 100 % which is same as that in the present.

(2) Cropping Plan

The cropping plan was made as shown in Fig. 8.4.1. In the plan, paddy is grown in an area of 42.4 ha which is the necessary area for securing of self-support amount of the area. As a high return crop, ladies' finger is grown in the remainder of 6.9 ha during the period from September to December.

(3) Crop Budget and Production Plan

The planned production amounts, the production costs and the net incomes of the cultivated crops are shown in Table 3.4.2. In the plan, the total net income in the command area amounted to Rs.867,800 which correspond to about 2.3 times of the present one. The increase in net income is brought about by the increased paddy yield and the income obtained by ladies' finger.

(4) Employment and Working Opportunity

The introduction of the ladies' finger for 6.9 ha will bring certain increase in employment and working opportunity, especially for the women in the command area. The labor amount required for the cultivation of ladies' finger is estimated at nearly 60 % that of the present.

(5) Farm Management and Farm Budget

1) Farm Management Plan

For Siruvalai Tank area, due to its basic location in a drought prone area, the utmost problem is water supply in the dry season for cropping. Presently, only paddy is cropped in the rainy season. The elaboration for use of well water for expanding the second crop would be subjected to be studied. At present, about 2 ha have been cropped for vegetables with irrigation from well water. The application of crop diversification in the first crop would be elaborated for a higher farm income.

The water problem would be solved in this tank area if a conduit structure with a gate is to be constructed for connecting the nearby seasonal river (Sarugani River) with this tank.

The application of integrated agriculture, particularly raising livestock i.e. chicken and goat at each farm is also recommended along with publication of related documents for making local farmers obtaining this knowledge.

From these basic directives, after confirming the related feasibilities for realization, a proper plan for farm management for each individual farm should be further elaborated for each corresponding farm based on the following elements:

- Existing natural conditions for farming
- Local traditions in agriculture
- Periods of possible water supply from tank, groundwater etc.
- Available capital for investing in agricultural production
- Evaluation of possible crop budgets

- Preparations of farmland, inputs and related techniques
- Selection of crops for planting through the year
- Harvesting and marketing capabilities and proceedings
- Estimates on net farm revenues after all production costs
- Estimates on the balance after all family living expenses

2) Farm Budget Plan

The farm budget is recommended to be elaborated on the basis of crop budget analysis for making a higher farm budget for small and marginal farms based on the following 3 basic alternatives:

- Mainly one first crop (All paddy in wet season and some vegetables in dry season) as at present
- Mainly one annual crop (Mulberry or Cassava etc.)
- For two seasonal crops with almost even shares (i.e. Groundnut and Cotton)

Besides, as the integrated agriculture is observed of being neglected in this tank area, the application of integrated agriculture should be considered also for increasing farm revenues, particularly on the aspect of raising livestock at farm level.

As the tank area is fortunately located on the trunk route in the region, further elaboration for making a better farm budget for small and marginal farms through basic post-harvest and marketing activities such as dried or simply processed agro-products would be recommended to be promoted in the village

(6) Marketing Plan

Due to the good location of tank area nearby the regional trunk route, marketing activities such as simple agro-processing and selling of some agricultural produces are recommended to be promoted in the village.

In this framework, basic post-harvest treatment facilities and shops for selling these products to passers-by as well as materials to local farmers for applying the integrated agriculture are recommended to be established on proper places nearby the trunk route.

Besides, some transport vans are subjected to be equipped for quick transportation of agricultural produces to district markets etc.

8.4.3 Agricultural Supporting Services and Institutional Plan

(Same as notified in this part for Echur Tank)

8.5 Rehabilitation of Tank Irrigation System

8.5.1 Present Conditions

(1) Irrigation and Drainage System

Siruvalai Tank is located on the left bank of the Sarugani river and south of Paganneil town. Bund of paddy field is usually very high at the western part of the ayacut for the protection of flood of the river. There were 3 small tanks in the ayacut area used for the cultivation area at present.

There are 10 sluices in the tank.2 sluices are installed at the western side from district road crossing the tank from north to south connecting Paganeri and Natarajapuram and covering about 2.5ha. Other 8 sluices are located on the eastern side.

Irrigation channel basically flows in a southward direction from the sluice to the Sarugani River meandering along the border of field plots. Distance between the tank bund and the river is widened from 100m at the district road to 500 m at the eastern end of the ayacut. Therefore, length of irrigation channel varies accordingly. The longest irrigation channel is No.1 sluice channel with 720m covering 15 ha., the channel commanding the largest area is No.2 sluice channel with 21 ha.

There is only one private open well near No. 4 sluice. It can irrigate only 0.4 ha of vegetables after NE monsoon.

There are two surplus arrangement, one is bye-wash and the other is a masonry weir: both are installed in the western area of the tank bund and drains water to the Sarugani river, one of the branch river of the Manimuthar river.

(2) Tank Bund

The existing dimensions of the tank bund are measured and soil mechanics properties are analyzed. The results are shown in Table 3.5.1 and Table 3.5.2. There is no damage in this tank bund except erosion of bund slope around intake facilities.

(3) Spillway (Surplus Arrangement)

1) Location

There are two (2) weirs of BC type in this tank. Location of these weirs are shown in Fig. 8.5.1.

2) Existing Condition

Weir No. 2 maintains its original shape and condition. Although weir 1 maintains its original shape, material of whole parts such as water cushion and crest, are deteriorated. However, weir No. 1 can flow the surplus water.

(4) Intake Facilities (Sluices)

1) Location

There are ten (10) sluices served by this tank. Most of the sluices are of Wing wall and Head wall type apart from sluice No. 1, 2, 5. Sluice No. 8 is a pipe culvert type. Location of the sluices is shown in Fig. 8.5.1.

2) Existing Condition

Sluice No. 3 is a culvert type, and hence not used as intake facility, and sluice No. 3 is closed a plug vent type by sand bag.

Regarding the other sluice, although some cracks and damages in the body are confirmed, these damage do not influence the functioning of the intake work. It is necessary to carry out repairs for the deteriorated parts only.

3) Water Control Device

Except for sluice 3, all sluices are of the plug and plug rod type, which are of the type as the same ones used in the Northern Study Area. All of plugs are not confirmed to be used for each sluice; in same cases, stone is substituted for plug.

(5) Groundwater Usage

In the command area, there are only 2 wells. One is a bore well and the other is large diameter dug well. In the recharge area, there are 3 large diameter wells which are used for irrigation. As the thickness of the weathered zone is less and the secondary porosity in the basement rock is also very less, groundwater yield will be very less in the wells. The wells present in this area generally pump only for about two to three hours.

(6) Operation and Maintenance

No formal water users' association exist in the ayacut area. Traditional irrigation is practiced. No conflicts occur concerning the irrigation water distribution. Most of irrigation channels are maintained at the beginning of the tank operation by farmers.

8.5.2 Water Resources Development Plan

(1) Liability of Water

The classification according to the Indian Meteorological Department to identify the excess to scanty rainfall years are given in Section 3.5.2. Following the same classification, the probability of the availability of water for Siruvalai Tank is presented in the following table.

Liability of Water Based on Rainfall

Classification	No. of Years	Total No. of Years	Probability (%)
Excess	0	60	0.0
Normal	4	60	6.7
Deficit	21	60	35.0
Scanty	34	60	56.7

Among the 60 years, 56.7 % of the years are classified as having scanty rainfall, followed by deficit rainfall; 35 %, normal rainfall only 6.67 %, and no excess rainfall years was found showing the scarcity of rainfall condition and the supply to the tank. Apart from this, as mentioned in Section 3.5.2, another important aspect is the occurrence of drought or flood based on the rain storm. For a five year return period (20 % of provability), the drought monsoon rainfall is estimated as 618.2 mm. When compared to tanks in the Northern Study Area, the availability of water is very scarce. So, it is an immediate need to develop drought management strategies such as:

- Promotion of rain water harvesting techniques such as conjunctive water use at village level by WUA.
- Developing a Monsoon Management Strategy, based on crop life saving research and contingency plans to suit the different water probabilities in order to reduce adverse impact of unfavorable monsoon on crop cultivation.
- Supporting the anticipatory research designed to enhance village capability to meet potential changes in rainfall pattern for planning the land and water use scientifically.

(2) Water Quality

Based on the field measurement of the Study Team, the pH level of 7.9 and EC level of 0.33 dS/m indicate no salinity hazard will be expected for crop cultivation. Groundwater in the well shows level of pH 8.0, and EC 2.48 dS/m, meaning that there is moderate salinity hazard for the crop cultivation when using groundwater for irrigation.

(3) Irrigation Water Requirement

Even though the availability of water is scarce, in the registered ayacut of 49.25 ha, paddy rice is the main crop. Based on the long term climatological data, the crop water requirement were calculated. Predominant soil type in the command area is black cotton soil. The average percolation rate of this soil is observed to be 1.5 mm/day. Assuming a present irrigation efficiency of 40 %, the gross irrigation requirement were calculated and are presented on fortnightly basis in Table 3.5.3. Pre-project total gross water requirement was estimated as 0.526 Mm^3. By lining of the field canals, the estimated increase in the irrigation efficiency is 75 % and post-project gross irrigation water requirement is estimated at 0.319 Mm^3. By this process, 0.207 Mm^3 water can be saved, which can be used for increasing tank command area and reducing the dependability precise ground water resources.

(4) Water Balance

The capacity of Siruvalai Tank is determined as 0.374 Mm^3, by a topographic survey. Based on daily rainfall for the years 1986 - 1995, runoff values were estimated by dry - damp - wet method and presented in the Table 3.5.4 and 3.5.5. As per the annual and monsoon (September - December) rainfall data, surplus occurred five out of 10 years. All the runoff water stored in the tank is used to irrigate a registered ayacut of 49.25 ha. With its richness in water resources, Siruvali tank could satisfy in an average 74 % of the irrigation demands. With present conditions (Ef = 40 %), the estimated irrigated area varies between a minimum of 21 % to a maximum of 100 % of the register ayacut, The runoff/irrigation ratio remains as 207 %. This situation could be further improved by canal lining, with an increased Ef = 75 %, resulting in decreased irrigation water requirements. By this change, tank water could able to irrigate in an average 86 % of the registered ayacut. Beside this, the runoff - irrigation ratio is increased to 343 % and more surplus water (average 0.243 Mm^3) is available to the down stream tanks. Monsoon data also showed the same trend, but with a slight increase in runoff ratio. The above facts point out that partial lining is desirable as rehabilitation measure to increase the command area of Siruvalai Tank.

(5) Drainage Water Requirements

The drainage water requirement for Siruvalai Tank is calculated according to the procedure described in Section 3.5.2 and details are given in Table 3.5.6. Using the Ryve's formula, the estimated maximum flood discharge is 35.82 m^3/s while that using the rational formula is 28.49 m^3/s. Hence a safe design discharge of 35.82 m^3/s can be adopted for designing the surplus arrangements. However, before finalizing this necessary to consider the seriousness of disaster, type of surplus weir and cost of rehabilitation.

(6) Basin Water Management

Siruvalai tank is part of chain tank receiving its water supply from its free catchment and an intercepted catchment encompassing two PWD tanks (Karuka and Senthuruthi tanks) and four Panchayat Union tanks (Koppangudi, Parisampuli, Pookkathan and Rakoorani tanks) and several *uranis*. During surplus months it also receives its water supply from the Sarugani River which acts as an inlet cum surplus weir. As presented in Table 3.2.1, various tank basin ratios were calculated and given here for quick reference.

- Free catchment / command area	2.87
- Intercepted catchment / command area	25.93
- Waterspread area / command area	0.72
- Tank Storage capacity / command area	0.008 Mm^3/ha
- Waterspread area / Tank storage capacity	0.955 km^2/Mm^3

The catchment - command area ratios of this magnitude, indicates that the changes that take place are as a result of encroachment and social forestry which can drastically cause a reduction in culturalble command area of the tank even during average annual rainfall years. A waterspread -command area ratio of 0.72 implies shallow storage capacity and implies the need for deepening the tank by way of desiliting which could increase the potential command area. The ratio of tank waterspread area to capacity indicates a low storage capacity. The ratio of capacity to command area is 0.008 Mm^3/ha, which is far less than the requirement of water for a single crop of rice under the current levels of efficiencies (storage, conveyance, and field application). These figures indicate that tank irrigation potential is under-utilized due to lack of tank management. Proper operation and management of tank irrigation is one of the major options to mitigate the severity of droughts. Existing designs and management procedures make it almost impossible to provide a timely and reliable water supply for modern agriculture based on high yielding crops.

The surface water resources of Siruvalai tank basin consists of direct runoff from rainfall and flow in Sarugani River. However, irrigation largely depends on available tank water and groundwater. The total groundwater recharge of the Sivaganga block to which, Siruvalai Tank belongs was estimated to be 8,494 ha. Utilizable recharge is 7,220 ha m, net groundwater draft is 1,252 ha m and the balance available is 5,968 ha m. This 70.26 % unutilized groundwater resources, can be drawn up to supplement the tank water, by digging up more wells.

The total surface water resources can not be utilized due to certain limitations, such as topographical, geological, technological and environmental constraints, and constraints the utilization of flood flows. Concentration of surface flow in four monsoon months necessitates proper tank rehabilitation storage structures The potentials for further development in basin water management can be put under hydrological and administrative potentials.

1) Hydrological Potentials

a) Conservative Water Use: Comparatively new and unconventional methods like sprinkler and drip systems of irrigation avoid water loss through percolation and evaporation and hold great saving of water to the extent of 50% compared to presently practiced irrigation methods. As a rehabilitation measure, conveyance losses can be reduced by lining the canals. Dry land technology may be adopted to grow crops under poor reach conditions.

b) Artificial Recharge: In large irrigated chain tank areas, there are attractive possibilities of providing underground storage through recharge provided by irrigation as well as excess rainfall in wet years for use in the dry years. Percolation tanks may be constructed at suitable places for replenishing the underground water.

c) Command Area Development: It is to increase the already created irrigation potential to secure optimum crop yield per unit of water, per unit of land and per unit of time.

d) Increasing the Irrigation Efficiency: Water application efficiency needs to be increased (from the present 40 % to 75 %) by land shaping, smoothening the land slope, and optimal plot size. With increased efficiency more areas can be irrigated with the same amount of water.

e) Change in Cropping Pattern: Emphasis on high water consuming paddy needs to be shifted to growing cereals requiring less water like maize, cambu, millets etc.

f) Equitable Water System: Farmers assured of equitable and adequate supplies may desist from over-irrigation. Volumetric supply of water needs to be encouraged and water rates charged on volumetric basis rather than present carpet rate of Rs.35/ha.

g) Grid of Water System: Inter basin transfer of water resource from tank areas where surplus water available to tank areas of scarcity is one of the promising means for augmentation of water resources. Thus, all supply channels, tanks, *uranis,* and pools of the sub-basin should be linked so as to form one single system.

2) Administrative and Sociological Potentials

In chain tank basin management, the important aspect is the participatory and chain basin approach to the tank rehabilitation. Moreover, a comprehensive and systematic program for the repair and maintenance of chain of tanks is necessary.

This can be achieved by formation of multi-tier farmers associations. By this approach, all farmers from catchment to farm level in the chain will form one single association of their own with specific responsibilities as shown below.

Tier	Association	Level	Responsibilities
I	Siruvalai WUA	Tank/village	To identify and suggest need based tank management program
II	Vaigai Minor Basin Farmers Council	Minor/chain basin	To resolve conflicts arising among the chain of tanks
III	Sivaganga District Tank Farmers Federation	District	To identify the opportunities available for inter and intra chain basin water transfer

Eventually the WUA need to be made as a multipurpose organization with the responsibilities of equitable water sharing, financial contribution to the tank rehabilitation and maintenance. The techno-mangerial quality control guidance will be provided by PWD. Later training needs to provided to farmers on scientific water management and improved agricultural practices.

Under this approach, the PWD and WUA will have to sign a MoU to undertake the rehabilitation and post project maintenance works. Among the chain of tanks for rehabilitating the PWD rainfed tanks the money will be used from the foreign financial assistance. For rehabilitating the other PWD tanks funds will have to be got from the State Tank Irrigation Project. For the PU tanks funds will be sanctioned from District Rural Development Agency. Farmers will also have to be asked to contribute for financing some costs of the project based on the category of the tank. For example, up to 25 % for PU tanks, 15 % in the case of PWD tanks and 10 % in the case of Foreign aided tanks among the chain of tanks.

The proposed advisory, consultative and administrative set up for Siruvalai Tank basin management is similar to as illustrated in Section 3.5.2. In addition to that, NGOs' like PRADAN (Professional Assistance for Development Action) who are ready to undertake (and active in neighboring Madurai District), the responsibility of organizing rehabilitation of one chain of tanks with farmers participatory approach should also be encouraged with specified basic concepts as shown in the following table.

Stage	Capacity Building	Planning	Implementation	Management
Activities	- Tank Selection - Formation of WUA - Farmers contribution	- Farmer Planning - Farmer implementation - System Repairs - Encroachment eviction	- Catchment Treatment - Integration with other tanks - Water Management - Conjunctive use and crop production	- Ongoing operation and maintenance - Endowment fund - Institution building - Turnover
Process	- Exposure visits - Farmers subgroup meeting	- Experience sharing - Specific training - System design and maintenance	- Hand holding of WUA - Integration of catchment and command area farmers - Monitoring	- Review process - Capacity building training - Setting up of self renewal mechanism

(7) Groundwater Development

Systematic studies and detailed geological mapping will be necessary to delineate the fracture patterns and identify regions of high intensity weathering. This will enable to locate new wells in this region for well planned groundwater development.

8.5.3 Tank Irrigation Facilities Rehabilitation Works

General layout of irrigation facilities is shown in Fig. 8.5.1, and required item for rehabilitation works are described in the table below.

Countermeasures for Rehabilitation of Siruvalai Tank

Component	Rehabilitation works	Section for Rehabilitation works	
Tank Bund Improvement (Total bund length 2,010m)	• Strengthening of the bund for reshaping to standard size.	2,010m	
Intake works (Sluice)	• Modification for intake system using gearing shutter • Protection of back-fill for side slope.	Tower head type Wing wall type	3 units 3 units
Surplus arrangement	• Repairing of water cushion by clogging wet masonry	B.C. weir	1 unit
Selective Lining for Field Channel including On-farm development	• Installation of lining canal • Provision of diversion boxes with paddle shutter for equal distribution. • Reshaping of existing canal. • Provision of incidental device such as cart, cattle, and canal/crossing.	930m as main 840m as branch	1 unit 5 units
Building for Farmers' Association	• Provision of community hall for WUA, local farmers and inhabitation.	50m^2	1 No.
Community well	• Provision for irrigation as supplemental use		2 Nos

8.6 Farmers' Organization

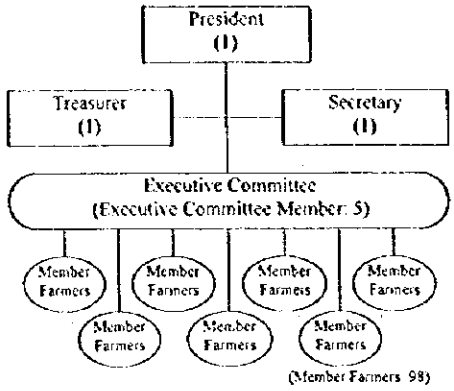
8.6.1 Present Situations of Farmers' Organization

There is no such registered organization as water users' association in the ayacut area as described in Sub-chapter 8.3.1. They have their informal society for water distribution appointing *Neerkatis* for watching water distribution.

8.6.2 Proposed Farmers' Organization

(1) Water Users' Association

Since there are 106 farmers in the ayacut areas, the number of the Executive Committee Member becomes five (5) and the number of member farmers is 98 deducting the number of bearers from the total farmers. The functions of the proposed WUA for the Echur tank are described in Sub-section 4.3.4 of Report Volume II.



PROPOSED ORGANIZATION FOR WATER USERS' ASSOCIATION OF SILVALAI TANK

(2) Farmers' Organization for Agricultural Production

As explained in Sub-section 4.3.4 of the Report Volume II, the sections which have the following functions are proposed to be attached to the WUA in Sirvalai Tank areas to realize sustainable agricultural development.

- Operation and maintenance technology for water-saving irrigation
- Agricultural technology extension services crop diversification and value-added agriculture, etc.
- Various agricultural supporting services such as supply of agricultural input materials, marketing, including agricultural credit services

8.7 Project Evaluation

8.7.1 Project Costs and Benefits

(1) Project Costs

Unit cost for rehabilitation works are estimated based on the *Standard schedule of Rates for Pusumpon Muthuramalinga Thevar District* issued by PWD. At the 1997 price level, direct construction cost is estimated at Rs. 1,857,000, as shown in the table.

Direct Construction Cost for Siruvalai Tank

Description	Total Cost (Rs.)	Percentage	Unit Rates (Ayacut 49.25 ha) (Rs./ha)
Tank Bund Improvements	144,000	7.75%	2,924
Sluices Improvement	565,000	30.43%	11,472
Surplus Improvement	133,000	7.16%	2,701
Tank Supply Channel Improvement	-	0.00%	-
Selective lining for Field Channel & OFD	485,000	26.11%	9,848
Building for Farmers' Association	130,000	7.00%	2,640
Community Well	400,000	21.54%	8,122
Direct Construction Cost	1,857,000	100.00%	

The Project cost consisting of direct cost, supervision charges, contingencies, preparation work cost and overhead charges is Rs.2,726,000.

Project Cost for Rehabilitation Works in Siruvalai Tank

Description	Total Cost (Rs.)
Economic price (Direct Construction Cost)	1,857,000
Petty Supervision Charges	298,000
Preparatio Cost (Govt. Share)	26,000
Overhead Charges	545,000
Total	2,726,000

Economic price for the economic analysis is estimated using the conversion factor (SCF, 0.8) for the direct construction cost.

(2) Project Benefits

The Project mainly aims at stabilizing the agricultural production through out the year in the limited command area of about 49 ha by introducing proper agricultural production techniques for better farming system for higher farm revenues as well as improving living conditions of small and marginal farms after the rehabilitation works.

At present, though the whole command area is subjected to paddy cultivation as first crop, the cultivated area for the second crop is let in fallow conditions. Besides, due to the main factor of unstable water supply for the first crop, the average unit yield of the first crop is observed to be low; between 3.0 to 4.0 ton/ha.

With the Project implementation, major benefits of the Project, therefore, will come from two sources: 1) increases of crop benefits; and 2) value-added benefits from post-harvest treatments.

For increasing crop benefits, the cropping pattern, detailed elaboration on water requirements, plan for land use, applied farming system including the cropping schedule, varieties as well as estimates on inputs and yields for projected crops etc. were carefully evaluated in order to obtain higher farm revenues. This is resulted in the increase in net production value of agriculture from presently at about Rs. 0.7 million to approximately Rs. 1.0 million (Table 8.7.1).

Besides, with the establishment of various facilities for organizing farm management and improving treatments on storing, marketing etc., an estimated amount of value-added of about Rs. 0.05 million as 5 % of the net agricultural production value "with Project" would be annually obtained. This is estimated on the basis of results from our site surveys that with the application of some basic post harvest treatments such as storage and selling at markets only, will provide a profit margin of average 10 % higher than selling at farm sites during harvesting periods.

8.7.2 Economic Evaluation

The economic evaluation is carried out to judge the project viability in terms of direct contribution to the national economy. The Project covers a command area of about 49 ha with a total number of 106 farms as beneficiaries.

For the economic analysis, the related EIRRs for Siruvalai tank area are as follows:

i)	EIRR under basic conditions :	8.7 %
ii)	EIRR at 10% cost-increase:	4.8 %
iii)	EIRR at 10% benefit-decrease:	6.4 %
iv)	EIRR at 3-year benefit delay:	2.4 %

From these figures, the EIRR under basic conditions of 8.7 % shows the low figure for this tank. The risk case of 3-year delay of benefit showed a view low EIRR of 2.4 %.

8.7.3 Financial Evaluation

In this Project, the financial evaluation is made for mainly dealing with the analysis of farm budget for the representative farms in both cases of "without project" and "with project situations". The related results are as follows:

-	"Without Project" Net Income per Farm:	Rs.3,627
-	"With Project" Net Income per Farm:	Rs.8,187
-	"With Project" Value Add per Farm:	Rs.981
-	Incremental Net Farm Income:	Rs.4,969

With the project implementation, the annual increase in net farm income for an average farm will be about Rs.5,000.

This limited amount could basically improve the farm budgets of small and marginal farms in this tank area. For further raising their living standards, they should employ largely in off-farm economic activities.

However, in order to achieve these figures, proper supports on technical aspects as well as more investments in farm inputs should be made accordingly. This should be made in a new scheme of financial and technical supports for these farm categories in the newly established farmers' organization.

8.7.4 Labour Force Requirement

Monthly labor force requirement for the planned cropping schedule are shown in Table 3.7.3. The peak of labor requirement in the area comes in December with the requirement of 3,652 man-day/month. To meet this labor amount, 7 days staggering period is needed with the potential family labor of 551 man-day in the area.

8.7.5 Farm Household Economy

With the Project implementation, the farm household economy of small and marginal farms will be largely improved. From the financial analysis on farm budgets of these farm categories, an increase in net production value of Rs.4,560 and a value added of about Rs.410 for a total amount of Rs.4,970 would be obtained annually per average farm in this tank area.

Besides, better conditions on water supply and supporting institutions for agricultural production will support small and marginal to improve their living standards from the present deficit situation of farm budgets.

Even for landless farmers, apart from the proposed work scheme for landless people in the farmers' organization as mentioned in the above, they would obtain more labour works from big and medium farms to support their living expenses. A legislative measure to make big and medium farms in the tank areas hiring on annual basis a quota of landless farmers i.e. 2 males or 1 male and 2 females per ha, if permissible, would be promoted for basically supporting their living.

8.8 Environmental Issues

8.8.1 Present Environmental Conditions

(1) Health and Sanitary Conditions

Major diseases in this area are diarrhea/ADD, dysentery and influenza. In relation to irrigation and drainage, neither waterborne nor mosquito-related diseases occur.

(2) Natural Environment

The Project Area is generally a flat land. Catchment area is either cultivated land or part of Paganeri village. Wildlife seen by the villagers are peacocks, foxes, rabbits, monkeys, spotted deer and other birds. Among these, particularly peacocks, the national birds of India, are important birds to be reserved.

(3) Surface Water and Groundwater

Quality of tank water is fair and no water contamination by agro-chemicals occurs, according to the farmers. Present groundwater utilization is minimal as only one private open well is seen in the ayacut.

From the results of the water quality measurement, it can be stated that the groundwater will have medium salinity problems for irrigation.

8.8.2 Environmental Impact of The Project

As summarized in Table 8.8.1 and Table 8.8.2, the environmental impact study for Siruvalai Tank area was conducted through the field survey and in consideration of the Project components.

(1) Social Environmental Impact

1) Social Institutions and Customs

In regard to the introduction of a WUA under the Project, almost the same impact as stated in Section 3.8 for Echur tank area will be considered.

2) Health and Sanitary Issues

As to agrochemical aspect, the same situation as stated in Section 3.8 for Echur Tank Area can be expected. That is, the use of agro-chemicals will be increased in the future. For rural health and diseases the Project will not be a cause of any waterborne or mosquito-related diseases.

(2) Natural Environmental Impact

1) Biological and Ecological Issues

Among animals seen in this area, peacocks are listed in Schedule I, foxes are in Schedule II, and rabbits, monkeys, spotted deer are in Schedule III of The Wildlife (Protection) Act of 1972. Therefore, the Project should take proper measures to safeguard the wildlife. Particularly for peacocks, the national birds of India, which may have their nests around the tanks and in the catchment area.

2) Soil and Land Resources

Since the groundwater is saline, the groundwater development for irrigation may induce soil salinization and damage the crops.

3) Hydrology and Quality of Water

Groundwater with EC value of about 2.5 dS/m is considered as medium saline for irrigation and groundwater in this area could be considered as having a development potential. Likely problems induced by the groundwater development will be the changes of groundwater table, salinization of soil and damage to crops. Large scale groundwater extraction will be a cause of lowering water table.

8.8.3 Recommendations

As a result of the environmental impact study described above, it can be concluded that the Project will not induce any serious direct negative environmental impact. But, the development activities may induce some indirect impacts. Details are presented in Volume IV of the Report.

i) For the establishment of WUAs, it is recommended that an effective procedure involving NGOs with close cooperation among government agencies shall be provided.

ii) For the expansion of the irrigated agriculture, it is recommended that AD shall extend the guidance to the farmers on agrochemical use.

iii) During rehabilitation works in the tank area, it is recommended that the works shall provide safeguard to wildlife particularly for peacocks.

iv) For the groundwater development for irrigation, it is recommended that the scale of groundwater development and the selection of crops considering water salinity shall be carefully planned.

Table 8.7.1 Calculation of Crop Economic Benefits for Sirvalai Tank

"Without Project":

Crop	Area (ha)	Production				Production Cost		Net Production Value (1000Rs)	Remarks
		Yield (T/ha)	Production (T)	Unit Price (Rs/T)	Value (1000Rs)	Unit Cost (Rs/ha)	Total Cost (1000Rs)		
1. Paddy (1st Crop)	49.3	3.9	192.3	4,736.0	910.6	5,008.0	246.9	663.7	
Total	49.3		192.3		910.6		246.9	663.7	

"With Project":

Crop	Area (ha)	Production				Production Cost		Net Production Value (1000Rs)	Remarks
		Yield (T/ha)	Production (T)	Unit Price (Rs/T)	Value (1000Rs)	Unit Cost (Rs/ha)	Total Cost (1000Rs)		
1. Paddy (1st Crop)	42.4	5.0	212.0	4,736.0	1,004.0	5,760.0	244.2	759.8	
2. Ladies Finger (2nd Crop)	6.9	15.0	103.5	3,600.0	372.6	18,800.0	129.7	242.9	
Total	49.3		315.5		1,376.6		373.9	1,002.7	

Incremental Crop Benefits:

"With Project" NPV:	1,002.7
"Without Project" NPV:	663.7
Incremental Crop Benefits:	339.0
Value Added (5%) :	50.1
IncrementalTotal:	389.1

Table 8.8.1 Possible Environmental Impacts for Siruvalai Tank Area

A : Significant environmental impact is unquestionably induced by the Project
B : Significant environmental impact is likely to be induced by the Project
C : There is no environmental impact likely to be induced by the Project
D : Not known or there likely to be no impact

Categories of Environmental Impact	Evaluation A	B	C	D	Evaluation Base
1. Planned residential settlement			x		No plan
2. Involuntary resettlement			x		No plan
3. Substantial changes in the way of life			x		Not expected
4. Conflict among communities and people		x			Conflict in water distribution may arise
5. Negative impact on native people			x		Positive impact by improvement of socio-economic conditions
6. Population increase			x		Not expected
7. Drastic change in population composition			x		Not expected
8. Changes in bases of economic activities			x		Not expected
9. Occupational change and loss of job opportunities			x		Positive impact by increase of seasonal employment in agriculture
10. Increase in income disparities			x		Not expected
11. Adjustment & regulation of water or fishing (repairing) rights		x			Establishment of WUAs needs new water sharing adjustment
12. Changes in social and institutional structures		x			Establishment of WUAs impacts on traditional community
13. Changes in existing institutions and customs		x			Traditional water sharing needs to be modernized
14. Increased use of agrochemicals				x	Agrochamicals application may increase under expansion of irrigated agriculture
15. Outbreak of endemic diseases			x		Not expected
16. Spreading of epidemic diseases			x		Not expected
17. Residual toxicity of agrochemicals			x		Not expected
18. Increase in domestic and other human wastes			x		Not expected
19. Impairment of historic remains and cultural assets			x		Not found in the area
20. Damage to aesthetic sites			x		Not expected
21. Impairment of buried assets			x		Not found in the area
22. Changes in vegetation			x		Not expected
23. Negative impact on important or indigenous fauna and flora				x	Peacocks may be living in and around tank area
24. Degradation of ecosystems with biological diversity			x		Not expected
25. Proliferation of exotic and/or hazardous species			x		Not expected
26. Destruction of wetlands and peatlands			x		No wetlands and peatlands in the area
27. Decrease of tropical rain forests and wildlands			x		No tropical rain forests in the area
28. Destruction or degradation of mangrove			x		No mangrove forests in the area
29. Degradation of coral reefs			x		No coral reefs in the area
30. Soil erosion			x		Not expected
31. Soil salinization		x			Introduction of saline groundwater use may lead to soil salinization
32. Deterioration of soil fertility			x		Not expected
33. Soil contamination by agrochemicals and others				x	Intensive/improper application of agrochemicals may lead to soil
34. Devastation or desertification of land			x		Not expected
35. Devastation of hinterland			x		Not expected
36. Ground subsidence			x		Not expected
37. Change in surface water hydrology			x		Not expected
38. Change in ground water hydrology		x			Large scale development may lower the water table
39. Inundation and flooding			x		Not expected
40. Sedimentation			x		Not expected
41. Riverbed degradation			x		Not expected
42. Impediment of inland navigation			x		Not expected
43. Water contamination and deterioration of water quality				x	Excess use of agrochemicals may lead to water contamination
44. Water eutrophication			x		Not expected
45. Sea water intrusion			x		Not expected
46. Change in temperature of water			x		Not expected
47. Air pollution			x		Not expected

Table 8.8.2 Environmental Impacts (Irrigation) for Siruvalai Tank Area

	Check Items	Major	Small	None	Not Clear	Problems	Action and Countermeasures Planned	Remarks
Pollution	1. Air Pollution caused by spraying of agricultural chemicals			x		Not expected		
	2. Effect on aquatic organisms, fisheries, and other water utilization of change in the water system resulting from project construction			x		Not expected		
	3. Water pollution caused by effluent from irrigated fields		x x		x	1. Excess and improper use of agrochemicals may lead to soil and water contamination. 2. Large scale groundwater development will lower water table. 3. Saline groundwater irrigation will cause soil salinization but not serious.	1. Farmers training on proper use of agrochemicals is extended. 2. Appropriate development scale is planned with careful hydrological study. 3. Cropping pattern is carefully planned.	
Natural Environment	1. Effect of construction and operation of the facilities on the ecology				x	1. Peacocks nests may be destroyed during rehabilitation works.	1. Safety shall be provided specially in breeding season during implementation stage.	
	2. Effect on landscape			x		Not expected		
Human Environment	1. Effect of the project on historical and cultural heritage			x		Not found in the project area		
	2. Effect on existing infrastructure			x		Not expected		
	3. Relocation and effect on land-use			x		Not expected		
	4. Effect on other water use				x	1. Introduction of WUA may cause increase of friction and conflict on water sharing in the community.	1. Appropriate procedure is taken in preparation stage through farmers participation.	
Others	1. Effect on the environment during construction period			x		Not expected		
	2. Environmental Monitoring		x			1 Present monitoring activities are not sufficient.	1. Monitoring shall be conducted by relevant agencies.	

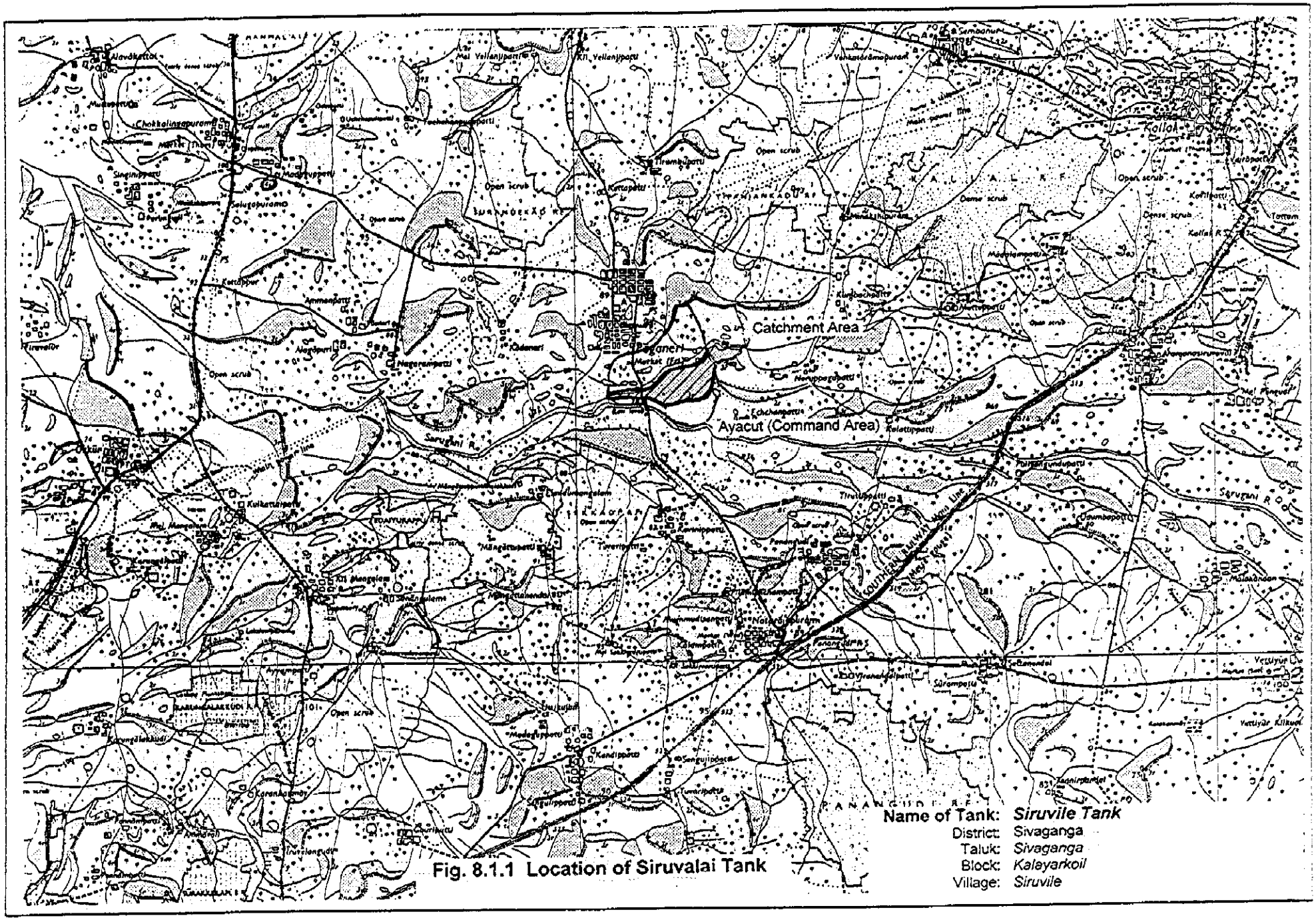


Fig. 8.1.1 Location of Siruvalai Tank

1 Name of Tank	SiruvalaiTank
2 Ayacut Area	49.3 ha
3 Main Soil	Black soil: 60%,Red Sandysoil: 40%
4 Water pH,EC	pH: Tank- -, Groundwater 8.0, EC: Tank- - , Groundwater 2.48 dS/m
5 No. of Farm Houscholds	106 farm households
6 Self-Support Amount of Rice	212tons (106 x 2,000 kg/Household)
7 Geographical Irrigable Area	Normal year: 49.3 ha
8 Total Irrigable Area and Month by Tank	Normal year:53.9ha(Aug-Dec)
9 No of Wells and Irrigable Area	0
10 Average Rainfall(mm)	

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
20.5	12.8	18.4	53.5	59.9	34.0	73.7	80.2	102.7	169.6	142.3	74.9	850.4

11 Cropping

1) Irrigable area and Period

Tank(53.9 ha)

2) Present Cropping Pattern

Paddy(49.3ha)

3) Cropping Plan

a) Paddy Area for Self-Support

42.4 ha (212 tons/5ton, Expected yield: 5ton/ha)

b) Cropping Plan

Paddy(42.4 ha)

Ledies' Finger(6.9ha)

c) Evaluation

	Crop Intensity(%)	Net Income(1000Rs)
Plan	100.0	867.8
Present	100.0	384.5
Plan/Present	1.00	2.26

Fig. 8.4.1 Cropping Plan in Sirvalai Tank Area

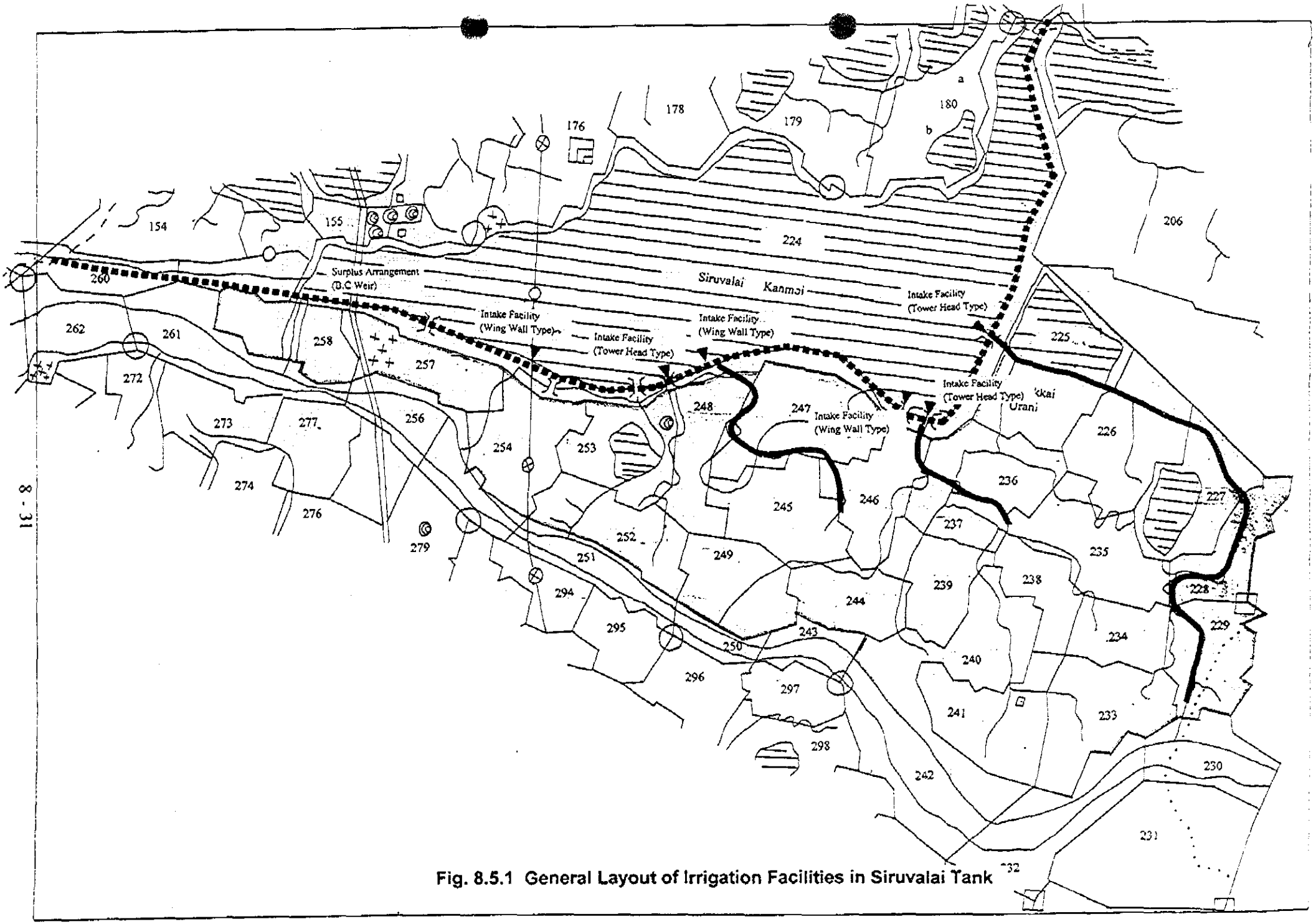


Fig. 8.5.1 General Layout of Irrigation Facilities in Siruvalai Tank