CHAPTER 9 A. RAMALINGAPURAM TANK AREA

9.1 General

9.1.1 Location

Ammapatti Ramalingapuram Tank (hereinafter referred to as "A.Ramalingapuram Tank") which has a registered command area 75.6 ha is located about three (3) km north to Sattur along the Sattur - Madurai road as shown in Fig. 9.1.1. The tank is located east of the Southern Railway Line adjacent to it. Administratively it belongs to Ammapatti Ramalingapuram Village in Sattur Taluk of Virudhunagar District.

The village area is surrounded by Veppilaippatti and Sandaiyur villages in its north side, Goluvarpatti village in its east side, Alampatti and Kattalampatti villages in south side, and E. Muttulingapuram village in its west side.

9.1.2 Topography

A.Ramalingapuram Tank is located three (3) km north of Sattur. Its waterspread area expanding between existing village road and the railway is measured as 0.13 km^2. The ayacut areas of 75.6 ha expand in the eastern area to the tank. The catchment area of the tank expands in the western areas of the tank.

The bund of about 3.0 km runs from north to south along the eastern edge of the tank. There is a surplus arrangements on the eastern side of the bund at the site of old river course, and the surplus water flows eastward along the river course. A supply channel is provided in the western side of the tank to draw water from the upstream tanks.

Two (2) unpaved village roads are available running in parallel from north to south connecting the village with Sattur Town. The residential areas of the village are located mainly along the road running east side.

The ayacut areas are generally flat mildly sloping towards the east, and the earthen channels run generally eastward. There are two (2) wells in the ayacut areas to take domestic and irrigation water.

9.1.3 Geology

The geological formations met in this area are mainly characterized by the archean crystalline rocks of charnockites and gneisses. In a few places granitic gneisses are also occur as basement. These formations are covered by a thin top soil, mostly a mixture of sand and clay. The basement granitic rock are intruded by dykes and veins of pegmatites. The basement granitic rock are fratuared and fissured upto the depth of about 35 m.

9.1.4 Soils

The type of soil is mainly black silt in the catchment and black clay in the ayacut area. Both of them are a little alkaline but not saline.

9.1.5 Vegetation

Most parts of the catchment are covered by the natural forest-specie of *Prosopis Juliflora Ipomia Cornia*. Tank bed plantation of acacia species under the social forestry program is found in the whole waterspread area. *Prosopis Juliflora* and *Ipomia Cornia* are also found in the tank bed area.

9.1.6 Objectives

A.Ramalingapuram Tank is categorized as a SR-1, which belongs to the Southern Study Area (agro-climatic zone III) which has an annual rainfall of less than 1,000 mm, and an average cultivation area of more than 75 % of registered ayacut area. But the ratio between free catchment area and registered ayacut is more than 5.0, which is more than the required ratio to cultivate all ayacut under a irrigation efficiency of 60 %. This means that water resources are rather rich on its surface and groundwater.

The Tank Baseline Survey, tanks in Sivakasi Panchayat Union show that about 40 % of the years have surplus water, and average cultivation ratio is about 58 %.

Objectives of A.Ramalingapuram 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.

9.2 Meteo-hydrology

9.2.1 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, A.Ramalingapuram Tank belongs to the same Southern agro-climatic zone, the climatological data of Kavalur Meteorological Station represents this tank also. The coordinates and the climatological parameters are presented in Section 8.2.1.

9.2.2 Rainfall

The rainfall in the catchment area of the 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 Sattur Rainfall Station, maintained by the

Revenue Department is used. The mean monthly rainfall data of this station of the last 60 years are estimated as follows:

Mean Monthly Rainfall of A.Ramalingapuram Tank Catchment Area

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	21.4	20.9	29.1	61.7	55.8	10.7	26.7	49.3	71.8	161.6	154.1	55.3	718.4
Maximum	211.8	215.4	135.6	210.3	192.8	81.6	198.0	269.5	299.0	467.4	582.0	262.2	1,123.2
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.0	4.1	0.0	401.8

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

- South West Monsoon (June-September):	159.1 mm	(22.1 %)
- North East Monsoon (October-December):	370.4 mm	(51.5 %)
- Winter (January - February):	43.0 mm	(6.0 %)
- Summer (March - May):	146.8 mm	(20.4 %)
- Total:	719.4 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 161.6 mm in October, and the minimum rainfall 10.7 mm in June. The annual maximum rainfall of 1,123.2 mm occurred during 1958 while the minimum of 401.8 mm occurred in the year 1976.

9.2.3 Catchment Area

A.Ramalingapuram Tank is a non-system tank located in the Vaippar River basin. In preparation for the field visits a 1:50,000 map of the tank was obtained which permitted an assessment of catchment and command area. A.Ramalingapuram Tank receives its runoff water from its free basin of 6.34 km^2 and an intercepted catchment of 146.34 km^2 hence the total catchment (free + intercepted) is 152.68 km2 and the equivalent catchment (free + $1/10^{th}$ of intercepted) is 20.974 km^2. As per the PWD norms, the catchment is classified as "average" having gentle slope and moderate vegetation and the irrigation source is designated as III (average). The registered ayacut of this tank is 76.55 ha, and hence the ratio between free catchment and Registered ayacut is 8.28. During the field visit, it was observed that lower portion of the waterspread area close to surplus weir was covered with hytal plants while the upper waterspread area is planted with juliflora. Since its construction in 1974, according to the farmers and officials of the PWD, the tank bed has silted at a rate of nearly 4 cm/year.

9.2.4 Hydrological Analysis

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

Yield and Runoff from the Catchment area of A.Ramalingapuram Tank

Year	September-December			January - December		
	RF(cm)	Yield(cm)	Runoff (Mm^3)	RF (cm)	Yield(cm)	Runoff (Mm^3)
1980	80.0	17.0	3.576	102.2	28.4	5.960
1981	60.7	9.0	1.884	75.5	15.1	3.169
1982	59.2	8.6	1.799	82.4	18.3	3.836
1983	36.7	2.5	0.523	48.6	5.4	1.142
1984	56.2	7.4	1.555	95.9	25.7	5.392
1985	29.3	0.2	0.043	54.9	6.6	1.381
1986	27.9	1.3	0.263	47.6	5.0	1.048
1987	52.3	6.3	1.316	66.4	11.2	2.339
1988	20.2	0.4	0.076	70.0	12.6	2.641
1989	48.7	5.4	1.123	80.0	17.0	3.574
1990	61.9	9.3	1.946	97.8	26.9	5.639
1991	30.0	1.4	0.295	43.6	0.4	0.082
1992	39.9	3.1	0.660	59.1	8.6	1.796
1993	61.6	9.9	2.067	89.3	21.0	4.403
1994	38.7	2.8	0.592	60.5	8.9	1.877
1995	15.7	0.1	0.017	44.3	4.0	0.846
Mean	44.9	5.3	1.109	69.9	13.4	2.820
Max	80.0	17.0	3.576	102.2	28.4	5.960
Minim	15.7	0.1	0.017	43.6	0.4	0.082

During 1980 - 1995, the average annual yield was 13.4 cm with a maximum of 28.4 cm in 1980 and 0.4 cm in 1991. The corresponding values of estimated annual runoff from the equivalent catchment area are 2.82 Mm^3, 5.960 Mm^3 and 0.082 Mm^3. The monsoonal (September - December) yield and runoff values also have been estimated and are presented in the table. The 16 year average monsoonal yield was 5.3 cm and that of runoff from the equivalent catchment was 1.109 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 runoff values vary from 1.631 Mm^3 to 7.223 Mm^3, with 10 year average value of 4.523 Mm^3 and a runoff ratio of 33 %. Similarly, during these years, seasonal (September - December) runoff vary from 0.916 Mm^3 to 5.438 Mm^3. The 10 year average monsoon runoff was 3.337 Mm^3 with a runoff ratio of 40 %.

9.3 Social Conditions

9.3.1 Present Social Conditions and Facilities

(1) Available Social Facilities in the Village

No piped drinking water supply system is provided in the village. About 75 % of the villagers take water from shallow wells, and about 25 % of them from deep wells. The water quality of these sources is considered to be good. Electricity supply system is provided for 85 % of the villagers.

There are two (2) primary schools (Grade 1 - 5) in the village, one is a private school. The other available public facilities are Health sub-center (HSC) and a community hall. There are village roads connecting to Sattur Town area, and bus services also available for Sattur.

(2) Social Settings of the Ayacut Area

1) Land Holding and Relating Villages or Hamlets

There are 49 farmers in the ayacut areas of A.Ramalingapuram Tank, and their average land holding size is calculated to be about 1.54 ha. About 96 % of the farmers are marginal and small farmers. The farmers in the ayacut areas live in A.Ramalingapuram and Kattalampatti villages. The most prevailing from holders are marginal farmers, sharing 82 %.

2) Caste Composition

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

Caste Composition in A.Ramalingapuram Tank Ayacut Area

(Unit: %)

Others	BC	MBC	SC	ST	Total
0	90	0	10	0	100

The most predominant caste category is BC composed mainly of the group of Reddiyar sharing as much as 90 % of the farmers in the ayacut area. The rest is SC composed of the group of Pariyan. Both practice Hinduism. The homogeneity of the farmers is considered high in this aspect.

3) Water Distribution and Decision Making Procedure

A.Ramalingapuram Tank was constructed in 1975, and thus there is no traditional water distribution system. Though there is no registered organization for distributing water in the ayacut area, an informal group of farmers consisting of selected five (5) members is formed, and they discuss on the water distribution and rotation during the irrigation season. In drought years some farmers may not be able to get irrigation water and to continue their cultivation. In such years they work in the match factories located near Sattur town.

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 tat the ail end reaches are apt to be left abandoned during the drought periods, and they have to work in the match factories in Sattur Town.

6) Other Employment Opportunity

The nearest town is Sattur located about three (3) km away from the village. Most of the farmers in the ayacut work in the match factories in Sattur Town during non-cultivation period as well.

9.3.2 Sociological Evaluation

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

Results of Social Scoring of A.Ramalingapuram Tank

Factors	Hamlets	Farm Size	Conflicts	WUA	Leader-ship	Resource Mobilization	Main-tenance	Overall Score
Scores	4	5	15	8	35	20	5	92

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

9.4 Agriculture

9.4.1 Present Agriculture

(1) Land Use

The registered command area is 76.5 ha of which the irrigable area is 66.0 ha (86.3 % of the command area). In 1995-96, only paddy was cropped in an area of 52.0 ha (68.0 % of the command area). In a normal year, paddy, pulses and cotton are cultivated in an area of 66.0 ha (86.3 %) in the rainy season, 3.5 ha (4.6 %) in the dry season and 1.2 ha (1.6 %) in the dry season, respectively. The total cropped area is 70.7 ha with a crop intensity of 92.4 %.

(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 but it is little alkaline. No saline soils are found in the ayacut area.

(3) Agricultural Production

1) Crop Production

In 1995-96, paddy was produced at a 157.0 tons level with varieties of IR-20 and CO-43 in the area. The average yield was 3,020 kg/ha. In a normal year, paddy, pulses and cotton are produced by 231.0 tons, 1.6 tons and 1.2 tons, respectively. The average yields are 3,500 kg/ha with varieties of IR-20 and CO4-3 in paddy, 450 kg/ha in green gram and 980 kg/ha in cotton.

2) Irrigation Water

Tank water is available during the period from the second week of October to the first week of December with an irrigable area of 66.0 ha in normal year. 18 wells are found with an irrigable area of 14 ha in a normal year.

3) Fertilizer Application

According to the data of farmers' interview survey, In 1995 - 1996, 81 kg/ha of N and 24 kg/ha of P_2O_5 and 3 kg/ha of K_2O was applied for the paddy. The amount of K_2O applied is remarkably low.

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 labour in the area is 2.2 men/house and the potential agricultural labor is 4.7 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 12 days when the potential labor is used. The labor requirements for vegetable, sugarcane and groundnut cultivation are around 4.3 timers, 2.3 times and 0.6 times of the paddy, respectively.

5) Livestock Breeding

18 heads of cattle, 342 heads of goat, 76 heads of sheep, 22 heads of sheep and 260 heads of chicken have been raised in this area. Cattle was raised as 1.6 heads on average by 22.4 % of the total farmers, goats were raised 2 heads on average by 77.6 % of the total farmers; sheep was raised as 5.5 heads on average by 8.2 % of the total farmers.

(4) Farm Size and Land Tenure

The number of farm holders in the area is 49 of which 4 % are farm holders of more

than 2 ha, 14 % are farm holders of 1.0 to 2.0 ha; and 82 % are farm holders of below 1 ha (marginal). The average farm size is 1.54 ha which is the largest among the Study Areas, and correspond to about 1.7 times of the state average and nearly the same as the national average.

9.4.2 Agricultural Development Plan

(1) Land Use

As shown in Table 3.4.1, paddy is grown in an area of 66.0 ha in the rainy season. Beside, ladies' finger and green gram are introduced in each of the area of 14.0 ha during the periods from February to May for ladies' finger and from May to August for green gram. Consequently, the crop intensity is increased by 30.5 points from 92.4 % in the present to 122.9 % in the plan.

(2) Farming and Cropping Plan

The cropping plan was made as shown in Fig. 9.4.1. In the plan, paddy is grown in an area of 66.0 ha which is the necessary area for securing of self-support amount of the area during the period from 1st of September to 16th of January using tank water. Beside, as a high return crop, ladies' finger is introduced in the area of 14.0 ha during the period from the 1st of February to 11th of May using well water and in the same field after harvesting the ladies' finger, green gram is introduced using well water.

(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 amounts to Rs.1,703,900 which correspond to 3.9 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 and green gram. The net incomes of ladies' finger and green gram correspond to 1.4 times and 0.3 times of the present total net income.

(4) Employment and Working Opportunity

The introduction of the ladies' finger and green gram for each 14.0 ha will bring certain increase in employment and working opportunity, especially for the women in the command area. These labor amounts required for the planned cropping are scattered over a year.

(5) Farm Management and Farm Budget

1) Farm Management Plan

For this tank area, due to its basic hydrological conditions, the chronical situation of no water in the dry season and the very unstable water supply even during the rainy season, are the utmost factors affecting the inferiority in annual agricultural productions. This tank area, therefore, even after the rehabilitation works, would be recommended for mainly cropping drought-resistant crops i.e. cotton, mulberry, cassava etc. other than mainly paddy as at present. The farmland used for cropping paddy should be minimized at appropriate areas only with the assured water supply and a proper soil. The application of integrated agriculture at each farm is also recommended to be established with related documents distributed to local farmers for making them understanding the situation for changing applied crops and obtaining knowledge on the integrated agriculture. Raising livestock such as goat is recommended to be largely practiced.

Apart from intensive rehabilitation works for collecting water into this tank and effectively discharging into subjected farms to be carried out in the Project framework, the management of water and soil as well as cares on crop growing conditions are to be recommended for a systematic application in large scale.

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 throughout the year
- Harvesting and marketing capabilities and proceedings
- Estimates on net farm revenues after deducting all production costs
- Estimates on the balance after deductingall family living expenses

2) Farm Budget Plan

The farm budget is recommended to be elaborated on the basis of crop budget analysis of possible crops to be introduced. The farm budgets for small and marginal farms, therefore, should be elaborated for a higher and stable net farm income based on the following items:

- A small portion i.e. approximately 1/3 of the whole farmland is to be used for for staple food crops (rice, millet etc.)
- The major portion of approximately 2/3 of the whole farmland is to be used for cash-crops of the highest marketability which are suitable for local cultivation conditions (cotton, groundnut etc.).

Besides, for improving the farm income, the integrated agriculture is strongly recommended for increasing farm revenues, particularly on the aspect of raising livestock such as chicken and goat at farm level (average 3 chickens and 1 goat per farm).

(6) Marketing Plan

Due to the rather remote location and the small scale agricultural production in this tank area, the supply of agricultural inputs is presently found in inferior conditions. The constant supply of agricultural inputs, particularly seeds and fertilizers, is recommended to be elaborated for always being available prior to the start of annual rain. Godowns for this purpose, therefore, are recommended to be established in the village with the management performed by the newly established farmers' organization.

Basic agro-processing treatment facilities (rice-mills, processed vegetable products, etc.) and shops for selling materials applied to the integrated agriculture are also recommended to be established at proper places in the village.

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

9.4.3 Agricultural Supporting Services and Institutional Plan

(Same as notified in this part for Echur Tank)

9.5 Rehabilitation of Tank Irrigation System

9.5.1 Present Conditions

(1) Irrigation and Drainage System

A.Ramalingapuram Tank was planned, designed and constructed by PWD about 15 years ago. The tank is constructed across the existing Uppodai Stream, which flows from near Narikkudi town to the Vaippar River through the Arjuna Nadi River. Upstream of the Uppodai Streamr, there are more than 6 similar tanks.

Southern Railway crossing the Uppodai Stream in the waterspread area of the tank,

therefore the high water level of the tank can not be more than the rail bed elevation. A district road connecting Sattur town and Ramalingapuram village runs along the tank bund as a distance about 150 m.

The longest channel of No.3 sluice runs eastwards with 1,050m length. There are 3 sluices, No. 1, 2 and 3 sluice irrigates 28.33, 16.0 and 32.22 ha , respectively.

One surplus weir is installed between No.1 and 2 sluice, the surplus channel, the Uppodai Stream, and the Vandakulam Supply Channel running along the southern border of ayacut are the main drainage channels of the ayacut.

(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 3.5.2. This bund varies its cross sectional dimensions such as slope and width in portion by potion and has cracks which are characteristics of the presence of Black Cotton Soil. Besides, soil erosion occurs in bund slope around facilities such as weir and head sluice.

(3) Spillway (Surplus Arrangement)

1) Location

One HC weir (high coefficient weir) is installed in this tank. Location of arrangement is shown in Fig. 9.5.1.

2) Existing Condition

This surplus facility was constructed in 1975 and still works properly. Steel gates for regulating the stored water are installed in this facilities, so that it can control excessive water.

(4) Intake Facilities (Sluices)

1) Location of the Sluices

Three (3) sluices are provided in this tank, and all of the sluices are of the Wing wall type. Location of these sluices are shown in Fig. 9.5.1.

2) Existing Condition

There are some damages and cracks on the top of the slab and wing wall of sluice No. 1. Countermeasures for lope erosion, siltation, utilization of barrel

vent is not available at present. Sluice 2 still works properly as intake facilities. Regarding sluice No. 3, some parts, such as the top of slab and wing wall, are damaged and show cracks. Since sill elevation was higher than the ayacut level when firstly constructed, additional barrel was installed under the original barrel. Then, sluice 3 is not stabilized considering the structure of the sluice.

3) Water Supply Control Device

During their construction, plug and plug rod type devices are installed for all sluices, these control devices are available only in sluice No. 2. There are no control devices for sluice No. 1 and 3.

(5) Groundwater Usage

There are only about 7 wells in the commend area, which are used for irrigation purposes.

9.5.2 Water Resources Development Plan

(1) Liability of Water

The Indian Meteorological Department's classification of drought based on the monsoon rainfall is given in Section 3.5.2. Following the same classification, the probability of availability of water for A.Ramalingapuram 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
Normal	3	60	5.0
Deficit	17	60	28.33
Scanty	40	60	66.67

Among the 60 years, 66.67 % of the years are classified as having scanty rainfall, followed by deficit rainfall 28.33 %, normal rainfall only 5.0 %, and no excess rainfall years. Apart from this, as mentioned in Section 3.5.2, for a five year return period (20 % of provability), the drought monsoon rainfall is estimated as 591.6 mm. The above facts and figures forces to develop drought management strategies similar to that of Siruvalai Tank.

(2) Water Quality

The water quality survey on pH and electrical conductivity in the tank area was conducted by the Study Team during the field inspection. According to these results, the tank stored water and groundwater in the ayacut shows pH 7.2 to 8.3 and EC between 1.5 and 2.1 dS/m, which means that the water in the area will have

moderate hazard of salinity for the crop cultivation and careful selection of crops having salinity tolerance shall be made.

(3) Irrigation Water Requirement

Like other pilot tank areas in the Southern Study Area, the major crop in A.Ramalingapuram Tank ayacut is paddy in a command area of 76.55 ha. The gross irrigation requirement for A.Ramalingapuram Tank command area is calculated to be 1.134 Mm^3 with present irrigation efficiency of 40 %. If this irrigation efficiency is increased to 75 % by rehabilitation measures such as field canal lining, provision diversion boxes and so on, the estimated gross irrigation requirements will decrease to 0.670 Mm^3, saving a net water quantity of 0.464 Mm^3. This saved water can be utilized to increase the tank irrigable area and also facilitates to grow other irrigable crops such as sugarcane, banana and so on. The fortnight crop water requirement area presented in Table 3.5.1.

(4) Water Balance

The capacity of A.Ramalingapuram Tank is determined as 0.639 Mm^3 by topographic survey. Based on daily rainfall for the years 1986 - 1995, runoff values were estimated by dry-damp-wet method and presented in 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 76.55 ha. With its available water resources, A.Ramalingapuram Tank could satisfy an average of 64% of the irrigation demands. With present conditions (Ef = 40%), the estimated irrigated area varies between a minimum of 2% to a maximum of 100% of the registerd ayacut, The runoff/irrigation ratio remains as 393%. 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 70% of the registered ayacut. Beside this, the runoff - irrigation ratio is increased to 668% and more surplus water (average 2.620 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 canal lining is desirable as a rehabilitation measure to increase the command area of A.Ramalingapuram Tank.

(5) Drainage Water Requirements

The drainage water requirements of A.Ramalingapuram Tank is calculated adopting procedures similar to that of Siruvalai Tank and the results are presented in Table 3.5.6. Using the Ryve's formula, the estimated maximum flood discharge is 173.02 m^3/s, while that using rational formula is 180.61 m^3/s. In deciding these two values, it becomes necessary to consider the seriousness of disaster/ inconvenience, type of surplus weir and the cost of construction.

(6) Basin Water Management

A.Ramalingapuram Tank was constructed in 1974 across the two supply channels Uppodai and Chinnavari. Before that, the present waterspread area was a barren land. It receives supply water from its free catchment, intercepted catchment comprising three tanks viz. Muthalannaickanpatti, Vetrilai Urain and Ottampatti tanks. The surplus water of A.Ramalingapuram Tank flows into Aalampatti tank. These tanks form a chain basin and this chain water management covers a large field encompassing many scientific and engineering disciplines such as hydrology, agricultural engineering and agronomy. From this tank, water is released either during the rainy season itself to protect the standing crop or if remaining storage permits to raise a second irrigated crop in the following months. Hence, there exists several factors (such as some ratios) that affect the irrigation or water management of this tank. These ratios are presented in Table 3.2.1 and summarized below for easy reference.

- Free catchment / command area 8.28
- Intercepted catchment / command area 189.56
- Waterspread area / command area 1.01
- Tank storage capacity / command area 0.008 Mm^3/ha
- Waterspread / Tank storage capacity 1.208 km^2/Mm^3

However, in this chain tank command area, irrigation also depends on available groundwater. The total groundwater recharge of Sattur Block to which, the A.Ramalingapuram Tank belongs was estimated to be 5,979 ha-m Utilizable recharge is 5,082 ha-m, Net Ground water draft is 1,917 ha-m and the balance available is 3,165 ha-m. This remaining 62.3 % of unexploited groundwater resources can supplement tank water in this chain cascade.

The total surface water resources can not be utilized due to certain limitations, as outlined for Siruvalai Tank. The potentials and strategies available to strengthen the hydrological relationships among A.Ramalingapuram chain tank are similar to that as briefed in Section 3.5.2 such as formation of multi-tier farmers association, encouraging participatory approach and NGO involvement.

(7) Groundwater Development

As the groundwater is under utilized in this region more number of deep bore wells can be drilled. The deep wells has to be located in region where more prominent fractured zones are present.

9.5.3 Tank Irrigation Facilities Rehabilitation Works

General layout of irrigation facilities is shown in Fig. 9.5.1, and required item for rehabilitation works are described in the table below.

Countermeasures for Rehabilitation of A. Ramalingapuram Tank

Component	Rehabilitation works	Section for Rehabilitation Works	
Tank Bund Improvement (Total bund length 2,016m)	• Strengthening of the bund for reshaping to standard size • Protection of bund using rough stone..	1,940m	
Intake works (Sluice)	• Modification of intake system using gearing shutter/rod • Protection of back-fill for side slope.	Wing wall type	3 units
Surplus arrangement	-	-	-
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.	1,930m as main	3 units
Building for Farmers' Association	• Provision of community hall for WUA, local farmers and inhabitation.	50m²	1 No.
Community well	• Provision for irrigation as supplemental use		2 Nos

9.6 Farmers' Organization

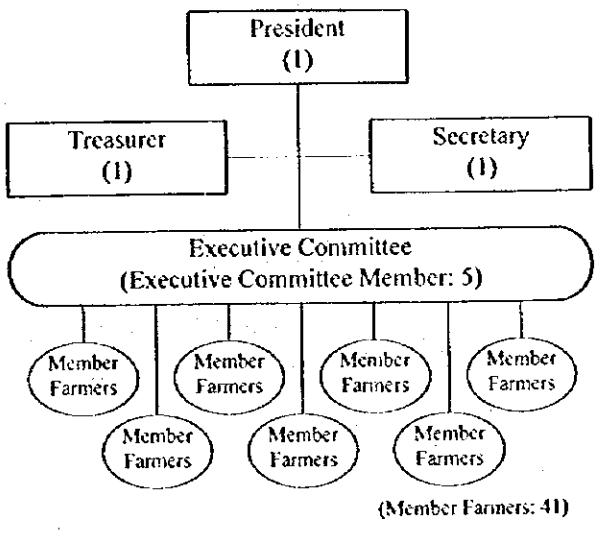
9.6.1 Present Situations of Farmers' Organization

There is no such registered organization as water users' association in the ayacut area as described in Sub-chapter 9.3.1. They have their informal society for water distribution.

9.6.2 Proposed Farmers' Organization

(1) Water Users' Association

Since there are 49 farmers in the ayacut areas, the number of the Executive Committee Members are five (5) and the number of member farmers are 41 deducting the number of office bearers from the total farmers. The functions of the proposed WUA for the Echur Tank are described in Sub-section 4.3.4 of the Report Volume II.



PROPOSED ORGANIZATION FOR WATER USERS' ASSOCIATION OF A. RAMALINGAPURAM 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 A.Ramalingapuram 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

9.7 Project Evaluation

9.7.1 Project Costs and Benefits

(1) Project Costs

Unit cost for rehabilitation works are estimated based on *the Standard schedule of Rates for Kamarajar and Ramanathapuram Districts* issued by PWD. At the 1997 price level, direct construction cost is estimated at about Rs.3,759,000, as shown in the table.

Direct Construction Cost for A. Ramalingapuram Tank

Description	Total Cost (Rs.)	Percentage	Unit Rates (Ayacut 76.53ha) (Rs./ha)
Tank Bund Improvements	1,869,000	49.72%	24,422
Sluices Improvement	126,000	3.35%	1,646
Surplus Improvement	-	0.00%	-
Tank Supply Channel Improvement	-	0.00%	-
Selective lining for Field Channel & OFD	1,284,000	32.83%	16,124
Building for Farmers' Association	130,000	3.46%	1,699
Community Well	400,000	10.64%	5,227
Direct Construction Cost	3,759,000	100.00%	

The Project cost consisting of direct cost, supervision charges, contingencies, preparation work cost and overhead charges is Rs.5,520,000.

Project Cost for Rehabilitation Works in A.Ramalingapuram Tank

Description	Total Cost (Rs.)
Direct Construction Cost	3,759,000
Petty Supervision Charges & Contingencies	602,000
Preparation Cost (Govt. Share)	55,000
Overhead Charges	1,104,000
Total	5,520,000

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 is mainly aims at stabilizing the agricultural production through the year in the relatively medium command area of 75.6 ha by improving water supply from tank and the introduction of proper agricultural production techniques for better farming system for higher farm revenues to improve basic living conditions of small and marginal farms after the rehabilitation works.

At present, though the whole command area is dominantly cropped with paddy for the first crop, the cultivated area for the second crop is almost let in fallow condition from May to July due to the main factor of insufficient water supply for the second crop.

With the Project implementation, major benefits of the Project, therefore, will be 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. The net production value of agriculture will be increased from a present Rs.0.77 million to approximately Rs.1.78 million, making an annual incremental benefit of approximately Rs. 1.0 million, or 2.3 times (Table 9.7.1).

Besides, with the establishment of various facilities for organizing farm management and improving treatments on storing, marketing etc., a value-added estimated at Rs. 0.09 million as 5 % of the mentioned agricultural production value "with Project" would be obtained accordingly. 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 will only make a profit margin of average 5 % higher than selling at farm sites during harvesting periods.

9.7.2 Economic Evaluation

The economic evaluation is made to judge the project viability in terms of direct contribution to the national economy. The Project covers a command area of 75.6 ha with a total number of 49 farms as beneficiaries.

For the economic analysis, the related EIRRs for A.Ramalingapuram Tank area are as follows:

i) EIRR in basic conditions : 14.7 %
ii) EIRR at 10% cost-increase: 12.9 %

iii) EIRR at 10% benefit-decrease: 12.6 %
iv) EIRR at 3-year benefit delay: 9.2 %

From these figures, the EIRR in basic conditions of 14.7 % shows the Project viability. the risk case of 3-year delay of benefits showed the lowest EIRR of 9.2 %.

9.7.3 Financial Evaluation

In this Project, the financial evaluation is made mainly for 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.8,951
- "With Project" Net Income per Farm: Rs.34,773
- "With Project" Value Add per Farm: Rs.1,739
- Incremental Net Farm Income: Rs.27,561

With the project implementation, a considerable increase in annual net farm income for an average farm will be approximately Rs.27,600. This amount would largely improve the living conditions of farmers in this tank area.

However, in order to achieve these figures, proper supports on technical aspects as well as more investments in farm inputs should be made with an annual increase of average Rs.5,000 for a small farm and Rs.2,500 for a marginal farm. This should be made in a new scheme of financial support for these farm categories in the newly established farmers' organization.

9.7.4 Labor Force Requirement

Monthly labour force requirement for the planned cropping schedule are shown in Table 3.7.3. The peak of labor requirement in the area comes in September with the requirement of 4,744 man-day/month. To meet this labour amount, 21 days in staggering period is needed with the potential family labor of 230 man-day in the area.

9.7.5 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 budget of the representative farm, an incremental benefit of about Rs.25,800 in agricultural production and a value added of about Rs.1,700 for a total amount of Rs.27,500 would be obtained annually per farm. This comes about resulted from better conditions on water supply and supporting institutions for agricultural production, and, per consequent, small and marginal farms in this tank area would improve largely their farm budgets and basic living standards.

Even for landless farmers, apart from the proposed work scheme for landless people in the farmers' organization as mentioned above, they would obtain more labor 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.

9.8 Environmental Issues

9.8.1 Present Environmental Conditions

(1) Health and Sanitary Conditions

Major diseases in this area are diarrhea/ADD, dysentery, common fever and eye disease. there is rare case of tuberculosis and skin disease. In relation to irrigation and drainage, neither waterborne nor mosquito-related diseases occur.

(2) Natural Environment

The tank area is generally a flat land. Catchment area is either natural forest or waste land. Tank bed plantation of acacia species under the social forestry program is found in the waterspread area. Wildlife seen by the villagers is only peacocks.

(3) Surface Water and Groundwater

Quality of tank water is good and there is no water contamination by agrochemicals. Present groundwater utilization is minimal as only one private open well is in use. There is another open well but only for emergency use due to high salinity.

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

9.8.2 Environmental Impact of The Project

As summarized in Table 9.8.1 and Table 9.8.2, the environmental impact study for A.Ramalingapuram 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

There is no habitat of important fauna and flora in the area except peacocks to be protected. Therefore, the same impact and measures to safeguard the wildlife as stated in Section 8.8 for Siruvalai Tank area shall be considered.

2) Soil and Land Resources

Since groundwater is highly saline, the groundwater development for irrigation will induce significant soil salinization.

3) Hydrology and Quality of Water

Groundwater with EC value of 1.6 to 6.9 dS/m is unsuitable for irrigation. But, groundwater in this area will still have development potential. Likely serious problems induced by the groundwater development will be the salinization of soil and the deterioration of soil fertility. Since the groundwater data available are not sufficient, further investigation is required.

9.8.3 Recommendations

As a result of the environmental impact study described above, it can be concluded that the Project, except groundwater component, will not induce any serious direct negative environmental impact. The groundwater development may induce significant impact on soils. In addition to that, some indirect impacts may arise. 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 no groundwater development be planned.

Table 9.7.1 Calculation of Crop Economic Benefits for A. Ramalingapuram 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)	66.00	3.50	231.0	4,736.0	1,094.0	5,008.0	330.5	763.5	
2. Cotton (2nd Crop)	1.20	0.98	1.2	12,000.0	14.1	7,400.0	8.9	5.2	
3. Greengram (2nd Crop)	3.50	0.45	1.6	9,600.0	15.1	3,800.0	13.3	1.8	
Total	70.70		233.8		1,123.2		352.7	770.5	

"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)	66.00	5.00	330.0	4,736.0	1,562.9	5,760.0	380.2	1,182.7	
2. Ladies Finger (2nd Crop)	14.00	15.00	210.0	3,600.0	756.0	18,800.0	263.2	492.8	
3. Greengram (3rd Crop)	14.00	1.20	16.8	9,600.0	161.3	4,400.0	61.6	99.7	
Total	94.00		556.8		2,480.2		705.0	1,775.2	

Incremental Crop Benefits:

"With Project" NPV:	1,775.2
"Without Project" NPV:	770.5
Incremental Crop Benefits:	1,004.7
Value Added (5%) :	88.8
IncrementalTotal:	1,093.4

Table 9.8.1 Possible Environmental Impacts for A. Ramalingapuram 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	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			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			Increase of saline groundwater use may enhance soil salinization
32. Deterioration of soil fertility		x			Increase of saline groundwater use may decrease soil fertility
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 9.8.2 Environmental Impacts (Irrigation) for A. Ramalingapuram 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. High saline groundwater will not be utilized.	
Natural Environment	1. Effect on construction and operation of the facilities on the ecology				x	1. Peacocks nests may be destroyed during rehabilitation works.	1. Safeguard 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.	

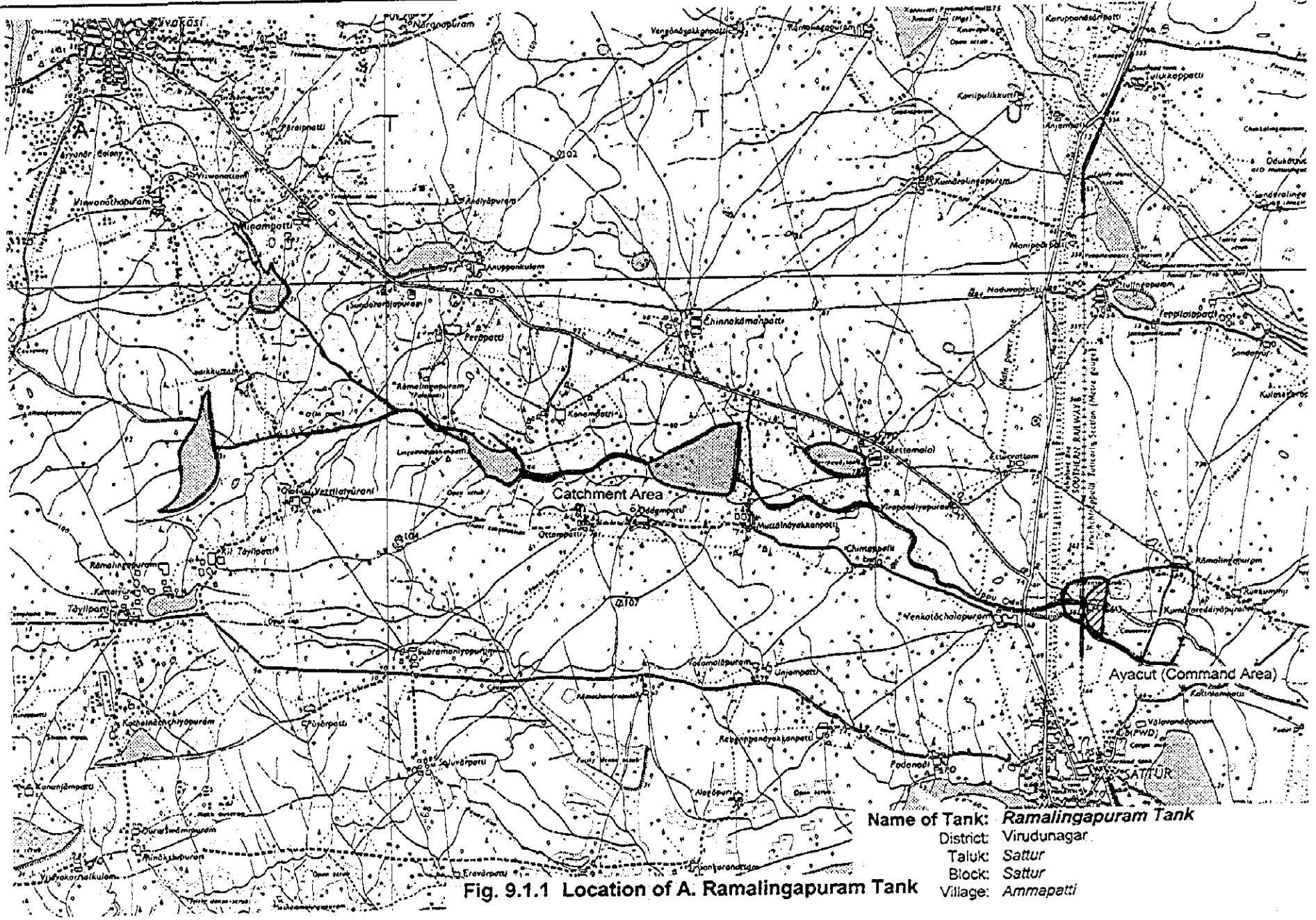


Fig. 9.1.1 Location of A. Ramalingapuram Tank

1 Name of Tank	A.Ramalingapuram Tank
2 Ayacut Area	76.5 ha
3 Main Soil	Black soil: 100 %
4 Water pH,EC	pH:Tank water 8.7,Groundwater 8.1 to 8.4, EC: Tank water 0.382 dS/m, Groundwater 0.487 to 6.92 dS/m
5 No. of Farm Households	49 farm households
6 Self-Support Amount of Rice	98 tons (49 x 2,000 kg/Household)
7 Geographical Irrigable Area	66.0 ha
8 Total Irrigable Area and Month by Tank	Normal year.66.0 ha(Oct-Dec), Drought year: 52.0 ha(Oct-Dec)
9 No. of Wells and Irrigable Area	18 wells, 14.0 ha
0 Average Rainfall(mm)	

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
40.6	3.7	4.2	12.2	38.6	96.4	61.8	77.2	157.9	197.9	232.6	80.6	1,003.7

1 Cropping 1) Irrigable Area and Period	Tank(66.0 ha) Well(14.0 ha)
2) Present Cropping Pattern	Paddy(66.0 ha) Paddy(66.0 ha) Green gram(3.5ha) Cotton(1.2ha)
3) Cropping Plan a) Paddy Area for Self-Support	19.6 ha(98 t/5t)
b) Cropping Plan	Paddy(66.0 ha) Ledies' Finger(14 Green gram(14.0 ha)
c) Evaluation	

	Crop Intensity(%)	Net Income(1000Rs)
Plan	122.9	1,704
Present	92.4	438.6
Plan/Presen	1.33	3.88

Fig. 9.4.1 Cropping Plan in A.Ramalingapuram Tank Area

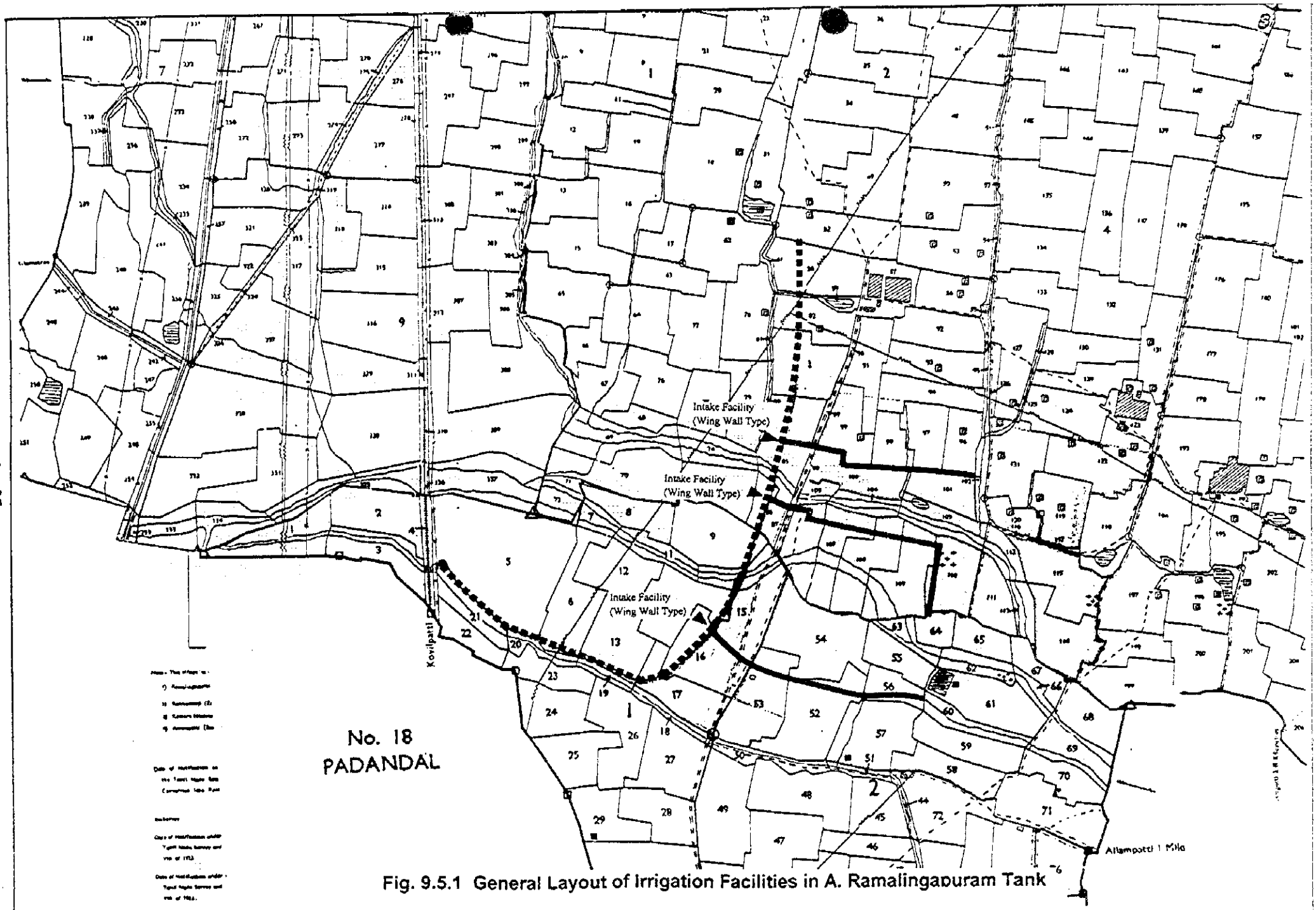


Fig. 9.5.1 General Layout of Irrigation Facilities in A. Ramalingapuram Tank

CHAPTER 10 : PANDIKANMOI TANK AREA

CHAPTER 10 PANDIKANMOI TANK AREA

10.1 General

10.1.1 Location

The Pandikanmoi Tank, with a registered command area of 41.9 ha is located about two (2) km southwest to Pandikanmoi Railway Station as shown in Fig. 10.1.1. Pandikanmoi Village to which the tank belongs is located about two (2) km away from the Madurai - Ramanathapuram road. Administratively it belongs to Pandikanmoi Village in Paramakudi Taluk of Ramanathapuram District.

Pandikanmoi Village has its territory as a long and slim strip laying from northwest to southeast. The village area is surrounded by Karungulam Kalaiyur, Kalayur and Manjur villages in its north side, Kumukkettai Village in its north and east sides, Mudukulattur taluk in its south side, and Pettanendal and Venkattankuruchchi villages in its west side. The tank is located around the center of the territory, south of Manjur Village.

10.1.2 Topography

The waterspread area of Pandikanmoi Tank is measured to be 0.45 km^2, and it lays from north to south with a narrow and long strip. The ayacut areas of 41.9 ha expand in the eastern area to the tank. The catchment area of the tank expands in the western areas of the tank.

The bund of about 3.0 km runs from north to south along the eastern edge of the tank. There is a surplus arrangements on the southern end of the bund. Dense social forests are developed in the waterspread area.

The residential area of the village is located at the northeastern corner of the ayacut area. A paved road is availble near the residential area of the village from the Madurai - Ramanathapuram road as well as the Pandikanmoi Railway Station.

The ayacut areas are generally flat with mild slope toward east, and the earthen channels run generally eastward. There are two (2) wells in the ayacut areas to take domestic and irrigation water.

10.1.3 Geology

This region is covered by thick alluvial formations. The alluvial formations are characterised by the mixture of clay and sand in various proportions. The clay lenses are extending to larger area in few places.

10.1.4 Soils

The type of soil is mainly black sandy loam which requires a little bit high infiltratrion rate both in the catchment and ayacut area.

10.1.5 Vegetation

The vegetation in the catchment is found only in waste land. Trees found in the waste land area are *Prosopis Juliflora* and acacia species. Tank bed area is covered by thick natural *Prosopis Juliflora* trees.

10.1.6 Objectives

Pandikanmoi Tank is categorized as a SP-4, which belongs to the Southern Study Area (agro-climatic zone III) or annual rainfall less than 1,000 mm, and having an average cultivation area of less than 75 % of the registered ayacut area.

The Baseline Survey of tanks in Bogalur Panchayat Union shows that about 60% of years have surplus water, and average cultivation ratio is about 60 %.

Objectives of Pandikanmoi Tank rehabilitation program are 1) maximize the tank water instead of groundwater, 2) distribute tank water evenly through the physical tank facility rehabilitation and channel lining.

10.2 Meteo-hydrology

10.2.1 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, Pandikanmai, Tank area belongs to the same Southern agro-climatic zone, the climatological data of Kavalur Meteorological Station represents Pandikanmai Tank also. The monthly average climatological parameters of the Kavalur Meteorological Station are already presented in Section 8.2.1.

10.2.2 Rainfall

The rainfall in the catchment area of the tank varies with the seasons and it receives considerable rainfall both in Southwest and Northeast monsoon. For all rainfall computations, data recorded at the nearest Paramakudi Rainfall Station, maintained by the Revenue Department is used. The mean monthly rainfall of this station of the last 60 years are shown in the following table:

Mean Monthly Rainfall of the Pandikanmai Tank Catchment Area

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	24.0	19.2	24.3	55.0	36.2	20.2	38.2	59.2	63.3	150.8	149.0	82.1	718.9
Maximum	216.0	191.0	146.0	271.8	116.0	110.0	210.0	217.0	194.2	454.9	397.3	403.6	1,484.8
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	7.9	0.0	370.3

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

- South-West Monsoon (June-September): 180.9 mm (25.1 %)
- North-East Monsoon (October-December): 381.9 mm (52.9 %)
- Winter (January - February): 43.1 mm (6.0 %)
- Summer (March - May): 115.5 mm (16.0 %)
- Total: 718.9 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 150.8 mm in October, and the minimum rainfall 19.2 mm in June. The annual maximum rainfall of 1,484.8 mm occurred during 1947 while the minimum was 370.3 mm occurred in the year of 1985.

10.2.3 Catchment Area

Pandikanmai Tank is a non-system tank located in the lower 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. Pandikanmai Tank receives its runoff water only from its free basin of 2.6 km^2. Since it is an isolated tank, the total catchment (free + intercepted) and the equivalent catchment (free + 1/5th of intercepted) is one and the same i.e. 2.6 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 41.88 ha, and hence the ratio between free catchment and Registered ayacut is 6.21.

10.2.4 Hydrological Analysis

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

During 1980 - 1995, the average annual yield was 12.9 cm with a maximum of 31.5 cm in 1984 and a minimum of 0.5 cm in 1994. The corresponding values of estimated annual runoff from the catchment area are 33.505 Mm^3, 81.799 Mm^3 and 1.216 Mm^3 respectively. The monsoon (September - December) yield and runoff values also have been estimated and are presented in the table. The 15 year average monsoon yield was

4.6 cm and that of runoff from the catchment was 11.886 Mm^3. In an average the monsoonal yield accounts for nearly 36 % of the total annual yield.

Yield and Runoff from the Catchment Area of Pandikanmai Tank

Year	September - December			January - December		
	Rainfall (cm)	Yield (cm)	Runoff (Mm^3)	Rainfall (cm)	Yield (cm)	Runoff (Mm^3)
1980	60.0	8.7	22.620	86.4	20.3	52.790
1981	34.0	2.0	5.299	51.9	6.1	15.908
1982	33.9	2.0	5.200	78.1	16.4	42.659
1983	38.1	2.7	7.134	43.1	3.9	10.095
1984	50.4	5.8	15.079	104.9	31.5	81.799
1985	18.3	0.2	0.476	37.0	2.6	6.739
1986	20.4	0.4	1.059	43.9	4.0	10.503
1987	33.6	1.7	4.545	48.8	5.4	13.957
1988	23.1	0.6	1.622	59.4	8.6	22.394
1989	53.2	6.5	17.020	83.5	18.8	48.871
1990	44.5	4.2	10.982	83.9	19.2	49.978
1991	54.4	7.1	18.394	73.4	14.2	36.827
1992	53.4	6.9	18.049	78.9	17.2	44.732
1993	89.7	22.2	57.826	103.8	30.9	80.409
1994	32.1	1.8	4.763	46.8	0.5	1.216
1995	21.3	0.0	0.111	52.9	6.6	17.199
Mean	41.3	4.6	11.886	67.3	12.9	33.505
Maximum	89.7	22.2	57.826	104.9	31.5	81.799
Minimum	18.3	0.0	0.111	37.0	0.5	1.216

The runoff calculated based on the daily rainfall data based for the years 1986 - 1995 using dry-damp-wet method is presented in Table 3.5.4 and 3.5.5. The annual total runoff vary from 0.267 Mm^3 to 1.22 Mm^3, with a 10 year average value of 0.593 Mm^3. The average runoff ratio calculated for this period is 32 %. Similarly, the estimated runoff values for the monsoon months (October-January), during these years ranged from 0.0436 Mm^3 to 1.163 Mm^3. The average seasonal runoff value for this 10 period is 0.493 Mm^3, with a runoff ratio of 42 %.

10.3 Social Conditions

10.3.1 Present Social Conditions and Facilities

(1) Available Social Facilities in the Village

About 50 % of villagers use a piped drinking water supply system, while the rest of the villagers take water from open wells. The water quality of the groundwater source is considered saline. The electricity supply system is provided for 75 % of villagers.

There are a primary school (Grade 1 - 5) and a community hall in the village. The other public facilities are not available.

(2) Social Settings of the Ayacut Area

1) Land Holding and Relating Villages or Hamlets

There are 110 farmers in the ayacut areas of Pandikanmoi Tank, and their average land holding size is calculated to be about 0.38 ha. About 95 % of the farmers are marginal and small farmers. All the farmers in the ayacut areas live in Pandikanmoi Village. The most prevailing land holding categoriy is the marginal farmers representing 68 %.

2) Caste Composition

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

Caste Composition in Pandikanmoi Tank Ayacut Area

(Unit: %)

Others	BC	MBC	SC	ST	Total
0	65	0	35	0	100

The most predominant caste category is BC composed mainly of the groups of Agamudaiyar and Nadar representing as much as 65 % of the farmers in the ayacut area. The rest is SC composed of the group of Adidravida. Both practice Hinduism.

3) Water Distribution and Decision Making Procedure

There is no registered organization for distributing water in the ayacut area. However, they have an informal village society among the villagers. Regular (monthly) meetings are held to discuss on villagers' welfare and water distributions. The present village president takes leadership role of the society.

In the irrigation season, three (3) persons called *Neerpaichi* are selected among non-farmer group of families to control the water distribution. They carry out water distribution with the instructions of the village president. The farmers in the ayacut areas pay with paddy in accordance with their 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 and the simple maintenance works such as removal of weeds and desilting on individual basis.

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 tail at the end portions are apt to be left abandoned during the drought periods, and they have to work in the near town as construction laborers.

6) Other Employment Opportunity

The nearest town is Paramakudi located about 12 km away from the village. Most of the farmers in the ayacut work as construction laborers.

10.3.2 Sociological Evaluation

Based on the criteria described in Section 3.3.2, the sociological conditions of Pandikanmoi Tank ayacut are evaluated as stated below.

Results of Social Scoring of Pandikanmoi Tank

Factors	Hamlets	Farm Size	Conflicts	WUA	Leader-ship	Resource Mobilization	Main-tenance	Overall Score
Scores	5	5	15	8	30	20	5	93

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

10.4 Agriculture

10.4.1 Present Agriculture

(1) Land Use

The registered command area is 41.9 ha of which irrigable area is 40.6 ha (96.9 % of the command area). In 1995-96, only paddy was cropped in the rainy season in an area of 40.6 ha (96.9 % of the command area). In a normal year, paddy, chili and cotton are cultivated in an area of 40.6 ha (96.9 %) in the rainy season, 2.0 ha (4.8 %) in the dry season and 2.5 ha (5.9 %) in the dry season, respectively. The total cropped area is 45.1 ha with a crop intensity of 107.6 %.

(2) Soil and Land Capability

The type of soil in the ayacut area is mainly black sandy loam with a little bit high infiltration rate. No saline soils are found in the ayacut area.

(3) Agricultural Production

1) Crop Production

In 1995-96, paddy was produced at a level of 56.8 tons using varieties of ADT-36 and IR-36. The average yield was 1,400 kg/ha. In the area, generally, due to shortage of the irrigation water, paddy is sown directly in the field under dry conditions with varieties of ADT-36 and IR-36 and is grown under submerged condition by irrigation of tank water after 20th November.

In a normal year, paddy, chili and cotton are produced at a level of 96.9 tons, 4.8 tons and 6.0 tons. The average yields are 2,000 kg/ha for paddy, 635 kg/ha for dry chili and 560 kg/ha for cotton.

2) Irrigation Water

Tank water is available during the period from the 4th week of October to the 1st week of January with a irrigable area of 40.6 ha in a normal year. There are no wells in the area because of the salinity of the groundwater.

3) 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 3.0 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 4 days 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.

4) Livestock Breeding

50 heads of cattle, 39 heads of goat have been raised in this area. The cattle was raised by 4.2 heads as an average by 10.9 % of the total farmers.

(4) Farm Size and Land Tenure

The number of farm holders in the area is 110 of which 5 % is farm holders of more than 2 ha, 27 % are farm holders of 1 to 2 ha; and 68 % are farm holders of below 1 ha (marginal). The average farm size is 0.38 ha which corresponds to 41 % of the state average and 24.3 % of the national average.

10.4.2 Agricultural Development Plan

(1) Land Use

In the plan, paddy is grown in an area of 40.6 ha (96.9 % of the command area) in the rainy season. Beside, cotton, black gram and green gram are introduced in the dry season under rainfed condition for each area of 10.0 ha (each 23.9 %). Consequently, the crop intensity increases 60.9 points from 107.6 % in the present to 168.5 % in the plan (Table 3.4.1).

(2) Farming and Cropping Plan

The cropping plan was made as shown in Fig. 10.4.1. In the plan, paddy is grown in an area of 40.6 ha which is the necessary area for securing enough amount for self-support in the area, during the period from 1st of October to 16th of February using paddy varieties of AD-T36 and IR-36. Beside, cotton (varieties: MC-47, LRA-5166), black gram (C-5, KM-2) and green gram (ADT-2, KM-2) are introduced under rainfed condition during the period from February to May/June.

(3) Crop Budget and Production Plan

The planned production amounts, the production costs and the net incomes of the area are shown in Table 3.4.2. The total net income amounts to Rs. 483,000 of which the paddy, the cotton, the black gram and the green gram share 76.5 %, 0.5 %, 11.7 % and 11.3 %. However, the net incomes to be obtained by the cotton, black gram and green gram will be changed by the rainfall condition. The present net income in the area is Rs.-74,500 because of the low yields caused by the drought.

(4) Employment and Working Opportunity

The introduction of cotton, black gram and green gram in the dry season will bring certain increase in employment and working opportunity, especially for the women. These labor amounts required are scattered in the 2 seasons.

(5) Farm Management and Farm Budget

1) Farm Management

For this tank area, apart from its severe hydrological conditions for no tank water in the dry season and the very unstable water supply even in the rainy season, saline problems of soil and groundwater are the utmost factors affecting the inferiority in average annual agricultural production.

This tank area, therefore, even after the rehabilitation works, would be recommended for mainly saline resistant crops i.e. mulberry, cassava etc. The

farmland used for cropping paddy should be limited to areas where the water supply and proper soil are available. The application of integrated agriculture at each farm is also recommended to be established with related documents distributed to local farmers for making them understanding the situation for changing applied crops and obtaining knowledge on the integrated agriculture.

Apart from intensive rehabilitation works for collecting water into this tank and effectively discharging into subjected farms to be carried out in the Project framework, the management of controlling saline problems from water and soil as well as cares on the projected crops are to be recommended for a systematic application in this tank area.

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 deducting all production costs
- Estimates on the balance after deducting all family living expenses

This will be done on the basis of combining evaluation for balancing the weights of all these elements to determine a proper farm management plan. For each year, this work will be renewed as per an annual cycle to check the results from the previous year and to identify the recent changes in each element for making proper measures to the new management plan.

2) Farm Budget Plan

In this tank area, due to insufficient water supply for agriculture, most small and marginal farmers are engaged as coolies and in charcoal production in nearby places which contribute largely to their family expenses.

The farm budget is recommended to be elaborated on the basis of crop budget analysis for possible saline resistant crops to be introduced. The farm budgets for small and marginal farms, therefore, should be elaborated for a higher and stable net farm income based on the following items:

- Only the proper farmland portion on soil and water to be used for paddy cultivation
- The major portion of the whole farmland to be used for cropping saline resistant crops .

Besides, for improving the farm income, the integrated agriculture is strongly recommended for increasing farm revenues, particularly on the aspect of aquaculture (average one installation for 10 farms) and raising livestock such as chicken and goat at farm basis (average 3 chickens and 1 goat per farm).

Also for the purpose of improving the farm budgets of small, marginal and landless farmers in this tank area, the introduction of some specific cottage industries for the villagers i.e. making of brick, charcoal etc, if no damages to the environment, is recommended to be promoted in the scheme of village cooperatives for job creation and, per consequence, for obtaining a higher income.

(6) Marketing Plan

Due to the rather remote location and the very small scale of agricultural production for this tank area, the marketing plan would be limited to recommend establishing some new shops in the village for selling basic agricultural inputs and daily goods to local inhabitants. Only basic post-harvest treatment facilities i.e. drying yard (1 unit) and godown (1 unit) are also recommended to be established at proper places in the village.

Besides, at least one transport van is subjected to be equipped for quick transportation of agricultural inputs and produces between the village and district markets.

10.4.3 Agricultural Supporting Services and Institutional Plan

(Same as notified in this part for Echur Tank)

10.5 Rehabilitation of Tank Irrigation System

10.5.1 Present Conditions

(1) Irrigation and Drainage System

Pandikanmoi Tank starts at the south of Manjur Tank bund, and extended about 3 km to the southwest with arch.

There are three sluices, No. 1, 2 and 3 sluices, which irrigate 14.16, 18.21 and 9.51

ha, respectively. No. 1 and 2 sluices are located within a 60 m distance. About 9 ha of cultivated area between No. 2 and 3 sluice is elevated land, therefore, no tank water is available for irrigation.

One well for irrigation is reported in the Tank Inventory List of PWD. Bit due to the scarcity of tank water, now, several wells were drilled in the command area of the No. 1 sluice.

At the southern end of the tank bund, surplus arrangement is installed. It is a natural earthen bye-wash weir with a length of 40 m. The surplus water enters to the adjacent Ilandaikkulam Tank. The tail water in the irrigation channel of No. 1 and 2 sluices flows into the Pallapullan Tank.

(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 to this tank bund except for cracks characterized of the presence of Black Cotton Soil on the top surface of the bund. Soil erosion occurs around intake facilities as well as another tank.

(3) Spillway (Surplus Arrangement)

1) Location

Natural bye-wash type weir by cutting the bund is installed at the end of the tank bund. Location of this weir is shown in Fig. 10.5.1.

2) Existing Condition

Natural bye-wash weir has a simple structure by a cut opening in tank bund and it is easy to carry out maintenance. However, crest level is not conformed to full tank level (F.T.L.). It is necessary to confirm the crest level based on leveling for design stored water.

(4) Intake Facilities (Sluices)

1) Location

There are three (3) sluices served by this tank. These sluices are of the Wing wall type according to depth of stored water in the tank. Location of these sluices are shown in Fig. 10.5.1.

2) Existing Condition

Reinforced concrete pipe rolled barrel is installed for all sluices, the size of the barrel is reduced to a minimum size of 60 cm (2 feet) for maintenance purposes.

Concerning present conditions, although there are some cracks and damages in the wing wall and slab, these damages do not disturb the function of the intake works.

3) Water Control Device

Plug and plug rod type are supposed to be installed in all sluices, however, there is no plug in all sluices at present.

(5) Groundwater Usage

Only 3 hand pumps and one bore well is present in the command area of this tank. Out of these four wells no one is used for irrigation purposes. Irrigation requirement completely depends on tank water. Depth of these wells range from 36 to 40 m. Groundwater quality in this region is comparatively bad and it is not suitable for drinking.

10.5.2 Water Resources Development Plan

(1) Reliability of Water

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

Liability of Water Based on Rainfall

Classification	No. of Years	Total No. of Years	Probability (%)
Excess	6	60	10.0
Normal	22	60	36.7
Deficit	21	60	35.0
Scanty	11	60	18.3

Among the 60 years 36.67 % of the years are classified as having normal rainfall, followed by deficit rainfall 35.0 %, scanty rainfall 18.3 %, and there was only 6 excess rainfall years accounting for 10.0 % excess rainfall years. 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 monsoon rainfall is estimated as 863.9 mm. Hence, it becomes more important to develop drought management strategies similar to that of Siruvalai Tank.

(2) Water Quality

Based on the field measurement of the Study Team, the water quality of stored water measured by its pH and EC showed 0.07 and 0.73 dS/m which indicates no salinity hazard will be expected for the crop cultivation. Groundwater (deep well) indicates pH 7.3 and EC more than 4.5 dS/m. The EC groundwater in shallow wells is better than deep wells with a EC at about 1.1 dS/m. The use of groundwater for the irrigation shall be carefully monitored.

(3) Irrigation Water Requirement

The major crop in the 41.88 ha of Pandikanmoi Tank command area is paddy rice. The fortnightly irrigation water requirement are calculated as outlined in Section 3.5.2 and the comprehensive results are presented in Table 3.5.3. Present gross irrigation requirement for Pandikanmoi Tank area at 45 % irrigation efficiency is 0.945 Mm^3. With an increased irrigation efficiency of 75 % by canal lining, the gross irrigation requirement will be reduced to 0.567 Mm^3, thus saving of 0.378 Mm^3. This saved water can be used to irrigate more command area and lessening the dependability of groundwater resources.

(4) Water Balance

The capacity of Pandikanmoi Tank is determined as 0.382 Mm^3, through topographic survey. Based on the daily rainfall for the years 1986 - 1995, runoff values were estimated using the dry - damp - wet method. After subtracting the irrigation demand and the evaporation losses, changes in tank storage were calculated and the results are summarized in Table 3.5.4 and 3.5.5. As per the annual data, among the nine years, surplus occurred only in 10 years accounting for 22.2 % of total years, with the present irrigation efficiency of 40 %. Estimated irrigation area fluctuated between none to 100 % with an average value of 40 % of the registered ayacut of 41.88 ha. This situation could be improved by increasing the irrigation efficiency to 75 % by canal lining and reducing the irrigation water requirements. By this change, the tank could be able to irrigate in an average of 58 % of the registered ayacut. With canal lining, runoff - ratio could be increased to 104 % from the present value of 62 %. Spill out years also could be increased from the present nil to one, benefiting the down stream tanks. Data based on the monsoon rainfall (October - January) also showed the same trend. Near 100 % ayacut irrigation is possible only in three out of nine years, even after canal lining. Hence it becomes necessary to increase the command area, by increasing the storage capacity of tank through desiltation.

(5) Drainage Water Requirements

The drainage water requirement of Pandikanmoi Tank was calculated adopting the procedures as outlined in Section 3.5.2 and presented in Table 3.5.5. Using the

Ryve's formula, the estimated discharge is 14.20 m^3/s while that using rational formula is 21.67 m^3/s. Hence a safe design discharge of 21.67 m^3/s can be adopted for designing surplus arrangements. However, before deciding so, it is necessary to consider the severity of local loss or inconvenience due to disaster, type of surplus weir and cost of rehabilitation.

(6) Basin Water Management

Pandikanmoi Tank is an isolated tank with a free catchment of 2.6 km^2. As presented in Table 3.2.1, various tank basin ratios were calculated and summarized here.

- Catchment / command area 6.21
- Water spread area / command area 0.98
- Storage capacity / command area 0.009 Mm^3/ha
- Water spread / Storage capacity 1.076 km^2/Mm^3

These ratios indicate the shallow storage and suggests for policy implications on deepening the tank by way of desiliting which could increase the command area by:

- Increasing the Storage Capacity of the tank
- Vegetative method of soil and water conservation system such as use of grasses for controlling the soil erosion in catchment areas of tanks that have proved cheaper and more effective when implemented correctly. This system will go a long way in reducing siltation of tanks to great extent and to increase their life.
- Reducing the evaporation losses by larger surface area exposed to sun. As Evaporation has disastrous effects in hot dry climate zone because they account for nearly 10 - 15%.

The surface water resources of Pandikanmoi Tank basin consists of direct runoff from rainfall and flow in streams and occasionally from nearby Manjur Tank. However, irrigation also generally depends on available tank water and groundwater. The total groundwater recharge of Paramakudi Block to which, Pandikanmoi Tank belongs, was estimated to be 1,948 ha m. Utilizable recharge is 1,656 ha m; net groundwater draft is 60 ha m and the balance available is 1,596 ha m. This 81.9 % of the not yet exploited groundwater resources, can supplement the tank water in irrigating the command area in this tank cascade. The total surface water resources can not be utilized due to topographical constraints which compels to develop certain management strategies as outlined for chain tank such as Sirvalai Tank.

10.5.3 Tank Irrigation Facilities Rehabilitation Works

General layout of irrigation facilities is shown in Fig. 10.5.1, and required item for rehabilitation works are described in the table.

Countermeasures for Rehabilitation of Pandikanmoi Tank

Component	Rehabilitation works	Section for Rehabilitation works	
Tank Bund Improvement (Total bund length 2,855m)	• Strengthening of the bund for reshaping to standard size.	2855m	
Intake works (Sluice)	• Modification for intake system using gearing shutter • Protection of back-fill for side slope.	Wing wall type	3 units
Surplus arrangement	• -	-	-
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.	1,550m as main	3 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

10.6 Farmers' Organization

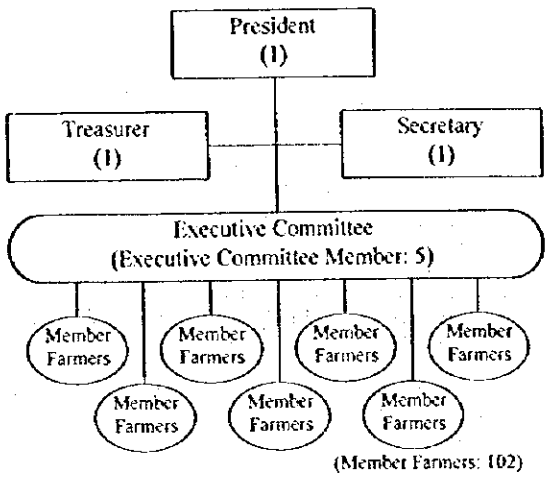
10.6.1 Present Situations of Farmers' Organization

There is no such registered organization as water users' association in the ayacut area as described in Sub-chapter 10.3.1. They have their informal society for water distribution.

10.6.2 Proposed Farmers' Organization

(1) Water Users' Association

Since there are 110 farmers in the ayacut areas, the number of the Executive Committee Members are five (5) and the number of member farmers are 102 deducting the number of office bearers from the total farmers. The functions of the proposed WUA for Pandikanmoi Tank are described in Sub-section 4.3.4 of the Report Volume II.



PROPOSED ORGANIZATION FOR WATER USERS' ASSOCIATION OF PANDIKANMOI TANK

(2) Farmers' Organization for Agricultural Production

As explained in Sub-section 4.4 of Volume II of the Report, the sections which have the following functions are proposed to be attached to the WUA in Pandikanmoi 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

10.7 Project Evaluation

10.7.1 Project Costs and Benefits

(1) Project Costs

Unit cost for rehabilitation works are estimated based on the *Standard schedule of Rates for Kamarajar and Ramanathapuram Districts* issued by PWD. At the 1997 price level, direct construction cost is estimated at about Rs. 1,797,000, as shown in the table.

Direct Construction Cost for Pandikanmoi Tank

Description	Total Cost (Rs.)	Percentage	Unit Rates (Ayacut 41.88ha) (Rs./ha)
Tank Bund Improvements	131,000	7.29%	3,128
Sluices Improvement	145,000	8.07%	3,462
Surplus Improvement	-	0.00%	-
Tank Supply Channel Improvement	-	0.00%	-
Selective lining for Field Channel & OFD	991,000	55.15%	23,663
Building for Farmers' Association	130,000	7.23%	3,104
Community Well	400,000	22.26%	9,551
Direct Construction Cost	1,797,000	100.00%	

The Project cost consisting of direct cost, supervision charges, contingencies, preparation work cost and overhead charges is Rs.2,638,000.

Project Cost for Rehabilitation Works in Pandikanmoi Tank

Description	Total Cost (Rs.)
Direct Construction Cost	1,797,000
Petty Supervision Charges & Contingencies	288,000
Preparatio Cost (Govt. Share)	25,000
Overhead Charges	528,000
Total	2,638,000

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 throughout the year in a small command area of about 42 ha by improving water supply from the tank and the introduction of proper agricultural production techniques for better farming system for higher farm revenues to improve living conditions of small and marginal farmers in this tank area after the rehabilitation works.

At present, though the whole command area is completely cropped with paddy as the first crop, but the cultivated area for the second crop starting from January to April has been taking place only in a small part of the whole command area due to lack of water supply from the tank. The command area is almost let in fallow condition from May to July. Besides, due to the main factor of very unstable water supply in the first crop, the average unit yield of the first paddy crop is observed at a very low level, about 2.0 ton per ha.

With the Project implementation, major benefits of the Project, therefore, will be economically 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 of the net production value of agriculture from the present at Rs.0.172 million to Rs.0.605 million, or about 3.5 times (Table 10.7.1).

Besides, with the establishment of various facilities for organizing farm management and improving treatments on storing, marketing etc., an estimate of value-added of approximately Rs.0.03 million as 5 % of the corresponding agricultural production value "with Project" would be obtained accordingly. 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 average 5 % higher than selling at farm sites during harvesting periods.

10.7.2 Economic Evaluation

The economic evaluation is made to judge the project viability in terms of direct contribution to the national economy. The Project covers a command area of 41.9 ha with a total number of 110 farms as beneficiaries.

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

i) EIRR under basic conditions : 12.3 %

ii) EIRR at 10% cost-increase: 10.6 %
iii) EIRR at 10% benefit-decrease: 9.7 %
iv) EIRR at 3-year benefit delay: 7.7 %

From these figures, the EIRR under basic conditions of 12.3 % shows a medium figure in the national economic point of view. Meanwhile, the risk case of 3-year delay of benefits showed the lowest EIRR of 7.7 %.

10.7.3 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.0
- "With Project" Net Income per Farm: Rs.4,391
- "With Project" Value Added per Farm: Rs.220
- Incremental Net Farm Income: Rs.5,288

With the project implementation, small and marginal farms can improve largely their farm incomes. The increase in annual net farm income of an average farm will be approximately Rs.5,300.

However, in order to achieve these figures, proper supports on technical aspects as well as more investments in farm inputs should be made with an annual increase of average Rs.5,000 for a small farm and average Rs.2,500 for a marginal farm. This should be made in a new scheme of financial support for these farm categories in the newly established Local Farmers' Organization.

10.7.4 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 February with the requirement of 3,613 man-day/ month. To meet this labor amount, 7 days in staggering period is needed with the potential family labor of 572 man-day in the area.

10.7.5 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, under the present conditions of inferior production proceedings, both small and marginal farms are generally faced with a deficit situation resulted from a low on-farm income versus a constant expenditure for family living.

With the Project implementation for better conditions on water supply and supporting

institutions for agricultural production, the small and marginal farms would adjust the present deficit situation of farm budgets for improving their basic living standards.

An incremental farm benefit of Rs.4,400 and a value added of about Rs.220 for a total of Rs.4,620 would be obtained annually by an average farm in this tank area. This limited amount, however, is considered just for improving their basic living conditions. Due to the limited average farm size of 0.38 ha for this tank area, in order to raise considerably their living standards, they should engaged largely in off-farm activities.

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

10.8 Environmental Issues

10.8.1 Present Environmental Conditions

(1) Health and Sanitary Conditions

Major diseases in this area are bronchitis, diarrhea/ADD, typoid, malaria, hepatitis, common fever and tuberculosis. In relation to irrigation and drainage, malaria, one of three major mosquito-related diseases in Tamil Nadu, occurs.

(2) Natural Environment

The Project Area is generally flat land. Catchment area is either cultivated land or waste land. Tank bed area is covered by thick natural *Prosopis Juliflora* trees. Wildlife seen by the villagers are peacocks and foxes.

(3) Surface Water and Groundwater

Quality of tank water will be good and there is no water contamination by agrochemical, according to the villagers. Present groundwater utilization is minimal as only two private boreholes are found in the ayacut. One is in use and another is not due to high salinity of water.

From the results of the water quality measurement, it can be stated that the groundwater will have significant salinity problems for irrigation. Deep borehole water shows relatively higher EC value than shallow well water. This could be due to sea water intrusion. However, further detailed survey may be desired to clarify the groundwater development potentiality.

10.8.2 Environmental Impact of the Project

As summarized in Table 10.8.1 and Table 10.8.2, the environmental impact study for Pandikanmoi 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 agrochemicals will be increased in the future.

For rural health and diseases, since the area is affected by malaria, mosquito-related disease, proper water management and adequate drainage shall be planned.

(2) Natural Environmental Impact

1) Biological and Ecological Issues

There is no habitat of important fauna and flora in the area except peacocks to be protected. Therefore, the same impact and measures to safeguard the wildlife as stated in Section 8.8 for Siruvalai Tank area shall be considered.

2) Soil and Land Resources

Since groundwater is highly saline, the groundwater development for irrigation will induce significant soil salinization.

3) Hydrology and Quality of Water

Deep groundwater with EC value of 4.6 to 5.3 dS/m is unsuitable for irrigation but groundwater in this area will have development potential. Likely significant problems induced by the groundwater development will be the salinization of soil and the deterioration of soil fertility. In addition to the above, lowering the groundwater table may lead to sea water intrusion in this area. Since the groundwater data available are not sufficient, further investigation is required.

10.8.3 Recommendations

As a result of the environmental impact study described above, it can be concluded that the Project, except groundwater component, will not induce any serious direct negative environmental impact. The groundwater development may induce significant negative impact on soils. In addition to that, some indirect impacts may arise. 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 expansion of the irrigation practice, it is recommended that proper water management and adequate drainage shall be provided and spread of malaria be monitored.

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

v) For the groundwater development for irrigation, it is recommended that no groundwater development be planned.

Table 10.7.1 Calculation of Crop Economic Benefits for Pandikanmoi Tank

"Without Project":

Crop	Area	Production				Production Cost		Net Production Value	Remarks
		Yield	Production	Unit Price	Value	Unit Cost	Total Cost		
	(ha)	(T/ha)	(T)	(Rs/T)	(1000Rs)	(Rs/ha)	(1000Rs)	(1000Rs)	
1. Paddy (1st Crop)	40.6	2.000	81.2	4,736.0	384.6	5,008.0	203.3	181.2	
2. Cotton (2nd Crop)	2.5	0.560	1.4	12,000.0	16.8	7,400.0	18.5	-1.7	
3. Chilli (1 year)	2.0	0.635	1.3	20,000.0	25.4	16,000.0	32.0	-6.6	
Total	45.1		83.9		426.8		253.8	172.9	

"With Project":

Crop	Area	Production				Production Cost		Net Production Value	Remarks
		Yield	Production	Unit Price	Value	Unit Cost	Total Cost		
	(ha)	(T/ha)	(T)	(Rs/T)	(1000Rs)	(Rs/ha)	(1000Rs)	(1000Rs)	
1. Paddy (1st Crop)	40.6	4.000	162.4	4,736.0	769.1	5,760.0	233.9	535.3	
2. Cotton (2nd Crop)	10.0	0.725	7.3	12,000.0	87.0	8,500.0	85.0	2.0	
3. Blackgram (2nd Crop)	10.0	0.700	7.0	11,200.0	78.4	4,400.0	44.0	34.4	
4. Greengram (2nd Crop	10.0	0.800	8.0	9,600.0	76.8	4,400.0	44.0	32.8	
Total	70.6		184.7		1,011.3		406.9	604.5	

Incremental Crop Benefits:

"With Project" NPV:	604.5
"Without Project" NPV:	172.9
Incremental Crop Benefits:	431.5
Value Added (5%) :	30.2
Incremental Crop Benefits:	461.8

Table 10.8.1 Possible Environmental Impacts for Pandikanmoi 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	Expansion of irrigation favours spread of malaria
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			Increase of saline groundwater use may enhance soil salinization
32. Deterioration of soil fertility		x			Increase of saline groundwater use may decrease soil fertility
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	Over-pumping of groundwater with deep boreholes development may enhance sea water intrusion.
46. Change in temperature of water			x		Not expected
47. Air pollution			x		Not expected

Table 10.8.2 Environmental Impacts (Irrigation) for Pandikanmoi 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. High saline groundwater will not be utilized.	
Natural Environment	1. Effect on construction and operation of the facilities on the ecology				x	1. Peacocks nests may be destroyed during rehabilitation works.	1. Safeguard 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.	
					x	2. Expansion of irrigation water use may cause increase of malaria.	2. Proper water management and drainage system are provided.	
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.	

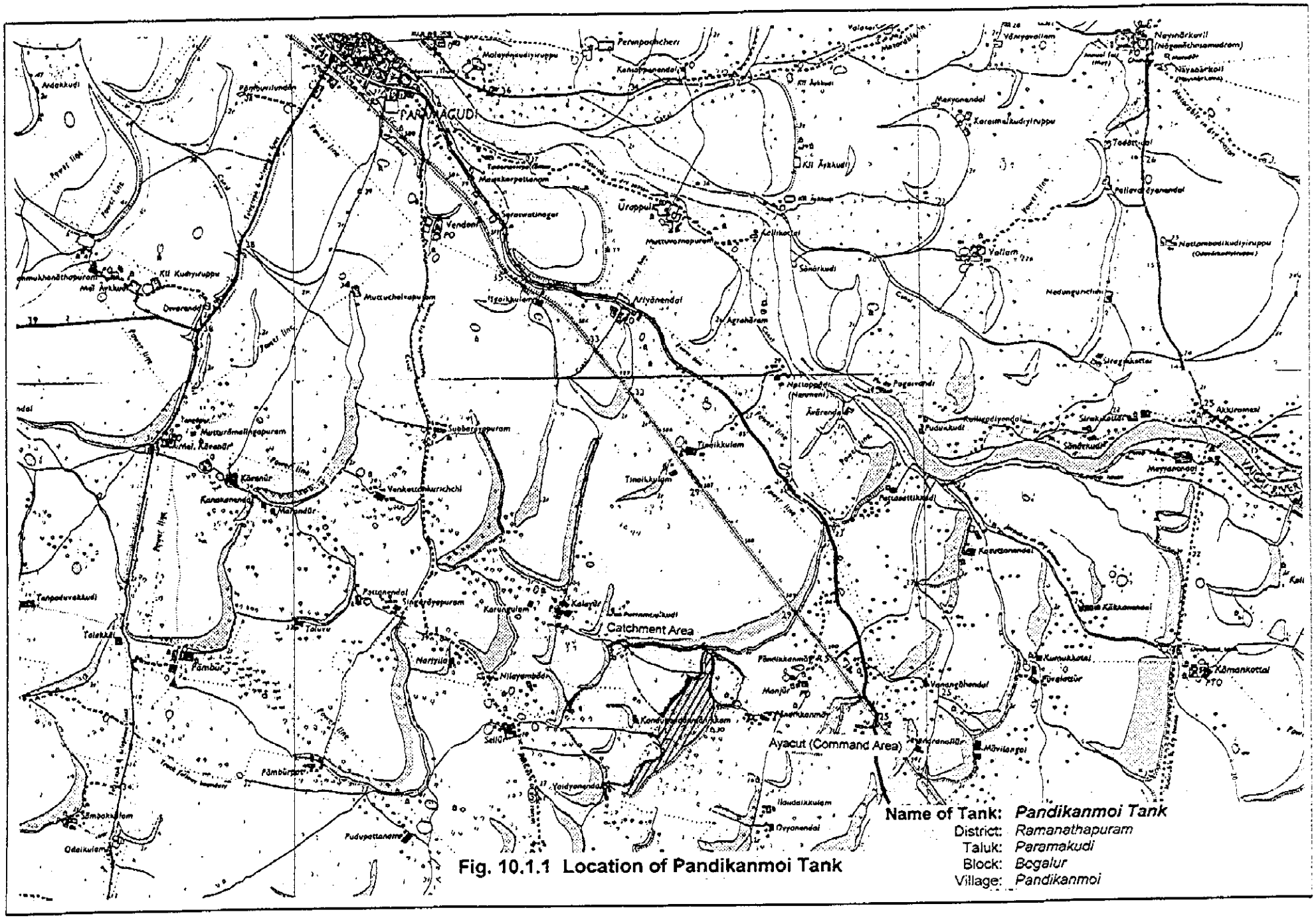


Fig. 10.1.1 Location of Pandikanmoi Tank

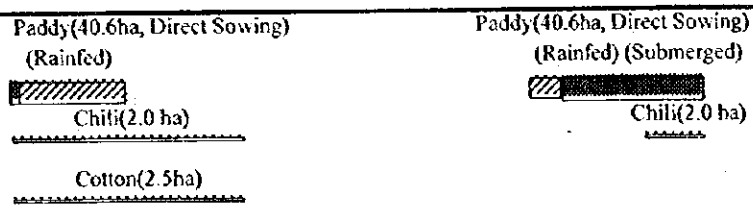
1 Name of Tank	Pandikanmoi Tank
2 Ayacut Area	41.9 ha
3 Main Soil	Black soil(Clay loam): 65%, Red Sandysoil: 35%
4 Water pH,EC	pH: Tank water- -, Groundwater 7.0 to 8.6, EC: Tank water- -, Groundwater 1.051 to 5.31 dS/m
5 No. of Farm Households	110 farm households
6 Self-Support Amount of Rice	220tons (110 x 2,000 kg/Household)
7 Geographical Irrigable Area	40.6 ha
8 Irrigable Area and Month by Tank	40.6 ha(Oct-Jan)
9 No. of Wells and Irrigable Area	0 (Ground water contains salt)
10 Average Rainfall(mm)	

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
21.8	21.3	28.7	62.4	55.8	10.9	27.2	50.0	71.0	159.8	156.4	54.3	719.4

11 Cropping

1) Irrigable Area and Period

2) Present Cropping Pattern

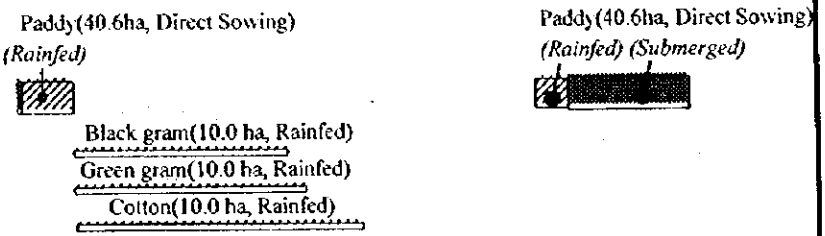


3) Cropping Plan

a) Paddy Area for Self-Support

44.0 ha(220t/5t)

b) Cropping Plan



c) Evaluation

	Crop Intensity(%)	Net Income(1000Rs)
Plan	168.5	-74.5
Present	107.6	483
Plan/Present	1.57	-

Fig. 10.4.1 Cropping Plan in the Pandikanmoi Tank Area

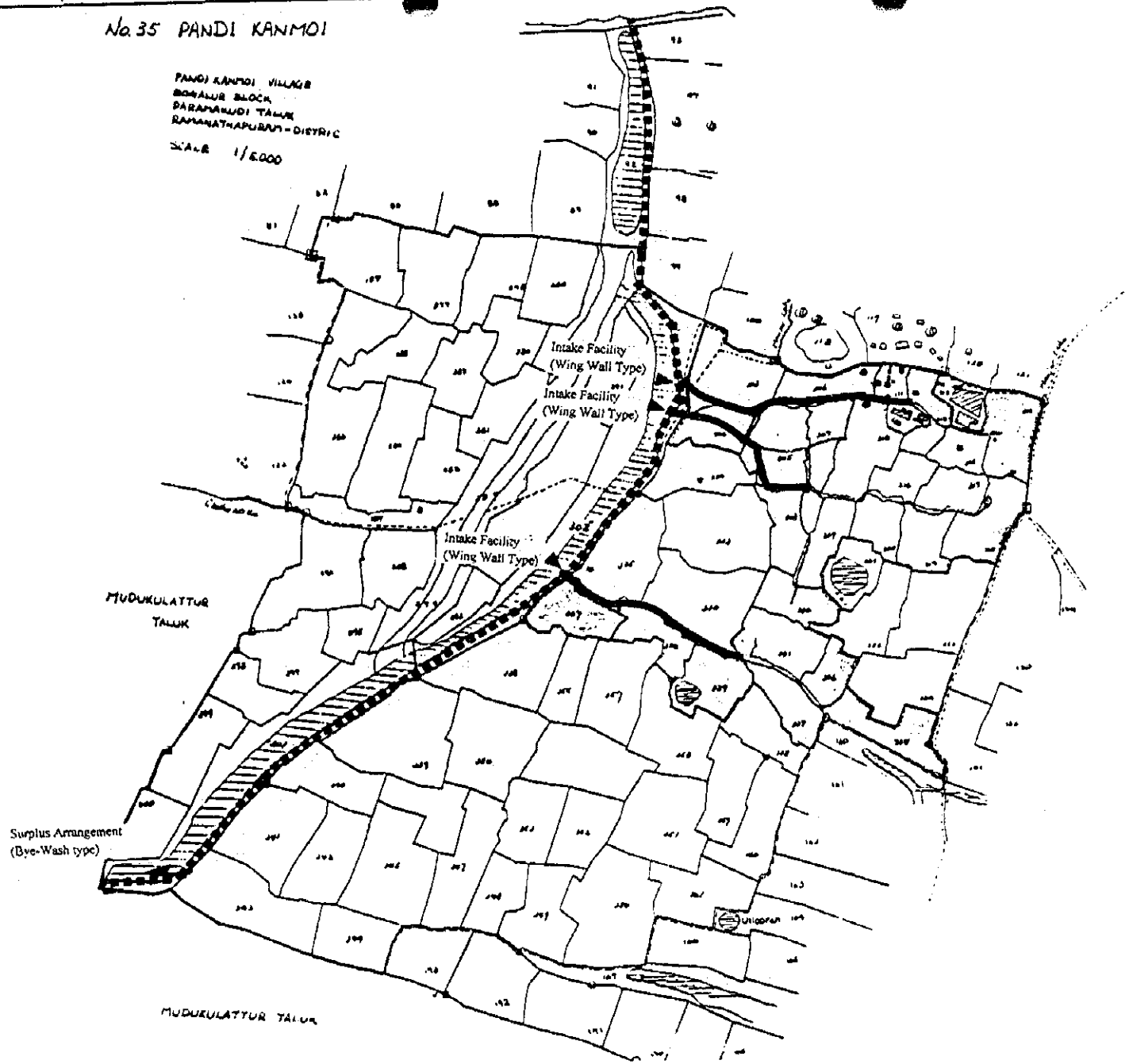


Fig. 10.5.1 General Layout of Irrigation Facilities in Pandikanmoi Tank