JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF WATER RESOURCES, GOVERNMENT OF INDIA
PUBLIC WORKS DEPARTMENT, GOVERNMENT OF TAMIL NADU

THE STUDY
ON
THE REHABILITATION OF MINOR IRRIGATION TANKS
FOR RURAL DEVELOPMENT
IN
TAMIL NADU

FINAL REPORT

VOLUME III
FEASIBILITY STUDY ON THE PILOT TANKS

JANUARY 1998

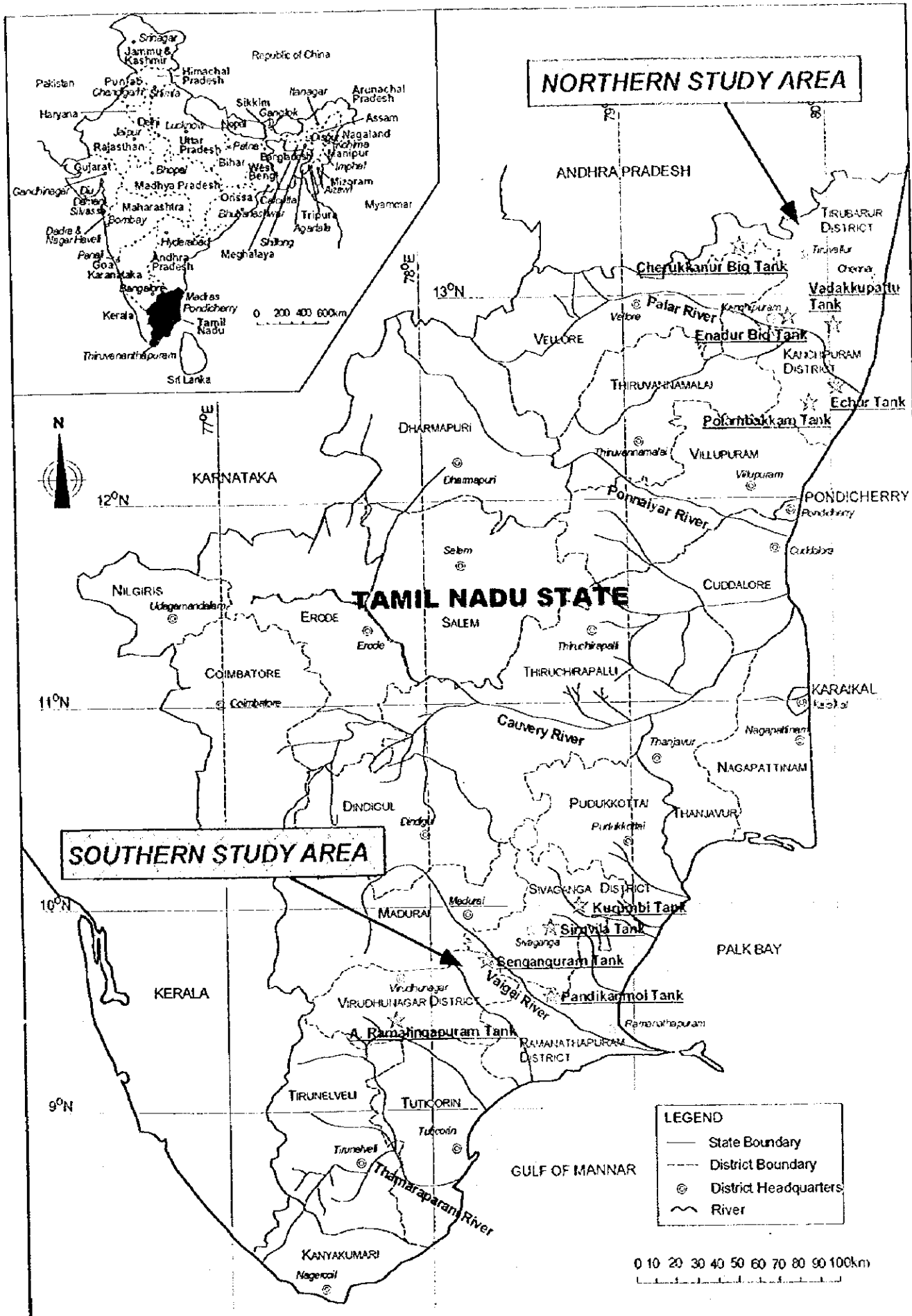
PACIFIC CONSULTANTS INTERNATIONAL
SANYU CONSULTANTS INC.

Exchange Rate

(as of July 1997)

US$ 1.00	=	Rs.35.25
Rs.1.00	=	US$ 0.0284
US$ 1.00	=	Japanese Yen 117.5

Rs. : Indian Rupee



Location of Pilot Tanks for Feasibility Study

THE STUDY ON THE REHABILITATION OF MINOR IRRIGATION TANKS FOR RURAL DEVELOPMENT

FINAL REPORT
VOLUME III
FEASIBILITY STUDY REPORT ON THE PILOT TANK AREAS

TABLE OF CONTENTS

List of Tables

List of Figures

ABBREVIATIONS

AD	Agricultural Department of Tamil Nadu State
AED	Agricultural Engineering Department of Tamil Nadu State
ATC	Agricultural Training Centre
BC	Backward Caste
CSSM	Child Survival and Safe Motherhood
CHC	Community Health Centre
CO	Community Organizer under EC Tank Modernization Project
DEA	Department of Economic Affairs of MOF, GOI
DRCS	Design, Resarch and Construction Support, WRO, PWD
EC	European Community (presently EU : European Union)
EC	Electric Conductivity (1.0 μS/cm=1.0 mmhos/cm=0.001 dS/m)
EFD	Environment and Forest Department of Tamil Nadu State
EID	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
FFDA	Fishery Farmers Development Association
GDP	Gross Domestic Product
GOI	Government of India
GOJ	Government of Japan
GOTN	Government of Tamil Nadu
HD	Horticulture Department, GOTN
IBRD	International Bank for Reconstruction and Development, World Bank
ICDS	Integrated Child Development Services
ICRSAT	International Centre for Research in Semi-arid Tropics
IMTI	Irrigation Management Training Institute of PWD, Tiruchy
IMR	Infant Mortality Rate
IIH	Institute of Hydraulics and Hydrology of PWD, Poondi
IWS	Institute of Water Studies of PWD, Taramani
JICA	Japan International Cooperation Agency
MBC	Most Backward Caste
MEF	Ministry of Environment and Forestry
MIDS	Madras Institute of Development Studies
MOA	Ministry of Agriculture
MOF	Ministry of Finance
MRD	Ministry of Rural Development
MWR	Ministry of Water Resources
NABARD	National Bank for Agriculture and Rural Development
NEP	New Economic Policy
NGO	Non Government Organization
NNP	Net National Product
O&M	Operation and Maintenance
OECF	Overseas Economic Cooperation Fund of Japan
PCB	Pollution Control Board
PHC	Primary Health Centre
PRA	Participatory Rural Appraisal
PRADAN	Professional Assistance for Development Action (NGO)
PWD	Public Works Department of Tamil Nadu State
RDD	Rural Development Department of Tamil Nadu State
RRA	Rapid Rural Appraisal
Rs.	Indian Rupees
SC/ST	Scheduled Caste/Scheduled Tribes
SDP	State Domestic Product
TNAU	Tamil Nadu Agricultural University
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
VAO	Village Administration Officer
WRO	Water Resources Organization in PWD
WUA	Water Users' Association

CHAPTER 1 : INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Objectives

The Project is expected to rehabilitate/improve all the PWD rainfed tanks for the rural development in the Study Area. In order to confirm the Project feasibility, the feasibility study was conducted for the selected 10 pilot tank areas . At first, based on the tank category of the Study tanks, the typical tanks representing particular category are examined for their feasibility. Then the total feasibility of the Project is assessed including prioritization of tank categories during the Project implementation. It dose not mean that if a pilot tank's rehabilitation is non-feasible then tanks in the same category will not to be rehabilitated. The feasibility results are used for the prioritization of rehabilitation works implementation.

1.2 Selection of Pilot Tank Areas

1.2.1 Selection Criteria

The pilot tank areas for the feasibility studies are selected among the tank areas considered as sample areas in the previous stages. The tanks are so selected that those selected tanks represent the following categories of tanks.

Categorization of Minor Irrigation Tanks

Cat.	Description
NR-1	Tanks located in the rainfall rich area, Northern Study Area, presently more than 75% of command area is cultivated mainly paddy sometimes double cropping under the tank surplus surface water conditions or supplemental supply by groundwater. The command area is small with less than 60 ha, so that rather simple operation of water distribution among farmers in command area. But maintenance of tank and irrigation facilities is not sufficient.
NR-2	As same as NR-1, but tanks having relatively medium (60 ha to 110ha) scale command area.
NR-3	As same as NR-1, but their command areas are more than 110ha. Some tanks in this category has been modernized under the EC Tank Modernization Project.
NR-4	Tanks located in the Northern Study Area, but because of shortage of storage water or reduction of deterioration of catchment area, or urbanization of command area, the cultivation area is limited to less than 75% of command area.
SR-1	Tanks located in the water scarcity or drought prone area, Southern Study Area, but having rather high water resources potential and catchment areas with more than 5 times of command area. Presently more than 75% of command area is cultivated by the conjunctive use of tank/surface water and groundwater. Therefore they will have high potential for agricultural development after rehabilitation and improvement of existing tank facilities. Some tanks in this category have been improved under the EC Tank Modernization.
SP-1	Tanks located in the water scarcity or drought prone area, Southern Study Area, under poor water resources potential with catchment areas with less than 5 times of command area. By farmers' effort, presently more than 75% of command area is cultivated by the conjunctive use of tank/surface water and groundwater. The scale of tank command area is small with less than 55 ha with rather easy operation of water distribution under small number of land holders. Therefore they will have high potential for agricultural development after improvement of existing tank facilities.
SP-2	As same as SP-1 but command area of medium (55 ha to 90 ha).
SP-3	As same as SP-1 but command area of larger than 90 ha.
SP-4	Tanks located in the water scarcity or drought prone area, Southern Study Area. Even with farmers' efforts, presently less than 75% of command area is cultivated by the conjunctive use of tank/surface water and groundwater. It might be caused by the less potential of water sources, poor command area, poor maintenance of tank/irrigation facilities, or farmers intention to paddy cultivation. Some of command area in this category cultivate once in three years. Some of farmers in this category tanks have to work in other industry to feed themselves.

1.2.2 Selection of Pilot Tanks for Feasibility Studies

The 10 pilot tank areas were selected for the feasibility studies so that the selected tanks represent each category considering the geographical distribution, etc. Consequently, the 10 tank areas were selected as the pilot tank areas for the feasibility study as shown in the table. The locations of these tanks are plotted in Fig. 1.21. And the characteristics of each pilot tank are tabulated in Table 1.2.1.

Selected 10 Pilot Tank Areas

Northern Study Area			
Category.	Name of Tank	District	Taluk
NR-1	Echur	Kanchipuram	Cheogalpattu
NR-2	Cherukkanur Big	Tiruvallur	Tiruthani
NR-2	Polampakkam	Kanchipuram	Madurantakam
NR-4	Enadur	Kanchipuram	Kanchipuram
NR-3	Vadakkapattu	Kanchipuram	Sriperumbudur
Southern Study Area			
Category.	Name of Tank	District	Taluk
SP-1	Siruvalai	Sivaganga	Sivaganga
SR-1	A.Ramalingapuram	Virudunagar	Sattur
SP-1	Pandikanmoi	Ramanathapuram	Paramakudi
SP-4	Sengangulam	Sivaganga	Manamadurai
SP-2	Kurumbi	Sivaganga	Karaikudi

1.3 Methodology of Feasibility Study

1.3.1 Technical Feasibility

The following field investigation were carried out.

(1) Engineering Aspects

The data collection and field survey were carried out for proceeding with the feasibility study on tank rehabilitation/improvement in the pilot areas. The field survey included the following items.

1) Irrigation and drainage including hydrological analyses

In the areas where the water shortage is remarkable, it is necessary to formulate the modernization plans which include conjunctive use of surface water and groundwater resources to maximize the available water resources. To realize the most optimum water distribution, the analyses are made considering whole of the chain of tanks as a complete system to which the tanks to be modernized belongs. The following analyses are carried out for these purposes.

- Hydrological analyses for all the basin of chain of tanks as a complete system including water balance study
- Hydro-geological analyses for available groundwater potential as well as impact to the existing wells and neighboring basins
- Calculation of water requirements for the cropping patterns which make it possible to minimize the water consumption as much as possible
- Water balance study to confirm the sustainability of water resources both groundwater and surface water as well as the most optimum water distribution manner.

2) Tank irrigation facilities including topographic survey

The rehabilitation of the existing tank irrigation facilities and the construction of additional facilities are also one of the important components for improvement of tank irrigation. The following item were carried out during the field survey.

- Grasp of the tank dimension through topographic survey such as ayacut area and waterspread area survey, longitudinal and cross section leveling (Comparison of the present condition and the standard section)
- Capacity of the existing irrigation facilities including tanks, intake works, and channel, etc.
- Network system of both the irrigation and the drainage channels and the existing land use
- Location of existing facilities such as the division box and community well
- Extent of deterioration of the tank facilities such as bund, intake works, and field channel, etc.
- Modification of design criteria of such irrigation facilities, if necessary
- Topographic surveys for tanks, sluices, irrigation canals, etc. to grasp the topographical conditions of these facilities.
- Preliminary design of the construction and the rehabilitation of irrigation facilities.
- Soil mechanical analyses and study of the existing bund materials and foundation.

Based on the results of these surveys and studies, obtained data were analyzed for each component, and the proposed sizes and types of tank irrigation facilities were obtained in an adaptable design maximizing utilization of available water resources.

3) Geographical Information System (GIS)

Simple GIS system was established for the tanks listed in the inventory lists provided by PWD in order to facilitate the operation and management of the tank modernization during implementation of the Project. The system includes the database on locations, names and properties of each tank such as catchment areas, command areas, engineering dimensions, sociological information.

The following surveys and investigations were carried out during the field survey hiring local surveyors under the supervision of the JICA Study Team.

1) Topographic Survey

The feasibility study was carried out for the selected 10 pilot areas on 1:5,000 village maps available for each tank, but there is no data indicating elevations on such village maps. Therefore, it is necessary to conduct topographic surveys to obtain elevation data at the major points of tank irrigation facilities as well as topographic profiles of major irrigation canals. The following surveys were conducted:

- Survey of the waterspread areas of tanks to grasp storage capacity and to observe variation of capacity even after the study
- Longitudinal profile surveys along bunds and irrigation canals
- Elevation survey at the sill of sluices and spillways, top of dikes, field plots to be irrigated, farm inlet etc.

2) Hydro-geological Survey

To carry out the hydro-geological analyses for the conjunctive use of water, it is necessary to proceed with the hydro-geological surveys consisting of:

- test drilling at the sites in waterspread and command areas, and on bund of the tanks,
- core samplings and permeability tests, and
- pumping-up tests.

The drillings were carried out in the following four (4) tank sites.

- Cherukkanur Big Tank
- Vadakkupattu Tank
- Sengangulam Tank
- Pandikanmoi tank

(2) Agricultural and Institutional Aspects

1) Agriculture and Farming Practices

The most water-saving and the promising cropping patterns have to be established under the present farming conditions considering the sociological possibilities of farmers to change and modify their farming practices in order to increase marginal farmers' income to the level which enables them to maintain a satisfactory living standard. To establish the sustainable and high profitable farming by introducing crop diversification and improved cropping pattern, the

following analyses and studies were conducted in the field surveys.

- Selection of the most suitable variety of crops to be introduced for the optimum water saving and promising the farmers income.
- Establishment of the cropping patterns in corporation the selected suitable crops.
- Introduction of the necessary farming practices and techniques.
- Grasping the present farming practices and the farmers' intention to improve their farming practices through farm surveys.

2) Farm Household Economy Survey

To grasp the farmers' household economy, the economic investigations were conducted including the following items.

- Farm household characteristics
- Life and production in the Area
- Land ownership
- Irrigation situation
- Agricultural production
- Other economic activities
- Farmers' attitudes

The surveys were carried out for the selected 10 pilot tank areas by the local surveyors selecting 10 sample farmers in each tank ayacut area under the supervision of the JICA Study Team. Additionally, the JICA Study Team members made the interview and surveyed the farmers condition in the Pilot Tank areas by themselves.

3) O&M of Tank and Irrigation Facilities and Farmer's Participation

In order to utilize the available water resources to the maximum extent, the most optimum water distribution method has to be established, and the established method has to be implemented in the manner adaptable and suitable for the farmers. The Water Users' Associations (WUAs) are proposed to be formulated to implement such water distribution with the farmers participating in such activities from the beginning. The following surveys were conducted in the field surveys.

- Surveys and analyses on the existing operation system of the irrigation facilities.
- Finding out the farmers' intention for the improvement of management system through the farm household economy survey.
- Establishment of the most suitable operation and maintenance practices for the modernized tank irrigation system.

- Establishment of formalization of WUAs with the farmers involvement and participation.

4) Value Adding Agricultural Products

In order to increase the value of the agricultural products for the farmers under the Project, possibility to introduce the value-adding agricultural products was studied on the following products.

- Processing of dried mango chips
- Canned/packed mango juice
- Tomato juice
- Bottled vegetable pickles
- Powdered turmeric
- Dried banana chips
- Roasted peanuts
- Bottled tamarind paste
- Prevention of grain loss by improved post harvest technologies.

5) Agricultural Support and Extension

Agricultural support and technology extension services are considered indispensable to attain the proposed profitable agriculture successfully. The following possibilities were studied in the field survey.

- Establishment of Experimental Demonstration Farm (EDF)
- Supply of Agricultural Input Materials
- Development of Markets
- Establishment of Farmers' Organization

6) Institutional Strengthening

In order to make the Project function successfully to achieve its objectives and obtain full benefits, the strengthening of institutional aspects should be properly applied in each related aspect and a smooth combination of all developments are basically required.

The programs for institution development on the following aspects are considered in the Study.

- Organization to oversee/administer the core staff of the Project
- Organization to guide the farmers
- Organization during the implementation and construction phases
- Coordinating body for the organizations and agencies relevant to the Project
- Necessary and available human resources to maintain and operate the

proposed organization and institutions
- Legal arrangement if necessary
- Necessary facilities for reinforcing the present institution

(3) Environmental Aspect

The Ministry of Environment and Forestry published the Handbook of Environmental Procedures and Guidelines. Since the proposed tank rehabilitation is considered to include only the rehabilitation of existing irrigation facilities and to be categorized into small irrigation development projects, it is not necessary to proceed with such assessment as PWD insists. GOI, however, intends to request it for the implementation with any foreign financial assistance.

Therefore, the environmental impact assessment is carried out in accordance with the criteria adaptable by such international financial agency in order to confirm its environmental safety and sustainability. The countermeasures to be taken for protecting its environment are also considered in the Study.

1.3.2 Formulation of Rehabilitation Plan

The rehabilitation plan of minor irrigation tanks is formulated for each pilot area based on the results obtained through the survey and study conducted so far. The plan is formulated so as to meet the primary objectives such as alleviation of poverty, improvement of living standard of marginal farmers, etc. The general feature of rehabilitation plan and basic concepts are established.

The rehabilitation plan includes the following items.

i) Rehabilitation plan of minor irrigation tanks
ii) Operation and maintenance plan of the tank irrigation facilities
iii) Farming practice and cropping pattern
iv) Farmers' organization and water management
v) Agricultural extension services
vi) Farmers' supporting services
vii) Environmental protection
viii) Preliminary design of major irrigation facilities
ix) Cost estimate and benefit calculation including project evaluation
x) Implementation schedule

1.3.3 Project Justification

(1) Basic Concept

The justification on economic feasibility of the 10 pilot tank areas should be mainly based on basic lines of justifications carried out for the Master Plan. From this background, the economic analysis of the feasibility study on national point of view

would offer also a positive figure for making this Project feasible on economic aspect.

On the financial aspect of farm budgets for small, marginal and landless farmers, as per consequence, the Project would improve farm revenues and the basic life-style of these categories' farmers and raise their basic rural living conditions.

For the aspect of financial procurement to implement the Project, due to a very limited time, cost for rehabilitation 10 tanks only compared their feasibility to examine the feasibility of the Master Plan totaling about 2,100 tanks, the process to accumulate this financial volume, therefore, is more applicable.

(2) Costs

Basically, initial costs for the Project comprise of mainly costs for tank rehabilitation, for installation of experimental demonstration farms if necessary and for institutional development programs of the Project. Other costs are annual administration and O&M costs and replacement costs at the 15th and 16th years. Other related costs such as contingencies, compensations, land acquisitions etc. should also be considered in the procedure of financial procurement.

(3) Benefits

Economic benefits for the project are allocated in the incremental increase of agricultural production and the value-added activities resulted from institutional development programs of the Project.

Intangible benefits would be considered on the aspect of improvement of daily living conditions to make local farmers and inhabitants having a mutual sharing in village life and activities.

(4) Economic and Financial Evaluation

Analyses on economic and financial aspects are applied accordingly in the feasibility study. Positive results obtained from the master plan study on these aspects would basically assure proper corresponding figures to be expected from the implementation of this feasibility study Project.

(5) Overall Justification

The feasibility studies were made as a pilot phase with intensive applications in all aspects for modeling all related proceedings and procedures of the whole master plan framework.

Besides the construction and installation of structures and facilities, the institutional development programs for the Project which form the decisive factor for fruitful

Project implementation should be made for effective functioning of each related aspect.

In the project framework, a proper monitoring system should be established for each local area of the Project in order to periodically evaluate results from project implementation and correct or adjust each related aspect in case of necessity.

Table 1.2.1 Characteristics of Pilot Tanks

		Northern Study Area					Southern Study Area				
		NR-1	NR-1	NR-2	NR-4	NR-3	SP-1	SR-1	SP-1	SP-4	SP-2
Tank Name	Tank Code	712	544	1053	449	597	1577	1940	2232	1660	1332
	Tank Name	Echue	Cherukkanur Big	Polambakkam	Enadur Big	Vadakkupattu	Siruvalai	A Ramalingapuram	Pandikanmoi	Sengangulam	Kurumbi
	District Name	Kanchipuram	Tiruvallur	Kanchipuram	Kanchipuram	Kanchipuram	Sivagangai	Virudunagar	Ramanathapuram	Sivagangai	Sivagangai
Administration	Taluk Name	Chengalpattu	Tiruttani	Madurantakam	Kanchipuram	Sriperumbudur	Sivaganga	Sattur	Paramakudi	Manamadurai	[illegible]
	Village Name	Echur	Cherukkanur	Polambakkam	Enadur	Vadakkupattu	Paganeri	Ramalingapuram	Pandikanmoi	Sankankulam	S R Pattinam
Latitude	Latitude	0.0000	0.0000	12.5603	12.8833	12.8113	9.9536	9.3833	9.4663	9.7464	10.0044
Longitude	Longitude	0.0000	0.0000	79.8254	79.7006	79.9560	78.5768	77.9000	78.6400	78.2505	78.7242
Altitude	Alt_m		27.5[illegible]	-	92.000	47.76[illegible]	-	60.00	-	-	-
River Basin	Basin_Name	Palar Minor	Nandiar	Kiliyar Minor	Kanchipuram Mi	Adayar Minor	-	Vaippar	Lower Vaigai	Lower Gundar	Manimuthar
Free	Free_Catch	1.570	19.606	2.276	14.630	6.325	3.106	6.34	0.830	2.490	2.455
Intercepted	Inter_Catch	-	0.000	3.693	13.050	4.660	7.252	146.34	-	-	4.33[illegible]
Total	Tot_Catch	1.570	19.606	5.969	27.680	10.995	10.360	152.68	0.830	2.490	6.79[illegible]
Equivalent	Equi_Catch	1.570	19.506	3.015	24.216	7.26[illegible]	4.558	35.61	0.830	2.490	[illegible]
Type	Catch_Type	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average
Dependable	Depen_Yield	137.7682	6.1530	0.15200	0.34455	0.34465	-	0.0699	-	-	10.8
Irrigable Area	Tank only	58.630	-	94.590	332.490	398.90[illegible]	49.250	72.72	41.85	99.230	52.67
	Wells-Tank	--	-	-	42.030	18.310	-	3.83	-	-	-
Registered	Registered Ayacut	58.680	91.260	94.590	374.670	417.240	49.250	76.53	41.800	99.230	52.67
	Average Cultivation										
Other	Non-cultivation	0.296	-	-	-	-		-	-	-	-
Permanent	Permanent Crop	-	-	-	0.100	0.07[illegible]		-	-	-	-
Full tank level	FullTank_L	21.000	130.060	44.450	92.000	47.760	74.520	60.00	8.000	31.70	30.65
Max water level	MaxWater_L	21.300	130.360	45.050	92.700	48.58	75.000	60.90	8.500	32.00	31.25
Top bund level	TopBund_L	22.200	131.610	45.050	94.950	50.200	76.500	61.90	9.600	33.90	32.25
Bund length	Bund_Length	1.207	1.740	1.300	2.100	1.35[illegible]	1.870	1,900	3,000	4,230	915
Top width	Bund_Width	2.00	1.83	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2
Side slope	BundSlope_F	1 5 1	1 5 1	1 5 1	1 5 1	1 5 1	1 5 1	1 5 1	1 5 1	1 5 1	1 5 1
	BundSlope_R	2 01	2 1	2 1	2 1	2 1	2 1	1 2	2 1	2 1	2 1
Live Storage Capacity	Live_Store	0.530	1.077	0.430	0.560	91.39	0.3100	0.394	18.160	-	0.13
Max. Depth	MaxT_Depth	2.100	3.300	4.350		-	2.630	1.00	2.300	-	5.49
Length of Weir	TotNo_Weir	3	0	1	0	1	2	1	0	1	1
	No_BC	1		1		1	2	1		1	1
	BC_Length1	38.00		35.70		143.40	5.960	75.00	-	22.500	49.19
	BC_Length2	0.50					60.960	0.00			
	No_Sand	2.00		0.00		0.0	0.000	0.00		0.000	0
	Sand_Length1	20.10		-		-	-	0	-	-	-
	Sand_Length2	4.00									
	Tot_WeirLength	42.100		35.70		143.40	65.53	75.00	-	22.500	48.19
Crest level	Crest_Level	21.000	30.500	44.350	92.900	47.760	15.160	60.00	8.000	31.700	30.65
Max. Flood Discharge	Max_Disch	624.000		25.100	63.640	12.30[illegible]	-	160.91	58.169	8.770	49.178
Design Flood Discharge	Design_Disch	637.000		25.190	-	110.42	-	150.91	-	-	49.3543905
Flood Lift	Flood_Lift	0.300	0.500	0.500	0.700	0.820	0.30	0.90	0.600	0.300	0.6
No. of Sluice	No_Sluice	3	1	2	2	4	10	3	2	0	1
Sill Level 1	Sill_L1	19.310	27.200	40.400		-	12.750	-	6.000	-	25.160
Sill Level 2	Sill_L2	20.420		40.100			12.530		6.000		
Sill Level 3	Sill_L3	18.360					13.060				
Energized	E_WellCom	0	0	0	0	0	[illegible]	0	1	0	[illegible]
	E_WellInd	69	13	37	43	28	[illegible]	2	0	7	[illegible]
Non Energized	NE_WellCom	6	0	0	0	0	[illegible]	0	0	0	[illegible]
	NE_WellInd	1	0	0	12	7	[illegible]	0	0	3	[illegible]
Total	Tot_Well	70	13	37	55	35	[illegible]	2	0	10	0
Well density per Ayacut Area		1.19	0.14	0.60	0.10	0.08	#VALUE!	0.03	0.00	0.10	0.00
Below 1 ha	Small_Farm	67	198	420	357	284	[illegible]	41	75	250	79
Between 1-2 ha	Medium_Farm	92	61	81	68	54	[illegible]	7	30	39	27
Above 2 ha	Large_Farm	7	9	16	23	17	[illegible]	2	5	24	6
Total	Tot_Farm	166	268	517	448	352	0	49	110	313	112
	Share of Marginal	40.36%	73.88%	81.24%	79.69%	80.30%	#DIV/0!	81.63%	68.18%	79.87%	70.54%
Average size	Avg_FarmSize	55	0.340	0.62		0.280	-	Below 1Ha	0.1700	0.79	0.47
No. of Persons Concerned	Farm_Pop	41	269	517	647	356	62	171	110	313	112
	FarmLab_Pop	97	1784	872	895	621	-	38	40	93	89
No. of Hamlets	No_Hamlets			1	1	1	0			0	1
Name of Hamlets 1	HamletName_1		Cherukkanur				-	Ramalingapuram		-	-
No. of Farmers	No_Farm1	-	268	517	1,788	1,076	62	89	110	313	112
No. of Person	No_Males1	-	1382	2127	895	535	150	89	200	452	[illegible]
	No_Females1	-	1353	2109	893	535	79	68	330	526	[illegible]
	No_Children1	-	385	212	-	-	26	64	150	91	
	Age_1	-	-		-	-	-	Below 12	6 to 12	45	
WUA	WUA_Name	-	-		-	-	-	-		-	-
	WUA_Date	-	-		* UNR	-	-	-		-	-
Status of Ongoing Project	Project_Name	-	-	-	** WST	-	-	-	-	-	-
Socio_Economic Survey	S_EconoSurvey	1 2 676	21 484	1 2 495	2 541	1 1 515	6 311	1 8 284	1 910	2 509	1 4 669
Baseline Survey	Tank Name or P	Sriperumbudur	Tiruttani PO	Polambakkam	anchipuram P	Kunnattur PO	Siruvalai	Sivakasi PO	Bogalur PO	Tiruppuvanam	Kurumbi
	Registered Ayacut		.	130.56			53.87				52.15
	Avg. Cultivated Area			103.25			45.61				38.09
	Tank Surplus 5year	89%	71%	3	86%	60%	4	38.50%	60%	40%	3
	Marginal Farmers			35			23				97
	Small Farmers			35			17				14
	Semi-medium Farm			60			9				2
	Medium Farmers			7			0				0
	Large Farmers			3			0				0
	% of Marg & Small	87.8%	94.0%	50.0%	84.1%	85.4%	81.6%	93.8%	99.3%	81.0%	98.2%
	Cultivated/Reg'd Com	117.0%	49.3%	79.1%	95.6%	65.3%	84.7%	60.8%	92.0%	50.0%	73.0%

Source : PWD Tank List (May 1997), and Base Line Survey PWD Rainfed Tanks in Tamil Nadu, Directorate of Economics and Statistics,1997

CHAPTER 2 : FIELD SURVEY AND INVESTIGATIONS

Chapter 2 Field Survey and Investigations

Apart from the Feasibility Study of the selected pilot tank areas, in order to identify the potentials of irrigated agricultural development in those areas, the following surveys and field investigations were carried out.

1) Farm Household Economy Survey
2) Topographic Survey
3) Ground Water Hydro-geological Survey.

These surveys were planned by the Study Team and carried out by the local survey companies under the supervision of the of the Study Team members. The method and results of these surveys are discussed in this chapter.

2.1 Farm Household Economy Survey

2.1.1 Objectives and Questionnaire

(1) Objectives

In order to grasp the present situation of socio-economy and agriculture at farm level in the Pilot Tank Areas, inquiries were made with the local farmers, particularly on the issue of the needs for tank rehabilitation as well as their intentions on participation in O&M works and sharing water-fees. This was made to have supporting information for properly directing the formulation of Project components. Having this in mind, a Farm Household Economy Survey was carried out for all categories of farms subjected to these areas.

The main purpose of the Farm Household Economy Survey was to know exactly the agricultural production and living conditions as well as related intentions of each farm category in the 10 Pilot Tank Areas in both regions in order to compare their disparities, and local specific problems and inquiries for directing a better formulation of the Project.

(2) Questionnaire

The Survey-Questionnaire prepared by the Study Team is made into seven parts as follows:

i) Household Characteristics
ii) Living and Production Situation
iii) Land Ownership
iv) Irrigation Situation
v) Agriculture
vi) Other Economic Activities

vii) Farmers' Attitudes towards the Project

A sample of the survey-questionnaire for this Farm Household Economy Survey is attached in Volume IV of the Report for reference purpose.

2.1.2 Farm Household Economy Survey

The Farm Household Economy Survey was conducted through the collaboration of a local consulting firm. The conditions for this Farm Household Economy Survey were as follows:

- Ten (10) farms are surveyed in each Pilot Tank Area (or 50 samples in the Northern Study Area and 50 samples in the Southern Study Area).

- Composition of farms for sampling in each area is determined as shown below.

Category of Farmer	Scale of Farm	Sampled No.
Big	more than 10 ha	1
Medium	2.0 to 10.0 ha	2
Small	1.0 to 2.0 ha	4
Marginal	below 1.0 ha	2
Landless	non	1

- Besides, in connection to this Farm Household Economy Survey, the concerned members of the JICA Team made a Reconnaissance Survey in each Pilot Tank Area with the participation of PWD counterparts and local agricultural officers in both regions in order to confirm the actual situation and problems at each individual Pilot Tank Area and to reconfirm the data of the Farm Household Economy Survey.

- After the field surveys, the collected data are used for compiling the reports related to aspects of agro-economy and agriculture of the Project.

- The collected data and information were analyzed and the description on the results in detail from the surveys was mentioned in the reports on the aspects related to agro-economy and project justification.

2.1.3 Results of Farm Household Economy Survey

The analysis of data collected from the Farm Household Economy Survey showed the results as follows;

(1) Farmers Characteristics

The data in the Farm Household Economy Survey collected for this part showed that all the surveyed farms have been living depending upon agriculture in the same place (tank area) for more than 10 years. Subjected farmers have been depended

mostly on tank irrigation for their crop cultivation, considering the irrigation tanks as their basic living properties.

Since their agriculture has been based on irrigation by rainfed tank which is unstable during the rainfall scarcity years (more than 5 years in a 10-year cycle in most parts of the Southern Region), the phenomena of migration to neighboring areas basically for agricultural employment during the drought years in their areas and returning back to their villages for cultivation on their own lands in normal years has been occurred up to now. Their assets in terms of houses, farm equipment and facilities, therefore, are observed to be comparatively less.

The average family size was varying from 4 for landless family to 5 for other farm categories in Northern tank areas, and 5 for landless family, 6 for marginal farm and 7 for other farm categories in the Southern region.

Regarding agricultural production, the constraints were cited in an descending order of from: i) irrigation water, ii) agricultural inputs, iii) finance, iv) labor insufficiency, v) marketing facilities and vi) rural infrastructures. For irrigation water, 32% and 39% of responding in the Northern and Southern Study Area were reported as having this top constraint. For the constraint in agricultural inputs, 32% mentioned this constraint with 16% in the North and 16% in the South. For lack of finance, 11% in the North and 33% in the South mentioned this financial constraint. For the constraint in marketing, 2% in the North and 12% in the South mentioned this constraint.

Apart from the constraints on agricultural production, the constraints on living conditions are notified to be: i) climate, ii) social infrastructures, iii) social environment, iv) administration and v) lack of income. Among these constraints, 23% in the North and 10% in the South mentioned the constraint of lack of income. Lack of social infrastructures is reported by 17% in the North and 2% in the South. Constraint on climatic factor is reported by 5% in the North and 7% in the South. Constraint on social environment is reported as 3% in the North and 4% in the South.

The survey data showed that more than 50% of the surveyed farms expressed their present living conditions to be as of medium level and all surveyed farms expressed their willingness to continue living in the same area. They cited various reasons but the most popular reasons were the native land and agriculture as their substantial job.

(2) Life and Production in the Area

More than 65% of surveyed farms considered their houses were constructed with good materials; meanwhile, about 35% of farms were reportedly made of bad materials. For local inhabitants, thatch huts generally lived by landless people are made of bad materials.

Regarding the space and equipment in their houses, about 75% of surveyed farms expressed "sufficient space" but only 32% for "well equipped".

Regarding the access condition to their houses, about 60% of surveyed farms expressed as having good access.

Regarding seasonal problems, about 40% of surveyed farms expressed as having problems in the wet season, but more than 65% for the dry season. These problems are different with farm categories as tabulated.

Farmers' Problems

Category	Wet Season	Dry Season
Big Farms	1) Far distances to their farms	1) Erratic electric supply 2) Scanty water supply
Medium Farms	1) Labor insufficiency 2) Transportation means 3) Lack of credits	1) Monsoon 2) Scarcity of water 3) No job
Small Farms	1) Flooding 2) Lack of drainage 3) Poor road 4) Lack of finance	1) Lack of drinking water 2) No water tank 3) Poor health condition 4) Lack of electricity
Marginal Farms	1) Poor road 2) Transportation means 3) Lack of finance	1) Lack of water 2) Lack of credit
Landless Farmers	1) Lack of water 2) No job 3) Lack of finance 4) Transport means	1) No job 2) Lack of drinking water 3) Lack of finance

Regarding annual farm incomes, 15% of surveyed farms were reported as less than Rs.10,000, and also 15% for the income range of Rs. 10,000 - 15,000, making a total percentage of 30% for an annual farm income of less than Rs.15,000 per annum.

For the annual farm income of Rs.15,000 - 25,000, 42% of the surveyed farms belonged to this group. This means that 72% of the surveyed farms have an annual farm income of less than Rs. 25,000. This group is found to be constituted by all landless farmers and marginal farms and partly small farms.

For an annual farm income of more than Rs.40,000, only 20% of all surveyed farms belonged to this group.

For annual off-farm incomes, 42% of surveyed farms were reported as having less than Rs.5,000, and 10% for the income range of Rs.5,000 - 10,000, making more than half of surveyed farms having an annual off-farm income of less than Rs.10,000.

Only 16% of surveyed farms were reported to have an annual off-farm income of Rs.10,000 - 20,000, and 14% for an off-farm income of more than Rs.20,000

For the average total annual incomes of the surveyed farms, the tabulated data showed the levels of about Rs.12,000 for the landless category, about Rs.18,000 for the marginal farm, about Rs.32,000 for the small farm category, about Rs.60,000 for the medium farm category and about Rs.130,000 for the big farm category. These figures were considered to be proportional with their possessing farm sizes.

For the costs of living expenditure of the surveyed farms, the tabulated data showed levels of about Rs.14,000 for the landless category, about Rs.18,000 for the marginal farm, about Rs.33,000 for the small farm, about Rs.50,000 for the medium farm and about Rs.85,000 for the big farm.

Considering the agricultural production costs to be included as expenses, except for the two categories of medium and big farms, the farm budgets for other farm categories are generally considered to be in deficit.

For agricultural expenses in the wet season, about 20% of surveyed farms had expenses of less than Rs.5,000, about 30%, Rs.5,000 - 10,000 and about 25%, Rs.10,000 - 20,000, making a total of 75% with expenses of less than Rs.20,000. Besides, there were about 10% with expenses of Rs.20,000 - 40,000, and about 5% with more than Rs.40,000 spend by medium and big farms in the wet season.

This fact was confirmed by the fact that a large percentage of surveyed farms (85%) have no money saving. Only 15% of the surveyed farms could save money with 5% of them saving less than Rs.5,000/year, 6%, Rs.10,000 -25,000/year; and 4%, more than Rs.25,000/year.

However, except for landless families, all other farm categories have carried out the storaged to be their agricultural produces, mainly rice. The quantities of stored rice were found proportionally with the farm sizes and production quantities. The stored rice would be partly sold for cash in emergency cases.

For selling their agricultural produces, 30% of surveyed farms including all landless families have no sale at all. Only 12% with sales of less than Rs.5,000/ year, about 10% for Rs.5,000 - 10,000, and about 30% for 10,000 - 25,000. This showed that only 22% of surveyed farms, mostly medium and big farms, could annually sell more than Rs.25,000 of their agricultural produces.

Regarding the aspect of borrowing money, as notified in the results of Farm Household Economy Survey, more than 40% of surveyed farms, due to various reasons, could not borrow money at all, 5% of them borrows less than Rs.1,500, 20% borrow Rs.1,500 - 5,000, and 10% borrow Rs.5,000 - 10,000. Only about 5% have borrows of more than Rs. 10,000.

(3) Land ownership

In the wet season, all farmlands are subjected to crop cultivation. For the total use of farmland (100%) in the wet season, only 83% of surveyed farms expressed their full cropping. Only 2% expressed the cultivation level to be 50%; and only 1% expressed the cultivation to be less than 50%.

About 80% of farmers do not cultivate their farmlands during the dry season. For the farms having full cropping in the dry season, 14% of the total farms expressed a full

cultivation in the dry season.

For the cropping in the dry season as the second crop, 20%, of the surveyed farms reported as "cropping" with 16% in the North and 4% in the South.

A large proportion of surveyed farmers expressed the needs of improvement works in their tank areas; 47% of farms expressed the need for farmland improvement and 20% expressed the need for improvements of irrigation facilities.

(4) Irrigation

For the inquiry to have more irrigation application, about 85% of the respondents expressed their willing to have more irrigation in wet season, but only about 40% for more irrigation the dry season. For their willing to pay the water fee for this supplementary irrigation, only about 30% of the respondents want to fully pay this additional fee; 82% of surveyed farms expressed their willing to pay the water fee for additional irrigation in the wet season. For the dry season, however, 37% of surveyed farms were willing to pay this additional water fee for irrigation.

The farmers participation in Water Use Association and O&M works was found to be very minimal. At present, only about 1% of surveyed farms were reported as belonging to some organization like WUA, and only 6% were working for the O&M works.

90% of surveyed farms were reported presently paying for some tank irrigation fee. For well water supply, the supplementing is based on a per hour basis which is Rs.10 - 20 per hour depending on the supply capacity of well water.

69% of surveyed farms expressed the tank rehabilitation works are "very helpful", 14% expressed "helpful" and 14% expressed "some helpful". For items for improvement works, 98% expressed the needs in structural improvements and also 98 % expressing the needs for managerial improvements. This showed the willingness of local farmers on the implementation of the Project at an early stage.

For the participation of farmers in the Project implementation, about 85% of the respondents expressed their willingness to participate in project-works with about 70% for rehabilitation-works and about 50% for O&M works. However, they expressed to be paid for these works, at least at coolies-fares or by rations as in "Food for Work Program".

(5) Agricultural Production

The data on the agricultural production showed the fact that the last year (1995 - 1996) was one of the rainfall scarcity year.

First, for the farming system in general, the raising of livestock was applied to some

extent (35% of total farmers) in all tank areas.

On the basis of farm categories, the raising of livestock was applied by about 50% of medium and big farms, and about 30% for small and marginal farms in the tank areas.

Paddy was the main first crop for all tank areas. The tank water was mainly used for paddy irrigation in all tank areas. The well water used for paddy cultivation was reported in some parts of some tank areas. Also well water was used for irrigation of chilly, cotton, groundnut, vegetables and orchards.

In average, the annual production cost calculated on agricultural inputs was Rs.10,000 to 20,000/ha. These figures varied mainly with the application of fertilizers and pesticides plus coolies-costs. For small and marginal farms, they have a tendency of limiting the application of fertilizers, pesticides and use of coolies due to financial constraints.

For the paddy production, the unit yield was found to largely vary from 1.5 to 4.5 ton per ha in the last year which was a year of rainfall scarcity.

For the sale of their agricultural produces, rice is the main transaction commodity. The average annual quantities of rice for sale were about 7,000 kg for big farm, 6,500 kg for medium farm and 4,600 kg for small farm. The average sale unit price is Rs.4.5 - 5.0 per kg. From the survey results, farmers in the Southern regions sold more than 50% of their agricultural produces, mainly rice, in nearby markets; meanwhile, farmers in the Northern region sold most of their rice production at farms.

For groundnut, the average amounts were 3,000 kg for big farm and 1,000 kg for small farm, or 2,000 kg per average farm. The unit farm price was Rs.12 per kg. For pulse, the average sale unit per farm was 850 kg, with averages of 1,500 kg for big farm and 200 kg for small farm. The average unit farm price was Rs.12.5 per kg. For other crops such as cotton, sugarcane, coconut etc., the cultivation was carried out for specific farms only.

(6) Other Economic Activities

Due to the lack of irrigation water in the dry season and the lack of community (*kudimaramath*) activities in the villages subjected to the tank areas, most farmers were found as unemployed during this period. This situation causes a serious local socio-economic inefficiency as expressed by surveyed farmers. On the other hand, the availability of off-farm income sources was found limited to only a few tank areas, and the high off-farm income sources were come from leases of bullocks and farm equipment from medium and big farms, and labor forces (coolies for agricultural and construction works) from small, marginal and landless farm categories.

From the survey results, 45% of the surveyed farms (39% from the Northern tank areas and 6% from the Southern tank areas) have off-farm incomes of less than Rs.5,000 per annum from labor works (coolies), making this the highest group of off-farm income for the subjected farmers. For the annual off-farm incomes of Rs. 5,000 - 10,000, 10% of surveyed farms (5% for both tank areas) were belonged to this group. For the annual off-farm incomes of Rs.10,000 - 20.000, there were 16 % of surveyed farms (4% from the Northern tank areas and 12% from the Southern tank areas) subjected to this group. And for the annual off-farm incomes of more than Rs.20,000, 14% of surveyed farms (2% from the Northern tank areas and 12% from the Southern tank areas) were belonged to this group.

(7) Farmers Attitudes

All surveyed farms expressed the necessity for the Project with 60% as "very necessary " and 40% as "necessary". Regarding the items needed for the Project, 86% expressed the need for improving irrigation works; meanwhile, 88% expressed the need for rural improvement works.

For the Project components, inquiries from surveyed farms were desiltation, canal lining, sluice modification/repairment and well construction. For tank bed desiltation, 52% of the surveyed farms agreed with this work item, 45% expressed the item of canal lining, 14% for sluice modification/repairment, and 23% for well construction.

For items related to rural improvement works, 59% of surveyed farms requested for the rehabilitation of rural road network, 30% for drinking water facilities, 21% for housing improvement and 12% for sewerage.

2.2 Topographic Survey

2.2.1 General

During the field survey period, the following topographic survey works were conducted by the Study team.

- Collection of basic topographic data and information on the selected pilot tank areas.
- Grid survey of the waterspread area of tank.
- Longitudinal profile and cross-section survey of the existing bund.
- Longitudinal profile and cross-section survey of the existing irrigation canals
- Spot elevation survey in the command areas

The works were conducted in the following ten (10) village areas selected for the feasibility study.

Pilot Tanks for Topographic Survey Works

Name of Tank	District	Taluk	Waterspread Area (km^2)	Irrigation Canal(km)	Existing Bund(km)	Ayacut Area(ha)
		*NORTHERN STUDY AREA**				
Echur	Kanchipuram	Thirukalikundram	0.25	2.7	1.2	54
Cherukkanur Big	Tiruvallur	Tiruthani	0.35	4.6	1.9	91
Polambakkam	Kanchipuram	Madurantakam	0.63	4.7	1.3	95
Enadur Big	Kanchipuram	Kanchipuram	0.73	28.7	2.1	575
Vadakkupattu	Kanchipuram	Sriperumbudur	1.00	20.9	1.4	417
		*SOUTHERN STUDY AREA**				
Siruvalai	Sivaganga	Sivaganga	0.45	2.7	2.3	49
Kurumbi	Sivaganga	Karaikudi	0.35	2.6	0.9	53
A. Ramalingapuram	Virudhunagar	Sattur	0.13	2.9	3.0	57
Sengangulam	Sivaganga	Manamadurai	0.85	5.0	4.2	99
Pandikanmoi	Ramanathapuram	Paramakudi	0.45	2.1	3.0	42

Note: Northern Study Area consists of Tiruvallur and Kanchipuram districts, and Southern Study Area consists of Virudhunagar, Sivaganga and Ramanathapuram districts.

2.2.2 Topographic Data Collection

(1) Topographic Map

The copies of topographic maps of 1:50,000 and 1:250,000 scales were collected. The maps were prepared by the Survey of India of GOI. These maps were collected cover all of the Study Areas.

(2) Other Maps

To facilitate the topographic survey, the taluk maps and the village maps (prepared by Directorate of Survey and Land Records of Tamil Nadu Government) were also collected covering all the Study areas including the selected pilot tank areas.

2.2.3 Field Survey

(1) Establishment of Benchmarks

Temporary benchmarks were established prior to commencing the survey works in each survey site. The benchmarks established are of concrete so as to enable easy reference in the future. The elevations of the benchmarks are set so as to meet those elevations which were used for the existing structures as much as possible referring to the available as-built drawings etc.

(2) Grid Survey of the Waterspread Area of Tank

Spot elevations were measured in the waterspread areas of the existing tanks with 50 m interval of the grid, and 50 cm interval of contour lines were drawn based on the measured grid elevations.

(3) Longitudinal Profile and Cross-section Survey of the Existing Bund

Longitudinal profile and cross-section surveys were conducted along the existing bund. The interval of the cross-section was 50 m and all the other points which are considered important in preparing rehabilitation plans of bund were also taken.

(4) Longitudinal Profile and Cross-section Survey of the Existing Irrigation Canals

Longitudinal profiles and cross-section surveys were conducted along the existing irrigation canals extending from the existing irrigation tank to the command area. The interval of each cross-section was 50 m and all the points which are considered necessary for preparing the facility plan were measured. The related irrigation structures such as culverts, drops, division boxes, foot paths, etc. were also measured and their locations were mentioned on the prepared profile.

(5) Spot Elevation Survey in the Command Areas

Spot elevations in the command areas were measured. The locations of spots of which elevations were measured and indicated on the 1:5,000 scale of maps; measured spot elevations were also indicated in the same maps.

2.2.4 Prepared Drawings

The following drawings were prepared to facilitate the preliminary design for the feasibility study.

Number of Topographic Drawings Prepared

Drawings \ Name of Tank	Echur	Cherukkanur Big	Polambakkam	Enadur Big	Vadakkupattu	Siruvalai	A. Ramalingapuram	Pandikanmoi	Sengangulam	Kurumbi	Total
Spot Elev. in Ayacut	1	1	1	3	4	1	1	1	2	1	16
Canal Align. & Contour in W/S Area	1	1	1	2	2	1	1	1	1	1	12
Profile of Tank Bund	1	1	1	1	1	1	1	1	1	1	10
Cross-section of Tank Band	8	5	8	8	5	11	4	7	11	9	76
Profile of Irrigation Canal	2	6	5	12	9	6	3	4	9	3	59
Cross-section of Irri. Canal	7	20	8	16	50	11	6	9	24	8	159
Inventory of Existing Structure	4	5	4	5	5	12	5	5	5	3	53
Benchmark Location	1	1	1	1	1	1	1	1	1	1	10
Photographs	1	1	1	1	1	1	1	1	1	1	10
Total	26	41	30	49	78	45	23	30	55	28	405

The total number of the prepared topographic drawings is 405 sheets, and they are used for the feasibility design. The prepared drawings are compiled in Volume VI: Data Book.

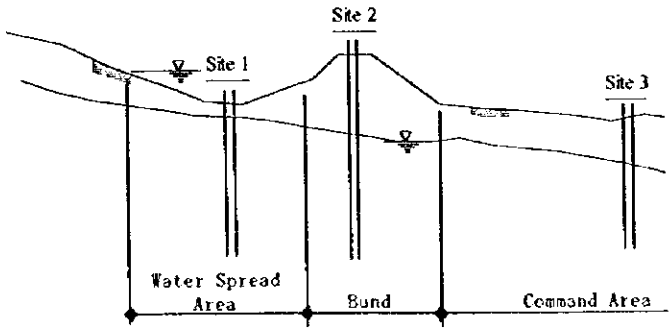
2.3 Groundwater and Hydrogeological Survey

2.3.1 General

The Groundwater and Hydrogeological Survey was carried out in ten (10) Pilot Tanks, five (5) in the Northern Study Area and five (5) from the Southern Study Area. A detailed geological and hydrogeological survey was carried out in all these tanks. This survey includes the study of lithology, structure, intensity of weathering, well particulars, and measurement of Electrical Conductivity (EC) and pH of groundwater. From this detailed hydrogeological survey, the following four (4) tanks were selected for test boring, two (2) each from Northern and Southern Study Areas considering various other factors.

Tanks for Detailed Hydrogeological Surveys

Study Area	Name of Tank	Geology
Northern Study Area	1. Cherukkanur Big	Arechean basement at 3 - 4 m
	2. Vadakkupattu	Sedimentary (Shales)
Southern Study Area	3. Sengangulam	Arechean basement at 20 - 24 m
	4. Pandikanmoi	Sedimentary (Alluvium)



Drilling was carried out in water spread area (Site 1), on bund (Site 2) and in command area (Site 3) of these tanks. During drilling lithological samples were collected and the subsurface geology was investigated. In the well drilled at the command area, step drawdown, constant discharge and recovery tests where carried out to estimate the hydrogeological parameters. The sizes of drilling holes and pipes installed were determined to fulfill the following requirements, and the drilled depths are tabulated below.

Required Sizes of Boreholes and Pipes

Site	Minimum Size	
	Hole	Casing & Screen
Site 1: Waterspread Area	4"	-
Site 2: Bund	6"	-
Site 3: Command Area	8"	6"

Depths of Drilled Boreholes

Name of Tank	Site 1	Site 2	Site 3
1. Cherukkanur Big	17 m	28.9 m	37.0 m
2. Vadakkupattu	30.0 m	22.5 m & 6.0 m	50.0 m
3. Sengangulam	22.0 m	15.1 m & 3.2 m	69.0 m
4. Pandikanmoi	24.0 m	21.3 m & 2.0 m	60.0 m

2.3.2 Results of Hydrogeological Survey and Analysis

From the results of various studies and analyses, and field surveys and investigations discussed above, the following conclusions and recommendations are derived.

(1) Cherukkanur Big Tank Area

The Study results reveals that the groundwater level is observed to be shallow, but the groundwater potential in the command area is very poor, where only 30 minutes of pumping could be carried out due to very low recharge. It is then difficult to use the groundwater as a continuous water source, but the intermittent use with some days interval may be possible as a supplemental or urgent water source. An open well with a large diameter will be applicable to facilitate the recharge and to increase the storage capacity of the well.

(2) Vadakkupattù Tank Area

The well drilled at the command area of the Vadakkupattu tank area also gave a very poor yield. However, the groundwater level is shallow and it is observed from two (2) to six (6) m below ground level in this area. It is, therefore, recommended to use the groundwater in this tank area as supplemental or urgent irrigation water sources only.

(3) Sengangulam Tank Area

The safe discharge of 1.5 l/sec is estimated for the tubewell constructed for pumping tests in this tank area. However, this discharge is not considered sufficient for constant irrigation taking into account of the irrigable areas and estimated drawdown. It is, therefore, recommended to use the groundwater as supplemental or urgent irrigation water sources to the limited areas. The groundwater level is observed deeper than the Northern Study Area.

(4) Pandikanmoi Tank

The groundwater level in this tank area is observed 19 - 20 m below the ground surface. However, the safe yield is estimated as 4.8 l/sec which is considered to be the largest in the pilot tanks for test boring. This groundwater may be able to be used for the irrigation purpose in view of the available yield, but the electrical conductivity is observed from 28 to 50 dS/cm, which is considered higher than the allowable range of the FAO guidelines.

The groundwater potential and the exploitable volume of the groundwater are summarized in Fig. 2.3.1 for the Ayacut of each pilot tank. Generally speaking, the potential in the Northern Study Area is larger comparing with the Southern Study Area. However, the draft is larger in the Northern Study Area than in the Southern Study Area.

As for the potential per ha, the unit potential is larger in the Southern Study Area comparing with the Northern Study Area. It is, therefore, concluded that the exploitable groundwater is expected in the Southern Study Area than in the Northern

Study Area considering the per-ha potential and the extent of the present draft.

However, in the Southern Study Area, the observed EC values sometimes indicate high salinity especially in the southern part of this study area. It is confirmed that the black soils exist in these areas. Therefore, it is recommended that a careful attention is need to be paid to the water quality in case the groundwater development is planned in these areas. In addition, since the Gondwana formation exists in the Study Area, which is generally considered as those bearing quite less groundwater, it is recommended to seek the other water sources in the areas having this formation. The details of hydrogeological survey and investigation are presented in Volume IV of this Report.

Hydrogeological Features of Pilot Tank Areas

Name of the Tank	Ground-water Potential in Ayacut (10^3m^3)	Draft in the Ayacut (10^3m^3)	Exploitable Volume of Groundwater in the Ayacut (10^3m^3)	Water Table During the Study (m)	pH	Electric Conductivity (μS/cm)	Unit Potential (10^3m^3/ha)
Echur Tank	6,750	1,350 (20%)	5,400	1.5 - 4.2	7.1 - 8.5	400 - 575	115
Cherukkanur Big	4,920	3,197 (65%)	1,723	1.0 - 4.5	6.5 - 8.0	400 - 850	54
Polambakkam Tank	3,396	2,343 (69%)	1,053	2.0 - 3.0	6.8 - 7.9	300 - 500	36
Enadur Big Tank	9,375	4,957 (53%)	4,418	3.0 - 7.0	7.0 - 7.8	270 - 520	16
Vadakkupattu Tank	8,340	1,668 (20%)	6,672	2.0 - 6.0	6.5 - 7.5	475 - 845	20
Siruvalai Tank	2,825	424 (15%)	2,401	3.6 - 14.0	6.9 - 8.1	540 - 3,000	53
Kurumbi Tank	3,156	227 (7%)	2,929	4.5 - 8.0	6.0 - 7.8	320 - 1,200	42
A. Ramalingapuram	3,217	123 (4%)	3,094	3.0 - 4.0	7.4 - 8.2	4,000 - 6,700	77
Sengangulam Tank	8,712	510 (6%)	8,202	13.0 -	6.8 - 8.1	1,050 - 2,500	88
Pandikanmoi Tank	3,520	87 (2%)	3,433	19.0 -	7.0 - 7.5	2,800 - 5,000	67

Note: The groundwater potential in tank areas is estimated using the total command area, average thickness of the saturated zone and their hydrological properties. The present groundwater usage is estimated from the block-wise data available in PWD.

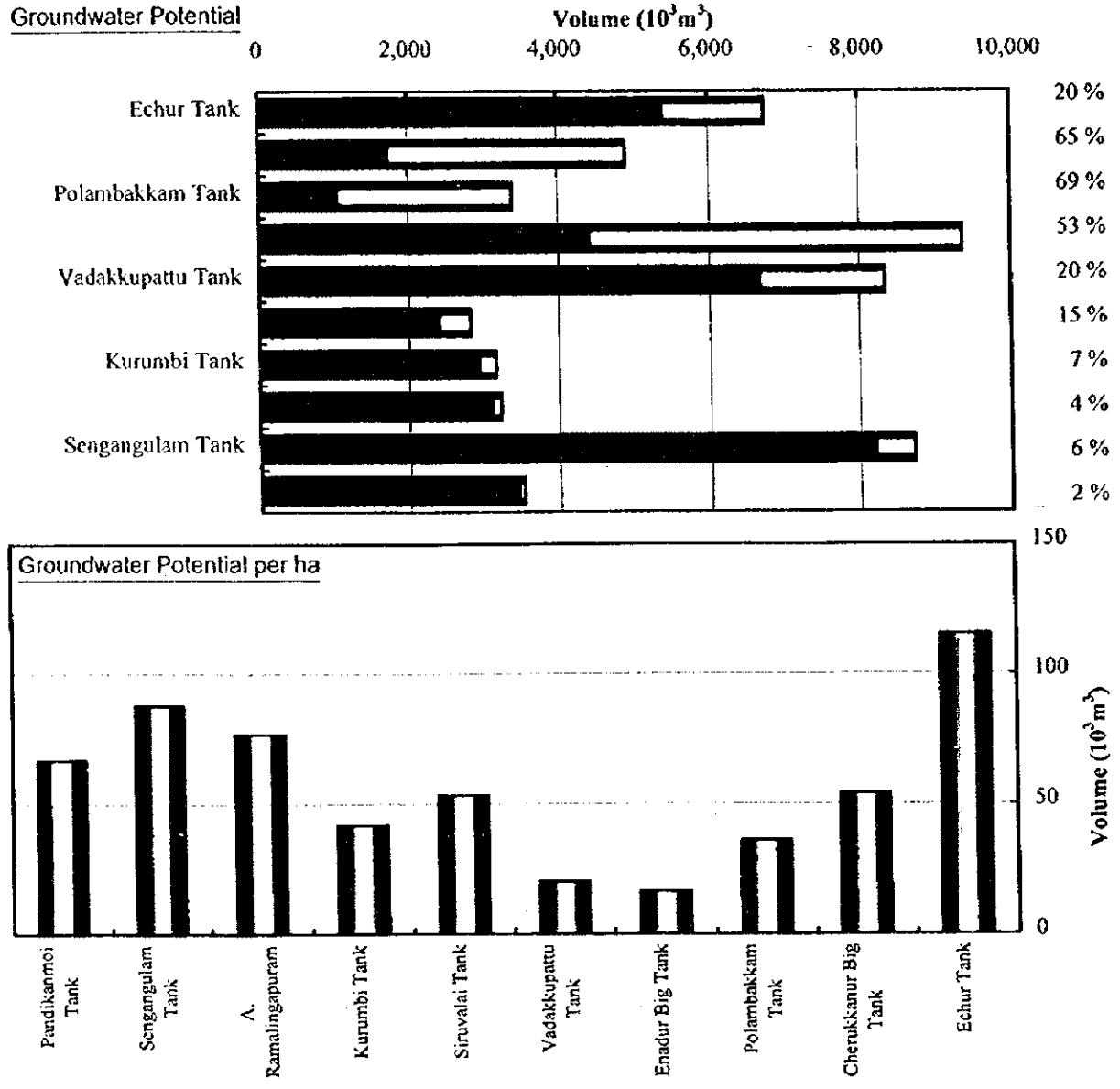


Fig. 2.3.1 GROUNDWATER POTENTIAL IN EACH PILOT TANK

CHAPTER 3 : ECHUR TANK AREA

CHAPTER 3 ECHUR TANK AREA

3.1 General

3.1.1 Location

Echur Tank of which registered command area is 58.6 ha is located about five (5) km east to Thirukalukundram town along the Thirukalukundram - Mamallappuram road as shown in Fig. 3.1.1. Administratively it belongs to Echur village in the Thirukalukundram Taluk of the Kanchipuram District.

The village area is surrounded by Nelvoy, Puliyur, Kulpanthandalam, Pulikundram villages in the north, south, east and west sides, respectively.

3.1.2 Natural Conditions

(1) Topography

Echur Tank is located west of the Thirukalukundram - Mamallappuram road adjacent to the road, and its waterspread area is measured to be 0.25 km^2. The ayacut areas of 58.6 ha expand in the north of the tank. The catchment area of the tank expands in the south and west areas of the tank. A supply channel flows into the tank at the western side of the tank.

The village areas are located at the southeastern corner of the ayacut areas, where the VAO's office, nursery and primary schools, a temple, etc. are situated. There exist some houses in the western end of the ayacut, too. An unpaved village road runs along the northern side of the tank, and another village road from the Puliyur to Nelvoy villages runs along the eastern side of the tank. These village roads cross at the northeastern corner of the tank.

The bund of about 1.2 km runs from east to west along the northern edge of the tank. The embankment of the Thirukalukundram - Mamallappuram road also plays a role of tank bund along the eastern side of the tank. The existing surplus weir of bye-wash type is provided at the northeastern corner of the tank, and a surplus channel runs northeastward from this weir.

The ayacut areas are generally flat with mild slope toward north or northeast, and the earthen irrigation channels runs generally northward branching many off-take channels. There are many dug wells scattered in the ayacut areas to take the irrigation water during the dry season. About 70 open wells are counted in the ayacut areas.

Some paddy fields expanding in the waterspread area of the tank are also cultivated in the western side of the spread area. These encroached lands are measured to be about eight (8) ha, and some open wells are also constructed in these encroached fields.

(2) Geology

Echur Tank region comprises Archean rocks with a thin soil cover. The oldest archean crystalline rocks are primarily made up of charnockites. The charnockites are intruded by quartz veins. Study of existing boreholes in this area shows that the rocks are weathered upto a depth of about 12m. Beyond this depth the rocks are fractured, jointed and fissured at different depths.

(3) Soils

The type of soil is generally black silty loam both in the catchment and ayacut areas. No saline soils are found in the area.

(4) Vegetation

The catchment area is mostly covered by the eucalyptus forest which was planted by Echur Panchayat. Beneficiaries of the forest are low caste people who uses fire wood. Other trees found in the catchment area are *Acacia Holoserica* and natural shrubs. No tank bed plantation is found.

3.1.3 Objectives

Echur Tank is categorized as a NR-1, which belongs to the Northern Study Area of annual rainfall more than 1,000 mm, and having an average cultivation area of more than 75 % of registered ayacut area, at a scale of less than 60ha. This means that surface water and groundwater resources are rather rich, and even at present all the ayacut area might be possible to be irrigated after irrigation efficiency is increased by channel lining.

According to the Baseline Survey, the tanks in Sriperumbudur Panchayat Union have surplus water about 90% of the year; cultivation ratio is more than 117 % with double cropping.

Therefore, objectives of Echur Tank rehabilitation are: 1) maximize the tank water instead of groundwater: 2) distribute tank water equally through the physical tank facility rehabilitation and channel lining.

3.2 Meteo-hydrology

3.2.1 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 the Tirutani Meteorological Station located in the Nandhi River basin. This station is maintained by the Ground Water Wing of the PWD and the access to the data is easy. Since Echur Tank belongs to the same North eastern agro-climatic zone, the climatological data of Tirutani Meteorological Station is considered to be the representative for Echur Tank also.

The coordinates of the Tirutani Station are:

- Latitude 13° 09' 20"N
- Longitude 70° 32' 40"E
- Altitude 86.59 m

All basic monthly climatological data is compiled in separate yearly records and is available on request from the Ground Water (GW) of PWD. Monthly totals and averages are presented in the table shown below.

Monthly Averages of Climatological Parameters

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean monthly temperature (°C)												
Average	24.4	26.0	28.5	31.5	33.4	31.9	30.2	29.5	29.2	27.8	25.4	24.4
Maximum	27.5	28.7	30.2	32.7	34.7	33.3	31.7	31.6	31.0	28.8	26.4	25.4
Minimum	22.6	24.1	27.0	30.3	31.2	30.5	28.6	28.3	28.0	26.7	24.1	23.2
Mean monthly humidity (%)												
Average	70.7	68.6	62.3	60.9	53.1	56.1	67.0	66.2	70.5	73.8	77.4	75.1
Maximum	80.0	85.3	81.3	85.5	69.1	73.1	100.0	81.3	82.8	85.1	94.0	88.1
Minimum	56.7	51.1	34.3	50.4	41.5	44.4	45.8	50.0	58.2	63.6	66.4	65.8
Monthly evaporation (mm)												
Mean	121.3	141.3	199.7	224.3	278.6	474.6	211.4	196.9	166.7	138.4	103.0	103.1
Maximum	179.2	169.4	256.0	287.0	632.1	493.1	368.9	273.2	226.7	179.1	137.4	149.6
Minimum	41.2	94.0	161.5	156.2	199.8	155.5	136.5	127.6	116.1	100.0	21.4	24.9
Average daily sunshine (hrs/day)												
Mean	8.3	9.5	10.0	10.0	9.2	6.1	5.3	6.1	6.2	6.4	6.1	7.0
Maximum	11.1	11.2	11.0	11.0	10.8	8.1	7.2	9.0	7.5	9.0	8.6	8.9
Minimum	2.0	6.3	8.7	9.2	6.3	4.3	3.8	4.2	4.8	4.8	3.1	4.5
Average wind speed (km/h)												
Mean	4.39	4.39	5.83	6.03	7.40	8.93	7.79	7.37	5.74	3.57	3.80	4.60
Maximum	11.90	8.60	11.67	7.96	12.55	14.40	17.45	17.45	15.98	6.50	5.60	12.00
Minimum	2.14	2.40	3.50	4.65	5.12	3.00	4.40	3.75	2.55	1.92	2.12	1.36

Temperature shows remarkably little/small variation. Mean annual temperature is 28.5 °C and North-east monsoon mean temperature is 25.9 °C. Relative humidity is influenced by the proximity to the coast of Bay of Bengal, which is nearly 25 km from

the tank. Annual mean relative humidity is 66.8 % with a higher 77.4 % in November and a lower 53.1 % in May.

Sunshine data are also available. Annual mean is 7.51 hrs/day, ranging from 6.5 hrs/day during the NE monsoon to 7.7 hrs/day between January and February. Similarly, total monthly evaporation fluctuates between 103.1 mm/month for December and 474.6.mm/month for June. As to be seen in the following section, agriculture in the tank area is seasonal unless irrigation is used by previously storing of rain water. November to February would be a pleasant cool and dry climate and from March to May would be hot and dry being summer, totally free from rainfall.

3.2.2 Rainfall

The rainfall in the catchment the area of Echur Tank varies with the seasons and it receives considerable rainfall both in Southwest and Northeast monsoon periods. For all rainfall computations, monthly rainfall data recorded at the nearest Chengalpattu Rainfall Station, maintained by the Revenue Department is utilized. The compiled daily rainfall data are available at Statistics Department. The mean monthly average rainfall based on the last 60 years data are shown as follows:

Mean Monthly rainfall (mm) of Echur Tank Catchment Area

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean	16.2	10.8	14.4	16.6	48.0	68.5	112.4	130.0	148.5	183.0	194.5	93.9	1023.5
Maximum	137.2	95.0	209.8	106.4	300.1	162.4	288.2	311.0	381.5	554.5	586.5	721.4	2161.8
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	19.0	14.0	8.6	24.0	0.0	0.0	465.0

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

- Southwest Monsoon (June-September): 454.6 mm (39.5 %)
- Northeast Monsoon (October-December): 603.6 mm (52.4 %)
- Winter (January - February): 29.9 mm (2.6 %)
- Summer (March - May): 63.0 mm (5.5 %)
- Total: 1151.1 mm (100 %)

The tank catchment receives its maximum rainfall in Northeast monsoon while the lowest rainfall occurs during the winter months of January and February. The mean monthly maximum rainfall is 194.5 mm in November, and the minimum rainfall is 10.8 mm in February. The annual maximum rainfall of 2,161.8 mm was recorded in 1947 while the minimum of 465 mm in 1989.

3.2.3 Catchment Area

Echur Tank is a non-system tank located in the Palar River basin. In preparation for the field visits a 1:50,000 map of the tank was obtained which permitted an assessment of the catchment and command area. As shown in Table 3.2.1, Echur Tank receives its

runoff water from its free basin of 1.57 km^2. Since this tank is the first in the group of tanks (comprising linked tanks), there is no intercepted catchment and hence the total catchment (free + intercepted) and the equivalent catchment (free + 20% of the intercepted) are one and the same which is 1.57 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 58.68 ha, and hence the ratio between free catchment and Registered ayacut is 2.68. The waterspread area of the tank in the PWD inventory list is 25 ha while that measured by the topography survey is 42 ha. No percolation ponds or other soil conservation structures was observed in the catchment area. Instead tank waterspread area is encroached by the rice farmers obstructing the flow to the tank.

3.2.4 Hydrological Analysis

The hydrological analysis comprises selection of method for estimation of runoff whereby certain percentage of rainfall is expected as yield from the given catchment conditions. Furthermore, the selected approach should be in line with the accepted procedures for yield estimation in the State. The method selected for estimating the runoff from the catchment is set out in the "College of Engineering Manual". The Strange Table is available to show the percentage of "monsoon" rainfall that can be expected as runoff for a range of total seasonal rainfalls varying from 25 mm to 1,500 mm. Data tables for three catchment conditions are provided: good, average and poor. There are short comings in this method such as not taking into account the extremely intense and variable nature of rainfall. Hence an approach Dry - Damp - Wet Method was used in which previous recorded moisture conditions were taken into account when estimating the runoff produced by a single storm.

Rainfall - runoff computations which have been carried out for monsoonal (September - December) and annual (January - December) periods for a continuous period of 18 years using the Strange Tables, are shown in the next page.

During 1978 - 1995, the mean annual yield was 36.4 cm with a maximum of 104.5 cm in 1978 and a minimum of 7.2 cm in 1989. The corresponding values of estimated annual runoff are 0.571 Mm^3, 1.640 Mm^3 and 0.305 Mm^3. The average runoff ratio is 34 %. The monsoonal (September - December) yield and runoff values also have been estimated and are presented in the table. The 18 year average monsoonal yield was 16.2 cm and that of runoff was 0.225 Mm^3. In average, the monsoon yield accounts for nearly 45% of total annual yield. Extreme variability of daily rainfall and resulting changes in soil moisture conditions have not taken into consideration and, hence, it is considered to either overestimate runoff for pre-monsoon months and under estimate for monsoon periods.

The runoff calculated based on the daily rainfall data for the years 1986 - 1995, using dry-damp-wet method is presented in Table 3.5.4 and 3.5.5. The annual runoff values vary from 0.2 Mm^3 in 1989 to 2.752 Mm^3 in 1993. The average annual runoff for this 10 years period is 0.866 Mm^3, the average runoff ratio being, 45 %. Similarly, the runoff

values calculated for the monsoon period, September - December varies between 0.122 Mm^3 in 1989 to 2.435 Mm^3 in 1993, with a monsoonal average of 0.630 Mm^3, the runoff ratio being 49 %.

Yield and Runoff from Catchment Area of Echur Tank

Year	September - December			January - December		
	Rainfall (cm)	Yield(cm)	Runoff (Mm^3)	Rainfall (cm)	Yield(cm)	Runoff (Mm^3)
1978	139.8	57.0	0.896	195.6	104.5	1.640
1979	121.9	43.0	0.676	164.0	80.8	1.269
1980	87.2	20.9	0.329	108.7	33.5	0.526
1981	26.1	0.9	0.014	67.9	11.7	0.183
1982	55.7	7.7	0.121	81.8	18.0	0.282
1983	41.3	3.4	0.053	68.0	11.7	0.184
1984	97.5	26.6	0.418	150.6	67.8	1.064
1985	35.7	2.2	0.035	69.1	12.4	0.195
1986	68.5	12.2	0.191	98.0	26.9	0.423
1987	87.2	20.9	0.329	101.5	28.5	0.448
1988	45.0	4.3	0.067	84.5	19.4	0.305
1989	31.9	1.5	0.024	55.5	7.2	0.113
1990	50.1	5.6	0.088	78.6	16.5	0.259
1991	92.9	23.9	0.375	112.8	36.7	0.576
1992	46.1	4.5	0.071	57.4	7.9	0.124
1993	91.0	22.7	0.357	107.3	32.4	0.509
1994	99.8	27.9	0.439	155.9	71.7	1.126
1995	53.7	6.7	0.105	149.7	67.4	1.058
Mean	70.6	16.2	0.255	105.9	36.4	0.571
Maximum	139.8	57.0	0.896	195.6	104.5	1.640
Minimum	26.1	0.9	0.014	55.5	7.2	0.113

3.3 Social Conditions

3.3.1 Sociological Survey and Assessment

The sociological assessment of the farmers in the Ayacut of Echur Tank was carried out during the field survey in order to grasp the farmers' sociological settings and to facilitate the prioritization of the projects in terms of organizing farmers as well as formalizing WUA.

3.3.2 Method of Assessment

The assessment was conducted in the manners employed for the rapid social appraisals for EC-assisted project. It would take 2 - 3 days and work to date has concentrated on identifying the key variables and ascribing to them relative importance in terms of social organization.

The social environment is very varied in its potential for collective action. Among others, the following 10 items of variables were surveyed as being important.

(1) Number of Hamlets

The number of hamlets served by a tank is a variable influencing the pattern of cooperation. If the number is low, the potential for conflicts is low. However hamlet number is not to be considered on its own. It is the combination of hamlets with the leadership pattern which is crucial. When preparing an index for ranking tanks for modernization these two factors have to be considered together.

(2) Variations in Farm Size

In general, the smaller the variation in farm size the better the cooperation among the farmers. However there are exceptions to this rule. If the homogeneity is due to the fact that most of the ayacuttars have very small holdings, then the chances for resource mobilizations seems to be limited. On the other hand, homogeneity of farm size based on bigger holdings seem to be better correlated with cooperation of farmers.

(3) Size and Number of Caste Groups

Caste is both a positive and negative force. It was found that it is not the case *per se* but the politicization of caste that leads to group conflict. With respect to water management different caste groups generally work together and cooperate in the maintenance of the system since water is a common resource.

(4) Distance of Tank from Major Center

If a tank is located close to a town, the possibilities of non-agricultural employment arise for those whose holdings are marginal. Involvement in forming and participating in water users associations is reduced. Drought increases this trend.

(5) Social History of the Tank

In villages where there has been a major change in land ownership cooperation is reduced. New leadership may not have emerged or a few big farmers belonging to the previous dominant caste may continue to hold lands but their leadership is no longer accepted. The situation is compounded when these caste groups are concentrated in different hamlets.

Also of importance is the history of interaction between groups based on caste and those differentiated by other factors.

(6) Farmers' Association

The presence of informal associations prior to modernization facilitates the

establishment of formal associations. The absence of any association makes the establishment of formal associations that much more difficult.

(7) Leadership

The type and quality of leadership is considered to be by far the most important single variable affecting social organization. The following classification of leadership is considered in the field survey.

a) Individual: an individual sets the tone for cooperation among ayacuttars.

b) Group: often one caste group acts as leader or there are a few families who traditionally have been able to mobilize resources for community activities. Group leadership is preferable to individual leadership since the latter can break down with the death or departure of the leader.

c) Vague: no individual or group is definitely looked upon and the task of enlisting the cooperation of farmers is difficult.

d) Vacuum of Leadership:
this situation exists where the traditional pattern has been disturbed and a new group leadership has not emerged. For example, the traditional land holders, the Brahmins, have mostly left the village. The remaining few are neither accepted by others, nor are they prepared to follow others. Thus there is a vacuum of leadership and the task of participatory management becomes difficult.

e) Absence of Positive Leadership:
in this situation not only is leadership absent but there is a negative element also. In for instance, the officials had made a great deal of effort to enlist the cooperation of the ayacuttars but still the ayacuttars have not shown enthusiasm. It is in such situations that training and motivation programs become necessary.

(8) Internal Resources Mobilization

The success of participatory management greatly depends upon the capacity and attitudes that farmers have towards resource mobilization. Some tanks have already established a pattern of raising funds through sale of trees or fish from the tank. An attitude of financial responsibility prevails. Elsewhere no thought is given to the collective raising of funds.

(9) Water Distribution

In Tamil Nadu there is a strong traditional system of water distribution and the work of opening the sluices used to be inherited down the family line. Its continued presence is a considerable asset for successful modernization.

(10) Maintenance of Tank Structures

In some tanks the farmers raise funds and undertake maintenance as a group. In others maintenance is the work of individual farmers. The former situation is desirable.

The assessment is conducted employing the scoring system as tabulated below

These results of scoring will be used for determine the degree of community organizer's effort and timing of their placement required to effect sustainable collective action as shown in the table.

Timing of Community Organizer Placement

Score	Rating	Timing of Community Organizer Placement
> 80	Good	At time of estimate preparation
60 – 80	Average	Two months prior to estimate preparation
< 60	Poor	Six months prior to estimate preparation

Social Scoring System

Variables	Range of Variables	Weight in Points	Total
Number of hamlets	1	5	5
	2	4	
	3 - 4	3	
	5 - 6	2	
	7 - 8	1	
	Above 8	0	
Farm Size	Homogenous ->70% with no variation in size	5	5
Conflicts	Rare conflicts	15	15
	Occasional conflict	10	
	Frequent conflict	5	
Association	Formal	10	10
	Informal	8	
	Absence	0	
Leadership	Group	35	35
	Individual	30	
	Vague	20	
	Vacuum	10	
	Absence (conflict)	0	
Resource Mobilization	Positive	20	20
	No potential	0	
Water distribution and maintenance of structures	Committee or Collective	10	10
	Individual and Committee	8	
	Individual Farmers	5	
Total Scoring		-	100

3.3.3 Present Social Conditions and Facilities

Socio-economic conditions of the pilot tank areas including Echur Tank area are summarized in Table 3.3.1.

(1) Available Social Facilities in the Village

The drinking water supply system is provided for all the villagers. About 64 % of villagers use the piped supply system, and the remaining 36 % take the water from deep and shallow wells. The water quality of these sources is considered to be fair. However, the electricity supply system is provided for only 78 % of villagers.

The village is located beside the paved main road from Thirukalikundram to Mamallappuram; regular bus services are also available. The unpaved village roads are also extended in the village areas connecting the neighboring villages.

There are a nursery school and a primary school (from Grade 1 - 5) in the village, but no health and clinic facility is available. A community hall is located at the center of village area.

(2) Social Settings of the Ayacut Area

1) Land Holding and Relating Villages or Hamlets

There are 166 farmers in the ayacut areas of Echur Tank, and their average land holding size is calculated to be about 0.35 ha. About 96 % of the farmers are marginal and small farmers. All the farmers in the ayacut areas live in Echur Village. There is no farmer of the other villages in the ayacut areas.

2) Caste Composition

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

Caste Composition in Echur Tank Ayacut Area

(Unit: %)

Others	Backward Caste (BC)	Most Backward Caste (MBC)	Scheduled Caste (SC)	Scheduled Tribe (ST)	Total
0	5	50	42	3	100

The farmers in the ayacut areas are composed of the caste categories of MBC and SC mainly composed of Vanniar and Adidravida, respectively. About 92 % is shared by these two (2) categories. The other caste groups are BC and ST, and they are Dhobi and Irulla, respectively. Hinduism is believed by all the peoples in the ayacut area.

3) Water Distribution and Decision Making Procedure

There is no such registered organization as water users' association in the ayacut area. The water distribution has been decided by the temple trustee selected among farmers in consultation with the farmers in the ayacut area. The actual operation of water distribution is carried out by the operators called *Neerkatis* who are selected among farmers periodically. In Echur Tank ayacut areas, two (2) *Neerkatis* are engaged in operation of water distribution. Some 30 kg/ha of paddy is paid for these *Neerkatis* during the irrigation period from December to April by the farmers in the ayacut area in accordance with their cultivated areas. Recently after the election of Village Panchayat, the Village President takes the

leadership role in the operation of water distribution.

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 such as temporary repair for breach of the tank bund, etc. The removal of weeds and the desilting works of the sluice are carried out by the assigned *Neerkatis*.

5) Conflicts and Problems

According to the farmers in the ayacut areas, there exists neither conflict among either the caste groups or nor disparity in receiving irrigation water. Some disadvantageous farmers in receiving irrigation water may not be able to receive enough irrigation water during the water scarce period. Such farmers abandon their cultivation and work as the agricultural labors for the other large farmers. Because of this traditional aid system, no conflict takes place even though marginal and small farmers have some complaints concerning water distribution.

6) Other Employment Opportunities

During the non-cultivation period, most of the farmers have to get income through non-agricultural employment. Usually they go out of the village and work as construction laborers in Thirukalukundram and Chengalpattu located about five (5) km and seven (7) km away from the village, respectively.

3.3.4 Sociological Evaluation

Based on the criteria described 3.3.2, the sociological conditions of Echur Tank Area are evaluated as stated below.

Results of Social Scoring of Echur Tank

Factors	Hamlets	Farm Size	Conflicts	WUA	Leader-ship	Resource Mobilization	Main-tenance	Overall Score
Scores	5	1	15	8	35	20	5	89

This result shows that the social condition in ayacut of Echur Tank is good score and timing of the community organizer's placement for the formulation of a WUA shall be at the commencement of the estimation preparation.

3.4 Agriculture

3.4.1 Present Agriculture

(1) Land Use

The registered command area is 58.6 ha of which the irrigable area is 47 ha (80.2 % of the command area) in normal year. In 1995-96, paddy was cultivated in the area of 47.1 ha (80.4 %) during the period from August to December, and an area of 11.3 ha (19.3 %) from December to April was cultivated as the 2nd crop. The total cropped area in the year was 58.4 ha and the crop intensity was 99.7 %. In normal year, in addition to paddy, groundnut is also cultivated in a small area of 2.0 ha (3.4 %) after harvesting the 1st crop of paddy. The crop intensity in normal year is 100.7 %.

(2) Soil and Land Capability

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

(3) Agricultural Production

1) Crop Production

The main crops cultivated in the area are paddy and groundnut. Ragi is occasionally cultivated in the dry season after paddy but the areas and production are negligible. The paddy is partially cultivated twice a year in the area of about 22 % of the field of 1st crop. The crop production in normal year was 218.6 tons for the 1st crop of paddy, 46.5 tons for the 2nd crop of paddy and 3.0 tons for groundnut. The average yield in normal year is 4,650 kg/ha for paddy in both seasons and 1,500 kg/ha on groundnut. The average yield of paddy in 1995-96 who also 4,650 kg/ha for both crops. The main varieties used are IR-50 and IR-20 for paddy and JL24 for groundnut.

2) Irrigation Water

Tank water is available from October to January with irrigable area of 58.6 ha in normal year, but the commencement time, the available period and the irrigable area vary year by year. While, at present, 61 wells with irrigable area of 12.6 ha are being used in the area.

3) Fertilizer Application

According to the data of farmers' interview survey, 62 kg of N, 35 kg of P_2O_5 and 5 kg of K_2O on average per ha was applied in 2 to 3 split applications for paddy. N and P_2O_5 were applied in all farmers' fields but K_2O was applied only 22 % of the farmers' fields. These amounts applied are less than those recommended by the government; N: 120-150 kg/ha, P_2O_5: 38-50 kg/ha, K_2O: 38-50 kg/ha. This result indicates that an increase in yield with improvement of fertilizer application could be expected.

4) Labor Input

The family agricultural labor in this command area was 2.5 men/house and the potential agricultural labor was 4.2 men on average. The necessary staggering period in the command area to accomplish the paddy farm works by family labor is enough for 5 days when the potential labor is used. This result shows that there is no shortage of agricultural labor in this command area at present.

5) Livestock Breeding

The data of livestock breeding considerably differed depending on the data source. According to the data collected from the AD branch office, cattle was the most popular livestock in this command area, which was raised by 84 % of the farmers in the area with 2.1 heads on average, followed by goat (12 %, 6.0 heads) and sheep (5.4 %, 7.2 heads). While, according to the data of the farmers' interview survey, the main livestock were cattle (44.4 %, 3.0 heads), poultry (33.3 %, 3.7 heads) and goat (11.1 %, 2.0 heads). Marketing activities such as selling, purchasing and consumption of livestock can not be seen throughout the year.

(4) Farm Size and Land Tenure

The number of farm holders in the tank area is 166 of which 4 % comprises farm holders of more than 2 ha, 55 % is farm holders of 1 to 2 ha and 40 % is farm holders below 1 ha (marginal). The average farm size is extremely small, that is, 0.35 ha which is only 38 % of that of the state (0.93 ha), and 22 % of that of all India (1.57 ha).

3.4.2 Agricultural Development Plan

(1) Land Use

As shown in Table 3.4.1, the crop intensity planned to be increased from 100.7 % at present to 122.2 % in plan with the effective use of well water in the dry season.

(2) Cropping Plan

1) Basic Concept for Cropping Plan

In order to improve the present low farming profit by paddy mono-culture, the target of farming of the command areas was focused on ***"Rice Based Profitable and Sustainable Agriculture"*** with introduction of high return crops. The rice cultivation aimed at securing of self-support amount which was set up at 2,000 kg per household based on the data obtained from the farmers' interview survey. The promising crops were chosen in consideration of the suitability of the crops to the areas.

2) High Return Crops

The highest net income per ha is obtained by turmeric which is more than 6 times of the one for paddy, followed by green chili (5.7 times of the one for paddy), banana (over 4 times), ladies' finger (3.3 times), egg plant (3.0 times), tomato (2.9 times), dry chili (2.9 times), sugarcane (2.7 times) and casuarina (1.7 times). Drip irrigation showed higher net income than that of surface irrigation. Turmeric showed the highest net income per day per ha and ladies' finger had 2nd position.

3) Cropping Plan of Echur Tank Area

The cropping plan is shown in Table 3.4.1 and Fig. 3.4.1. In this plan, 52.0 ha were allotted as paddy area and 19.6 ha allotted as ladies' finger in the dry season from January to April (7.0 ha) and May to August (12.6 ha) using well water.

(3) Crop Budget and Production Plan

The planned production amounts, the production costs and the net incomes of crops are shown in Table 3.4.2. The net income of the paddy almost keeps the present level. The ladies' finger generated the net income of Rs.863,200 from the 19.6 ha which corresponded to 108.4 % of the present total net income of the command area. In the study areas where the expansion of irrigable area is difficult, an introduction of high return crops will play a great role in increase in farming income.

(4) Employment and Working Opportunity

As vegetable cultivation requires labor around 4 times of paddy, the introduction of ladies' finger for 19.6 ha will bring certain increase in employment and working opportunity throughout a year, especially for the women in the command area.

(5) Farm Management and Farm Budget

1) Farm Management Plan

i) Basic Concepts for the Farm Management Planning

Due to the fundamental factors of a limited farmland area and limited capabilities in finance and techniques for each farm, particularly for small and marginal farms, the plan of farm management should be planned as follows:

- A maximum cropping intensity for minimizing the fallow land area in both seasons. Crop diversification, therefore, will be intensively carried out. For drought prone areas, drought-resistant crops such as cassava, mulberry, etc., should be basically considered for application.
- Land consolidation works and intensive soil management in each farm should be done, particularly during the dry season when there are few farming works.
- An intensive elaboration of conjunctive use of water from rainfall with tank water and available groundwater for double cropping on each farmland.
- Evaluation of crop budgets for suitable crops based on experiences and the cropping patterns recommended by this Study.
- Accordingly a selection of varieties with higher yields and higher marketability based on available corresponding inputs should be made.
- For agricultural produces subjected to value added purposes, the selection of varieties suitable for the corresponding processing treatments should be done accordingly.
- Post-harvest treatments should be intensively elaborated for maximizing the value-addition of agricultural produces.
- A careful elaboration on local resources and measures for reducing the expenditure on farm inputs as much as possible.
- Programmes on finance procurement and labour arrangements should be clarified.
- A considerable application of the integrated agriculture even in a small scale for balanced cultivation, livestock and aquaculture for evenly distributing the family labour force and for higher farm revenues.

ii) Specific Elements on Farm Management for Echur Tank Area

In the command area of Echur Tank, the cultivation of rice is dominantly performed but the application of an integrated agriculture has been observed to be very neglected. After the harvest of the second paddy crop in late April, all paddy fields are observed to be in fallow condition and almost farmers have no activities until August. Only a few farms in the

village are tending home gardens with well water during this period

Out of the two seasons of rice cultivation, the first crop starting from August is observed to heavily rely on the rainfall pattern, bringing about low average yield. For other farm management works on paddy cropping, the situation has been observed as being done in a proper way.

Specific elements for farm management in this tank area would be as follows:

- The elaboration on extra water supply i.e. groundwater for conjunctive use with rainfall for obtaining constant good yield in the first crop.
- The elaboration for partly crop diversification and integrated agriculture i.e. more applications for home garden and raising livestock at family base.
- The elaboration for implementing possible agro-processing treatments i.e. works for making processed fruit and rice products for value-added purposes.

All these specific elements will be taken into consideration on the basis of a combined evaluation for balancing all these elements to establish a proper management plan for each farm in this tank area. And, for each year, this plan will be reviewed to check the results from the previous year and to identify the necessary changes in each element for making the new management plan for the next year.

At each farm, the elaboration on farm management plan is subjected to be gradually carried out with a basic knowledge on agricultural techniques, market distribution etc. by each farm, Official supporting services related to these aspects, therefore, are considered necessary, particularly for small and marginal farms. The establishment of Local Farmers' Organization, therefore, should be able to support local farmers in these farm management activities.

2) Farm Budget Plan

i) Background

As farm budget is an important element in the farm management, this element should be intensively elaborated for properly implementing at farmer level. This means individual farmers should have the basic capability to perform the financial analysis of their own farm budget to know their present situation and to make a better plan for higher farm incomes in the next crop year.

From the results of our farm surveys, the general deficit situation was considered in the farm budget for small and marginal farms, particularly for marginal farms whose farmland areas are less than one ha.

From this background, it is necessary to make the basic directives for improving this situation for local farmers in the Pilot Tank Areas, especially for the categories of marginal and small farmers to develop their own institutions for improving life conditions through increasing their agricultural production.

ii) Basic Concepts for Farm Budget Planning

For planning the farm budget for each individual farm, the following basic concepts are recommended for preliminary considerations by each farm prior to starting each annual production works:

- Possibilities for maximizing the cropping area per season
- Selecting the crops and varieties of highest revenues
- Checking the possible markets and possible prices.
- Estimating the final farm income after all production costs have been considered
- Estimating the annual family expenditure and the balance remained.

This would require local farmers to have a basic level of knowledge on related items but through the Local Farmers' Organization with the collaboration from local agricultural officers, these basic calculations on farm budgets could be solved accordingly.

In this procedure, due to the limited cropping areas for small and marginal farms, the consideration for crop diversification for higher farm revenues would be the basic point for planning farm budget. Besides, the value-added amount from various post-harvest works will be elaborated for intensive applications.

At the final stage, the items of living expenses with possible monthly or annual amounts should be calculated for gaining a positive balance after all related deductions.

iii) Farm Budgeting Procedure

Regarding the procedure for farm budgeting in Echur Tank area, specific considerations are recommended in 3 basic parts as follows:

- Evaluation of costs and benefits of the first and second paddy crops
- Evaluation of costs and benefits of various possible patterns of crop diversification
- Evaluation on costs and benefits for items of integrated agriculture and post-harvest treatments for value-addition

The cross-examination of these 3 evaluations would prove the proper alternative on farm budget for each farm. In order to assist individual farms in the tank area to properly elaborate their farm budgeting plan, representative farm models with different farm sizes will be used.

(6) Marketing Plan

1) Basic Concept

Basically the existing systems of regulated markets and taluk/district open markets will be maintained.

With the implementation of new programs on agricultural production, and for supporting small and marginal farmers to access the more profitable marketing channel(s), proper arrangements for supplying agricultural inputs and materials for their production, as well as proper facilities for them to sell their surplus produces should be established accordingly.

2) Development Strategies

Two components on marketing activities will be considered as follows:

i) The strengthening works for local open village markets including the installation of some proper common ground with sheds and perhmanent shops selling necessary daily goods and basic agricultural inputs. These shops would be managed or supported by *Panchyat Unions*

ii) The facilities relating to the new agricultural production programme to be promoted under the control of the newly established farmers' organization consisting of post-harvest and agro-processing facilities and transportation vans.

3) Marketing Plan

The following marketing facilities are proposed to be established for this tank area :

- Installation of some farm shops in the village for selling necessary

agricultural inputs and materials to farmers, as well as local produces to local inhabitants
- Installation of a godown of foodgrains under the control of farmers' organization.
- Installation of some units for processing processed fruit and rice products
- Arrangement of some transport vans for transporting local produces etc.
- Training of subjected farmers for the above activities

3.4.3 Agricultural Supporting Services and Institutional Plan

(1) Agricultural Extension Service

1) Present Activities

Presently agricultural extension service in the Study Areas is carried out by Agricultural Department (AD); the block level office is directly related with the farmers. Technology development and agricultural research is left to state agricultural university. AD and Horticultural Department (HD) are suppliers of certified seeds and seedlings to the farmers. Fertilizers are supplied by private dealers and cooperative societies. Agricultural chemicals and agricultural machinery are supplied by AD and private dealers, respectively. Main activities of agricultural extension services are technology extension through farmers training, meeting farmers and dissemination of printed matters. Technology demonstration is seldom carried out due to lack of budget.

2) Establishment of Technology Demonstration Centers

With introduction of profitable cash crops, however, growers' needs will be increased toward the technologies for cultivation, post-harvesting, packing and shipment and food processing etc. It is, therefore, proposed to establish a technology demonstration center located in each district. In order to smoothly and effectively carry out the activities of the centers, it is also proposed to establish a Institutional Support System comprising relevant support agencies of PWD, DA, HD and state agricultural university.

The activities, the staff members and the facilities of the centers are listed below.

Activities
- Demonstration of new crops and new cultivation technology
- Demonstration of water management technology
- Demonstration of drip irrigation technology
- Demonstration of post-harvest technology
- Demonstration of packing and shipment of agricultural products
- Demonstration of food processing
- Supply of seeds and seedlings of new high return crops

- Farmers' training

Staff Members

- Agronomist: 1 - Superintendent
- Agronomist: 1 - In-charge of new crops cultivation
- Agronomist: 1 - In-charge of post-harvest technology and processing technology
- Assistant staff: 6
- Farm worker: 10

Facilities

- Building:	Staff room	75 m^2
	Farm workers' room	15 m^2
	Training room	75 m^2
	Processing room	100 m^2
- Area:	Building site	300 m^2
	Field	17,000 m^2
- Equipment:	Dryer	1
	Cutter	1
	Sterilizer	1
	Refrigerator	1
	Canning machine	1
	Tractor	1
	Pedestrian Manual tractor	1
	Harrowing rotor for tractor	1
	Others (tables, stuff desks and chairs etc.)	

As far as the study of drip irrigation is concerned, as shown in the table below, remarkable effects of drip irrigation on water-saving and net return of cash crops can be recognized. Judging from the agricultural conditions of the State, it seems that drip irrigation is a recommendable practice for the future in the State, especially for the Southern Study Area.

Results of Drip Irrigation(Agricultural Research Station, Bhavanisagar)

Crop	Irrigation Method	Quantity of Water Used (%)	WUE	Yield (ton/ha)	Cost of Cultivation (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	Effective Rainfall (mm)
Turmeric	Surface	100	15	28	25,100	110,720	85,620	212
	Drip	80	30	32	32,100	128,400	96,300	212
	Drip	60	24	34	32,100	135,800	103,700	212
	Drip	40	20	34	32,100	134,960	102,860	212
Sugarcane	Surface	1,824	69	125	25,800	60,780	34,980	
	80%	1,531	109	167	34,300	85,200	50,900	
	60%	1,250	131	167	34,300	75,000	40,700	
	40%	1,028	153	157	34,300	71,040	36,740	
Banana	Surface	2,553	13	28	25,100	83,895	58,795	
	24 L*	1,391	26	31	32,100	92,970	60,870	
	32 L*	1,726	21	32	32,100	96,210	64,110	
	40 L*	2,062	17	32	32,100	96,000	63,900	

Notes: * Litter/plant/once in 2 days **Including effective rainfall ** *Average of 2 years
WUE: Water use efficiency (kg/ha/mm)

(2) Agricultural Credits System

1) General

In order to achieve the project objective for improving the farm income and living conditions of small and marginal farms, it is necessary to effectively support their agricultural production activities. At present, due to the situation of seriously lacking finance, small and marginal farmers have to borrow money on loans for rice production as staple food. From the local loan society, farmers could borrow only about Rs.2,000 - 3,000 per ha for rice cultivation with an annual interest of 12 - 14 %. But for availability of loan, they should have properties as guarantees with a very high interest rate of more than 22 % per annum. The loan interest is considered too high for them. A special credit scheme, therefore, is proposed for implementation to support the farm activities of these underprivileged farm categories.

2) The Agricultural Credit Scheme for Underprivileged Farmers

The agricultural credit aiming at the underprivileged farmers, therefore, should be made in a special scheme with substantial incentives for these farm categories.

3) Credit Scheme

Judging the present financial situation in India and the financial justification on the categories of small and marginal farms subjected to the farm revenue targeted by the Project, only these farm categories should be financed by a credit scheme with substantial subsidies for their farm production i. e. Rs.5,000 per ha with an annual interest of approximately 10 %. Measures for calamities should be taken into consideration for this credit scheme.

The flow of loan disbursement, therefore, would be made in the following two-step procedure: 1) from the central government bank to the newly established Local Farmers' Organization, and 2) from the farmers' organization to the farmers (small and marginal farms only).

The prime interest from the central government bank to each Local Farmers Organization will be at the same rate of 4 % as being disbursed to the state bank at present. The amount from the differential of 6 % (10 % - 4 %) would be used for the operation capital of each Local Farmers' Organization and for the relief measures to farmers who are unable to repay due to natural calamities. This would be made also as a mutual fund in the tank area to help landless people for working in various O&M programs for the Project.

3.5 Rehabilitation of Tank Irrigation System

3.5.1 Present Conditions

(1) Irrigation and Drainage System

Ground slope in the ayacut has inclination towards south from the tank bund. The area along sluice No. 2 channel is the lowest.

According to the village map prepared in 1985, about 40 wells are installed and distributed as follows: 1) 16 wells at higher elevated area between No. 2 and 3 sluice channel, 2) 10 wells at tail reaches of irrigation channel at the northern part of the ayacut. Presently 70 wells are existing (by Tank Inventory List), then the average wells per ayacut is 1.19 wells/ha. These figure shows, the tank water is not considered as a liable water source for irrigation. And more wells in tail reaches shows the inequity irrigation water distribution made.

Main sluice is No. 1 sluice having the lowest sill elevation and covering more than 60% of ayacut area. No.1 sluice channel diverted into two main channels after crossing the village road along the tank bund. One main channel runs along the northern border of Echur village, the other main channel flows into No.2 sluice channel running along the village road at the foot of the tank bund. Both of them have one branch channel with length about 730m and 750m, respectively.

No.2 sluice channel flows toward North with 475 m receiving surplus water from No.1 and 3 sluice channels. It is possible that No. 2 sluice channel to have a dual function.

No.3 Sluice channel has the highest sill elevation, about 2m higher than No. 1 sluice. This sluice can take water only for a short period compared to other sluices. Many wells are installed in the command area of No. 3 sluice.

Because of topography of the ayacut area, plot to plot irrigation is mostly practiced, and the height of the irrigation channel bund is high.

(2) Tank Bund

Existing dimension and soil mechanics properties of tank bund are shown in Table 3.5.1 and 3.5.2. Soil erosion easily occurs on the rear slope of the bund, and seepage is observed at the foot of the bund. The crest of the bund has been heavily affected by erosion and animal crossing. The bund was protected by sand bags as temporary works.

(3) Spillway (Surplus Arrangement)

1) Location

2 types of weir are installed in this tank. Weir 1 is B.C. type and 2 is Natural Bye-wash type. Location of these arrangements is shown in Fig. 3.5.1.

2) Existing Condition

There is no damage and cracking in both structures. Weir 1 (B.C. weir) has an orifice for irrigation; water from this facility is utilized at the end of ayacut area. Because this facility has no control device, it is obstructed to store the water in rainy season.

(4) Intake Facilities (Sluices)

1) Location

There are 2 head sluices in this tank, one (Sluice 1) is a head wall type and one (Sluice 2) is a head tower type. Apart form the above, a vent of 30cm height and 30cm width, is installed in the apron of B.C. weir as shown in Fig. 3.5.1.

2) Existing Condition

The masonry body of these sluices have some deteriorated parts; it is not considered necessary to rehabilitate them. However, since wall for sheathing is not installed in the tower head type, slope failure occurs around the sluice point. Plug and plug rod type sluice mechanics is operated by *Neerkatis* to control the amount of intake water, the effective control of water delivery is not confirmed at the site.

(5) Groundwater Irrigation

Groundwater is used for irrigation purposes during non -monsoon periods. Most of wells in this area are large diameter open wells. These large diameter dug wells give very high yield and are highly exploited for agricultural purposes.

(6) Operation and Maintenance

No formal WUA exist. Traditional water distribution is applied in the area, but no conflicts on water distribution take place. If there is not sufficient water they operate their own well for irrigation. Most of irrigation channels are well maintained concerning slope and desiltation at present. The maintenance is done by the rotation of irrigation by plugging and removing the temporary earth checks by farmers.