4.6.4 Tube Wells

The existing wells in Stage III & IV are easy to be dried up due to draw down of groundwater level during end of dry season and closure period of the main canal. Number of proposed new tube wells in Stage III and IV are 30 and 20, respectively. The location map is given in Fig. 4.6.3. Tube wells are planned to be dug by boring machine and deep-well handpumps are required to install in each well. Rusting of rods and riser pipes of hundpump should be done because of need for good maintenance (Fig. 4.6.4). Most handpumps employ a piston with leather washers which moves up and down inside a cylinder, and the washers must be regularly replaced.

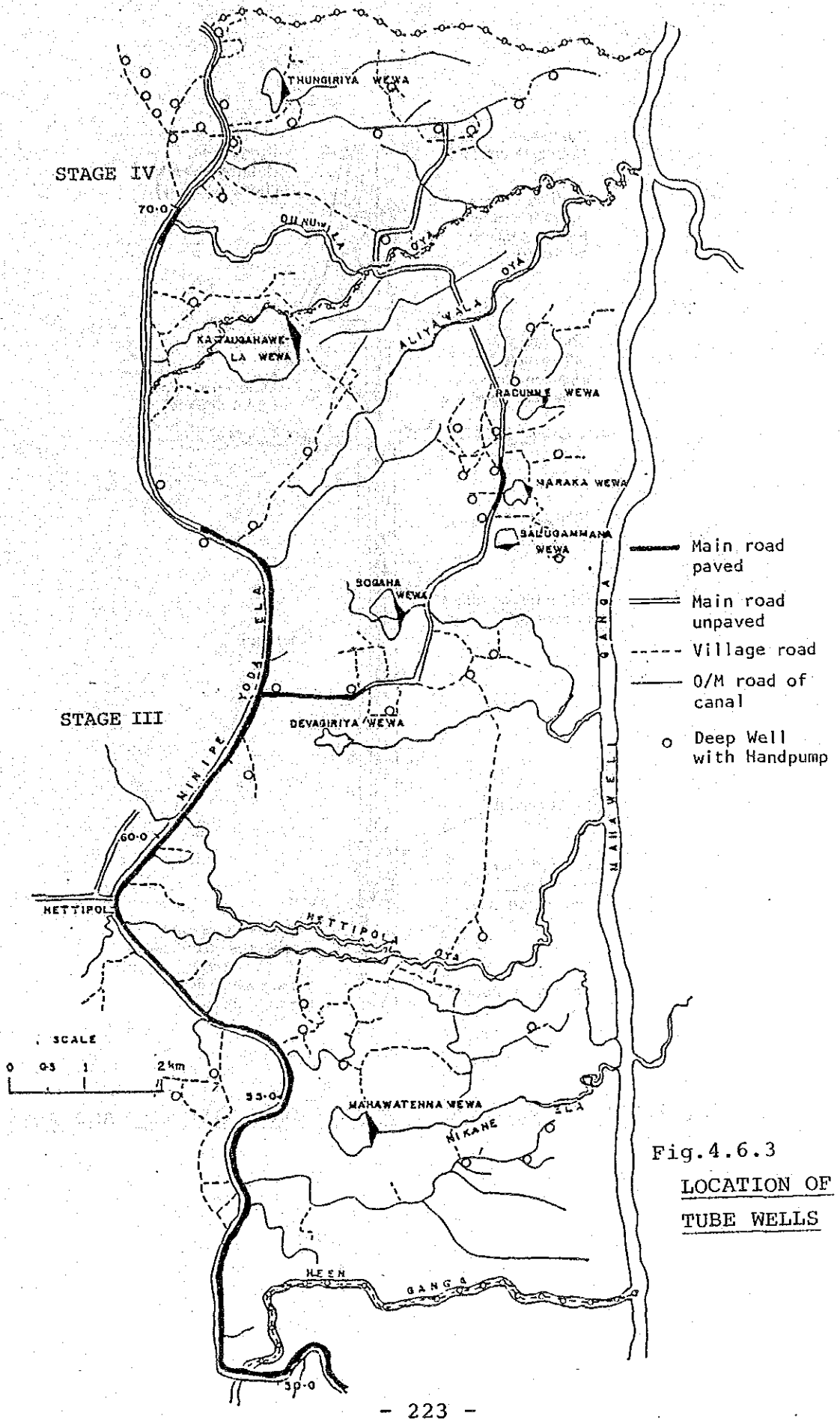


Fig.4.6.3
LOCATION OF TUBE WELLS

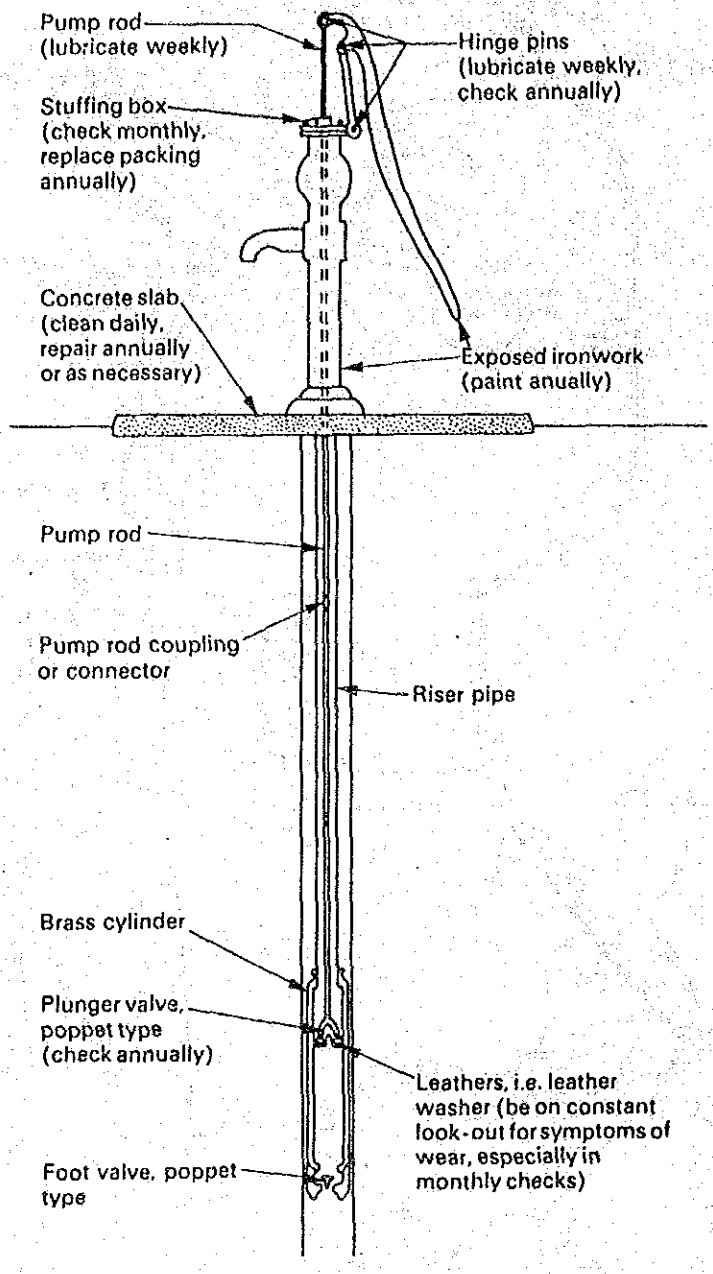


Fig.4.6.4 MAINTENANCE POINTS ON A SIMPLE HAND PUMP

4.7 OPERATION AND MAINTENANCE

4.7.1 Basic Policy

Operation and maintenance of facilities in the Minipe Scheme can be divided broadly into two categories, i.e. water management facilities and road facilities. The government agencies related the INMAS Programme stated in para 4.3.1 are required to be functional and to maintain the main canal and D-canals forming part of the Scheme. Field canals are to be maintained by the farmers under the supervision of the related agencies.

The Highway Department is required to maintain the main roads and paved portion of the O & M road of the main canal (except in Stage I) since these roads are being used not only for the operation and maintenance of the main canal but also as public roads for economic activities serving as bus routes and roads for the use of trucks and other vehicles. Up to now, these roads are being maintained by the Highway Department.

The Land Commissioner has been expected to maintain village roads except O & M roads of canals up to the present. But the maintenance of village roads has been abandoned due to the lack of any budgetary provision. Therefore, the village roads would have to be maintained by the line agencies under the INMAS Programme and the farmer organisation in future.

4.7.2 Agencies and Organisation

The operation and maintenance of the irrigation systems would continue to be responsibility of the Irrigation Department under the overall coordinated programme by the Irrigation Management Division.

The ID staffs such as technical assistants, work supervisors and water distributors being engaged in O & M would continue working for the system.

The farmers in the Scheme are expected to have within their competence to participate gradually and necessarily in the organisation under the coordinated control of the agencies. They would be imposed upon O & M for field canals regarding the following aspects:

(a) Maintaining and cleaning.
(b) Water distribution and control.

4.7.3 Operation and Maintenance Cost

O & M expenditures under the existing limited budgetary appropriation are about Rs 300 per ha including farmers labour contributions to cleaning field canals and ID costs as shown in Table 3.8.2.

According to the "Typical O & M Cost per ac per annum for gravity irrigation works (1982 prices)" which was analysed on performance in 16 selected schemes by the Irrigation Department.

The O & M cost for gravity irrigation works in 1982 was justified to be Rs 200 per ac. (Rs 500 per ha).

In consideration of price escalation, these expenditures have to be raised to Rs 600 per ha for proper O & M.

5. IMPLEMENTATION PLAN

5.1 BASIC POLICY

By taking into consideration of the present cropping in the Scheme Area, the project implementation has to be planned on the following assumptions:

(1) It would takes five years for the civil works and another three years for implementation of the programms.

(2) The construction programme would be so worked out as in principle to concentrate the construction works in the Yala season and to bring the project area under full cultivation during the rainy (Maha) season.

(3) It would be necessary to start from the works on the rehabilitation of the Heen Ganga intake facilities as well as on the construction of canals in the Stage III and IV because after the completion of these works it would make possible to release irrigation water downwards from the Heen Ganga even in the construction period of the main canal in the upstream section. Stages I and II.

(4) The required labour force for the construction works would be obtainable primarily from the project area and the settlers would be able to share the benefit of the project in the form of labour wages earned from the inception of project implement of during the periods when cultivation cannot be undertaken.

(5) Because construction is to be concentrated in the Yala season and it would be necessary to handle a large volume of construction works in a short period, machinery would be utilized as much as possible.

(6) As for the machinery and materials necessary for the construction works, those which are available in Sri Lanka would be mainly used.

(7) The major works would be executed by a general contractor but the minor works could be done under force account in case of need.

5.2 PROJECT EXECUTING AGENCY

The Irrigation Management Division of the Ministry of Lands and Land Development, which acts as the executing agency for the "Programme for Integrated Management of Major Irrigation Schemes" starting from 1985 in Sri Lanka and the Irrigation Department organized under the same Ministry would be jointly responsible for the implementation of this project.

5.3 REHABILITATION WORK PLAN

5.3.1 Construction Method

(1) Canal

Rehabilitation works on canals would be carried out in a dry condition by stopping flows in the canals. It is necessary to do the works efficiently during the Yala season since water would be made available in the canal during the Maha season. Accordingly, all the construction materials would be procured during Maha season and stored in designated places with the required storage capacity in order to commence the canal works as soon as water flow through the canal system ceases.

For the provision of rubble packing for bank protection, the rubble would be laid on a crushed stone foundation made above an impervious layer to minimize seepage loss from the embankment body.

The portions where the existing canal bottom level is higher than the design level would be stripped while lower-level portions would be left as they are.

(2) Heen Ganga Intake Facilities

As a rule, the bund road of the existing feeder canal would be utilized as the approach road for transportation of construction materials but some sections in, and around, the site proposed for construction of the diversion weir would be widened towards the moutain side.

Since the construction of the diversion weir should be completed within two dry season, a two-shift system in a day would preferably be adopted. The old diversion weir would be used as a coffer dam during the construction period and the half river closure method would be used.

(3) Road

The Yala season would be best suited mainly for the construction of a road network used for D/M road of the distributary canals as well as of rural roads, because it would be difficult to carry out the construction works in Maha in view of the requirement that the project area should be under cultivation during that season.

5.3.2 Construction Materials and Machinery

Most of the construction materials required for this project are available in Sri Lanka. Since there is some difficulty in procuring explosives, which would be used for production of embankment-protection stones, utmost care would have to be exercised in its procurement and storage.

Aggregates used for concrete work and stones for embankment protection purpose could be procured within the project area.

Major construction machinery required for rehabilitation works are grouped into each unit by works (shown in Table 5.3.1).

Each work would require the following number of machinery unit to meet construction schedule.

Work	Unit
Main Canal	2
D & F Canal	3
Heen Ganga Diversion	1
Road System	2

5.3.3 Surveys and Detailed Design

Prior to the commencement of the construction works for this project, the following works should be done.

(1) Topographical Survey

- Topographical survey on canals and roads, based on the preliminary design work done in this Study.
- Topographical survey on the sites for construction of project offices and INMAS stations.

(2) Detailed Design and Preparation of Tender Documents

- Detailed designs, preparation of bills of quantities and estimation of construction costs.
- Preparation of tender documents including the design drawings required for bidding.

Table 5.3.1 LIST OF MACHINERY : MINIPE SCHEME

Machinery for one Unit

Main Canal		D- & F-Canal		Heen Ganga Diversion		Road System	
Dozer, Crawler	100 HP	Dozer, Crawler	100 HP	Dozer, Crawler	320 HP	Dozer, Crawler	100 HP
Loader, Crawler 1.4 cu.m		Backhoe, Crawler 0.8 cu.m		Dozer, Crawler	190 HP	Motor Grader	
Backhoe, Crawler 0.8 cu.m		Dump Truck 11 ton	2 Nos.	Backhoe, Crawler 1.0 cu.m		Dump Truck 11 ton	2 Nos.
Dump Truck 11 ton	3 Nos.	Concrete Mixer		Loader, Crawler 1.4 cu.m		Roller, Vibratory	
Concrete Mixer		Water Pump 2"		Dump Truck 11 ton	4 Nos.	Water Bowser	
Water Pump 2"		Air Compressor		Air Compressor		Farm Tractor 45 HP & 2.8 cyd Trailor	2 Nos.
Air Compressor		Roller, Vibratory		Concrete Mixer			
Pneumatic Drill		Farm Tractor 45 HP & 2.8 cyd Trailor	5 Nos.	Water Pump 6"			
Roller, Vibratory				Water Pump 2"			
Farm Tractor 45 HP & 2.8 cyd Trailor	5 Nos.			Pneumatic Drill	2 Nos.		
				Generator, Diesel			
				Roller, Vibratory			
				Farm Tractor 45 HP & 2.8 cyd Trailor	2 Nos.		

5.4 WORK SCHEDULE

Based on the basic policies adopted for the implementation of this project, the work schedule has been prepared on the following basis:

(1) Construction Period

Construction takes five years, following the detailed design work which would be completed within one year.

(2) Canal Works and Water Issue

The construction of canals would be concentrated in the dry season but some work could possibly be continued even when the irrigation water is being issued for the Maha cultivation during the rainy season.

(3) The improvement of the Heen Ganga intake facilities and the rehabilitation of the canal running in the Stage III and IV would be completed during the 3rd Yala season. Taking full advantage of the improved Heen Ganga intake facilities, irrigation water could be made available for Stages III and IV before the 4th Yala season.

(4) The construction of the canals in Stages I and II would take two full years, centering on the 4th and 5th Yala season.

(5) The rehabilitation of the drainage canals would be completed within 3 years.

(6) The INMAS stations are proposed to build at the first year for using as field offices.

The work schedule is given in Fig. 5.4.1 and the main construction machinery proposed are given in Table 5.4.1.

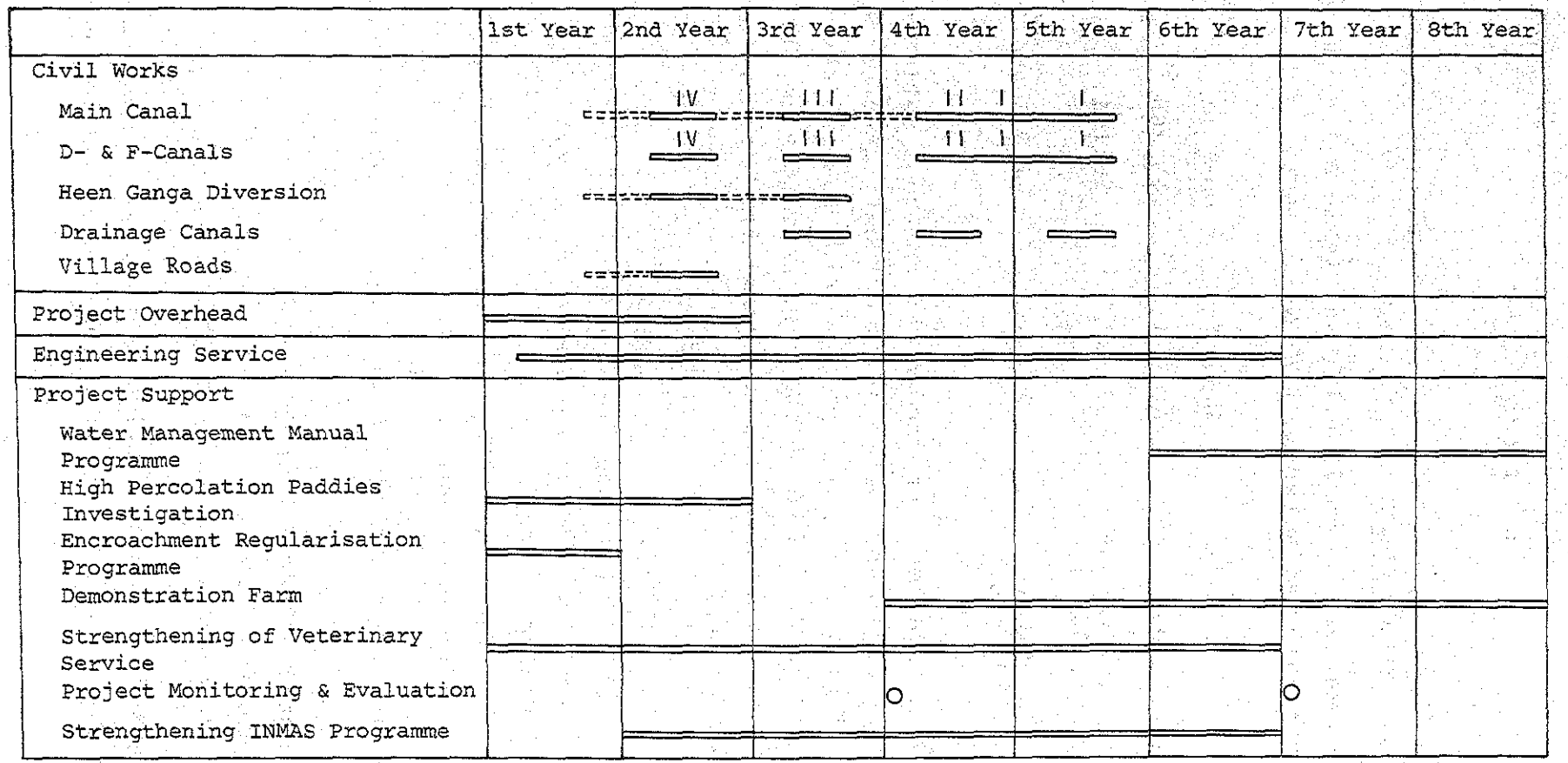


Fig. 5.4.1 WORK SCHEDULE OF MINIPE SCHEME

6. PROJECT COST

6.1 WHOLE PROJECT COSTS

As summarized in Table 6.1.1 and Table 6.1.4 the total project costs are estimated as follows:

	Work I	Work II
(Rs. 1,000)	359,900	278,400
Dollar Equivalent (US$1,000)	13,100	10,134
Yen Equivalent (¥1,000,000)	2,750	2,127

These figures have been computed based on those estimated as of the end of December, 1985 plus price contingencies reflecting the inflation rates anticipated during the project duration. The major element included in the cost estimates is civil works which are made up of the following five rehabilitations and improvement works:

1) Main canal,
2) Distributary and field canals,
3) Heen Ganga diversion and feeder canal,
4) *Drainage canals and*
5) Village roads (canal maintenance roads are included in above 1) & 2).)

The other components included in the cost estimates on Work (I) are:

Project overhead (shown in Table 6.1.2),
Engineering Services, and
Project Support (shown in Table 6.1.3).

Project Support as administration overhead will cover various programmes and strenghtening line agencies in the Project.

Physical contingencies rated at 10% and price contingencies set at an annual rate of 5% for the foreign exchange component and at an annual rate of 15% for the local currency portion are also added to calculate the total project costs.

6.2 BREAKDOWNS OF PROJECT COSTS

(1) Unit Cost

The unit cost used for estimating the construction costs as of the end of December 1985 has been taken from the "Data for Costing, January, 1980" published by the Government of Sri Lanka (Irrigation Department of the Ministry of Lands and Land Development) and also based on revised unit costs of January 1985 issued by the same department. Recourse has also been taken to the "Revised Rates for Civil Engineering Works, 1984" issued by the Mahaweli Engineering Construction Agency.

(2) Foreign Exchange and Local Currency Components

The construction costs divided into the two components of foreign exchange and local currency have been estimated in terms of the unit costs taken from the above cited "Data for Costing (1980)".

(3) Price Contingencies

Based on the "International Financial Statistics, November 1985" issued by IMF, price contingencies reflecting the inflation rates have been tentatively fixed at an annual rate of 5% for the foreign exchange component and at an annual rate of 15% for the local currency component (based on the average inflation rates from 1980 through 1984 in Sri Lanka). The undermentioned table incorporates the future inflation rates from 1986 through 1994 estimated by using the above inflation rates. Construction costs, which are those estimated at the beginning of the corresponding year, have been computed in each fiscal year by a multiplication of the inflation rate over the previous year.

Table 6.1.1 MINIPE SCHEME PROJECT COST - WORK (I) -

Unit: Rs. '000

	Total Cost	F.C.	L.C.
1. Civil Works			
1) Main Canal	112,400	54,900	57,500
2) D- & F-Canals	36,600	18,500	18,100
3) Heen Ganga Diversion	28,600	14,600	14,000
4) Drainage Canals	2,700	1,400	1,300
5) Roads	2,700	1,400	1,300
Sub-total	183,000	90,800	92,200
2. Project Overhead	14,600	11,700	2,900
3. Engineering Services	20,400	14,300	6,100
4. Base Cost (1 + 2 + 3)	218,000	116,800	101,200
5. Project Support (Administration)	12,800	4,300	8,500
6. Physical Contingency (10 % of Base Cost)	21,200	12,800	8,400
7. Sub-total (4 + 5 + 6)	252,000	133,900	118,100
8. Price Contingency	107,900	24,710	83,190
Total Project Cost	359,900	158,610	201,290
(Dollar Equivalent to US$1,000)	13,100	5,770	7,330
J.Yen 1,000,000	2,750	1,212	1,538

* Currency Equivalents:

1 US$ = 27.5 Rs = 210 Yen

1 Rs. = 0.0364 US$ = 7.64 Yen

Table 6.1.2 MINIPE SCHEM PROJECT OVERHEAD DETAILED COST - WORK (I) - IRRIGATION DEPT. PROCUREMENT

Unit : Rs '000

	Unit Cost	Quantity	Total Cost	F.C.	L.C.
A. Office & Quaters					
Grade III	200	3	600	180	420
Grade III Repair	6	15	90	30	60
Grade II	150	5	750	230	520
INMAS Stations (Field Offices)	500	4	2,000	600	1,400
Miscelloneous			60	60	0
Sub-total			3,500	1,100	2,400
B. Vehicles					
Jeeps	380	6	2,280	2,280	0
Staff Car	300	1	300	300	0
Spare Parts & Tools			420	420	0
Sub-total			3,000	3,000	0
C. Construction, O & M Machinery					
Pickup Trucks 1.5 ton	440	4	1,760	1,760	0
Farm Tractors & Trailors	300	8	2,400	2,400	0
Lorries 5 ton	450	4	1,800	1,800	0
Sub-total					
D. Office Equipment & Miscellaneous			1,300	800	500
TOTAL			14,600	11,700	2,900

Table 6.1.3 MINIPE SCHEME - WORK (I)
PROJECT SUPPORT DETAILED COST

(unit : Rs. '000)

	Quantity	Unit Cost	Total Cost	F.C.	L.C.
A. Irrigation Department					
Water Management Mannual Programme			1,500	700	800
High Percolation Paddies Investigation			800	480	320
Others			200	120	80
Sub-total			2,500	1,300	1,200
B. Land Commissioner's Dept.					
Buildings					
Quarters, Repair	15	50	750	250	500
Encroachment Regularisation Programme			270		270
Others			80	50	30
Sub-total			1,100	300	800
C. Dept. of Agriculture					
Buildings					
Quarters Grade III	1	200	200	60	140
Grade II	3	150	450	130	320
Demonstration Farm			500	150	350
Literature & Extension Materials			350	100	250
Farmer Training, Field days			350	100	250
Others			150	60	90
Sub-total			2,000	600	1,400
D. Dept. of Agrarian Services					
Buildings					
Quarters Grade III	4	200	800	240	560
Vehicles					
Motorcycles	4	30	120	120	
Bicycles	28	2	56		56
Power Sprayer	4	10	40	40	
Others			84		84
Sub-total			1,100	400	700

	Quantity	Unit Cost	Total Cost	F.C.	L.C.
E. Dept. of Animal Production & Health					
Buildings					
Quarters Grade III	2	200	400	120	280
Grade II	2	150	300	100	200
Construction of Wind Mills			200	100	100
Cattle & Buffaloes Upgrading Programme			200	100	100
Strengthening of Veterinary Services			800	260	540
Curd Project			80		80
Others			20	20	
Sub-total			2,000	700	1,300
F. Irrigation Management Div.					
Training Centre	1	500	500	200	300
Office Building	1	500	500	200	300
Quarters Grade III	1	200	200	60	140
Grade II	1	150	150	50	100
Salaries & Other Payment for I.O.'s (5 years)			800		800
Project Monitoring and Evaluation			800	200	600
Strengthening INMAS Programme (5 years)			1,000	200	800
Others			150	90	60
Sub-total			4,100	1,000	3,100
Total :			12,800	4,300	8,500

Table 6.1.4 MINIPE SCHEME PROJECT COST - WORK (II) -

Unit: Rs. '000

		Total Cost	F.C.	L.C.
1.	Civil Works			
	1) Rural Water Supply	44,630	24,550	20,080
	2) Pastureland Development	8,600	5,460	3,140
	3) Bridge	40,440	19,270	21,170
	4) Road	60,540	31,420	29,120
	Sub-total	154,210	80,700	73,510
2.	Project Overhead	15,420	12,340	3,080
3.	Engineering Services	15,420	10,800	4,620
4.	Base Cost (1 + 2 + 3)	185,050	103,840	81,210
5.	Project Support (Administration)	12,350	7,460	4,890
6.	Physical Contingency (10% of Base Cost)	18,500	11,100	7,400
7.	Sub-total (4 + 5 + 6)	215,900	122,400	93,500
8.	Price Contingency	62,500	14,320	48,180
	Total Project Cost	278,400	136,720	141,680
	(Dollar Equivalent to US$1,000)	10,134	4,977	5,157
	J.Yen 1,000,000	2,127	1,045	1,082

* Currency Equivalents:

1 US$ = 27.5 Rs. = 210 Yen

1 Rs. = 0.0364 US$ = 7.64 Yen

6.3 INVESTIMENT SCHEDULE

The project costs by year are estimated from the first year as commencement of works through the 8th year as per the implementation schedule. (shown in Tables 6.3.1 - 6.3.3)

Table 6.3.1 IMPLEMENTATION SCHEDULE MINIPE SCHEME : WORK (I)
DETAILED COSTS BY YEAR

Unit : Rs. '000

Item	Cost	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year
1. Civil Work									
a) Main Canal	112,400		7,200	18,200	42,900	44,100			
b) D- & F-Canal	36,600		2,200	4,200	17,800	12,400			
c) Heen Ganga Diversion	28,600		18,600	10,000					
d) Drainage Canals	2,700			900	900	900			
e) Roads	2,700		2,700						
Sub-total	183,000		30,700	33,300	61,600	57,400			
2. Project Overhead	14,600	12,300	2,300						
3. Engineering Service	20,400	5,400	5,000	3,000	3,000	3,000	1,000		
4. Base Cost (1+2+3)	218,000	17,700	38,000	36,300	64,600	60,400	1,000		
5. Project Support (Administration)	12,800	1,600	1,700	3,100	1,700	850	1,450	1,550	850
6. Physical Contingency (10 % of Base Cost)	21,200	1,700	3,700	3,500	6,300	5,900	100	0	0
Sub-total	252,000	21,000	43,400	42,900	72,600	67,150	2,550	1,550	850
7. Price Contingency	107,900	1,540	8,880	14,410	34,830	42,930	2,080	1,970	1,260
Total Project Cost	359,900	22,540	52,280	57,310	107,430	110,080	4,630	3,520	2,110

Table 6.3.2 MINIPE SCHEME IMPLEMENTATION SCHEDULE OF PROJECT SUPPORT : WORK (I)

DETAILED COSTS BY YEAR

Unit : Rs. '000

	Cost	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year
Irrigation Department									
Water Management Manual Programme	1,100						500	500	600
High Percolation Paddies Investigation	900	500	400						
Land Commissioner's Department									
Quarters	800	400	400						
Encroachment Regularisation Programme	300	300							
Department of Agriculture									
Quarters	700		400	300					
Demonstration Farm	500				100	100	100	100	100
Literature & Extension Materials	400				100	100	100	100	
Farmer Training, Field Days	400						200	200	
Department of Agrarian Service									
Quarters	800			400	400				
Vehicles	300	300							
Dept. of Animal Production & Health									
Quarters	700			400	300				
Construction of Wind Mills	200		100	100					
Cattle & Baffaloes Upgrading Programme	200		100	100					
Strengthening of Veterinary Service	800	100	100	150	150	150	150		
Curd Project	100					100			
Irrigation Management Division									
Training Centre	550			550					
Office and Quarters	900			900					
Salaries & Other Payment for I.O.'s (5 years)	850				150	200	200	150	150
Project Monitoring & Evaluation	800				300			500	
Strengthening INMAS Programme	1,000		200	200	200	200	200		
TOTAL	12,800	1,600	1,700	3,100	1,700	850	1,450	1,850	850

Table 6.3.3 IMPLEMENTATION SCHEDULE MINIPE SCHEME : WORK (II)

DETAILED COSTS BY YEAR

Unit : Rs. '000

	Cost	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year
1. Civil Work									
a) Rural Water Supply	44,630		12,300	12,330	10,000	10,000			
b) Pastureland Development	8,600		4,000	4,600					
c) Bridge	40,440		20,440	20,000					
d) Road	60,540	8,000	27,540	25,000					
Sub-total	154,210	8,000	64,280	61,930	10,000	10,000			
2. Project Overhead	15,420	12,000	3,420						
3. Engineering Service	15,420	4,420	3,500	3,500	2,000	2,000			
4. Base Cost (1+2+3)	185,050	24,420	71,200	65,430	12,000	12,000			
5. Project Support (Administration)	12,350	1,350	2,000	2,000	3,000	2,000	2,000		
6. Physical Contingency (10 % of Base Cost)	18,500	2,440	7,120	6,540	1,200	1,200			
Sub-total	215,900	28,210	80,320	73,970	16,200	15,200	2,000		
7. Price Contingency	62,500	2,070	16,430	24,850	7,760	9,720	1,670		
Total Project Cost	278,400	30,280	96,750	98,820	23,960	24,920	3,670		

NAGADEEPA

3. PRESENT CONDITION OF PROJECT AREA

3.1 LOCATION AND AREA

Nagadeepa Reservoir was constructed across the Hepola Oya, a tributary of the Mahaweli River as a water resource for the Nagadeepa Scheme. The area is situated in the Bintenne Division of the Badulla District in the Uva Province. The township nearest to the project area are Mahiyangana, 12.8 km north-west of the reservoir and Bibile, 16 km south-east of the reservoir. The provincial capital is Badulla, 48 km by road.

The Scheme is skirted by the Mahaweli Trans-basin Canal on the west, from which water is released to Mapakada Wewa, Dambarawa Wewa and Horaborawewa but the Nagadeepa reservoir cannot derive any benefit from it due to its higher elevation.

The Main Canal runs along the right bank of Diyabana Oya, the Branch Canal runs through the area confined by the Diyabana Oya and Hepola Oya. Those canals release water to the land developed on the slopes.

The Scheme had been divided into 13 Tracts. All the villagers in Tract 13 have been shifted to the Mahaweli System C Area because Tract 13 was used as borrow area for the construction of the Trans-basin Canal. The number of Tracts has been reduced in 12 at present.

3.2 CLIMATE

3.2.1 Agro-Ecological Characteristics

Based on the annual rainfall pattern, Sri Lanka is broadly divided into three distinct agro-ecological areas, namely the Wet Zone, Intermediate Zone and Dry Zone. These broad areas are further classified according to several sub-zones depending on the altitude of a particular area.

The agro-ecological regions are shown in Fig. 3.2.1. This type of classification has become necessary because the climate of any particular region is affected both by its rainfall and by its elevation. The different agro-ecological regions as classified by the Department of Agriculture and the 75% expectant level of annual rainfall is shown in Table 3.2.1.

According to this classification the Nagadeepa Scheme has the characteristics of the Intermediate Low Country Zone 2. The 75% expectancy of annual rainfall is more than 1,143 mm (45") and a greater part of this annual precipitation is due to the North East Monsoon, which is normally from October through January.

3.2.2 Meteorological Station

There is the Mapakada Meteorological Station close to the Scheme, where only the precipitation is recorded. Data of the Girandurukotte has to be used for other basic climatic records. The precipitation of the Mapakada Meteorological Station is shown in Table 3.2.2.

Table 3.2.2 PRECIPITATION OF MAPAKADA

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
308.7	145.6	102.0	102.9	50.7	12.7	26.7	43.7	62.9	169.0	272.5	393.8	1687.8

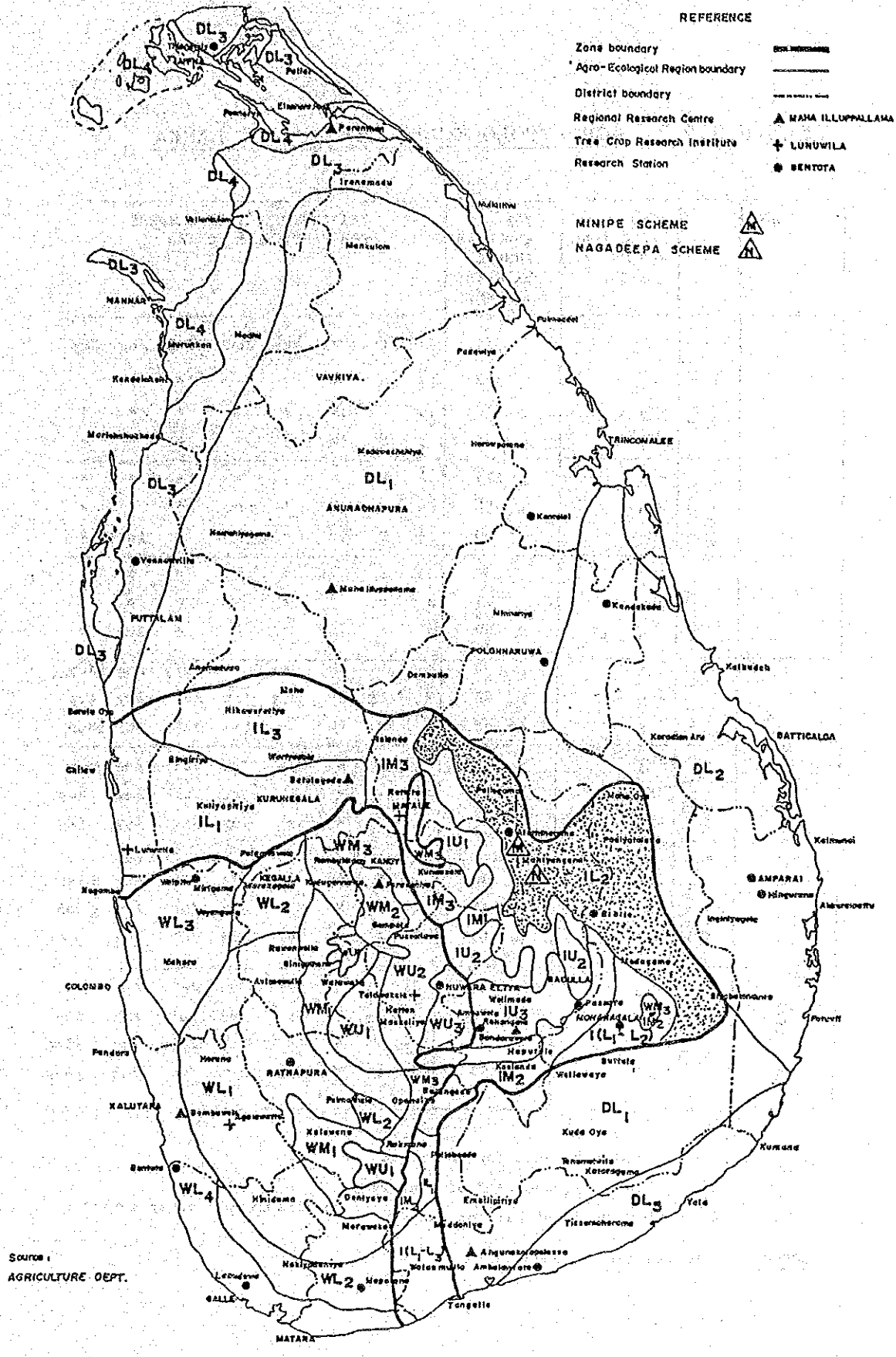


Fig.3.2.1 AGRO-ECOLOGICAL REGIONS

Table 3.2.1 AGRO-ECOLOGICAL DATA OF SRI LANKA

ZONE		AGRO-ECOLOGICAL REGION & SYMBOL	75% EXPECTANCY ANNUAL RAINFALL (INCHES)	75% EXPECTANCY OF DRYNESS FOR PARTICULAR MONTHS							
				Jan.	Fe.	Mar.	May	Jun	Jul	Aug	Sep
WET ZONE	UP COUNTRY	WU_1	> 125	J½	F	*	*	*	*	*	*
		WU_2	> 75	J½	F	½M	*	*	*	*	*
		WU_3	> 55	J½	F	½M	*	*	*	*	*
	MID COUNTRY	WM_1	> 125	J½	F	*	*	*	*	*	*
		WM_2	> 55	J½	F	½M	*	*	*	*	*
		WM_3	> 50	J½	F	½M	*	*	*	Aug½	*
	LOW COUNTRY	WL_1	> 100	J½	F	*	*	*	*	*	*
		WL_2	> 75	J	F	*	*	*	*	*	*
		WL_3 + 4	> 60	J	F	½M	*	*	*	Aug	*
INTERMEDIATE ZONE	UP COUNTRY	$1U_1$	> 85	*	*	½M	*	*	Jul½	Aug	½Sep
		$1U_2$	> 55	*	F½	½M	May½	Jun	Jul	Aug	Sep
		$1U_3$	> 45	*	F	½M	*	Jun	Jul	Aug	½Sep
	MID COUNTRY	$1M_1$	> 55	*	*	M	My½	Jun	Jul	Aug	½Sep
		$1M_2$	> 45	J½	F	*	*	Jun	Jul	Aug	Sep
		$1M_3$	> 35	*	F	M	My½	Jun	Jul	Aug	Sep
	LOW COUNTRY	$1L_1$	> 40	J	F	½M	*	*	Jul	Aug	½Sep
		$1L_2$	> 45	*	F½	M	My½	Jun	Jul	Aug	½Sep
		$1L_3$	> 35	J	F	½M	My½	Jun	Jul	Aug.	½Sep
DRY ZONE	LOW COUNTRY	DL_1	> 30	J½	F	½M	My½	Jun	Jul	Aug	½Sep
		DL_2	> 35	J	F½	M	My	Jun	Jul	Aug	Sep
		DL_3 + 4	> 23	J½	F	M	My	Jun	Jul	Aug	½Sep
		DL5	> 20	J½	F	M	My	Jun	Jul	Aug	½Sep

NOTE * denotes wetness for the month

J½ denotes second half of January } Applicable to other months

½J denotes first half of January }

SOURCE : Agriculture Department

3.3 WATER RESOURCES

3.3.1 Source of Irrigation Water

The water source of the Nagadeepa Scheme depends on a reservoir across Hepola Oya, a right bank tributary of the Mahaweli River, whose confluence with the Mahaweli is about 6 km downstream of the Minipe Anicut.

Nagadeepa Reservoir (earth dam)

Construction	1970
(Lifted embankment 10 feet)	1972
Catchment Area	70 sq km
Capacity (Max)	33.4 x 10^6 cu.m
Water level (Max)	155.5 m MSL.
Sluce sill level	143.26 m MSL
Dam Height	23.5 m
Length	1173.8 m
Spill way	24.4 m
Gate 6.1 x 3.0 m	4 Nos
Crest	158.50 MSL

In 1972, the capacity of the reservoir was increased by raising the dam height by 10 feet, but over spilling has occurred only twice since dam was completed in 1970. Except in years extraordinary rainfall, the farmers in the area have not enjoyed paddy cultivation during the Yala season.

Notwithstanding the farmers' wasteful use of irrigation water during Maha season, it might be said that the original plan was too optimistic in its water balance studies.

3.3.2 Evaluation on Proposed Water Source

Consequently, two reservoirs, Liyangahawela and Loggal Oya were proposed as additional water sources for the Scheme, by the Irrigation Engineer's Office, Mapakada to get over the severe water shortage every Yala.

The parameters of the proposed water resources are shown in Table 3.3.1. The discharge, measured in July 1985, was 0.127 cu.m/sec at Liyangahawela and 0.57 cu.m/sec at Loggal Oya. All discharge at Loggal Oya was diverted into the existing irrigated area of 280 ha on the left bank. It is expected that new area would be developed along the canal in the case of completion of the new canals which would connect the proposed new reservoirs with the Nagadeepa reservoir. The areas expected to be developed, for Liyangahawela and for Loggal Oya, are 200 ha and 400 ha respectively. In view of the social conditions in these areas, it would be impossible to supply water without releasing any water to the newly developed land. As the result of evaluation of these two Schemes, it was judged that the schemes were not sound and feasible on both economic and social grounds for the following reasons:

(i) Big conveyance losses (canal length 14.0 km, 24.6 km)
(ii) Share of irrigation water to farmers along side the canals (estimate of more than 50%)
(iii) High construction costs due to canal alignment through mountains zone.

Therefore the Nagadeepa Scheme has to depend on the Nagadeepa reservoir as its only water resource.

Table 3.3.1 PARAMETERS OF PROPOSED WATER RESOURCES

	Unit	Liyangahawela	Loggal Oya
Catchment Area	sq.km	25.9	154.2
Net Yield N.E.M	cu.m	16.0×10^6	95.5×10^6
S.W.M	cu.m	3.1×10^6	22.0×10^6
Sedimentation	cu.m	1.0×10^6	6.2×10^6
Canal Length	km	14.0	24.6

3.4 SOIL AND LAND CLASSIFICATION

3.4.1 General

In the Nagadeepa Area, the soil survey was conducted in the fields commanded by the Nagadeepa reservoir built across the Hepola Oya.

As in the Minipe Area, weathered residual materials or their secondary sediments derived from biotite gneiss, Khondalite and meta-sedimentary rock constitute the parent materials of the soils.

During the time of the soil survey, there were no irrigation water issues. It was therefore impossible to collect sufficient data on water use in the area. Soil types in Nagadeepa Area have been identified based only on the water permeability tests and results of analysis on physico-chemical properties of soil samples.

3.4.2 Typical Soil Types

In the area, there are soil associations (catenas) similar to those in Minipe Area because the catchment basins are dominant in both areas and the topographic conditions are similar.

As the soils were always in a dry condition during the time of soil survey, it was difficult to clearly distinguish the differences in the characteristics of the soil profiles between the upper and the middle parts of the catchment basin. The soils in the Nagadeepa Area have been grouped into two types of Type A and C referred to in the account of the Minipe Area.

3.4.3 Examination on Water Permeability

It is clear that the water permeability of the soil samples taken from Type A is extremely high, and that their values are 3 to 7 times as much as those from the Minipe Area. The reason for this may be that since the paddy lands are left

uncultivated during Yala season, there is an acceleration in the dehydration process of iron hydroxide which acts as a cementing material for the soil particles. This matter should be further investigated. Assumed high permeability area is shown in Fig. 3.4.1.

3.4.4 Physico-chemical Properties of Soil Samples

Physico-chemical properties of soils samples from surface stratum of each soil type were analyzed. It was found that there was little difference in physico-chemical properties between both soil types.

3.4.5 Clay Mineral Composition of Soil Samples

Clay fractions were separated from soils taken from each stage and their clay mineral compositions were analyzed by using X-ray diffraction diagrams. It was found that kaolinite was the dominant clay mineral and there was little difference in clay mineral compositions between two soil types.

3.4.6 Soil Fertility

Soil fertility in the area was diagnosed based on physico-chemical properties of soil samples. Cation Exchange Capacity (CEC), which is an index of retained fertility, was medium (6 - 20 m.e.) and the degree of saturation of exchangeable calcium was also medium (30 - 50%) in both soil types. Natural soil fertility is not a factor inhibiting plant growth at present.

The nutrient conditions of soils were examined based on exchangeable-calcium, exchangeable-magnesium, exchangeable-potassium and available nitrogen. The analysis shows that the nutrient conditions were medium. Exchangeable-calcium, exchangeable-magnesium, exchangeable-potassium and available nitrogen were 10 - 5 m.e., 2 - 0.8 m.e., 0.4 - 0.2 m.e. and 0.15 - 0.10%, respectively.

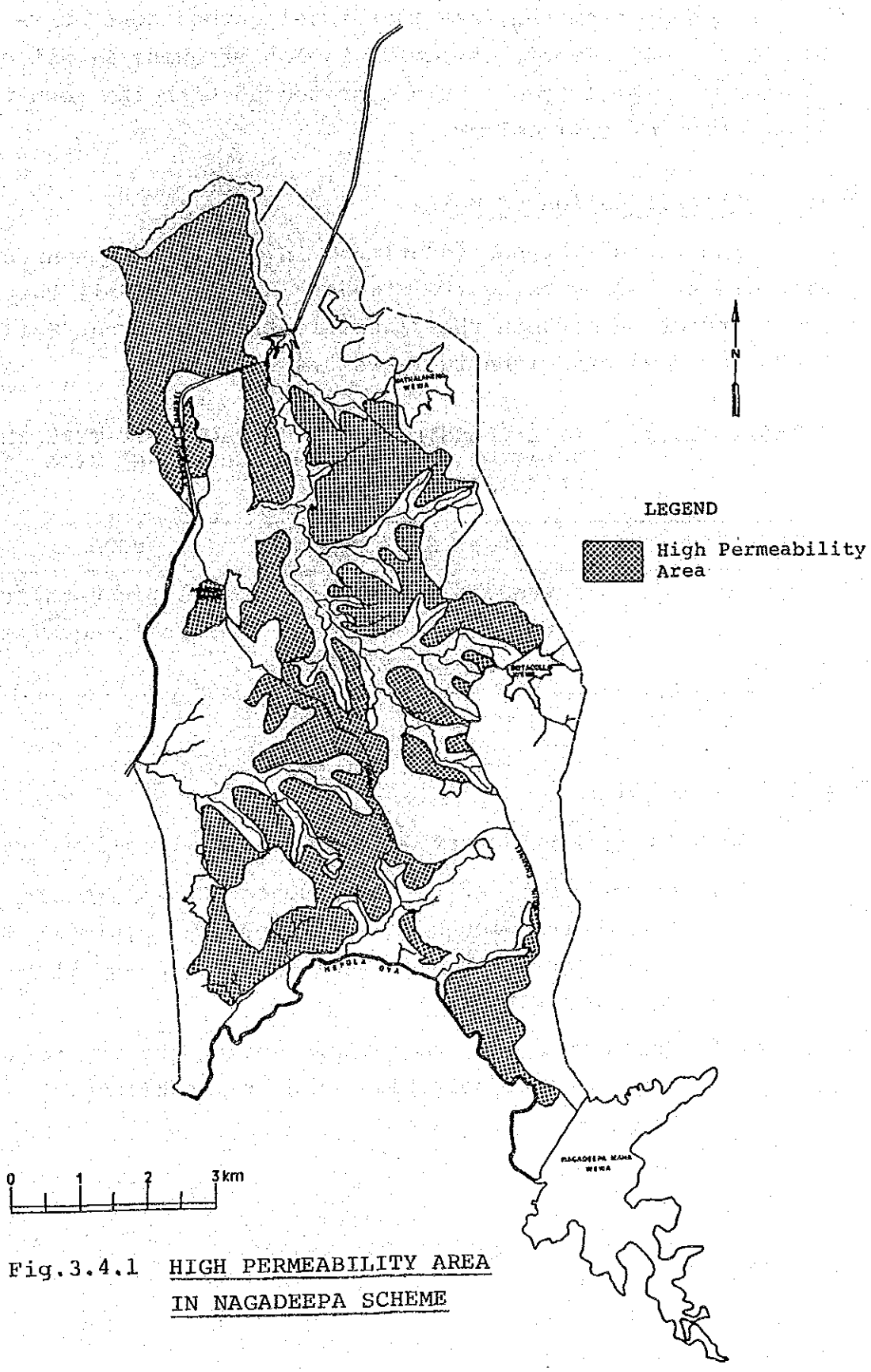


Fig.3.4.1 HIGH PERMEABILITY AREA IN NAGADEEPA SCHEME

Judging from the fact that total-carbon content is less than 2% in all layers, the accumulation of humus is not developed in either soil type. This corresponds with the results of observation of soil colour.

3.4.7 Classification of Soils

The two soil types identified in the Nagadeepa Area are also classified by using the standard of USDA (Soil Taxonomy). The co-relation between the classifications by Great Soil Group and USDA are given in Table 3.4.1.

Table 3.4.1 SOIL CLASSIFICATION OF EACH SOIL TYPE IN RELATION TO GREAT SOIL GROUP AND USDA CLASSIFICATION

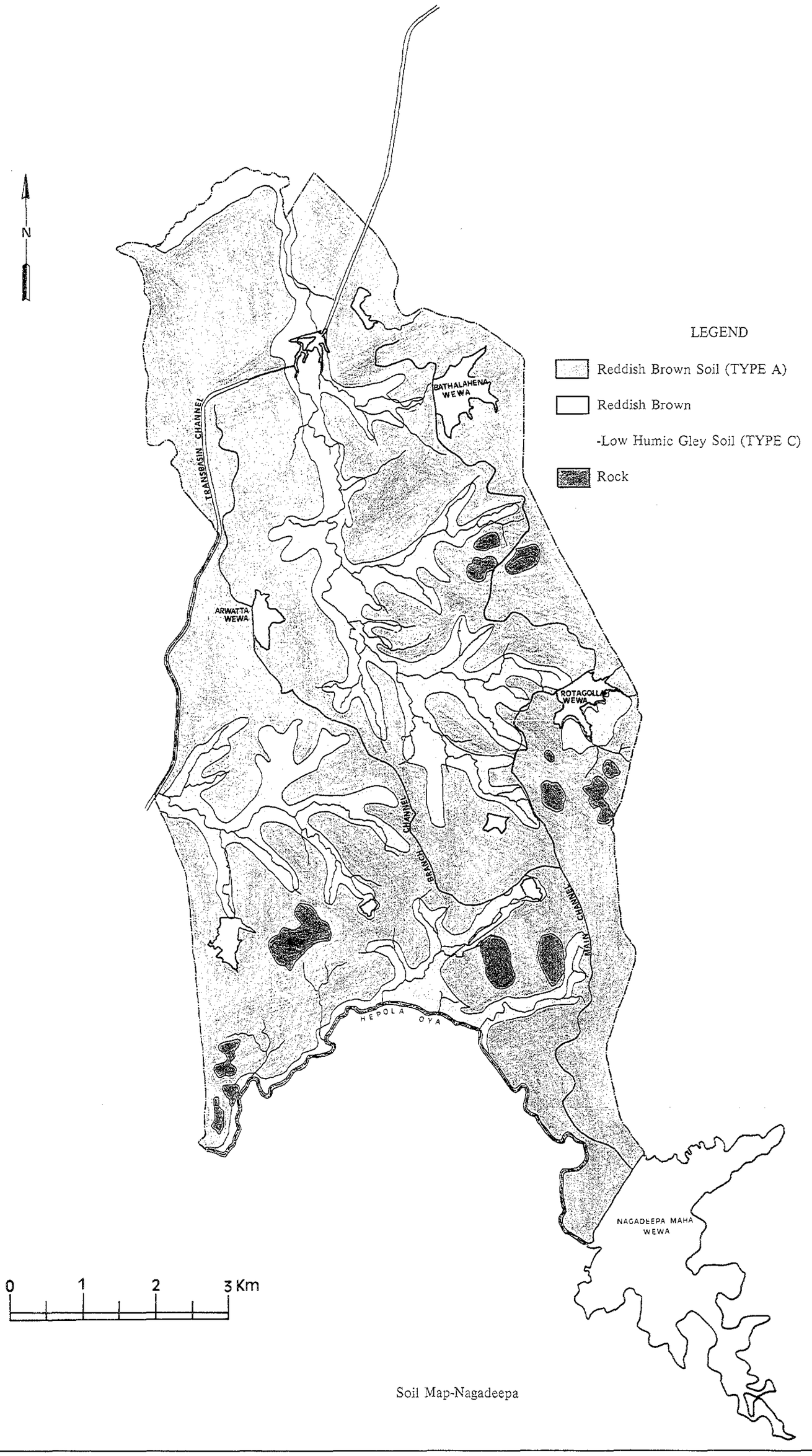
Soil Type	Great Soil Group	USDA
A	Reddish Brown Soils	Alfisols-ustalfs
C	Reddish Brown Soils	Alfisols-aqualfs
	Low Humic Gley Soils	

3.4.8 Conclusions

Results of soil survey are summarised as follows.

(1) On the examination of sequence of soil layers, and their colours and textures, two typical soil types for the Nagadeepa Area (Type A and C) have been identified.

(2) Soils in uncultivated area during the dry season have an extremely high water permeability.



Soil Map-Nagadeepa

3.5 SOCIO ECONOMIC CONDITIONS

3.5.1 Population

The population trend at Nagadeepa during the last decade and half is shown in Table 3.5.1.

Table 3.5.1 POPULATION TREND AND OUTLOOK

	1971	1981	Annual Growth Rate 1971 - 1981	1985	Annual Growth Rate 1981 - 1985
Population	13885	17658	2.4	18764	1.5
Male	7139	9115	2.4	9741	1.7
Female	6758	8543	2.4	9023	1.4
Over 18	5320	8008	4.2	8366	1.1
Under 18	8565	9650	1.2	10298	1.6
No.of Families	2492	3007	increase 515	3295	increase 288

Source: A.G.A. Ridimaluyadda Gramasevaka at each area.

It may be noted that the population growth rate of 2.4% in the Nagadeepa Scheme over the decade from 1971 to 1981 is relatively high, as is the case with the Minipe Scheme too (q.v.).

The number of families has also increased from 2,492 in 1971 to 3,295 in July 1985. This increase shows not only the natural increase in the member of families among the settlers themselves but also the increase of the farmers who are sharecropper farmers or illegal encroachers.

3.5.2 Employment

As in Minipe agriculture is generally the only economic activity generating employment. In Yala when a decision is

taken that there would be no water issues, the farmers lose the opportunity of earning their livelihood from agricultural activities. They have therefore to leave their homes for temporary jobs elsewhere. As we gathered from the interviews, 90 - 95% of the farmers had gone for temporary employment outside the Project Area.

It is evident that in the Nagadeepa Scheme the employment outlook changes drastically with the season. In Maha almost all the inhabitants are engaged in agriculture, whereas in Yala they work as casual labourers outside the Scheme.

3.5.3 Land Tenure

(1) Unit of Alienation

The unit of alienation in the Nagadeepa Scheme is the same as in Minipe: Stages II - IV for paddy land while the highland extent is only 0.41 ha (1 Ac).

(2) General Observations

The mode of alienation including the issue of grants under the "Swarenabhoomi" Scheme and the account of fragmentation, as outlined in the section on Minipe are equally applicable to Nagadeepa. The remarks made therein regarding de facto sub-division and informal leasing arrangements and encroachments would generally be true of Nagadeepa as well though to a lesser degree in that the Nagadeepa paddy lands can be cultivated under irrigated conditions only in Maha.

The encroachments in Nagadeepa however, are mainly on the highlands, as revealed in the intensive survey in the selected Sample Areas. According to the survey, the results of which are recorded in Table 3.5.2, encroachers have occupied 22.7 ha (56 Acs) in Tract 3 and 30.4 ha (75 Acs) in Tract 12. This table clearly shows that the greater part of the total encroachment 20.2 ha (50 Acs) in each of the Sample Areas consists of highland.

Table 3.5.2 EMPLOYMENY AND LAND TENURE SURVEY (1985)

Survey Block	Name of Sample Area	Irrigable Area ha. (Acres)	Popula-tion	No. of Family	No. of Lands Owners Family	No. of Share Cropper Family	No. of Encroa-chers Family	Family Engaged in Agri-culture	Family Engaged in Non-Agricul-ture	Encroached Area (Acreage)	Name of the Village and Gramasevaka
	D Tract 3	(378 Acs)	1418	248	189 (189 lots)	44	15	248	Shops 4 R/Mill (Part time)	06 Paddy 50 High Lands	Tract 03 J.M. Wijeratne Uva Tissapura
	D1 Tract 12	(412 Acs)	1379	261	206 (206 lots)	19	36	206	Labour 36 (Full time) Shops 08 R/Mill 1 (Part time)	25 Paddy 50 High Lands	Tract 12 No Gramasevaka Acting J.M. Wijeratne

Source: Prepared by Survey Team

3.5.4 Government Agencies

The government agencies related to the Project have their branch offices in the Scheme Area. The Project Manager's office has newly been built with intention of coordinating these various agencies of which details are given in Table 3.5.3. Through the Phase II investigations, these agencies were identified to be requisite for strengthening their functions and facilities so as to implement the Project effectively.

3.5.5 Social Constraints and their Implications

Some account has been given already, (in the corresponding section relating to Minipe), on the position of Nagadeepa in the socio-economic scale at the top end of which Minipe Stage I stands. The differences and similarities between Nagadeepa and Minipe have been outlined therein.

The cheif features of the socio-economic conditions in Nagadeepa are:

(a) increasing pressure on the land as a result of the growth population,

(b) seasonal change in source of income, and

(c) inferiority of the socio-economic conditions in Nagadeepa as compared with those in the surrounding areas.

In consequence of the peculiar characteristics of the Nagadeepa Scheme as outlined above, the following social constraints arise:

(a) as in the case of Minipe, but more markedly so, the rapid population growth, the limited land available for expansion, the lack of other employment opportunities, the decrease of the productivity of labour in the agricultural sector, the low (subsistence level) income of most of the settlers as well as the fact that investment in productive activities is limited are parts of the vicious circle which holds the stttlers in its grip like a vice,

Table 3.5.3 LIST OF GOVERNMENT AGENCIES IN NAGADEEPA SCHEME

NAME	COMPETENT AUTHORITIES	LOCATION	MEMBERS		FUNCTION
Irrigation Engineer's	M.L.L.D. I.D.	Outside (Mapakada)	Irrigation Engineer Technical Assistant (in charge of Nagadeepa	1 8 2)	Operation and maintenance of irrigation system Training of farmers
Agrarian Service Centre	M.A.D.R. D.A.S	One	Divisional Officer Cultivation Officer	1 3	Supply of fertilizer and agro-chemicals Provision of agricultural credit through the Bank of Ceylon Issue of Agro-Identity Cards to farmers Concilation for farmers except the technical and legal problem
K.V.S Office	M.A.D.R. D.A.	One	Agricultural Instructor K.V.S.	1 5	Training for agricultural extension Supply of inputs(seeds) Monitoring and evaluation of the crops and its production
Land Commissioner's Office	M.L.L.D. L.C.D.	Two	each Colonization Officer Field Instructor	1 3	Concilation for settlers on the legal land problem Regulaisation Evaluation and allocation on the damage due to animal and climate
Co-operative Society	M.F.C. C.D.	One			Supply of agricultural inputs Purchase of paddy and vegetables Provision of agricultural credit through Co-operative Rural Bank
P.M.B. Store	M.A.D.R. P.M.B.	None			Purchase and store of paddy
V.S's Office	M.R.I.D. D.A.P.H.	Outside (Mahiyangana)	Veterinary Surgeon	1	Development of livestock and agro-industry
Project Manager's Office	M.L.L.D. I.M.D.	Outside	Project Manager	1	Implementation of Irrigation Management Programme in three Scheme(including another two Schemes)

(b) the drastic seasonal change of employment jeopardises the chances of second generation settlers obtaining permanent employment,

(c) the Scheme is relatively isolated from the neighbouring areas, due to lack of adequate transportation facilities which affects the mobility of the residents.

3.5.6 Mobility of Villages

The results of the rural life survey conducted in the Sample Area in the Scheme are recorded in Table 3.5.4. Because of the poor socio-economic conditions such as poor transportation and other facilities the mobility of the villagers is generally limited to a narrow range except in Yala when they move outside the Scheme to obtain casual labourers' jobs.

3.5.7 Farmers' Organisation

As in Minipe there are five types of farmers organisations in the Scheme, the chief features of which are the same as in Minipe: (See corresponding section of Report relating to Minipe). Table 3.5.5 shows the structure of these organisation in terms of meetings, and scope.

3.5.8 Rural Industry

As in Minipe, there are no rural industries as such worth mentioning within, and around, the Nagadeepa Scheme.

According to the result of the survey shown in Table 3.5.6. Nagadeepa area is poor in terms of rural industries. There are one weaving centre and ten brick making centres which have two or three temporary workers. Most of these workers are farmers.

Table 3.5.4 RURAL LIFE SURVEY (NAGADEEPA)

LIFE BOUNDARY	TRACT NO. 03	TRACT NO. 12
Distance from cultivating land to house	0.5 Miles approximately	Within 0.5 Miles encroachers have their houses close to their cultivating land.
Schools	Tissapura School 2 Miles (Grade 12)	Keselpotha School, 2 Miles (Grade 10)
Place for job opportunity	Almost all the men in village go for temporary jobs at the rate of Rs. 25 - 35/day. to Mahiyangana	Go for the Temporary jobs at Girandurukotte, Ratkinda and Mahiyangana 07 Miles, 08 Miles and 06 Miles away accordingly.
Hospital	Mahiyangana (12 Miles) Tissapura Dispensary (2 Miles)	Mahiyangana (06 Miles) Tissapura (05 Miles)
Shopping & Daily Matters	Tissapura (2 Miles) Mahiyangana (12 Miles)	Tissapura (05 Miles) Mahiyangana (06 Miles)
Places to go for leisure	There are no such places for enjoyment	There are no such places for enjoyment.
Temple	Tissapura Temple (02 Miles)	Keselpotha Temple (03 Miles)

Source: Multi Interview with Farmers

Table 3.5.5a FARMER'S ORGANISATION

Name	Members	Meeting Time and Place	Discussion Matter Purpose
Project Committee	P.M. A.O D.O I.E. T.A.(2) C.O.(2) Bank of Ceylon A.D.A. Manager Farmers Representative 15 Crop Insurance Manager A.I.	Once for two months at Tissapura School, at begining of the month	Irrigation Problems Agricultural inputs, Agriculture credits, extention duties, Land problems, Making the Agriculture production programme, Making Agriculture implementation programme Irrigation rehabilitation
Sub Project Committee (5)	Farmers representatives 20 Nos. K.V.S. 04 Cultivation Officers 03 T.A. (2) A.I. C.O. (2) D.O.	Once a month at Tissapura at Gamunupura at Senevipura end of the month	Discussion the problems in the particular Areas for each division

Source: Prepared by the Team

Abbreviation
P.M. Project Manager
A.O. Agricultural Officer
D.O. Divisional Officer
I.E. Irrigation Engineer
T.A. Technical Assistant
C.O. Colonization Officer
A.D.A. Agricultural Development Authority
A.I. Agricultural Instructor

Table 3.5.5b FARMER'S ORGANISATION

Name	Members	Meeting Time and Place	Discussion Matter Purpose
Field Canal Committee 100	20 Members for each Field Canal K.V.S. Cultivation Officer W.S. Irrigation Field Instructor (Land Development)	Once a month mid of the month at the particular field	Discussion of the F.C. prpblems. Carrying out the Farmers training, Agricultural Advices.
Agrarian Services Committee	D.O. A.I. C.O. (2) T.A. (2) A.D.A. Morayaya Farmers 06	Once a month on the 3rd week of the each month at the A.S.C. Tissapura	Discussion of the farmers inputs Carry out: The crop Insurance; Agricultural Advices.
Rural Development Committee 11	Village Members G. Sevaka R.D.O. Special Services Officers Chairman of the Gramodaya Mandalaya A.I. K.V.S. C.O.	Once for two months at the party under the village	Discussion of the: 1. Welfair Work 2. Culture 3. Develop the Rural Roads and Wells Etc. Build up the village's Unity

Source: Prepared by the Team

Abbreviation: W.S. Work Supervisor
R.D.O. Regional Development Officer

Table 3.5.6 ACTIVITIES OF RURAL INDUSTRY

(In the Scheme)	
01. Weaving Centre	01 at Tissapura
02. Sewing Machine Training Centre	01 Tract No. 6
03. Brick Making Centre	10 All over the area in the Scheme
04. Carpentry Training Centre	01 at Tract No. 06
05. Masons Training Centre	01 at Tract No. 09
06. Workshops (Blacksmoth's Level)	07
(Around the Scheme)	
01. Driving Training Centre	01 at Mapakadawewa
02. Carpentary Training Centre	02 at Mapakadawewa & Mahiyangana
03. Tile Factory	01 at Mahiyangana
04. Workshop (Machine Repairing) (Lathe Machine, Welding, Cutting etc.)	10 Private
05. Weaving Centres	03 at Mapakadawewa, Dambarawa and Sorabora
06. Rice Milling Machines-Large Scale (With boiling) Middle Small	01(Co-operative) 03 10
07 Workshops (Blacksmith's Rural Level)	20 Approximately
08. Bullock Cart Repairing Centres	04 Approximately

SOURCE : Surveyed by the team

3.6 IRRIGATION AND DRAINAGE SYSTEM

3.6.1 General

The water source for the Nagadeepa Scheme is a reservoir with an effective storage capacity of 33 million cu.m constructed on the Hepola Oya, a right bank tributary of the Mahaweli River. The reservoir was completed in 1970 and its dam height was increased by 10 feet in 1972. The irrigation system for this Scheme consists of a Main Canal originating from the right bank of the Nagadeepa Reservoir, a Branch Canal, distributary canal networks to irrigate 1,791 ha of

paddy field. Besides the above, about 650 ha of highland was initially developed by lift irrigation, but this system was later abandoned due to shortage of water and the difficulty in maintaining and operating it. The highland has since become rainfed dry field or wasteland.

Yala cultivation is almost impossible mainly due to shortage of water resources.

The outline of the exisiting irrigation system of the Nagadeepa Scheme is as shown below, and in the modelized schematic diagram as per Fig. 3.6.1.

Outline of Existing Irrigation System

Nagadeepa Reservoir

Catchment Area		70 km^2 (27 sq. miles)
Net Capacity		33.4 x 10^6 cu.m
Embankment:	Type	Earthfill
	Maximum Height	23.5 m

Canal / Section	Length	Irr. Area	Turnout	D. Canal	Design Discharge
	(km)	(ha)	(Nos.)	(Nos.)	(m^3/sec)
Main Canal U/S	4.2	169	10	2	2.5
- do - D/S	7.4	535	21	5	0.7
Branch Canal	7.6	1,087	23	14	2.1
Total	19.2 km	1,791 ha	54 Nos.	21 Nos.	-

3.6.2 Irrigation System

(1) Irrigation System and Irrigation Area

The irrigation system of this Scheme consists of the Nagadeepa Reservoir across the Hepola Oya, a right bank tributary of the Mahaweli River, the main canal extending

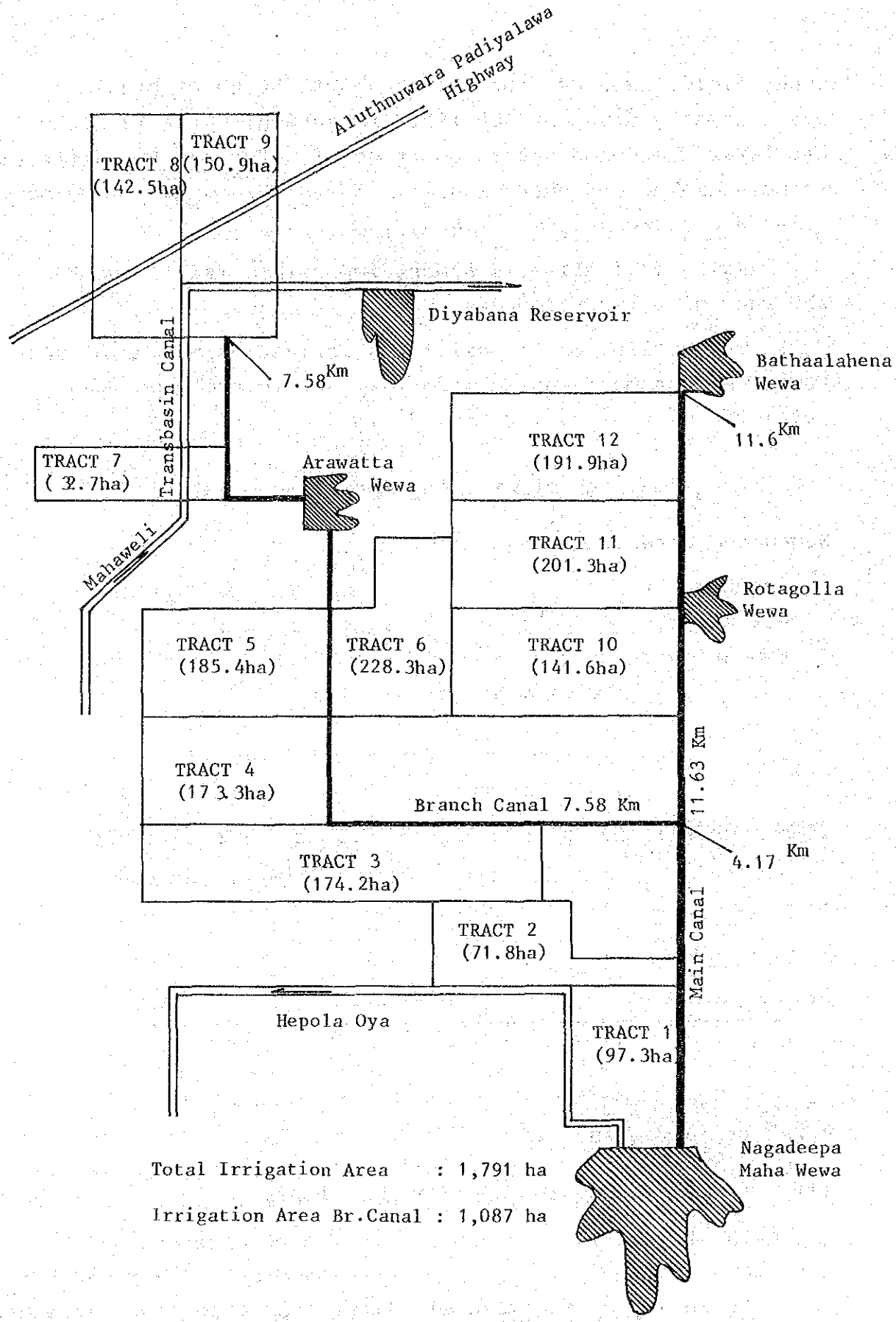


Fig. 3.6.1 OUTLINE OF NAGADEEPA IRRIGATION SYSTEM

11.6 km long, the Branch Canal extending 7.6 km long, 21 Distributary Canals and 275 Field Canals. The system irrigates 1,791 ha of paddy field.

The irrigation area is divided into 12 tracts. The main canal supplies irrigation water to tracts 1, 2, 10, 11 and 12, while the Branch Canal, originating from 4,165 m junction with the main canal, supplies water to Tracts 3 to 9. Both the main canal and the Branch Canal have a minor tank in their respective line and these tanks concurrently serve as regulating reservoirs and sources of domestic water for the use of the settlers. This irrigation system and its canal system diagram are as shown on Fig. 3.6.2 and DWG. No. 01, respectively.

The irrigation area of the Nagadeepa Scheme was 1,680 ha (4,150 Acs) of paddy lands and 650 ha (1,600 Acs) of lift irrigated dry fields when it was initially developed, but 122.1 ha of paddy fields have been lost later due to the construction of the Mahaweli Development Trans-basin Canal while 233.8 ha consisting of grasslands, public lands reservation areas along the canals and roads have been asweddumized (converted to paddy fields) by encroachers, so that all in all, the existing irrigation area is now effectively 1,791.2 ha. The highlands irrigated by lift irrigation system have since been turned into rainfed highlands for very extensive cultivation or abandoned as wasteland due to the shortage of water, the high operating cost of the irrigation system and inadequate education of the farmers. The command area is given in Table 3.6.1.

(2) Irrigation Facilities

Major facilities comprising the irrigation system of the Nagadeepa Scheme are the Nagadeepa Reservoir which is the water source, the main canal, a Branch Canal, appurtenant structures of these facilities, the distributary and field canal networks, etc. These major

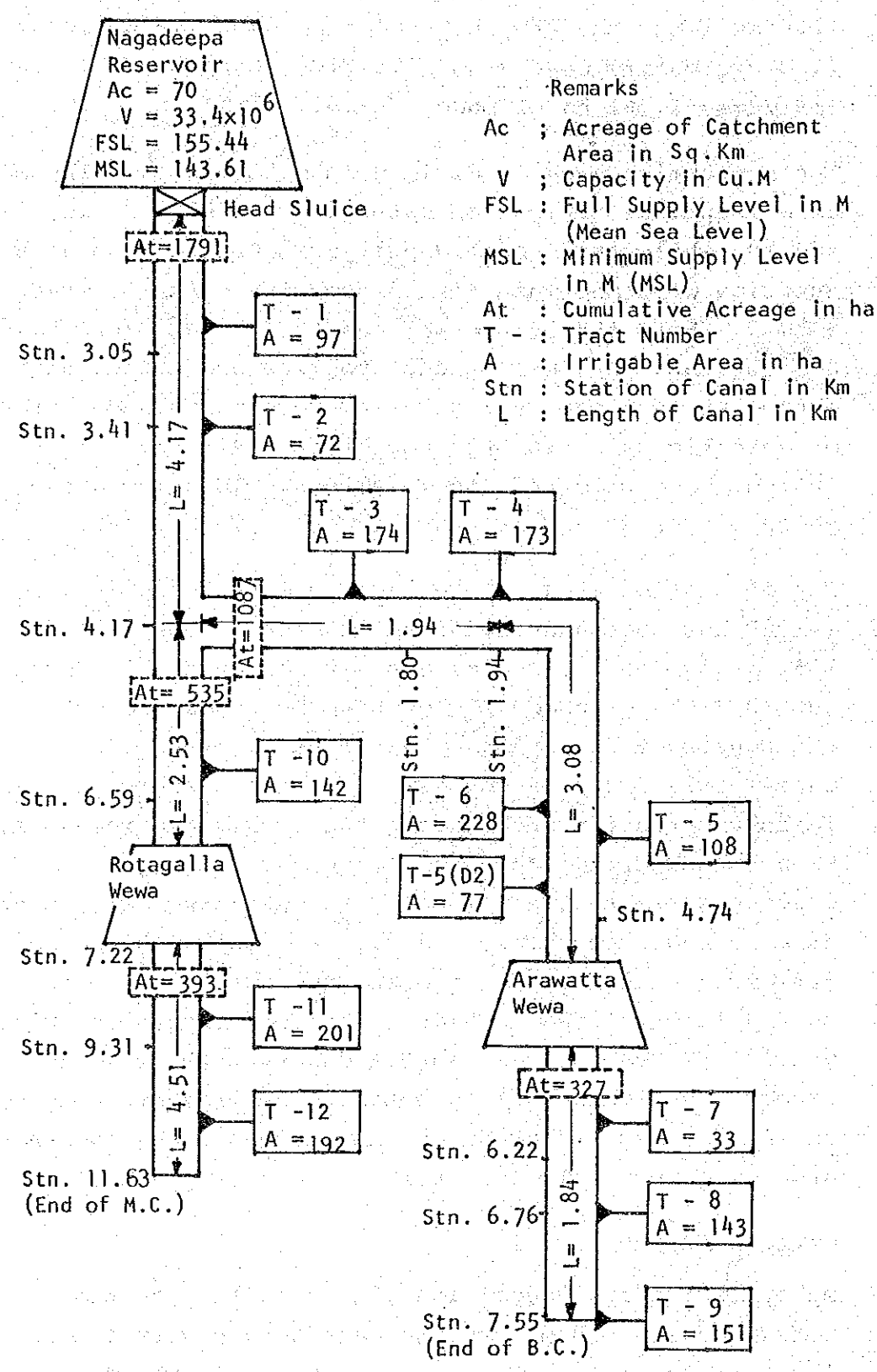


Fig. 3.6.2 IRRIGATION SYSTEM OF NAGADEEPA SCHEME

Table 3.6.1 IRRIGATION AREA IN NAGADEEPA SCHEME

Tract No.	Defined Command Area	Add. for Encroachment [1]	Total Command Area	Remarks
	ha (Acs)	ha (Acs)	ha (Acs)	
1	84.6 (209)	12.7 (34)	97.3 (243)	13 Acs Private Paddy.
2	62.4 (154)	9.4 (23)	71.8 (177)	
3	151.5 (374)	22.7 (56)	174.2 (430)	2 Acs Private Paddy.
4	150.7 (372)	22.6 (56)	173.3 (428)	
5	161.2 (398)	24.2 (59)	185.4 (457)	4 Acs Private, 10 Acs School.
6	198.5 (490)	29.8 (73)	228.3 (563)	
7	28.4 (70)	4.3 (11)	32.7 (81)	
8	123.9 (306)	18.6 (46)	142.5 (352)	12 Acs Private Paddy.
9	131.2 (324)	19.7 (49)	150.9 (373)	
10	123.1 (304)	18.5 (47)	141.6 (351)	64 Acs School & Seed Paddy.
11	175.0 (432)	26.3 (64)	201.3 (496)	
12	166.9 (412)	25.0 (62)	191.9 (474)	
13	- (-)	- (-)	- (-)	
Total	1,557.4(3,845)	233.8 (580)	1,791.2(4,425)	

Note : Area of 74 Acs in Tract 7
20 Acs in Tract 8
102 Acs in Tract 9 and
106* Acs in Tract 13
have been abandoned due to construction of Mahaweli Transbasin Canal.

* Including 14 Acs of School Paddy and Seed Paddy.

[1] Assumed to be 15% of Command Area

facilities are briefly described below and also summarized in Table 3.6.2.

i) Nagadeepa Reservoir

The Nagadeepa Reservoir had been constructed in 1970 and had its crest lifted 10 feet in 1972. The parameters of reservoir are given in Table 3.6.3.

ii) Irrigation Canals

The main canal starts from the outlet of the sluice located at the Nagadeepa Reservoir and extends north along the contour line, branches off the Branch Canal at 4.17 km point down the main canal, forms a minor tank at 6.7 km point and terminates at 11.63 km point. The main canal is a single bunded earth canal, so that the canal receives drainage from the hilly zone on its right bank. Excluding the afore-stated minor tank, however, it forms over crossings with all natural drains by providing under-crossings. The main canal irrigates Tract 1 and 2 in its upstream section, and after branching off the Branch Canal, irrigates Tract 9, 10 and 11, with the design discharge of 2.5 cu.m/sec and 0.7 cu.m/sec at the head of each section.

The Branch Canal has the design discharge of 2.1 cu.m/sec and irrigates seven Tracts (Tract 3 through Tract 9), which cover 60% of the whole area. One half of its total length has the same type of structure as the main canal, but its central section is structured as a double-bunded earth canal on account of the topographical conditions, and distributes water to both sides of distributary canals on it. As the topographical slope of this section is relatively steep, drop structures are

Table 3.6.2 LIST OF IRRIGATION FACILITIES IN NAGADEEPA SCHEME

Facility	Unit	Main Canal			Branch Canal	Total	Remarks
		km 0.0 - 4.17	km 4.17 - 11.63	Total	Km 0-7.58		
Main/Branch Canal	Km	4.17	7.46	11.63	7.58	19.21	Including tank portions
Distributary Canal	Nos.	2	5	7	14	21	
	Km	2.80	4.63	7.4	22.32	29.75	
Field Canal	Nos.	30	83	113	162	275	
	Km	8.51	31.65	40.16	54.94	95.10	
Turnout	Nos.	10	21	31	23	54	
Regulator	Nos.	-	2	2	3	5	Two are gated regulator
Spillway	Nos.	3	3	6	2	8	
Drop	Nos.	-	-	-	5	5	
Bridge (Road)	Nos.	6	7	13	9	22	
(Foot)	Nos.	1	-	1	-	1	
(Temporary)	Nos.	14	25	39	8	47	
Bridge cum culvert	No.	1	-	1	-	1	
Undercrossing	Nos.	3	6	9	2	11	
Reservoir	No.	-	1	1	1	2	Rotagolla Wewa, Arawatta Wewa

Note : Rotagolla Wewa portion is 550 m long.
Arawatta Wewa portion is 960 m long.

Table 3.6.3 PARAMETERS OF NAGADEEPA RESERVOIR

General			
Catchment Area		70 sq.Km	
Average Rainfall		N.E.M.	1,394 mm
		S.W.M.	326 mm
Design Yield:	Average Annual	72.6×10^6 Cu.m	
	Lower Quarter	29.0×10^6 Cu.m	
Design Flood:	Frequency	100 year	50 year
	Max. Inflow	430 Cu.m/s	390 Cu.m/s
Reservoir			
Full Supply Level		155.44 m MSL	
Area at F.S.L.		8.7 sq.Km	
Net Capacity		33.4×10^6 Cu.m	
Dead Storage		0.15×10^6 Cu.m	
Full Supply Head		12.19 m	
High Flood Level		156.36 m MSL	
Embankment			
Type		Earthfill	
Length & Max. Height		23.5 m high x 1,173 m long	
Top Width		6.10 m	
Top Elevation		158.50 m MSL	
Side Slopes		U/S 1 on 2.0	D/S 1 on 2.5
Spillway			
Radial Gate		4 Nos. 6.1 m x 3.05 m Crest level 155.45 m MSL	
Natural Spill		335 m long Crest level 156.36 m MSL	
Sluice			
Type		R.C. Tower and Conduit	
Size of Gate		1.07 m x 0.99 m	
Size of Conduit		1.22 m x 1.37 m	
Spill Level		143.26 m MSL	

provided at five spots, and the canal flows into a minor tank, Arawatta Wewa, at the end of this section. After leaving the tank, the canal continues for another 1.9 km and supplies irrigation water to Tract 7, 8 and 9.

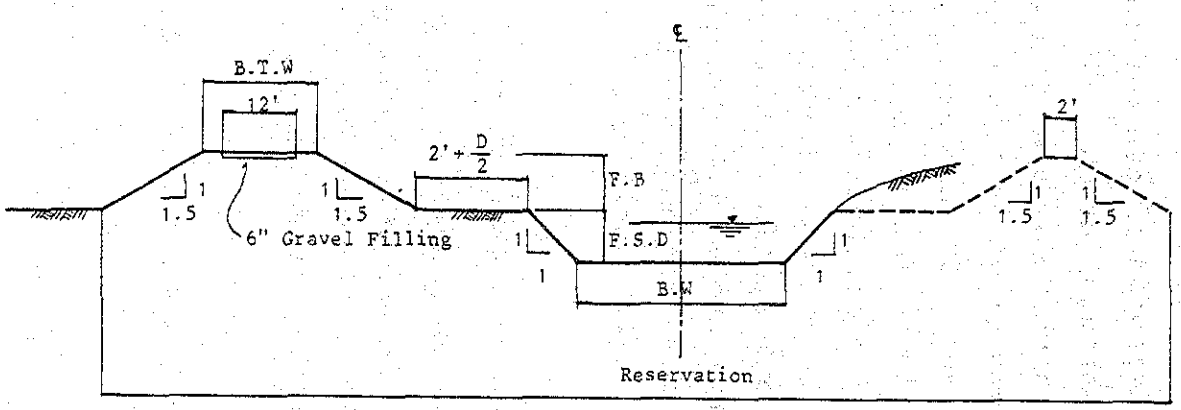
Irrigation water is distributed to distributary canals or field canals through turnouts provided in the main canal and Branch Canal and then supplied to each plot. The numbers of distributary canals and field canals are 21 and 275, respectively, and their total lengths are 30 km and 95 km, respectively. The average scale of distributary canals is 1.4 km in length and 90 ha in command area per canal. The original design sections of the main canal and the Branch Canal are as illustrated in Fig. 3.6.3, and the distribution and length of distributary canals and field canals are as shown in Table 3.6.4.

iii) Structures related to the Main & Branch Canals

There are turnouts which are conduit type, regulators, spillways, drop structures, bridges, drainage undercrossings and minor tanks in the main canal and/or the Branch Canal. Their respective numbers are as given in Table 3.6.2.

Flow measuring devices are not provided in either canals.

Fig. 3.6.3 ORIGINAL CANAL SECTION OF NAGADEEPA MAIN & BRANCH CANAL



Note : 1. Canal Duty = 40 Acs/cusec 2. Gradient = 0.00035 3. n = 0.025

Item \ Section		Main Canal						Branch Canal			
		upto Km 4.17	Km 6.11	Km 8.69	Km 9.01	Km 10.86	Km 11.63	Km 1.94	Km 4.74	Km 6.76	Km 7.58
Designed Area Command	(Ac)	4,000	1,254	982	828	566	460	2.603	1,857	884	426
Mean Supply Discharge	(cusec)	90.0	25.1	24.6	20.7	14.2	11.5	74.5	50.0	24.6	11.8
B.W	(ft)	14.0	6.0	6.0	6.0	5.0	5.0	9.0	7.0	5.0	4.0
F.S.D	(ft)	2.8	2.1	2.0	1.8	1.7	1.5	3.2	2.8	2.1	1.5
Velocity	(ft/sec)	1.91	1.56	1.54	1.45	1.36	1.24	2.07	1.87	1.65	1.43
F.B	(ft)	2.0	2.0	2.0	1.5	1.5	1.5	3.0	2.0	2.0	2.0
B.T.W	(ft)	30.0	30.0	30.0	30.0	30.0	30.0	20.0	20.0	20.0	20.0
Full Reservation	(ft)	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	99.0	99.0

Table 3.6.4 SUMMARY TABLE OF CANAL SYSTEM IN NAGADEEPA SCHEME

Canal/ Tract	No. of D. Canal	No. of F. Canal	Length of D. Canal	Total Length of F. Canal
Main Canal (Irrigation Area = 704 ha, Canal Length = 11.63 km)				
Tract 1	1 No.	22 Nos.	D1 = 0.75 km	5.17 km
Tract 2	1	8	D1 = 2.05	3.34
Tract 10	2	22	D1 = 0.46, D2 = 0.69	8.12
Tract 11	1	27	D1 = 1.01	11.54
Tract 12	2	34	D1 = 1.22, D2 = 1.25	11.99
Sub-total	7 Nos.	113 Nos.	7.43 km	40.16 km
Branch Canal (Irrigation Area = 1,087 ha, Canal Length = 7.58 km)				
Tract 3	1	24	D1 = 3.55	8.50
Tract 4	4	27	D1 = 2.54, D2 = 0.88, D3 = 0.49, D4 = 0.41	8.54
Tract 5	2	26	D1 = 0.91, D2 = 1.46	8.10
Tract 6	3	37	D1 = 2.35, D2 = 0.20 D3 = 0.21	12.49
Tract 7	1	8	D2 = 1.98	1.83
Tract 8	1	22	D1 = 3.34	7.63
Tract 9	2	18	D2 = 2.31, D3 = 1.69	7.85
Sub-total	14 Nos.	162 Nos.	22.32 km	54.94 km
Total	21 Nos.	275 Nos.	29.75 km	95.10 km

3.6.3 Water Availability

(1) General

The study of water availability of Nagadeepa Scheme has been made on the basis of the past discharge records of the sluice at Nagadeepa Reservoir, data on cropping in the scheme area, rainfall records and other similar information, because it was difficult to identify water availability conditions in '85 Yala due to the non-issue of irrigation water.

Water balance studies were executed in 1982/83 Maha and 1983/84 Maha of which daily discharge records of the sluice and daily rainfall records are available and harvests were confirmed. Some valuable informations, such as monthly discharge records of the sluice, cultivated acreage cropping conditions are listed in Table 3.6.5.

(2) Discharge through the Nagadeepa Sluice

Irrigation water was fed to the Nagadeepa Scheme from 7th December to 15th April with total amount of 23.50 Million cu.m in 1983/84 Maha, which was rainy year.

(3) Field Irrigation Requirement

i) Crop Water Requirement

Crop Water Requirement is obtained from reference crop evapo-transpiration and crop factor. The reference crop evapo-transpiration for the Nagadeepa Scheme has been estimated on the basis of the meteorological data of Girandurukotte. Irrigation Department Design Notes (IDDN) were used for determining the crop factor for each growth stage of crops. Cultivation in 1982/83 Maha was started from 1st December for an extent of 1,417 ha, under 135-day paddy, and from 21st December for an extent of 1,700 ha, under the same variety of paddy in 1983/84 Maha.

Table 3.6.5 QUANTITY OF WATER ISSUES

Year	Season	Quantity of Water Issues			Crops	Duty mm (Ac.ft/Ac)	Culitivated Area in ha	Remarks
		Month	Issues x 10^6 m^3	Total x 10^6 m^3				
1979/80	Maha	November December January February March April	9.46 10.12 13.19 14.96 8.34 0.43	56.52	Paddy	2782 (9.15)	2025	Drmax = 2.4 ℓ/s/ha (Jan) Successful
1980	Yala	June July August September	1.44 1.43 1.30 0.54	4.71	Subsidiary Food Crops	1158 (3.81)	405	Drmax = 1.8 ℓ/s/ha (June) Successful
1980/81	Maha	NA						
1981	Yala							20 Acs of subsidiary food crop successful
1981/82	Maha	December January February	7.92 8.93 7.16	22.77	Paddy	1122 (3.69)	2025	Drmax = 1.6 ℓ/s/ha (Jan)
1982	Yala							No Cultivation
1982/83	Maha	December January February March April	2.43 6.88 6.90 6.47 1.40	24.09	Paddy	1693 (5.57)	1417	Drmax = 20 ℓ/s/ha Successful
1983	Yala							No Cultivation
1983/84	Maha	December January February March April	1.82 5.82 3.47 5.98 2.74	19.84	Paddy	1161 (3.82)	1700	Drmax = 1.4 ℓ/s/ha (May) Successful (Heavy Rain)
1984	Yala	May June July August September	3.88 10.03 4.85 6.63 1.23	26.62	Paddy & Subsidiary Food Crops	2092 (6.88) & 1381 (4.53)	1215 & 81	Assumed 1000 Ac/ft for month September and 4.53 Ac.ft/Ac in the duty for subsidiary food crops. Drmax = 3.1 ℓ/s/ha (June)
1984/85	Maha	January February March April May	5.95 5.86 7.22 7.30 1.94	28.27			1782	Drmax = 1.6 ℓ/s/ha (Apr) 100 % Successful

Noute: Effective rainfall is not included in Diversion Requirement (Dr)

Source: I.D. at Mapakada

ii) Land Preparation Losses

Land preparation loss of 12 in/15 days, i.e. 12 mm/day, for low land is determined by IDDN.

iii) Farm Losses

The result of soil survey shows that soil in the Nagadeepa area have a larger clay content than those in the Minipe Area. Consequently, Farm Losses in the Nagadeepa area during irrigation period can be estimated to have smaller values than in the Minipe area. Farm Loss of 6 in/month, i.e. 5 mm/day, for low land has been adopted.

iv) Field Water Requirement

Field water requirement is the total amount of crop water requirement, land preparation loss, and farm loss. The total amounts of field water requirement were estimated as 1,394 mm in 1982/83 Maha and 1,439 mm in 1983/84 Maha.

v) Effective Rainfall

Using the daily rainfall records at Girandurukotte, the values of effective rainfall have been determined on the following formula:

Effective Rainfall (Pe) = Daily Rainfall (R) x 0.8
where, 5 mm < R < 80 mm

vi) Field Irrigation Requirement

The total amount of field irrigation requirement has been estimated as 822 mm in 1982/83 Maha and 418 mm in 1983/84 Maha.

(4) Water Balance Study and System Efficiency

System Efficiency, i.e. Conveyance Efficiency, of the Main Canal (including the Branch Canal) and the D-canals

in the Nagadeepa Scheme can be estimated by relating the field irrigation requirements as indicated above and the sluice discharges. The results of water balance study are shown in Table 3.6.6 and Table 3.6.7. The study on system efficiency has been done for 1982/83 Maha, since Maha 1983/84 was in a rainy year, and the sluice seemed to have been operated without any consideration for the effect of precipitation.

According to the water balance study, the values of system efficiency would have varied to large extent, and is estimated as 45% - 50%. The present conveyance efficiency of the main canal (including the Branch Canal) and the D-canals is estimated at 65% - 70% respectively taking into consider on the system efficiency indicated above, the present conditions of the canals and the standard values in IDDN. Fig. 3.6.4 illustrates the sluice discharges, farm water requirements and rainfalls in 1982/83 Maha.

Table 3.6.6 WATER BALANCE STUDY OF NAGADEEPA SCHEME IN '82/83 MAHA

WATER BALANCE STUDY (NAGADEEPA) *CASE-2-1* PADDY=135 DAY,A=1417 HA *1982/83*

Y	M	DAY	ISSUED WATER (CM/S)	ISSUED WATER (MCM)	FIELD WATER REQUIREMENT (MM)	FIELD WATER REQUIREMENT (MCM)	RAINFALL (MM)	EFFECTIVE RAINFALL (MM)	EFFECTIVE RAINFALL (MCM)	FIELD IRRIGATION SYSTEM REQUIREMENT (MM)	FIELD IRRIGATION SYSTEM REQUIREMENT (MCM)	EFFICIENCY (PERCENT)	DIVERVION REQUIREMENT (MM)	DIVERVION REQUIREMENT (MCM)	BALANCE (MCM)
1982	11	1- 5	0.000	0.000	42.5	0.603	73.0	56.0	0.794	0.0	0.000	0.0	0.0	0.000	0.000
		6- 10	0.000	0.000	42.5	0.603	33.1	26.5	0.375	16.0	0.227	0.0	26.7	0.379	-0.379
		11- 15	0.000	0.000	42.5	0.603	178.0	78.4	1.111	0.0	0.000	0.0	0.0	0.000	0.000
		16- 20	0.000	0.000	64.0	0.907	87.2	67.2	0.952	0.0	0.000	0.0	0.0	0.000	0.000
		21- 25	0.000	0.000	64.0	0.907	65.0	52.0	0.737	12.0	0.170	0.0	20.0	0.283	-0.283
		26- 30	0.000	0.000	64.0	0.907	125.5	98.8	1.400	0.0	0.000	0.0	0.0	0.000	0.000
	SUB-TOTAL		0.000	0.000	319.5	4.528	561.8	378.9	5.369	28.0	0.397		46.7	0.662	0.000
	12	1- 5	0.000	0.000	40.5	0.574	106.5	83.2	1.179	0.0	0.000	0.0	0.0	0.000	0.000
		6- 10	2.258	0.195	40.5	0.574	205.5	107.6	1.525	0.0	0.000	0.0	0.0	0.000	0.195
		11- 15	2.568	0.222	40.5	0.574	150.5	96.4	1.366	0.0	0.000	0.0	0.0	0.000	0.222
		16- 20	2.568	0.222	41.7	0.590	107.3	83.1	1.178	0.0	0.000	0.0	0.0	0.000	0.222
		21- 25	12.129	1.048	41.7	0.590	30.1	22.8	0.323	18.9	0.267	25.5	31.4	0.445	0.602
		26- 31	10.017	0.865	50.2	0.712	36.2	26.0	0.368	24.2	0.343	39.7	40.4	0.572	0.293
	SUB-TOTAL		29.540	2.552	255.1	3.614	606.1	419.1	5.939	43.1	0.611		71.8	1.018	1.535
1983	1	1- 5	17.346	1.498	46.3	0.656	3.0	0.0	0.000	46.3	0.656	43.8	77.1	1.093	0.406
		6- 10	17.632	1.523	46.3	0.656	0.0	0.0	0.000	46.3	0.656	43.0	77.1	1.093	0.431
		11- 15	10.943	0.945	46.3	0.656	69.0	55.2	0.782	0.0	0.000	0.0	0.0	0.000	0.945
		16- 20	3.363	0.291	46.3	0.656	26.3	15.2	0.215	31.1	0.440	151.5	51.8	0.734	-0.443
		21- 25	9.450	0.816	46.4	0.657	2.5	0.0	0.000	46.4	0.657	80.5	77.3	1.095	-0.279
		26- 31	14.495	1.252	56.1	0.795	11.2	7.4	0.104	48.7	0.690	55.1	81.2	1.151	0.102
	SUB-TOTAL		73.229	6.327	287.6	4.075	112.0	77.8	1.102	218.7	3.099		364.5	5.165	1.162
	2	1- 5	14.397	1.244	50.9	0.721	0.0	0.0	0.000	50.9	0.721	57.9	84.8	1.201	0.043
		6- 10	14.235	1.230	51.1	0.724	0.0	0.0	0.000	51.1	0.724	58.8	85.1	1.206	0.024
		11- 15	14.045	1.213	51.4	0.728	0.0	0.0	0.000	51.4	0.728	60.0	85.7	1.214	-0.000
		16- 20	15.173	1.311	51.4	0.728	0.0	0.0	0.000	51.4	0.728	55.6	85.7	1.214	0.097
		21- 25	17.614	1.522	51.4	0.728	0.0	0.0	0.000	51.4	0.728	47.9	85.7	1.214	0.308
		26- 28	11.981	1.036	30.8	0.437	0.0	0.0	0.000	30.8	0.437	42.2	51.4	0.728	0.308
	SUB-TOTAL		87.455	7.556	287.0	4.066	0.0	0.0	0.000	287.0	4.066		478.3	6.777	0.779
	3	1- 5	18.367	1.587	56.2	0.796	0.0	0.0	0.000	56.2	0.796	50.2	93.7	1.327	0.260
		6- 10	16.034	1.385	56.2	0.796	0.0	0.0	0.000	56.2	0.796	57.5	93.7	1.327	0.058
		11- 15	15.569	1.347	52.3	0.741	0.0	0.0	0.000	52.3	0.741	55.0	87.2	1.235	0.112
		16- 20	18.105	1.564	28.1	0.398	0.0	0.0	0.000	28.1	0.398	25.4	46.8	0.663	0.901
		21- 25	15.183	1.312	28.1	0.398	0.0	0.0	0.000	28.1	0.398	30.3	46.8	0.663	0.649
		26- 31	16.354	1.413	24.2	0.343	0.0	0.0	0.000	24.2	0.343	24.3	40.3	0.571	0.842
	SUB-TOTAL		99.632	8.608	245.0	3.472	0.0	0.0	0.000	245.0	3.472		408.4	5.787	2.821
	4	1- 5	2.104	0.182	0.0	0.000	0.0	0.0	0.000	0.0	0.000	0.0	0.0	0.000	0.182
		6- 10	10.021	0.866	0.0	0.000	0.0	0.0	0.000	0.0	0.000	0.0	0.0	0.000	0.866
		11- 15	7.763	0.671	0.0	0.000	0.0	0.0	0.000	0.0	0.000	0.0	0.0	0.000	0.671
		16- 20	0.000	0.000	0.0	0.000	0.0	0.0	0.000	0.0	0.000	0.0	0.0	0.000	0.000
		21- 25	0.000	0.000	0.0	0.000	0.0	0.0	0.000	0.0	0.000	0.0	0.0	0.000	0.000
		26- 30	0.000	0.000	0.0	0.000	17.5	14.0	0.198	0.0	0.000	0.0	0.0	0.000	0.000
	SUB-TOTAL		19.888	1.718	0.0	0.000	17.5	14.0	0.198	0.0	0.000		0.0	0.000	1.718
	TOTAL		309.744	26.762	1394.2	19.755	1297.4	889.8	12.608	821.8	11.646		1369.7	19.409	8.015

Table 3.6.7 WATER BALANCE STUDY OF NAGADEEPA SCHEME IN '83/84 MAHA

WATER BALANCE STUDY (NAGADEEPA) *CASE-2-3* PADDY=135 DAY,A=1700 HA *1983/84*

Y	N	DAY	ISSUED WATER (CM/S)	ISSUED WATER (MCM)	FIELD WATER REQUIREMENT (MM)	FIELD WATER REQUIREMENT (MCM)	RAINFALL (MM)	EFFECTIVE RAINFALL (MM)	EFFECTIVE RAINFALL (MCM)	FIELD IRRIGATION REQUIREMENT (MM)	FIELD IRRIGATION REQUIREMENT (MCM)	SYSTEM EFFICIENCY (PERCENT)	DIVERVION REQUIREMENT (MM)	DIVERVION REQUIREMENT (MCM)	BALANCE (MCM)
1983	11	21- 25	0.000	0.000	42.5	0.723	2.2	0.0	0.000	42.5	0.723	0.0	70.8	1.204	-1.204
		26- 30	0.000	0.000	42.5	0.723	68.6	53.8	0.914	0.0	0.000	0.0	0.0	0.000	0.000
		SUB-TOTAL	0.000	0.000	85.0	1.445	70.8	53.8	0.914	42.5	0.723		70.8	1.204	0.000
	12	1- 5	0.000	0.000	42.5	0.723	47.0	37.3	0.634	5.2	0.089	0.0	8.7	0.148	-0.148
		6- 10	0.000	0.000	62.8	1.067	167.4	107.8	1.833	0.0	0.000	0.0	0.0	0.000	0.000
		11- 15	0.000	0.000	62.8	1.067	148.7	119.0	2.022	0.0	0.000	0.0	0.0	0.000	0.000
		16- 20	0.000	0.000	62.8	1.067	287.2	214.6	3.649	0.0	0.000	0.0	0.0	0.000	0.000
		21- 25	3.846	0.332	40.5	0.688	80.2	64.2	1.091	0.0	0.000	0.0	0.0	0.000	0.332
		26- 31	15.937	1.377	48.6	0.826	29.9	22.5	0.382	26.1	0.444	32.2	43.5	0.740	0.637
		SUB-TOTAL	19.783	1.709	319.9	5.437	760.4	565.4	9.611	31.3	0.533		52.2	0.888	0.969
1984	1	1- 5	15.374	1.328	43.8	0.744	57.0	45.6	0.775	0.0	0.000	0.0	0.0	0.000	1.328
		6- 10	16.534	1.429	44.9	0.763	99.9	79.2	1.346	0.0	0.000	0.0	0.0	0.000	1.429
		11- 15	5.115	0.442	44.9	0.763	269.4	171.0	2.906	0.0	0.000	0.0	0.0	0.000	0.442
		16- 20	12.915	1.116	45.2	0.768	66.7	51.4	0.873	0.0	0.000	0.0	0.0	0.000	1.116
		21- 25	7.778	0.672	46.3	0.787	57.9	46.3	0.787	0.0	0.000	0.0	0.0	0.000	0.672
		26- 31	9.352	0.808	55.5	0.944	86.8	68.5	1.164	0.0	0.000	0.0	0.0	0.000	0.808
		SUB-TOTAL	67.068	5.795	280.5	4.769	637.7	461.9	7.853	0.0	0.000		0.0	0.000	5.795
	2	1- 5	10.388	0.898	50.3	0.855	50.8	40.6	0.691	9.7	0.164	18.3	16.1	0.274	0.624
		6- 10	6.286	0.543	50.3	0.855	174.8	139.8	2.377	0.0	0.000	0.0	0.0	0.000	0.543
		11- 15	1.568	0.135	50.5	0.859	248.7	149.8	2.547	0.0	0.000	0.0	0.0	0.000	0.135
		16- 20	0.000	0.000	50.8	0.864	43.0	31.6	0.537	19.2	0.327	0.0	32.1	0.545	-0.545
		21- 25	10.114	0.874	50.8	0.864	18.8	15.0	0.256	35.8	0.609	69.7	59.7	1.015	-0.141
		26- 29	11.895	1.028	40.8	0.693	56.4	43.2	0.734	0.0	0.000	0.0	0.0	0.000	1.028
		SUB-TOTAL	40.251	3.478	293.6	4.991	592.5	420.2	7.143	64.7	1.100		107.9	1.834	1.644
	3	1- 5	**********		56.2	0.955	383.3	215.2	3.658	0.0	0.000	0.0	0.0	0.000	**********
		6- 10	**********		56.2	0.955	137.7	64.0	1.088	0.0	0.000	0.0	0.0	0.000	**********
		11- 15	**********		56.2	0.955	0.0	0.0	0.000	56.2	0.955	0.0	93.7	1.592	**********
		16- 20	**********		56.2	0.955	0.0	0.0	0.000	56.2	0.955	0.0	93.7	1.592	**********
		21- 25	**********		56.2	0.955	2.1	0.0	0.000	56.2	0.955	0.0	93.7	1.592	**********
		26- 31	**********		65.9	1.120	43.7	34.2	0.581	31.7	0.539	0.0	52.9	0.899	**********
		SUB-TOTAL		5.980	346.9	5.897	566.8	313.4	5.327	200.3	3.405		333.9	5.676	0.304
	4	1- 5	6.208	0.536	43.1	0.732	18.3	14.0	0.238	29.1	0.494	92.1	48.4	0.823	-0.287
		6- 10	10.051	0.868	28.4	0.483	0.4	0.0	0.000	28.4	0.483	55.6	47.3	0.805	0.064
		11- 15	7.760	0.670	26.8	0.456	9.6	5.0	0.086	21.8	0.370	55.2	36.3	0.617	0.054
		16- 20	2.602	0.225	14.7	0.249	28.0	19.3	0.328	0.0	0.000	0.0	0.0	0.000	0.225
		21- 25	2.599	0.225	0.0	0.000	39.0	24.4	0.415	0.0	0.000	0.0	0.0	0.000	0.225
		26- 30	2.595	0.224	0.0	0.000	10.7	8.6	0.146	0.0	0.000	0.0	0.0	0.000	0.224
		SUB-TOTAL	31.815	2.749	112.9	1.920	104.0	71.3	1.212	79.2	1.347		132.0	2.245	0.504
	5	1- 5	0.000	0.000	0.0	0.000	3.5	0.0	0.000	0.0	0.000	0.0	0.0	0.000	0.000
		6- 10	0.000	0.000	0.0	0.000	3.5	0.0	0.000	0.0	0.000	0.0	0.0	0.000	0.000
		11- 15	0.000	0.000	0.0	0.000	0.0	0.0	0.000	0.0	0.000	0.0	0.0	0.000	0.000
		16- 20	8.789	0.759	0.0	0.000	16.7	11.3	0.192	0.0	0.000	0.0	0.0	0.000	0.759
		21- 25	14.853	1.283	0.0	0.000	0.0	0.0	0.000	0.0	0.000	0.0	0.0	0.000	1.283
		26- 31	21.158	1.828	0.0	0.000	0.0	0.0	0.000	0.0	0.000	0.0	0.0	0.000	1.828
		SUB-TOTAL	44.800	3.871	0.0	0.000	23.7	11.3	0.192	0.0	0.000		0.0	0.000	3.871
	TOTAL		203.717	23.501	1438.8	24.459	2755.9	1897.1	32.251	418.1	7.108		696.8	11.846	13.087

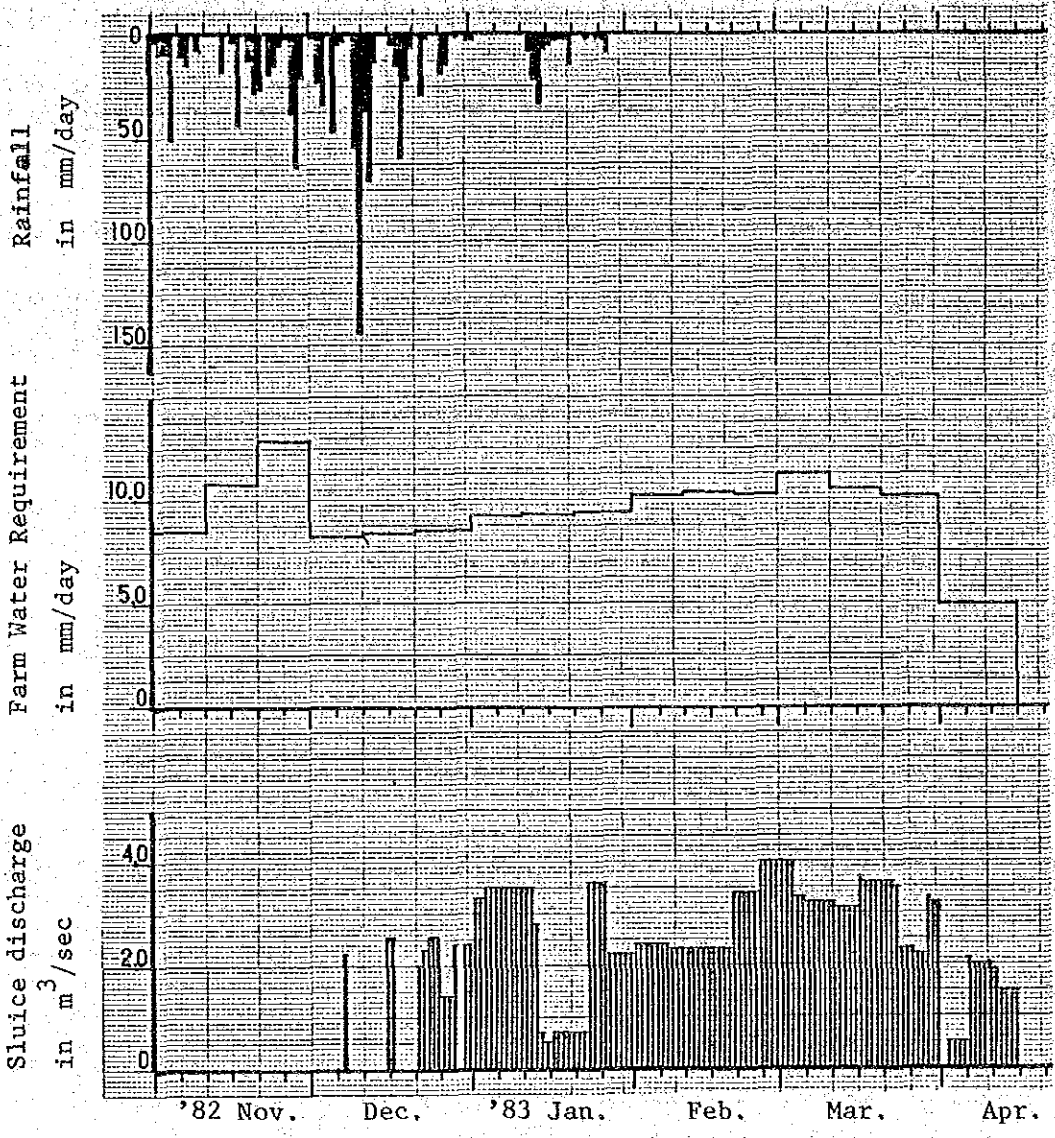


Fig. 3.6.4 SLUICE DISCHARGE OF NAGADEEPA RESERVOIR IN 82/83 MAHA