Table 6.1 PERCOLATION TEST RESULT

(Unit: mm/day)

Serial Number of Testing Days	Testing Date	Testing Station		
		No. 1	No. 2	No. 3
1	(1985) Sept. 21	8	10	2
2	Sept. 22	8	10	3
3	Sept. 23	9	11	3
4	Sept. 24	16	13	5
5	Sept. 25	11	13	3
6	Sept. 26	13	17	5
7	Sept. 27	10	12	7
8	Sept. 28	9	13	5
9	Sept. 29	-	-	-
10	Sept. 30	-	-	-
11	Oct. 1	5	16	4
12	Oct. 2	3	10	3
13	Oct. 3	5	12	6
14	Oct. 4	6	10	3
15	Oct. 5	6	9	1
16	Oct. 6	6	10	2
17	Oct. 7	7	10	2
18	Oct. 8	2	12	4
19	Oct. 9	-	12	4
20	Oct. 10	5	8	2
21	Oct. 11	10	10	0
22	Oct. 12	-	10	5
23	Oct. 13	-	10	6
24	Oct. 14	-	11	6
25	Oct. 15	-	6	1
26	Oct. 16	3	13	2
27	Oct. 17	5	11	8
28	Oct. 18	4	8	8
29	Oct. 19	2	7	5
30	Oct. 20	2	8	5
31	Oct. 21	3	8	5
32	Oct. 22	4	11	5
33	Oct. 23	-	7	1
34	Oct. 24	6	14	2
35	Oct. 25	5	0	0
36	Oct. 26	4	2	2
37	Oct. 27	4	3	3
38	Oct. 28	4	3	3
39	Oct. 29	6	11	5
40	Oct. 30	2	8	3
41	Oct. 31	3	9	3
42	Nov. 1	1	7	6
43	Nov. 2	2	7	0
44	Nov. 3	2	7	0
45	Nov. 4	3	7	0
46	Nov. 5	5	6	2
47	Nov. 6	6	7	3
48	Nov. 7	5	12	6
49	Nov. 8	4	7	2
50	Nov. 9	3	7	5
51	Nov. 10	3	7	5
52	Nov. 11	4	8	5
Average Percoration (52 days) (21/9/'85 - 11/11/'85)		5.3	9.2	3.5

Note: All tests were measured at 10:00 A.M.

Table 6.2 CROP COEFFICIENT (Kc)

Crop	Season	Crop Coefficients									
		* 1	2	3	4	5	6	7	8	9	10
Paddy	Dry	1.03	1.13	1.22	1.31	1.37	1.39	1.34	1.24	1.10	0.99
Paddy	Rainy	1.02	1.10	1.17	1.20	1.22	1.23	1.20	1.14	1.06	0.97
Maize	Rainy	0.77	0.80	0.87	0.98	1.06	1.09	1.08	1.00	0.85	0.59
Tomato	Dry	0.96	1.04	1.08	1.11	1.13	1.12	1.08	1.00	0.83	0.60
Soybean	Dry	0.49	0.56	0.74	1.00	1.09	1.10	1.08	1.04	0.90	0.48
Groundnut	Dry	0.50	0.54	0.66	0.90	1.01	1.04	1.02	0.96	0.85	0.57
Groundnut	Rainy	0.90	0.90	0.91	0.93	0.94	0.96	0.96	0.95	0.84	0.60

* We divide each growing season by ten (10) terms by means of calculation.
All growing seasons can be shown in Fig.

Table 6.3 POTENTIAL EVAPOTRANSPIRATION (ETo)
BY PAN EVAPORATION METHOD (CLASS A PAN)

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Average
RH mean (%)	57 Medium	55 Medium	62 Medium	74 High	80 High	81 High	83 High	83 High	81 High	78 High	69 High	61 Medium	72 High
Wind speed (m/s) (km/day)	1.2 104 Light	1.6 138 Light	1.6 138 Light	1.4 121 Light	1.2 104 Light	1.1 95 Light	1.0 86 Light	1.1 95 Light	1.1 95 Light	1.4 121 Light	1.2 104 Light	1.0 86 Light	1.2 104 Light
Windward	East	East	East	East	East	East	West	West	West	West	East	East	East
Windward distance of green crop (m)	10	10	10	10	10	10	1000	1000	1000	1000	10	10	10
Pan coefficient (Kp)	0.75	0.75	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	0.81
Pan evaporation Epan (mm/day)	5.2	6.5	6.1	4.9	4.0	3.5	2.9	2.8	3.3	3.9	4.4	4.6	4.3
Reference crop evaporation Eto (mm/day)	3.9	4.9	4.6	4.2	3.4	3.0	2.5	2.4	2.8	3.3	3.3	3.5	3.5

Note: The pans were placed in short green cropped area (Case A)

Table 6.4 FARM WATER REQUIREMENT IN PADDY CROPS

(1) Paddy, Dry Season

(Unit: mm)

PLANTING DATE	GROWING STAGE DEC. 1	DEC. 2	DEC. 3	JAN. 1	JAN. 2	JAN. 3	FEB. 1	FEB. 2	FEB. 3	MAR. 1	MAR. 2	MAR. 3	APR. 1	APR. 2	APR. 3	MAY 1	MAY 2	MAY 3
DEC. 21	14.	98.	77.	74.	79.	94.	84.	89.	71.	74.	63.	58.	26.					
JAN. 1	2.	21.	100.	72.	76.	91.	82.	87.	71.	75.	65.	61.	30.	37.				
JAN. 11			22.	99.	73.	88.	79.	85.	70.	74.	66.	63.	32.	41.	35.			
JAN. 21				22.	100.	85.	76.	82.	68.	73.	65.	64.	34.	44.	39.	16.		
FEB. 1				10.	21.	102.	73.	79.	65.	70.	63.	63.	34.	47.	42.	18.	9.	7.
FEB. 3					20.	18.	144.	78.	65.	70.	63.	63.	34.	47.	42.	19.	10.	20.
AVERAGE	2.	19.	40.	55.	71.	88.	81.	84.	69.	73.	65.	62.	32.	36.	24.	7.	1.	0.07

(2) Paddy, Rainy Season

PLANTING DATE	GROWING STAGE JUNE 3	JULY 1	JULY 2	JULY 3	AUG. 1	AUG. 2	AUG. 3	SEP. 1	SEP. 2	SEP. 3	OCT. 1	OCT. 2	OCT. 3	NOV. 1	NOV. 2	NOV. 3	DEC. 1	DEC. 2
JUL. 11	0	0.	12.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.					
JUL. 21		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.				
AUG. 1			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	11.	46.			
AUG 11				0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	53.	53.		
AUG. 21				0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	59.	68.	47.	
AUG. 24				0.	0.	0.	12.	0.	0.	0.	0.	0.	6.	32.	59.	69.	61.	7.
AVERAGE	0.41	0.	2.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.27	4.	32.	23.	8.	0.01

Table 6.5 EFFECTIVE RAINFALL IN PADDY CROPS

(1) Paddy, Dry Season

(Unit: mm)

PLANTING DATE	GROWING STAGE DEC. 1	DEC. 2	DEC. 3	JAN. 1	JAN. 2	JAN. 3	FEB. 1	FEB. 2	FEB. 3	MAR. 1	MAR. 2	MAR. 3	APR. 1	APR. 2	APR. 3	MAY 1	MAY 2	MAY 3
DEC. 21	7.	0.	0.	0.	0.	0.	8.	8.	6.	24.	24.	40.	53.					
JAN. 1		0.	0.	0.	0.	0.	8.	8.	6.	24.	24.	40.	53.	40.				
JAN. 11			0.	0.	0.	0.	8.	8.	6.	24.	24.	40.	53.	40.	40.			
JAN. 21				0.	0.	0.	8.	8.	6.	24.	24.	40.	53.	40.	40.	83.		
FEB. 1				0.	0.	0.	8.	8.	6.	24.	24.	40.	53.	40.	40.	83.	35.	0.
FEB. 3					0.	0.	8.	8.	6.	24.	24.	40.	53.	40.	40.	83.	35.	0.
AVERAGE	7.	0.	0.	0.	0.	0.	8.	8.	6.	24.	24.	40.	53.	40.	40.	83.	35.	0.

(2) Paddy, Rainy Season

PLANTING DATE	GROWING STAGE JUNE 3	JULY 1	JULY 2	JULY 3	AUG. 1	AUG. 2	AUG. 3	SEP. 1	SEP. 2	SEP. 3	OCT. 1	OCT. 2	OCT. 3	NOV. 1	NOV. 2	NOV. 3	DEC. 1	DEC. 2
JUL. 11	52.	25.	75.	70.	59.	59.	65.	64.	51.	97.	76.	60.	40.					
JUL. 21		63.	24.	83.	47.	58.	65.	64.	51.	75.	68.	77.	52.	37.				
AUG. 1			33.	38.	60.	73.	65.	63.	51.	75.	59.	73.	55.	37.	10.			
AUG. 11				35.	38.	75.	83.	62.	51.	74.	59.	70.	55.	37.	10.	0.		
AUG. 21				95.	22.	47.	69.	82.	50.	74.	59.	70.	55.	37.	10.	0.	7.	0.
AUG. 24					28.	12.	47.	74.	50.	74.	58.	70.	55.	37.	10.	0.	7.	0.
AVERAGE	52.	57.	53.	68.	42.	54.	66.	68.	51.	78.	63.	70.	52.	37.	10.	0.	7.	0.

Table 6.6 DIVERSION WATER REQUIREMENT IN PADDY CROPS

(1) Paddy, Dry Season

(Unit: lit./sec/ha)

	Dec.			Jan.			Feb.			Mar.			Apr.			May		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Diversion Water Requirement	0.046	0.434	0.842	1.273	1.644	1.852	1.875	1.944	1.996	1.690	1.504	1.304	0.740	0.834	0.556	0.162	0.024	0.002

(2) Paddy, Rainy Season

	Jun.	Jul.			Aug.			Sep.			Oct.			Nov.			Dec.	
	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2
Diversion Water Requirement	0.010	0.000	0.046	0.000	0.000	0.000	0.021	0.000	0.000	0.000	0.000	0.000	0.006	0.093	0.741	0.532	0.186	0.000

Table 6.7 WATER HOLDING CAPACITY OF UPLAND FIELD

No.	Crop	Rooting Depth (mm)	Fraction of A.M.	Correction by ET crop	Water Content	Water Holding Capacity (mm)
		(1)	(2)	(3)	(4)	(5) =(1)x(2)x(3)x(4)
1	Maize (Rainy Season)	750	0.6	1.3	0.5	293
2	Tomato (Dry Season)	900	0.4	1.0	0.5	180
3	Soybean (Dry Season)	800	0.5	1.0	0.5	200
4	Groundnuts (Dry Season)	600	0.4	1.1	0.5	132
5	Groundnuts (Rainy Season)	500	0.4	1.3	0.5	130

(2):

(3): Coefficient by ET crop (ETo * Kc)

(4): Volume content of Water

Table 6.8(1/2) FARM WATER REQUIREMENT IN UPLAND CROPS

(Unit: mm)

(1) Maize, Rainy Season

PLANTING DATE	GROWING STAGE JUNE 1	JUNE 2	JUNE 3	JULY 1	JULY 2	JULY 3	AUG. 1	AUG. 2	AUG. 3	SEP. 1	SEP. 2	SEP. 3	OCT. 1	OCT. 2	OCT. 3	NOV. 1	NOV. 2	NOV. 3	DEC. 1
JUN 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.				
JUN 11		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.			
JUN 21			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.		
JUL 1				0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
JUL 11				1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
JUL 15					0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
AVERAGE	0.	0.21	0.41	0.13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

(2) Tomato, Dry Season

PLANTING DATE	GROWING STAGE FEB. 2	FEB. 3	MAR. 1	MAR. 2	MAR. 3	APR. 1	APR. 2	APR. 3	MAY 1	MAY 2	MAY 3	JUNE 1	JUNE 2	JUNE 3
FEB 16	70.	35.	33.	21.	21.	1.	0.	1.	0.	0.				
FEB 21	53.	34.	31.	20.	20.	1.	1.	2.	0.	0.	0.			
MAR 1		48.	28.	16.	19.	1.	2.	2.	0.	0.	0.			
MAR 11			33.	22.	13.	0.	1.	2.	0.	0.	0.	0.		
MAR 21				25.	13.	0.	0.	0.	0.	0.	0.	0.	0.	
APR 1					12.	4.	0.	0.	0.	0.	3.	6.	0.	0.
AVERAGE	11.	16.	19.	15.	13.	1.	1.	1.	0.	0.	0.03	0.07	0.	0.

(3) Soybean, Dry Season

PLANTING DATE	GROWING STAGE DEC. 3	JAN. 1	JAN. 2	JAN. 3	FEB. 1	FEB. 2	FEB. 3	MAR. 1	MAR. 2	MAR. 3	APR. 1	APR. 2	APR. 3	MAY 1	MAY 2	MAY 3	JUNE 1
JAN 1	61.	18.	20.	28.	27.	39.	40.	35.	21.	18.	0.	0.	0.				
JAN 11		61.	19.	24.	20.	29.	35.	34.	20.	19.	0.	0.	0.	0.			
JAN 21			61.	23.	16.	23.	25.	29.	18.	19.	0.	0.	0.	0.	0.		
FEB 1				62.	14.	20.	16.	19.	12.	16.	0.	0.	2.	0.	0.	0.	
FEB 11					53.	19.	14.	12.	4.	8.	0.	0.	0.	0.	0.	0.	0.
FEB 14						65.	13.	11.	1.	5.	0.	0.	0.	0.	0.	0.	0.
AVERAGE	5.	14.	19.	26.	23.	26.	25.	25.	15.	16.	0.05	0.	0.46	0.	0.	0.	0.

Table 6.8(2/2) FARM WATER REQUIREMENT IN UPLAND CROPS (Unit: mm)

(4) Groundnut, Dry Season

PLANTING DATE	GROWING STAGE DEC. 3	JAN. 1	JAN. 2	JAN. 3	FEB. 1	FEB. 2	FEB. 3	MAR. 1	MAR. 2	MAR. 3	APR. 1	APR. 2	APR. 3	MAY 1	MAY 2	MAY 3	JUNE 1
JAN 1	61.	19.	20.	26.	23.	34.	36.	32.	18.	15.	0.	0.	0.				
JAN 11		61.	20.	24.	18.	26.	30.	30.	17.	16.	0.	0.	0.	0.			
JAN 21			61.	23.	16.	22.	21.	25.	15.	15.	0.	0.	0.	0.	0.		
FEB 1				62.	15.	20.	15.	16.	8.	11.	0.	0.	0.	0.	0.	0.	
FEB 11					53.	19.	14.	12.	1.	5.	0.	0.	0.	0.	0.	0.	0.
FEB 14						65.	14.	11.	0.	2.	0.	0.	0.	0.	0.	0.	0.
AVERAGE	5.	14.	19.	26.	22.	25.	22.	22.	11.	12.	0.	0.	0.	0.	0.	0.	0.

(5) Groundnut, Rainy Season

PLANTING DATE	GROWING STAGE JULY 1	JULY 2	JULY 3	AUG. 1	AUG. 2	AUG. 3	SEP. 1	SEP. 2	SEP. 3	OCT. 1	OCT. 2	OCT. 3	NOV. 1	NOV. 2	NOV. 3	DEC. 1	DEC. 2	DEC. 3
JUL 1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.					
JUL 11		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.				
JUL 21			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.	16.			
AUG 1				0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	6.	29.	14.		
AUG 11				2.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.	31.	23.	21.	
AUG 14					0.	0.	0.	0.	0.	0.	0.	0.	0.	6.	32.	24.	28.	2.
AVERAGE	0.19	1.	0.	0.25	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.	15.	7.	4.	0.00

Table 6.9(1/2) EFFECTIVE RAINFALL IN UPLAND CROPS (Unit: mm)

(1) Maize, Rainy Season

PLANTING DATE	GROWING STAGE JUNE 1	JUNE 2	JUNE 3	JULY 1	JULY 2	JULY 3	AUG. 1	AUG. 2	AUG. 3	SEP. 1	SEP. 2	SEP. 3	OCT. 1	OCT. 2	OCT. 3	NOV. 1	NOV. 2	NOV. 3	DEC. 1
JUN 1	38.	52.	36.	20.	26.	26.	25.	26.	30.	29.	24.	36.	23.	27.	10.				
JUN 11		52.	40.	19.	25.	24.	23.	25.	30.	29.	24.	36.	25.	31.	32.	7.			
JUN 21			52.	22.	24.	22.	21.	23.	28.	28.	24.	38.	27.	33.	37.	19.	0.		
JUL 1				52.	23.	21.	20.	21.	27.	27.	24.	38.	27.	35.	40.	22.	10.	0.	
JUL 11				83.	23.	21.	19.	20.	25.	26.	23.	37.	27.	35.	42.	24.	10.	0.	7.
JUL 15					51.	21.	19.	20.	24.	25.	22.	37.	27.	35.	43.	24.	10.	0.	7.
AVERAGE	38.	52.	45.	40.	29.	23.	21.	22.	27.	27.	23.	37.	26.	33.	34.	19.	8.	0.	7.

(2) Tomato, Dry Season

PLANTING DATE	GROWING STAGE FEB. 2	FEB. 3	MAR. 1	MAR. 2	MAR. 3	APR. 1	APR. 2	APR. 3	MAY 1	MAY 2	MAY 3	JUNE 1	JUNE 2	JUNE 3
FEB 16	8.	6.	24.	24.	40.	53.	40.	40.	65.	13.				
FEB 21	8.	6.	24.	24.	40.	53.	40.	40.	68.	24.	0.			
MAR 1		6.	24.	24.	40.	53.	40.	40.	69.	29.	26.			
MAR 11			24.	24.	40.	53.	40.	40.	73.	31.	29.	29.		
MAR 21				24.	40.	53.	40.	40.	73.	31.	29.	38.	18.	
APR 1					40.	51.	39.	40.	51.	32.	29.	38.	39.	22.
AVERAGE	8.	6.	22.	23.	40.	53.	40.	40.	67.	27.	23.	35.	28.	22.

(3) Soybean, Dry Season

PLANTING DATE	GROWING STAGE DEC. 3	JAN. 1	JAN. 2	JAN. 3	FEB. 1	FEB. 2	FEB. 3	MAR. 1	MAR. 2	MAR. 3	APR. 1	APR. 2	APR. 3	MAY 1	MAY 2	MAY 3	JUNE 1
JAN 1	0.	0.	0.	0.	8.	8.	6.	24.	24.	40.	53.	40.	20.				
JAN 11		0.	0.	0.	8.	8.	6.	24.	24.	40.	53.	40.	40.	26.			
JAN 21			0.	0.	8.	8.	6.	24.	24.	40.	53.	40.	40.	65.	11.		
FEB 1				0.	8.	8.	6.	24.	24.	40.	53.	40.	40.	73.	29.	16.	
FEB 11					8.	8.	6.	24.	24.	40.	53.	40.	40.	75.	30.	29.	16.
FEB 14						8.	6.	24.	24.	40.	53.	40.	40.	80.	30.	29.	29.
AVERAGE	0.	0.	0.	0.	8.	8.	6.	24.	24.	40.	53.	40.	37.	64.	25.	25.	22.

Table 6.9(2/2) EFFECTIVE RAINFALL IN UPLAND CROPS

(Unit: mm)

(4) Groundnut, Dry Season

PLANTING DATE	GROWING STAGE DEC. 3	JAN. 1	JAN. 2	JAN. 3	FEB. 1	FEB. 2	FEB. 3	MAR. 1	MAR. 2	MAR. 3	APR. 1	APR. 2	APR. 3	MAY 1	MAY 2	MAY 3	JUNE 1
JAN 1	0.	0.	0.	0.	8.	8.	6.	24.	24.	40.	53.	37.	15.				
JAN 11		0.	0.	0.	8.	8.	6.	24.	24.	40.	53.	40.	40.	14.			
JAN 21			0.	0.	8.	8.	6.	24.	24.	40.	53.	40.	39.	38.	11.		
FEB 1				0.	8.	8.	6.	24.	24.	40.	53.	40.	40.	47.	27.	16.	
FEB 11					8.	8.	6.	24.	24.	40.	53.	40.	40.	46.	29.	29.	15.
FEB 14						8.	6.	24.	24.	40.	53.	40.	40.	47.	29.	29.	25.
AVERAGE	0.	0.	0.	0.	8.	8.	6.	24.	24.	40.	53.	39.	36.	38.	24.	25.	20.

(5) Groundnut, Rainy Season

PLANTING DATE	GROWING STAGE JULY 1	JULY 2	JULY 3	AUG. 1	AUG. 2	AUG. 3	SEP. 1	SEP. 2	SEP. 3	OCT. 1	OCT. 2	OCT. 3	NOV. 1	NOV. 2	NOV. 3	DEC. 1	DEC. 2	DEC. 3
JUL 1	20.	27.	24.	22.	22.	26.	25.	21.	34.	24.	31.	35.	18.					
JUL 11		24.	24.	22.	22.	26.	25.	21.	34.	24.	31.	37.	20.	0.				
JUL 21			24.	22.	22.	25.	25.	21.	33.	24.	31.	38.	22.	10.	0.			
AUG 1				22.	22.	25.	24.	20.	33.	23.	31.	38.	22.	10.	0.	7.		
AUG 11				37.	22.	25.	24.	20.	32.	23.	31.	38.	22.	10.	0.	7.	0.	
AUG 14					18.	25.	24.	20.	32.	23.	31.	38.	22.	10.	0.	7.	0.	0.
AVERAGE	28.	30.	28.	27.	21.	25.	25.	21.	33.	24.	31.	37.	21.	8.	0.	7.	0.	0.

Table 6.10(1/2) DIVERSION WATER REQUIREMENT IN UPLAND CROPS

(1) Maize, Rainy Season (Unit: lit./sec/ha)

	Jun.			Jul.			Aug.			Sep.			Oct.			Nov.			Dec.
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
Diversion Water Requirement	0.014	0.004	0.010	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

(2) Tomato, Dry Season

	Feb.		Mar.			Apr.			May			Jun.		
	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Diversion Water Requirement	0.254	0.462	0.440	0.348	0.274	0.012	0.016	0.024	0.000	0.000	0.000	0.002	0.000	0.000

(3) Soybean, Dry Season

	Dec.	Jan.			Feb.			Mar.			Apr.			May			Jun.
	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
Diversion Water Requirement	0.106	0.324	0.440	0.548	0.532	0.602	0.724	0.578	0.348	0.336	0.002	0.000	0.010	0.000	0.000	0.000	0.000

Table 6.10(2/2) DIVERSION WATER REQUIREMENT IN UPLAND CROPS

(Unit: lit./sec/ha)

(4) Groundnut, Dry Season

	Dec.	Jan.			Feb.			Mar.			Apr.			May			Jun.
	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
Diversion Water Requirement	0.106	0.324	0.440	0.548	0.510	0.578	0.636	0.510	0.254	0.252	0.000	0.000	0.000	0.000	0.000	0.000	0.000

(5) Groundnut, Rainy Season

	Jul.			Aug.			Sep.			Oct.			Nov.			Dec.		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Diversion Water Requirement	0.004	0.014	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.348	0.162	0.092	0.000

Table 6.11 DIVERSION WATER REQUIREMENT IN PROPOSED CROPPING PATTERN

(Unit: lit./sec/ha)

1st year

	Jan.			Feb.			Mar.			Apr.			May			Jun.		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Total Diversion Water Requirement	0.694	0.920	1.052	1.059	1.186	1.295*	1.100	0.926	0.805	0.374	0.421	0.287	0.081	0.012	0.001	0.008	0.002	0.010

	Jul.			Aug.			Sep.			Oct.			Nov.			Dec.		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Total Diversion Water Requirement	0.002	0.012	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.003	0.035	0.347	0.266	0.116	0.208	0.437

2nd year

	Jan.			Feb.			Mar.			Apr.			May			Jun.		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Total Diversion Water Requirement	0.694	0.920	1.052	1.054	1.180	1.273	1.083	0.903	0.784	0.373	0.421	0.284	0.081	0.012	0.001	0.004	0.001	0.008

	Jul.			Aug.			Spe.			Oct.			Nov.			Dec.		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Total Diversion Water Requirement	0.002	0.016	0.000	0.002	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.003	0.035	0.359	0.353	0.157	0.231	0.437

* Peak 10 days Requirement adopted as the design unit water requirement

Table 6.12 LIST OF RELATED STRUCTURES TO IRRIGATION CANALS

Canal Name	Turnout (TO)		Drop (DP)		Culvert (CV)		/1 Check Gate (CG)		/2 Spillway (SW)	
	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type
DMIC	No.1 TO	-	No.1 DP	-			No.1 CG	B	No.1 SW	A
	No.2 TO	-	No.2 DP	-			No.2 CG	A		
	No.3 TO	-	No.3 DP	-			No.3 CG	A		
	No.4 TO	-								
DSIC-1	No.1 TO	-			No.1 CV	-	No.1 CG	A	No.1 SW	B
	No.2 TO	-			No.2 CV	-	No.2 CG	A		
							No.3 CG	A		
DSIC-2	No.1 TO	-			No.1 CV	-	No.1 CG	A	No.1 SW	B
	No.2 TO	-					No.2 CG	A		
Sub-total	8		3		3		8		3	
JMIC	No.1 TO	-					No.1 CG	B		
	No.2 TO	-					No.2 CG	A		
	No.3 TO	-					No.3 CG	A		
JSIC-1	No.1 TO	-				-	No.1 CG	A	No.1 SW	B
							No.2 CG	A		
JSIC-2	No.1 TC	-					No.1 CG	A	No.1 SW	B
	No.2 TO	-					No.2 CG	A		
							No.3 CG	A		
Sub-total	6		0		0		8		2	
Total	14		3		3		16		5	

/1 Type A is without Drop, B is with Drop.
/2 Type A is Box Type, B is Pipe Type.

Table 6.13 LIST OF CATCH DRAINS

Name of Canal	Canal Length (m)	Design Discharge (m^3/s)	Canal Base Width (m)	Water Depth (m)
1. Ndoup Small Basins				
DCD - 1	2,500	1.29	1.00	0.97
DCD - 2	1,850	0.69	0.80	0.77
DCD - 3	1,150	0.18	0.50	0.46
DCD - 4	1,900	0.23	0.50	0.52
DCD - 5	1,500	0.47	0.70	0.66
DCD - 6	600	0.84	0.80	0.84
DCD - 7	1,700	0.50	0.70	0.68
DCD - 8	1,500	0.47	0.70	0.66
DCD - 9	1,300	0.66	0.80	0.75
DCD -10	1,150	0.50	0.70	0.68
Sub-total	15,150	5.83	-	-
2. Nja Small Basins				
JCD - 1	1,300	0.37	0.60	0.62
JCD - 2	2,400	0.26	0.60	0.52
JCD - 3	1,150	0.06	0.30	0.31
JCD - 4	2,000	0.21	0.50	0.49
JCD - 5	2,000	1.17	1.00	0.92
JCD - 6	1,150	0.36	0.60	0.61
JCD - 7	1,200	0.95	0.90	0.86
JCD - 8	1,050	1.82	1.10	1.12
JCD - 9	1,400	1.33	1.00	0.99
JCD -10	1,500	0.75	0.80	0.80
Sub-total	15,150	7.28	-	-
3. Volcanic Island				
VCD - 1	1,300	0.23	0.50	0.52
VDC - 2	1,350	0.18	0.50	0.46
VCD - 3	3,450	0.48	0.70	0.67
Sub-total	6,100	0.89	-	-
TOTAL	36,400	14.00	-	-

Table 6.14(1/4) LIST OF RELATED STRUCTURES TO DRAINAGE CANALS

Canal Name	Drainage Junction (DJ)		/1 Drainage Inlet (DI)		Drop (DP)		/2 Culvert (CV)		/3 Cross Drain (CD)	
	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type
KMDC	No. 1 DJ	-	No. 1 DI	B	No. 1 DP	-	No. 1 CV	A		
			No. 2 DI	B						
			No. 3 DI	B						
			No. 4 DI	A						
			No. 5 DI	B						
			No. 6 DI	A						
			No. 7 DI	A						
JMDC			No. 1 DI	C	No. 1 DP	-	No. 1 CV	B		
			No. 2 DI	C	No. 2 DP	-	No. 2 CV	B		
			No. 3 DI	C	No. 3 DP	-				
			No. 4 DI	C						
			No. 5 DI	C						
			No. 6 DI	B						
			No. 7 DI	A						
			No. 8 DI	B						
			No. 9 DI	C						
			No.10 DI	C						
			No.11 DI	C						
			No.12 DI	C						
			No.13 DI	C						
			No.14 DI	C						
			No.15 DI	C						
			No.16 DI	C						
			No.17 DI	C						
			No.18 DI	C						

Table 6.14(2/4) LIST OF RELATED STRUCTURES TO DRAINAGE CANALS

Canal Name	Drainage Junction (DJ)		/1 Drainage Inlet (DI)		Drop (DP)		/2 Culvert (CV)		/3 Cross Drain (CD)	
	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type
DMDC			No. 1 DI	C	No. 1 DP	-	No. 1 CV	B		
			No. 2 DI	C	No. 2 DP	-	No. 2 CV	B		
			No. 3 DI	B	No. 3 DP	-	No. 3 CV	B		
			No. 4 DI	C	No. 4 DP	-				
			No. 5 DI	B	No. 5 DP	-				
			No. 6 DI	A	No. 6 DP	-				
			No. 7 DI	A	No. 7 DP	-				
					No. 8 DP	-				
					No. 9 DP	-				
					No.10 DP	-				
					No.11 DP	-				
KSDC-1			No. 1 DI	C			No. 1 CV	C		
			No. 2 DI	B						
			No. 3 DI	C						
			No. 4 DI	C						
			No. 5 DI	A						
			No. 6 DI	C						
KSDC-2			No. 1 DI	C			No. 1 CV	c		
			No. 2 DI	C						
			No. 3 DI	A						
			No. 4 DI	A						

Table 6.14(3/4) LIST OF RELATED STRUCTURES TO DRAINAGE CANALS

Canal Name	Drainage Junction (DJ)		/1 Drainage Inlet (DI)		Drop (DP)		/2 Culvert (CV)		/3 Cross Drain (CD)	
	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type
1. Ndoup Small Basins										
DCD-1									(Flow into Flood way)	
DCD-2									No. 2 CD	B
DCD-3									No. 1 CD	A-2
DCD-4									No. 3 CD	B
DCD-5									No. 4 CD	B
DCD-6									No. 5 CD	B
DCD-7									No. 6 CD	B
DCD-8									No. 7 CD	B
DCD-9									No. 8 CD	B
DCD-10										
2. Nja Small Basins										
Nja River									No. 1 CD	A-1
JCD-1									No. 2 CD	B
JCD-2									No. 3 CD	B
JCD-3									( )	
JCD-4									No. 4 CD	B
JCD-5									No. 5 CD	B
JCD-6									No. 6 CD	B
JCD-7									No. 7 CD	B

Table 6.14(4/4) LIST OF RELATED STRUCTURES TO DRAINAGE CANALS

Canal Name	Drainage Junction (DJ)		/1 Drainage Inlet (DI)		Drop (DP)		/2 Culvert (CV)		/3 Cross Drain (CD)	
	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type	Name of Structure	Type
(Nja Small Basins)										
JCD-8									No. 8 CD	A-2
JCD-9									No. 9 CD	B
JCD-10									No.10 CD	B
3. Volcanic Island										
VCD-1									No. 1 CD	B
									No. 2 CD	B
VCD-2									No. 3 CD	B
VCD-3									No. 4 CD	B
-									No. 5 CD	B
TOTAL	1		42(2)		15(9)		8(2)		23	

/1 Type A is single-box type, B is double-pipe type and C is single-pipe type.

/2 Type A is triple-box type, B is double-box type and C is single box type.

/3 Type A-1 is double-box type, type A-2 is double-pipe type and B is single-pipe type.

Table 6.15 (1/2) WORK QUANTITIES

Work Items	Unit	Quantity
1. Irrigation Facilities		
(1) Ndoup Intake Weir		
a) Excavation	m^3	500
b) Back Filling	m^3	91
c) Reinforced Concrete	m^3	330
d) Reinforcement Bar	t	9.9
e) Concrete Form	m^2	430
f) Slide Gate	nos	3
(2) Irrigation Canals		
a) Stripping	m^3	15,030
b) Excavation, Crayey Soil	m^3	52,910
c) Embankment	m^3	55,130
(3) Related Structures		
a) Turnout	nos	14
b) Drop	nos	3
c) Culvent	nos	3
d) Check Gate	nos	16
e) Spillway	nos	5
2. Drainage Facilities		
(1) Drainage Canals		
a) Stripping	m^3	31,180
b) Excavation, Crayey Soil	m^3	766,890
c) Excavation, Rock	m^3	30,340
d) Embankment	m^3	24,480
(2) Related Structures		
a) Drainage Inlet	nos	42
b) Drop	nos	15
c) Culvent	nos	8
d) Drainage Junction	nos	1
e) Cross Drain	nos	23
(3) Diversion Flood Way		
a) Stripping	m^3	1,082
b) Excavation, Crayey Soil	m^3	39,709
c) Back Filling	m^3	2,207
d) Plain Concrete	m^3	20
e) Reinforced Concrete	m^3	221
f) Reinforcement Bar	t	15.4
g) Concrete Form	m^2	1,104
h) Gabion	m^3	95

Table 6.15 (2/2) WORK QUANTITIES

Work Items	Unit	Quantity	
(4) Regulating Gate			
a) Excavation, Crayey Soil	m^3	68	
b) Excavation, Rock	m^3	158	
c) Back Filling	m^3	418	
d) Plain Concrete	m^3	40	
e) Reinforced Concrete	m^3	603	
f) Reinforcement Bar	t	24.12	
g) Concrete Form	m^2	1,016	
h) Gabion	m^2	61	
i) Roller Gate (W3.0m x H2.5m)	nos	3	
3. Farm Road			
(1) Main Farm Road			
a) Stripping	m^3	8,690	
b) Embankment	m^3	54,150	
c) Gravel Pavement	m^3	54,280	
(2) Inspection Road			
a) Stripping	m^3	28,280	
b) Embankment	m^3	152,610	
c) Gravel Pavement	m^3	184,620	
4. On-Farm Work			
		Type-A	Type-B
(1) Irrigation Canals			
a) Stripping	m^3/120 ha	5,248	5,248
b) Excavation, Crayey Soil	m^3/120 ha	11	11
c) Embankment	m^3/120 ha	17,881	17,881
(2) Drainage Canals			
a) Excavation, Crayey Soil	m^3/120 ha	13,183	13,183
(3) Related Structures			
a) Division Box	nos/120 ha	5	5
b) Quarternary Outlet	nos/120 ha	20	20
c) Culvent	nos/120 ha	9	9
d) Drop	nos/120 ha	-	85
e) Drainage Junction	nos/120 ha	18	18
f) Drainage Culvent	nos/120 ha	8	8
g) Drainage Drop	nos/120 ha	-	85
(4) On-Farm Road			
a) Stripping	m^3/120 ha	1,672	
b) Embankment	m^3/120 ha	8,448	
(5) Field Border			
a) Embankment	m^3/120 ha	9,720	12,960

Fig. 6.1 ELEVATION-AREA, CAPACITY RELATIONSHIP OF NDOUP RESERVOIR

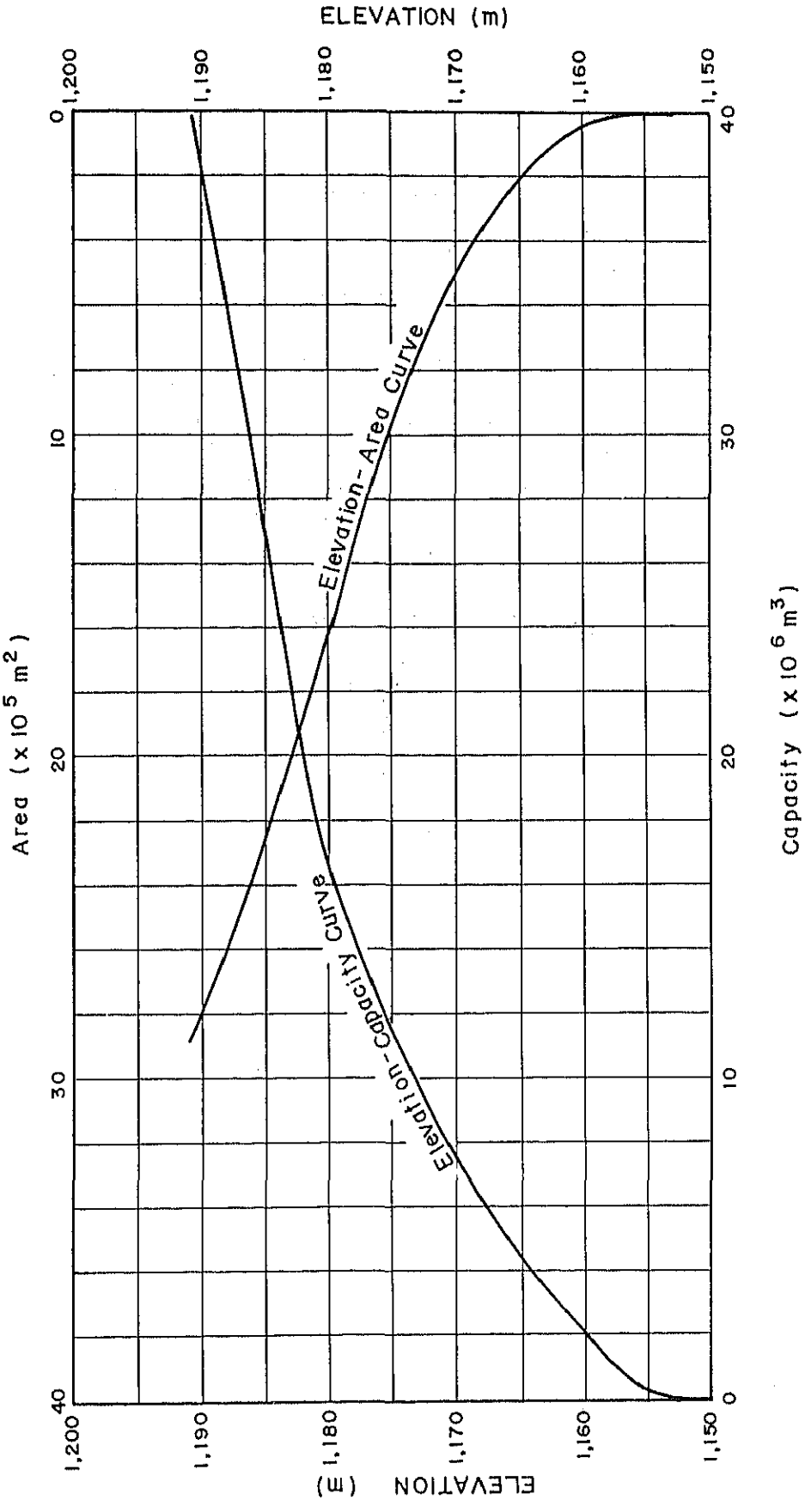


Fig. 6.2 ELEVATION-AREA, CAPACITY RELATIONSHIP OF NJA RESERVOIR

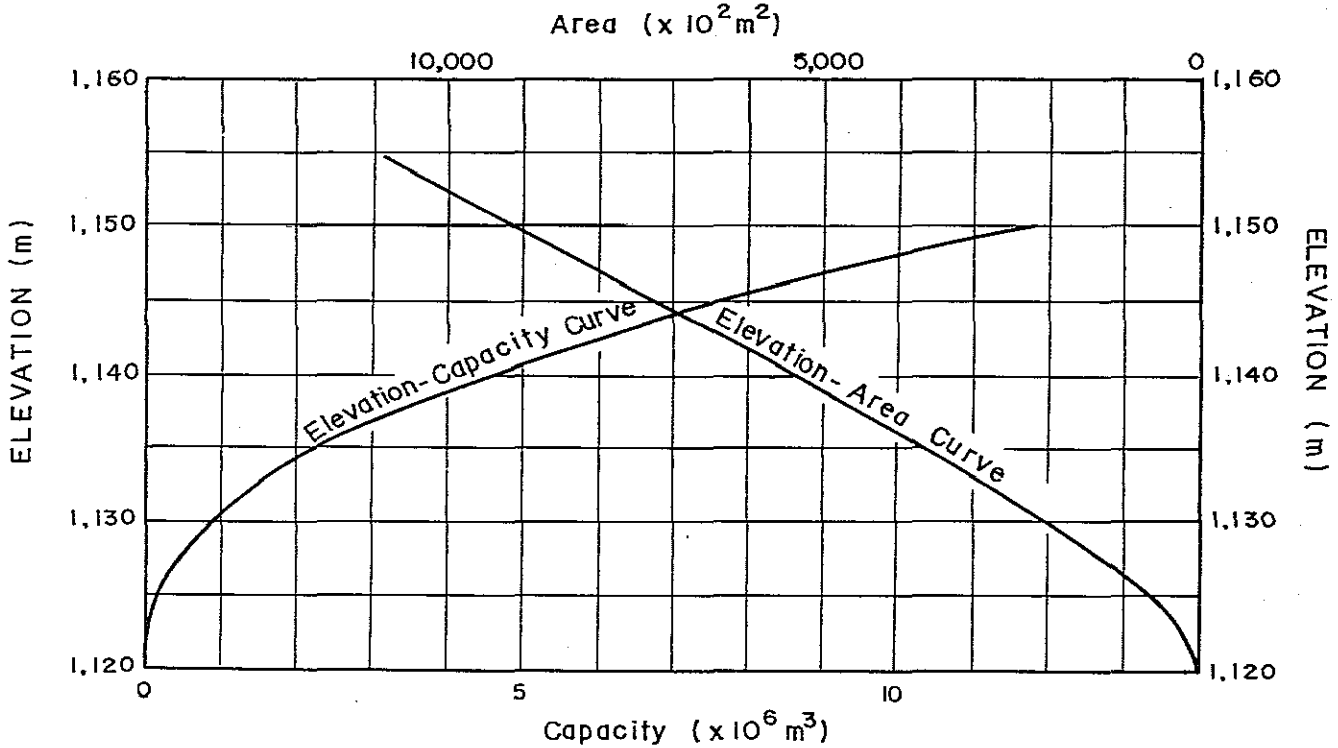
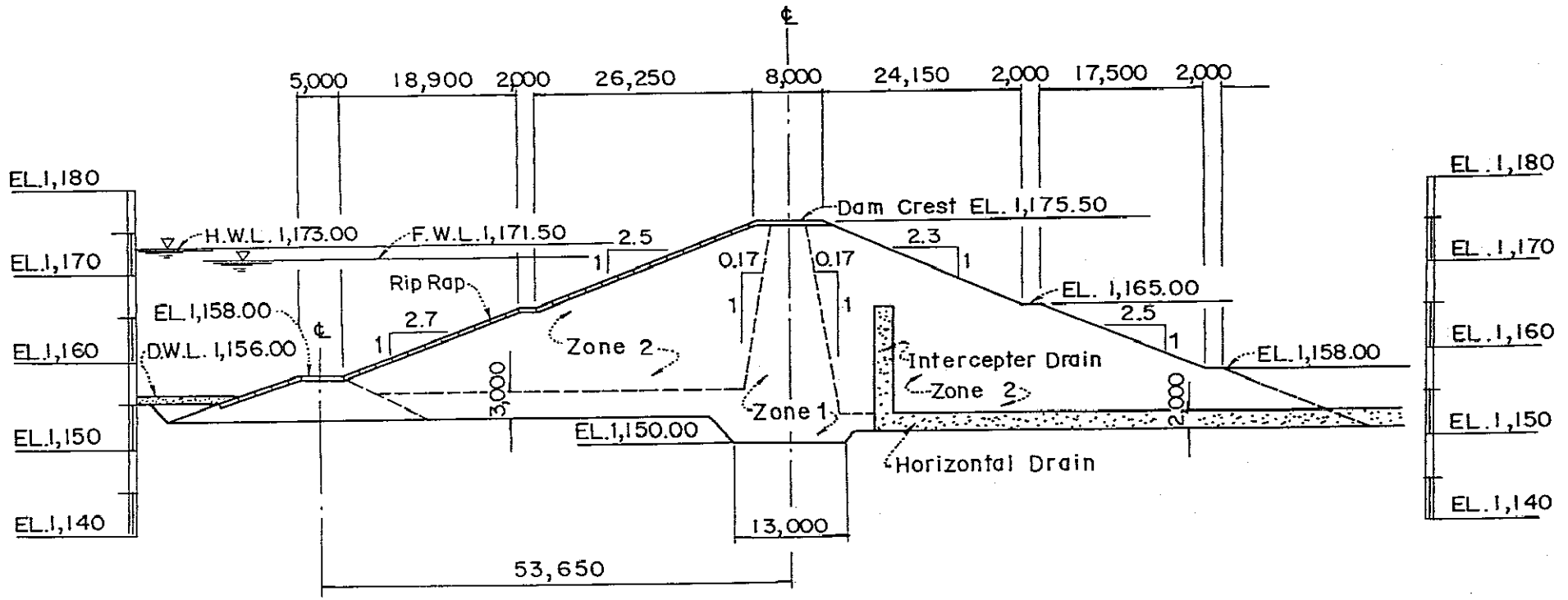
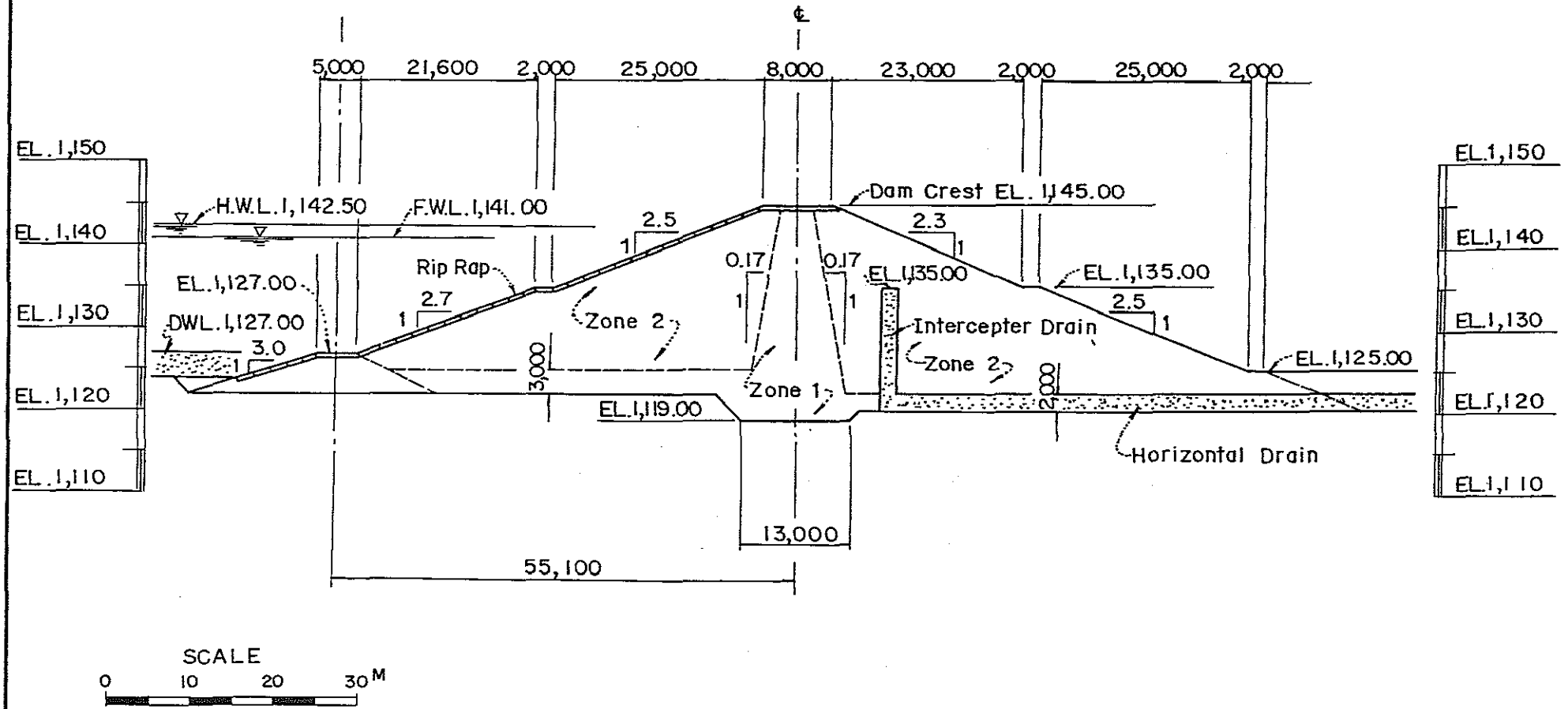


Fig. 6.3 TYPICAL SECTION OF NDOUP DAM



SCALE
0 10 20 30 M

Fig. 6.4 TYPICAL SECTION OF NJA DAM



SCALE
0 10 20 30 M

Fig. 6.5 PERCOLATION TEST POINTS (EXPERIMENTAL FARM ZONE 2)

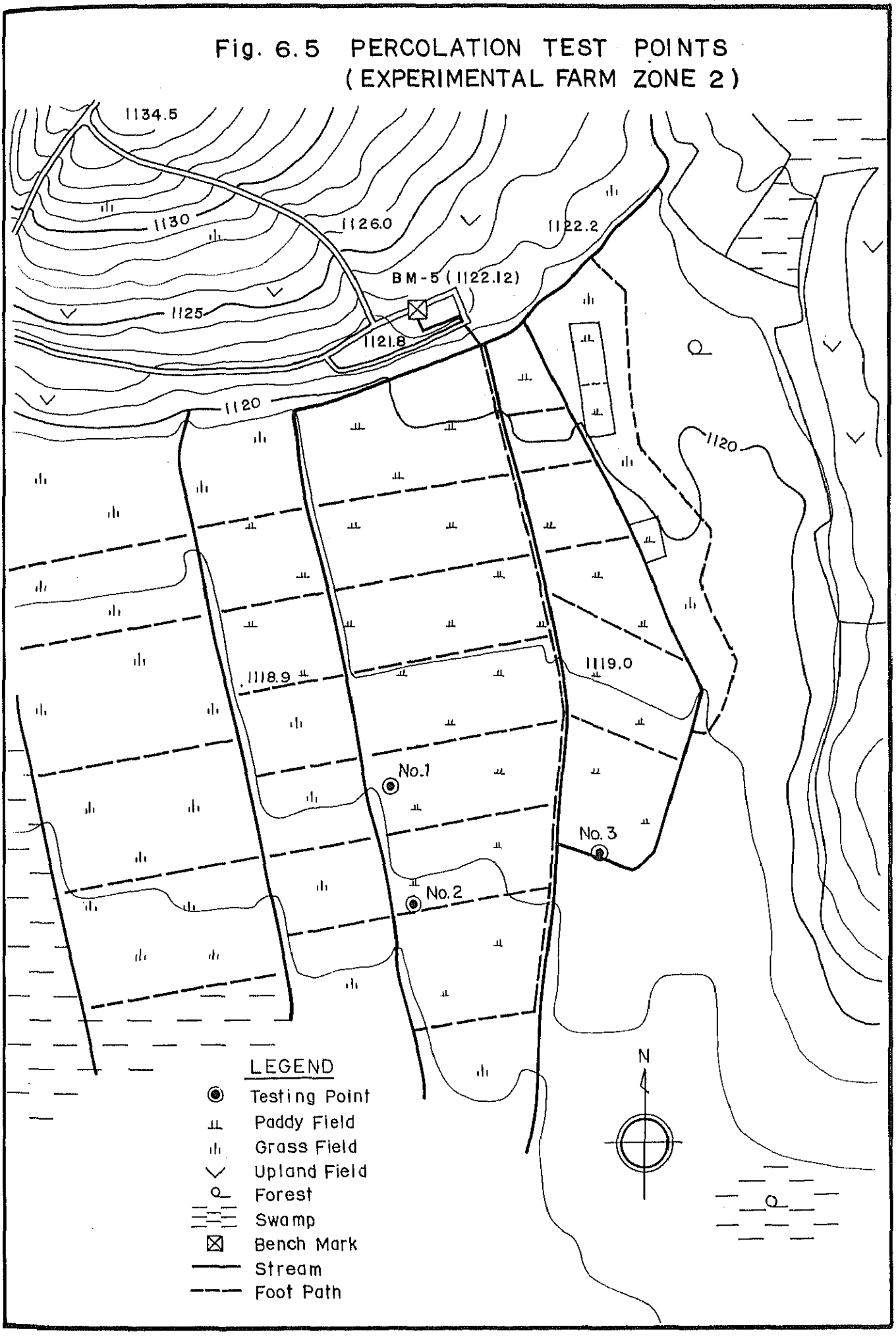


Fig. 6.6 (1/7) CROP COEFFICIENT

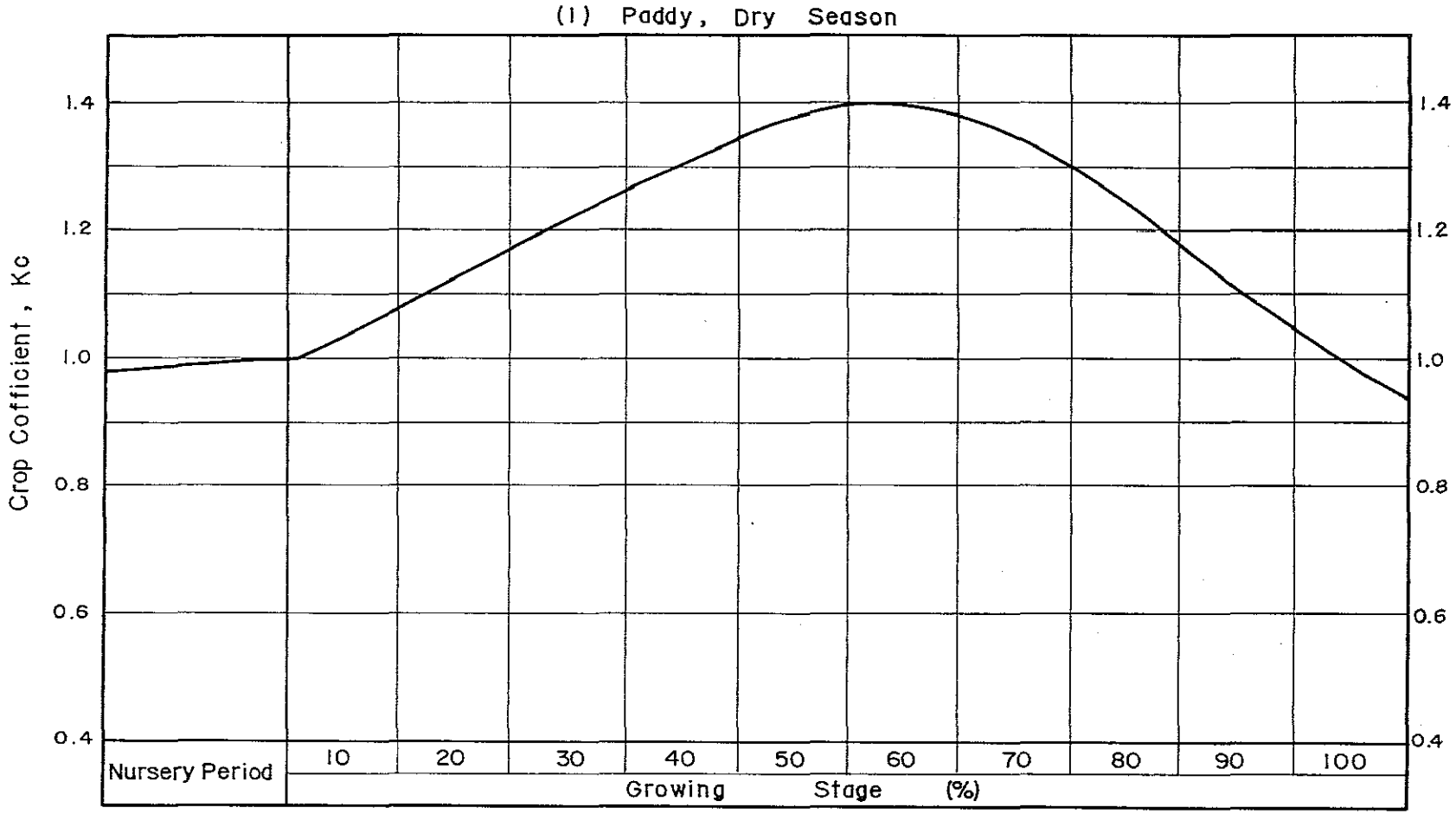


Fig. 6.6 (2/7) CROP COEFFICIENT

(2) Paddy, Rainy Season

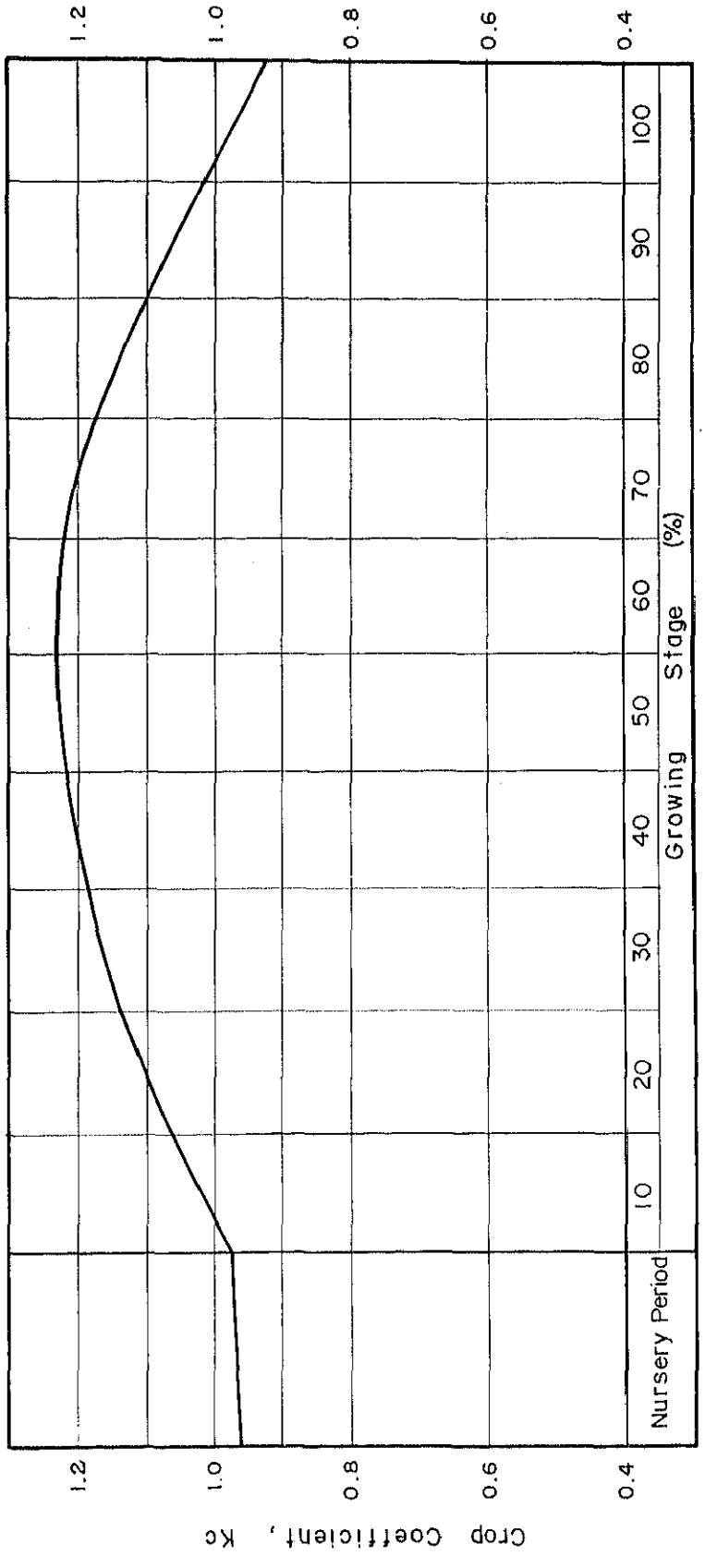


Fig.6.6 (3/7) CROP COEFFICIENT

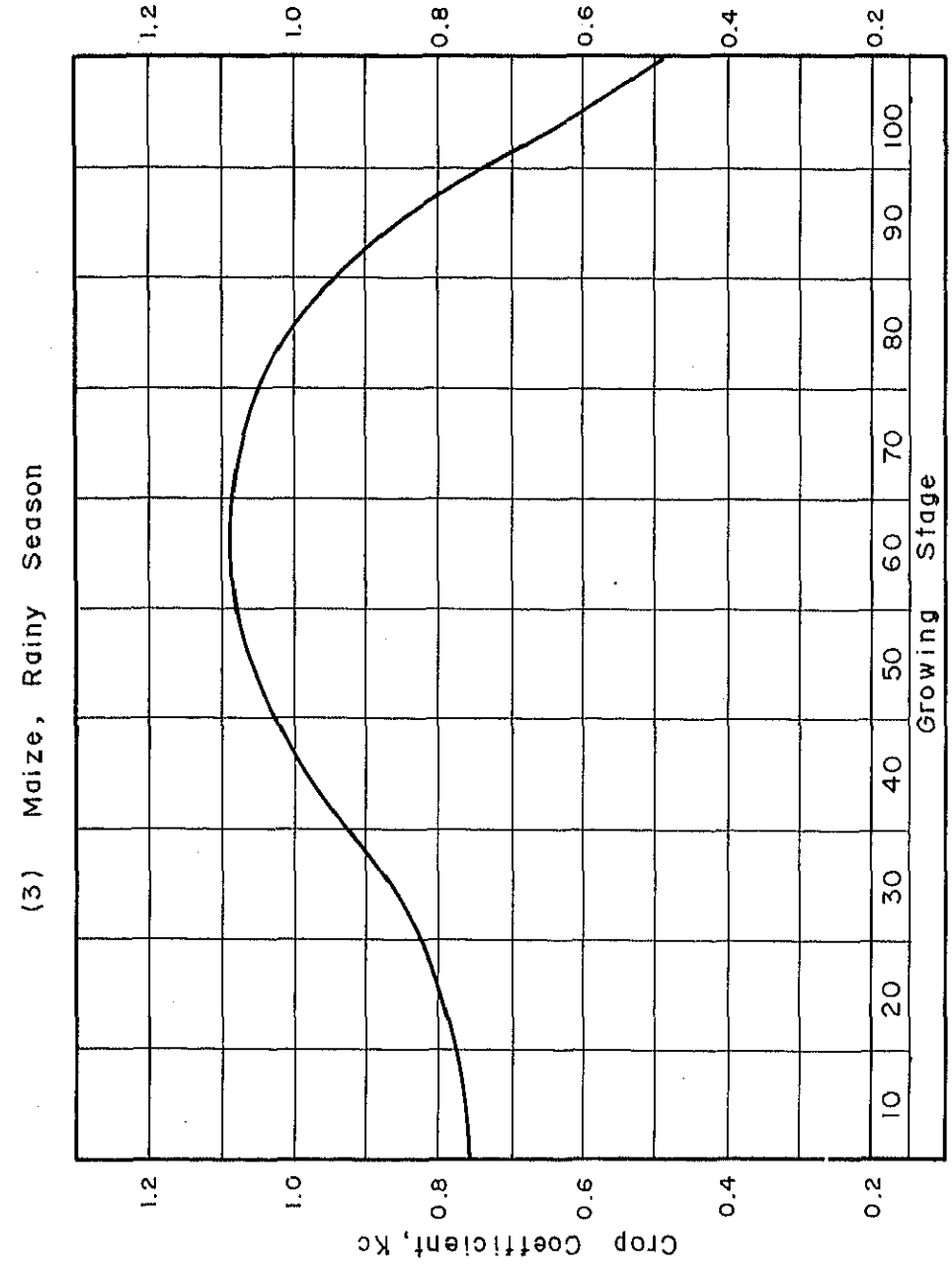


Fig.6.6 (4/7) CROP COEFFICIENT

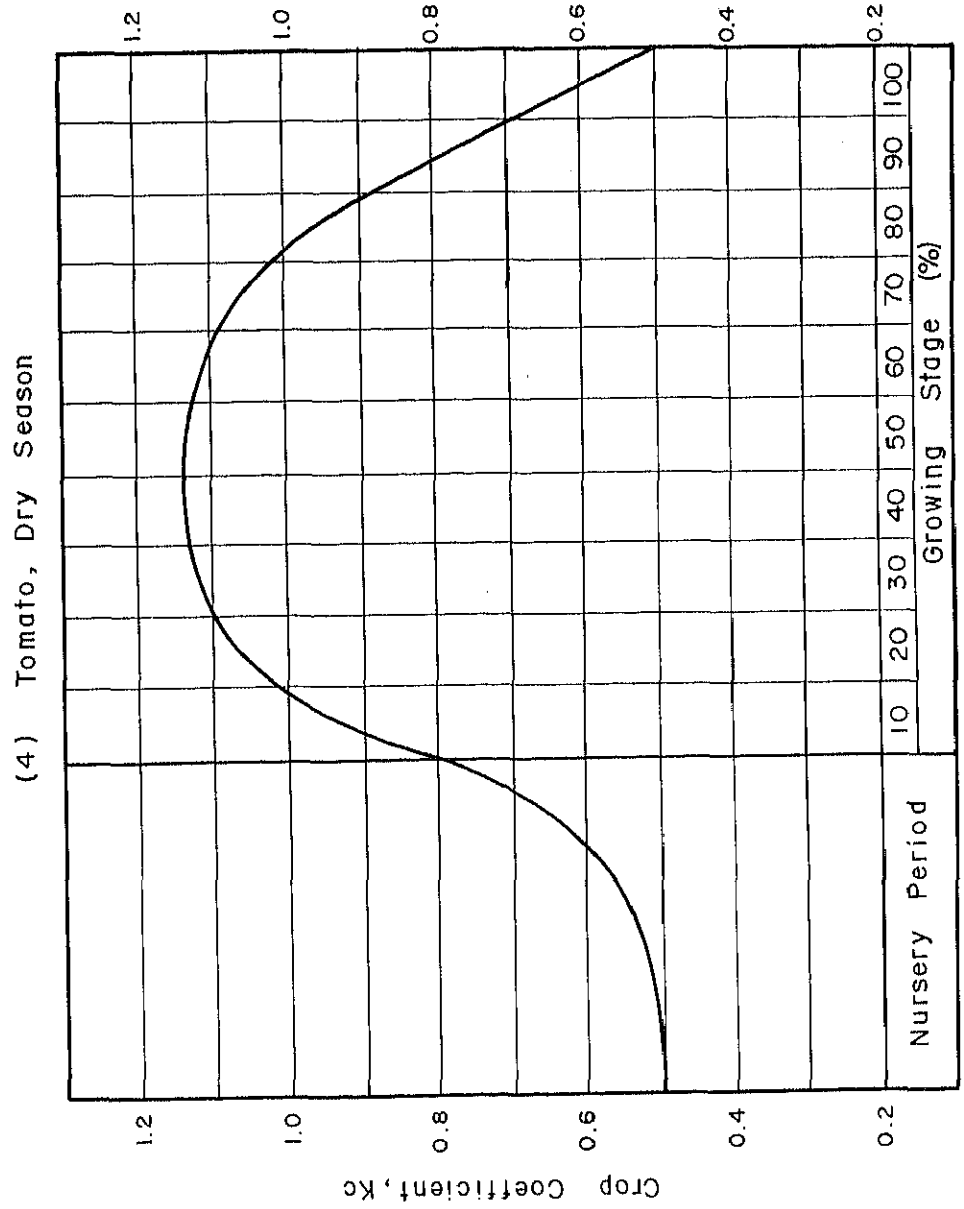


Fig. 6.6 (5/7) CROP COEFFICIENT

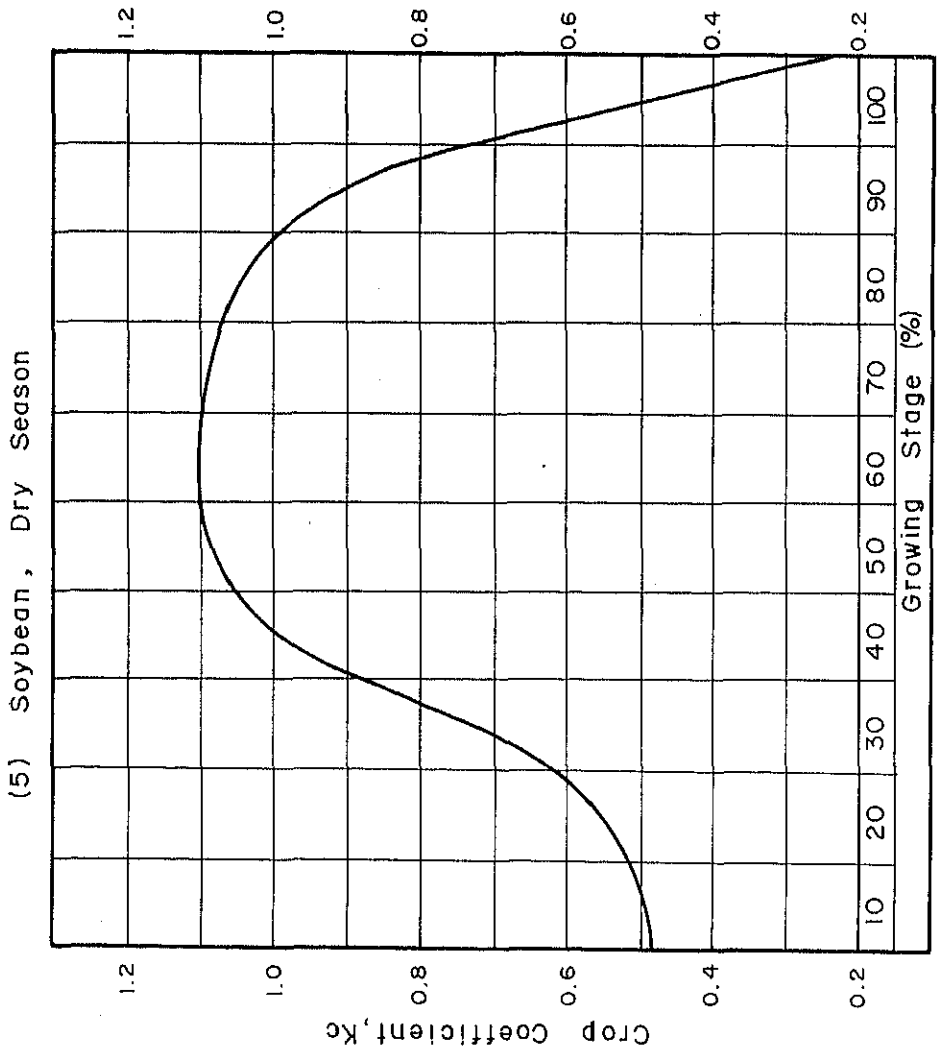


Fig. 6.6 (6/7) CROP COEFFICIENT

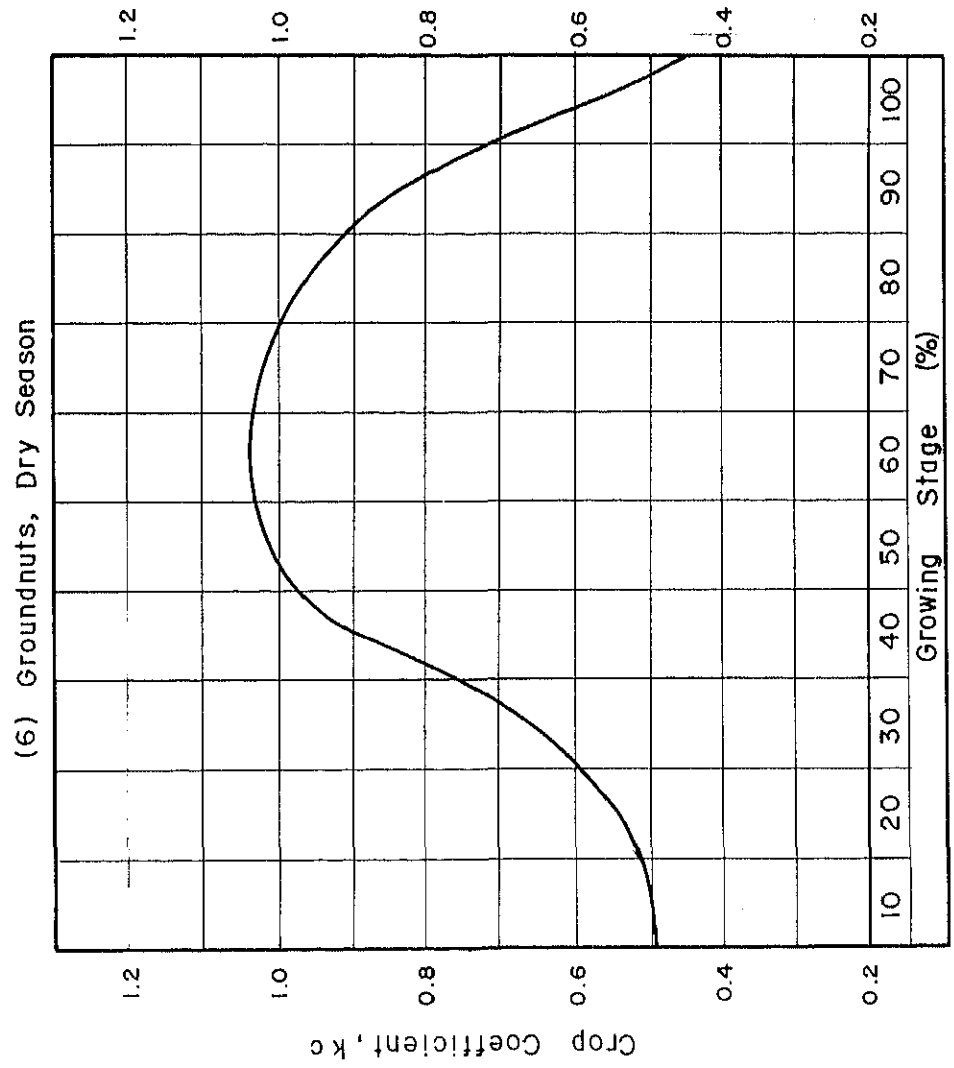


Fig. 6.6 (7/7) CROP COEFFICIENT

(7) Groundnuts, Rainy Season

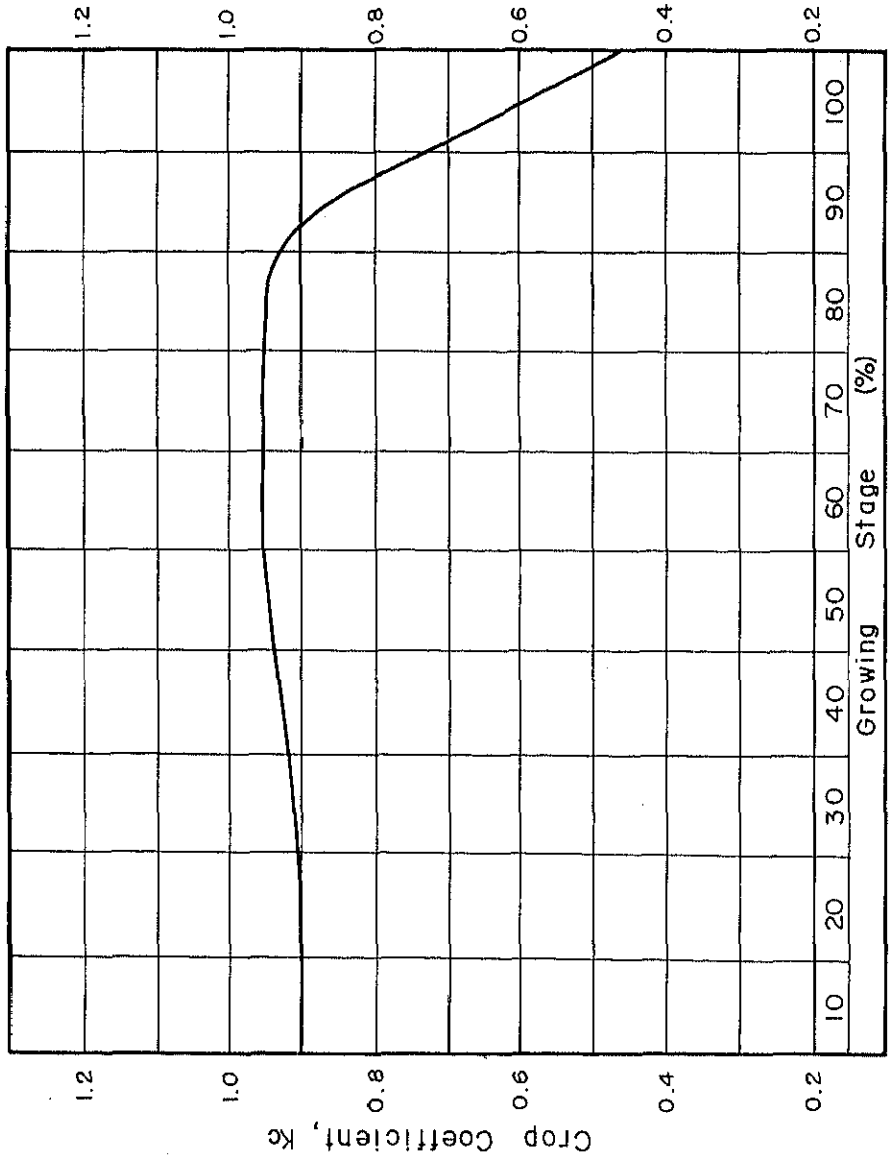


Fig. 6.7 POTENTIAL EVAPOTRANSPIRATION (ETO)

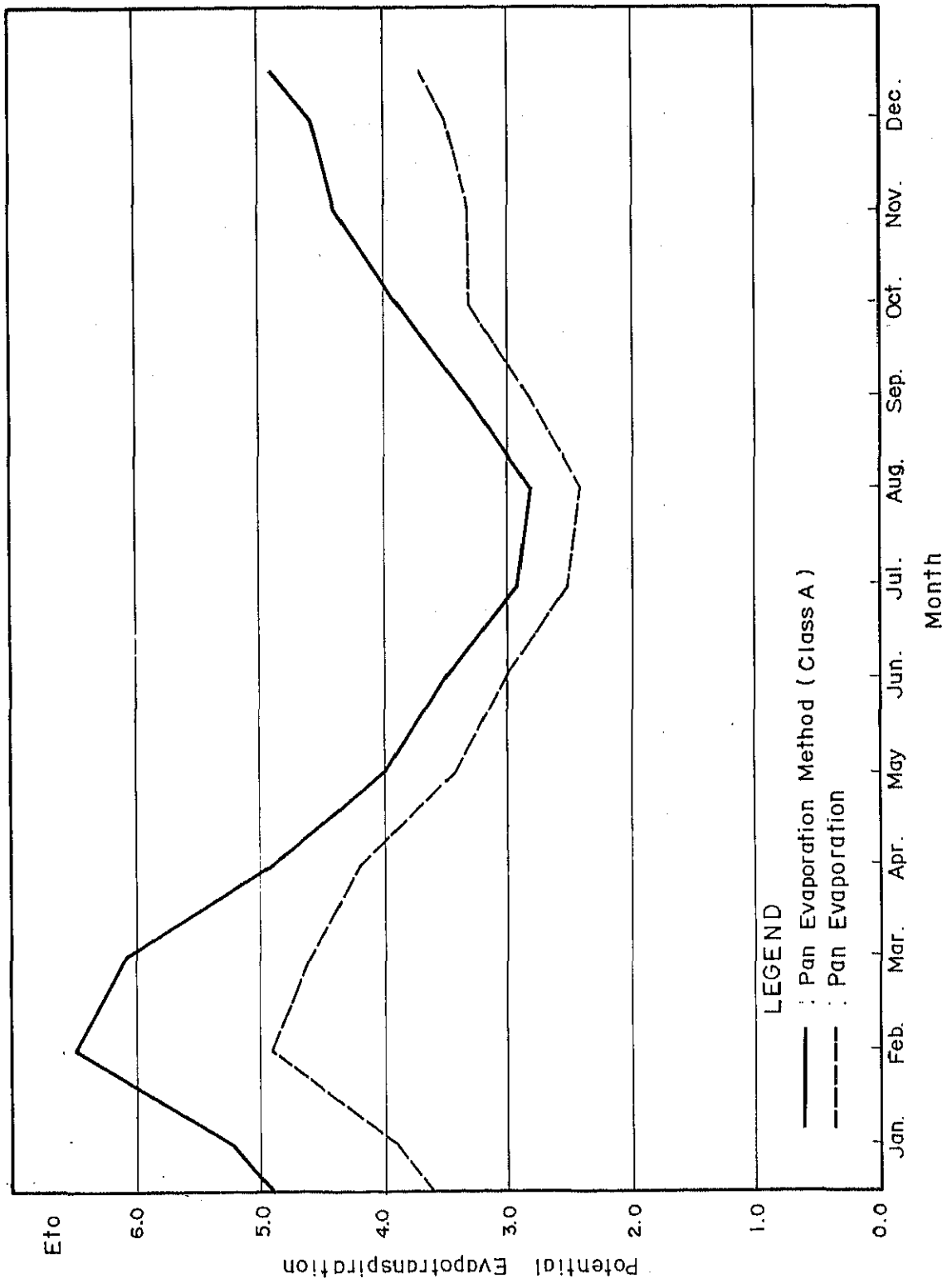


Fig. 6.8 PROPOSED IRRIGATION AND DRAINAGE SYSTEMS

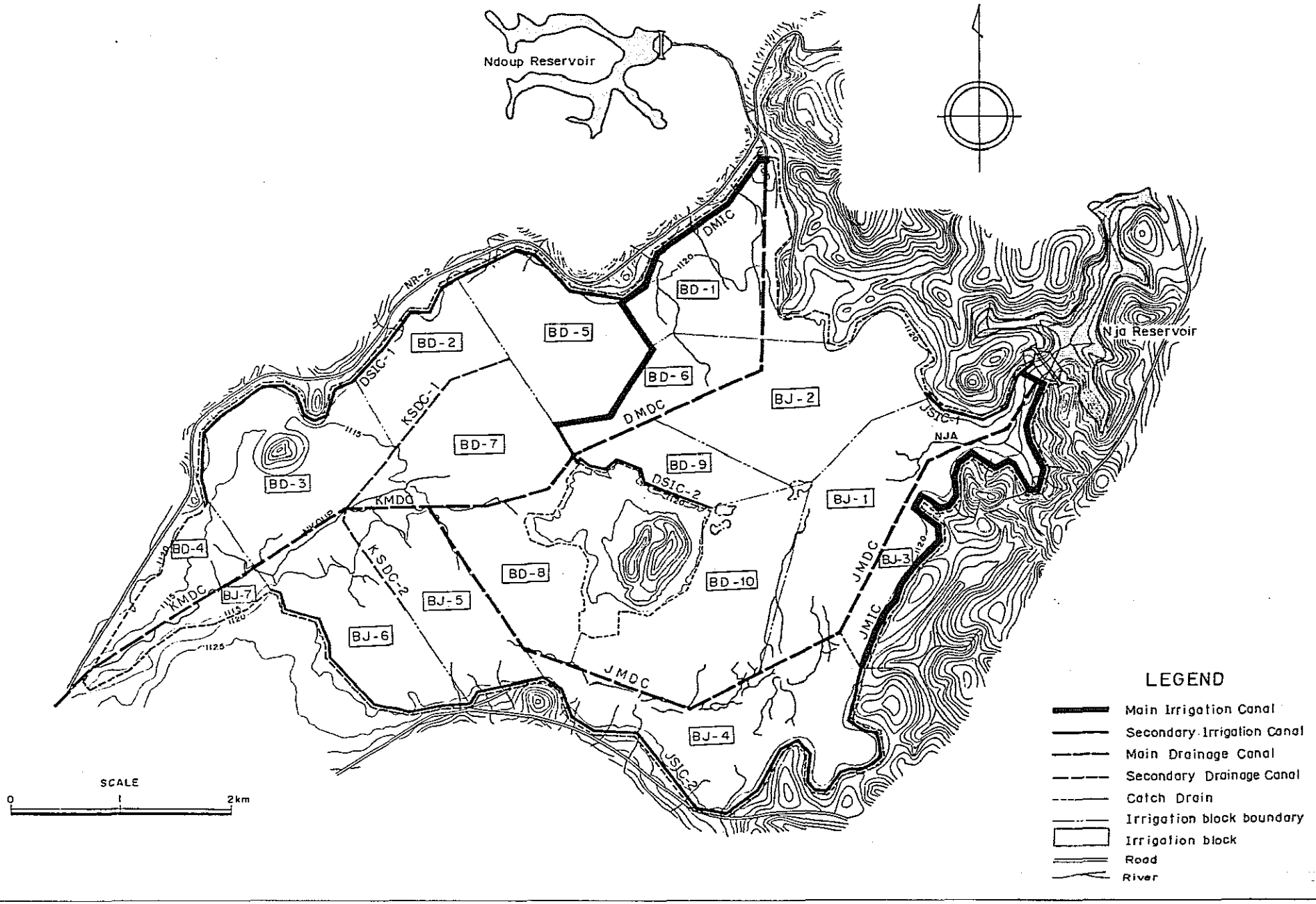
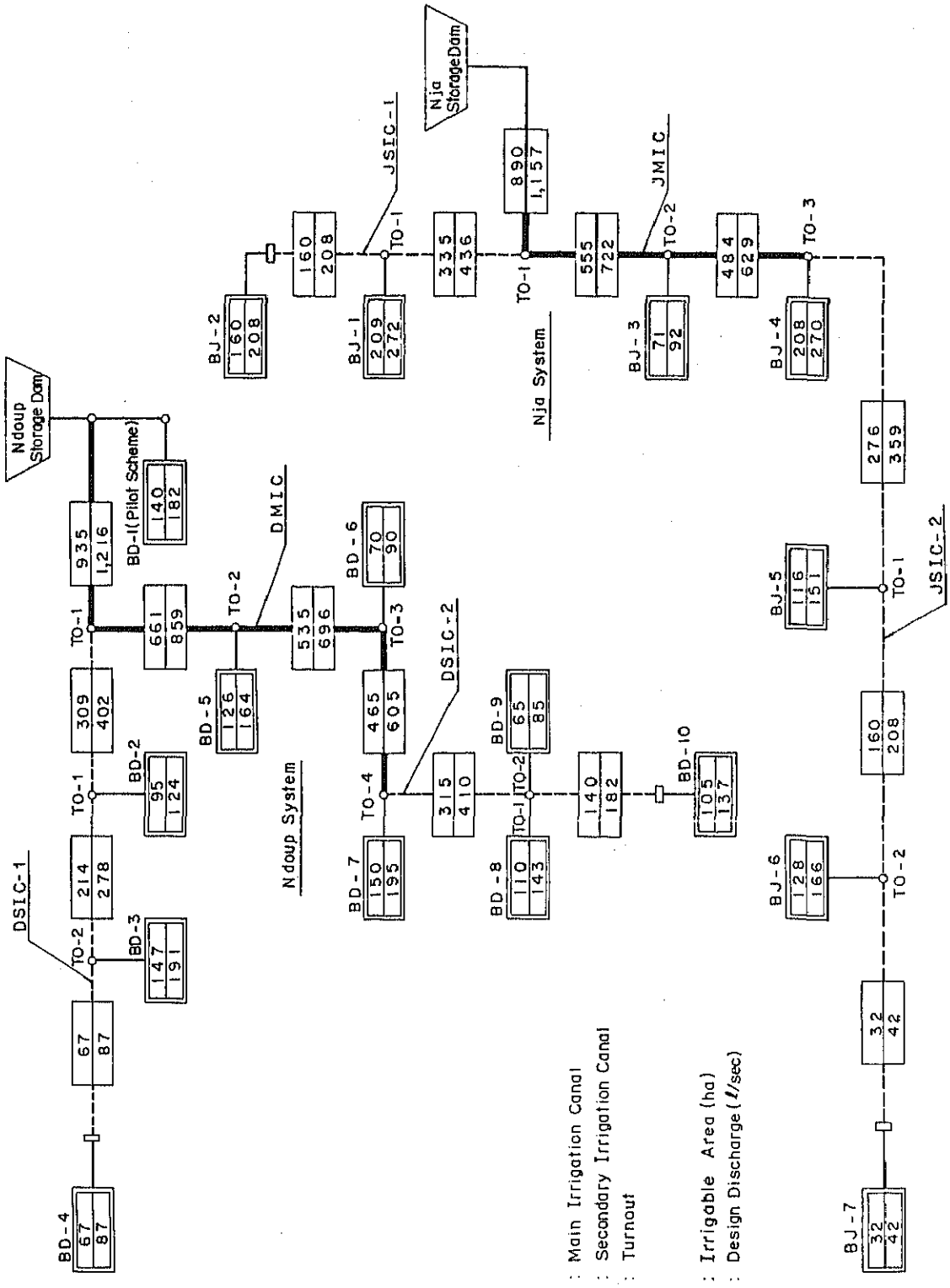


Fig. 6.9 IRRIGATION DIAGRAM



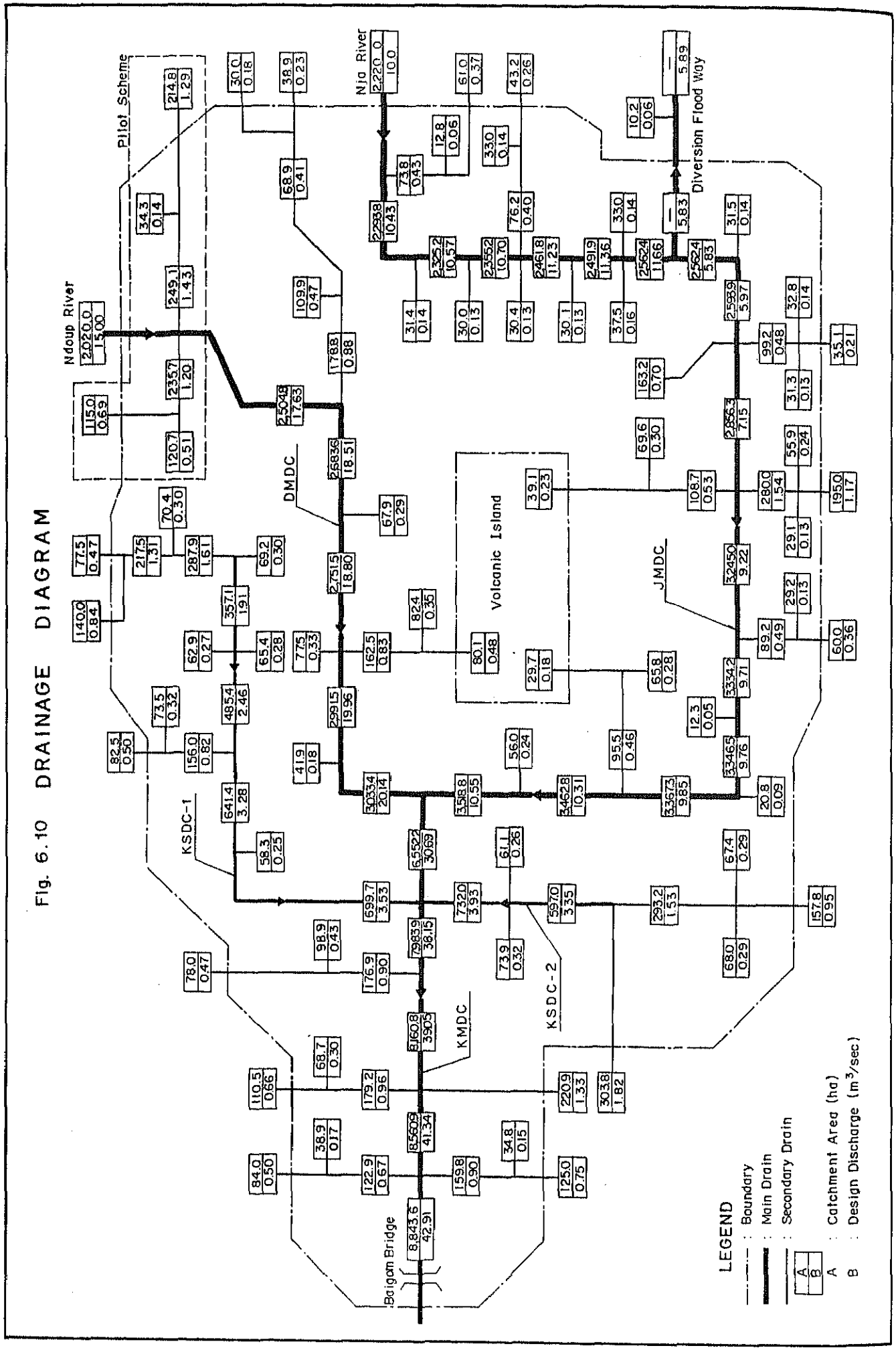
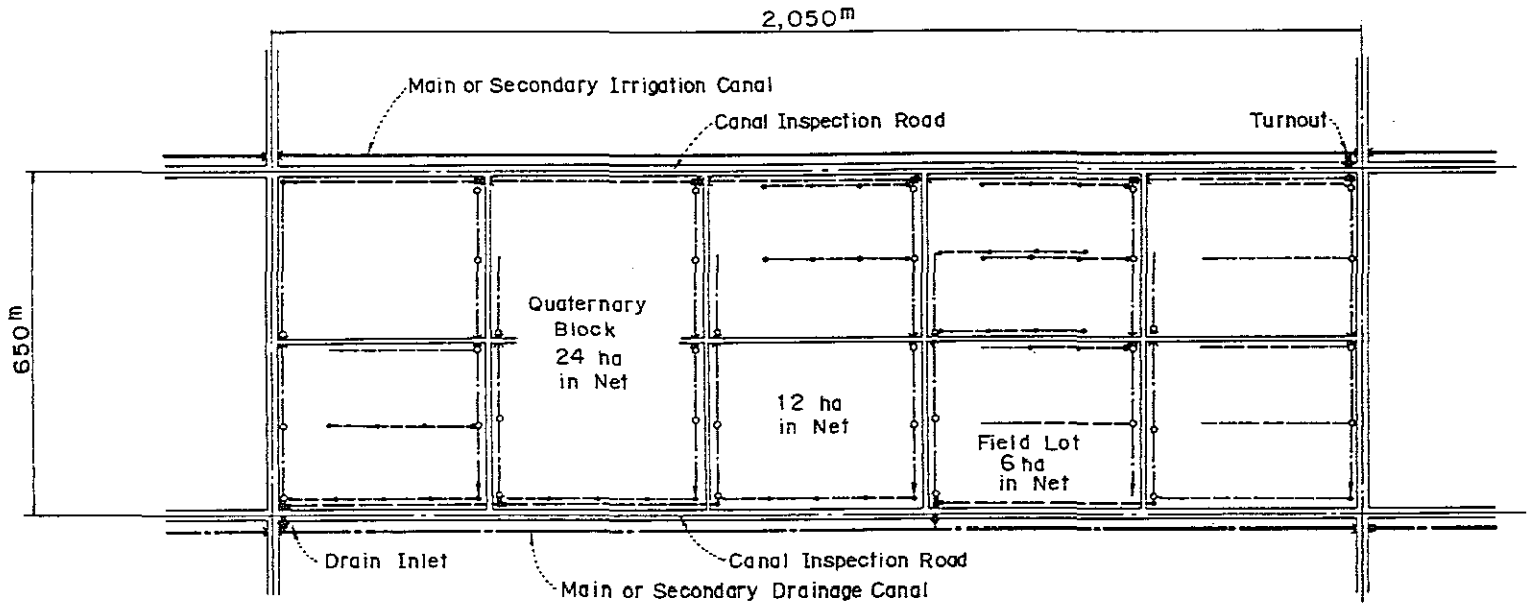
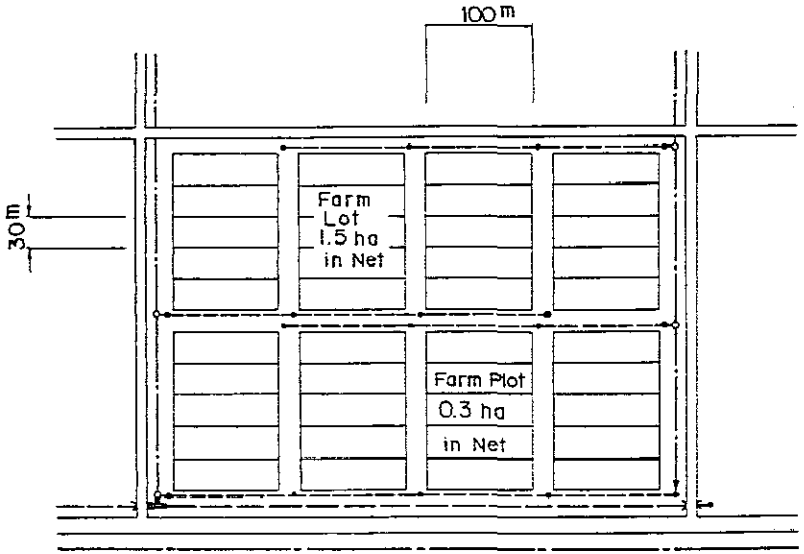


Fig. 6.10 DRAINAGE DIAGRAM
Ndoup River
Pilot Scheme
Nja River
Diversion Flood Way
DMDC
Volcanic Island
JMDC
KSDC-1
KSDC-2
KMDC
Bajgom Bridge
LEGEND
: Boundary
: Main Drain
: Secondary Drain
A : Catchment Area (ha)
B : Design Discharge (m³/sec)

Fig. 6-11 TYPICAL ON-FARM LAYOUT





LEGEND

(Irrigation Facilities)

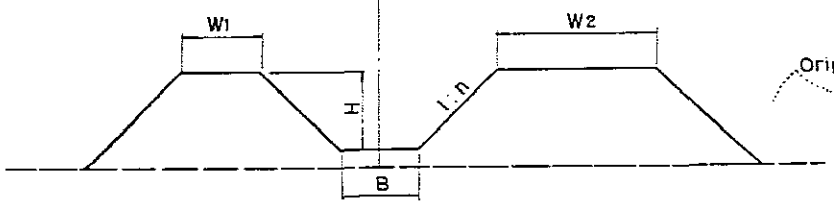
- Tertiary Irrigation Canal
- Quaternary Irrigation Canal
- Main Farm Ditch
- Division Box
- Quaternary Outlet

(Drainage Facilities)

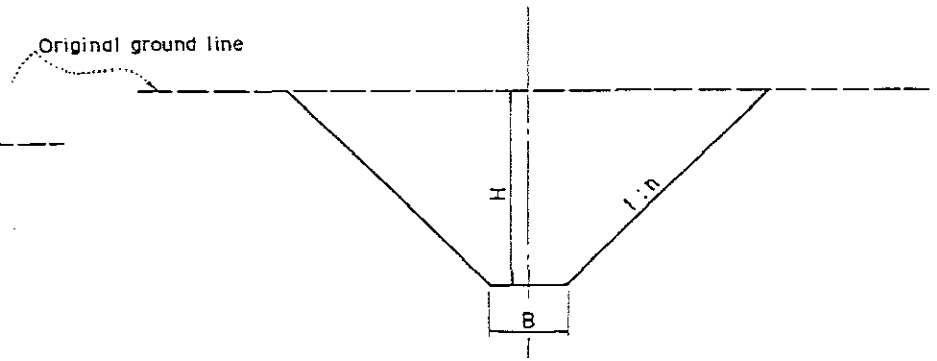
- Tertiary Drainage Canal
- Quaternary Drainage Canal
- Main Drainage Ditch
- Drainage Junction in Tertiary Drainage Canal
- Drainage Junction in Quaternary Drainage Canal

Fig. 6.12 TYPICAL SECTION OF ON-FARM CANALS AND ROAD

IRRIGATION CANALS
(TYPICAL SECTION)



DRAINAGE CANALS
(TYPICAL SECTION)



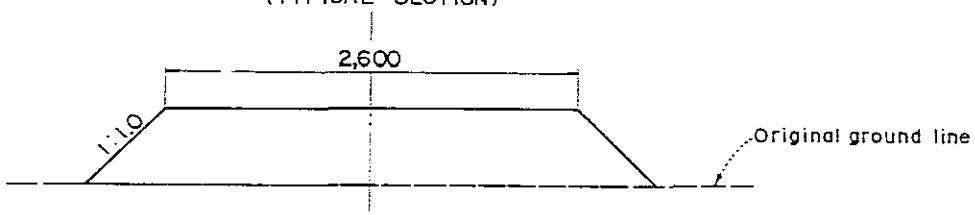
(DIMENSIONS)

	B	H	W1	W2	n	m
Tertiary Irrigation Canal	0.5 ~0.3	0.6~0.4	0.5	1.0	1.0	1.0
Quaternary Irrigation Canal	0.3	0.4	0.5	1.0	1.0	1.0
Main Farm Ditch	0.3	0.3	0.4	0.4	0.5	1.0
Supplementary Farm Ditch	0.3	0.25	0.3	0.3	0.3	0.3

(DIMENSIONS)

	B	H	n
Tertiary Drainage Canal	0.5 ~0.4	1.4~1.25	1.0
Quaternary Drainage Canal	0.4	1.1	1.0
Main Drainage Ditch	0.3	0.8	0.5
Supplementary Drainage Ditch	0.3	0.7	0.5

ON-FARM ROAD
(TYPICAL SECTION)



ANNEX VII

FARMERS SETTLEMENT PLAN AND FARMERS' ORGANIZATION

ANNEX VII

FARMERS' SETTLEMENT PLAN AND FARMERS' ORGANIZATION

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CHAPTER 1 GENERAL

The project site located in the Baigom plain is mostly covered with swampy bushes and forests, and marginally cultivated by the surrounding farmers.

The active work force in the adjacent villages is estimated to be about 1,800 persons at present. In order to realize the introduction of intensive farming practice in the whole area, it would be essential to transmigrate farm households into the project area.

CHAPTER 2 LAND DISTRIBUTION AND POPULATION TO BE SETTLED

2.1 Land Distribution

The reclaimed land will be distributed to both the local farmers and young farmers selected by the Committee of Selection. To determine the optimum farm size, a study was conducted on the following alternatives: 1.5 ha, 1.8 ha and 2.1 ha per household in due consideration of man-power demand for the cultivation, target living standard of the region, etc.

As a result of the comparative study, a farm size of 2.1 ha per household would be appropriate for each household in order to enable a rational use of familial and marginal labour force.

To keep to the cropping schedule fixed by the Development Authority (SODABA), small scale mechanization would be introduced.

2.2 Population to be Settled

After deduction of a part of the area for construction of infra-structure, the net area available for agricultural development by smallholder system would be 2,000 ha. The total number of households to be settled in these 2,000 ha was estimated to be 952. At the first stage, the priority of migration will be given to the households living around the project area.

New villages of settled farm households would be established around the project area in such a manner that families of same ethnic origin will be regrouped together. With a view to facilitating the communication and collaboration between the Development Authority and farmers' group, it would be recommendable to locate the "Village Community Center" near or in the Administration Office of the Development Authority.

CHAPTER 3 SELECTION OF FARMERS FOR SETTLEMENT

The result of the settlement plan would greatly depend upon the fitness and farming capability of the families to be settled in the area. Selection of farmers for settlement would be carried out on the basis of the following qualifications:

For Local Farmers
(residing in the radius of 10 to 20 km from the site)

- Inhabitants of one of the Sub-Divisions in the project zone;
- Ability of reading and writing;
- Aged 20 - 55 years;
- Good health and mental conditions;
- Capability of satisfying adequately the conditions fixed by the development Authority;
- Having no other wage-earning occupations;
- Married or having at least 2 other family members over 15 years old who can help cultivate the alotted land.

For Young Farmers

- Aged 20 - 35 years;
- Ability of reading and writing;
- Good health and mental conditions;
- Capability of satisfying adequately the conditions fixed by the Development Authority;
- Having no other wage-earning occupations;
- Having at least 2 other family members of over 15 years old who can help cultivate the alotted land; and
- Trained by the National Civic Service Center for Participation in Development (preferably) or having participated in other training programs.

The application documents for settlement in the project area will be submitted to the Development Authority or the Divisional Agricultural Delegation Office. The selection committee composed of the following persons will be convened to pick out the most appropriate candidates:

- Prefect of Noun Division;
- Divisional Delegate of the Ministry of Agriculture;
- Divisional Delegate of the Ministry of Planning and Regional Development;
- Sub-Prefects concerned;
- Director of the Development Authority (SODABA); and
- Representatives of Farmers' Associations.

CHAPTER 4 SETTLEMENT SCHEDULE

The settlement schedule would mainly follow the project construction schedule. As the farmers should engage themselves in the construction works, it was planned that their settlement be made progressively by sectors because the construction works would be carried out also in the same manner.

A total of 952 farm households would be transmigrated into the project area during a period of 4 years from the 3rd year after the commencement of construction work. The settlement schedule is summarized below:

Year	Developed Area (ha)	Number of Households Settled		Total Number of Settled Farmers
		Local Farmers	Young Farmers	
1990	200	76 (80%)	19 (20%)	95
1991	300	114 (80%)	29 (20%)	143
1992	500	167 (70%)	71 (30%)	238
1993	1,000	333 (70%)	143 (30%)	476
Total	2,000	690	262	952

As to the residence area of settled farmers, it will be prepared by the government outside and, if possible, near around the project area so as to ensure practical use of the developed area to a maximum extent.

More detailed regulations relating to the settlement will be stipulated by the Board of Directors of SODABA.

CHAPTER 5 GOVERNMENT SUPPORT AND SETTLEMENT PROCEDURE

Young farmers' households to be settled in the project area would need an initial capital investment for construction of their houses and purchase of farm equipment, etc. These farmers (especially young farmers) have no own financial means to cover necessary expenses for settlement and cultivation. Therefore, the Government would have to assist them by providing them with agricultural grants or credits according to the clauses of the Order No. 88/MINAGRI of October 31th 1977 adopted following the Decree No. 77/430 of October 29th 1977, relating to the public aids to settled farmers.

The total assistance amount of CFA F360,000 will be allocated by the Government to each young farmer. This amount is broken down as follows:

Grants (CFA F 160,000)

- Settlement premium : CFA F 10,000 to be paid in kinds such as seeds, plants, small material, etc.
- Subsistence premium : CFA F 60,000/year, to be paid in every trimester (CFA F 5,000/month) in the first year of settlement in proportion to the progress of subscribed works.

Advances (CFA F 20,000)

- Fund for construction of house : CFA F 60,000 to be supplied in kind.
- Fund for preparatory works : CFA F 140,000

CFA F 70,000 : CFA F 17,500/trimester in the 2nd year of settlement;

CFA F 35,000 : CFA F 8,750/trimester in the 3rd year of settlement;

CFA F 35,000 : CFA F 8,750/trimester in the 4th year of settlement.

The percentage of young farmers was assumed to be 20% - 30% of the total farmers to be settled. The amount of agricultural loans or credits to be extended by the Government through ONPD (National Office for Participation in Development) to the settled young farmers was estimated to be CFA F 94.3 million, as shown in Table 7.1.

The reimbursement of the above-mentioned advances will be made in 6 years without interest, starting from 2nd year of cultivation.

Besides, as to the general fund that farmers need for agricultural investment, (especially for local farmers) the Administrative Authority (SODABA) would arrange with FONADER to provide farmers' credits. The initial fund requirements for agricultural production per farm household was estimated to be 2.4 million, as shown in Table 7.2.

The farmers who desire to cultivate in the developed area commanded by SODABA will, first of all, make a contract with the Authority for 3-year land location and residence area in case of new settled farmers.

The farmers who obtained the right of cultivation under the contract for a determined period of 3 years, will be required to observe the following obligations:

- Respect of the technical standards and farming calendar fixed by the Authority;
- Commercialization of products through the farmers' organization designated by the Authority;
- Reimbursement of advances and credits which are granted with the help of the Authority;
- Attendance to the agricultural extension programs and farmers' meetings organized by the Authority and the farmers' associations;
- Participation in the cooperative and community works required by the sectional association to which the farmers belong; and
- Other reasonable requirements by the Authority.

At the expiration of the 3-year contract, the Board of Directors of SODABA will examine the adaptability of each farmer in every respects to decide the renewal or termination of the contract. The term of the second contract will be 5 years and tacitly renewable as far as the farmer fulfills the above-mentioned obligations. For the farmers who enter into a second contract, the right of land ownership would be allowed under the aforesaid restricted conditions.

However, in case the farmers repeatedly fail to fulfill the obligations in spite of warning of the Authority or they intended to abandon the land, the contract will be cancelled even within the validity period after the approval of the Board of Directors.

All problems related to the principles of operation and management of SODABA would be discussed and resolved with a majority of two thirds or more of the numbers of the Board of Directors.

CHAPTER 6 FARMERS' ORGANIZATION

In the project zone, there is no other cohesive farmers' organization than the cooperative sections and centers of UCCAO which are mainly in charge of the collection of coffee and distribution of agricultural inputs.

For rational management, operation and maintenance of the developed areas in the Baigom plain with irrigation and drainage systems, it is recommended to set up farmers' associations among the settled farmers as shown in Fig. 7.1.

As a first step, Farmers' Groups (FG) will be organized in each quaternary irrigation area (24 ha). FG would later be regrouped into Farmers' Association (FA) at the rate of about one association per 360 ha. At the final stage, FA would be integrated into a Federation of Farmers' Associations (FFA). FFA would be administered by a Board of Directors composed of five (5) mebers: a President, a Vice-President, a Secretary, a Treasurer and an Auditor. Operational expenses of the FFA would be covered by incentive suvention from SODABA and contribution from member-farmers.

The organization of FG, FA and FFA would be implemented within a period of 8 years from 1990 to 1997 after preparation of parcellary maps of the developed areas as shown in Table 7.3.

From the social aspects, Farmers' Groups (FG) would in principle be organized by the farmers living in the same administrative unit under the guidance of SODABA and local authorities. To assure the smooth setting up of farmers' organization and communication among the authorities concerned and farmers, it is recommendable that a "Village Community Center" will be established near or in the Administration Office of SODABA.

Table 7.1 FORECAST OF FUND REQUIREMENTS FOR YOUNG FARMERS

(Unit: CFA F 10^3)

Items of Expenditures	1990	1991	1992	1993	1994	1995	1996	Total Amount
Grants								
Settlement premium	1,900	2,900	7,100	14,300	-	-	-	26,200
Subsistence premium	1,140	1,740	4,260	8,580	-	-	-	15,720
Sub-Total	3,040	4,640	11,360	22,880	-	-	-	41,920
Advances								
Fund for housing construction	1,140	1,740	4,260	8,580	-	-	-	15,720
Fund for preparatory works	-	1,330	2,695	6,650	13,510	7,490	5,005	36,680
Sub-Total	1,140	3,070	6,955	15,230	13,510	7,490	5,005	52,400
Total	4,180	7,710	18,315	38,110	13,510	7,490	5,005	94,320

Table 7.2 FORECAST OF INITIAL FUND REQUIREMENTS FOR AGRICULTURAL PRODUCTION

(Unit: CFA F 10^3)

Item of Expenditure	Unit Price	Annual Amount	Year/1 1990 (95)	1991 (143)	1992 (238)	1993 (476)	Total Amount
1) Farming Appliances							
- Tiller	1,318		125,210	188,474	313,684	627,368	1,254,736
- Sprayer /2	682		21,824	32,736	53,878	108,438	216,876
- Thresher	596		56,620	85,228	141,848	283,696	567,392
2) Agricultural Inputs							
- Seeds		13	1,235	1,859	3,094	6,188	12,376
- Agro-chemicals		32	3,040	4,576	7,616	15,232	30,464
- Fertilizer		233	22,135	33,319	55,454	110,908	221,816
Total	-	-	230,064	346,192	575,574	1,151,830	2,303,660

Initial Fund Requirement per farm household: 2,303,660 ÷ 952 = 2,419.8 ≒ 2,420

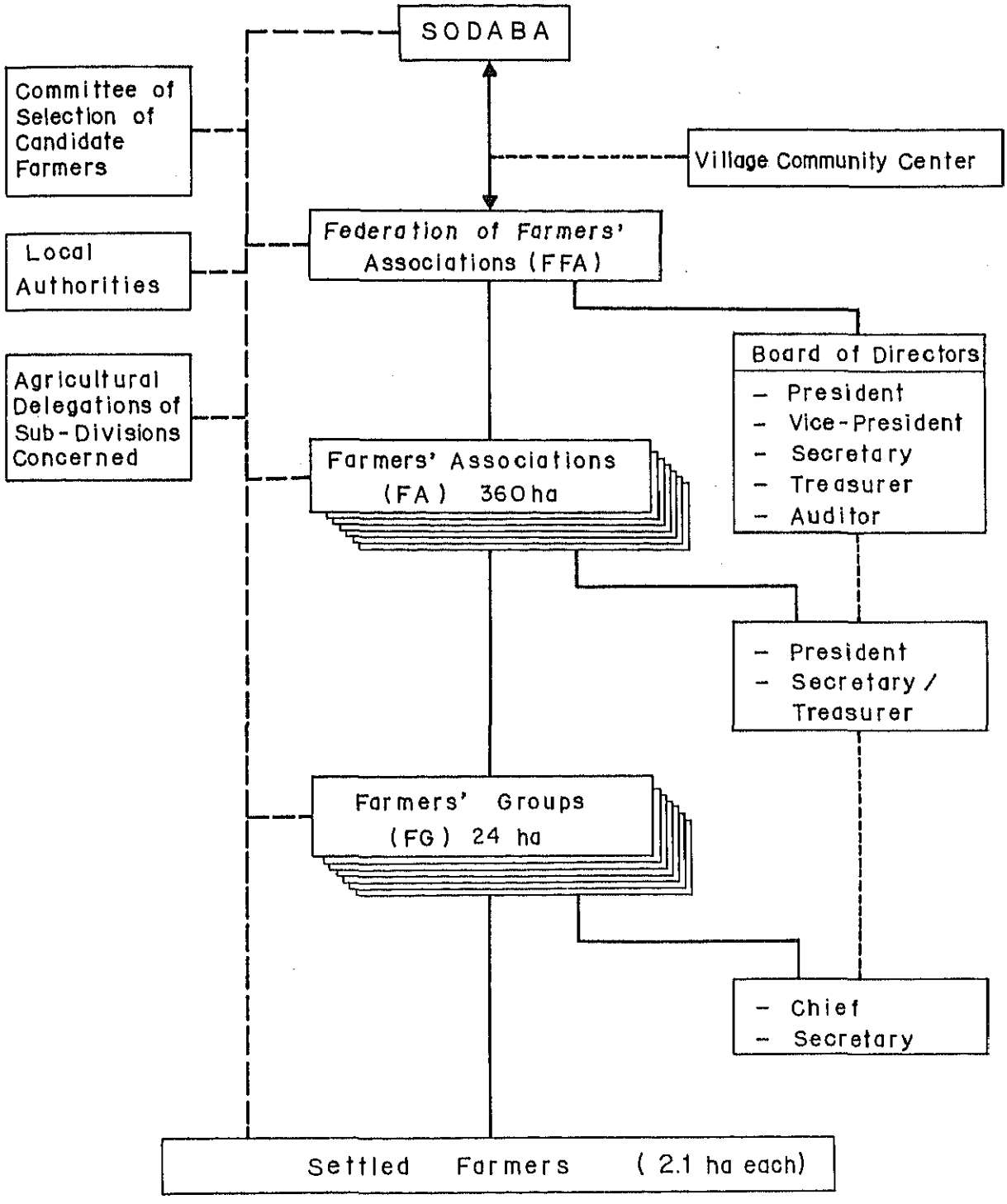
Remarks: /1 Figures in parentheses ( ) are number of settled farmers in each year.

/2 One sprayer will be equipped for every 3 farm households.

Table 7.3 SCHEDULE OF FARMERS' ORGANIZATION SETTING-UP

Year	Command Area (ha)	No. of Settled Farm Households	No. of FG	No. of FA	No. of FFA
1990	200	95	8	0	0
1991	500	238	21	1	0
1992	1,000	476	42	2	0
1993	2,000	952	83	3	0
1994	"	"	"	6	0
1995	"	"	"	"	0
1996	"	"	"	"	0
1997	"	"	"	"	1

Fig. 7.1 PROPOSED ORGANIZATIONAL STRUCTURE OF FARMERS' ASSOCIATIONS



Remarks :

——— : Direct linkage

---------- : Supervisory relation

— — — — : Coordinating relation

ANNEX VIII

ORGANIZATION AND MANAGEMENT

ANNEX VIII

ORGANIZATION AND MANAGEMENT

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CHAPTER 1 ORGANIZATION FOR PROJECT IMPLEMENTATION

To ensure the successful implementation of the Project, it is proposed to establish as soon as possible at the initial stage, the Baigom Agricultural Development Authority (SODABA) under an establishment agreement with the Government of Republic of Cameroon, as same as in the case of similar projects such as SODERIM, UNVDA, SEMRY, etc.

For the actual project implementation, the present Baigom Rice Cultivation Project Office (cf. Fig. 4.2) will be reinforced and transformed into SODABA to undertake the project implementation and management under the control of the Directorate of Studies and Projects, Ministry of Agriculture. Such a structure shall enable the Project Office to effectively control the work execution during the construction stage and to undertake the operation and management of the Project upon its completion.

At the project implementation stage, the main duty of the organization would be to control the execution of detailed design and construction works (See Fig. 8.1).

In view of its present activities in the project area and its future functions during the project execution, the Project Office of SODABA should need administrative cooperation from the local authorities at provincial, divisional and sub-divisional levels. It is therefore proposed to create at the head of SODABA, the "Board of Directors" consisting of representatives from each authority concerned, e.g.:

- Prefect of Noun Division;
- Divisional Delegate of the Ministry of Agriculture;
- Divisional Delegate of the Ministry of Planning and Regional Development;
- Sub-Prefects concerned; and
- Director of the Development Authority (SODABA).

The organization of SODABA (Project Office) at the project implementation stage will consist of a Secretariat and three (3) Sections: Administrative & Financial Section, Construction Supervision Section and Operation & Maintenance Section.

For smoothly carrying out the construction and its supervision, it would be necessary to install a Construction Supervision Section. In view of the importance of management and accounting operations during the construction stage, the Administrative and Financial Section would have to be reinforced. The Construction Supervision Section would be transformed gradually into Operation and Maintenance Section with the progress of construction works.

CHAPTER 2 ORGANIZATION FOR OPERATION AND MAINTENANCE

Upon completion of the stage-by-stage construction works, the organization of SODABA (Project Office) would have to be strengthened progressively to enable it to undertake efficiently the operation and management of the developped area (See Fig. 8.2).

The Project Office of SODABA will consist of a Secretariat and five (5) Departments, such as Financial Department, Administrative Department, Operation and Maintenance Department, Production and Marketing Department, and Farmers Organization Department, each with a number of sections.

Considering the work volume at full development stage, the Administration & Financial Section at project implementation stage would be reinforced by dividing into two Departments: Administrative Department and Financial Department. The Construction Supervision Section and Operation and Maintenance Section would be transformed into Operation and Maintenance Department. In view of the importance of production and marketing and farmers organization during the operation and management stage, the Production and Marketing Department and Farmers Organization Department would be newly established.

CHAPTER 3 AGRICULTURAL SUPPORT SYSTEM AND STAFFING

3.1 Agricultural Support Services

Establishment of a system for technical and financial assistance to farmers and for stable operation and maintenance of the Project will be of major importance to enable to attain the anticipated agricultural production in the project area through intensive cropping practice.

Therefore, it would be essential in the first place to use rationally the existing agricultural support agencies and institutions in charge of research and extension, investment and credit services, cooperative and farmers' organizations, etc. (See Fig. 4.3)

(1) Extension services

The agricultural support institutions in Cameroon are systematically organized as explained in Annex IV.

As to the agricultural extension activities around the project area, several extension workers are assigned through the agricultural post, but their activities are mostly concentrated on coffee cultivation in cooperation with UCCAO. Most of them have no experience on irrigation farming, especially on rice cultivation.

Considering the present situation of the agricultural extension services as well as the present staff of the Baigom Rice Cultivation Project Office, there would be lack of qualified extension staff to provide appropriate agricultural extension services necessary for the effective operation of the Project. It would be therefore indispensable for the Authority to establish as early as possible its own extension system to maximize the effects of the development project.

The proposed organization structure of the agricultural extension system is as illustrated in Fig. 8.3. As seen in this Figure, the project area will be divided into two extension blocks, i.e., Nja and Ndoup Blocks. In the Nja Block, 3 extension workers will be assigned and each worker will cover two tertiary irrigation units; in the Ndoup Block, 4 extension workers will be assigned and each worker will cover one or two units. Each extension worker will be in charge of about 130 - 140 unit farmers. All technical guidance and information from the Authority will be transmitted to farmers through the extension service system.

(2) Supply of agricultural inputs

Fertilizers and agrochemicals are available in free markets in Cameroon. For the effective operation of the field application in time and in quantity, it is recommendable to supply these farm inputs in kind by the Authority and the cost thereof will be reduced from the payment for the products sold by farmers to the Authority.

The Authority is required to install warehouses to store the inputs. The quantity of fertilizers required for one crop season was estimated to be about 2,200 tons for the total project area. The agrochemicals required were estimated to be about 15 tons for one crop season. About a half of the quantities required for one season will be stored by the Authority. The required area of the warehouses for the inputs was estimated to be about 500 m^2.

3.2 Staffing for Each Stage of the Project

As mentioned in Annex IV, the present agricultural support institutions in the region are not yet well developed and the Project could not expect, for the time being, a full assistance from these organizations.

To ensure smooth implementation of the Project, it is therefore recommended to assign the number of staff with adequate qualifications required, as shown in Table 8.1. The number of staff, especially that of senior officers will be gradually increased according to the volume of services. This means that during the first period of each stage, the senior officers should cumulate also other posts as much as possible from the standpoint of financial rationality.

The staff and annual amounts required at the operation and maintenance stage for both cases without and with the government subsidy are given in Tables 8.2(A) and 8.2(B), respectively.

The staff number required for SODABA in each stage (or year by year) was estimated paying due attention to the work quantities, implementation method and schedule and so on. The total number of staff required at the project implementation stage (1992) was estimated to be 125 at maximum, which includes managing, technical and administrative staff, workers, laborers, etc.

The required number of staff at the operation and maintenance stage (1995) would be 193, including seasonal temporary laborers.

To cope with the shortage of experienced personnel in Cameroon, some foreign specialists would have to be recruited, especially in each initial period of the deisgn and construction and operation and management.

The personnel expenses of SODABA were calculated on the following conditions.

a) All remunerations including base salaries and allowances will be in principle borne by the SODABA. However, following the case of similar projects, the base salaries for national officials might be paid by the Government according to the stipulations of the agreement concluded between the Government and SODABA. The total amounts of personnel expenses for both cases without and with the government subsidy are given in Tables 8.2(A) and 8.2(B), respectively.

b) Project allowances equal to 20% to 40% of the base salary will be paid to national officials according to their responsibility, technical level, diligence and for their transportation, etc.

c) The amounts appropriated for local staff as Project Allowances (added by 10%) will cover the overtime and so on.

d) Social charges (estimated to be about 15%) for all staff will be paid by SODABA. In case the government subsidy is available, SODABA will bear only social charges for the local staff.

e) The travelling allowances at each of the two stages were calculated by applying the following percentages to those in the target year of 1995.

- 20% -65% for the project implementation stage
- 80% -100% for the operation and maintenance stage

f) For members of the Board of Directors or Committee of Selection of Candidate Farmers, only travelling allowances will be borne by SODABA.

3.3 Qualifications and Requirements of the Staff to be Assigned

To ensure smooth operation and management of the Baigom Agricultural Development Project, it would be indispensable to assign the right staff in the right post. The qualifications and requirements of the staff to be assigned could be proposed as below:

No.	Post	Qualifications Required	Least Experience (years)	Other Abilities or Qualifications Expected
1.	Director General	Bachelor	15	Master or Ph.D.
2.	Department Director	Bachelor	8	Master, Proficiency in English
3.	Senior Officer & Principal Engineer	Bachelor	5	Command of English
4.	Civil Engineer, Agricultural Engineer, Agricultural Technician	Bachelor or Diploma of College	3	Command of English
5.	Accountant & Cashier, Nurse	Diploma of College or Senior High School	2	Certificate of Accountancy, Notion of English
6.	Agricultural Monitor	Graduate of Junior High School	1	Completion of Training Program, Notion of English
7.	Secretary & Typist, Draftsman, Clerk & Store Keeper	Diploma of Senior or Junior High School	2	Certificate of Speciality, Notion of English
8.	Mechanic, Electrician, Mason, etc.	Diploma of Senior or Junior High School	3	Certificate of Speciality, Notion of English
9.	Gatekeeper, Milling Operator	Diploma of Junior High School	2	Certificate of Speciality, Notion of English
10.	Driver and Operator of Tractor	Graduate of Primary School	5	Certificate of Speciality, Proficiency in English
11.	Laborer	Good health and diligence	-	Notion of French

Table 8.1 REQUIRED NUMBER OF PROTECT STAFF

Stage		Project Implementation						Operation and Maintenance		
		Detailed Design	Construction (including O & M)							
Staff	Category & Grade	1987	1988	1989	1990	1991	1992	1993	1994	1995 -
Managing Staff										
a) Director General of the Project	A2/940	1	1	1	1	1	1	1	1	1
b) Department Director	A2/605	-	-	-	2(2)	3(3)	3(3)	4	4	5
c) Senior Officer or Principal Engineer	B2/610	2	2	2	2	2	2	3	3	3
Technical and Administrative Staff										
d) Civil Engineer	A1/530	1	2	2	2	2	2	2	2	2
e) Agricultural Engineer	B2/420	1	3	3	4(1)	4(1)	4(1)	5	5	6
f) Agricultural Technician	B1/480	2	3	3	6(3)	9(6)	11(8)	12	12	17
g) Accountant & Cashier, Nurse	B1/480	2	2	2	2	2	2	3	3	4
h) Agricultural Extension Worker	C/250	-	-	-	3(3)	5(5)	5(5)	6	6	7
i) Secretary & Typist, Clerk, Store Keeper	V/D	8	16	16	16	16	16	18	20	22
j) Mechanic, Electrician	V/D	-	-	-	1(1)	2(2)	2(2)	2	2	3
Workers and Laborers										
k) Gatekeeper, Milling Operator	IV/D	-	-	-	10(10)	12(12)	15(15)	22	22	22
l) Driver, Operator of Tractor and Foreman	III/D	5	5	5	8(3)	10(5)	10(5)	11	12	15
m) Guardsman, Office Keeper	II/D	3	5	5	10(5)	11(6)	11(6)	12	13	13
n) Laborers - Permanent	II/D	4	6	6	10(4)	14(8)	16(10)	18	20	23
- Temporary(A)	II/D	-	-	-	5(5)	5(5)	5(5)	8	10	10
- Temporary(B)	II/D	-	-	-	15(15)	20(20)	20(20)	30	35	40
Total		29	45	45	97(52)	118(73)	125(80)	157	170	193

Remarks: Figures in parentheses ( ) show the number of staff required for operation and maintenance during the construction stage.

Table 8.2(A) ESTIMATE OF PERSONNEL EXPENSE FOR OPERATION AND MAINTENANCE (IN CASE WITHOUT GOVERNMENT SUBSIDY)

A. REMUNERATION

(Unit: CFA F)

Qualifications	Category & Grade	Monthly Gross Salary (a)	Additional Lump Sum Allowance (b)	Housing Allowance (c)=(a)x0.2 /1	Monthly Gross Amount (d)=(a)+(b)+(c)	Number of Staff (e)	Annual Expenses (f)=(d)x(e)+12	Anual Project Allowances (%)	Annual Amount to be borne by SODABA (g)=(f)x(%)
Managing Staff									
a) Director General of the Project	A2/940	356,419	550	71,283	428,252	1	5,139,024	140	7,194,634
b) Department Director	A2/605	248,566	550	49,713	298,829	5	17,929,740	135	24,205,149
c) Senior Officer (A) or Principal Engineer	B2/610	250,172	550	50,034	300,756	3	10,827,216	130	14,075,381
Technical and Administrative Staff									
d) Civil Engineer	A1/530	224,479	550	44,895	269,924	2	6,478,176	120	7,773,811
e) Agricultural Engineer Senior Officer (B)	B2/420	180,469	900	36,093	217,462	6	15,657,264	120	18,788,717
f) Agricultural Technician	B1/480	206,251	900	41,250	248,401	17	50,673,804	120	60,808,565
g) Accountant & Cashier, Nurse	B1/480	206,251	900	41,250	248,401	4	11,923,248	120	14,307,898
h) Agricultural Extension Worker (Monitor)	C/250	107,422	2,000	21,484	130,906	7	10,996,104	120	13,195,325
i) Secretary & Typist, Draftsman, Clerk, Stroke Keeper	V/D	56,275	-	20,000	76,275	22	20,136,600	110	22,150,260
j) Mechanic, Electrician, etc.	V/D	56,275	-	20,000	76,275	3	2,745,900	110	3,020,490
Workers and Laborers									
k) GateKeeper, Milling Operator	IV/D	38,980	-	15,000	53,980	22	14,250,720	110	15,675,792
l) Driver, Operator of Tractor, Foreman	III/D	26,215	-	13,000	39,215	15	7,058,700	110	7,764,570
m) Guardsman, Office Keeper	II/D	22,390	-	10,000	32,390	13	5,052,840	110	5,558,124
n) Laborers-Permanent	II/D	22,390	-	10,000	32,390	23	8,939,640	110	9,833,604
-Temporary(A)	II/D	22,390	-	-	22,390	10	1,343,400 /2	110	1,477,740
-Temporary(B)	II/D	22,390	-	-	22,390	40	7,164,800 /3	110	7,881,280
Sub Total:						193			233,711,340

Source: Nouveau Barème de Solde Indicaire pour compter du 1er juillet 1985, Ministère des Finances;

Barème Valable le 1er juillet 1985;

Décision No. ..... du ..... fixant les primes, indemnités et avantages alloués au personnel de la Société de Développement de la Riziculture dans la Plaine des Mbo (SODERIM).

Remarks: /1 20% of housing allowance was applied only for managing and technical staff who belong to the Government Office.

/2 Calculated based on the employment period of six (6) months per year.

/3 Calculated based on the employment period of eight (8) months per year.

B. SOCIAL CHARGES

(Unit: CFA F)

Annual Total Amount		Estimated Rate or Social Charges (15%) /1		Total Social Charges
233,711,340	x	0.15	=	35,056,701

C. TRAVELLING ALLOWANCE (AT THE TARGET YEAR OF 1995)

(Unit: CFA F)

	Average Travelling Allowance per day /1 (a)	Estimated Number of Travelling Persons and Days per Year (b)	Annual Total (c)=(a)x(b)
(1) Inland Trips			
- Member of the Board of Directors or Committee of Selection of Candidate Farmers	25,000	1 person x 5 days/month x 12 = 60 man-days	1,500,000
- Managing Staff	20,000	1 person x 5 days/month x 12 = 60 man-days	1,200,000
- Drivers	7,000	1 person x 5 days/month x 12 = 60 mon-days	420,000
(2) Overseas Trips			
- Responsible Staff	40,000	1 person x 15 days/year = 15 man-days	600,000
Total			3,720,000

Remarks: /1 Estimated based on the travelling allowance regulation of SODERIM.

/2 The travelling allowance for overseas trips was estimated in annual lump sum.

D. TOTAL (A + B + C) : 272,488,041

(Rounded) 272,488,000

Table 8.2(B) ESTIMATE OF PERSONNEL EXPENSE FOR OPERATION AND MAINTENANCE (IN CASE WITH GOVERNMENT SUBSIDY)

A. REMUNERATION

(Unit: CFA F)

Qualifications	Category & Grade	Monthly Gross Salary (a)	Additional Lump Sum Allowance (b)	Housing Allowance (c)=(a)x0.2 /1	Monthly Gross Amount (d)=(a)+(b)+(c)	Number of Staff (e)	Annual Expenses (f)=(d)x(e)x12	Annual Project Allowances (%)	Annual Amount to be borne by SODABA (g)=(f)x(%)
Managing Staff									
a) Director General of the Project	A2/940	356,419	550	71,283	428,252	1	5,139,024	40	2,055,610
b) Department Director	A2/605	248,566	550	49,713	298,829	5	17,929,740	35	6,275,409
c) Senior Officer (A) or Principal Engineer	B2/610	250,172	550	50,034	300,756	3	10,827,216	30	3,248,165
Technical and Administrative Staff									
d) Civil Engineer	A1/530	224,479	550	44,895	269,924	2	6,478,176	20	1,295,635
e) Agricultural Engineer Senior Officer (B)	B2/420	180,469	900	36,093	217,462	6	15,657,264	20	3,131,453
f) Agricultural Technician	B1/480	206,251	900	41,250	248,401	17	50,673,804	20	10,134,761
g) Accountant & Cashier, Nurse	B1/480	206,251	900	41,250	248,401	4	11,923,248	20	2,384,650
h) Agricultural Extension Worker (Monitor)	C/250	107,422	2,000	21,484	130,906	7	10,996,104	20	2,199,221
i) Secretary & Typist, Draftman, Clerk, Strole Keeper	V/D	56,275	-	20,000	76,275	22	20,136,600	110	22,150,260
j) Mechanic, Electrician, etc.	V/D	56,275	-	20,000	76,275	3	2,745,900	110	3,020,490
Workers and Laborers									
k) Gatekeeper, Milling Operator	IV/D	38,980	-	15,000	53,980	22	14,250,720	110	15,675,792
l) Driver, Operator of Tractor, Foreman	III/D	26,215	-	13,000	39,215	15	7,058,700	110	7,764,570
m) Guardsman, Office Keeper	II/D	22,390	-	10,000	32,390	13	5,052,840	110	5,558,124
n) Laborers-Permanent	II/D	22,390	-	10,000	32,390	23	8,939,640	110	9,833,604
-Temporary(A)	II/D	22,390	-	-	22,390	10	1,343,400 /2	110	1,477,740
-Temporary(B)	II/D	22,390	-	-	22,390	40	7,164,800 /3	110	7,881,280
Sub Total:						193			104,086,764

Source: Nouveau Barème de Solde Indicaire pour compter du 1er juillet 1985, Ministère des Finances;

Barème Valable le 1er juillet 1985;

Décision No. ..... du ..... fixant les primes, indemnités et avantages alloués au personnel de la Société de Développement de la Riziculture dans la Plaine des Mbo (SODERIM).

Remarks: /1 20% of housing allowance was applied only for managing and technical staff who belong to the Government Office.

/2 Calculated based on the employment period of six (6) months per year.

/3 Calculated based on the employment period of eight (8) months per year.

B. SOCIAL CHARGES

(Unit: CFA F)

Annual Total Amount of Local Staff i) - n)		Estimated Rate of /1 *Social Charges* (15%)		Total Social Charges
73,361,860	x	0.15	=	11,004,279

C. *TRAVELLING ALLOWANCE (AT THE TARGET YEAR OF 1995)*

(Unit: CFA F)

	Average Travelling Allowance per day /1 (a)	Estimated Number of Travelling Persons and Days per Year (b)	Annual Total (c)=(a)x(b)
(1) Inland Trips			
- Member of the Board of Directors or Committee of Selection of Candidate Farmers	25,000	1 person x 5 days/month x 12 = 60 man-days	1,500,000
- Managing Staff	20,000	1 person x 5 days/month x 12 = 60 man-days	1,200,000
- Drivers	7,000	1 person x 5 days/month x 12 = 60 man-days	420,000
(2) Overseas Trips			
- Responsible Staff	40,000	1 person x 15 days/year = 15 man=days	600,000
Total			3,720,000

Remarks: /1 Estimated based on the travelling allowance regulation of SODERIM.

/2 The travelling allowance for overseas trips was estimated in annual lump sum.

D. TOTAL (A + B + C) : 118,811,043

(Rounded) 118,811,000

Fig. 8.1 PROPOSED ORGANIZATION FOR PROJECT IMPLEMENTATION

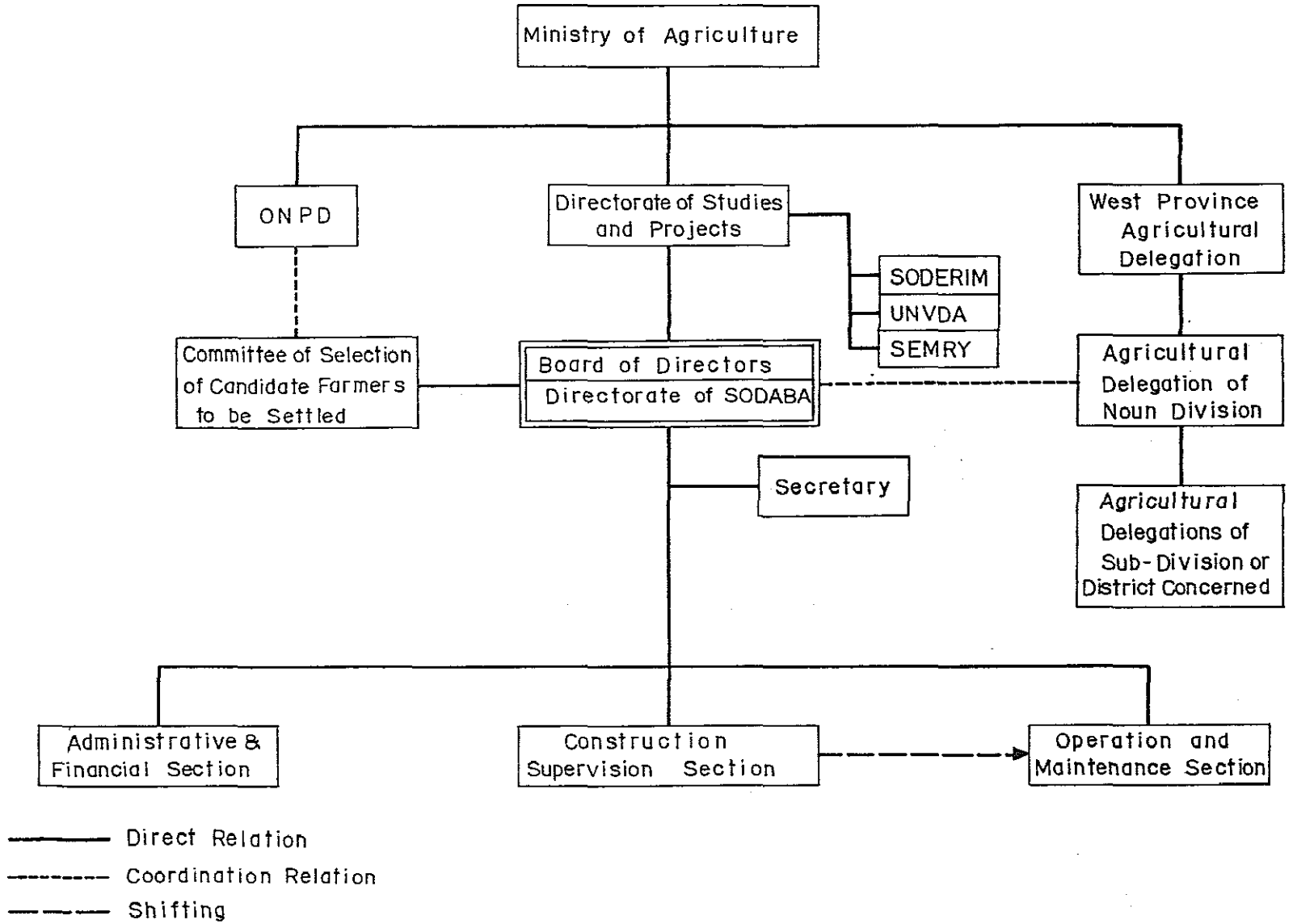
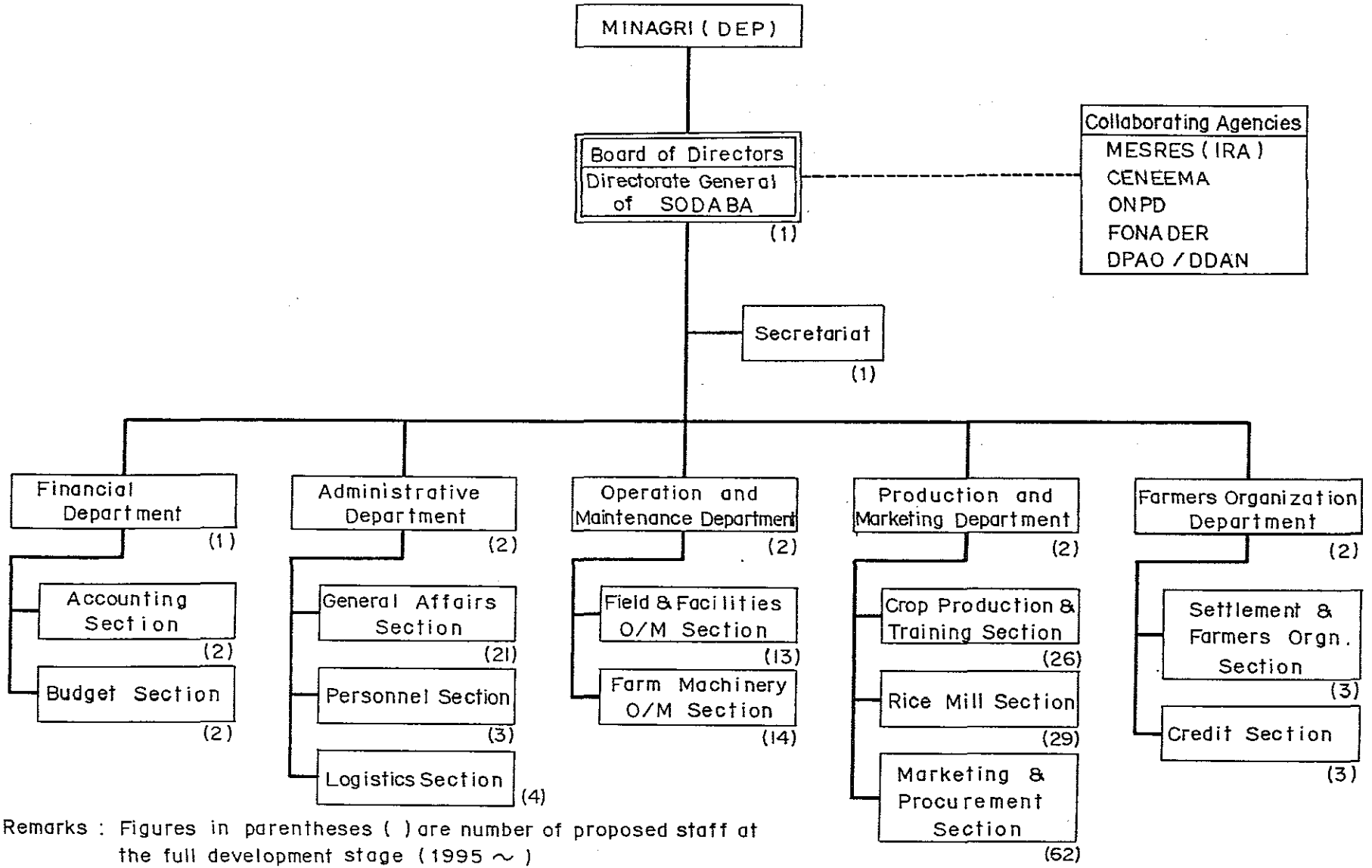
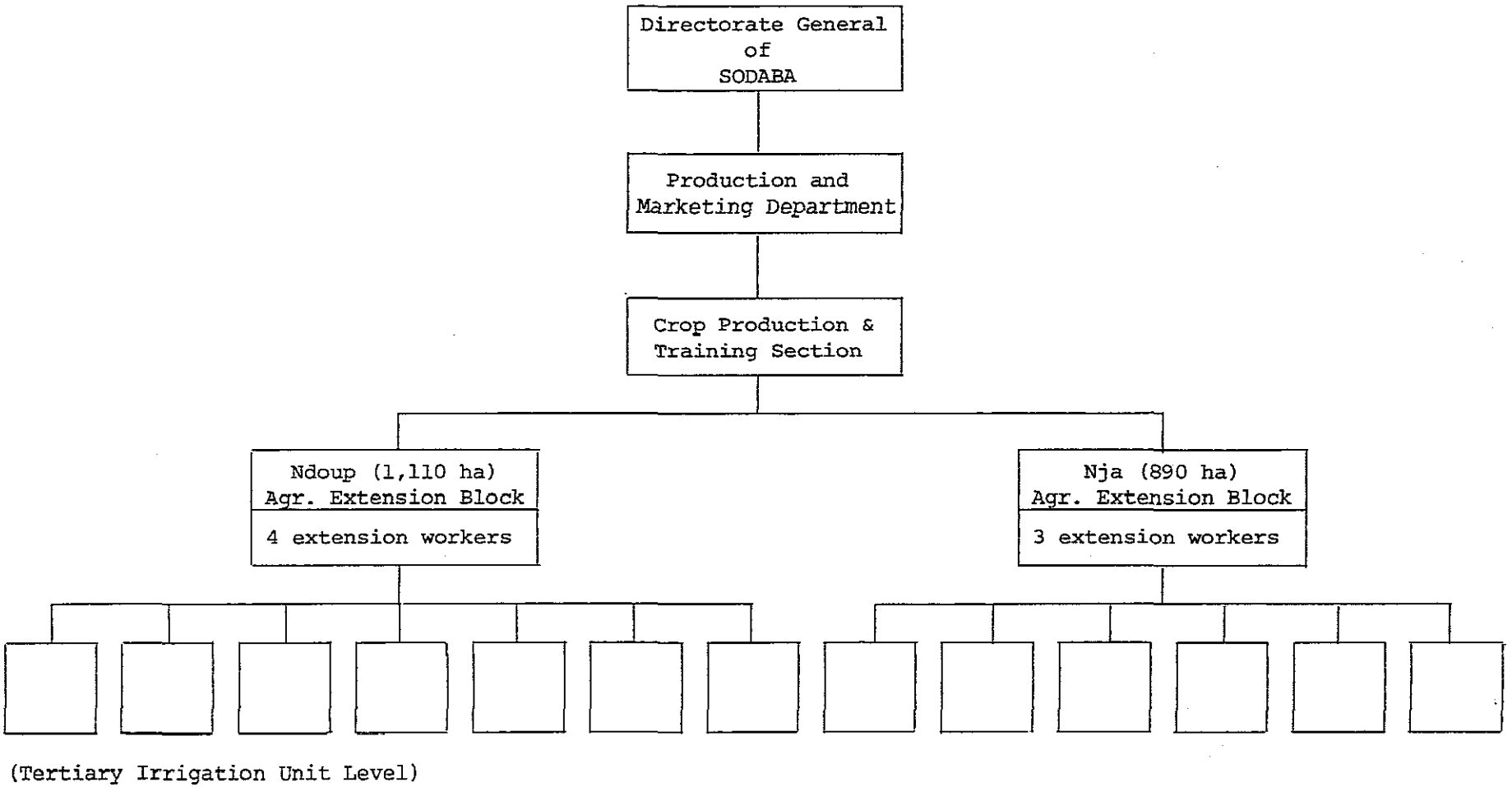


Fig. 8.2 PROPOSED ORGANIZATION FOR OPERATION AND MAINTENANCE



Remarks : Figures in parentheses ( ) are number of proposed staff at the full development stage (1995 ~)

Fig. 8.3 PROPOSED ORGANIZATION STRUCTURE OF THE AGRICULTURAL EXTENSION SYSTEM



ANNEX IX

CONSTRUCTION PLAN AND COST ESTIMATE

ANNEX IX

CONSTRUCTION PLAN AND COST ESTIMATE

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CHAPTER 1 CONSTRUCTION PLAN

1.1 General

Construction works of the Project consist of new construction of the Ndoup and Nja storage dams, irrigation and drainage canal systems, farm road networks and on-farm facilities. As these construction works are mainly concerned with earth works, due attention should be paid to the characteristics of earth materials which directly affect earth moving plan, selection of construction equipment, etc.

Major construction works having a large amount of earth volume would be executed by heavy construction equipment but the remaining minor works would be implemented by manpower to increase employment opportunities for tne local people in and around the project area. Earth works consist or excavation, loading, hauling, spreading and compacting. The following equipments would be basically introduced on these earth works:

Earth Works	Earth Materials	Proposed Equipments
Excavation	Normal soil, gravel	Bull-dozer, Back-hoe Shovel
	Weathered rock, rock	Blasting & Bull-dozer, Ripper-dozer
Loading	Any kind of materials	Back-hoe Shovel, Tractor Shovel
Hauling	Any kind of materials	Dump Truck
Spreading	Any kind of materials	Bull-dozer
Compacting	Impervious materials Coarse materials Normal soil	Tamping Roller Vibrating Roller Compactor, Tamper

Earth works are mostly governed by rainfall. Since embankment of impervious materials are controlled by moisture density, special attention must be paid to execute the construction works for rainy days. The annual workable days were estimated to be 213 days for earth works and 264 days for concrete works based on the daily rainfall records at the Koundja meteorological station for recent 9 years.

1.2 Dam Works

Prior to the excavation of dam foundation, diversion structures should be constructed to prevent from flood during the dam construction. After diverting the river flow, excavation of dam foundation would be started. Most of the embankment materials of the dams would be obtained from the dam sites, but drain materials should be purchased since they can not be found around the dam sites. The embankment materials would be spread by bull-dozer and compacted by tamping roller and vibrating roller.

Excavation of spillway would be executed in parallel with the dam embankment, because the useful excavated materials are planned to haul directly to the dam. Concrete works would be carried out after completion of the excavation. The diversion structures would be utilized as the outlet conduit of the intake structures after completion of the dam embankment.

1.3 Irrigation and Drainage Works

The drainage works would be commenced from the downstream of the Nkoup river. The excavation works would be made mainly by swamp bull-dozer and back-hoe shovel, and the excavated materials would be used for embankment of the farm roads and for reclamation of farm lands. The basaltic shelf on the Nkoup river would be removed by use of dynamites and some of them would be used as the riprap materials of the Ndoup and Nja dams. The irrigation works would be implemented according to the progress of the drainage works. The farm road works would be executed using the excavated materials of canals in parallel with the irrigation and drainage works. Concrete works for structures related to the irrigation and drainage canals would be carried out mainly by manpower using concrete mixers.

1.4 On-Farm Works

Cutting of trees would be made by chain-saw and grabbing be executed by swamp rake-dozer. Levelling of farm lands would be made by swamp bull-dozer. Construction of on-farm facilities such as tertiary canals, farm ditches and their related structures would be carried out mainly by manpower due to minor works.

1.5 Implementation Schedule

The implementation period of the Project was assumed to be 6 years from 1987 to 1992 as shown in Fig. 9.1. The detailed design would be carried out in 1987 and actual construction works would be commenced in 1988 and continued for five years until 1992. Considering the present swampy condition of the area, firstly the drainage works would be required and implemented for about 3 months from 1988 to 1990. Dam construction works including the diversion structure, excavation and embankment, spillway and outlet structure, would need about 3.5 years in all. The irrigation works would be executed for about 2.5 years from 1989 to 1991 according to the progress of the drainage works.

CHAPTER 2 COST ESTIMATE

2.1 General

The project cost comprises the direct construction cost, initial farm investment, administration cost, engineering cost, physical contingency and price contingency.

The following considerations were taken into account for the cost estimate of the project:

(1) The exchange rate used in the estimate was US$1.0 = CFA F 384.5 = ¥203.0 as of December, 1985.

(2) The construction works would be executed on a contract basis. The construction machinery and equipment required for the construction works would be provided by the contractors themselves. Therefore, depreciation costs of machinery and equipment were included in the construction unit costs.

(3) The construction cost consists of foreign currency and local currency portions. The local currency portion was estimated on the basis of the current prices in Cameroon in December 1985 and the foreign currency portion was estimated on the CIF prices at Douala.

(4) The physical contingency related to the construction quantities was set at 10% of the direct cost. The price contingency was assumed to be 12% for the local currency portion and 3% for the foreign currency portion, respectively.

2.2 Project Cost

The project cost was estimated at CFA F 15,533 million comprising CFA F 7,090 million of foreign currency and CFA F 8,443 million of local currency as shown in Table 9.1.

The direct construction cost was estimated for the individual work items by unit cost basis. The summary and breakdown are shown in Tables 9.2 and 9.3. The unit costs of labours and materials are shown in Tables 9.4 and 9.5.

The initial farm investment consists of rice-mill, buying center, warehouse and office required for the Project and the breakdown is shown in Table 9.6. The administration cost comprises staff salaries and direct cost such as office expenses equipment running cost, etc. as shown in Tables 9.7 and 9.8. Engineering services by consultants would be required for the detailed design and construction supervision stages of the Project. Table 9.9 shows the breakdown of the engineering cost and the required man-month of consultant engineers is shown in Table 9.10.

2.3 Annual Disbursement Schedule

The annual disbursement schedule was worked out as shown in Table 9.11 based on the construction time schedule and the summary is as follows:

(Unit: CFA F 10^6)

Financial Year	Foreign Currency	Local Currency	Total
1987	444	175	619
1988	1,053	1,253	2,306
1989	1,861	2,000	3,861
1990	1,476	1,829	3,305
1991	1,249	1,692	2,941
1992	1,007	1,494	2,501
Total	7,090	8,443	15,533

2.4 Annual Operation and Maintenance Cost

The operation and maintenance cost covers the salaries of administrative and technical staff, the material and labor costs for repair and maintenance of project facilities, the costs for operation and maintenance of rice-mill. The operation and maintenance cost annually required for the Project was estimated at CFA F 362.9 million as shown below:

(Unit: CFA F 10^6)

Item	Cost
1. Personal Expenses	272.5
2. Direct Cost	54.5
3. Rice-mill Operation Cost	35.9
Total	362.9

2.5 Replacement Cost

Some of the facilities installed or constructed in the Project have some shorter useful life than the project life of 50 years, and would require replacement within the project useful life. The replacement costs of steel gates, stoplogs and rice-mill were estimated as follows:

(Unit: CFA F 10^6)

Item	Useful Life	Replacement Cost
1. Steel Gates	25 years	153.00
2. Stop-logs	10 years	0.24
3. Rice-mill Equipment	10 years	228.12

Table 9.1 PROJECT COST

(Unit: CFA F 10^6)

Item	Local Currency	Foreign Currency	Total
1. Direct Construction Cost	3,293	4,135	7,428
1-1. Storage Dam Works	1,345	1,396	2,741
1-2. Irrigation Works	70	73	143
1-3. Drainage Works	694	1,248	1,942
1-4. Farm Road Works	344	505	849
1-5. On-Farm Works	840	913	1,753
2. Initial Farm Investment	408	475	883
2-1. Rice-Mill	38	228	266
2-2. Buying Center	184	123	307
2-3. Warehouse	33	22	55
2-4. Office	153	102	255
3. Administration Cost	596	-	596
4. Engineering Cost	133	1,002	1,135
Sub-total	4,430	5,612	10,042
5. Physical Contingency	443	561	1,004
Total	4,873	6,173	11,046
6. Price Contingency	3,570	917	4,487
Grand Total	8,443	7,090	15,533

(US$1.0 = CFA F384.5 = ¥203.0)

Table 9.2 DIRECT CONSTRUCTION COST

(Unit: CFA F 10^3)

Work Item	Local Currency	Foreign Currency	Total
1. Storage Dam Works			
1-1. Ndoup Dam	573,722	636,959	1,210,681
1-2. Nja Dam	771,363	758,722	1,530,085
Sub-total	1,345,085	1,395,681	2,740,766
2. Irrigation Works			
2-1. Ndoup Intake Weir	18,191	18,483	36,674
2-2. Ndoup Irrigation Canals	37,612	23,075	60,687
2-3. Nja Irrigation Canals	13,886	31,186	45,072
Sub-total	69,689	72,744	142,433
3. Drainage Works			
3-1. Nkoup Drainage Canals	298,096	775,840	1,073,936
3-2. Ndoup Drainage Canals	204,769	202,842	407,611
3-3. Nja Drainage Canals	156,116	215,356	371,472
3-4. Catch Drains	35,170	54,452	89,622
Sub-total	694,151	1,248,490	1,942,641
4. Farm Road Works			
4-1. Main Farm Roads	81,648	114,733	196,381
4-2. Inspection Roads	262,763	389,875	652,638
Sub-total	344,411	504,608	849,019
5. On-Farm Works	840,224	912,947	1,753,171
Total	3,293,560	4,134,470	7,428,030

¥3,922,000,000

$19,320,200

$9,600/ha

Table 9.3 (1/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
1. Dam Works							
1-1 Ndoup Dam							
1) Preparation	L.S.			22,134,000		24,574,000	46,708,000
2) Dam							
a) Excavation of Dam Foundation							
i) Stripping	m^3	13,500	266	3,591,000	812	10,962,000	14,553,000
ii) Normal Soil	"	44,200	229	10,121,800	697	30,807,400	40,929,200
iii) Gravel	"	11,100	368	4,084,800	1,133	12,576,300	16,661,100
b) Excavation of Borrow-pit &							
Quarry							
i) Clayey Soil	m^3	185,700	138	25,626,600	483	89,693,100	115,319,700
ii) Rock Blasting	"	4,200	117	491,400	443	1,860,600	2,352,000
c) Transportation							
i) Zone I & II	m^3	185,700	107	19,869,900	278	51,624,600	71,494,500
ii) Riprap	"	4,200	113	474,600	293	1,230,600	1,705,200
iii) Drain	"	9,100	8,300	75,530,000	-	-	75,530,000
d) Embankment							
i) Spreading & Compacting, Zone I	m^3	45,300	81	3,669,300	202	9,150,600	12,819,900

Table 9.3 (2/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
ii) Spreading & Compacting,ZoneII	m^3	123,500	81	10,003,500	202	24,947,000	34,950,500
iii) " Drain	"	8,300	355	2,946,500	31	257,300	3,203,800
iv) " Riprap	"	3,800	84	319,200	211	801,800	1,121,000
Sub-total				156,728,600		233,911,300	390,639,900
3) Spillway							
i) Excavation, Normal Soil	m^3	36,900	178	6,568,200	538	19,852,200	26,420,400
ii) Back filling	"	6,700	345	2,311,500	-	-	2,311,500
iii) Concrete	"	3,760	30,730	115,544,800	11,060	41,585,600	157,130,400
iv) Form	m^2	4,700	5,170	24,299,000	80	376,000	24,675,000
v) Reinforcement Bar	ton	132.4	49,150	6,507,460	124,480	16,481,152	22,988,612
Sub-total				155,230,960		78,294,952	233,525,912
4) Diversion Structure							
i) Excavation, Normal Soil	m^3	2,800	178	498,400	538	1,506,400	2,004,800
ii) Concrete	"	1,720	30,730	52,855,600	11,060	19,023,200	71,878,800
iii) Form	m^2	1,180	5,170	6,100,600	80	94,400	6,195,000
iv) Reinforcement Bar	ton	77.4	49,150	3,804,210	124,480	9,634,752	13,438,962

Table 9.3 (3/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
Sub-total				63,258,810		30,258,752	93,517,562
5) Outlet Works							
i) Concrete	m^3	140	30,730	4,302,200	11,060	1,548,400	5,850,600
ii) Form	m^2	400	5,170	2,068,000	80	32,000	2,100,000
iii) Reinforcement Bar	ton	6.4	49,150	314,560	124,480	796,672	1,111,232
iv) Screen	"	0.4	212,000	84,800	848,000	339,200	424,000
v) Steel Pipe ø800	"	131.1	185,400	24,305,940	741,600	97,223,760	121,529,700
vi) Regulating Valve ø500	nos.	1	5,682,000	5,682,000	22,728,000	22,728,000	28,410,000
vii) Plain Concrete	m^3	340	28,325	9,630,500	8,658	2,943,720	12,574,220
Sub-total				46,388,000		125,611,752	171,999,752
6) Others (2+3+4+5) x 5%	L.S			21,080,320		123,403,840	44,484,160
7) Temporary Works (2+3+4+5+6) x 3%	L.S			13,280,600		14,744,420	28,025,020
8) Overhead (1+2+3+4+5+6+7) x 20%	L.S			95,620,710		106,159,984	201,780,694
Total				573,722,000		636,959,000	1,210,681,000

Table 9.3 (4/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
1-2 Nja Dam							
1) Preparation	L.S.			29,759,000		29,272,000	59,031,000
2) Dam							
a) Excavation of Dam Foundation							
i) Stripping	m^3	12,100	266	3,218,600	812	9,825,200	13,043,800
ii) Normal Soil	"	41,300	229	9,457,700	697	28,786,100	38,243,800
iii) Gravel	"	10,300	368	3,790,400	1,133	11,669,900	15,460,300
b) Excavation of Borrow-pit &							
Quarry							
i) Clayey Soil	m^3	247,400	138	34,141,200	483	119,494,200	153,635,400
ii) Rock Blasting	"	5,200	117	608,400	443	2,303,600	2,912,000
c) Transportation							
i) Zone I & II	m^3	247,400	107	26,471,800	278	68,777,200	95,249,000
ii) Riprap	"	5,200	113	587,600	293	1,523,600	2,111,200
iii) Drain	"	17,600	8,300	146,080,000	-	-	146,080,000
d) Embankment							
i) Spreading & Compacting,Zone I	m^3	46,300	81	3,750,300	202	9,352,600	13,102,900
ii) " ZoneII	"	178,600	81	14,466,600	202	36,077,200	50,543,800
iii) " Drain	"	16,000	355	5,680,000	31	496,000	6,176,000

Table 9.3 (5/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
iv) Spreading & Compacting,Riprap	m^3	4,700	84	394,800	211	991,700	1,386,500
Sub-total				248,647,400		289,297,300	537,944,700
3) Spillway							
i) Excavation, Normal Soil	m^3	63,800	178	11,356,400	538	34,324,400	45,680,800
ii) Back Filling	"	9,700	345	3,346,500	-	-	3,346,500
iii) Concrete	"	5,030	30,730	154,571,900	11,060	55,631,800	210,203,700
iv) Farm	m^2	5,920	5,170	30,606,400	80	473,600	31,080,000
v) Reinforcement Bar	ton	176.4	49,150	8,670,060	124,480	21,958,272	30,628,332
Sub-total				208,551,260		112,388,072	320,939,332
4) Diversion Structure							
i) Excavation, Normal Soil	m^3	2,800	178	498,400	538	1,506,400	2,004,800
ii) Concrete	"	1,720	30,730	52,855,600	11,060	19,023,200	71,878,800
iii) Farm	m^2	1,180	5,170	6,100,600	80	94,400	6,195,000
iv) Reinforcement Bar	ton	77.4	49,150	3,804,210	124,480	9,634,752	13,438,962
Sub-total				63,258,810		30,258,752	93,517,562

Table 9.3 (6/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
5) Outlet Works							
i) Concrete	m^3	140	30,730	4,302,200	11,060	1,548,400	5,850,600
ii) Form	m^2	400	5,170	2,068,000	80	32,000	2,100,000
iii) Reinforcement Bar	ton	6.4	49,150	314,560	124,480	796,672	1,111,232
iv) Screen	"	0.4	212,000	84,800	848,000	339,200	424,000
v) Steel Pipe ø800	"	131.1	185,400	24,305,940	741,600	97,223,760	121,529,700
vi) Regulating Valve ø500	nos.	1	5,682,000	5,682,000	22,728,000	22,728,000	28,410,000
vii) Plain concrete	m^3	340	28,325	9,630,500	8,658	2,943,720	12,574,220
Sub-total				46,388,000		125,611,752	171,999,752
6) Others (2+3+4+5) x 5%	L.S			28,342,270		27,877,790	56,220,060
7) Temporary Works (2+3+4+5+6) x 3%	L.S			17,855,630		17,563,010	35,418,640
8) Overhead (1+2+3+4+5+6+7) x 20%	L.S			128,560,630		126,453,324	255,013,954
Total				771,363,000		758,722,000	1,530,085,000
Grand Total of Dam Works				1,345,085,000		1,395,681,000	2,740,766,000

Table 9.3 (7/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
2. Irrigation Works							
2-1 Ndoup Intake Weir							
1) Preparation	L.S			702,000		713,000	1,415,000
2) Earth Works							
i) Excavation of Soil	m^3	500	76	38,000	286	143,000	181,000
ii) Back Filling	"	91	345	31,395	-	-	31,395
iii) Wooden Pile	"	3.2	140,000	448,000	-	-	448,000
Sub-total				517,395		143,000	660,395
3) Concrete Works							
i) Concrete	m^3	330	30,730	10,140,900	11,060	3,649,800	13,790,700
ii) Form	m^2	430	5,170	2,223,100	80	34,400	2,257,500
iii) Reinforcement Bar	ton	9.9	49,150	486,585	124,480	1,232,352	1,718,937
Sub-total				12,850,585		4,916,552	17,767,137

Table 9.3 (8/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
4) Metal Works							
i) Slide Gate	nos.	3	-	-	2,841,000	8,523,000	8,523,000
5) Others (2+3+4) x 5%	L.S			668,400		679,130	1,347,530
6) Temporary Works (2+3+4+5) x 3%	L.S			421,090		427,850	848,940
7) Overhead (1+2+3+4+5+6) x 20%	L.S			3,031,530		3,080,468	6,111,998
Total				18,191,000		18,483,000	36,674,000
2-2 Ndoup Irrigation Canals							
1) Preparation	L.S			1,451,000		890,000	2,341,000
2) Earth Works							
i) Stripping	m^3	6,980	70	488,600	208	1,451,840	1,940,440
ii) Excavation of Crayey Soil	"	17,720	76	1,346,720	286	5,067,920	6,414,640
iii) Embankment	"	50,450	345	17,405,250	-	-	17,405,250

Table 9.3 (9/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
Sub-total				19,240,570		6,519,760	25,760,330
3) Related Structurers							
i) Turnout Type A	nos.	1	311,930	311,930	775,580	775,580	1,087,510
" B	"	5	252,660	1,263,300	628,220	3,141,100	4,404,400
" C	"	2	124,770	249,540	310,230	620,460	870,000
ii) Vertical Drop Type A	"	1	710,400	710,400	181,420	891,420	891,820
" B	"	2	1,014,860	2,029,720	259,170	518,340	2,548,060
iii) Pipe Culvent Type A	"	2	517,900	1,035,800	171,330	324,660	1,378,460
" B	"	1	243,410	243,410	80,530	80,530	323,940
iv) Checkgate Type A	"	1	523,830	523,830	1,506,320	1,506,320	2,030,150
" B	"	2	272,390	544,780	783,290	1,566,580	2,111,360
" C	"	3	110,000	330,000	316,330	948,990	1,278,990
" D	"	2	57,620	115,240	165,690	331,380	446,620
v) Spillway Type A	"	1	532,230	532,230	199,780	199,780	732,010
" B	"	2	245,310	508,620	112,020	224,040	732,660
Sub-total				8,398,800		10,437,180	18,835,980
4) Others (2+3) x 5%	L.S			1,381,970		847,850	2,229,820

Table 9.3 (10/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
5) Temporary Works (2+3+4) x 3%	L.S			870,640		534,140	1,404,780
6) Overhead (1+2+3+4+5) x 20%	L.S			6,269,020		3,846,070	10,115,090
Total				37,612,000		23,075,000	60,687,000
2-3 Nja Irrigation Canals							
1) Preparation	L.S			536,000		1,203,000	1,739,000
2) Earth Works							
i) Stripping	m^3	8,050	70	563,500	208	1,674,400	2,237,900
ii) Excavation of Clayey Soil	"	35,190	76	2,674,440	286	10,064,340	12,738,780
iii) Transportation (ℓ=500m)	"	13,000	96	1,248,000	247	3,211,000	4,459,000
iv) Embankment	"	4,680	345	1,614,600	-	-	1,614,600
Sub-total				6,100,540		14,949,740	21,050,280
3) Related Structures							
i) Turnout Type A	nos.	1	311,930	311,930	775,580	775,580	1,087,510

Table 9.3 (11/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
Turnour Type B	nos.	4	252,660	1,010,640	628,220	2,512,880	3,523,520
" C	"	1	124,770	124,770	310,230	310,230	435,000
iii) Checkgate Type A	"	1	523,830	523,830	1,506,320	1,506,320	2,030,150
" B	"	1	272,390	272,390	783,290	783,290	1,055,680
" C	"	4	110,000	440,000	316,330	1,265,320	1,705,320
" D	"	2	57,620	115,240	165,690	331,380	446,620
iv) Spillway Type A	"	1	532,230	532,230	199,780	199,780	732,010
" B	"	1	254,310	254,310	112,020	112,020	366,330
Sub-total				3,584,340		7,796,800	11,382,140
4) Others (2+3) x 5%	L.S			484,300		1,137,330	1,621,630
5) Temporary Works (2+3+4)	L.S			305,110		716,520	1,021,630
6) Overhead (1+2+3+4+5) x 20%	L.S			2,202,710		5,160,610	7,363,320
Total				13,214,000		30,964,000	44,178,000
Grand Total of Irrigation Works				69,017,000		72,522,000	141,539,000

Table 9.3 (12/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
3. Drainage Works							
3-1 Nkoup Drainage Canals							
1) Preparation	L.S			11,501,000		29,932,000	41,433,000
2) Earth Works							
i) Stripping	m^3	9,510	70	665,700	208	1,978,080	2,643,780
ii) Excavation of Clayey Soil	"	292,370	76	22,220,120	286	83,617,820	105,837,940
iii) Transportation (ℓ=500m)	"	280,380	96	26,916,480	247	69,253,860	96,170,340
iv) Excavation of Rock	"	30,340	2,270	68,871,800	9,090	275,790,600	344,662,400
v) Transportation (ℓ=1,000m)	"	30,340	135	4,095,900	349	10,588,660	14,684,560
vii) Embankment	"	8,700	345	3,001,500	-	-	3,001,500
Sub-total				125,771,500		441,229,020	567,000,520
3) Related Structures							
i) Drainage Inlet Type A	nos.	6	315,330	1,891,980	278,860	1,673,160	3,565,140
" B	"	5	570,990	2,854,950	504,960	2,524,800	5,379,750
" C	"	4	852,230	3,408,920	753,670	3,014,680	6,423,600
" D	"	2	2,164,420	4,328,840	513,410	1,026,820	5,355,660

Table 9.3 (13/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
ii) Inclined Drop Type A	nos.	1	13,919,970	13,919,970	5,524,010	5,524,010	19,443,980
iii) Box Culvert Type A	"	1	21,753,400	21,753,400	8,721,090	8,721,090	30,474,490
" C	"	2	9,098,120	18,196,240	3,270,620	6,541,240	24,737,480
iv) Drainage Junction, Gabion	m^2	892	340	303,280	2,650	2,363,800	2,667,080
Sub-total				66,657,580		31,389,600	98,047,180
4) Regulating Gates							
i) Excavation, Common	m^3	68	76	5,168	286	19,448	24,616
ii) " Rock	"	158	2,270	358,660	9,090	1,436,220	1,794,880
iii) Back Filling	"	418	345	144,210	-	-	144,210
iv) Plain Concrete	"	40	28,325	1,133,000	8,658	346,320	1,479,320
v) Reinforced Concrete	"	603	30,730	18,530,190	11,060	6,669,180	25,199,370
vi) Form	m^2	1,016	5,170	5,252,720	80	81,280	5,344,000
vii) Reinforcement Bar	ton	24.12	49,150	1,185,498	124,480	3,002,458	4,187,956
viii) Gabion	m^2	61	340	20,740	2,650	161,650	182,390
ix) Roller Gate (W3.0m x H2.5m)	nos.	3	-	-	28,600,000	85,800,000	85,800,000
Sub-total				26,630,186		97,516,556	124,146,742

Table 9.3 (14/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
5) Others (2+3+4) x 5%	L.S			10,952,960		28,506,760	39,459,720
6) Temporary Works (2+3+4+5) x 3%	L.S			6,900,370		17,959,260	24,859,630
7) Overhead (1+2+3+4+5+6) x 20%	L.S			49,682,404		129,306,804	178,989,208
Total				298,096,000		775,840,000	1,073,936,000
3-2 Ndoup Drainage Canals							
1) Preparation	L.S			7,900,000		7,826,000	15,726,000
2) Earth Works							
i) Stripping	m^3	6,510	70	455,700	208	1,354,080	1,809,780
ii) Excavation of Clayey Soil	"	210,200	76	15,975,200	286	60,117,200	76,092,400
iii) Transportation (ℓ=500m)	"	162,350	96	15,585,600	247	40,100,450	55,686,050
iv) Embankment	"	6,590	345	2,273,550	-	-	2,273,550
Sub-total				34,290,050		101,571,730	135,861,780

Table 9.3 (15/22) *BREAKDOWN OF DIRECT CONSTRUCTION COST*

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
3) Related Structures							
i) Drainage Inlet Type A	nos.	3	315,330	945,990	278,860	836,580	1,782,570
" B	"	2	570,990	1,141,980	504,960	1,009,920	2,151,900
" C	"	2	852,230	1,704,460	753,670	1,507,340	3,211,800
ii) Inclined Drop Type B	"	11	5,846,390	64,310,290	2,320,080	25,520,880	89,831,170
iii) Box Culvert Type B	"	3	16,028,000	48,084,000	6,204,770	18,614,310	66,698,310
Sub-total				116,186,720		47,489,030	163,675,750
4) Others (2+3) x 5%	L.S			7,523,840		7,453,040	14,976,880
5) Temporary Works (2+3+4) x 3%	L.S			4,740,020		4,695,400	9,435,420
6) Overhead (1+2+3+4+5) x 20%	L.S			34,128,340		33,806,800	67,935,140
Total				204,769,000		202,842,000	407,611,000
3-3 Nja Drainage Canals							
1) Preparation	L.S			6,023,000		8,308,000	14,331,000

Table 9.3 (16/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
2) Earth Works							
i) Stripping	m^3	5,890	70	412,300	208	1,225,120	1,637,420
ii) Excavation of Clayey Soil	"	218,600	76	16,613,600	286	62,519,600	79,133,200
iii) Transportation (ℓ=500m)	"	204,384	96	19,620,864	247	50,482,848	70,103,712
iv) Embankment	"	9,190	345	3,170,550	-	-	3,170,550
Sub-total				39,817,314		114,227,568	154,044,882
3) Related Structures							
i) Drainage Inlet Type A	nos.	15	315,330	4,729,950	278,860	4,182,900	8,912,850
" B	"	2	570,990	1,141,980	504,960	1,009,920	2,151,900
" C	"	1	852,230	852,230	753,670	753,670	1,605,900
ii) Inclined Drop Type B	"	3	5,846,390	17,539,170	2,320,080	6,960,240	24,499,410
iii) Box Culvert Type B	"	2	16,028,000	32,056,000	6,204,770	12,409,540	44,465,540
Sub-total				56,319,330		25,316,270	81,635,600
4) Waste Way							
i) Stripping	m^3	1,082	70	75,740	208	225,056	300,796
ii) Excavation	"	39,709	76	3,017,884	286	11,356,774	14,374,658

Table 9.3 (17/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
iii) Back Filling	m^3	2,207	345	761,415	-	-	761,415
iv) Transportation (ℓ=500m)	"	9,137	96	877,152	247	2,256,839	3,133,991
v) Plain Concrete	"	20	28,325	566,500	8,658	173,160	739,660
vi) Reinforced Concrete	"	221	30,730	6,791,330	11,060	2,444,260	9,235,590
vii) Form	m^2	1,104	5,170	5,707,680	80	88,320	5,796,000
viii) Reinforcement Bar	ton	15.4	49,150	756,910	124,480	1,916,992	2,673,902
ix) Gabion	m^2	95	340	32,300	2,650	251,750	284,050
Sub-total				18,586,911		18,713,151	37,300,062
5) Others (2+3+4) x 5%	L.S			5,736,180		7,912,850	13,649,030
6) Temporary Works (2+3+4+5) x 3%	L.S			3,613,790		4,985,100	8,598,890
7) Overhead (1+2+3+4+5+6) x 20%	L.S			26,019,475		35,893,061	61,912,536
Total				156,116,000		215,356,000	371,472,000

Table 9.3 (18/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
3-4 Catch Drains							
1) Preparation	L.S			1,357,000		2,101,000	3,458,000
2) Earth Works							
i) Stripping	m^3	9,270	70	648,900	208	1,928,160	2,577,060
ii) Excavation of Clayey Soil	"	45,720	76	3,474,720	286	13,075,920	16,550,640
iii) Transportation (ℓ=500m)	"	45,720	96	4,389,120	247	11,292,840	15,681,960
Sub-total				8,512,740		26,296,920	34,809,660
3) Related Structures							
i) Cross Drain Type A1	nos.	1	1,056,780	1,056,780	597,450	597,450	1,654,230
" A2	"	14	538,900	7,544,600	426,520	5,971,280	13,515,880
" B	"	5	975,840	4,879,200	772,340	3,861,700	8,740,900
" C	"	3	1,456,480	4,369,440	1,152,740	3,458,220	7,827,660
Sub-total				17,850,020		888,650	738,670
4) Others (2+3) x 5%	L.S			1,318,190		2,009,270	3,327,410

Table 9.3 (19/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
5) Temporary Works (2+3+4) x 3%	L.S			830,420		1,265,840	2,096,260
6) Overhead (1+2+3+4+5) x 20%	"			5,973,690		9,112,320	15,086,010
Total				35,842,000		54,674,000	90,516,000
Grand Total of Drainage Works				694,823,000		1,248,712,000	1,943,535,000

Table 9.3 (20/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
4. Farm Road Works							
4-1 Main Farm Roads							
1) Preparation	L.S			3,150,000		4,426,000	7,576,000
2) Earth Works							
i) Stripping	m^3	8,690	70	608,300	208	1,807,520	2,415,820
ii) Embankment	"	54,150	345	18,681,750	-	-	18,681,750
iii) Gravel Pavement	m^2	54,280	750	40,710,000	1,520	82,505,600	123,215,600
Sub-total				60,000,050		84,313,120	144,313,170
3) Others (2) x 5%	L.S			3,000,000		4,215,660	7,215,660
4) Temporary Works (2+3) x 3%	L.S			1,890,000		2,655,860	4,545,860
5) Overhead (1+2+3+4) x 20%	L.S			13,607,950		19,122,360	32,730,310
Total				81,648,000		114,733,000	196,381,000

Table 9.3 (21/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
4-2 Inspection Roads							
1) Preparation	L.S			10,137,000		15,041,000	25,178,000
2) Earth Works							
i) Stripping	m^3	28,280	70	1,979,600	208	5,882,240	7,861,840
ii) Embankment	"	152,610	345	52,650,450	-	-	52,650,450
iii) Gravel Pavement	m^2	184,620	750	138,465,000	1,520	280,622,400	419,087,400
Sub-total				193,095,050		286,504,640	479,599,690
3) Others (2) x 5%	L.S			9,654,750		14,325,230	23,979,980
4) Temporary Works (2+3) x 3%	L.S			6,082,490		9,024,900	15,107,390
5) Overhead (1+2+3+4) x 20%	L.S			43,793,710		64,979,230	108,772,940
Total				262,763,000		389,875,000	652,638,000
Grand Total of Farm Road Works				344,411,000		504,608,000	849,019,000

Table 9.3 (22/22) BREAKDOWN OF DIRECT CONSTRUCTION COST

(Unit: CFA F)

Works	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
5. On-Farm Works							
1) Preparation	L.S			32,416,000		35,222,000	67,638,000
2) On-Farm Works							
Type A	ha	1,700	266,420	452,914,000	303,630	516,171,000	969,085,000
" B	"	300	548,450	164,535,000	515,730	154,719,000	319,254,000
Sub-total				617,449,000		670,890,000	1,288,339,000
3) Others (2) x 5%	L.S			30,872,450		33,544,500	64,416,950
4) Temporary Works (2+3) x 3%	L.S			19,449,640		21,133,040	40,582,680
5) Overhead (1+2+3+4) x 20%	L.S			140,036,910		152,157,460	292,194,370
Total				840,224,000		912,947,000	1,753,171,000

Table 9.4 UNIT COST OF LABOUR

No.	Item	Unit	Cost (CFA F)	Unit	Cost (CFA F)	Category
1	Common Labourer	m.d	1 760	hr	220.0	II.D
2	Earth Worker	m.d	1 650	hr	206.3	I.D
3	Concrete Worker	m.d	2 030	hr	253.8	III.D
4	Rein Forcement Worker	m.d	2 030	hr	253.8	III.D
5	Structural Steel Worker	m.d	2 030	hr	253.8	III.D
6	Carpenter	m.d	2 910	hr	263.8	IV.D
7	Rigger	m.d	2 910	hr	363.8	IV.D
8	Painter	m.d	2 030	hr	253.8	III.D
9	Plasterer	m.d	2 030	hr	253.8	III.D
10	Glass Worker	m.d	1 760	hr	220.0	II.D
11	Plumbing Worker	m.d	2 910	hr	363.8	IV.D
12	Electrician	m.d	4 100	hr	512.5	V.D
13	Mechanical Worker	m.d	4 100	hr	512.5	V.D
14	Welder	m.d	2 910	hr	363.8	IV.D
15	Foreman General	m.d	4 100	hr	512.5	V.D
16	Operator (Heavy Equipment)	m.d	5 260	hr	675.5	VI.D
17	Driver (Lisht Equip-ment)	m.d	4 100	hr	512.5	V.D
18	Driver (General)	m.d	2 030	hr	253.8	III.D
19	Driller	m.d	2 910	hr	363.8	IV.D
20	Blaster	m.d	4 100	hr	512.5	V.D

Table 9.5 UNIT COST OF MATERIAL

(Unit: CFA F)

Item		Local Currency	Foreign Currency	Total
1. Fuel & Oil				
a) Gasoline	ℓ	132	33	165
b) Diesel oil	"	112	28	140
c) Kerosine	"	64	16	80
d) Engine oil	"	85	21	106
e) Gear oil	"	99	25	124
2. Aggregate				
a) Sand	m^3	8,300	-	8,300
b) Gravel	"	10,800	1,200	12,000
3. Wood				
a) Square lumber	m^3	70,000	-	70,000
b) Plank	"	77,000	-	77,000
c) Playwood	"	110,000	-	110,000
4. Cement	ton	21,000	21,000	42,000
5. Reinforcement bar	"	-	319,000	319,000
6. Structural steel	"	-	530,000	530,000
7. Asbestos cement board				
a) Plate	m^2	-	2,000	2,000
b) Corrugated	"	-	3,000	3,000
8. Galvanized iron sheet				
a) Plate	m^2	-	3,000	3,000
b) Corrugated	"	-	4,500	4,500
9. Blasting				
a) Dynamite	Kg	-	1,700	1,700
b) ANFO	"	-	720	720
10. Drilling				
a) Rod d22	pc	-	13,800	13,800
b) Bit	"	-	8,100	8,100

Table 9.6 INITIAL FARM INVESTMENT

(Unit: CFA F 10^3)

Description	Local Currency	Foreign Currency	Total
1. Rice-Mill			
(1) Equipment	14,980	213,140	228,120
(2) Building ($320\ m^2$)	22,730	15,150	37,880
2. Buying Center ($2,700\ m^2$)	184,090	122,730	306,820
3. Warehouse ($500\ m^2$)	32,950	21,970	54,920
4. Office ($1,500\ m^2$)	153,410	102,270	255,680
Total	408,160	475,260	833,420

Table 9.7 ADMINISTRATION COST

(Unit: CFA F 10^3)

Description	Local Currency	Foreign Currency	Total
1. Detailed Design Stage			
1-1. Staff Salaries	53,706	-	53,706
2-2. Direct Costs	16,112	-	16,112
Total	69,818	-	69,818
2. Construction Stage			
2-1. Staff Salaries	404,660	-	404,660
2-2. Direct Costs	121,398	-	121,398
Total	526,058	-	526,058
Grand Total	595,876	-	595,876

Table 9.8 REQUIRED NUMBER OF PROJECT STAFF

Staff	Detailed Design Stage (1 year)	Construction Stage (5 years)	Total
1. Managing Staff			
- General Director	1	5	6
- Senior Officer	2	10	12
2. Technical and Adnimistrative Staff			
- Civil Engineer	1	10	11
- Agricultural Engineer	1	15	16
- Agricultural Technician	2	15	17
- Accountant & Cashier	2	10	12
- Secretary & Typist, Clerk	8	80	88
3. Workers and Laborers			
- Drivers	5	25	30
- Guardsman	3	25	28
- Laborers	4	30	34
Total	29	225	254

Table 9.9 ENGINEERING COST

(Unit: CFA F 10^3)

Description	Foreign Currency	Local Currency	Total
I. Detailed Design Stage			
1. Remuneration (95 M/M)			
Foreign Consultant (65 M/M)	246,212	-	246,212
Local Consultant (30 M/M)	39,773	-	39,773
2. Direct Cost	94,697	37,879	132,576
3. Cost for Survey Works	-	18,939	18,939
Total	380,682	56,818	437,500
II. Construction Supervision Stage			
1. Remuneration (150 M/M)			
Foreign Consultant (110 M/M)	416,667	-	416,667
Local Consultant (40 M/M)	53,030	-	53,030
2. Direct Cost	151,515	75,758	227,273
Total	621,212	75,758	696,970
Grand Total	1,001,894	132,576	1,134,470

Table 9.10 REQUIRED MAN-MONTHS OF CONSULTANT ENGINEERS

Specialist	Man-Month		
	Foreign Consultant	Local Consultant	Total
I. Detailed Design Stage			
1. Project Director	1.0	-	1.0
2. Team Leader (Irrigation & Drainage Engineer)	12.0	-	12.0
3. Irrigation Design Engineers	10.0	5.0	15.0
4. Drainage Design Engineers	10.0	5.0	15.0
5. Dam Design Engineers	10.0	5.0	15.0
6. Hydrologists	3.0	3.0	6.0
7. Engineering Geologist	2.0	-	2.0
8. Soil Mechanic Engineers	2.0	2.0	4.0
9. Topo-Survey Engineers	6.0	10.0	16.0
10. Equipment Engineer	2.0	-	2.0
11. Cost & Specification Engineer	2.0	-	2.0
12. Specialists as required	3.0	-	3.0
13. Home Support Engineers	2.0	-	2.0
Total	65.0	30.0	95.0
II. Construction Supervision Stage			
1. Project Director	1.0	-	1.0
2. Team Leader (Irrigation & Drainage Engineer)	40.0	-	40.0
3. Dam Engineer	5.0	-	5.0
4. Design Engineers	5.0	5.0	10.0
5. Construction Engineers	40.0	30.0	70.0
6. On-farm Development Engineers	5.0	5.0	10.0
7. Equipment Engineer	3.0	-	3.0
8. Mechanical Engineer	3.0	-	3.0
9. Specialist as required	5.0	-	5.0
10. Home Support Engineers	3.0	-	3.0
Total	110.0	40.0	150.0

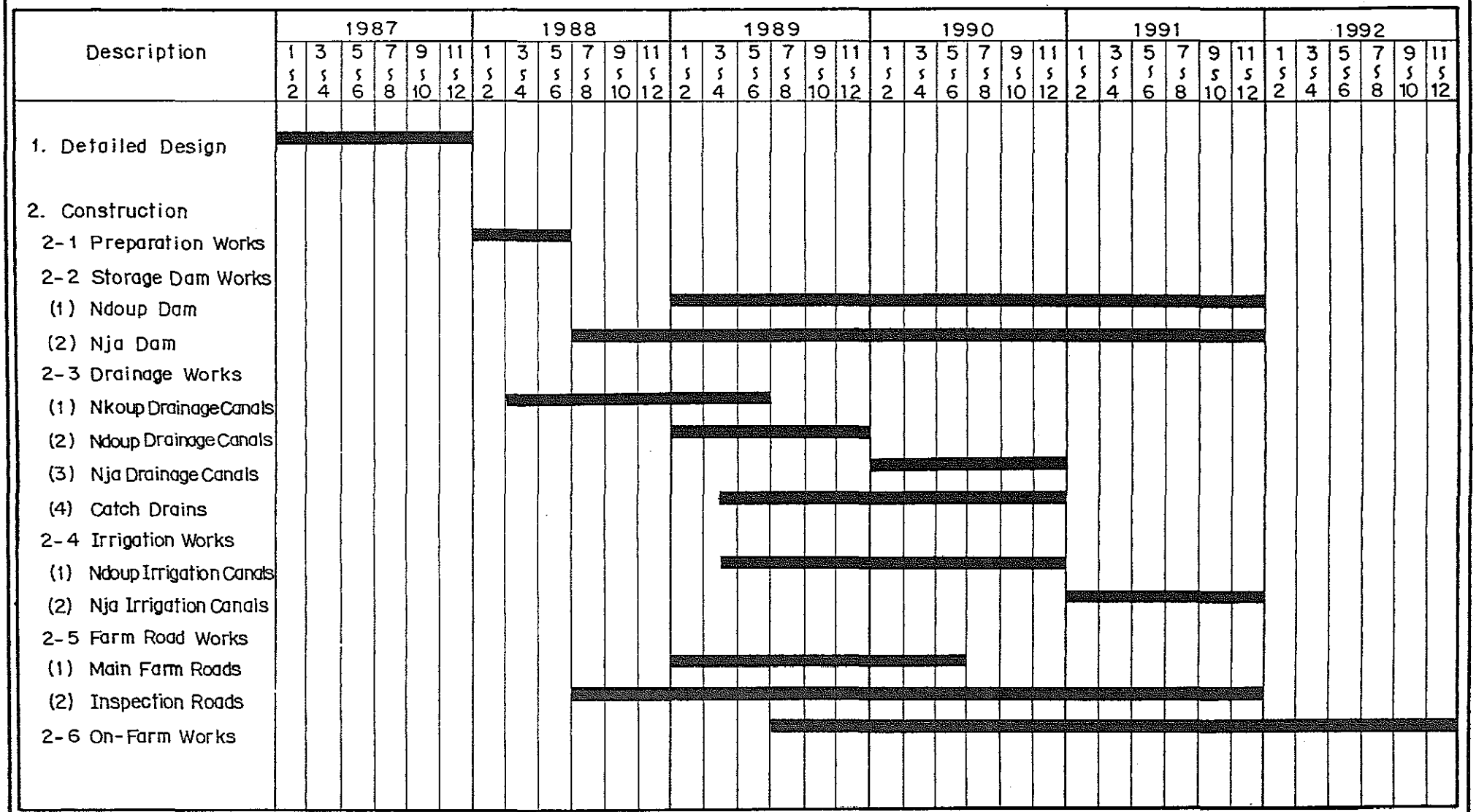
Table 9.11 ANNUAL DISBURSEMENT SCHEDULE

(Unit: CFA F 10^3)

Description		1987	1988	1989	1990	1991	1992	Total
1. Direct Construction Cost	L/C	-	494,034	823,390	823,390	658,712	494,034	3,293,560
	F/C	-	620,170	1,033,618	1,033,618	826,894	620,170	4,134,470
	Total	-	1,114,204	1,857,008	1,857,008	1,485,606	1,114,204	7,428,030
2. Initial Farm Investment	L/C	-	196,590	211,570	-	-	-	408,160
	F/C	-	131,060	344,200	-	-	-	475,260
	Total	-	327,650	555,770	-	-	-	883,420
3. Administration Cost	L/C	69,816	105,212	105,212	105,212	105,212	105,212	595,876
	F/C	-	-	-	-	-	-	-
	Total	69,816	105,212	105,212	105,212	105,212	105,212	595,876
4. Engineering Cost	L/C	56,818	15,152	15,152	15,152	15,151	15,151	132,576
	F/C	380,682	124,243	124,243	124,242	124,242	124,242	1,001,894
	Total	437,500	139,395	139,395	139,394	139,393	139,393	1,134,470
5. Sub-Total (1 + 2 + 3 + 4)	L/C	126,634	810,988	1,155,324	943,754	779,075	614,397	4,430,172
	F/C	380,682	875,473	1,502,061	1,157,860	951,136	744,412	5,611,624
	Total	507,316	1,686,461	2,657,385	2,101,614	1,730,211	1,358,809	10,041,796
6. Physical Contingency	L/C	12,663	81,099	115,532	94,375	77,908	61,440	443,017
	F/C	38,068	87,547	150,206	115,786	95,114	74,441	561,162
	Total	50,731	168,646	265,738	210,161	173,022	135,881	1,004,179
7. Total (5 + 6)	L/C	139,297	892,087	1,270,856	1,038,129	856,983	675,837	4,873,189
	F/C	418,750	963,020	1,652,267	1,273,646	1,046,250	818,853	6,172,786
	Total	558,047	1,855,107	2,923,123	2,311,775	1,903,233	1,494,690	11,045,975
8. Price Contingency	L/C	35,381	361,295	729,471	791,054	834,701	818,439	3,570,341
	F/C	25,544	89,561	208,186	202,510	202,973	188,336	917,110
	Total	60,925	450,856	937,657	993,564	1,037,674	1,006,775	4,487,451
9. Grand Total (7 + 8)	L/C	174,678	1,253,382	2,000,327	1,829,183	1,691,684	1,494,276	8,443,530
	F/C	444,294	1,052,581	1,860,453	1,476,156	1,249,223	1,007,189	7,089,896
	Total	618,972	2,305,963	3,860,780	3,305,339	2,940,907	2,501,465	15,533,426

(Note: Price Escalation - 12% per year for local currency portion, 3% per year for foreign currency portion)

Fig. 9.1 IMPLEMENTATION SCHEDULE OF THE PROJECT



ANNEX X

PROJECT EVALUATION

CHAPTER 1 GENERAL

The object of project evaluation is to ascertain the economic and financial feasibility of the Project.

The economic evaluation of the Baigom Agricultural Development Project was made from the point of view of the whole national economy to confirm the economic viability of the Project through computation of the economic internal rate of return (EIRR), benefit-cost ratio (B/C) and benefit minus cost (B-C).

Moreover, a sensitivity test was also conducted in order to evaluate the eventual fluctuation of the project return due to various causes, such as increase in project cost, decrease in market prices of farm products and delay in attaining production targets, etc.

The financial evaluation was carried out by analyzing the capacity to pay of beneficiary farmers and by preparing the cash flow statement of the Project as a whole. The analysis of capacity to pay was made to assess the viability of the development from the farmers' economic standpoint. As for the analysis of cash flow statement, it was made to evaluate the repayment capacity of the Project for the estimated fund requirement.

The indirect benefits and socio-economic impacts, which would have effects on the regional development, were also studied briefly.

CHAPTER 2 BASIC FACTORS CONSIDERED IN PRICE FORECAST

In order to determine the real and nominal costs to be used in project economic and financial evaluation, a study was made of the trend of crop production, agricultural inputs and construction materials and machinery and equipment. The exchange rate applied in project evaluation was US$1 = CFA F 384.5 = ¥203 as of December 1985.

The escalation rates were tentatively estimated to be 3% per annum for imported construction materials and equipment (in foreign currency component) and 12% per annum for local materials and man-power (in local currency component), based on the data of International Financial Statistics and on the past escalation rate observed in Cameroon.

2.1 Economic (Real) Prices

The real farm-gate purchase and selling prices of agricultural inputs and products, etc. were estimated on the basis of international market prices forecast by the World Bank in 1983 US$ value, for the short term until 1986 and the long term until 1995.

The economic prices of imported materials and equipment were estimated based on CIF Douala prices in December 1985. All duties and taxes related to the import of these materials and equipment were estimated to be 15% for the foreign currency portion.

The standard conversion factor (SCF) determined by the World Bank to be 0.77 for Cameroon was applied to the domestic portion of all costs to bring them to the border price equivalents. As for the farm labor, the shadow price evaluated at CFA F 600 per man-day by the World Bank was applied.

2.2 Financial (Nominal) Prices

The prices of main agricultural products and inputs are controlled by the Government at present. In some cases, the Government subsidizes these prices to a certain extent. However, in order to make realistic study of the project feasibility from the financial viewpoint, the forecast financial prices of these items were estimated based directly on the present market prices. The financial unit prices of construction works were also based on actual unit prices in Cameroon in December 1985.

Based on the conditions established above and the constitutional factors affecting price prospects, the financial and economic prices of farm inputs and outputs were estimated as shown in Annex V.

CHAPTER 3 PROJECT COSTS

Project costs are investment fund required for proejct realization which consists of the following cost items as broken down in the cost estimate: (1) costs of construction of main facilities and structures, (2) initial investment cost for operation including rice mill and its subsidiary installations, (3) remuneration for engineering services and (4) physical contingency and price escalation contingency. Costs of such necessary preparatory works as additional investigations, detailed design and drawings, preparation of tender documents, etc. are included in remuneration for engineering services.

3.1 Economic Cost

The economic cost of the Project was calculated as shown in Table 10.1 which is summarized below:

Economic Project Cost

Items of Expenditures	Total Amount (US$10^6)
- Direct construction cost	6,050.3
- Cost for rice mill, office, etc.	718.2
- Administration cost	441.5
- Engineering cost	953.7
- Physical contingency (10%)	816.4
Total	8,980.1

The economic project cost is inclusive of contingencies for technical changes equivalent to 10% of direct cost plus remuneration for engineering services.

3.2 Financial Cost

The financial project cost estimated on the basis of market prices prevailing in December 1985 would amount to CFA F15.5 billion (or US$40.4 million equivalent) as broken down in Table 9.1. A physical contingency equal to 10% of direct cost and a contingency for price escalation tentatively estimated to be 3% per annum for foreign currency portion and 12% for local currency portion were included in the financial project cost.

3.3 Operation and Maintenance and Replacement Costs

The O & M cost of the Project will be initially disbursed in 1990 when partial operation will commence.

The required annual expenses for O & M at the full development stage of the Project were estimated to be about CFA F 269.6 million for economic evaluation and CFA F 362.9 million for financial evaluation. These expenses include the costs of depreciation and maintenance of equipment, electricity, procurement of fuel and lubricants, salaries of personnel, etc. Details are given in Tables 10.2 and 9.7.

Steel gates to be installed in the development area will be replaced once during the entire project life, while the stoplog and rice mill equipment will be replaced every 10 years.

CHAPTER 4 PROJECT BENEFITS

The project benefits expected to be brought about after project realization would comprise direct benefits and indirect benefits as evaluated hereafter.

The direct benefits would result from the increase in crop products and the deforestation of woods in the Baigom plain. The expectable indirect benefits, which are generally intangibles, would include socio-economic effects of the project on rural and regional activities, such as increase in income of farmers in particular and considerable improvement of land productivity.

4.1 Direct Benefits

The direct benefits determined in this report are principal benefits directly attributable to the project realization. The net values added of annual production estimated in real terms on the basis of crop production forecast and prices mentioned in Annex V are shown in Table 10.3. A summary of these values is given below:

Project Benefits
(Estimated According to Economic Prices)

(Unit: CFA F 10^6)

Crops	Total Value							
	1990	1991	1992	1993	1994	1995	1996	1997-
With Project								
- Rice	46.4	132.5	290.4	595.7	736.2	845.6	909.5	942.6
- Maize	8.2	24.1	53.3	111.8	147.8	175.7	195.2	195.2
- Tomato	20.9	72.2	166.7	347.0	488.6	568.6	608.6	608.6
- Soybeans	0.5	4.1	9.1	20.1	30.6	38.1	42.9	42.9
- Groundnuts	0.2	4.0	10.1	25.2	48.2	62.2	72.2	72.2
Sub-total	76.2	236.9	529.6	1,099.8	1,451.4	1,690.2	1,828.4	1,861.5
Without Project	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9
Incremental Benefit	9.3	170.0	462.7	1,032.9	1,384.5	1,623.3	1,761.5	1,794.6

Assuming that the Development Authority (SODABA) will be granted the right to exploit the existing forest resource within the project site, the benefit to be derived there was computed both in the economic and financial evaluations.

On the basis of the aerial photos, the wood production was evaluated rather conservatively by classifying trees into the following three categories:

1) Lumber whose diameter is more than 50 cm:

1,730 m^3 in common forest,

2) Lumber whose diameter is from 20 cm to 50 cm:

7,475 m^3 in common forest, and

3) Firewoods:

11,340 m^3 in forest zone (2,590 m^3 in common forest and 8,750 m^3 in swampy forest).

In this study, tiny trees, raffias and other by-products were not counted because of lack of reliable data on these wood resources.

The wood exploitation in the plain would be carried out during 4 years from 1989 to 1992.

4.2 Indirect Benefits

Indirect benefits are favorable secondary effects brought about by the realization of the Project. Although a greater part of these benefits are generally intangible, their contribution to the rural and national economic development would be fairly important.

CHAPTER 5 ECONOMIC EVALUATION

5.1 Internal Rate of Return (IRR)

The internal rate of return (IRR) of the Baigom Agricultural Development Project was calculated on the basis of costs and benefits of the Project (See Table 10.4). The economic benefits of the Project were estimated based on the direct benefits from crop production and forest resources in the Baigom plain.

The estimation of IRR was made on the assumption that the project life will be 50 years from the start of construction works in 1987, and that the project final objective will be attained within a period of 5 years after completion of the construction. As shown in the above table, the internal rate of return (IRR) of the Project in a foreseeable normal case would be 12.1%. This value justifies that the Project is economically feasible.

In addition, the B/C and B-C were also computed at the discount rates of 10%, 12% and 15% as shown hereunder.

Discount Rate	10%	12%	15%
B/C	1.206	1.006	0.788
B-C (CFA F 10^6)	1,829.76	52.03	-1,557.14

5.2 Sensitivity Test

In addition to the calculation of IRR, a sensitivity test was carried out to examine the eventual fluctuation of IRR in the following critical situations:

(1) In case the project costs exceed the provisions for physical contingency and price escalation contingency.

(2) In case the project benefits diminish for certain reasons, such as the fall of market prices of crop products, decrease in yield of these products, etc.

(3) In case the project execution period is extended (1 year).

Fig. 10.1 show the results of sensitivity test carried out under the above conditions. These results are summarized below:

Results of Sensitivity Test

Construction Cost Increased	Internal Rate of Return (%) Benefit Decreased 0%	-10%	-20%	Delay in Reaching Project Objective (1 year)
0%	12.1	10.9	9.7	10.9
+10%	11.0	9.9	8.7	10.0
+20%	10.1	9.0	7.8	9.2

As seen from the above table, the Project IRR would not substantially fluctuate from 7.8% in the worst case characterized by a 20% fall in production or prices and a 20% increase in project costs, to 12.1% in a normal case as anticipated.

CHAPTER 6 FINANCIAL EVALUATION

The financial feasibility of the Project was analyzed taking into account the farm budget and the project budget. A study was made of the possibilities of repayment of investment cost by estimating the farmers' capacity of bearing operation and maintenance expenses and the general balance of the project account.

6.1 Capacity to Pay

Details of the budget of a typical farm, consisting of gross revenues, production cost, net income, overhead expenses (living cost), etc. estimated based on financial prices, are shown in Tables 5.9 and 5.14.

According to the forecast of expenditures for and revenues from the production, the annual gross income per farm household would be around CFA F 2,130,000 (or US$5,540 equivalent), which represents an increase of 3.9 times the income obtained in the present situation.

The living cost was estimated to be CFA F 700,000 (or US$1,821 equivalent) on the basis of foodstuffs requirement. The capacity to pay of a farm unit would be obtained by deducting this living cost and the production cost from the above-mentioned gross income amount. The estimated capacity to pay would be CFA F 614,000 (or US$1,597 equivalent) at the full production stage.

At present, the settled farmers in the areas developed by such Development Authorities as SODERIM, UNVDA, etc. pay in kind (paddy) the farming assistance charges for the use of farm machinery and inputs provided by the Authorities. These charges amount to CFA F 108,000 (or US$281 equivalent) per hectare.

In case of the Baigom Agricultural Development Project, this sum corresponds to 10.4% of the gross income which a farm unit would be able to pay anually. In order to encourage farmers to increase their agricultural production, the annual O & M service fee to be paid by farmers for an area of 2.1 ha should remain within the limit of their payment capacity (CFA F 614,000). As such, it can be anticipated that farmers will be capable enough to pay annual O &M costs including farming assistance charges amounting to CFA F 222,000.

6.2 Cash-flow

The capacity of repayment of investment fund was studied by means of cach-flow which would be discounted on the basis of anticipated revenues and fund requirement of the Project. Direct revenues would comprise O & M and replacement costs and net income from forest exploitation at the beginning of the construction stage.

For the purpose of analysis of repayment capacity, it was assumed that investment fund required for project realization be provided under the following conditions:

(1) The foreign currency component will be financed by a bilateral or international agency in the form of a loan with the following conditions: interest rate will be 3.5% per annum and repayment period will be 30 years including a 10-year grace period.

(2) The local currency component will be allocated from the national budget in conformity with the investment policy of the Government of Cameroon.

A study by discounted cash-flow method was made on the above conditions and assumptions in view to examine the possibilities of repayment of investment fund and O & M and replacement costs by use of revenues obtained from the Project. The study was also aimed at evaluating special fund requirements for repayment of the cost component allocated by the Government. The study results are summarized in Table 10.5.

The total fund to be provided by bilateral or international institutions was estimated to be CFA F 7,090 million (US$18.4 million equivalent at the exchange rate of US$1.0 = CFA F 384.5) and the capital to be invested by the Government would amount to CFA F 8,443.6 million.

As for the anticipated project revenue, this would consist of the benefit from wood exploitation in the plain, profit from sale of milled rice and O & M service fees to be collected from farmers.

As a result, the project revenue could not cover the annual repayment of the fund, except for the O & M and replacement costs. Therefore, the repayment of capital will have to be made by the Government subsidies which were estimated to be about 388.5 million per annum on an average during the repayment period from 1988 to 2016.