₦14.16 million for the Auchi Project. More detailed breakdown of the cost is given in Tables 9.3 and 9.4 for the Owerri and Auchi Projects, respectively. The breakdown of the cost for construction machinery is shown in Table 9.5. The cost for the engineering services includes the cost required for the detailed design and technical supervision during construction by foreign experts. Contingencies consist of physical contingency and provisions for price escalation, which are estimated on the conditions mentioned previously.

9.2.2 Construction Cost of Processing, Storage, Office Facilities

Cost required for construction of these facilities is estimated at ₦6.22 million and ₦5.49 million for the Owerri Project and Auchi Project respectively. Detailed breakdown is given in Tables 9.6 and 9.7 for the Owerri and Auchi Projects.

In the cost for the office and related facilities, the cost necessary for the related facilities of the pilot scheme is included.

9.2.3 Initial Farm Investment

The initial farm investment comprises the procurement cost of agricultural machinery and farming expenses required for the initial operation of the project. The estimated costs for the initial farm investment are ₦3.77 million for the Owerri Project and ₦3.27 million for the Auchi Project. Breakdown of the cost is given in Table 9.10.

9.2.4 Total Project Cost and Annual Disbursement Schedule

Total project costs for the Owerri Project and the Auchi Project are ₦22.64 million and ₦22.92 million respectively as summarized into tables 9.13 and 9.14.

These costs are broken down into the annual fund requirement in compliance with the implementation schedule of the projects. Tables 9.15 and 9.16 show the annual disbursement schedules of the cost for each of the Owerri and Auchi Projects.

9.3 Operation and Maintenance Cost

The operation and maintenance cost (OM cost) is needed annually after the commencement of the project operation. It comprises the costs for: (i) operation and maintenance of the irrigation and drainage facilities, and roads, (ii) maintenance of the project offices and their related facilities, and (iii) overhead and personnel expenses.

At the full operation stage of the project, annual OM cost is estimated in Table 9.17.

Table 9.1 Construction Cost of Civil Works for Owerri Project

(Unit: 10^3N)

Work Item	Foreign currency	Local currency	Total
1. Preparatory works	-	26	26
2. Head works	63	91	154
3. Head race	125	372	497
4. Irrigation canals	133	1,261	1,394
5. Drainage canals	103	944	1,047
6. Roads	575	549	1,124
7. Reclamation	600	547	1,147
8. Construction machinery	2,290	-	2,290
Sub-total	3,889	3,790	7,679
9. Engineering services	770	570	1,340
10. Contingencies	1,021	2,610	3,631
Grand total	5,680	6,970	12,650

Table 9.2 Construction Cost of Civil Works for Auchi Project

(Unit: 10^3N)

Work item	Foreign currency	Local currency	Total
1. Preparatory works	-	32	32
2. Head works	23	57	80
3. Head race	105	272	377
4. Irrigation canals	185	1,333	1,518
5. Drainage canals	96	1,259	1,355
6. Roads	607	575	1,182
7. Reclamation	896	889	1,785
8. Construction machinery	2,230	-	2,230
Sub-total	4,142	4,417	8,559
9. Engineering services	840	660	1,500
10. Contingencies	1,128	2,973	4,101
Grand total	6,110	8,050	14,160

Table 9.3 Detailed Breakdown of Construction Cost for Owerri Project

I. Preparatory Works (Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Land Acquisition	ha	28	-	0	470	13,160	13,160
2. Access Road	m	5,500	-	0	1.95	10,730	10,730
3. Miscellaneous	L.S.					2,110	2,110
Total				0		26,000	26,000

II. Head Works for Owerri Project (Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Clearing							
1.1 Forest clearing	ha	2.73	141	384.93	125	341.25	726.18
1.2 Miscellaneous	L.S.			15.07		58.75	73.82
(Sub-total)				(400)		(400)	(800)
2. Diversion canal & Coffer dam							
2.1 Excavation-E	m^3	1,150	0.34	391	0.30	345	736
2.2 Embankment-D	m^3	500	0.39	195	0.37	185	380
2.3 Miscellaneous	L.S.			114		30	144
(Sub-total)				(700)		(600)	(1,300)
3. Weir, Sand scouring & Intake							
3.1 Weir							
3.1.1 Excavation-E	m^3	3,000	0.34	1,020	0.30	900	1,920
3.1.2 Concrete-A	m^3	70	0.30	21	0.25	17.5	38.5
Concrete-B	m^3	3,100	0.07	217	1.65	5,115	5,332
Concrete-C	m^3	160	0.75	120	22	3,520	3,640
3.1.3 Reinforcement bar	Ton	20	410	8,200	30	600	8,800
3.1.4 Form for concrete	m^2	1,750	0.10	175	1.40	2,450	2,625
3.2 Sand scouring							
3.2.1 Excavation-E	m^3	100	0.34	34	0.30	30	64
3.2.2 Concrete-A	m^3	80	0.75	60	35	2,800	2,860
Concrete-B	m^3	50	0.75	37.5	30	1,500	1,537.5
Concrete-C	m^3	10	0.75	7.5	22	220	227.5
Mortar	m^3	1	-	0	34	34	34
3.2.3 Reinforcement bar	Ton	5	410	2,050	30	150	2,200
3.2.4 Form for concrete	m^2	330	0.10	33	1.40	462	495
3.2.5 Sluice gate 2.5m x 1.6m	Pc	1	-	0	205	205	205
3.2.6 Stoplog	m^3	1	-	0	26	26	26
3.2.7 Hoist-A	Pc	1	5,800	5,800	-	5,800	5,800
3.3 Intake							
3.3.1 Excavation-A	m^3	280	0.30	84	0.25	70	154
3.3.2 Excavation-B	m^3	310	0.07	21.7	1.65	511.5	533.2
3.3.3 Concrete-A	m^3	80	0.75	60	35	2,800	2,860
Concrete-C	m^3	10	0.75	7.5	22	220	227.5
Mortar	m^3	1	-	0	34	34	34
3.3.4 Reinforcement bar	Ton	4	410	1,640	30	120	1,760
3.3.5 Form for concrete	m^2	200	0.10	20	1.40	280	300
3.3.6 Sluice gate 2.0m x 1.5m	Pc	2	-	0	160	320	480
3.3.7 Stoplog	m^3	1	-	0	26	26	26
3.3.8 Hoist-A	Pc	2	5,800	11,600	-	0	11,600
3.4 Plug for Diversion Conduit							
3.4.1 Mortar	m^3	15	-	0	34	510	510
3.4.2 Stoplog	m^3	1	-	0	26	26	26
3.5 Miscellaneous	L.S.			1,691.8		1,937.5	3,629.3
(Sub-total)				(32,900)		(35,000)	(67,900)
4. Earth Dike							
4.1 Coffer dam							
4.1.1 Embankment-D	m^3	1,200	0.39	468	0.37	444	912
4.2 Earth Dike (Right)							
4.2.1 Excavation-A	m^3	900	0.30	270	0.25	225	495
4.2.2 Embankment-C	m^3	7,000	0.75	5,250	1.50	10,500	15,750
4.2.3 Sod facing	m^2	1,800	-	0	0.08	144	144
4.3 Earth Dike (Left)							
4.3.1 Excavation-E	m^3	8,400	0.34	2,856	0.30	2,520	5,376
4.3.2 Embankment-C	m^3	25,000	0.75	18,750	1.50	37,500	56,250
4.3.3 Sod facing	m^2	2,800	-	0	0.08	224	224
4.4 Miscellaneous	L.S.			1,406		3,443	4,849
(Sub-total)				(29,000)		(55,000)	(84,000)
Total				53,000		93,000	156,000

III. Head Race for Owerri Project

(Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Race							
1.1 Stripping	m^2	278,000	0.06	16,680	0.06	16,680	33,360
1.2 Excavation-C	m^3	165,000	0.07	11,550	1.40	231,000	242,550
1.3 Embankment-A	m^3	116,000	0.37	42,920	0.25	29,000	71,920
1.4 Sod facing	m^2	141,000	-	0	0.08	11,280	11,280
1.5 Miscellaneous	L.S.			3,850		15,040	18,890
(Sub-total)				(75,000)		(303,000)	(378,000)
2. Related Structures							
2.1 Spillway							
2.1.1 Concrete-A	m^3	15	0.75	11.25	35.0	525	536.25
Concrete-B	m^3	6	0.75	4.5	30.0	180	184.5
Concrete-C	m^3	2	0.75	1.5	22.0	44	45.5
2.1.2 Reinforcement bar	Ton	1.1	410	451	30	33	484
2.1.3 Form for concrete	m^2	75	0.10	7.5	1.40	105	112.5
2.1.4 Concrete pipe ϕ1,000mm	m	10	-	0	75	750	750
2.1.5 Hoist-A	Pc	1	5,800	5,800	-	0	5,800
2.1.6 Sluice gate (2.0m x 1.5m)	Pc	1	-	0	160	160	160
2.1.2 Excavation-C	m^3	70	0.07	4.9	1.40	98	102.9
2.1.8 Embankment-B	m^3	15	0.04	0.6	1.50	22.5	23.1
2.2 Culvert							
2.2.1 Concrete-A	m^3	800	0.75	600	35.0	28,000	28,600
Concrete-B	m^3	190	0.75	142.5	30.0	5,700	5,842.5
Concrete-C	m^3	45	0.75	33.75	22.0	990	1,023.75
2.2.2 Reinforcement bar	Ton	55	410	22,550	30	1,650	24,200
2.2.3 Form for concrete	m^2	3,250	0.10	325	1.40	4,550	4,875
2.2.4 Embankment-B	m^3	1,800	0.04	72	1.50	2,700	2,772
2.3 Cross drain							
2.3.1 Concrete-A	m^3	330	0.75	247.5	35.0	11,550	11,797.5
Concrete-C	m^3	25	0.75	18.75	22.0	550	568.75
2.3.2 Reinforcement bar	Ton	25	410	10,250	30	750	11,000
2.3.3 Form for concrete	m^2	1,000	0.10	100	1.40	1,400	1,500
2.3.4 Excavation-C	m^3	700	0.07	49	1.40	980	1,029
2.3.5 Embankment-B	m^3	1,100	0.04	44	1.50	1,650	1,694
2.4 Turnout							
2.4.1 Concrete-A	m^3	23	0.75	17.25	35.0	805	822.25
Concrete-B	m^3	11	0.75	8.25	30.0	330	338.25
Concrete-C	m^3	4	0.75	3	22.0	88	91
2.4.2 Reinforcement bar	Ton	2	410	820	30	60	880
2.4.3 Form for concrete	m^2	120	0.10	12	1.40	168	180
2.4.4 Hoist-A	Pc	1	5,800	5,800	-	0	5,800
2.4.5 Sluice gate (2.0m x 1.5m)	Pc	1	-	0	160	160	160
2.4.6 Staff gage	m	3	15	45	6.5	19.5	64.5
2.4.7 Excavation-D	m^3	20	-	0	2.60	52	52
2.4.8 Embankment-B	m^3	30	0.04	1.2	1.50	45	46.2
2.5 Concrete Lining							
2.5.1 Concrete-B	m^3	30	0.75	22.5	30.0	900	922.5
Miscellaneous	L.S.			2,557.05		3,985	6,542.05
(Sub-total)				(50,000)		(69,000)	(119,000)
Total				125,000		372,000	497,000

IV. Secondary Canal for Overri Project

(Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Canals							
1.1 Stripping	m^2	46,600	0.06	2,796	0.06	2,796	5,592
1.2 Excavation-C	m^3	14,000	0.07	980	1.40	19,600	20,580
" -B	"	3,500	0.07	245	1.65	5,775	6,020
1.3 Embankment-A	m^3	25,000	0.37	9,250	0.25	6,250	15,500
1.4 Sod facing	m^2	62,000	-	0	0.08	4,960	4,960
1.5 Miscellaneous	L.S.			729		2,619	3,348
(Sub-total)				(14,000)		(42,000)	(56,000)
2. Related Structures							
2.1 Turnout							
2.1.1. Concrete-A	m^3	200	0.75	150	35.0	7,000	7,150
" -B	"	105	0.75	78.75	30.0	3,150	3,228.75
" -C	"	40	0.75	30	22.0	880	910
2.1.2 Rainforcement bar	ton	15	410	6,150	30	450	6,600
2.1.3 Form for concrete	m^2	1,050	0.10	105	1.40	1,470	1,575
2.1.4 Sluice gate 1.5mx1.1m	Pc	10	-	0	65	650	650
2.1.5 Stoplog	m^3	2	-	0	26	52	52
2.1.6 Staf gage	m	15	15	225	6.5	97.5	322.5
2.1.7 Excavation-D	m^3	250	-	0	2.60	650	650
2.1.8 Embankment-B	"	450	0.04	18	1.50	675	693
2.2 Spillway							
2.2.1 Concrete-A	m^3	20	0.75	15	35.0	700	715
" -B	"	8	0.75	6	30.0	240	246
" -C	"	2	0.75	1.5	22.0	44	45.5
2.2.2 Rainforcement bar	ton	1.5	410	615	30	45	660
2.2.3 Form for concrete	m^2	100	0.10	10	1.40	140	150
2.2.4 Concrete pipe ϕ 800mm	m	20	-	0	58	1,160	1,160
2.2.5 Hoist-B	Pc	1	3,300	3,300	-	0	3,300
2.2.6 Sluice gate 1.1mx1.1m	Pc	2	-	0	37.5	75	75
2.2.7 Excavation-D	m^3	20	-	0	2.60	52	52
2.2.8 Embankment-B	"	15	0.04	0.6	1.50	22.5	23.1
2.3 Culvert							
2.3.1. Concrete-A	m^3	450	0.75	337.5	35.0	15,750	16,087.5
" -B	"	65	0.75	48.75	30.0	1,950	1,998.75
" -C	"	65	0.75	48.75	22.0	1,430	1,478.75
2.3.2. Rainforcement bar	ton	22	410	9,020	30	660	9,680
2.3.3. Form for concrete		1,300	0.10	130	1.40	1,820	1,950
2.3.4. Concrete pipe ϕ1,200	m	33	-	-	92	3,036	3,036
" ϕ1,000	m	58	-	-	75	4,350	4,350
" ϕ800	m	55	-	-	58	3,190	3,190
2.3.5. Embankment-B	m^3	1,800	0.04	72	1.50	2,700	2,772
2.4 Cross Drain							
2.4.1. Concrete-A	m^3	68	0.75	51	35	2,380	2,431
" -B	"	14	0.75	10.5	30	420	430.5
" -C	"	10	0.75	7.5	22	220	227.5
2.4.2. Rainforcement bar	ton	5	410	2,050	30	150	2,200
2.4.3. Form for concrete	m^2	280	0.10	28	1.40	392	420
2.4.4. Embankment-B	m^3	155	0.04	6.2	150	232.5	238.7
2.5 Miscellaneous				1,484.95		3,066.5	4,551.45
(Sub-total)				24,000		59,000	83,000
Total				38,000		101,000	139,000

V. Tertiary Canals and Supply Canals for Owerri Project

(Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Canals							
1.1 Excavation-B	m^3	9,400	0.07	658	1.65	15,510	16,168
Excavation-D	m^3	10,700	-	0	2.60	27,820	27,820
1.2 Embankment-A	m^3	91,500	0.37	33,855	0.25	22,875	56,730
Embankment-B	m^3	445,000	0.04	17,840	1.50	669,000	686,840
1.3 Sod facing	m^2	92,000	-	0	0.08	7,360	7,360
1.4 Miscellaneous	L.S.			2,647		37,435	40,082
(Sub-total)				(55,000)		(780,000)	(335,000)
2. Related Structures							
2.1 Turnout							
2.1.1 Concrete-A	m^3	800	0.75	600	35.0	28,000	28,600
Concrete-B	m^3	120	0.75	90	30.0	3,600	3,690
Concrete-C	m^3	100	0.75	75	22.0	2,200	2,275
2.1.2 Reinforcement bar	Ton	60	410	24,600	30	1,800	26,400
2.1.3 Form for concrete	m^2	4,000	0.10	400	1.40	5,600	6,000
2.1.4 Stoplog	m^3	15	-	0	26	390	390
2.1.5 Excavation-D	m^3	3,200	-	0	2.60	8,320	8,320
2.1.6 Embankment-B	m^3	5,300	0.04	212	1.50	7,950	8,162
2.2 Culvert							
2.2.1 Concrete-A	m^3	160	0.75	120	35.0	5,600	5,720
Concrete-B	m^3	160	0.75	120	30.0	4,800	4,920
Concrete-C	m^3	180	0.75	135	22.0	3,960	4,095
2.2.2 Reinforcement bar	Ton	11	410	4,510	30	330	4,840
2.2.3 Form for concrete	m^2	520	0.10	52	1.40	728	780
2.2.4 Concrete pipe ϕ400mm	m	1,298	-	0	28	36,344	36,344
ϕ300mm	m	709	-	0	21	14,889	14,889
2.2.5 Embankment-B	m^3	5,400	0.04	216	1.50	8,100	8,316
2.3 Cross drain							
2.3.1 Concrete-A	m^3	140	0.75	105	35	4,900	5,005
Concrete-B	m^3	140	0.75	105	30	4,200	4,305
Concrete-C	m^3	220	0.75	165	22	4,840	5,005
2.3.2 Reinforcement bar	Ton	10	410	4,100	30	300	4,400
2.3.3 Form for concrete	m^2	500	0.10	50	140	70,000	70,050
2.3.4 Concrete pipe ϕ500mm	m	1,065	-	0	34	36,210	36,210
ϕ300mm	m	1,200	-	0	21	25,200	25,200
2.3.5 Embankment-B	m^3	56,000	0.04	2,240	1.50	84,000	86,240
2.4 Miscellaneous	L.S.			2,105		17,739	19,844
(Sub-total)				(40,000)		(380,000)	(420,000)
Total				95,000		1,160,000	1,255,000

VI. Collector Drains and Field Drains for Owerri Project (Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Drains							
1.1 Excavation-C for collector drains	m^3	242,600	0.07	16,982	1.40	339,640	356,622
1.2 Excavation-C for field drains	m^3	301,900	0.07	21,133	1.40	422,660	443,793
1.3 Miscellaneous	L.S.			1,885		38,700	40,585
(Sub-total)				(40,000)		801,000)	(841,000)
2. Related Structures							
2.1 Drop							
2.1.1 Concrete-A	m^3	110	0.75	82.5	35	3,850	3,932.5
Concrete-B	m^3	100	0.75	75	30	3,000	3,075
Concrete-C	m^3	10	0.75	7.5	22	220	227.5
2.1.2 Reinforcement bar	Ton	8	410	3,280	30	240	3,520
2.1.3 Form for concrete	m^2	580	0.10	58	1.40	812	870
2.1.4 Embankment-B	m^3	300	0.04	12	1.50	450	462
2.2 Drain culvert of collector drains							
2.2.1 Concrete-A	m^3	1,800	0.75	1,350	35	63,000	64,350
Concrete-B	m^3	500	0.75	375	30	15,000	15,375
Concrete-C	m^3	200	0.75	150	22	4,400	4,550
2.2.2 Reinforcement bar	Ton	130	410	53,300	30	3,900	57,200
2.2.3 Form for concrete	m^2	7,450	0.10	745	1.40	10,430	11,175
2.2.4 Concrete pipe ϕ1,000mm	m	256	-	0	75	19,200	19,200
2.2.5 Embankment-B	m^3	5,900	0.04	236	1.50	8,850	9,086
2.3 Drain culvert of field drains							
2.3.1 Concrete-A	m^3	5	0.75	3.75	35	175	178.75
Concrete-B	m^3	4	0.75	3	30	120	123
Concrete-C	m^3	7	0.75	5.25	22	154	159.25
2.3.2 Reinforcement bar	Ton	0.4	410	164	30	12	176
2.3.3 Form for concrete	m^2	20	0.10	2	1.40	28	30
2.3.4 Concrete pipe ϕ500mm	m	44	-	0	42	1,848	1,848
2.3.5 Embankment-B	m^3	160	0.04	6.4	1.50	240	246.4
2.4 Miscellaneous				3,144.6		7,071	
(Sub-total)				(63,000)		(143,000)	(206,000)
Total				103,000		944,000	1,047,000

VII. Main and Branch Road for Owerri Project (Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Main Road							
1.1 stripping	m^2	202,000	0.06	12,120	0.06	12,120	24,240
1.2 Excavation-C	m^3	1,000	0.07	700	1.40	1,400	2,100
1.3 Embankment-A	m^3	71,000	0.37	26,270	0.25	17,750	44,020
1.4 Laterite pavement	m^3	42,420	1.50	63,630	1.60	67,872	131,502
1.5 Miscellaneous	L.S.			5,280		5,858	11,138
(Sub-total)				(108,000)		(105,000)	(213,000)
2. Branch Road							
1.1 Stripping	m^2	1,040,000	0.06	62,400	0.06	62,400	124,800
1.2 Excavation-C	m^3	3,700	0.07	259	1.40	5,180	5,439
1.3 Embankment-A	m^3	364,000	0.37	134,680	0.25	91,000	225,680
1.4 Laterite pavement	m^3	164,680	1.50	247,020	1.60	263,488	510,508
1.5 Miscellaneous	L.S.			22,641		21,932	44,573
(Sub-total)				(467,000)		(444,000)	(911,000)
Total				575,000		549,000	1,124,000

VIII. Land Reclamation for Owerri Project (Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Land Reclamation							
1.1 With forest clearing	ha	330	391	129,030	354	116,820	245,850
1.2 Without forest clearing	ha	1,770	250	442,500	228	403,560	846,060
1.3 Miscellaneous	L.S.			28,470		26,620	55,090
Total				600,000		547,000	1,147,000

Table 9.4 Detailed Breakdown of Construction Cost for Auchi Project

I. Preparatory Works

(Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Land Acquisition	ha	14	-	0	470	6,580	6,580
2. Access Road	m	12,000	-	0	1.95	23,400	23,400
3. Miscellaneous	L.S.					2,020	2,020
Total				0		32,000	32,000

II. Head Works for Auchi Project

(Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Intake Structure							
1.1 Excavation-A	m^3	440	0.30	132	0.25	110	242
1.2 Embankment-A	m^3	270	0.37	99.9	0.25	67.5	167.4
1.3 Concrete-A	m^3	300	0.75	225	35	10,500	10,725
Concrete-B	m^3	150	0.75	112.5	30	4,500	4,612.5
Concrete-C	m^3	50	0.75	375	22	1,100	1,137.5
Mortar	m^3	1	-	0	34	34	34
1.4 Reinforcement bar	ton	16	410	6,560	30	480	7,040
1.5 Form for concrete	m^2	1,130	0.10	113	1.40	1,582	1,695
1.6 Sluice gate 2.0m x 1.5m	Pc	2	-	0	160	320	320
1.7 Stoplog	m^3	1	-	0	26	26	26
1.8 Hoist-A	Pc	2	5,800	11,600	-	0	11,600
1.9 Miscellaneous				1,520.1		1,680.5	3,200.6
(Sub-total)				20,400		20,400	40,800
2. Diversion Canal & Coffer dam							
2.1 Diversion Canal							
2.1.1 Excavation-E	m^3	850	0.34	289	0.30	255	544
2.1.2 Embankment-D	m^3	70	0.39	27.3	0.37	25.9	53.2
2.2 Coffer dam							
2.2.1 Embankment-D	m^3	600	0.39	234	0.37	222	456
2.3 Miscellaneous				49.7		97.1	146.8
(Sub-total)				600		600	1,200
3. Weir							
3.1 Excavation-E	m^3	1,010	0.34	343.4	0.30	303	646.4
3.2 Concrete-A	m^3	150	0.75	112.5	35	5,250	5,362.5
Concrete-B	m^3	920	0.75	690	30	27,600	28,290
3.3 Reinforcement bar	ton	1	410	410	30	30	440
3.4 Form for concrete	m^2	540	0.10	54	1.40	756	810
3.5 Miscellaneous				390.1		2,061	2,451.1
(Sub-total)				(2,000)		(36,000)	(38,000)
Total				23,000		57,000	80,000

III. Head Race for Aushi Project

(Unit: ¥)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Race							
1.1 Stripping	m^2	138,500	0.06	8,310	0.06	8,310	16,620
1.2 Excavation-C	m^3	95,000	0.07	6,650	1.40	133,000	139,650
1.3 Embankment-A	m^3	96,200	0.37	35,594	0.25	24,050	59,644
1.4 Sod facing	m^2	96,000	-	-	0.08	7,680	7,680
1.5 Miscellaneous				2,446		8,960	11,406
(Sub-total)				(53,000)		(182,000)	(235,000)
2. Related Structures							
2.1 Spillway							
2.1.1 Concrete-A	m^3	11.0	0.75	8.25	35	385	393.25
Concrete-B	m^3	4.0	0.75	3	30	120	123
Concrete-C	m^3	1.0	0.75	0.75	22	22	22.75
2.1.2 Reinforcement bar	ton	0.8	410	328	30	24	352
2.1.3 Form for concrete	m^2	55	0.10	5.5	1.40	77	82.5
2.1.4 Concrete pipe ϕ800mm	m	7.0	-	-	58	40.6	40.6
2.1.5 Hoist-A	Pc	1	5,800	5,800	-	-	5,800
2.1.6 Sluice gate 2.0m x 1.5m	Pc	1	-	-	160	160	160
2.1.7 Excavation-C	m^3	50	0.07	3.5	1.40	70	73.5
2.1.8 Embankment-B	m^3	15	0.04	0.6	1.50	22.5	23.1
2.2 Flume							
2.2.1 Concrete-A	m^3	550	0.75	412.5	35	19,250	19,662.5
Concrete-B	m^3	20	0.75	15	30	600	615
Concrete-C	m^3	150	0.75	112.5	22	3,300	3,412.5
2.2.2 Reinforcement bar	ton	39.0	410	15,990	30	1,170	17,160
2.2.3 Form for concrete	m^2	3,900	0.10	390	1.40	5,460	5,850
2.2.4 Embankment-B	m^3	2,000	0.04	80	1.50	3,000	3,080
2.3 Culvert							
2.3.1 Concrete-A	m^3	100	0.75	75	35	3,500	3,575
Concrete-B	m^3	20	0.75	15	30	600	615
Concrete-C	m^3	10	0.75	7.5	22	220	227.5
2.3.2 Reinforcement bar	ton	7.0	410	2,870	30	210	3,080
2.3.3 Form for concrete	m^2	380	0.10	38	1.40	532	570
2.3.4 Embankment-B	m^3	250	0.04	10	1.50	375	385
2.4 Cross Drain							
2.4.1 Concrete-A	m^3	740	0.75	555	35	25,900	26,455
Concrete-C	m^3	70	0.75	52.5	22	1,540	1,592.5
2.4.2 Reinforcement bar	ton	52	410	21,320	30	1,560	22,880
2.4.3 Form for concrete	m^2	3,400	0.10	340	1.40	4,760	5,100
2.4.4 Concrete pipe ϕ1,000mm	m	35	-	0	75	2,625	2,625
2.4.5 Excavation-C	m^3	2,000	0.07	140	1.40	2,800	2,940
2.4.6 Embankment-B	m^3	3,000	0.04	120	1.50	4,500	4,620
2.5 Concrete lining							
2.5.1 Concrete-B	m^3	90	0.75	67.5	30	2,700	2,767.5
2.6 Miscellaneous				3,239.9		4,476.9	7,716.8
(Sub-total)				(52,000)		(90,000)	(142,000)
Total				105,000		272,000	377,000

IV. Main Canal for Aichi Project

(Unit: ¥)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		Total
			Unit Price	Amount	Unit Price	Amount	
1. Canal							
1.1 Stripping	m^2	58,000	0.06	3,480	0.06	3,480	6,960
1.2 Excavation-B	m^3	8,000	0.07	560	1.65	13,200	13,760
-C	"	18,500	0.07	1,295	1.40	25,900	27,195
1.3 Embankment-A	"	123,500	0.37	45,695	0.25	30,875	76,570
1.4 Sod facing	m^2	43,500	-	0	0.08	3,480	3,480
1.5 Miscellaneous				2,970		4,065	7,035
(Sub-total)				(54,000)		(81,000)	(135,000)
2. Related Structures							
2.1 Turnout							
2.1.1 Concrete-A	m^3	70	0.75	52.5	35	2,450	2,502.5
" -B	"	16	0.75	12	30	480	492
" -C	"	10	0.75	7.5	22	220	227.5
2.1.2 Reinforcement bar	ton	5	410	2,050	30	150	2,200
2.1.3 Form for concrete	m^2	350	0.10	35	1.40	490	525
2.1.4 Sluice gate 1.1m x 1.1m	pc	10	-	0	37.5	375	375
2.1.5 Hoist-B	"	1	3,300	3,300	-	0	3,300
2.1.6 Staff gage	"	10	15	150	6.5	65	215
2.1.7 Excavation-D	m^3	80	-	0	2.60	208	208
2.1.8 Embankment-B	m^3	130	0.04	5.2	1.50	195	200.2
2.2 Spillway							
2.2.1 Concrete-A	m^3	10.5	0.75	7.875	35	367.5	375.375
" -B	"	3.8	0.75	2.85	30	114	116.85
" -C	"	1.0	0.75	0.75	22	22	22.75
2.2.2 Reinforcement bar	ton	0.75	410	307.5	30	22.5	330
2.2.3 Form for concrete	m^2	55	0.10	5.5	1.40	77.0	82.5
2.2.4 Concrete pipe ϕ 700mm	m	10	-	0	50	500	500
2.2.5 Hoist-B	pc	1	3,300	3,300	-	0	3,300
2.2.6 Sluice gate 1.1m x 1.1m	"	1	-	0	37.5	37.5	37.5
2.2.7 Excavation-D	m^3	15	-	0	2.60	39	39
2.2.8 Embankment-B	"	10	0.04	0.4	1.50	15	15.4
2.3 Culvert							
2.3.1 Concrete-A	m^3	77.4	0.75	58.05	35	112.4	170.45
" -B	"	12.6	0.75	9.45	30	378	387.45
" -C	"	13.3	0.75	9.975	22	292.6	302.575
2.3.2 Reinforcement bar	ton	5.5	410	2,255	30	165	2,420
2.3.3 Form for concrete	m^2	383	0.10	38.3	1.40	536.2	574.5
2.3.4 Concrete pipe ϕ 1,000mm	m	14	-	0	75	1,050	1,050
ϕ 800mm	"	14	-	0	58	812	812
2.3.5 Embankment-B	m^3	400	0.04	16	1.50	600	616
2.4 Drop							
2.4.1 Concrete-A	m^3	6	0.75	4.5	35	210	214.5
" -B	"	4	0.75	3	30	120	123
" -C	"	1	0.75	0.75	22	22	22.75
2.4.2 Reinforcement bar	ton	0.4	410	164.0	30	12	176
2.4.3 Form for concrete	m^2	30	0.10	3	1.40	42	45
2.4.4 Embankment-B	m^3	14	0.04	0.56	1.50	21	21.56
2.5 Cross Drain							
2.5.1 Concrete-A	m^3	920	0.75	690	35	32,200	32,890
" -B	"	47	0.75	35.25	30	1,410	1,445.25
" -C	"	15	0.75	11.25	22	330	341.25
2.5.2 Reinforcement bar	ton	19	410	7,790	30	570	8,360
2.5.3 Form for concrete	m^2	1,290	0.10	129	1.40	1,806	1,935
2.5.4 Concrete pipe ϕ 1,000mm	m	14	-	0	75	1,050	1,050
ϕ 700mm	"	24	-	0	50	1,200	1,200
2.6 Miscellaneous				1,544.84		3,233.3	4,778.14
(Sub-total)				(22,000)		(52,000)	(74,000)
Total				76,000		133,000	209,000

V. Secondary Canals for Auchi Project

(Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		Total
			Unit Price	Amount	Unit Price	Amount	
1. Canals							
1.1 Stripping	m^2	43,200	0.06	2,592	0.06	2,592	5,184
1.2 Excavation-B	m^3	67,000	0.07	4,690	1.65	110,550	115,240
-D	m^3	7,500	-	0	2.60	19,500	19,500
1.3 Embankment-A	m^3	48,000	0.37	17,760	0.25	12,000	29,760
-B	m^3	4,000	0.04	160	1.50	6,000	6,160
1.4 Sod facing	m^2	50,000	-	0	0.08	4,000	4,000
1.5 Miscellaneous	L.S.			1,198		8,358	10,156
(Sub-total)				(27,000)		(163,000)	(190,000)
2. Related Structures							
2.1 Turnout							
2.1.1 Concrete-A	m^3	230	0.75	172.5	35	8,050	8,222.5
Concrete-B	m^3	80	0.75	60	30	2,400	2,460
Concrete-C	m^3	50	0.75	37.5	22	1,100	1,137.5
2.1.2 Reinforcement bar	Ton	16	410	6,560	30	480	6,940
2.1.3 Form for concrete	m^2	1,150	0.10	115	1.40	1,610	1,725
2.1.4 Hoist-B	Pc	1	3,300	3,300	-	0	3,300
2.1.5 Sluice gate 1.1m x 1.1m	Pc	20	-	0	37.5	750	750
0.5m x 0.5m	Pc	15	-	0	10	150	150
2.1.6 Stoplog	m^3	3	-	0	26	78	78
2.1.7 Staff gage	m	30	15	450	6.5	195	645
2.1.8 Excavation-D	m^3	500	-	0	2.6	1,300	1,300
2.1.8 Embankment-B	m^3	750	0.04	30	1.50	1,125	1,155
2.2 Drop							
2.2.1 Concrete-A	m^3	130	0.75	97.5	35	4,550	4,647.5
Concrete-B	m^3	50	0.75	37.5	30	1,500	1,537.5
Concrete-C	m^3	21	0.75	15.75	22	462	477.75
2.2.2 Reinforcement bar	Ton	9	410	3,690	30	270	3,960
2.2.3 Form for concrete	m^2	630	0.10	63	1.40	882	945
2.2.4 Embankment-B	m^3	120	0.04	4.8	1.50	180	184.8
2.3 Spillway							
2.3.1 Concrete-A	m^3	48	0.75	36	35	1,680	1,716
Concrete-B	m^3	12	0.75	9	30	360	396
Concrete-C	m^3	3	0.75	2.25	22	66	68.25
2.3.2 Reinforcement bar	Ton	3.5	410	1,435	30	105	1,540
2.3.3 Form for concrete	m^2	250	0.10	25	1.40	350	375
2.3.4 Excavation-D	m^3	30	-	0	2.60	78	78
2.3.5 Embankment-B	m^3	18	0.04	0.72	1.50	27	27.72
2.4 Culvert							
2.4.1 Concrete-A	m^3	43	0.75	32.25	35	1,505	1,537.25
Concrete-B	m^3	30	0.75	22.5	30	900	922.5
Concrete-C	m^3	51	0.75	38.25	22	1,122	1,160.25
2.4.2 Reinforcement bar	Ton	3.0	410	1,230	30	90	1,320
2.4.3 Form for concrete	m^2	153	0.10	15.3	1.40	214.2	229.5
2.4.4 Concrete pipe ϕ700mm	m	61	-	0	50	3,050	3,050
ϕ600mm	m	69	-	0	42	2,890	2,890
ϕ500mm	m	138	-	0	34	4,692	4,692
ϕ400mm	m	66	-	0	28	1,848	1,848
ϕ300mm	m	44	-	0	21	924	924
2.4.5 Embankment-B	m^3	1,250	0.04	50	1.50	1,875	1,875
2.5 Cross Drain							
2.5.1 Concrete-A	m^3	240	0.75	180	35	8,400	8,580
Concrete-B	m^3	20	0.75	15	30	600	615
Concrete-C	m^3	3	0.75	2.25	22	66	68.25
2.5.2 Reinforcement bar	Ton	8	410	3,280	30	210	3,520
2.5.3 Form for concrete	m^2	600	0.10	60	140	840	900
2.5.4 Embankment-B	m^3	340	0.04	13.6	1.50	510	523.6
2.6 Miscellaneous	L.S.			1,919.33		3,515.8	5,435.13
(Sub-total)				(23,000)		(61,000)	(84,000)
Total				50,000		224,000	274,000

VI. Tertiary Canals and Supply Canals for Auchi Project

(Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		Total
			Unit Price	Amount	Unit Price	Amount	
1. Canals							
1.1 Excavation-B	m^3	1,000	0.07	70	1.65	1,650	1,720
" -D	"	29,000	-	0	2.60	75,400	75,400
1.2 Embankment-A	"	9,100	0.37	3,367	0.25	2,275	5,642
" -B	"	403,000	0.04	16,120	1.50	604,500	620,620
1.3 Sod facing	m^2	12,000	-	0	0.08	960	960
1.4 Miscellaneous	L.S.			1,443		34,215	35,658
(Sub-total)				(21,000)		(719,000)	(740,000)
2. Related Structures							
2.1 Turnout							
2.1.1 Concrete-A	m^3	860	0.75	645	35	30,100	30,745
" -B	"	140	0.75	105	30	4,200	4,305
" -C	"	88	0.75	66	22	1,930	1,996
2.1.2 Reinforcement bar	ton	65	410	26,650	30	1,950	28,600
2.1.3 Form for concrete	m^2	4,400	0.10	440	1.40	6,160	6,600
2.1.4 Stoplog	m^3	17	-	0	26	442	442
2.1.5 Excavation-D	"	3,500	-	0	2.60	9,100	9,100
2.1.6 Embankment-B	"	5,700	0.04	228	1.50	8,550	8,778
2.2 Culvert							
2.2.1 Concrete-A	m^3	96	0.75	72	35	3,360	3,432
" -B	"	140	0.75	105	30	4,200	4,305
" -C	"	140	0.75	105	22	1,380	1,485
2.2.2 Reinforcement bar	ton	8	410	3,280	30	240	3,520
2.2.3 Form for concrete	m^2	350	0.10	35	1.40	490	525
2.2.4 Concrete Pipe ϕ 300mm	m	1,809	-	0	21	37,989	37,989
2.2.5 Embankment-B	m^3	4,300	0.04	172	1.50	6,450	6,622
2.3 Cross drain							
2.3.1 Concrete-A	m^3	80	0.75	60	35	2,800	2,860
" -B	"	90	0.75	67.5	30	2,700	2,767.5
" -C	"	120	0.75	90	22	2,640	2,730
2.3.2 Reinforcement bar	ton	6	410	2,460	30	180	2,640
2.3.4 Form for concrete	m^2	250	0.10	25	140	35,000	35,025
2.3.5 Concrete pipe ϕ 500mm	m	360	-	0	34	12,240	12,240
ϕ 300mm	"	1,065	-	0	21	22,365	22,365
2.3.6 Embankment-B	m^3	33,000	0.04	1,320	1.50	49,500	50,820
2.4 Miscellaneous	L.S.			2,014.5		13,034	15,108.5
(Sub-total)				(38,000)		(257,000)	(295,000)
Total				59,000		976,000	1,035,000

VII. Collector Drains and Field Drains for Auchi Project

(Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		
			Unit Price	Amount	Unit Price	Amount	Total
1. Drains							
1.1 Excavation-C for collector drains	m^3	455,000	0.07	31,850	1.40	637,000	668,850
1.2 Excavation-C for field drains	m^3	283,500	0.07	20,265	1.40	405,300	425,565
1.3 Miscellaneous	L.S.			2,885		52,700	55,585
(Sub-total)				(55,000)		(1,095,000)	(1,150,000)
2. Related Structures							
2.1 Drop							
2.1.1 Concrete-A	m^3	580	0.75	435	35	20,300	20,735
" -B	"	660	0.75	495	30	19,800	20,295
" -C	"	60	0.75	45	22	1,320	1,365
2.1.2 Reinforcement bar	ton	44	410	18,040	30	1,320	19,360
2.1.3 Form for concrete	m^2	2,985	0.10	298.5	1.40	4,179	4,477.5
2.1.4 Embankment-B	m^3	1,475	0.04	59	1.50	2,212.5	2,271.5
2.2 Drain culvert of collector drains							
2.2.1 Concrete-A	m^3	540	0.75	405	35	18,900	19,305
" -B	"	290	0.75	2,175	30	8,700	10,875
" -C	"	274	0.75	205.5	22	6,028	6,233.5
2.2.2 Reinforcement bar	ton	39	410	15,990	30	1,170	17,160
2.2.3 Form for concrete	m^2	2,170	0.10	217	1.40	3,038	3,255
2.2.4 Concrete pipe ϕ 1,000 mm	m	347	-	0	75	26,025	26,025
ϕ 900 mm	"	77	-	0	66	5,082	5,082
ϕ 800 mm	"	300	-	0	58	17,400	17,400
ϕ 600 mm	"	66	-	0	42	2,772	2,772
ϕ 500 mm	"	55	-	0	34	1,870	1,870
2.2.5 Embankment-B	m^3	5,500	0.04	220	1.50	8,250	8,470
2.3 Drain culvert of field drains							
2.3.1 Concrete-A	m^3	14	0.75	10.5	35	490	500.5
" -B	"	15	0.75	11.25	30	450	461.25
" -C	"	17	0.75	12.75	22	374	386.75
2.3.2 Reinforcement bar	ton	1	410	410	30	30	440
2.3.3 Form for concrete	m^2	50	0.10	5	1.40	70	75
2.3.4 Concrete pipe ϕ 500 mm	m	66	-	0	42	2,772	2,772
ϕ 300 mm	"	99	-	0	21	2,079	2,079
2.3.5 Embankment-B	m^3	500	0.04	20	1.50	750	770
2.4 Miscellaneous	L.S.			1,945.5		8,618.5	10,564
(Sub-total)				(41,000)		(164,000)	(205,000)
Total				96,000		1,259,000	1,355,000

VIII. Main and Branch Road for Auchi Project

(Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		Total
			Unit Price	Amount	Unit Price	Amount	
1. Main Road							
1.1 Stripping	m^2	234,000	0.06	14,040	0.06	14,040	28,080
1.2 Excavation-C	m^3	1,000	0.07	70	1.40	1,400	1,470
1.3 Embankment-A	"	81,900	0.37	30,303	0.25	20,475	50,778
1.4 Laterite pavement	"	49,140	1.50	73,710	1.60	78,624	152,334
1.5 Miscellaneous	L.S.			6,247		6,461	12,708
(Sub-total)				(125,000)		(121,000)	(246,000)
2. Branch Road							
2.1 Stripping	m^2	1,085,000	0.06	65,100	0.06	65,100	130,200
2.2 Excavation-C	m^3	4,000	0.07	280	1.40	5,600	5,880
2.3 Embankment-A	"	379,750	0.37	140,507.5	0.25	94,937.5	235,445
2.4 Laterite pavement	"	166,740	1.50	250,110	1.60	266,784	516,894
2.5 Miscellaneous	L.S.			23,482.5		21,578.5	45,061
(Sub-total)				(482,000)		(454,000)	(936,000)
Total				607,000		575,000	1,182,000

IX. Land Reclamation for Auchi Project

(Unit: ₦)

Works	Unit	Quantity	Financial Cost				
			Foreign Currency		Local Currency		Total
			Unit Price	Amount	Unit Price	Amount	
1. Land Reclamation							
1.1 With forest clearing	ha	1,300	460	598,000	470	611,000	1,209,000
1.2 Without forest clearing	"	800	319	255,200	295	236,000	491,200
1.3 Miscellaneous	L.S.			42,800		42,000	84,800
Total				896,000		889,000	1,785,000

Table 9.5 Procurement Cost of Construction Machinery and Equipment

Machinery and Equipment		Unit price* (₦)	Required Number		Procurement Cost (₦)	
			Owerri Project	Auchi Project	Owerri Project	Auchi Project
1. Bulldoser	13 ton - 15 ton	57,300	2	2	114,600	114,600
2. - " -	21 ton	72,300	8	7	578,400	506,100
3. - " -	21 ton w/rake	74,900	2	3	149,800	224,700
4. - " -	33 ton	84,300	2	2	168,600	168,600
5. Backhoe	0.3 m^3	36,800	3	3	110,400	110,400
6. - " -	0.6 m^3	50,300	2	2	100,600	100,600
7. Crawler loader	1.3 m^3	50,300	1	1	50,300	50,300
8. Motor grader	9 ton	35,800	2	2	71,600	71,600
9. Roadroller	8 - 10 ton	16,700	1	1	16,700	16,700
10. Dump truck	6 ton	17,700	12	10	212,400	177,000
11. Tractor shovel	0.6 m^3	5,600	2	2	11,200	11,200
12. Tractor crane	5 ton	37,400	1	1	37,400	37,400
13. Tamping roller	500 kg	12,200	2	1	24,400	12,200
14. Tamping rammer	80 kg	800	10	10	8,000	8,000
15. Concrete mixer	0.2 m^3	6,100	2	2	12,200	12,200
16. - " -	0.6 m^3	8,100	2	1	16,200	8,100
17. Ordinary truck	6 ton	11,600	10	10	116,000	116,000
18. Jeep		5,600	5	5	28,000	28,000
19. Water tanker	2 m^3	18,200	1	1	18,200	18,200
20. Fuel tanker	5 m^3	20,200	1	1	20,200	20,200
21. Grease car		37,400	1	1	37,400	37,400
22. Diesel generator	3.5 KVA	2,100	2	1	4,200	2,100
23. 100 mm sub. pump		1,700	1	1	1,700	1,700
Sub-total					1,908,500	1,853,300
24. Spare parts (20%)					381,500	376,700
Grand total					2,290,000	2,230,000

* Delivery price at site

Table 9.6 Construction Cost of Processing, Storage and Office Facilities, Owerri

Description	Unit	Quantity	Unit Cost	Amount
			(₦)	(₦)
1. Project office	m^2	1,500	144	216,000
2. Garage	"	800	45	36,000
3. Training center	"	200	144	29,000
4. Weather station	"	25	45	1,000
5. Houses for senior staff	"	600	190	114,000
6. Dormitory	"	1,000	190	190,000
7. Warehouse	"	1,800	71	128,000
8. Generator house	"	450	339	153,000
9. Workshop	"	300	190	57,000
10. Motor pool	"	2,400	45	109,000
11. Rice mill buildings	"	6,000		1,174,000
i) Receiving, clearing & drying house	"	1,800	263	(473,000)
ii) Parboiling house	"	1,800	280	(504,000)
iii) Milling house	"	200	207	(41,000)
iv) Storage house	"	2,200	71	(156,000)
12. Rice mill/1	LS			2,102,000
13. Contingencies	"			1,911,000
Total				6,220,000

/1. Refer to Table 9.8

Table 9.7 Construction Cost of Processing, Storage and Office Facilities, Auchi

Description	Unit	Quantity	Unit Cost (N)	Amount (N)
1. Project office	m^2	1,500	144	216,000
2. Garage	"	800	45	36,000
3. Training center	"	200	144	29,000
4. Weather station	"	25	45	1,000
5. Houses for senior staff	"	600	190	114,000
6. Dormitory	"	1,000	190	190,000
7. Warehouse	"	1,800	71	128,000
8. Generator house	"	450	339	153,000
9. Workshop	"	300	191	57,000
10. Motor pool	"	2,200	45	100,000
11. Rice mill buildings	"	5,300		999,000
i) Receiving, clearing & drying house	"	1,800	263	(473,000)
ii) Parboiling house	"	1,200	280	(336,000)
iii) Milling house	"	200	207	(41,000)
iv) Storage house	"	2,100	71	(149,000)
12. Rice mill /1	LS			1,848,000
13. Contingencies	"			1,619,000
Total				5,490,000

/1. Refer to Table 9.9

Table 9.8 Cost of Rice Mill and Storage Facilities for Owerri Project

Item		Required Nos.	Amount (₦)
1) Receiving and drying equipment		3	588,000
- Receiving equipment:	3.5 t/hr		
- Drying equipment:	10 t/hr		
2) Parboiling equipment	1 t/hr	3	513,000
3) Milling equipment	1.5 t/hr	3	96,000
4) Storage equipment	1,000 t bin	5	600,000
5) Power supplying equipment	200 KVA	3	114,000
6) Spare parts (about 10% of the above)		L.S.	191,000
Total			2,102,000

Table 9.9 Cost of Rice Mill and Storage Facilities for Auchi Project

Item	Required Nos.	Amount (₦)
1) Receiving and drying equipment - Receiving equipment: 3 t/hr - Drying equipment: 10 t/hr	3	588,000
2) Parboiling equipment 0.6 t/hr	3	312,000
3) Milling equipment 1 t/hr	3	66,000
4) Storage equipment 1,000 t bin	5	600,000
5) Power supplying equipment 200 KVA	3	114,000
6) Spare parts (about 10% of the above)	L.S.	168,000
Total		1,848,000

Table 9.10 Initial Farm Investment

Item	Owerri Project (₦1000)	Auchi Project (₦1000)
1) Farm inputs		
Seed	43	59
Fertilizer		
- Compound	88	88
- Urea	62	62
Agro-chemicals		
- Fungicide	265	265
- Insecticide	35	35
- Herbicide	335	320
Sub-total	828	829
2) Farm machinery/1	1,733	1,371
3) Contingencies/2	1,209	1,070
Total	3,770	3,270

/1 The details of the farm machinery are given in Table 9.11 and 9.12.

/2 Contingencies include physical contingency and provisions for price escalation.

Table 9.11 Farm Machinery and Equipment of the Owerri Project Area

		Quantity (Nos.)	Unit Price (N)	Amount (N)
1) Tractor and combine				
- Wheel type tractors	60PS class	30	7,300	219,000
- Wheel type tractors	40PS class	40	5,900	236,000
- Crowler type tractors	60PS class	5	22,200	111,000
- Crowler type tractors	40PS class	5	13,900	69,500
- Self-propelled type combines	100PS class	20	27,200	544,000
2) Other equipment and attachment				
- Disc Plows	26" x 3	5	1,000	5,000
- Disc harrows	20" x 24	4	1,100	4,400
- Rotavaters	1.8 - 2.0 m	28	800	22,400
- Broad casters	350 kg	9	700	6,300
- Swath sprayer	400 ℓ	16	4,700	75,200
- Dusters	35 kg	6	900	5,400
- Puddling rakes	3.0 m	9	1,000	9,000
- Rear-mounted mowers	1.8 - 2.0 m	8	800	6,400
- Dump trailers	2-ton	25	1,700	42,500
- Trucks	6-ton	5	12,400	62,000
- Tool bar	3.0 m	10	40	400
- Float wheels		20 set	300	6,000
3) Spare parts		L.S.		283,500
4) Service tools and equipments		L.S.		25,000
Total				1,733,000

Table 9.12 Farm Machinery and Equipment of the Auchi Project Area

		Quantity (Nos.)	Unit Price (N)	Amount (N)
1) Tractor and combine				
- Wheel type tractors	60PS class	27	7,300	197,100
- Wheel type tractors	40PS class	27	5,900	159,300
- Crowler type tractors	60PS class	3	22,200	66,600
- Crowler type tractors	40PS class	3	13,900	41,700
- Self-propelled type combines	100PS class	16	27,200	435,200
2) Other equipment and attachment				
- Disc Plows	26" x 3	7	1,000	7,000
- Disk harrows	20" x 24	5	1,100	5,500
- Rotavaters	1.8 - 2.0 m	20	800	16,000
- Broad casters	350 kg	7	700	4,900
- Swath sprayer	400 ℓ	16	4,700	75,200
- Dusters	35 kg	5	900	4,500
- Puddling rakes	3.0 m	6	1,000	6,000
- Rear-mounted mowers	1.8 - 2.0 m	6	800	4,800
- Dump trailers	2-ton	20	1,700	34,000
- Truks	6-ton	5	12,400	62,000
- Tool bar	3.0 m	10	40	400
- Float wheels		15 set	300	4,500
3) Spare parts		L.S.		221,300
4) Service tools and equipments		L.S.		25,000
Total				1,371,000

Table 9.13 Project Cost for Owerri Project

(Unit: 1,000N)

Item	Foreign currency	Local currency	Total
1. Civil works	5,680	6,970	12,650
2. Processing, storage and office facilities	2,980	3,240	6,220
3. Initial farm investment	2,390	1,380	3,770
Total	11,050	11,590	22,640

Table 9.14 Project Cost for Auchi Project

(Unit: 1,000N)

Item	Foreign currency	Local currency	Total
1. Civil works	6,110	8,050	14,160
2. Processing and storage facilities	2,580	2,910	5,490
3. Initial farm investment	1,880	1,390	3,270
Total	10,570	12,350	22,920

Table 9.15 Annual Disbursement Schedule of Project Cost, Owerri Project

(Unit: ₦1,000)

Item	Total Cost FC	LC	Total	1977 FC	LC	Total	1978 FC	LC	Total	1979 FC	LC	Total	1980 FC	LC	Total	1981 FC	LC	Total	1982 FC	LC	Total	1983 FC	LC	Total
1. Civil works	5,680	6,970	12,650	231	27	258	2,828	382	3,210	812	1,828	2,640	855	2,148	3,003	465	1,237	1,702	489	1,348	1,837	-	-	-
2. Processing, storage office facilities	2,980	3,240	6,220	-	291	291	-	874	874	-	160	160	960	1,885	2,845	-	-	-	1,093	-	1,093	957	-	957
3. Initial farm investment	2,390	1,380	3,770	-	-	-	-	-	-	-	-	-	723	332	1,055	852	494	1,346	815	554	1,369	-	-	-
Total	11,050	11,590	22,640	231	318	549	2,828	1,256	4,084	812	1,988	2,800	2,538	4,365	6,903	1,317	1,731	3,048	2,397	1,902	4,299	957	-	957

F.C.: Foreign currency in naira equivalent

L.C.: Local currency

Table 9.16 Annual Disbursement Schedule of Project Cost, Auchi Project

(Unit: ₦1,000)

Item	Total Cost FC	LC	Total	1977 FC	LC	Total	1978 FC	LC	Total	1979 FC	LC	Total	1980 FC	LC	Total	1981 FC	LC	Total	1982 FC	LC	Total	1983 FC	LC	Total
1. Civil works	6,110	8,050	14,160	270	39	309	2,868	570	3,438	1,074	2,516	3,590	755	1,857	2,612	557	1,483	2,040	586	1,585	2,171	-	-	-
2. Processing, storage office facilities	2,580	2,910	5,490	-	291	291	-	873	873	-	147	147	848	1,599	2,447	906	-	906	-	-	-	826	-	826
3. Initial farm investment	1,880	1,390	3,270	-	-	-	-	-	-	359	190	549	269	185	454	481	371	852	530	394	924	241	250	491
Total	10,570	12,350	22,920	270	330	600	2,868	1,443	4,311	1,433	2,853	4,286	1,872	3,641	5,513	1,944	1,854	3,798	1,116	1,979	3,095	1,067	250	1,317

F.C.: Foreign currency in naira equivalent

L.C.: Local currency

Table 9.17 Annual Operation and Maintenance Cost

(Unit: N1,000)

Item	Owerri Project	Auchi Project
1. Irrigation & drainage facilities including road	206	224
2. Project office and related facilities	10	10
3. Personnel expenses and overhead		
i) Nigerian staff	81	81
ii) Foreign exports/1	200	150
Total	497	465

/1. Operation guidance by foreign exports will cover the first three years of operation.

10. MARKETING, PRICE PROSPECTS AND BENEFIT ESTIMATION

10. MARKETING, PRICE PROSPECTS AND BENEFIT ESTIMATION

10.1 Market and Price Prospects

10.1.1 Market Prospects of Rice

In 1974, about 500,000 tons of rice including 6,000 tons of the imports was consumed in whole Nigeria, which means that per-capita consumption of rice is equivalent to only 7.0 kg. This low per-capita consumption seems not to represent the actual demand for rice in the country.
Current shifting of dietary preference from root crops to rice is significant in the country even in the low income group. Per-capita income has also increased significantly which accelerates further to raise the demand for rice. In this situation, present per-capita consumption would be too low compared with the potential demand. Existing potential demand for rice is reflected by the present high price which may be caused partly by the import restriction and partly by insufficient domestic production.

In this section, demand for rice in the future is forecasted for investigating the market prospect. The forecast is made on the basis of the present demand though it does not represent potential demand. For the estimate it is assumed that the demand for rice will increase corresponding to per capita income increase and anticipated population growth as given below:

i) Population in the country is 75 million in 1976 and will increase by 2.5% per annum;

ii) Present per-capita consumption of rice is 7.0 kg and will increase by the rate of (income elasticity of demand) x (growth rate of per capita income);

iii) Income elasticity for rice is 0.6; and

iv) Growth rate of per capita income is 4.0%.

Result of the estimation are shown in Table 10.1
Total demand of rice is expected to attain 815,200 tons in 1985 and 1,320,000 tons in 1995. This estimate seems to be relatively low and conservative since the demand forecast is made on the basis of the present low per capita consumption of 7.0 kg instead of the higher potential demand in the country.

Table 10.1 Demand Forecast of Rice

Year	Per-Capita Consumption (kg)	Population (10^3)	Total-Demand (t)	Year	Per-Capita Consumption (kg)	Population (10^3)	Total-Demand (t)
1976	7.0	75,000	525,000	91	10.0	108,600	1,086,000
77	7.2	76,900	553,700	92	10.2	111,300	1,135,300
78	7.3	78,800	575,200	93	10.5	114,100	1,198,100
79	7.5	80,800	606,000	94	10.7	117,000	1,251,900
80	7.7	82,800	637,600	95	11.0	120,000	1,320,000
81	7.9	84,900	670,700	96	11.2	122,900	1,376,500
82	8.1	87,000	704,700	97	11.5	126,000	1,449,000
83	8.3	89,000	738,700	98	11.8	129,100	1,523,400
84	8.5	91,000	773,500	99	12.1	132,300	1,600,800
85	8.7	93,700	815,200	2000	12.4	135,700	1,682,700
86	8.9	96,000	854,400	01	12.7	139,000	1,765,300
87	9.1	98,400	895,400	02	13.0	142,500	1,852,500
88	9.3	100,900	938,400	03	13.3	146,100	1,943,100
89	9.5	103,400	982,300	04	13.6	149,700	2,035,900
90	9.8	106,000	1,038,800	05	13.9	153,500	2,133,700

Another demand forecast made by Federal Ministry of Agriculture and Natural Resources in 1974[1] indicates that the demand for rice is expected to reach 865,000 tons in 1985. Although the estimated figure is slightly higher than our estimate, it shows that our estimate is within a reasonable range.

In order to meet our estimated demand, anticipated increase in rice production would be around 5% per annum. Domestic production of rice is expected to grow at an annual rate of 14% in the third National Development Plan for satisfying the domestic demand, but, the expected growth rate seems to be too much ambitious in due consideration of the past trend and even 5% could not be attainable without intensive support of the Government for the implementation of rice development projects.

Incremental rice production generated by the Owerri Project and Auchi Project is expected to reach 23,000 tons at the full development stage in 1989. Taking into consideration of the existing potential demand for rice and its future increase the increased amount will be readily absorbed into the economy with no significant impact on domestic price.

10.1.2 Price Prospects

1) Price of Food Crops

Domestic retail prices or local market prices for food crops have been collected in the project area. On the basis of the average of the current local market prices, farm gate price is estimated for financial analysis by deducting market overhead cost, transportation cost and assembly cost.

Domestic price of rice has increased considerably since 1973. The price differs widely depending on the variety, location of the market and season. According to the collected information, present local market price of milled rice is around 700 - 1,000 ₦/t, which is considerably high compared with the current international market price of 170 - 200/t./2 However, in due consideration of the strong demand caused by the expected population increase and increase in per capita income, it is reasonably assumed that the present demand supply condition for rice will not change substantially in the domestic market and its relatively high price will continue in the future. Domestic inflationary trend for food crops is also expected to support the current high price. In this context, mill gate price of rice is estimated conservatively at 560 ₦/t for the financial analysis on the basis of the current market price. Farm gate price of paddy is also estimated at 308 ₦/t in view of the current market price and assumed milling efficiency.

Financial farm gate prices of other food crops are also estimated on the basis of the local market price, which are shown in Table 10.2.

Farm gate prices to be used for economic analysis are estimated principally on the basis of the international market price. The economic prices for tradable goods such as rice and maize are estimated by using IBRD forecast price around 1985 taking into account the transportation cost and marketing cost. For the conversion from US$ to ₦, shadow exchange rate of ₦ = US$1.27 is applied instead of the official rate. The economic prices for non-tradable goods such as yam, cassava and cocoyam are estimated based on the crop production cost plus assumed mark up rate. Results of the estimate are listed in Table 10.2 and the estimated figures are applied for economic analysis.

2) Price of Farm Inputs

As in the case of the estimate for the price of the food crops, financial prices of farm inputs are estimated on the basis of the current market price, while the economic prices are estimated by using international market prices taking into account the transportation cost, marketing cost, etc. Results of the estimate are shown in Table 10.3.

/1 "Agriculture Development in Nigeria 1973-1985" Federal Ministry of Agriculture and Natural Resources, Joint Planning Committee, Lagos 1974.

/2 Price of rice FOB Bangkok around 1976.

10.2 Estimate of Irrigation Benefit

Irrigation benefit to be expected from the project is estimated by calculating net incremental value. The net incremental value is defined as the difference of the total returns to be produced in the project area between under future without-project condition and future with-project condition. For estimating the benefit, estimated economic prices are applied both for inputs and outputs including shadow wage rate of farm labor which is valued at 60% of the current rate. Calculation for the estimate of the irrigation benefit is conducted in the following step.

10.2.1 Estimate of Net Income per Crop

On the basis of the estimated price and volume for inputs and outputs, net income of each crop is firstly calculated both on future without-project condition and future with-project condition. In the estimation, it is assumed that present condition of agricultural production will not change considerably and remain at the present level without introducing substantial investment in agricultural infrastructure and/or institutions. Results of the calculation are presented in Table 10.10 and Table 10.11 for the Owerri Project and the Auchi Project respectively. Retailed calculation for the estimate of the net income is shown in Table 10.12 to Table 10.14.

10.2.2 Estimate of Net Incremental Value

Multiplying the net income per crop estimated above by the cultivated area for each crop, total returns of agricultural production in the project area are calculated both for without-project condition and with-project condition. The irrigation benefit is estimated as the difference of two total returns. As shown in Table 10.15 to Table 10.16. The estimated annual irrigation benefits are ₦2.927 million and ₦1.925 million for the Owrri Project and the Auchi Project respectively.

Build-up period of the irrigation project is assumed at 5 years for the estate farm and 7 years for the small holder both for the Owerri Project and Auchi Project after completion of the irrigation facilities during which the benefit will increase linearly. Based on this assumption, the expected annual irrigation benefits are calculated and presented in Table 10.17.

Table 10.2 Economic and Financial Farm Gate Price of Food Crops

(N/t)

	Financial Price /1	Economic Price /2
Yam	232	175
Cassava	63	50
Maize	184	164
Cocoyam	136	102
Rice (Paddy) /3	560(308)	394(251)

/1 Financial farm gate price is estimated on the basis of the recent domestic retail price collected in the project areas taking into account the market overhead cost, transportation and assembly cost.

/2 Economic farm gate price for internationally traded crops is estimated on the basis of forecasted international price prepared by IBRD taking into account the transportation and marketing costs. The price for non-traded crops such as yam, cassava and cocoyam is estimated by assumed crop profit calculations.

/3 Price of rice is mill gate price while price of paddy is farm gate price.

Table 10.3 Economic and Financial Price of Farm Inputs

(₦/t)

	Economic/1	Financial/2
Seed		
Paddy	251	308
Yam	175	290
Cassava	-	-
Maize	164	230
Cocoyam	102	170
Fertilizer		
Urea	230	230
Compound	166	210
Chemicals		
Fungicide	3.5₦/kg	4.2₦/kg
Insecticide	4.5₦/kg	5.6₦/ℓ
Herbicide	1.9₦/kg(4.0₦/ℓ)	2.4₦/kg(5.0₦/ℓ)
Farm Labor	1.2₦/Manday	2.0₦/Manday

/1 Estimated basically on the basis of the international market price forecasted by IBRD.

/2 Estimated on the basis of the current market price.

Table 10.4 Local Market Price of Rice, Bendel State

(Kobo/kg)

1973		1974		1975		1976	
Jan.	29	Jan.	14	Jan.	32	Jan.	92
" Feb.	29	" Feb.	20	" Feb.	56	" Feb.	92
" Mar.	29	" Mar.	16	" Mar.	56	" Mar.	92
" Apr.	25	" Apr.	34	" Apr.	58	" Apr.	104
" May	25	" May	36	" May	58		
" June	19	" June	32	" June	70		
" July	19	" July	26	" July	70		
" Aug.	16	" Aug.	26	" Aug.	70		
" Sept.	13	" Sept.	26	" Sept.	72		
" Oct.	13	" Oct.	26	" Oct.	72		
" Nov.	12	" Nov.	26	" Nov.	72		
" Dec.	14	" Dec.	26	" Dec.	72		
Average of the year	20.3		25.7		63.2		(95)

Source : Regional Agricultural Office in Auchi, Bendel State

Table 10.5 Local Market Price of Rice, Imo State

(Kobo/kg)

1974		1976	
Average	55	Jan.	76
		" Feb.	74
1975 April	65	" March	-
" May	64	" April	67
" June	65	" May	75
		" June	83
Average of 1975	64	Average of 1976	75

Source : Abstract of Statistics, Imo State, June '76

Table 10.6 Recent Local Price of Rice (Mill Gate Price)

(Kobo/kg)

		SML	IR-5	TOS
1976	Jan.	75	65	65
	Feb.	80	66	66
	March	80	66	66
	April	80	66	66
	May	80	66	66
	June	80.5	66.5	66.5
	July	80.5	66.5	66.5
	Aug.	85	70	70
	Sept.	85	70	70
	Oct.	75	65	70
	Nov.	75	65	65
	Dec.	75	65	65
Average		79	66	70

Data Source : Adani Rice Mill

Table 10.7 Prices of Other Food Crops

(Kobo/kg)

	Imo State (Owerri)		Bendel State (Auchi)		
	1975	1976	1975	1976	Average
Yam	26	24/1	24	43/2	29
Cassava	-	-	8	11/2	9
Garri	17	18/1	-	-	17
Cocoyam	-	-	-	17/3	17
Maize	22	26/1	20	24/2	23
Beans	35	35/1	-	-	35

Note: /1 Average of Jan. to June
/2 Average of Jan. to April
/3 Average of Feb. to March

Data Source:

- Abstract of Statistics, Imo State, June '76
- Regional Agricultural Office in Auchi, Bendel State

Table 10.8 Economic Price of Paddy (Import Substitution)

International market price /1	US$359
Shipping cost incl. insurance	US$60
(CIF Port Harcourt)	US$419
Using shadow rate 1N = 1.27US$	N329.9
Unloading, port charge and import margin	N40
(CIF Price Warehouse Port Harcourt)	N369.9
Storage and insurance costs	N4
(Ex-Warehouse Price)	N373.9
Transport cost from Port Harcourt to the Project area	N20
Selling price of paddy (milling efficiency 0.70)	N275.7
Milling charge	-N24
Farm gate price	N251.7
	(≒N251)

/1 IBRD projected price for 1985 at 1976 constant price

Table 10.9 Economic Price of Maize (Import Substitution)

International market price /1	US$115
Shipping cost incl. insurance	US$45
(CIF Port Harcourt)	US$160
Using shadow rate 1N = 1.27US$	N125.9
Unloading, port charge and import margin	N14
(CIF Price Warehouse Port Harcourt)	N139.9
Storage and insurance costs	N4
(Ex-Warehouse Price)	N143.9
Transport cost from Port Harcourt to the Project area	N20
Farm gate price in the project area	N163.9
	(≈N164)

/1 IBRD projected price for 1985 at 1976 constant price

Table 10.10 Net Income per Ha for the Owerri Project

(₦/ha)

Kind of Crops	Future Without-Project			Future With-Project		
	Gross Returns /1	Production Costs /2	Net Income	Gross Returns /1	Production Costs /3	Net Income
Rice /4						
Direct Sowing	-	-	-	1,241.1	494.2	746.9
Transplanting	-	-	-	1,379		
Yam	1,225	673	552		575.0	804
Cassava	375	144	231	-	-	-
Maize	98	26	72	-	-	-
Cocoyam	316	142	174	-	-	-

/1 Economic price of the crop (₦/t) multiplied by crop production per ha (t/ha).

/2 Including the cost mainly for seed, and labor.

/3 Including the cost for farm inputs and operation and maintenance costs for farm machineries, rice mill and storage facilities.

/4 The net income for rice is calculated using mill gate price of rice.

Table 10.11 Net Income per Ha for the Auchi Project

(N/ha)

Kind of Crops	Future Without-Project			Future With-Project		
	Gross Returns /1	Production Costs /2	Net Income	Gross Returns /1	Production Costs /3	Net Income
Rice /4						
Direct sowing	301	81	220	1,241.1	506.6	734.5
Transplanting	-	-	-	1,379	595.1	783.9
Yam	1,278	673	605	-	-	-
Cassava	375	144	231	-	-	-
Maize	180	50	130	-	-	-

/1 Economic price of the crop (N/t) multiplied by crop production per ha (t/ha)

/2 Including the cost mainly for seed and labor.

/3 Including the cost for farm inputs and operation and maintenance costs for farm machineries, rice mill and storage facilities.

/4 The net income for rice on future without-project condition is calculated using farm gate price of paddy, while that of future with-project condition is calculated using mill gate price of rice.

Table 10.12 Net Income per Crop per Ha (Without-Project)

(1) Owerri Project Area

	Yam	Cassava	Maize	Cocoyam
Gross Income				
Production (t/ha)	7.0	7.5	0.6	3.1
Price (N/t)	175	50	164	102
Gross Income (N)	1,225	375	98.4	316.2
Production Cost				
Seed	473	-	2	102
Fertilizer & Chemicals	-	-	-	-
Farm Labor	200	144	24	40
Total Production Cost (N)	673	144	26	142
Net Income (N)	552	231	72.4 (±72)	174.2 (±174)

(2) Auchi Project Area

	Rice	Yam	Cassava	Maize
Gross Income				
Production (t/ha)	1.2	7.3	7.5	1.1
Price (N/t)	251	175	50	164
Gross Income (N)	301.2	1,277.5	375	180.4
Production Cost				
Seed	15	473	-	2
Fertilizer & Chemicals	-	-	-	-
Farm Labor	66	200	144	48
Total Production Cost (N)	81	673	144	50
Net Income (N)	220.2 (±220)	604.5 (±605)	231	130.4 (±130)

Table 10.13 Net Income of Paddy Production per Ha (with-Project)

Direct Sowing

(Unit: ₦)

Item		Owerri Project	Auchi Project
Gross Income			
Production (paddy)		4.5 t	4.5 t
Production (milled rice)/1		3.15 t	3.15 t
Price of Rice (at mill gate)		394/t	394/t
Gross Income		1,241.1	1,241.1
Production Cost			
Seed	100 kg x ₦0.251/kg	25.1	25.1
Fertilizer			
Compound	200 kg x ₦0.166/kg	33.2	33.2
Urea	129 kg x ₦0.23/kg	29.7	29.7
Agro-chemicals			
Fungicide	30 kg x ₦3.5/kg	105	105
Insecticide	3 ℓ x ₦4.5/ℓ	13.5	13.5
Herbicide	30 ℓ x ₦4.0/ℓ	120	120
O & M Cost of Farm Machineries		86.9	94.6
Personnel Cost		37.1	36.1
O & M Cost of Rice Mill		43.7	49.4
Total Cost		494.2	506.6
Net Income		746.9	734.5

/1 Milling efficiency is assumed to be 70%

Table 10.14 Net Income of Paddy Production per Ha (with -Project)

Transplanting

(Unit: ₦)

Item		Owerri Project	Auchi Project
Gross Income			
Production (paddy)		5.0 t	5.0 t
Production (milled rice)/1		3.5 t	3.5 t
Price of Rice (at mill gate)		394/t	394/t
Gross Income		1,379	1,379
Production Cost			
Seed	100 kg x ₦0.251/kg	8.7	8.7
Fertilizer			
Compound	200 kg x ₦0.166/kg	33.2	33.2
Urea	129 kg x ₦0.23/kg	29.7	29.7
Agro-chemicals			
Fungicide	30 kg x ₦3.5/kg	105	105
Insecticide	3 ℓ x ₦4.5/ℓ	13.5	13.5
Herbicide	70 kg x ₦1.9/ℓ	133	133
O & M Cost of Farm Machineries		74.6	88.2
Per sonnel Cost/2		128.8	129
O & M Cost of Rice Mill		48.5	54.8
Total Cost		575.0	595.1
Net Income		804.0	783.9

/1 Milling efficiency is assumed to be 70%

/2 Includes the cost for family laborers

Table 10.15 Estimate of Irrigation Benefit (Owerri Project)

Kind of Crops	With-Project			Without-Project			(3)-(6) Net Incremental Income (₦)
	(1) Cult. Area (ha)	(2) Net Income (₦/ha)	(3) Total Return (₦)	(4) Cult. Area (ha)	(5) Net Income (₦/ha)	(6) Total Return (₦)	
Paddy							
Direct sowing	2,030	746.9	1,516,210	-	-	-	1,516,210
Transplanting	2,170	804	1,744,680	-	-	-	1,744,680
Yam	-	-	-	240	552	132,480	-132,480
Cassava	-	-	-	720	231	166,320	-166,320
Maize	-	-	-	320	72	23,040	- 23,040
Cocoyam	-	-	-	70	174	12,180	- 12,180
Total	4,200		3,260,890	1,350		334,020	2,926,870 (≒2,927,000)

Table 10.16 Estimate of Irrigation Benefit (Auchi Project)

Kind of Crops	With-Project			Without-Project			(3)-(6)
	(1) Cult. Area (ha)	(2) Net Income (₦/ha)	(3) Total Return (₦)	(4) Cult. Area (ha)	(5) Net Income (₦/ha)	(6) Total Return (₦)	Net Incremental Income (₦)
Paddy							
Direct sowing	2,200	734.5	1,615,900	100	220	22,000	1,615,900
Transplanting	500	783.9	391,950	-	-	-	391,950
Yam	-	-	-	40	605	24,200	-24,200
Cassava	-	-	-	120	231	27,720	-27,720
Maize	-	-	-	70	130	9,100	- 9,100
Total	2,700		2,007,850	330		83,020	1,924,830 (≒1,925,000)

11. PROJECT EVALUATION

11. PROJECT EVALUATION

11.1 Economic Evaluation

11.1.1 General

Economic feasibility of the two projects is analized by calculating internal rate of return on the basis of the estimated economic costs for the implementation of the project and economic benefits. Sensitivity analysis is also made with respect to change in the construction cost, productivity of rice and price of rice for checking the sensitivity of the project feasibility.

For the economic analysis the project life is assumed at 30 years after completion of the project facilities from 1983 - 2012.

11.1.2 Economic Project Costs and Benefits

1) Economic project costs

In order to estimate the economic construction cost, adjustments are made to the project costs (or financial project cost) estimated in Chapter 9 in the following manner:

a) Cost for the construction machineries is valued by their depreciation cost instead of the procurement cost;

b) Compensation costs for land acquisition are excluded;

c) Price contingency for the construction cost is excluded;

d) Shadow exchange rate of ₦ = US$1.27 is applied instead of the official rate for conversions from US$ to ₦;

e) Wage of the unskilled labor is shadowed at 60% of the current wage rate; and

f) Import taxes on the construction machineries are excluded.

Through these adjustments, the economic construction costs for the Owerri Project and the Auchi Project are estimated as shown below.

Economic cost of the Owerri Project

Economic construction cost of the Owerri Project is estimated at ₦14.37 million consisting of ₦8.556 million of foreign currency portion and ₦5.814 million of local currency portion. Details of the cost estimate are presented in Table 11.1 and its annual disbursement schedule is shown in Table 11.2.

Annual operation, maintenance and replacement costs for the Owerri Project are estimated at ₦497,000 at its full development stage in 1983.

Economic cost of the Auchi Project

Economic construction cost of the Auchi Project is estimated at ₦14.56 million comprising of ₦8.164 million of foreign currency portion and ₦6.396 million of local currency portion. Details of the cost estimate are shown in Table 11.3 and its annual disbursement schedule is given in Table 11.4.

Annual operation, maintenance and replacement costs are estimated at ₦465,000 at the full development stage of the project in 1983.

2) Project benefits

As explained in the preceding chapter (Chapter 10), irrigation benefits are estimated at ₦2,927,000 and ₦1,925,000 for the Owerri Project and the Auchi Project respectively at the full development stage of the projects.

11.1.3 *IRR of the Projects*

On the basis of the economic construction costs and benefits estimated above, economic internal rate of return of the two projects are calculated for the project life of 30 years after completion of the project construction works.

The estimated IRRs are 12.0% for the Owerri Project and 7.1% for the Auchi Project, which indicate that the Owerri Project is economically feasible while the Auchi Project possesses relatively low economic viability.

Sensitivity test

For the analysis of the project sensitivity, sensitivity test is made with respect to the project cost, productivity of rice and price of rice. The results of the sensitivity analysis show that the economy of the project is quite sensitive to the change in productivity of rice and price of rice but not so sensitive to increase in the project cost. Details of the analysis are shown in Table 11.5 and Table 11.6 for the Owerri Project and the Auchi Project respectively.

11.2 Financial Evaluation

11.2.1 General

Financial evaluation of the two projects is made both from the view point of farmers to be involved in the projects and of the estate farm.

Typical farm budget is firstly analized to assess whether the project will have sufficient incentive to the farmers in the project area with enough income increase and to assess the plausible amount of the charges for irrigation water and machinery services to be provided by the estate farm.

Profitability of the estate farm is assessed on the basis of the expected revenue and the operation cost.

11.2.2 Farm Budget Analysis

For evaluating the feasibility of the project from farmer's economy, farm budget both in the Owerri Project area and the Auchi Project area is investigated.

As explained in Chapter 4, Present Agricultural Condition, gross farm incomes for typical farmer holding 1.0 ha in the Owerri Project area and 1.5 ha in the Auchi Project area are N883 and N1,021 respectively. The net incomes after deducting crops production cost and living expenses from the gross income are only N14 and N92 for the typical farmer in the Owerri Project area and the Auchi Project area.

Upon completion of the project, 1.2 ha of the irrigated land will be allocated to the farmers. Through the introduction of the intensive agricultural production, farm income from selling food crops is expected to increase considerably. Instead, income gaining from tree crops will decrease since most of the available family labor will be used for paddy cultivation and the land for tree crops will be reduced.

In the Owerri Project area, the gross income will reach N3,742 at the full development stage of the project, which means about 4 times increase from that of the present. The gross income will be about N3,166 in the Auchi Project area, which is slightly lower than that of the Owerri Project area due to the less intensive agricultural production.

As for expenses, farming expenses will increase considerably in proportion to the increase in farm input dosage. Living expenses will also increase for the improvement of their Living standard. Total expenses will be N2,085 and N2,016 for the typical farmer in the Owerri Project and the Auchi Project areas.

Annual net reserve or capacity to pay which is defined as the difference between the gross income and the total expenses will grow to N1,657 in the Owerri Project and N1,150 in the Auchi Project. The increased net reserves indicate sufficient capacity to pay for charges on the irrigation water and machinery services. (Details of the farm budgets on future with-project condition are presented in Table 11.7 to Table 11.8).

11.2.3 Profitability of the Estate Farm

Profitability of the estate farm is assessed by calculating the profit investment ratio and financial rate of return on the basis of the expected revenue and the operation cost.

1) Project revenue

The revenue for the estate farm consists of income from selling rice and charges on irrigation water and machinery services to be collected from farmers in the small holder area.

With respect to income from selling rice, it is assumed that all the products both in the estate farm and small holder area will be sold through the Processing and Marketting Department of the estate farm except home consumption of farmers. Selling price of milled rice is set at N560/t for the calculation of the revenue.

The irrigation water charge and machinery services charge to be imposed on the farmers are set in such a manner that the charges shall cover the operation and maintenance cost of the irrigation facilities, farm machineries and rice mills. The estimated charges are N210/ha (or about N500/farm family) and N270/ha (or N540/farm family) for the Owerri Project area and the Auchi Project area respectively. The proposed charges amount to 30% and 47% of the net reserve for the typical farmer in the Owerri Project area and the Auchi Project area.

The estimated annual revenue is N8.11 million and N4.95 million at the full development stage for the Owerri Project and the Auchi Project respectively.

2) Operation cost

Operation cost for the estate farm comprises such rice production costs as farm input costs, operation and maintenance costs of farm machinery and rice mill and depreciation cost for all equipment and building facilities. Purchasing cost of paddy at the rate of N308/t from farmers in the small holder area is also included in the operation cost.

The estimated operation costs of the estate farm are N5.40 million for the Owerri Project and N2.80 million for the Auchi Project.

3) Investment profit ratio and financial rate of return

Net profit is calculated by deducting the project operation cost from the revenue. The estimated net profit is ₦2.71 million and ₦2.15 million for the Owerri Project and the Auchi Project respectively.

At the full development stage of the project, the profit ratios to the investment cost are estimated at 11.9% for the Owerri Project and 9.4% for the Auchi Project. However, due to the low profitability during the build-up period and required long gestation period the financial rates of return for the estate farms are estimated at 10.2% for the Owerri Project and 7.8% for the Auchi Project on the basis of the calculated cash flow table as shown in Table 11.11 and Table 11.12.

11.3 Socio-Economic Impact of the Project

In addition to the irrigation benefits which are evaluated in the preceding chapter of Economic Evaluation, favourable socio-economic impacts are expected to be derived from the implementation of the project.

Creation of employment opportunity will be one of the valuable contribution to the regional economy from the stage of the construction to the operation. During the construction of the irrigation facilities, considerable number of laborers will be employed at the project site. In the operation stage, about 321 permanent staffs and labores and 24,600 mandays of seasonal laborers will be employed for the Owerri Project, while about 248 permanent staffs and laborers and 35,000 mandays of seasonal laborers will be employed for the Auchi Project. Increase in employment opportunity is also expected on farm by the introduction of intensive crop cultivation. Since there exist considerable unemployment and under-employment on farm, increased job opportunity will no doubt provide benefit for solving the unemployment problem in the region. Additional income to be gained from the increased labor opportunity will further contribute to the national economy by increasing the aggregate consumption.

Transfer of knowledge and demonstration effect are another impacts on the economy. The implementation of the project will provide good opportunity to the local staff for gaining the experience in various work fields and will improve their skills and technics. The project staffs, extension workers and farmers in the project area will be trained intensively for acquiring the know-how and technics of the irrigation farming together with the operation and maintenance of the farm machineries and equipment. Transfer of the knowledge for operation and management of the project are also expected through the project implementation. Since the project is the first intensive irrigated paddy cultivation project with mechanized farming in each state, considerable demonstration effects will be provided to the region, which will facilitate the agricultural development in the region.

Increased agricultural production with the irrigation project will give effects to solve the food shortage in the country and will also increase farm income in the project areas, since the project aims to develops not only the estate farm but also the small holder in the area. As the farm income is relatively lower compared with the income of urban people, the increased farm income of the small holder will not only contribute to enhance the economic activity in the region through its multiple effects on other sectors of the economy but also contribute to even income distribution considerably.

Living conditions including health and sanitary conditions will be improved. Irrigation water will be used for convenient water source for home consumption of the farmers in the region, who are now getting their drinking water from the distant stream. Although it is feared that the application of the agricultural

chemicals will damage the environment in the region, the effect is considered to be negligible in view of the scale of the project and present environmental situation in the region. Instead, faborable effect for improvement health is expected to be derived from the chemical dosage by diminishing flies and mosquitoes.

All these effects mentioned above will contribute to promote the national policy of the third development plan which includes even distribution of income, reduction of unemployment and increase in the food supply. Socio-economic stability is also expected to be facilitated in the region through these effects.

Table 11.1 Economic Construction Cost of the Owerri Project

(10^3 ₦)

Cost Item	Foreign Currency	Local Currency	Total
Civil Works	3,560	3,790	7,350
Rice Mill, Storage Facilities and Office Facilities	2,746	2,024	4,770
Initial Farm Investment	2,250	-	2,250
Total	8,556	5,814	14,370

Table 11.3 Economic Construction Cost of the Auchi Project

(10^3 ₦)

Cost Item	Foreign Currency	Local Currency	Total
Civil Works	3,970	4,530	8,500
Rice Mill, Storage Facilities and Office Facilities	2,414	1,866	4,280
Initial Farm Investment	1,780	-	1,780
Total	8,164	6,396	14,560

Table 11.2 Annual Disbursement of Economic Construction Cost, Owerri Project

(Unit: ₦1,000)

Item	Total Cost	1977	1978	1979	1980	1981	1982	1983
Civil works								
1) Construction works	5,169	7	259	1,568	1,756	789	790	-
2) Engineering services, & administration	1,525	299	306	317	250	180	173	-
3) Physical contingency	656	-	34	200	224	99	99	-
Sub-Total	7,350	306	599	2,085	2,230	1,068	1,062	-
Processing, storage, officee facilities								
1) Processing facilities	3,554	-	-	-	1,866	-	927	761
2) Workshop & storage facilities	147	-	147	-	-	-	-	-
3) Office and related facilities	678	203	386	89	-	-	-	-
4) Physical contingency	391	30	80	13	184	-	46	38
Sub-Total	4,770	233	613	102	2,050	-	973	799
Initial farm investment								
1) Agricultural machinery	2,142	-	-	-	691	764	687	-
2) Farm inputs	-	-	-	-	-	-	-	-
3) Physical contingency	107	-	-	-	36	38	34	-
Sub-Total	2,250	-	-	-	727	802	721	-
Grand Total	14,370	539	1,212	2,187	5,007	1,870	2,756	799

Table 11.4 Annual Disbursement of Economic Construction Cost, Auchi Project

(Unit: ₦1,000)

Item	Total Cost	1977	1978	1979	1980	1981	1982	1983
Civil works								
1) Construction works	6,032	16	368	2,202	1,468	989	989	-
2) Engineering services, & administration	1,680	346	388	319	269	247	111	-
3) Physical contingency	788	5	50	286	191	128	128	-
Sub-Total	8,500	367	806	2,807	1,928	1,364	1,228	-
Processing, storage, office facilities								
1) Processing facilities	3,099	-	0	-	1,621	821	-	657
2) Workshop & storage facilities	147	-	147	-	-	-	-	-
3) Office and related facilities	670	202	388	80	-	-	-	-
4) Physical contingency	364	33	80	12	165	41	-	33
Sub-Total	4,280	235	615	92	1,786	862	-	690
Initial farm investment								
1) Agricultural machinery	1,694	-	-	369	258	431	447	189
2) Farm inputs	-	-	-	-	-	-	-	-
3) Physical contingency	86	-	-	18	13	22	23	10
Sub-Total	1,780	-	-	387	271	453	470	199
Grand Total	14,560	602	1,421	3,286	3,985	2,679	1,698	889

Table 11.5 Sensitivity Analysis of the Owerri Project

	Project Cost	Productivity of Rice	Price of Rice	IRR (%)
1)	0	0	0	12.0
2)	+5%	0	0	11.3
3)	+10%	0	0	10.7
4)	0	-10%	0	9.4
5)	0	-20%	0	6.0
6)	0	0	-10%	9.4
7)	0	0	-20%	6.0
8)	+5%	-10%	-10%	7.2

Table 11.6 Sensitivity Analysis of the Auchi Project

	Project Cost	Productivity of Rice	Price of Rice	IRR (%)
1)	0	0	0	7.1
2)	+5%	0	0	6.6
3)	+10%	0	0	6.1
4)	0	-10%	0	4.7
5)	0	0	-10%	4.7

Table 11.7 Typical Farm Budget in the Owerri Project Area (Future With-Project)

	Cult. Area (ha)	Unit Yield (t/ha)	Total Yield (t)	Unit Price (₦/t)	Total Value (₦)
Average Farm Size		(1.2 ha)			
I. Gross Income					
1. Food crops					
Wet season paddy	1.2	5.0	6.0	308	1,848
Dry season paddy	1.2	5.0	6.0	308	1,848
(Sub-total)					(3,696)
2. Tree crops and others					46
Total Gross Income					3,742

	Area (ha)	Unit Amount (kg/ha)	Total Amount (kg)	Unit Price (₦/kg)	Total Cost (₦)
II. Gross Outgo					
1. Farming expenses					
Seed	2.4	35	84	0.31	26.0
Fertilizer					
Urea	2.4	129	309.6	0.23	71.2
Compound	2.4	200	480	0.21	100.8
Chemicals					
Insecticide	2.4	3 ℓ/ha	7.2 ℓ	5.6 ₦/ℓ	40.3
Fungicide	2.4	30	72	4.2	302.4
Herbicide	2.4	70	168	2.4	403.2
(Sub-total)					(943.9)
2. Living expenses					
Food consumption/1					781
Other living expenses					360
(Sub-total)					(1,141)
Total Gross Outgo					2,084.9
III. Net Reserve					1,657.1

/1 Includes the value of food crops which are produced by farmers themselves.

Table 11.8 Typical Farm Budget in the Auchi Project Area (Future With-Project)

	Cult. Area (ha)	Unit Yield (t/ha)	Total Yield (t)	Unit Price (₦/t)	Total Value (₦)
Average Farm Size		(1.2 ha)			
I. Gross Income					
1. Food crops					
Wet season paddy	1.2	5.0	6.0	308	1,848
Dry season paddy	0.8	5.0	4.0	308	1,232
(Sub-total)					(3,080)
2. Tree crops and others					86
Total Gross Income					3,166

	Area (ha)	Unit Amount (kg/ha)	Total Amount (kg)	Unit Price (₦/kg)	Total Cost (₦)
II. Gross Outgo					
1. Farming expenses					
Seed	2.0	35	70	0.31	21.7
Fertilizer					
Urea	2.0	129	258	0.23	59.3
Compound	2.0	200	400	0.21	84
Chemicals					
Insecticide	2.0	3 (/ha	6 (	5.6 ₦/(	33.6
Fungicide	2.0	30	60	4.2	252
Herbicide	2.0	70	140	2.4	336
(Sub-total)					(786.6)
2. Living expenses					
Food consumption/1					841
Other living expenses					388
(Sub-total)					(1,229)
Total Gross Outgo					2,015.6
III. Net Reserve					1,150.4

/1 Includes the value of food crops which are produced by farmers themselves.

Table 11.9 Project Revenue and Cost (Owerri Project)

Item		Amount (N1,000)
I)	Project Revenue	
	1) Sales of rice 13,670 t/1 x N560/t	7,655
	2) Machinery & water charge 2,170 ha x N210/ha/2	456
	Total	8,111
II)	Operation Cost	
	1) Production cost	
	- Farm inputs 2,030 ha x N395.3/ha	802
	- Farm machinery cost	523
	- Rice mill & storage	205
	- Depreciation cost /3	375
	Sub-total	1,905
	2) O & M cost /4 4,200 ha x N70.8	297
	3) Purchasing cost of paddy from farmer (10,850 - 460)t x N308/t	3,200
	Total	5,402
III)	Net Profit	2,709

/1 Rice production (13,990 t) - Self consumption of farmers (320 t) = 13,670 t

/2

O & M cost for irrigation	:	N70.8/ha
O & M cost for farm machinery	:	N83.4/ha
O & M cost for rice mill & storage facilities	:	N51.3/ha
Total		N205.5/ha ≒ N210/ha

/3 Includes the depreciation cost for the farm machineries, rice mill and building facilities.

/4 Inclues OM cost for irrigation facilities and project offices.

Table 11.10 Project Revenue and Cost (Auchi Project)

Item		Amount (N1,000)
I) Project Revenue		
1) Sales of rice	8,590 t/1 x N560/t	4,810
2) Machinery & water charge	500 ha x N270/ha/2	135
Total		4,945
II) Operation Cost		
1) Production cost		
- Farm inputs	2,200 ha x N395.3/ha	870
- Farm machinery cost		417
- Rice mill & storage		147
- Depreciation cost /3		318
Sub-total		1,752
2) O & M cost /4	2,700 ha x N116.7	315
3) Purchasing cost of paddy from farmer	(2,500 - 130)t x N308/t	730
Total		2,797
III) Net Profit		2,148

/1 Rice production (8,680 t) - Self consumption of farmers (90 t) = 8,590 t

/2

O & M cost for irrigation	:	N116.7/ha
O & M cost for farm machinery	:	N 97.4/ha
O & M cost for rice mill & storage facilities	:	N59.3/ha
Total		N273.4/ha ≒ N270/ha

/3 Includes the depreciation cost for the farm machineries, rice mill and building facilities.

/4 Includes OM cost for irrigation facilities and project offices.

Table 11.11 Cash Flow Statement of the Owerri Project

(Unit: ₦1,000)

Year	Year in Order	Cash Inflow: Sales of Rice /1	Cash Inflow: Machinery Charge & Water Charge	Cash Inflow: Total Inflow	Cash Outflow: Project Cost: Irrigation Facilities	Cash Outflow: Project Cost: Farm Machineries Rice Mill & Storage Facilities	Cash Outflow: Production Cost	Cash Outflow: O & M Cost	Cash Outflow: Total Outflow	Balance
1977	1	-	-	0	258	291	-	-	549	-549
1978	2	-	-	0	3,210	874	-	-	4,084	-4,084
1979	3	-	-	0	2,640	160	-	-	2,800	-2,800
1980	4	441	-	441	3,003	3,900	266	53	7,222	-6,781
1981	5	1,776	-	1,776	1,702	1,346	897	179	4,124	-2,348
1982	6	3,999	137	4,136	1,837	2,462	2,327	372	6,998	-2,862
1983	7	5,896	303	6,199	-	957	3,654	497	5,108	1,091
1984	8	6,634	339	6,973	-	-	3,935	497	4,432	2,541
1985	9	6,889	356	7,245	-	-	4,134	497	4,631	2,614
1986	10	7,144	392	7,536	-	-	4,333	297	4,630	2,906
1987	11	7,400	419	7,819	-	-	4,531	297	4,828	2,991
1988	12	7,655	456	8,111	-	241	4,730	297	5,268	2,843
1989	13	7,655	456	8,111	-	301	4,730	297	5,328	2,783
1990	14	7,655	456	8,111	-	607	4,730	297	5,634	2,477
1991	15	7,655	456	8,111	-	355	4,730	297	5,382	2,729
1992	16	7,655	456	8,111	-	310	4,730	297	5,337	2,774
1993	17	7,655	456	8,111	-	-	4,730	297	5,027	3,084
1994	18	7,655	456	8,111	-	-	4,730	297	5,027	3,084
1995	19	7,655	456	8,111	-	-	4,730	297	5,027	3,084
1996	20	7,655	456	8,111	-	241	4,730	297	5,268	2,843
1997	21	7,655	456	8,111	-	301	4,730	297	5,328	2,783
1998	22	7,655	456	8,111	-	314	4,730	297	5,341	2,770
1999	23	7,655	456	8,111	-	-	4,730	297	5,027	3,084
2000	24	7,655	456	8,111	-	1,253	4,730	297	6,280	1,831
2001	25	7,655	456	8,111	-	355	4,730	297	5,382	2,729
2002	26	7,655	456	8,111	-	1,403	4,730	297	6,430	1,681
2003	27	7,655	456	8,111	-	927	4,730	297	5,954	2,157
2004	28	7,655	456	8,111	-	241	4,730	297	5,268	2,843
2005	29	7,655	456	8,111	-	301	4,730	297	5,328	2,783
2006	30	7,655	456	8,111	-	314	4,730	297	5,341	2,770
2007	31	7,655	456	8,111	-	-	4,730	297	5,027	3,084
2008	32	7,655	456	8,111	-	-	4,730	297	5,027	3,084
2009	33	7,655	456	8,111	-	-	4,730	297	5,027	3,084
2010	34	7,655	456	8,111	-	2,178	4,730	297	7,205	906
2011	35	7,655	456	8,111	-	355	4,730	297	5,380	2,729
2012	36	7,655	456	8,111	-	551	4,730	297	5,578	2,533

/1 Price of milled rice: 560 ₦/t

Table 11.12 Cash Flow Statement of the Auchi Project

(Unit: ₦1,000)

Year	Year in Order	Cash Inflow: Sales of Rice /1	Cash Inflow: Machinery Charge & Water Charge	Cash Inflow: Total Inflow	Cash Outflow: Project Cost: Irrigation Facilities	Cash Outflow: Project Cost: Farm Machineries Rice Mill & Storage Facilities	Cash Outflow: Production Cost	Cash Outflow: O & M Cost	Cash Outflow: Total Outflow	Balance
1977	1	-	-	0	309	291	-	-	600	-600
1978	2	-	-	0	3,438	873	-	-	4,311	-4,311
1979	3	-	-	0	3,590	696	-	-	4,286	-4,286
1980	4	940	-	940	2,612	2,901	598	174	6,285	-5,345
1981	5	1,766	-	1,766	2,040	1,758	975	281	5,054	-3,288
1982	6	2,941	-	2,941	2,171	924	1,317	375	4,787	-1,846
1983	7	3,928	73	4,001	-	1,317	1,782	456	3,555	446
1984	8	4,497	92	4,589	-	-	1,909	465	2,374	2,215
1985	9	4,575	103	4,678	-	-	1,972	465	2,437	2,241
1986	10	4,634	111	4,745	-	-	2,020	315	2,335	2,410
1987	11	4,693	119	4,812	-	116	2,068	315	2,499	2,313
1988	12	4,752	127	4,879	-	123	2,116	315	2,554	2,325
1989	13	4,810	135	4,945	-	314	2,164	315	2,793	2,152
1990	14	4,810	135	4,945	-	271	2,164	315	2,750	2,195
1991	15	4,810	135	4,945	-	294	2,164	315	2,773	2,172
1992	16	4,810	135	4,945	-	225	2,164	315	2,704	2,241
1993	17	4,810	135	4,945	-	83	2,164	315	2,562	2,383
1994	18	4,810	135	4,945	-	-	2,164	315	2,479	2,466
1995	19	4,810	135	4,945	-	116	2,164	315	2,280	2,665
1996	20	4,810	135	4,945	-	123	2,164	315	2,602	2,343
1997	21	4,810	135	4,945	-	176	2,164	315	2,655	2,290
1998	22	4,810	135	4,945	-	187	2,164	315	2,666	2,279
1999	23	4,810	135	4,945	-	238	2,164	315	2,717	2,228
2000	24	4,810	135	4,945	-	932	2,164	315	3,411	1,534
2001	25	4,810	135	4,945	-	1,100	2,164	315	3,579	1,366
2002	26	4,810	135	4,945	-	225	2,164	315	2,704	2,241
2003	27	4,810	135	4,945	-	1,025	2,164	315	3,504	1,441
2004	28	4,810	135	4,945	-	123	2,164	315	2,602	2,343
2005	29	4,810	135	4,945	-	176	2,164	315	2,655	2,290
2006	30	4,810	135	4,945	-	187	2,164	315	2,666	2,279
2007	31	4,810	135	4,945	-	100	2,164	315	2,579	2,366
2008	32	4,810	135	4,945	-	-	2,164	315	2,479	2,466
2009	33	4,810	135	4,945	-	138	2,164	315	2,617	2,328
2010	34	4,810	135	4,945	-	1,638	2,164	315	4,162	783
2011	35	4,810	135	4,945	-	310	2,164	315	2,789	2,156
2012	36	4,810	135	4,945	-	348	2,164	315	2,827	2,118

/1 Price of milled rice: 560 ₦/t

Fig. 11.1 Estimate of IRR, Owerri Project

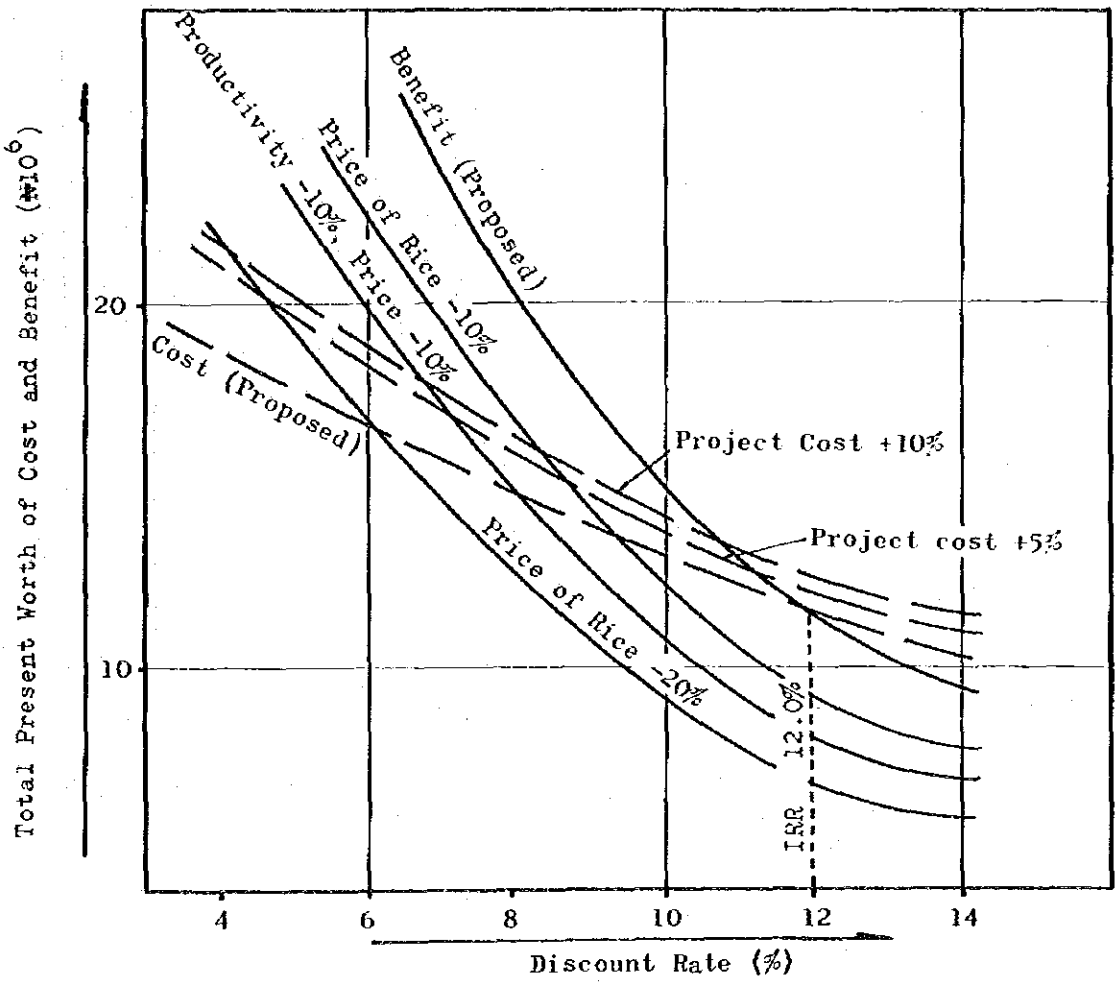
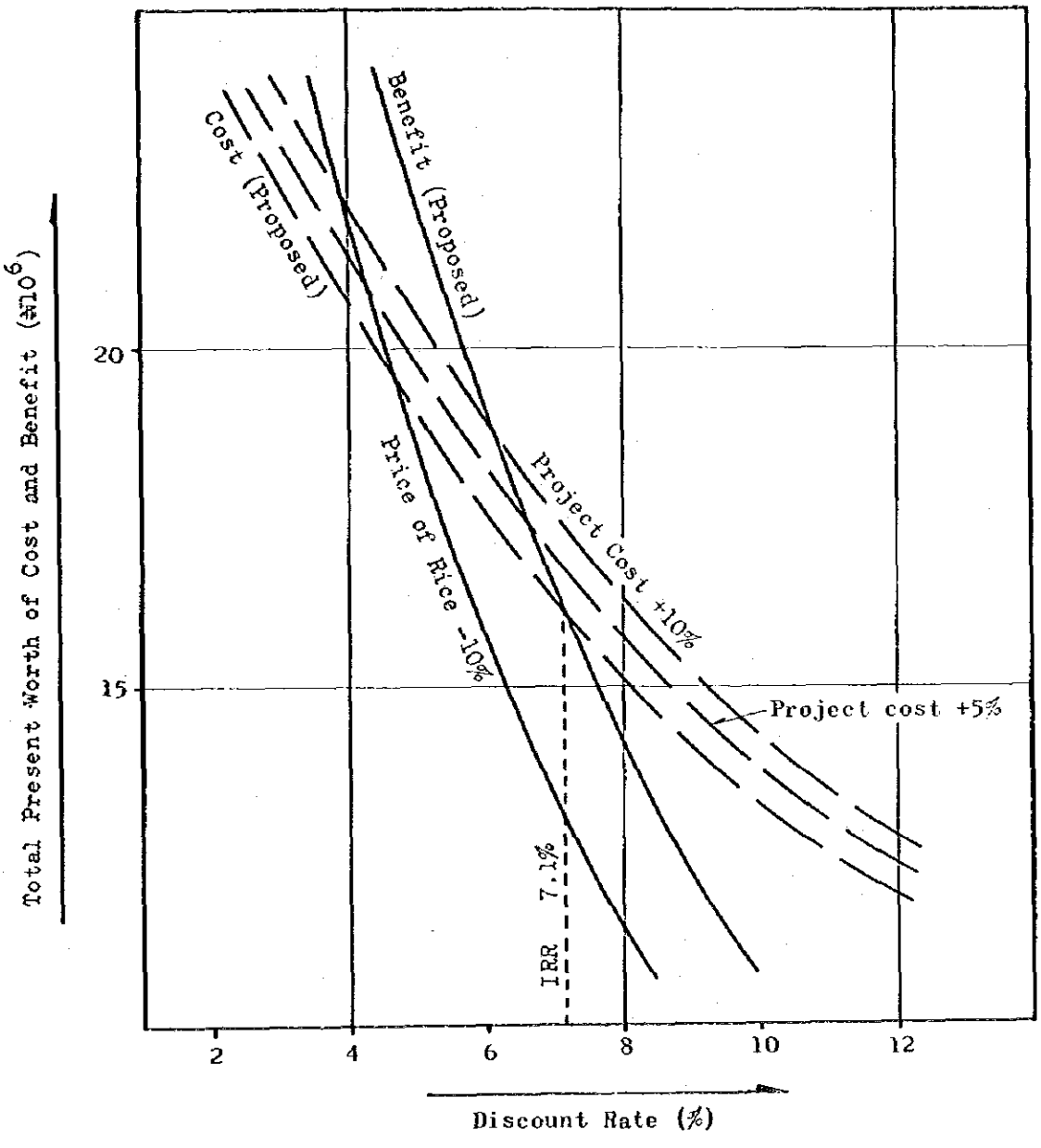


Fig. 11.2 Estimate of IRR, Auchi Project



12. STUDY ON THE DEVELOPMENT SCALE

12. STUDY ON THE DEVELOPMENT SCALE

12.1 The Owerri Project

12.1.1 Introduction

This study aims to select the most optimum rice production-oriented agricultural development plan in the Oramirukwa river basin in Imo State, Nigeria.

There exist two physical constraints for preparing the agricultural development plan in the basin, namely, scarcity of available land and limited available water resources. Most of the cultivable area along the river is already settled and suitable land for large irrigation development is limited. The recent land acquisition for rubber plantation and for the resettlement from Equatorial Guinea in the basin makes the range for selective area narrower. In due consideration of the economy of gravity irrigation, the maximum extent of the available area for the sizable agricultural development project is estimated at around 4,000 to 4,500 ha.

Available water from the Oramirukwa river fluctuates monthly. The estimated monthly mean discharges are ranging from 2.65 m^3/sec in the driest month to 11.31 m^3/sec in the midst of the rainy season. On the basis of the proposed cropping pattern, critical time for irrigation will occur in March when available water from the river is 2.65 m^3/sec. This is another constraint for the irrigation plan.

Within the constraints mentioned above, three alternative plans with different development scale are formulated for determining the optimum development scale. The alternative plans are:

Plan I: Development scale of 1,000 ha;
Plan II: Development scale of 2,100 ha; and
Plan III: Development scale of 3,000 ha.

The location of the areas to be developed is shown in Fig. 12.1.

12.1.2 Comparative Study

1) Project Features and Implementation Schedule

Features of the three alternative plans are summarized in Table 12.1. Rice is to be planted as a main crop for each development plan. The cropping calendar and the farming practices to be applied as well as the productivity of rice are assumed to be same for each plan.

The implementation schedules for the three alternative plans are worked out as presented in Fig. 12.2 to Fig. 12.4.

2) Project Costs

Project costs for the three alternative plans are estimated on the same conditions mentioned in Chapter 9. The project costs are ₦12.262 million for Plan I, ₦22.640 million for Plan II and ₦32.017 million for Plan III. Details of the costs are presented in Table 12.2.

By applying the same adjustment presented in Chapter 11.1 to the project costs, economic costs of the alternative plans are estimated. They are ₦8.437 million for Plan I, ₦14.370 million for Plan II and ₦19.813 million for Plan III. The economic costs are summarized into Table 12.3.

Annual operation and maintenance costs are estimated at ₦315 thousand for Plan I, ₦417 thousand for Plan II and ₦508 thousand for Plan III.

3) Project Benefits

Irrigation benefit is calculated by using the estimated economic price for the production cost and output value as presented in Chapter 10.2. The estimated irrigation benefits to be incorporated in the economic analysis are ₦1.38 million for Plan I, ₦2.93 million for Plan II, and ₦3.46 million for Plan III at their full development stages. The target will be attained in the 7th year for Plan I, 9th year for Plan II and 9th year for Plan III.

4) Economic Evaluation

Economic evaluation is made by calculating the economic internal rate of return on the basis of the estimated economic costs and benefits for each development scale. The calculated internal rates of return are 8.3 % for Plan I, 12.0 % for Plan II and 9.9 % for Plan III.

12.1.3 Conclusion

As shown in Fig. 12.5, most optimum scale of the project would be around 2,100 to 2,300 ha in view of the economy of the project. However, since the available data for hydrological analysis of the river water is quite limited, there still remain many uncertainities in the estimated monthly mean discharges. In due consideration of the allowance for these uncertainities involved in the present estimation, the optimum development scale is determined conservatively at 2,100 ha.

12.2 The Auchi Project

12.2.1 Introduction

Nigerian Government has a plan to establish a rice farm with a scale of 2,000 to 4,000 ha in each of the states along the Lower Niger. In accordance with this plan, the proposed development scale of the Auchi Project was determined at 2,100 ha, taking also into account the impacts on the regional economy.

In this section, most economically optimum plan is assessed in terms of the economic internal rate of return by setting aside the scale constraints mentioned in the above agreement and taking into accounts only the physical constraints in the basin.

12.2.2 Optimization Study

1) General

There exist two physical constraints for preparing the agricultural development plan in the basin, i.e., the limited available land for the sizable project and the limited available water resources.

The Ojo river basin is relatively small and the longitudinal gradient is steep. Furthermore, the lowland between the attitude of 200 ft. to 250 ft. is inundated annually by the flood of the Orle river. Due to these natural conditions, available land for sizable agricultural development project is quite limited and only about 3,000 ha along the provincial road from Auchi to Agenebode is found to be suitable.

Available water quantity from the Ojo river is also limited and it fluctuates monthly. The estimated monthly mean discharges are ranging from 0.30 m^3/sec in the driest season to 2.35 m^3/sec in the midst of the rainy season. On the basis of the proposed cropping pattern, critical time for irrigation will occur in March, when the available water from the river is 0.3 m^3/sec. This is another physical constraint for the irrigation plan.

In due consideration of these physical constraints, four alternative plans with different development scale are formulated. The alternative plans are:

Plan I: Development scale of 500 ha;
Plan II: Development scale of 600 ha;
Plan III: Development scale of 1,000 ha; and
Plan IV: Development scale of 2,100 ha.

The location of the areas to be developed is shown in Fig. 12.6.

2) Comparative Study

Comparative study for selecting the most optimum scale is made by calculating the internal rates of return for the four alternative plans on the basis of the estimated economic construction cost and benefit. (Project features for the alternative plans are briefly shown in Table 12.4 and their implementation schedules are illustrated in Fig. 12.7 to Fig. 12.10).

Project costs

Project costs for the four alternative plans are estimated on the same conditions stipulated in Chapter 9. The estimated costs are ₦7.444 million for Plan I, ₦8.49 million for Plan II, ₦13.5 million for Plan III and ₦22.92 million for Plan IV. (Refer to Table 12.5).

The economic construction costs are estimated for each plan by applying the same adjustment presented in Chapter 11.1. The estimated economic costs are ₦5.004 million for Plan I, ₦6.098 million for Plan II, ₦8.445 million for Plan III and ₦14.56 million for Plan IV. (Refer to Table 12.6).

Annual operation and maintenance costs are estimated at ₦171 thousand for Plan I, ₦190 thousand for Plan II, ₦250 thousand for Plan III and ₦465 thousand for Plan IV.

Benefits

Irrigation benefit is calculated by using the estimated economic price for the production cost and output value. The estimated irrigation benefits are ₦0.735 million for Plan I, ₦0.898 million for Plan II, ₦1.167 million for Plan III and ₦1.925 million for Plan IV at their full development stages.

Evaluation

On the basis of the estimated economic costs and benefits for each development scale economic internal rates of return are calculated. The calculated internal rates of return are 8.3 % for Plan I, 9.2 % for Plan II, 8.0 % for Plan III and 7.1 % for Plan IV.

Fig. 12.11 indicates that the most optimum development scale is around 600 ha from the view point of the project economy which is assessed by the simple comparison of the direct benefit and the economic construction cost.

Brief explanation on the project features in case of 600 ha is given in the following section.

12.2.3 Outline of the Most Economically Optimum Plan

1) Development Plan

The project area of 600 ha will comprise 300 ha of the estate farm and 300 ha of the small holder area. On the whole area complete double cropping of paddy will be realized (Refer to Fig. 12.12). The expected productivity of paddy will be 4.5 t/ha for the estate farm and 5.0 t/ha for the small holder area. Total production of milled rice will be about 4,000 tons at the full development stage scheduled in 1987.

2) Project Works

The features of the project works are summarized as below.

Major Project Works	Unit	Scale or Quantity
1. Headworks		
- Concrete weir, height	m	5.5
- " , length	"	45
- " , volume	m^3	1,500
2. Irrigation canals		
- Head race	km	11.7
- Main canal	"	3.5
- Secondary canal	"	6.3
- Tertiary canal	"	14.0
- Supply canal	"	66.0
3. Drainage canals		
- Collector drain	km	10.0
- Filled drain	"	35.0
4. Farm road	km	54.0
5. Paddy field construction	ha	600
6. Processing and storage facilities		
- Rice mill buildings	m^2	2,500
- Rice mill (1.0 t/hr)	Nos	1
7. Office and related facilities	m^2	5,200

Construction period will be shortened to 39 months, starting in October 1977 and terminating at the end of December 1980. Full operation of the project will, therefore, be possible at the beginning of 1981.

3) Cost Estimate

Project Cost

Total project cost or financial cost required for the implementation of the project is estimated at ₦8.49 million comprising the foreign currency portion of ₦4.054 million equivalent and the local currency portion of ₦4.436 million. The breakdown of the cost is given in Table 12.7 and the annual disbursement schedule is shown in Table 12.8.

Operation and Maintenance Cost

Operation and maintenance cost is estimated at ₦100 thousands per annum.

4) Project Evaluation

Economic Evaluation

Estimated economic benefit is ₦898 thousand at the full development stage of the project in 1987. Economic cost of the project is estimated at ₦6.098 million by making the necessary adjustment to the project cost. (Refer to Table 12.9).

On the basis of the estimated economic benefit and the economic cost, economic internal rate of return is calculated at 9.2 %. (Refer to Fig. 12.13).

Financial Evaluation

Gross income of the typical farmer holding 1.2 ha of the cultivated area will increase to ₦3,753 under future with-project condition. Although the farming expenses and living expenses will also increase considerably net reserve will attain ₦1,580, indicating that the farmer in the project area will prossess considerable capacity to pay for charges on the irrigation water and machinery services. The typical farm budget is presented in Table 12.10.

Expected project revenue of the project executing organization will be ₦2,322 thousand, which consists of the income from sales of rice and charges on machinery services and irrigation water. The project operation cost will amount to ₦1,573 thousand. The expected annual net profit will reach ₦749 thousand at the full development stage of the project which is equivalent to 10.5 % of the investment cost on the project cost. (Refer to Table 12.11). The calculated profit investment ratio shows that the financial viability of the project will become slightly higher compared with the proposed development plan (2,100 ha).

Table 12.1 Features of Major Project Works, Owerri Project

Major Project Works	Unit	Scale of Quantity Plan I	Plan II	Plan III
1. Civil Works				
Head works				
Concrete weir, height	m	5.5	5.5	8.0
" , length	"	42	42	42
" , volume	m^3	3,500	3,500	8,500
Embankment	"	32,000	32,000	62,500
Max. intake discharge	m^3/sec	1.4	3.0	3.0
Irrigation canals				
Head race	km	14.0	16.4	14.4
Secondary canal	"	7.5	11.4	15.4
Tertiary canal	"	24.1	50.6	72.3
Supply canal	"	104	219	313
Drainage canals				
Collector drain	km	22	26	30
Field drain	"	53	110	157
Farm road				
Main farm road	km	18	20	24
Branch farm road	"	72	150	214
Paddy field construction	ha	1,000	2,100	3,000
2. Processing & Storage Facilities				
Rice mill building	m^2	3,520	6,000	8,340
Rice mill	nos.	2 (1t/hr)	3 (1.5t/hr)	4 (1.5t/hr)
3. Office & Related Facilities	m^2	6,175	9,075	11,325

Table 12.2 Project Cost, Owerri Project

(Unit: ₦1,000)

Item	Plan I			Plan II			Plan III		
	FC	LC	Total	FC	LC	Total	FC	LC	Total
1. Civil works	3,008	2,380	5,388	4,659	4,360	9,019	6,202	5,953	12,155
2. Processing, storage and office facilities	1,030	1,534	2,564	2,102	2,207	4,309	2,850	2,804	5,654
3. Initial farm investment	886	528	1,414	1,743	864	2,607	2,369	1,561	3,930
4. Physical contingency	262	526	788	544	930	1,474	609	1,176	1,785
5. Provision for price escalation	778	1,330	2,108	2,002	3,229	5,231	3,180	5,313	8,493
Total	5,964	6,298	12,262	11,050	11,590	22,640	15,210	16,807	32,017

FC : Foreign currency

LC : Local currency

Table 12.3 Economic Construction Cost, Owerri Project

(Unit: ₦1,000)

Item	Plan I			Plan II			Plan III		
	FC	LC	Total	FC	LC	Total	FC	LC	Total
1. Civil works	2,211	1,951	4,162	3,326	3,368	6,694	4,649	4,869	9,518
2. Processing, storage and office facilities	1,280	1,227	2,507	2,615	1,764	4,379	3,540	2,243	5,783
3. Initial farm investment	1,088	-	1,088	2,137	-	2,137	2,911	-	2,911
4. Physical contingency	267	413	680	478	682	1,160	654	947	1,601
Total	4,846	3,591	8,437	8,556	5,814	14,370	11,754	8,059	19,813

Table 12.4 Features of Major Project Works, Auchi Project

Major Project Works	Unit	Scale of Quantity Plan I	Plan II	Plan III	Plan IV
1. Civil Works					
Head works					
Concrete weir, height	m	5.5	5.5	5.5	5.5
" , length	"	45	45	45	45
" , volume	m^3	1,500	1,500	1,500	1,500
Irrigation canals	km	83	101.5	153	302.4
Drainage canals	km	35	45	66	136.8
Farm road	km	43	54	86	178.4
Paddy field construction	ha	500	600	1,000	2,100
2. Processing & Storage Facilities					
Rice mill building	m^2	2,090	2,500	3,580	5,300
Rice mill (1.0 t/hr)	nos.	1	1	2	3
3. Office & Related Facilities	m^2	4,900	5,200	6,200	8,875

Table 12.5 Project Cost, Auchi Project

(Unit: ₦1,000)

Item	Plan I			Plan II			Plan III			Plan IV		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
1. Civil works	1,951	1,485	3,436	2,078	1,653	3,731	3,120	2,574	5,694	5,042	5,077	10,119
2. Processing, storage and office facilities	496	1,079	1,575	741	1,358	2,099	859	1,692	2,551	1,848	2,023	3,871
3. Initial farm investiment	401	260	661	607	237	844	762	857	1,619	1,371	829	2,200
4. Physical contingency	182	392	574	195	420	615	306	722	1,028	499	1,008	1,507
5. Provision for price escalation	316	882	1,198	433	768	1,201	694	1,914	2,608	1,810	3,413	5,223
Total	3,346	4,098	7,444	4,054	4,436	8,490	5,741	7,759	13,500	10,570	12,350	22,920

FC: Foreign currency

LC: Local currency

Table 12.6 Economic Construction Cost, Auchi Project

(Unit: ₦1,000)

Item	Plan I			Plan II			Plan III			Plan IV		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
1. Civil works	1,412	1,185	2,597	1,496	1,289	2,785	2,312	2,043	4,355	3,687	4,025	7,712
2. Processing, storage and office facilities	617	863	1,480	921	1,087	2,008	1,069	1,354	2,423	2,299	1,617	3,916
3. Initial farm investiment	499	-	499	749	-	749	948	-	948	1,691	-	1,691
4. Physical contingency	154	274	428	204	352	556	259	460	719	487	754	1,241
Total	2,682	2,322	5,004	3,370	2,728	6,098	4,588	3,857	8,445	8,164	6,396	14,560

Table 12.7 Project Cost (Financial cost), Auchi Project

(Unit: N1,000)

Item	FC	LC	Total
1. Civil works	2,078	1,653	3,731
2. Processing, storage & office facilities	741	1,358	2,099
3. Initial farm investment	607	237	844
4. Physical contingency	195	420	615
5. Provisions for price escalation	433	768	1,201
Total	4,054	4,436	8,490

Table 12.9 Economic Construction Cost, Auchi Project

(Unit: N1,000)

Item	FC	LC	Total
1. Civil works	1,496	1,289	2,785
2. Processing, storage & office facilities	921	1,087	2,008
3. Initial farm investment	749	-	749
4. Contingency	204	352	556
Total	3,370	2,728	6,098

FC: Foreign currency

LC: Local currency

Table 12.8 Annual Disbursement Schedule, Auchi Project

(Financial Cost)

(Unit: ₦1,000)

Item	Total			1977			1978			1979			1980			1981		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
1) Civil works	2,078	1,653	3,731	173	108	281	1,421	394	1,815	314	686	1,000	170	465	635	-	-	-
2) Processing, storage & office facilities																		
- Rice mill equipment	741	-	741	-	-	-	-	-	-	741	-	741	-	-	-	-	-	-
- Storage	-	334	334	-	-	-	-	-	-	-	334	334	-	-	-	-	-	-
- Office	-	1,024	1,024	-	512	512	-	512	512	-	-	-	-	-	-	-	-	-
3) Initial investment																		
- Farm machinery	607	-	607	-	-	-	-	-	-	261	-	261	207	-	207	139	-	139
- Farm inputs	-	237	237	-	-	-	-	-	-	-	79	79	-	79	79	-	79	79
4) Contingency	195	420	615	-	77	77	81	120	201	97	153	250	10	70	80	7	-	7
5) Price escalation	433	768	1,201	-	-	-	94	120	214	205	354	559	89	247	336	45	47	92
Total	4,054	4,436	8,490	173	697	870	1,596	1,146	2,742	1,618	1,606	3,224	476	861	1,337	191	126	317

Table 12.10 Typical Farm Budget (Future With-Project), Auchi Project

	Cult. Area (ha)	Unit Yield (t/ha)	Total Yield (t)	Unit Price (₦/t)	Total Value (₦)
Average Farm Size		(1.2 ha)			
I. Gross Income					
1. Food crops					
Wet season paddy	1.2	5.0	6.0	308	1,848
Dry season paddy	1.2	5.0	6.0	308	1,848
(Sub-total)					(3,696)
2. Tree crops and others					57
Total Gross Income					3,753

	Area (ha)	Unit Amount (kg/ha)	Total Amount (kg)	Unit Price (₦/kg)	Total Cost (₦)
II. Gross Outgo					
1. Farming expenses					
Seed	2.4	35	84	0.31	26.0
Fertilizer					
Urea	2.4	129	309.6	0.23	71.2
Compound	2.4	200	480	0.21	100.8
Chemicals					
Insecticide	2.4	3 ℓ/ha	7.2 ℓ	5.6 ₦/ℓ	40.3
Fungicide	2.4	30	72	4.2	302.4
Herbicide	2.4	70	168	2.4	403.2
(Sub-total)					(943.9)
2. Living expenses					
Food consumption /1					841
Other living expenses					388
(Sub-total)					(1,229)
Total Outgo					2,172.9
III. Net Reserve					1,580.1

/1 Includes the value of food crops which are produced by farmers themselves.

Table 12.11 Project Revenue and Cost, Auchi Project

Item		Amount (₦1,000)
I) Project Revenue		
1) Sales of rice	3,900 t/1 x ₦560/t	2,184
2) Machinery & water charge from farmer	600 ha x ₦230/ha	138
Total		2,322
II) Operation Cost		
1) Production cost		
- Farm inputs	600 ha x ₦395.3/ha	237
- Farm machinery cost		103
- Rice mill & storage		73
- Purchasing cost of paddy from farmer	(3,000 - 130)t x ₦308/t	884
- Depreciation cost		176
Sub-total		1,473
2) O & M cost	1,200 ha x ₦83.3/ha	100
Total		1,573
III) Net Profit		749

/1 Rice production (3,990t) - Self consumption of farmers (90t) = 3,900t

Fig. 12.1 LOCATION MAP, OWERRI PROJECT

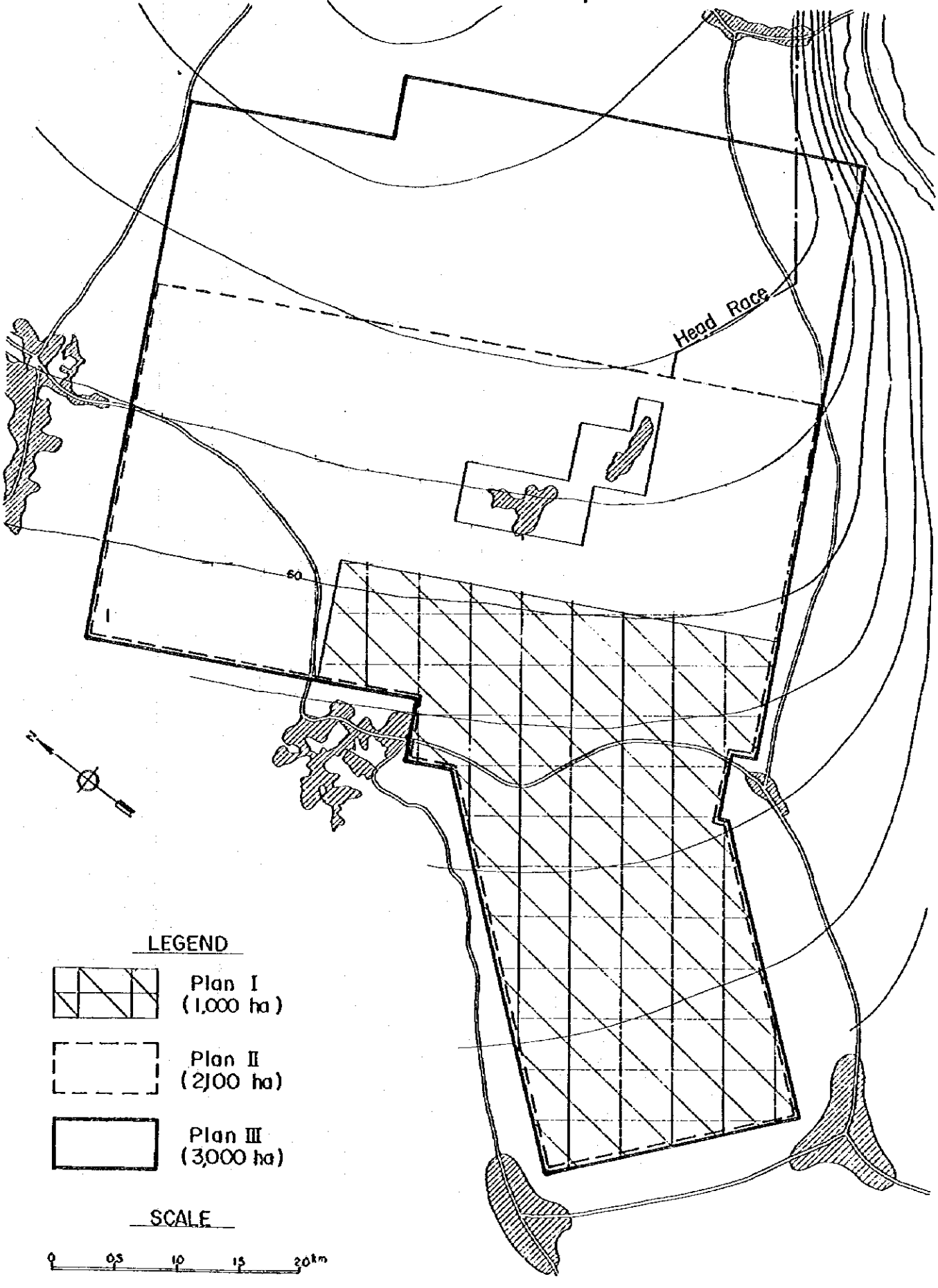


Fig. 12.2 Implementation Schedule for Plan I, Owerri Project

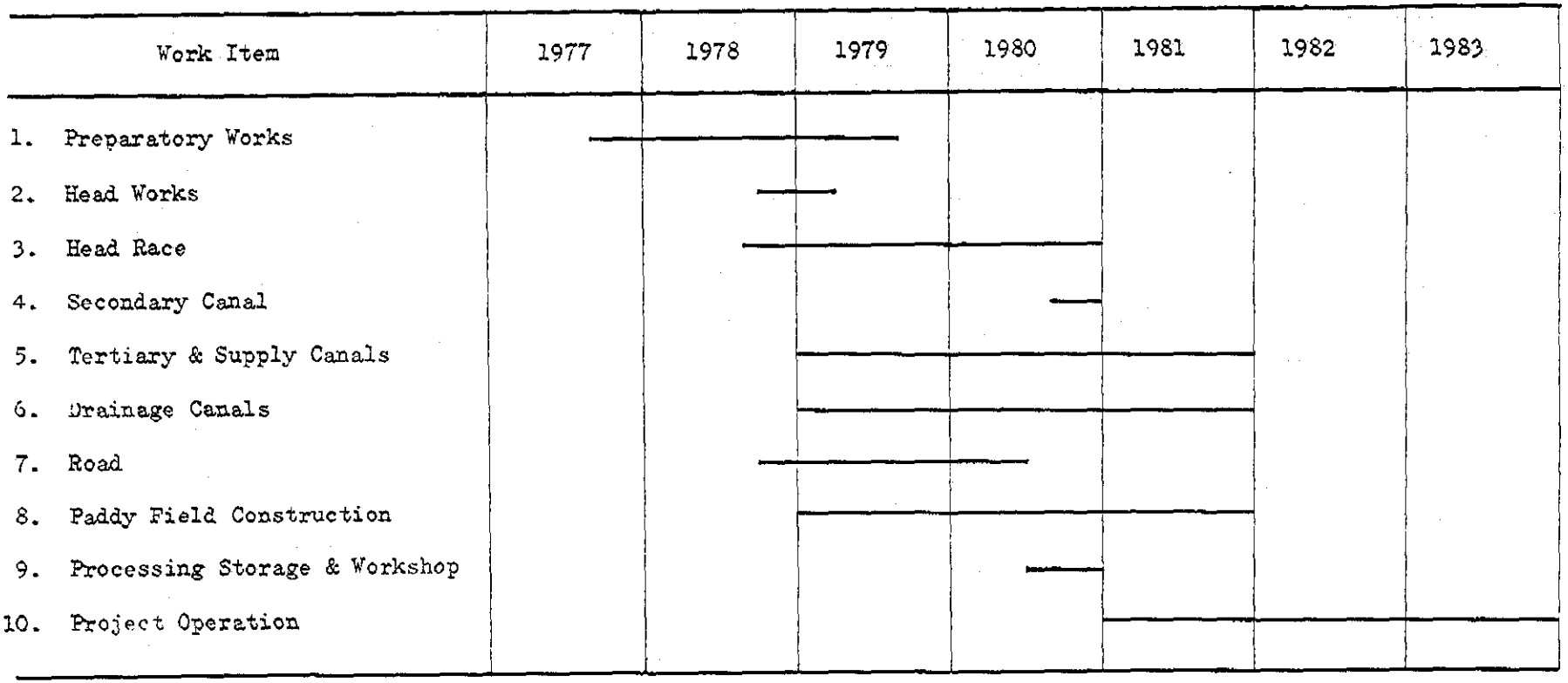


Fig. 12.3 Implementation Schedule for Plan II, Owerri Project

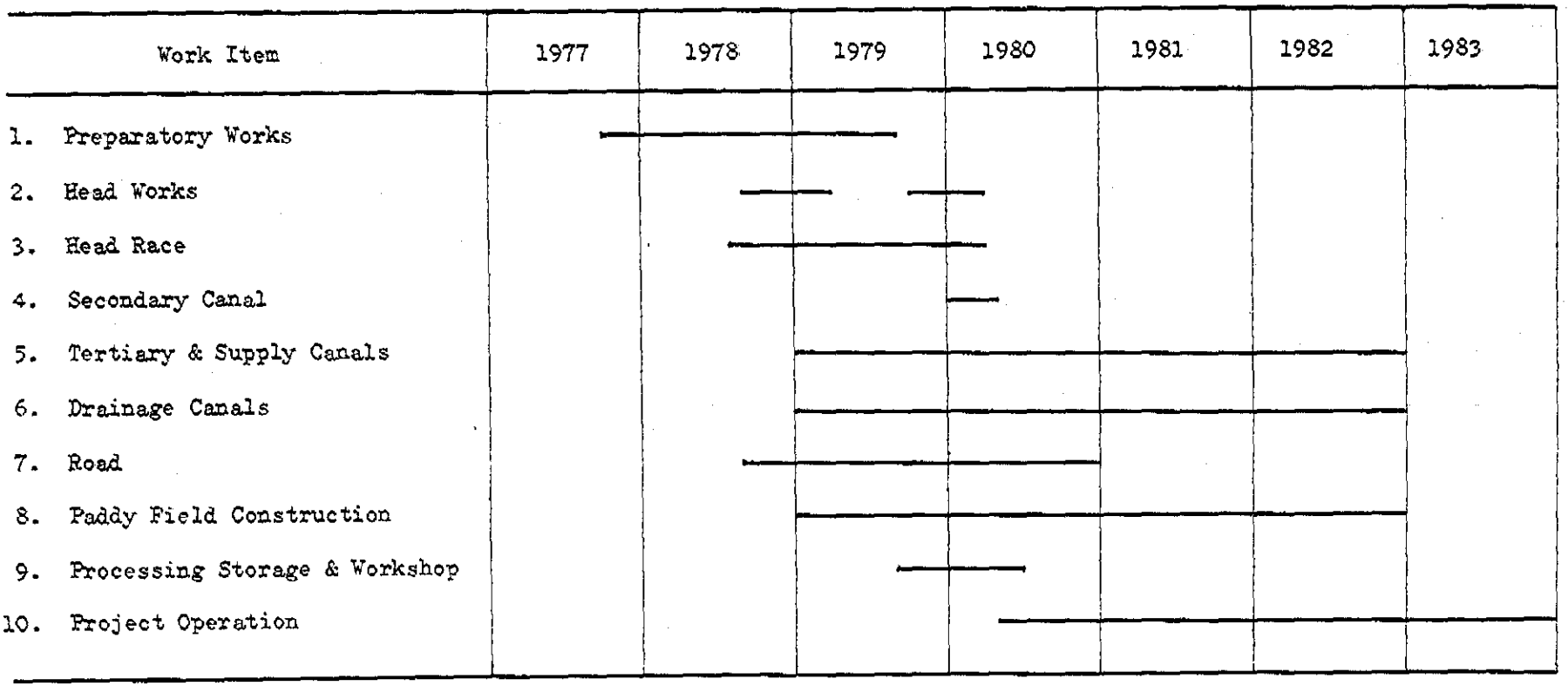


Fig. 12.4 Implementation Schedule for Plan III, Owerri Project

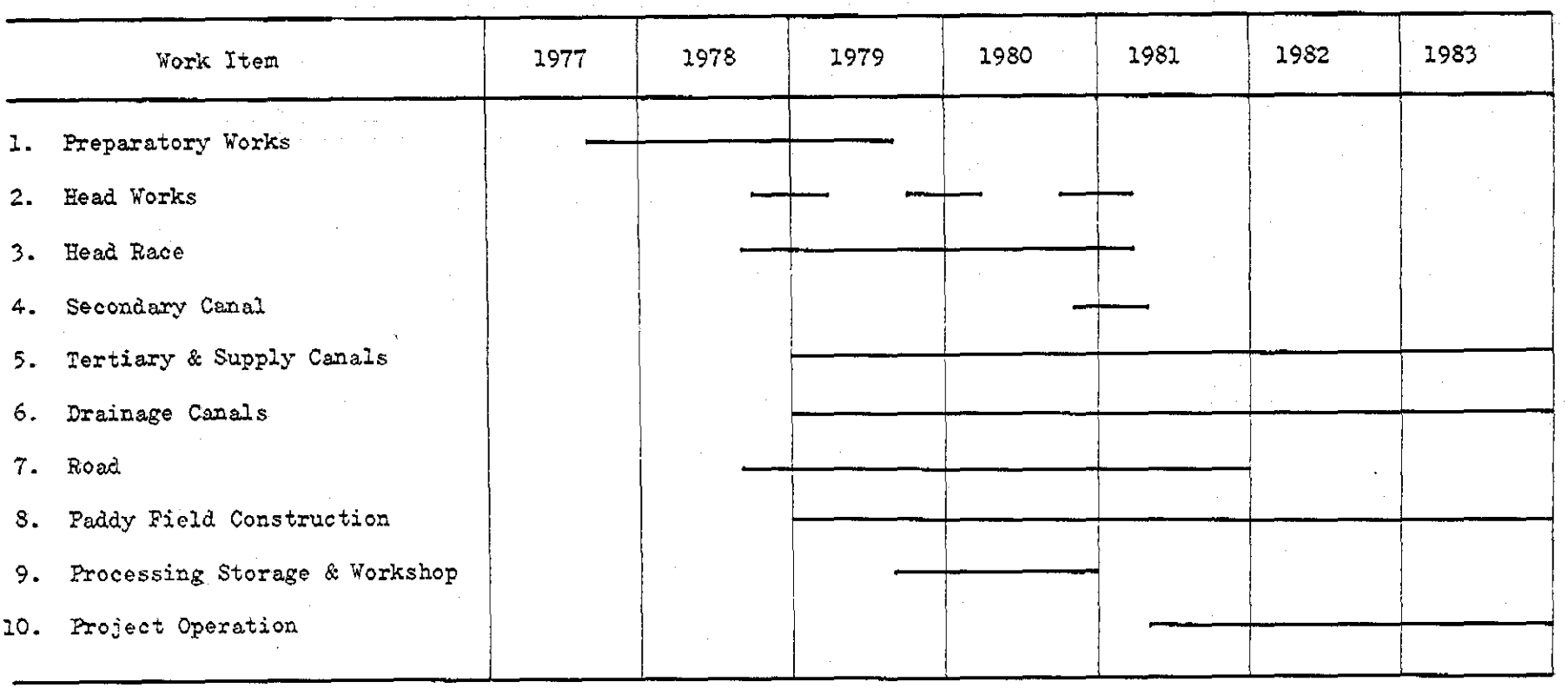


Fig. 12.5 Internal Rate of Return for each Plan, Owerri Project

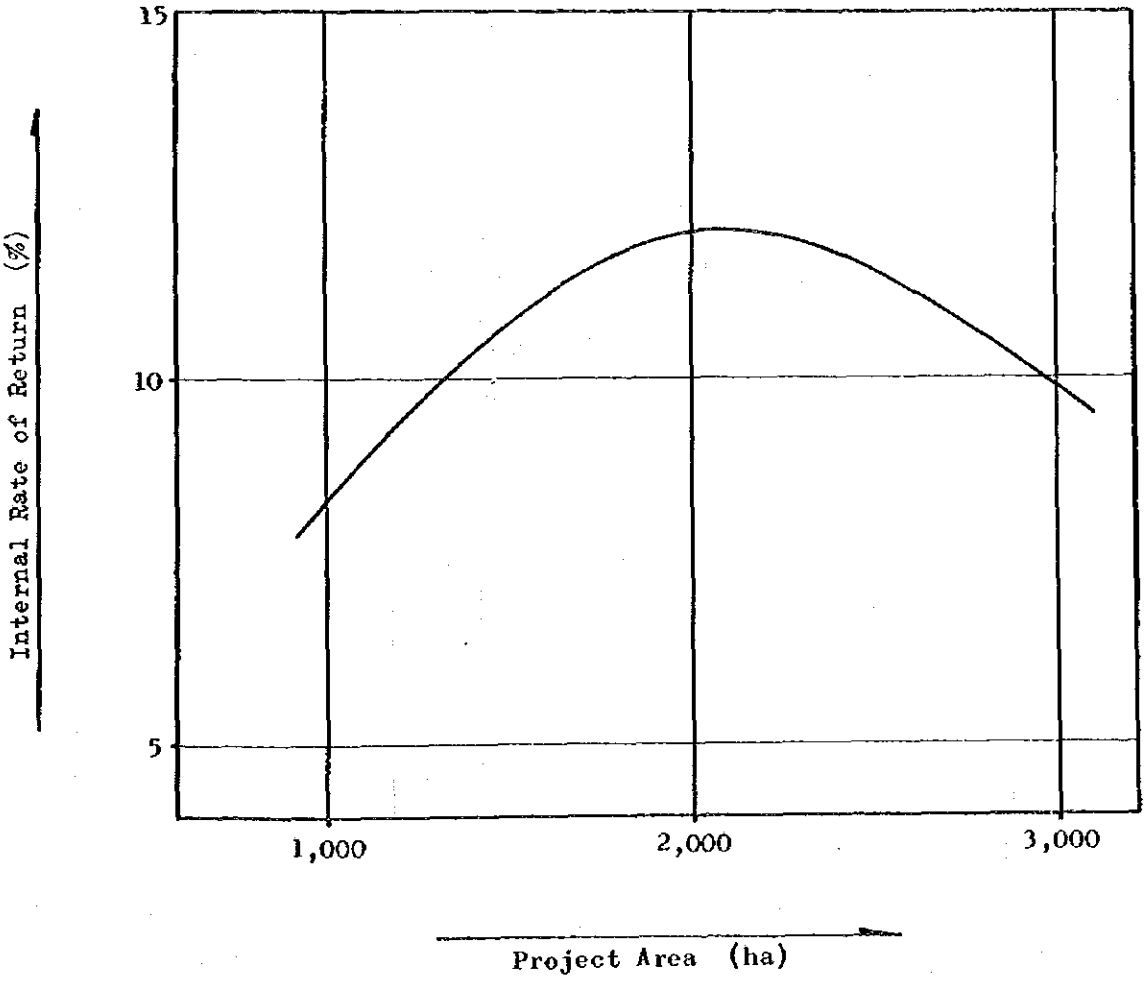


Fig. 12. 6 LOCATION MAP, AUCHI PROJECT

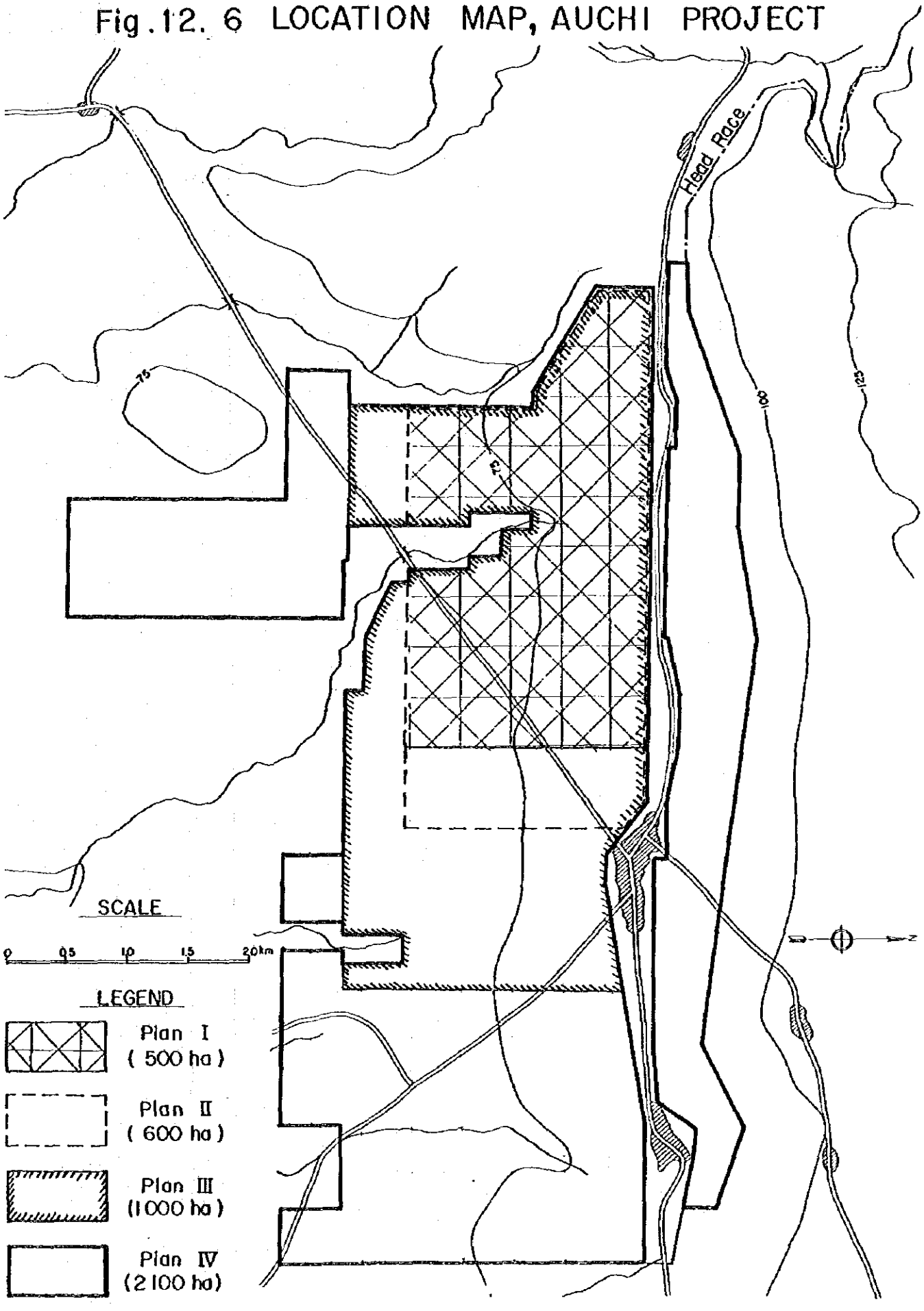


Fig. 12.7 Implementation Schedule for Plan I, Auchi Project

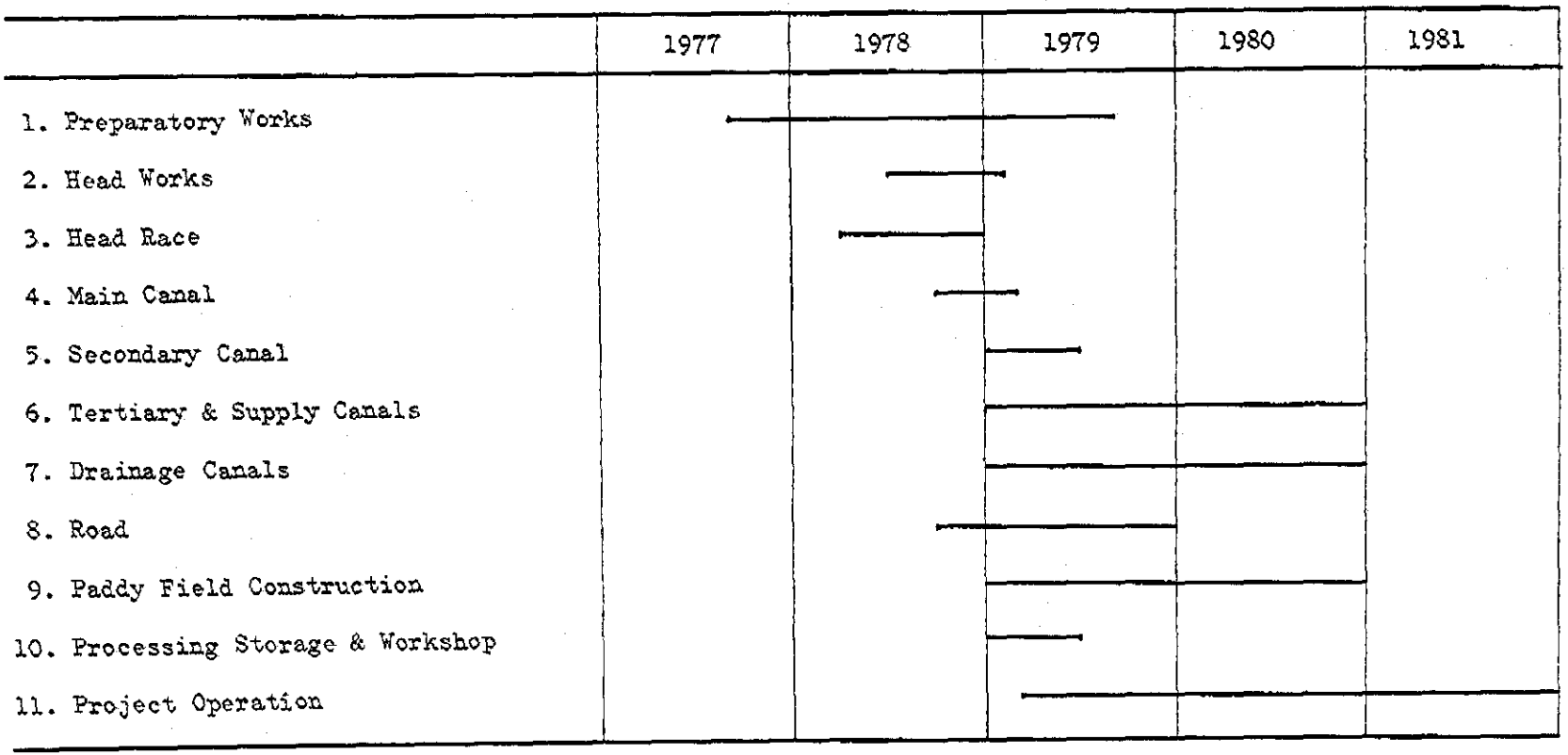


Fig. 12.8 Implementation Schedule for Plan II, Auchi Project

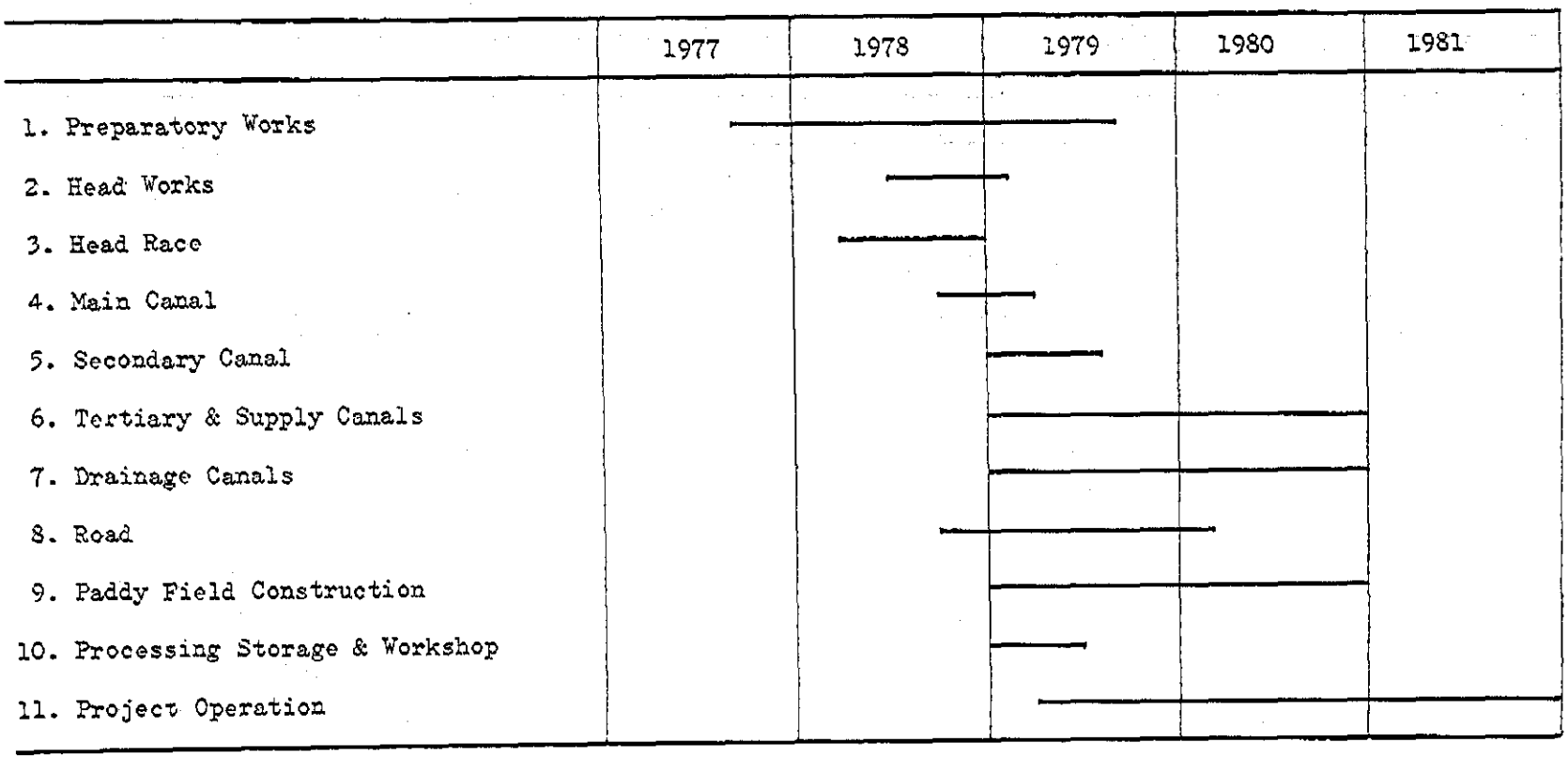


Fig. 12.9 Implementation Schedule for Plan III, Auchi Project

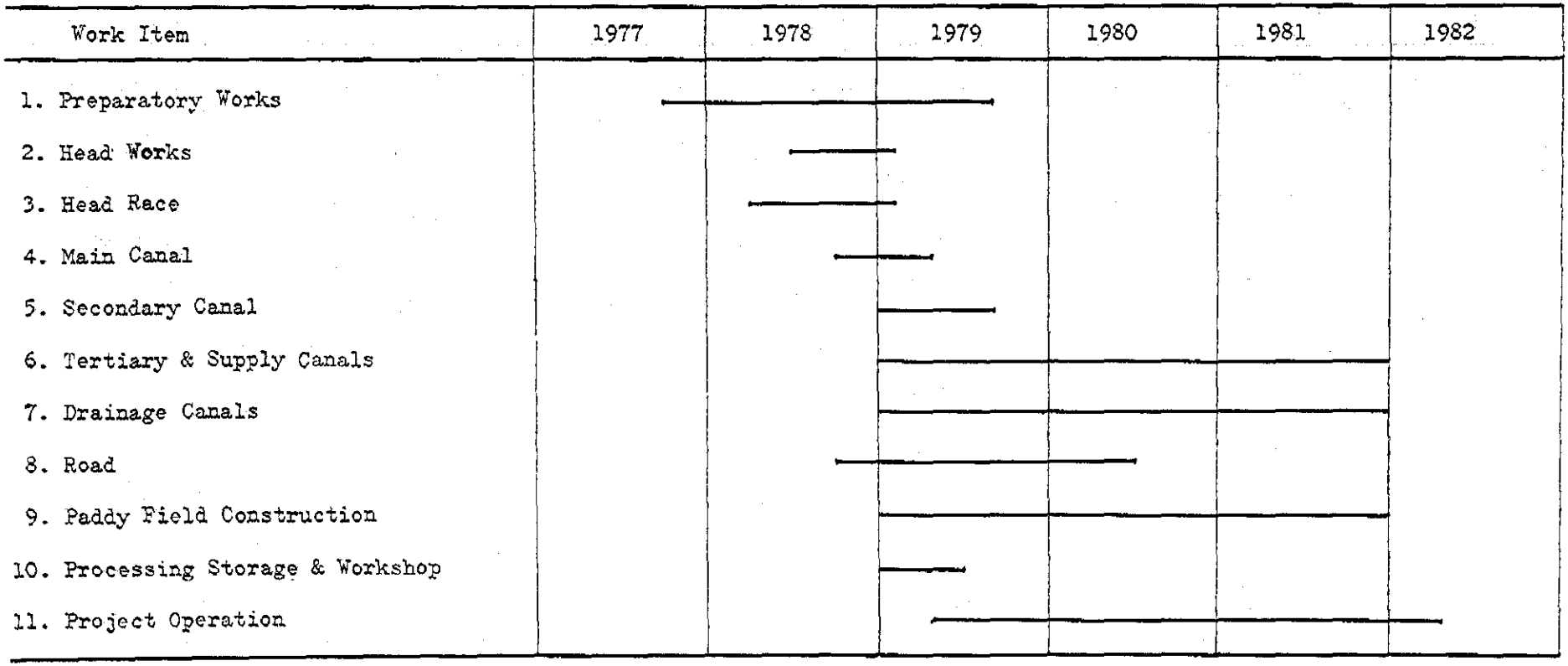


Fig. 12.10 Implementation Schedule for Plan IV, Auchi Project

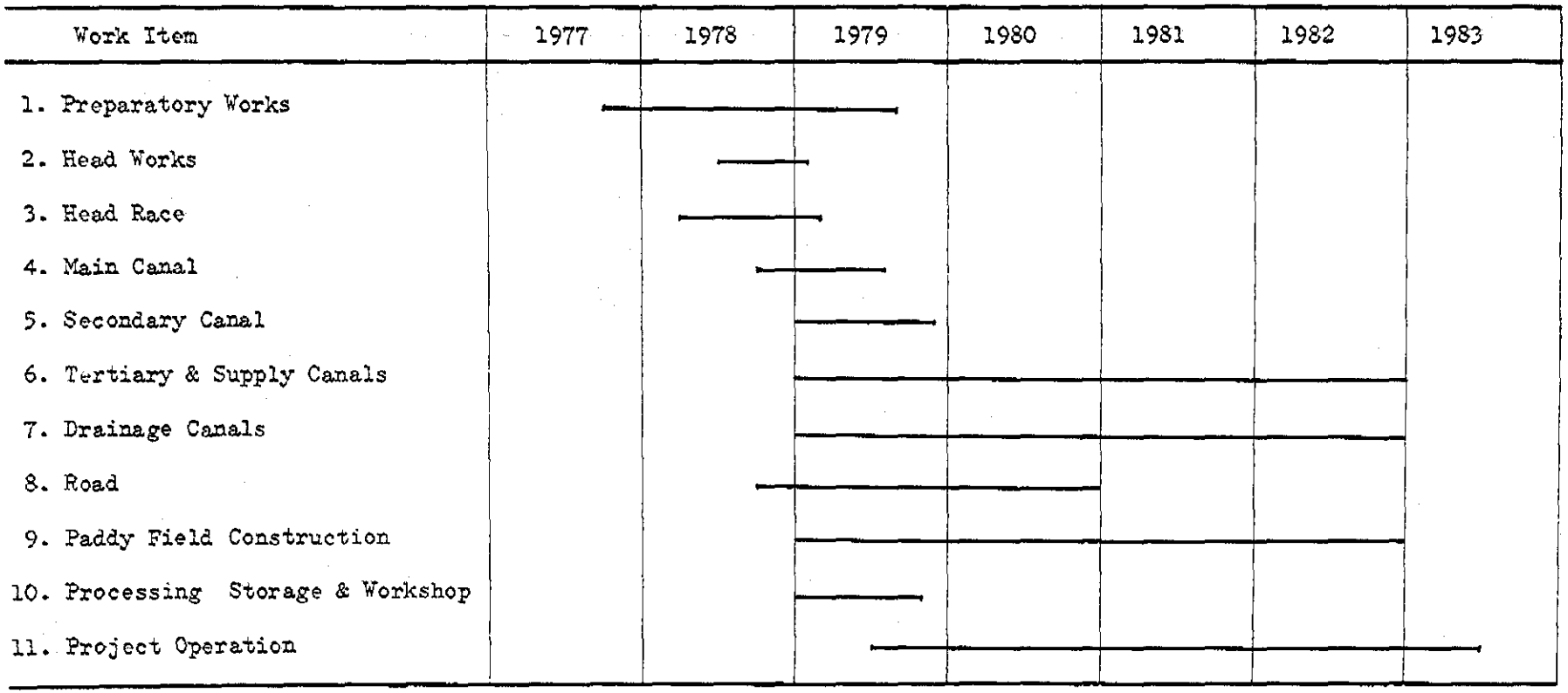


Fig. 12.11 Internal Rate of Return for each Plan, Auchi Project

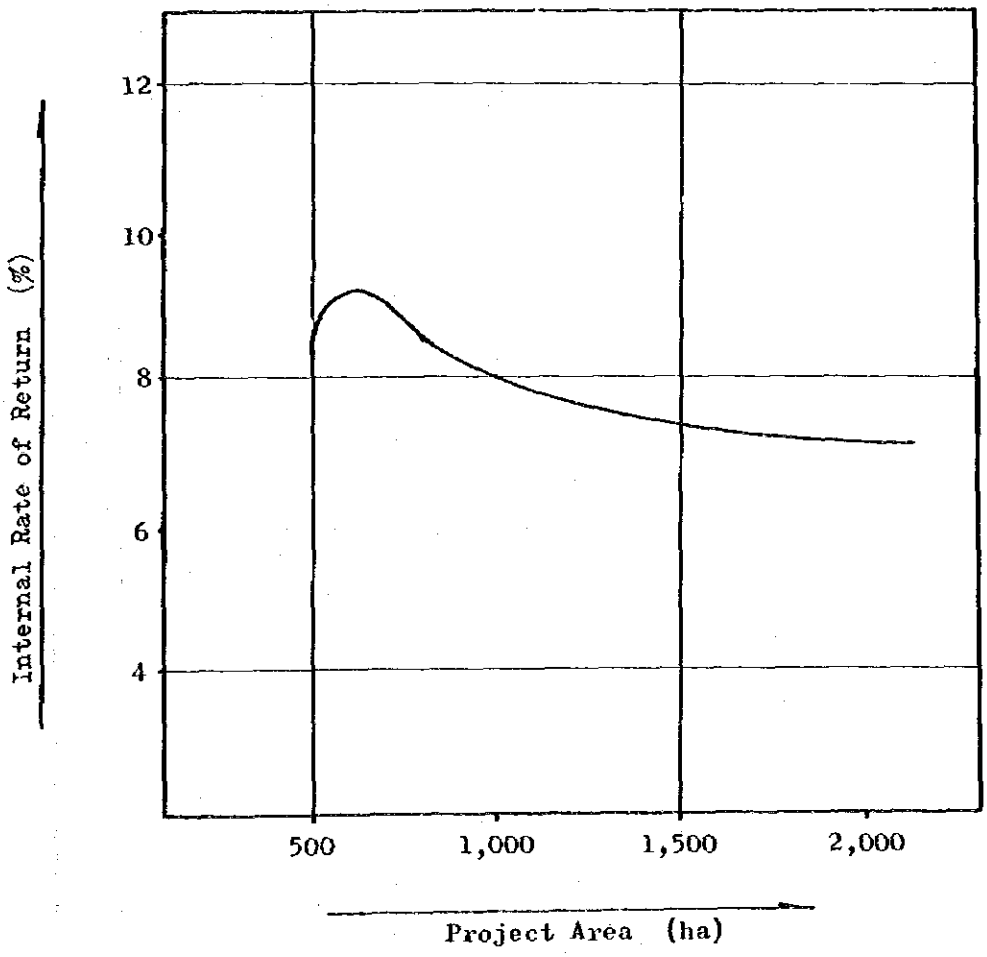


Fig. 12.12 Proposed Cropping Pattern, Auchi Project

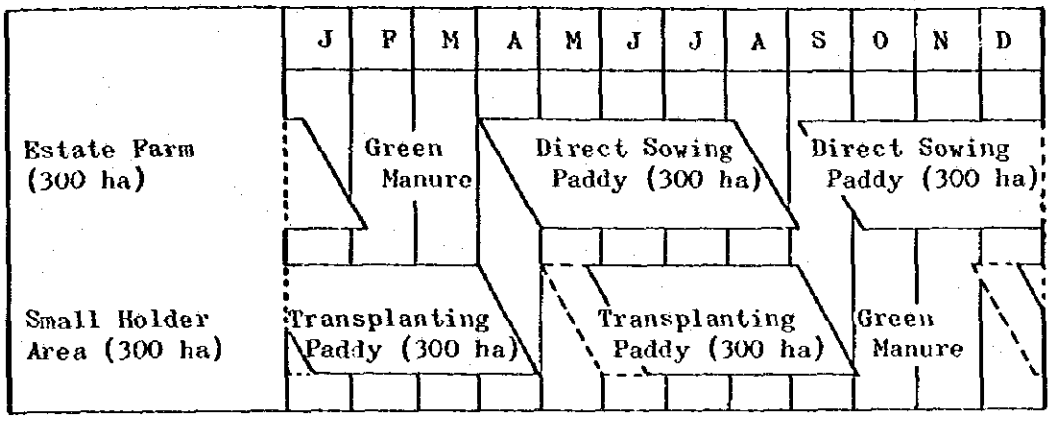
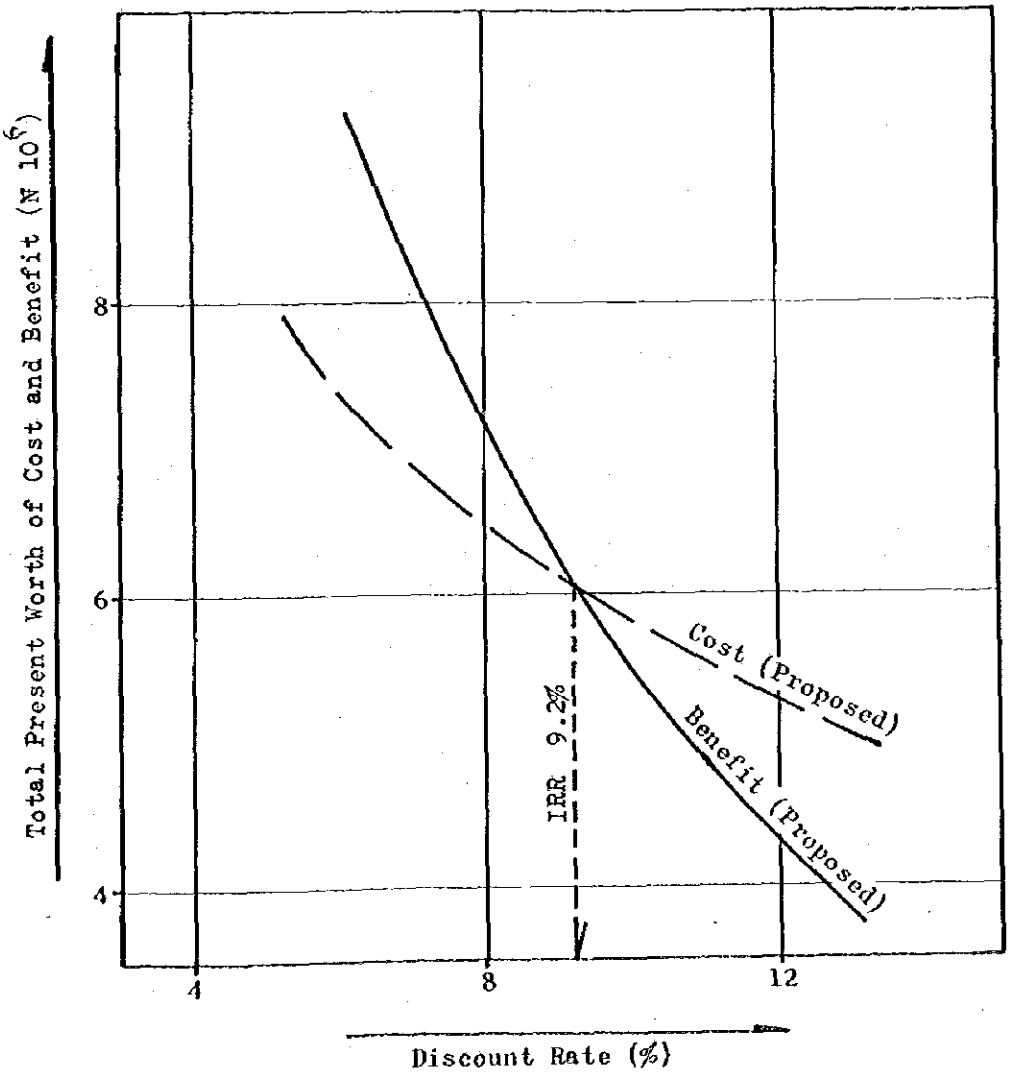
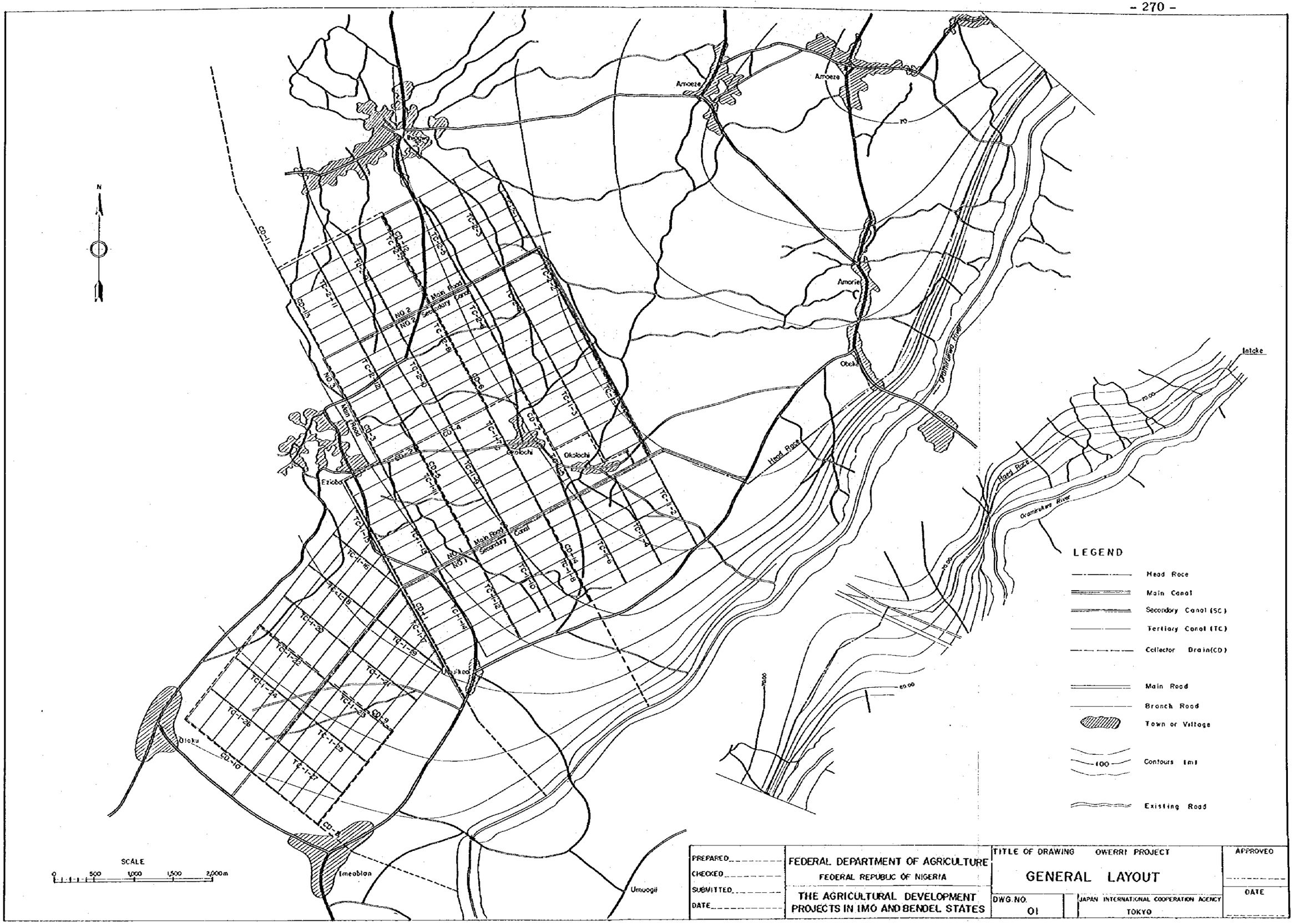


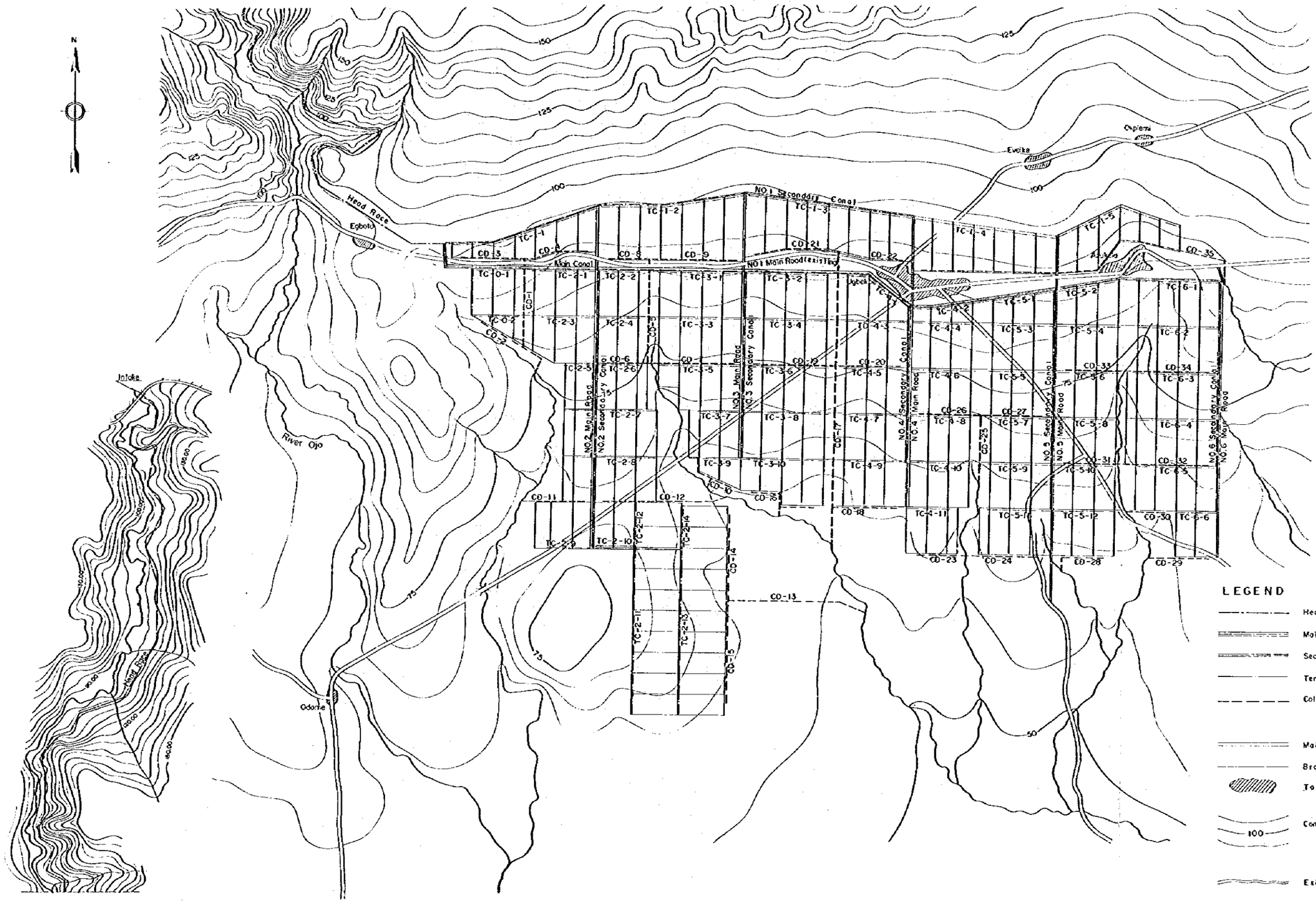
Fig. 12.13 Estimate of IRR, Auchi Project



DRAWING



PREPARED	FEDERAL DEPARTMENT OF AGRICULTURE FEDERAL REPUBLIC OF NIGERIA	TITLE OF DRAWING OWERRI PROJECT GENERAL LAYOUT	APPROVED
CHECKED			
SUBMITTED	THE AGRICULTURAL DEVELOPMENT PROJECTS IN IMO AND BENDEL STATES	DWG.NO. 01	DATE
DATE		JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	

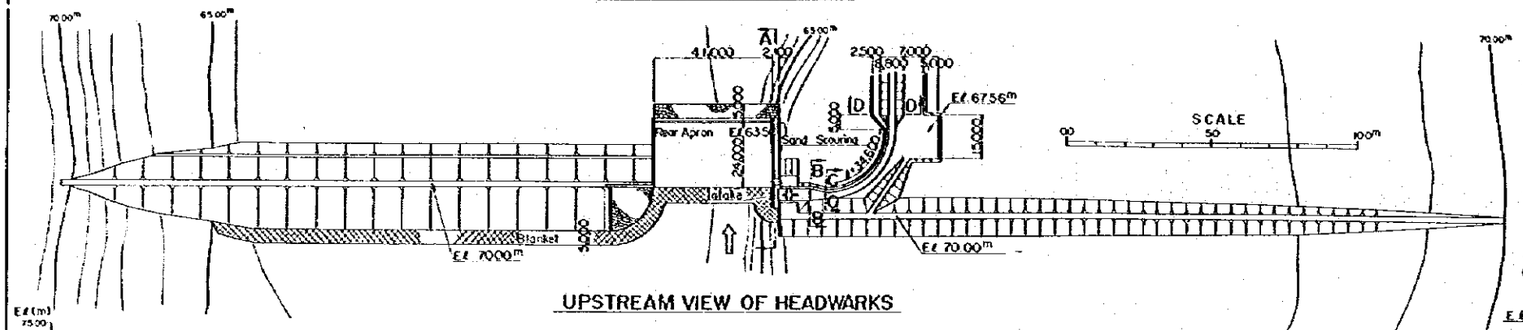


SCALE
0 500 1,000 1,500 2,000m

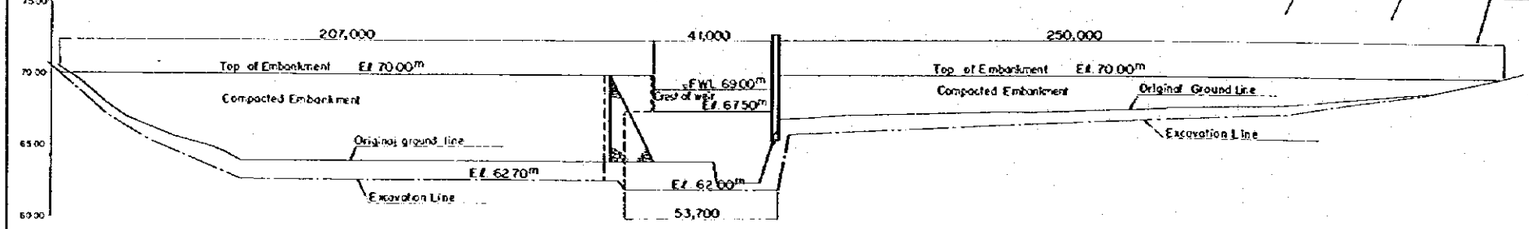
PREPARED	FEDERAL DEPARTMENT OF AGRICULTURE FEDERAL REPUBLIC OF NIGERIA	TITLE OF DRAWING AUCHI PROJECT GENERAL LAYOUT	APPROVED
CHECKED			
SUBMITTED	THE AGRICULTURAL DEVELOPMENT PROJECTS IN IMO AND BENDEL STATES	DWG.NO. 02	DATE
DATE		JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	

PLATE NO.

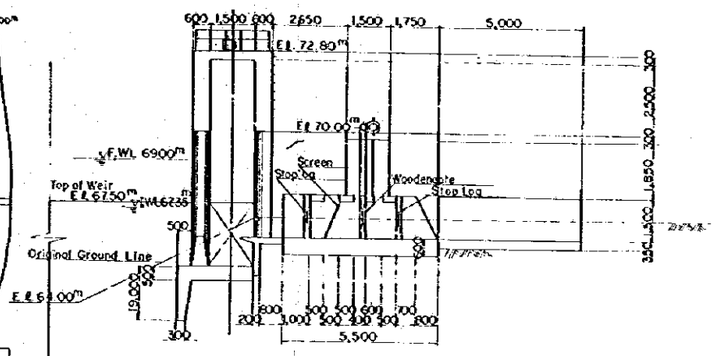
PLAN OF HEADWORKS



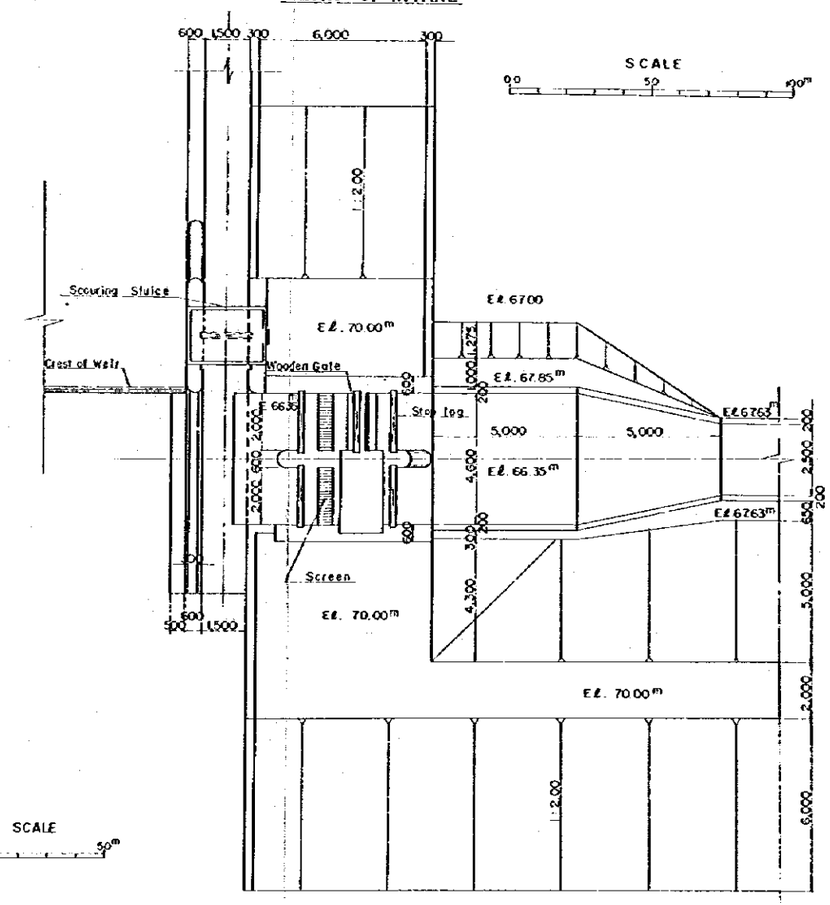
UPSTREAM VIEW OF HEADWARKS



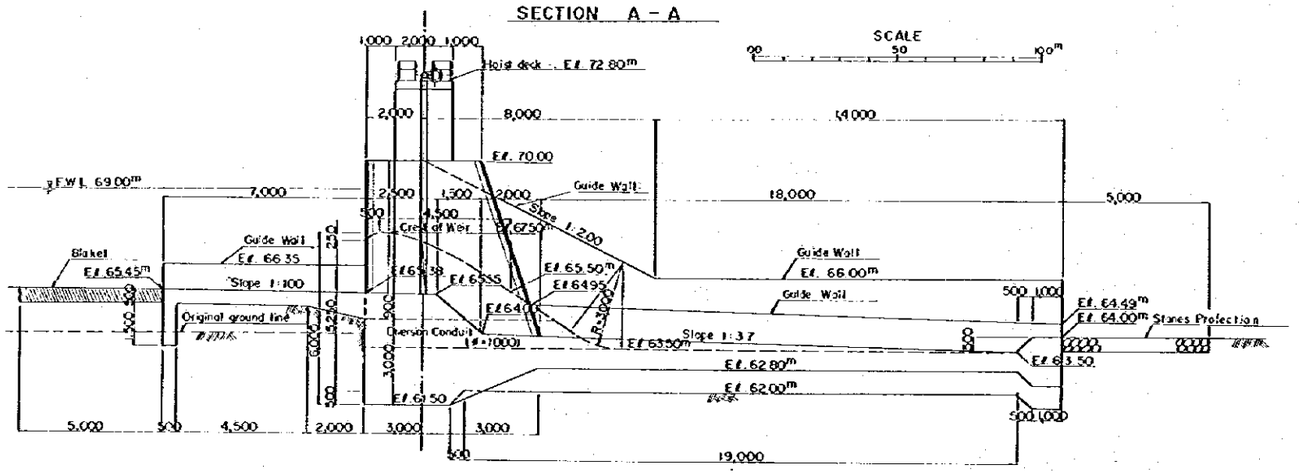
PROFILE OF INTAKE



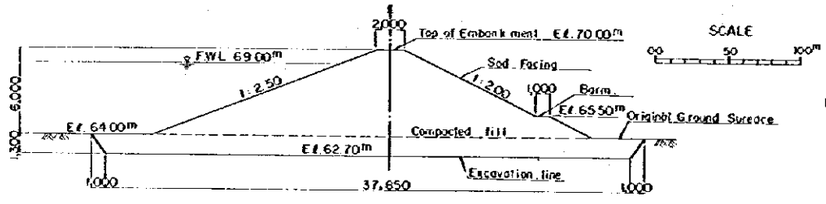
PLAN OF INTAKE



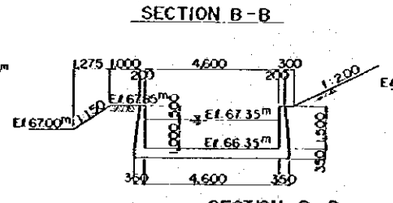
SECTION A - A



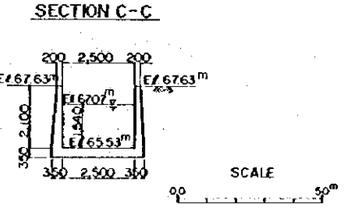
TYPICAL CROSS SECTION OF LEFT SIDE EMBANKMENT



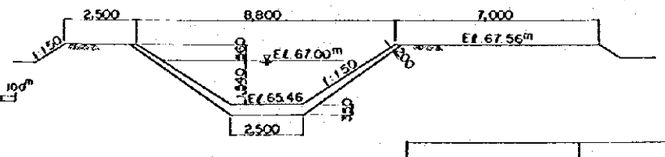
SECTION B-B



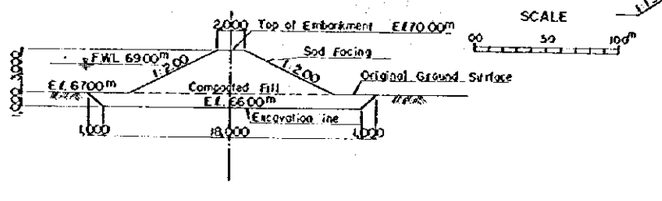
SECTION C-C



SECTION D-D



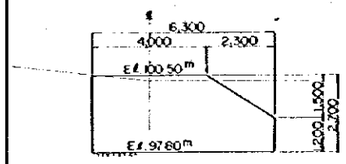
TYPICAL CROSS SECTION OF RIGHT SIDE EMBANKMENT



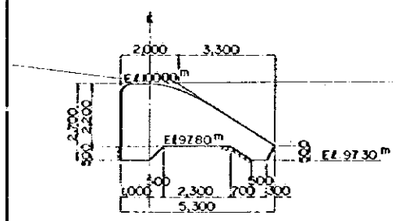
PREPARED	FEDERAL DEPARTMENT OF AGRICULTURE FEDERAL REPUBLIC OF NIGERIA	TITLE OF DRAWING OWERRI PROJECT HEAD WORKS	APPROVED
CHECKED			
SUBMITTED	THE AGRICULTURAL DEVELOPMENT PROJECTS IN IMO AND BENDEL STATES	DWG. NO. 03	DATE
DATE		JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	

PLATE NO.

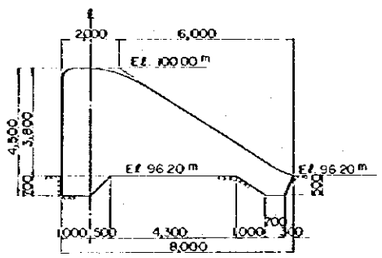
SECTION A - A'



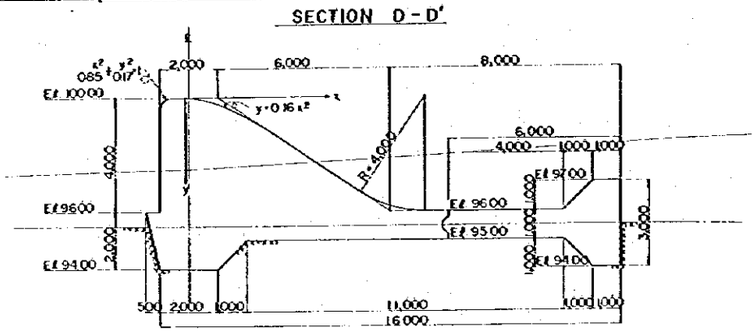
SECTION B - B'



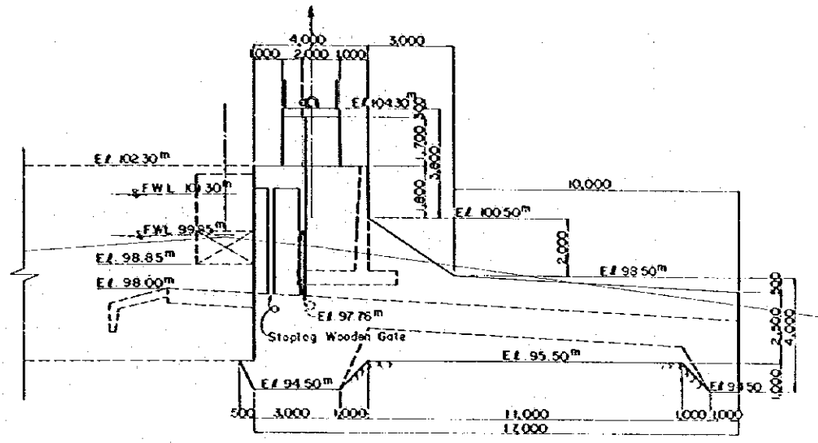
SECTION C - C'



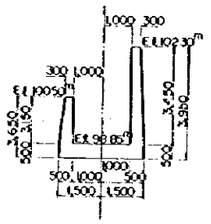
SECTION D - D'



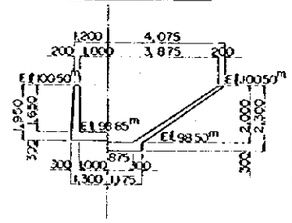
SECTION E - E'



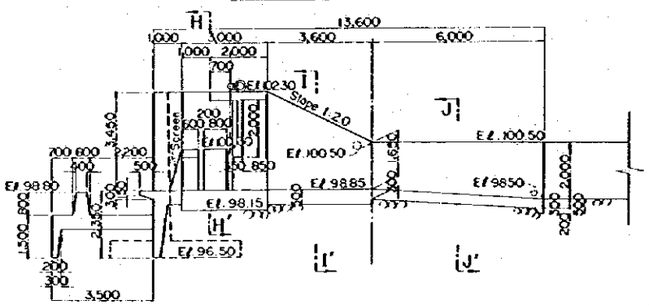
SECTION I - I



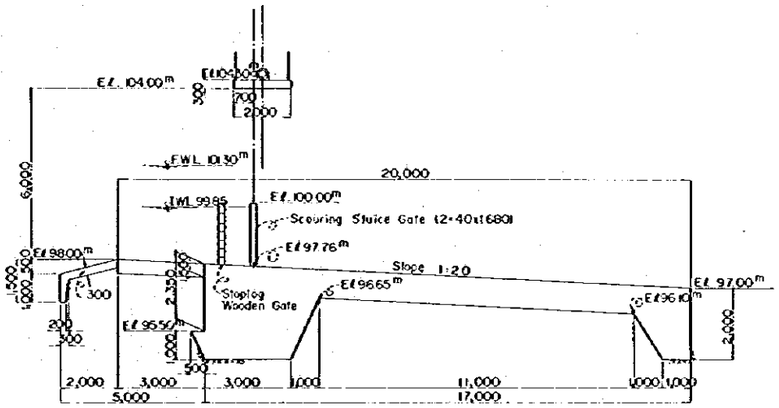
SECTION J - J'



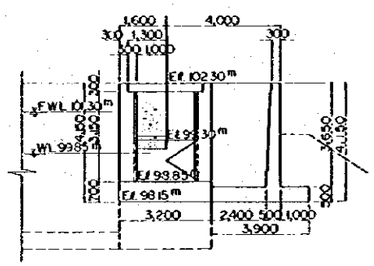
SECTION G - G'



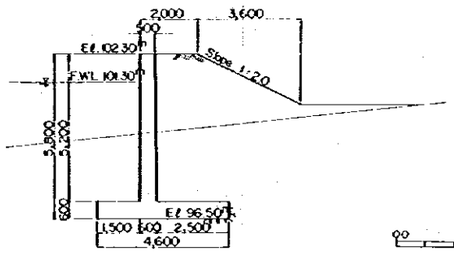
SECTION F - F'



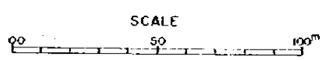
SECTION H - H'



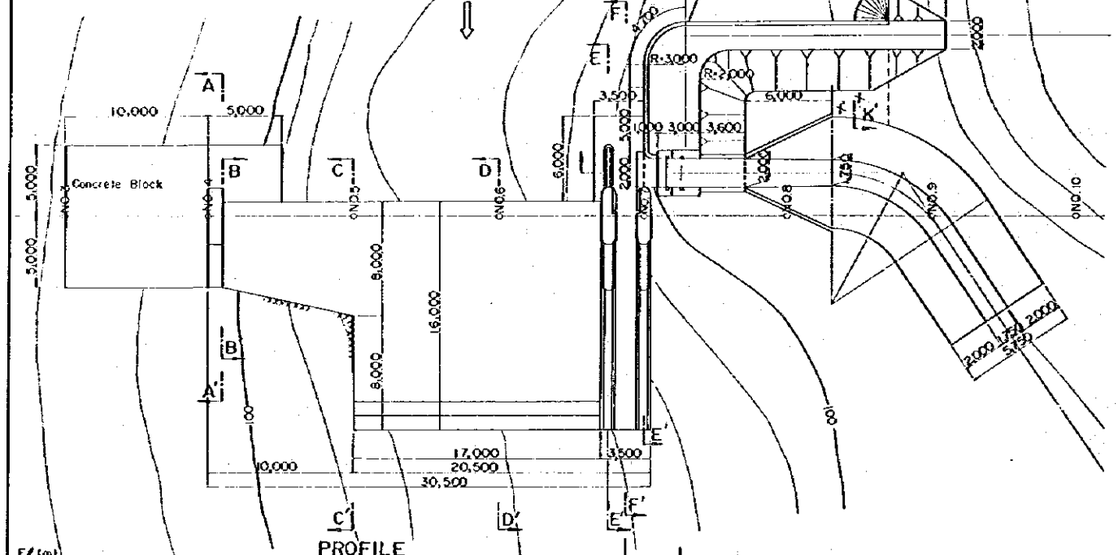
SECTION K - K'



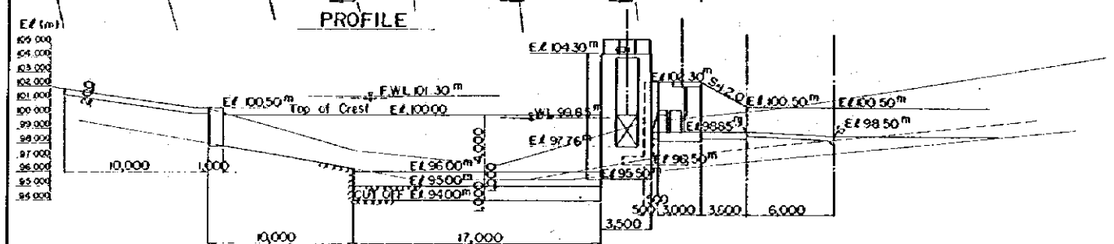
SCALE



GENERAL PLAN

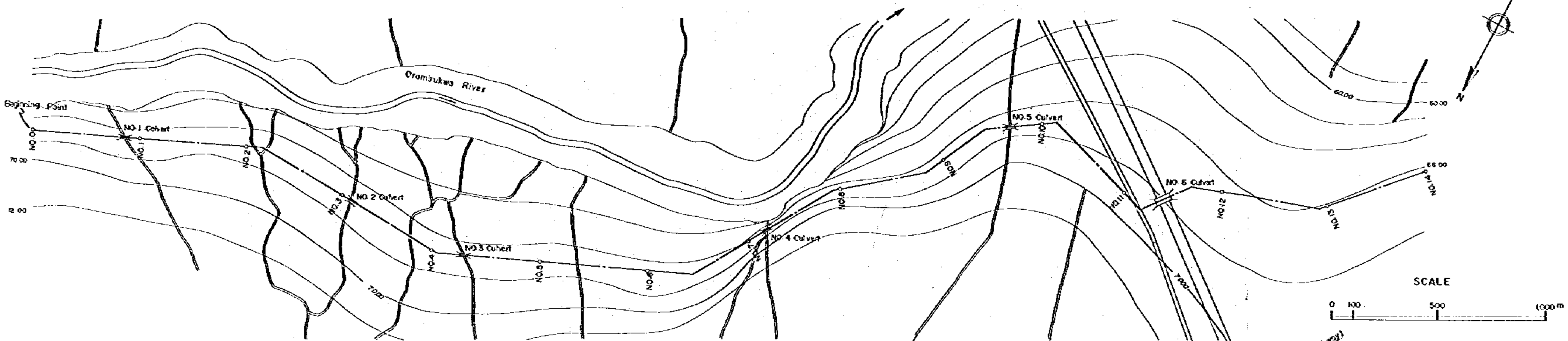


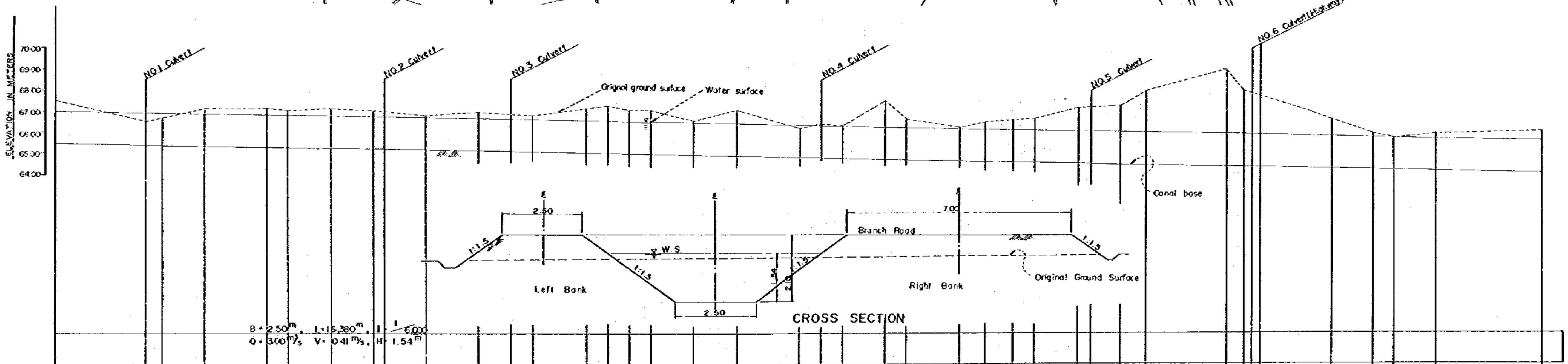
PROFILE



PREPARED	FEDERAL DEPARTMENT OF AGRICULTURE FEDERAL REPUBLIC OF NIGERIA	TITLE OF DRAWING AUCHI PROJECT HEAD WORKS	APPROVED
CHECKED			
SUBMITTED	THE AGRICULTURAL DEVELOPMENT PROJECTS IN IMO AND BENDEL STATES	DWG. NO. 04	DATE
DATE		JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	

PLATE NO.





B = 2.50 m, L = 16,380 m, I = 1/6,000
Q = 3.00 m³/s, V = 0.41 m/s, H = 1.54 m

IRRIGATION CANAL

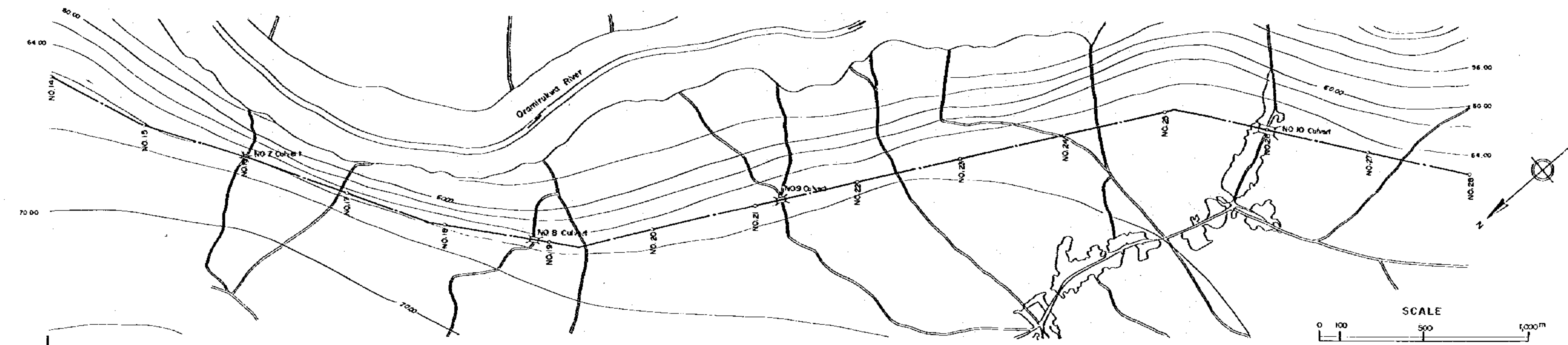
STATION	DISTANCE	REDUCED DISTANCE	GROUND SURFACE ELEVATION	WATER SURFACE ELEVATION	CANAL BASE ELEVTION
NO.0	0	0	67.50	67.00	65.46
	+ 420	420	66.50	66.93 / 66.90	65.39 / 65.36
NO.1	80	500	66.70	66.89	65.35
	+ 200	700	67.10	66.86	65.32
NO.2	300	1,000	67.10	66.81	65.27
	+ 100	1,100	67.00	66.79	65.25
	+ 200	1,300	67.10	66.76	65.22
NO.3	200	1,500	67.00	66.73 / 66.71	65.19 / 65.17
	+ 50	1,550	66.95	66.68	65.14
	+ 200	1,750	66.75	66.65	65.11
NO.4	250	2,000	66.90	66.61	65.07
	+ 150	2,150	66.80	66.58 / 66.55	65.04 / 65.01
	+ 100	2,250	66.75	66.53	64.99
NO.5	250	2,500	67.05	66.49	64.95
	+ 100	2,600	67.20	66.47	64.93
	+ 100	2,700	67.00	66.45	64.91
	+ 100	2,800	67.00	66.43	64.89
NO.6	200	3,000	66.60	66.40	64.86
	+ 200	3,200	67.00	66.37	64.83
NO.7	300	3,500	66.15	66.32	64.78
	+ 100	3,600	66.35	66.31 / 66.28	64.77 / 64.74
	+ 100	3,700	66.30	66.26	64.72
	+ 200	3,900	67.50	66.23	64.69
NO.8	100	4,000	66.60	66.21	64.67
	+ 250	4,250	66.25	66.17	64.63
	+ 120	4,270	66.50	66.15	64.61
NO.9	130	4,500	66.60	66.13	64.59
	+ 100	4,600	66.70	66.11	64.57
	+ 200	4,800	67.20	66.08	64.54
	+ 60	4,860	67.25	66.07 / 66.04	64.53 / 64.50
NO.10	140	5,000	67.30	66.02	64.48
	+ 120	5,120	68.00	66.00	64.46
NO.11	380	5,500	69.00	65.94	64.40
	+ 80	5,580	67.95	65.93	64.39
	+ 40	5,620	67.85	65.92	64.38
	+ 40	5,660	67.70	65.89	64.35
NO.12	340	6,000	66.65	65.83	64.29
	+ 200	6,200	66.00	65.80	64.26
	+ 100	6,300	65.80	65.78	64.24
NO.13	200	6,500	66.00	65.75	64.21
NO.14	500	7,000	66.15	65.67	64.13

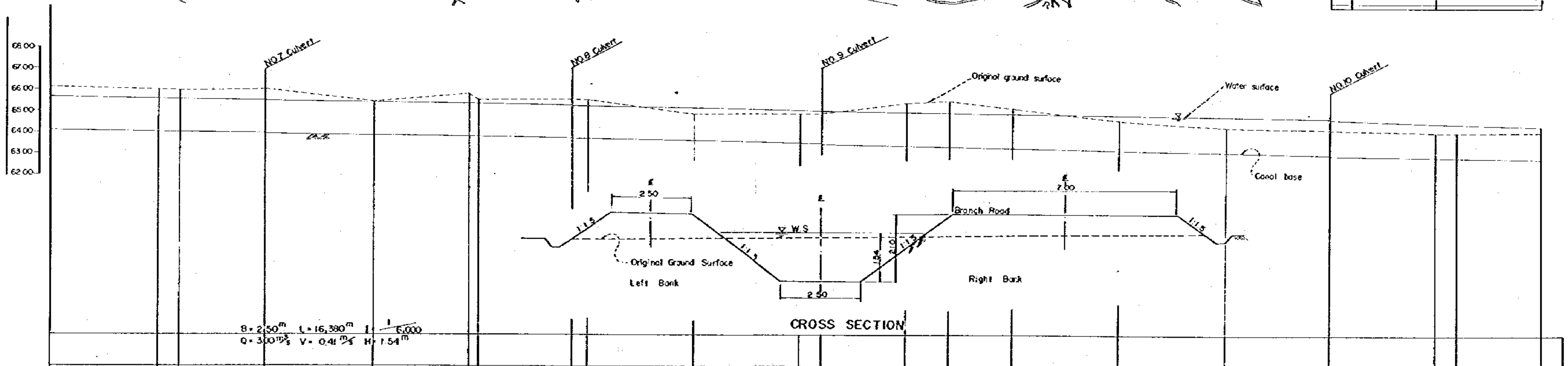
SCALE
VERTICAL 1 : 100
HORIZONTAL 1 : 10,000

NOTE
—⌶— : Culvert
B : Canal Base Width
L : Canal Length
I : Longitudinal Gradient
Q : Discharge
V : Velocity
H : Water Depth

PREPARED ________	FEDERAL DEPARTMENT OF AGRICULTURE FEDERAL REPUBLIC OF NIGERIA	TITLE OF DRAWING OWERRI PROJECT HEAD RACE (I)	APPROVED
CHECKED ________			
SUBMITTED ________	THE AGRICULTURAL DEVELOPMENT PROJECTS IN IMO AND BENDEL STATES	DWG. NO. 05 | JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	DATE
DATE ________			

PLATE NO.

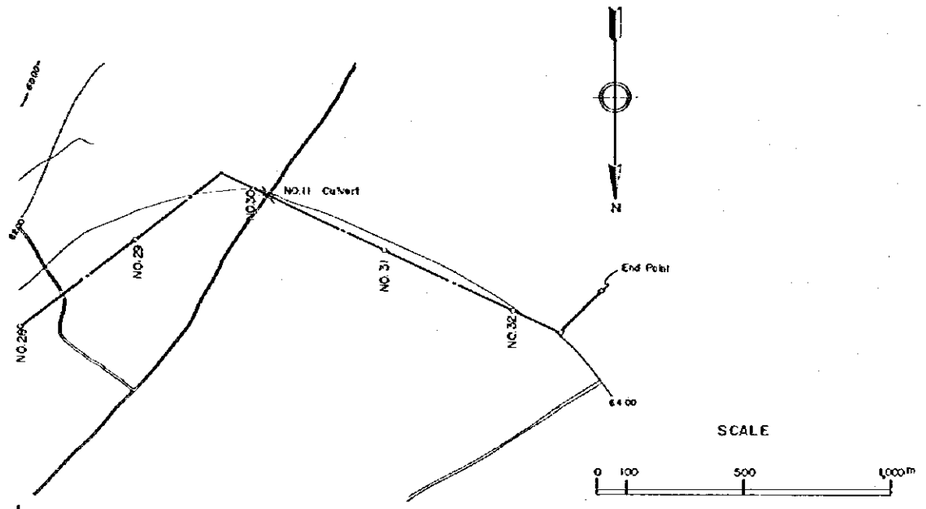




IRRIGATION CANAL																					
CANAL BASE ELEVATION	64.13	64.05	64.03	63.96 63.93	63.85	63.77	63.76	63.69 63.66	63.65	63.57	63.49	63.46 63.43	63.36	63.33	63.28	63.20	63.11	63.02 62.99	62.91	62.89	62.83
WATER SURFACE ELEVATION	65.67	65.59	65.57	65.50 65.47	65.39	65.31	65.30	65.23 65.20	65.19	65.11	65.03	65.00 64.97	64.90	64.87	64.82	64.74	64.65	64.56 64.53	64.45	64.43	64.37
GROUND SURFACE ELEVATION	66.15	66.05	66.00	66.00	65.50	65.80	65.50	65.47	65.50	64.75	64.85	64.90	65.40	65.50	65.15	64.60	64.30	64.22	64.12	64.10	64.10
REDUCED DISTANCE	7,000	7,500	7,600	8,000	8,500	8,960	9,000	9,430	9,500	10,000	10,500	10,600	11,000	11,200	11,500	12,000	12,500	13,000	13,500	13,600	14,000
DISTANCE	0	500	+ 100	400	500	+ 460	40	+ 430	70	500	500	+ 100	400	+ 200	300	500	500	500	500	+ 100	400
STATION	NO.14	NO.15		NO.16	NO.17		NO.18		NO.19	NO.20	NO.21		NO.22		NO.23	NO.24	NO.25	NO.26	NO.27		NO.28

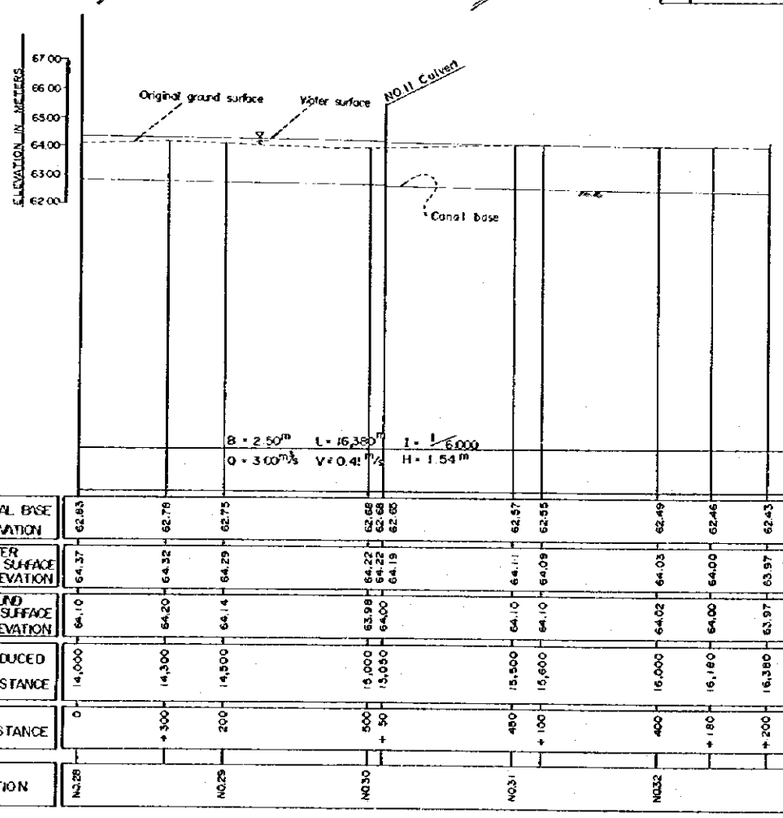
PREPARED ______	FEDERAL DEPARTMENT OF AGRICULTURE FEDERAL REPUBLIC OF NIGERIA	TITLE OF DRAWING OWERRI PROJECT HEAD RACE (2)	APPROVED
CHECKED ______			
SUBMITTED ______	THE AGRICULTURAL DEVELOPMENT PROJECTS IN IMO AND BENDEL STATES	DWG. NO. 06 | JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	DATE
DATE ______			

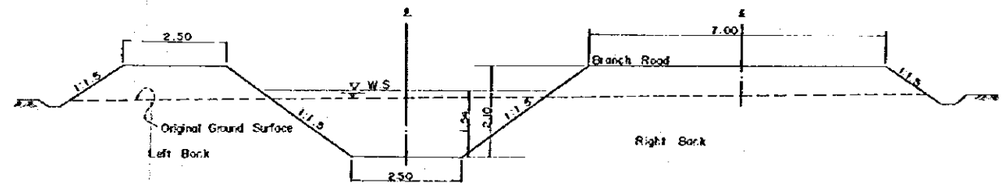
PLATE NO.



SCALE

0 100 500 1,000m

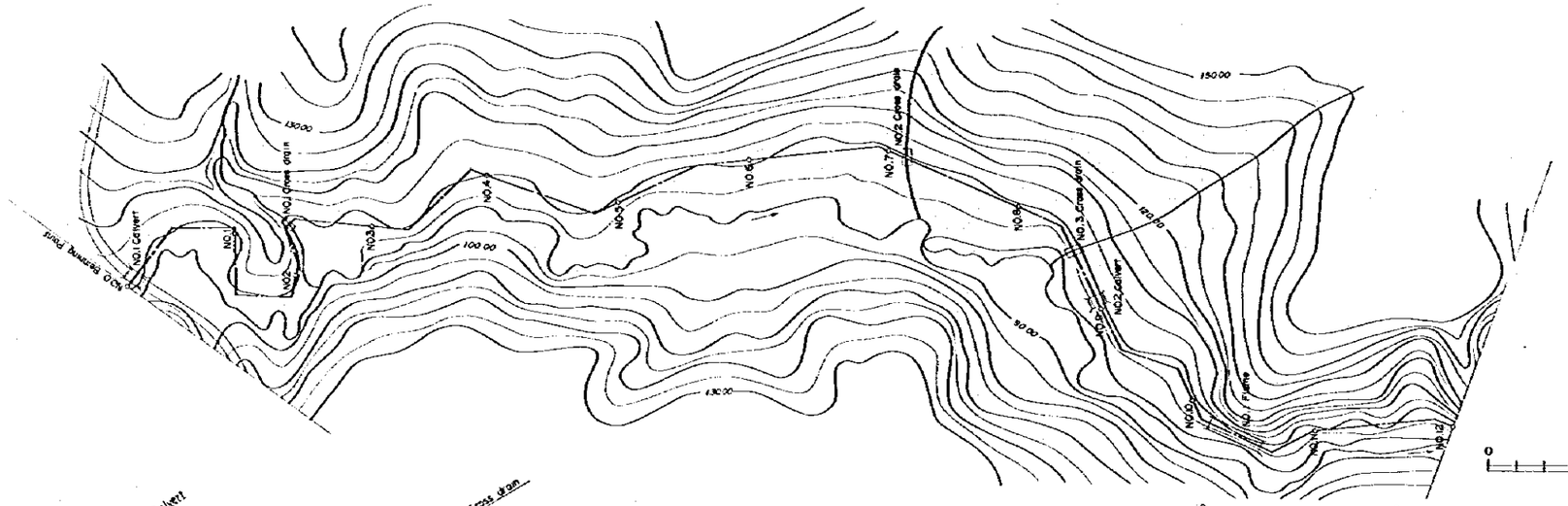




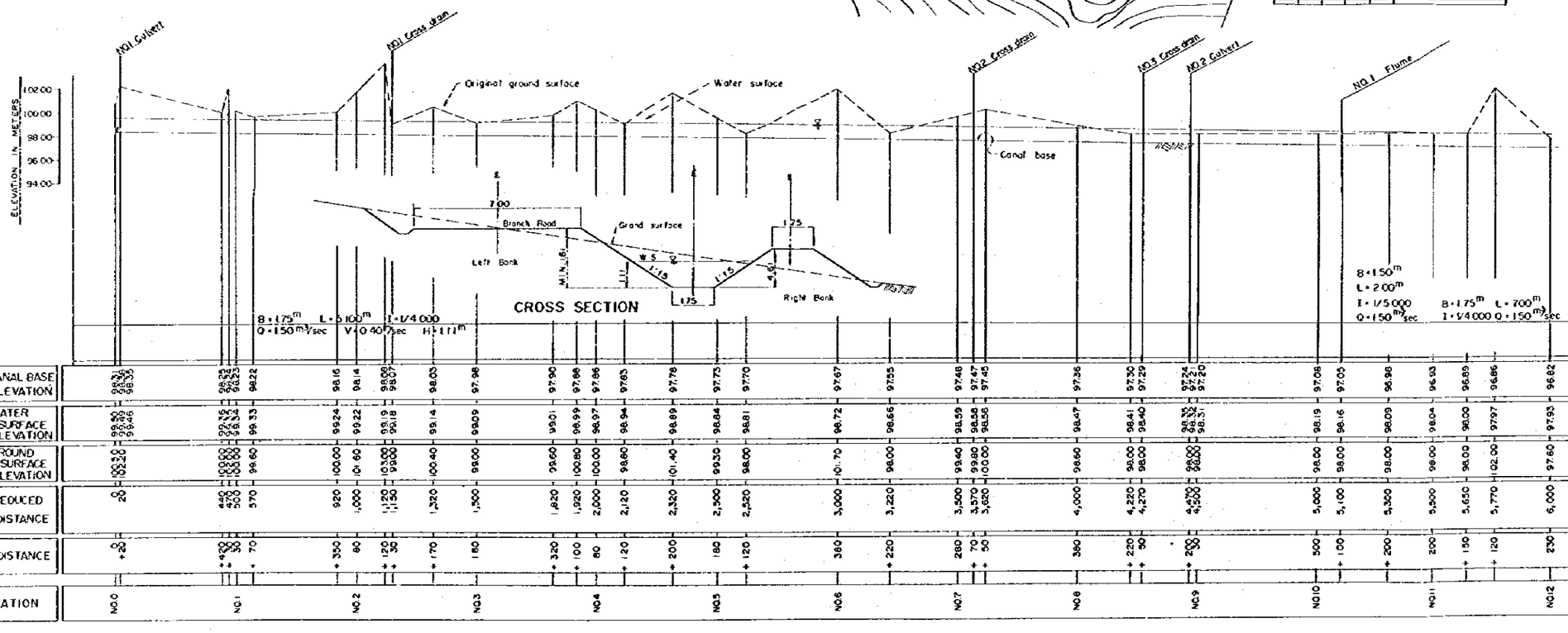
CROSS SECTION

PREPARED	FEDERAL DEPARTMENT OF AGRICULTURE	TITLE OF DRAWING OWERRI PROJECT	APPROVED
CHECKED	FEDERAL REPUBLIC OF NIGERIA	HEAD RACE (3)	
SUBMITTED	THE AGRICULTURAL DEVELOPMENT PROJECTS IN IMO AND BENDEL STATES	DWG. NO. 07	DATE
DATE		JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	

PLATE NO.



SCALE
0 500 1,000 m



IRRIGATION CANAL	NO.0	NO.1	NO.2	NO.3	NO.4	NO.5	NO.6	NO.7	NO.8	NO.9	NO.10	NO.11	NO.12
CANAL BASE ELEVATION	98.31 98.36 98.25 98.35	98.22	98.16 98.14 98.08 98.07	98.03	97.98	97.90	97.88 97.86 97.83	97.78	97.73	97.70	97.67	97.55	97.48 97.47 97.45	97.35	97.30 97.29	97.24 97.24 97.20	97.08 97.05	96.98	96.93 96.89	96.86	96.82
WATER SURFACE ELEVATION	99.50 99.46 99.46	99.33	99.24 99.22 99.19 99.18	99.14	99.09	99.01	98.99 98.97 98.94	98.89	98.84	98.81	98.72	98.66	98.59 98.58 98.56	98.47	98.41 98.40	98.32 98.32 98.31	98.19 98.16	98.09	98.04 98.00	97.97	97.93
GROUND SURFACE ELEVATION	98.30 98.30 98.30 98.30	98.60	100.00 101.60 101.00 99.00	100.40	99.00	99.60	100.80 100.00 98.60	101.40	99.30 98.00	101.70	98.00	98.60	99.40 98.00 98.00	98.00	98.00 98.00	98.00 98.00	98.00 98.00	98.00	98.00 98.00	102.00	97.60
REDUCED DISTANCE	0 20	440 460 500 570	920 1,000 1,120 1,150	1,320	1,500	1,820	1,920 2,000 2,120	2,320	2,500 2,520	2,620	3,000	3,220	3,500 3,570 3,620	4,000	4,220 4,270	4,450 4,500	5,000 5,100	5,300	5,500 5,650	5,770	6,000
DISTANCE	0 +20	+420 30 + 70	+ 350 80 120 30	+ 170	180	+ 320	100 80 + 120	+ 200	180 + 120	380	+ 220	280	70 50	380	+ 220 90	+ 200 50	500 + 100	+ 200	200 + 150	+ 120	230
STATION	NO.0	NO.1	NO.2	NO.3	NO.4	NO.5	NO.6	NO.7	NO.8	NO.9	NO.10	NO.11	NO.12

NOTE

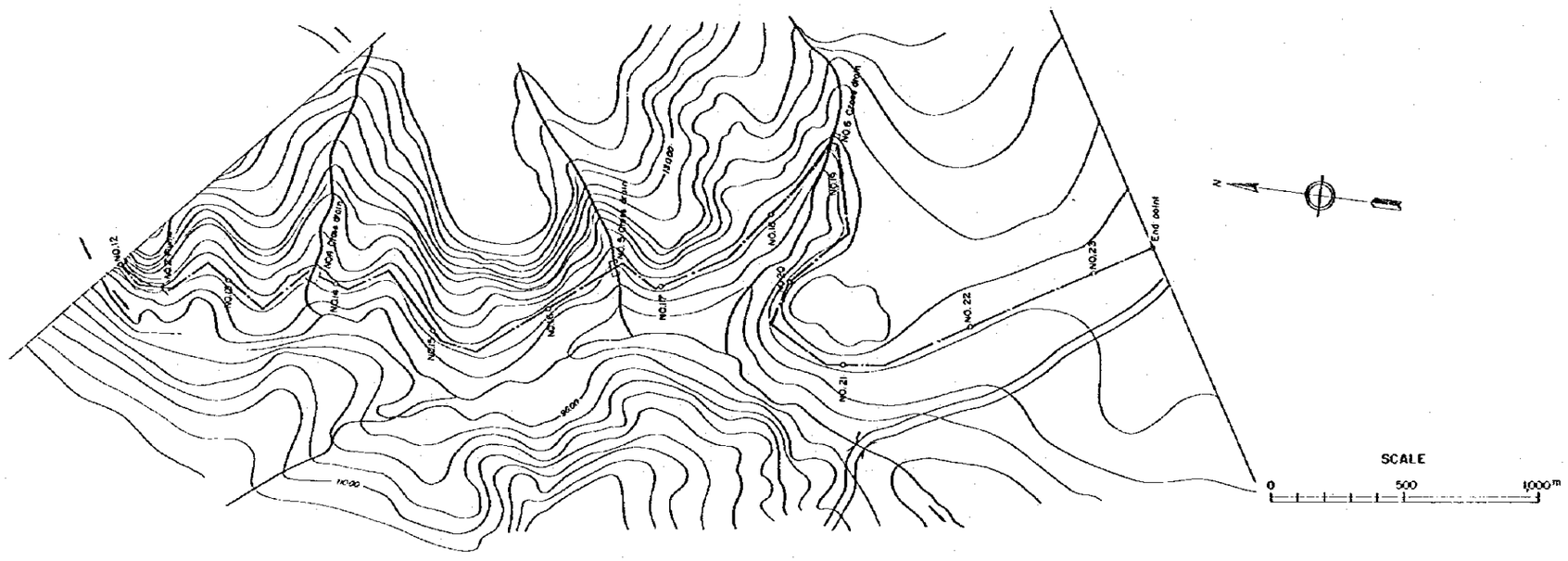
: Culvert
: Cross Drain
: Flume

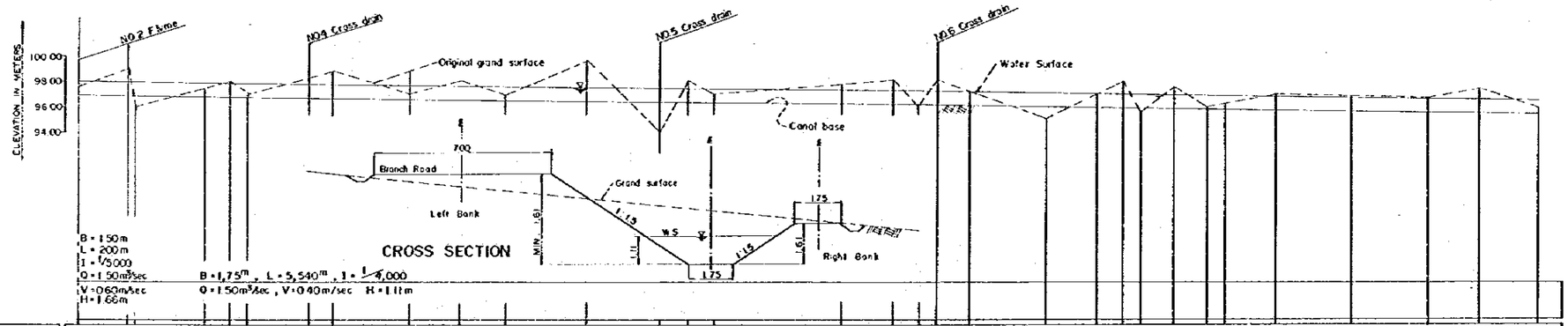
B : Canal Base Width
L : Canal Length
I : Longitudinal Gradient
Q : Discharge
V : Velocity
H : Water Depth

SCALE
VERTICAL 1:200
HORIZONTAL 1:10,000

PREPARED	FEDERAL DEPARTMENT OF AGRICULTURE	TITLE OF DRAWING AUCHI PROJECT	APPROVED
CHECKED	FEDERAL REPUBLIC OF NIGERIA	HEAD RACE (1)	
SUBMITTED	THE AGRICULTURAL DEVELOPMENT PROJECTS IN IMO AND BENDEL STATES	DWG. NO. 08	DATE
DATE		JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	

PLATE NO.





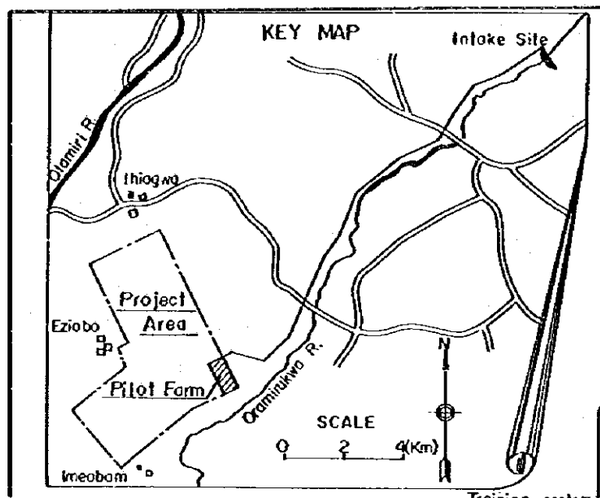
IRRIGATION CANAL																															
CANAL BASE ELEVATION	96.82	96.73	96.74	96.67	96.64	96.63	96.57	96.54	96.46	96.41	96.37	96.29	96.22	96.19	96.16	96.04	95.99	95.96	95.95	95.92	95.84	95.79	95.76	95.73	95.72	95.69	95.66	95.63	95.55	95.42	95.42	95.36
WATER SURFACE ELEVATION	97.93	97.86	97.85	97.78	97.75	97.74	97.68	97.65	97.57	97.52	97.48	97.40	97.33	97.30	97.27	97.15	97.10	97.07	97.06	97.05	96.98	96.90	96.87	96.86	96.83	96.80	96.79	96.74	96.66	96.58	96.53	96.47
GROUND SURFACE ELEVATION	97.60	99.00	96.00	97.40	98.00	97.00	98.30	98.80	97.00	98.00	97.00	98.60	94.00	98.00	97.00	97.70	98.00	96.00	98.00	97.20	95.00	97.00	98.00	93.60	97.60	96.00	96.30	97.00	96.90	96.80	97.40	96.00
REDUCED DISTANCE	6,000	6,200	6,230	6,500	6,600	6,670	6,910	7,000	7,300	7,500	7,680	8,000	8,290	8,400	8,500	9,000	9,200	9,300	9,370	9,500	9,800	10,000	10,100	10,170	10,300	10,430	10,500	10,700	11,000	11,300	11,500	11,740
DISTANCE	230	+ 200	+ 30	270	+ 100	+ 70	+ 240	90	+ 300	200	+ 180	320	+ 290	+ 110	100	500	+ 200	+ 100	+ 70	130	+ 300	200	+ 100	+ 70	+ 130	+ 130	70	+ 200	300	+ 300	200	+ 240
STATION	NO.12			NO.13			NO.14			NO.15			NO.16			NO.17					NO.18							NO.19				
STATION																						NO.20						NO.21				
STATION																													NO.22			
STATION																														NO.23		

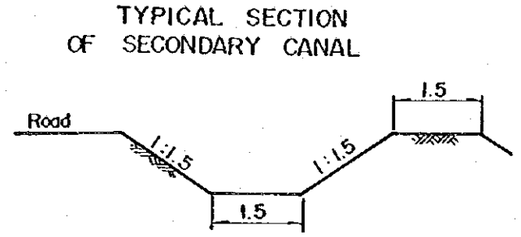
SCALE

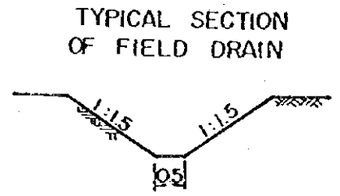
VERTICAL 1:200

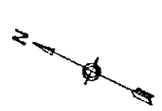
HORIZONTAL 1:10000

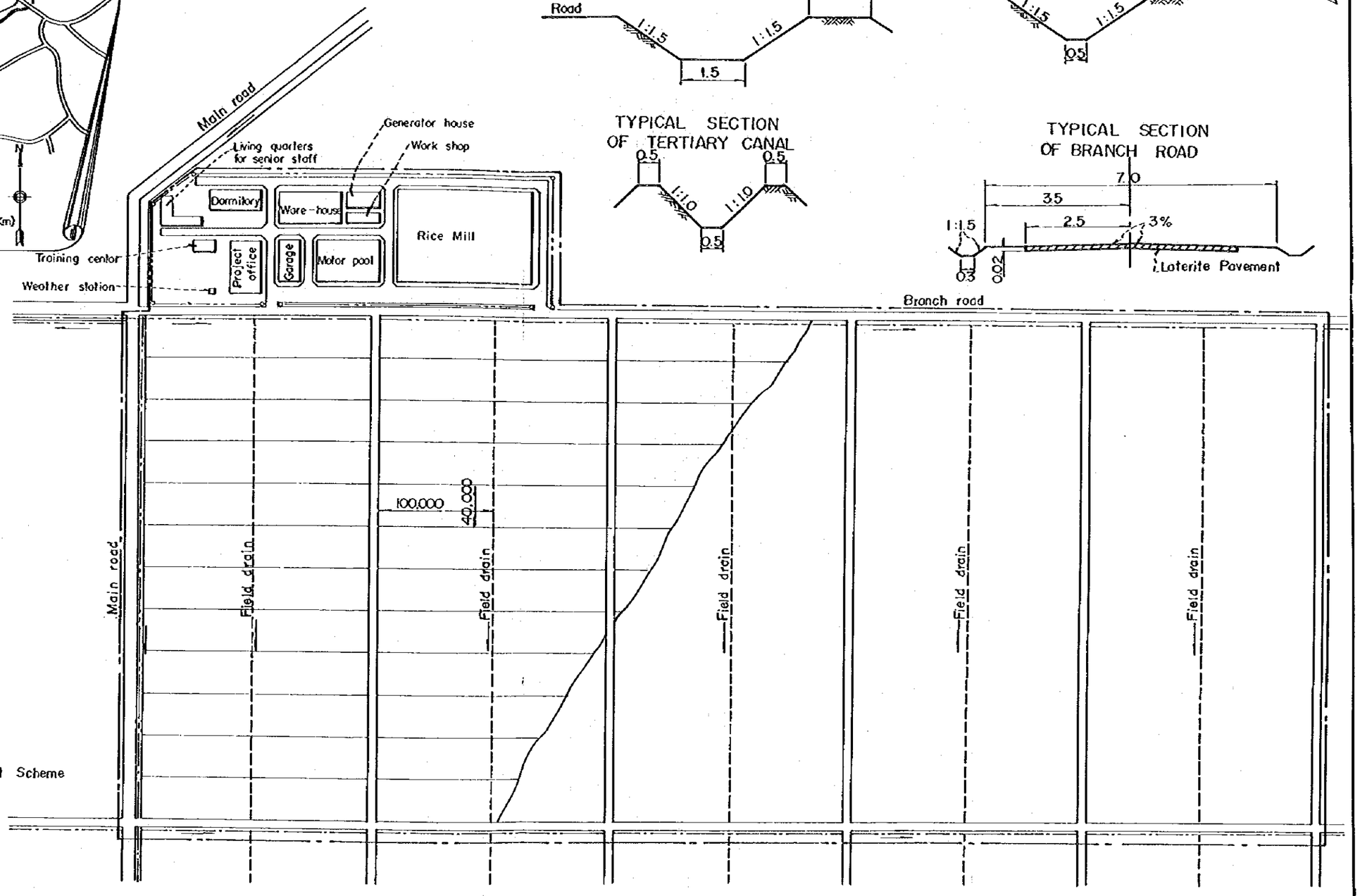
PREPARED	FEDERAL DEPARTMENT OF AGRICULTURE	TITLE OF DRAWING AUCHI PROJECT	APPROVED
CHECKED	FEDERAL REPUBLIC OF NIGERIA	HEAD RACE (2)	
SUBMITTED	THE AGRICULTURAL DEVELOPMENT PROJECTS IN IMO AND BENDEL STATES	DWG. NO. 09	DATE
DATE		JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	











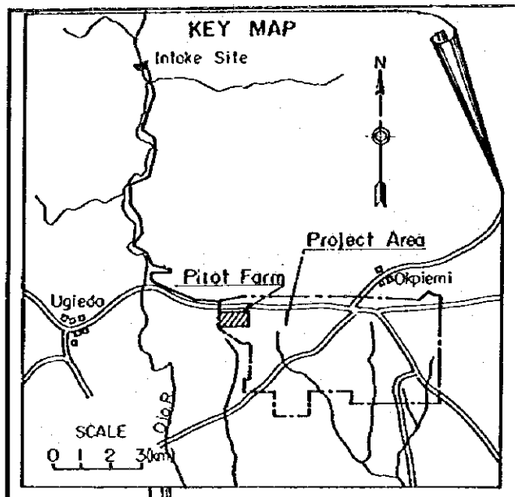
LEGEND

- Head Race
- Secondary Canal
- Tertiary Canal
- Field Drain
- Main Road
- Branch Road
- Boundary of Pilot Scheme

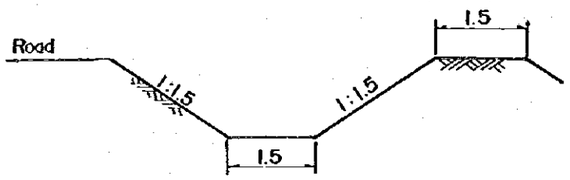
SCALE
0 100 200m

PREPARED	FEDERAL DEPARTMENT OF AGRICULTURE	TITLE OF DRAWING OWERRI PROJECT	APPROVED
CHECKED	FEDERAL REPUBLIC OF NIGERIA	GENERAL LAYOUT OF PILOT SCHEME	
SUMITTED	THE AGRICULTURAL DEVELOPMENT	DWG. NO. 10	DATE
DATE	PROJECTS IN IMO AND BENDEL STATES	JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO	

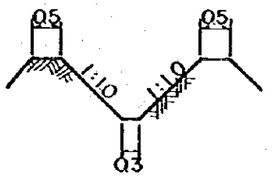
KEY MAP



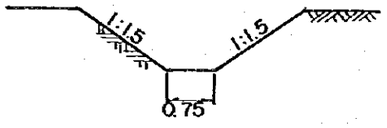
TYPICAL SECTION OF MAIN CANAL



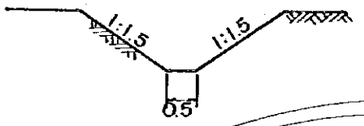
TYPICAL SECTION OF TERTIARY CANAL

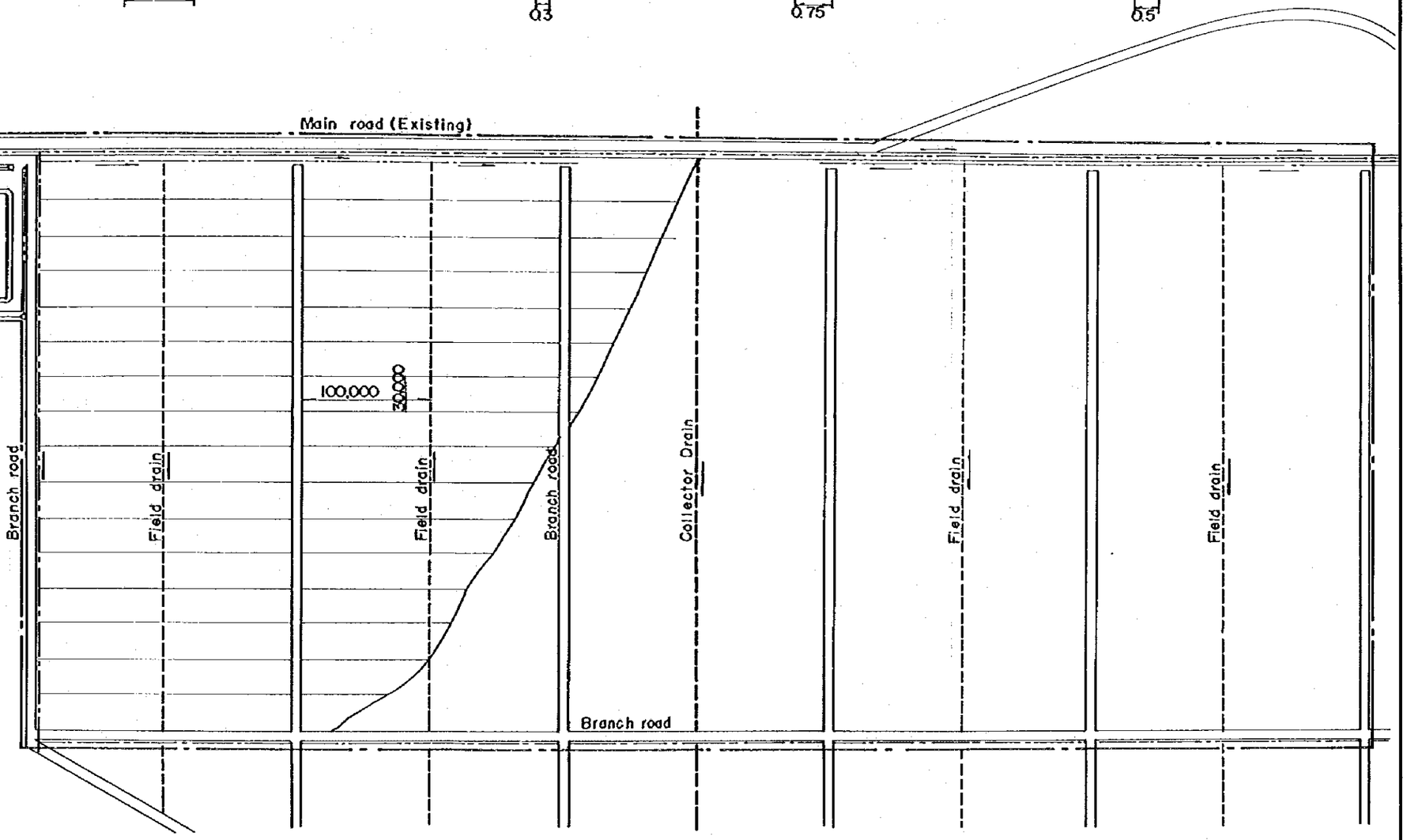


TYPICAL SECTION OF COLLECTOR DRAIN



TYPICAL SECTION OF FIELD DRAIN

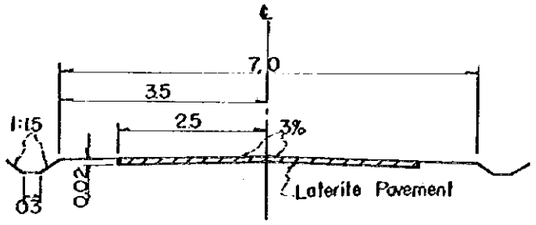




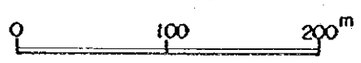
LEGEND

- Main Canal
- Tertiery Canal
- Field Drain
- Drain
- Main Road
- Branch Road
- Boundary of Pilot Scheme

TYPICAL SECTION OF BRANCH ROAD



SCALE



PREPARED	FEDERAL DEPARTMENT OF AGRICULTURE	TITLE OF DRAWING: AUCHI PROJECT	APPROVED
CHECKED	FEDERAL REPUBLIC OF NIGERIA	GENERAL LAYOUT OF PILOT SCHEME	
SUBMITTED	THE AGRICULTURAL DEVELOPMENT PROJECTS IN IMO AND BENDEL STATES	DRG NO. 11	DATE
DATE		JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO