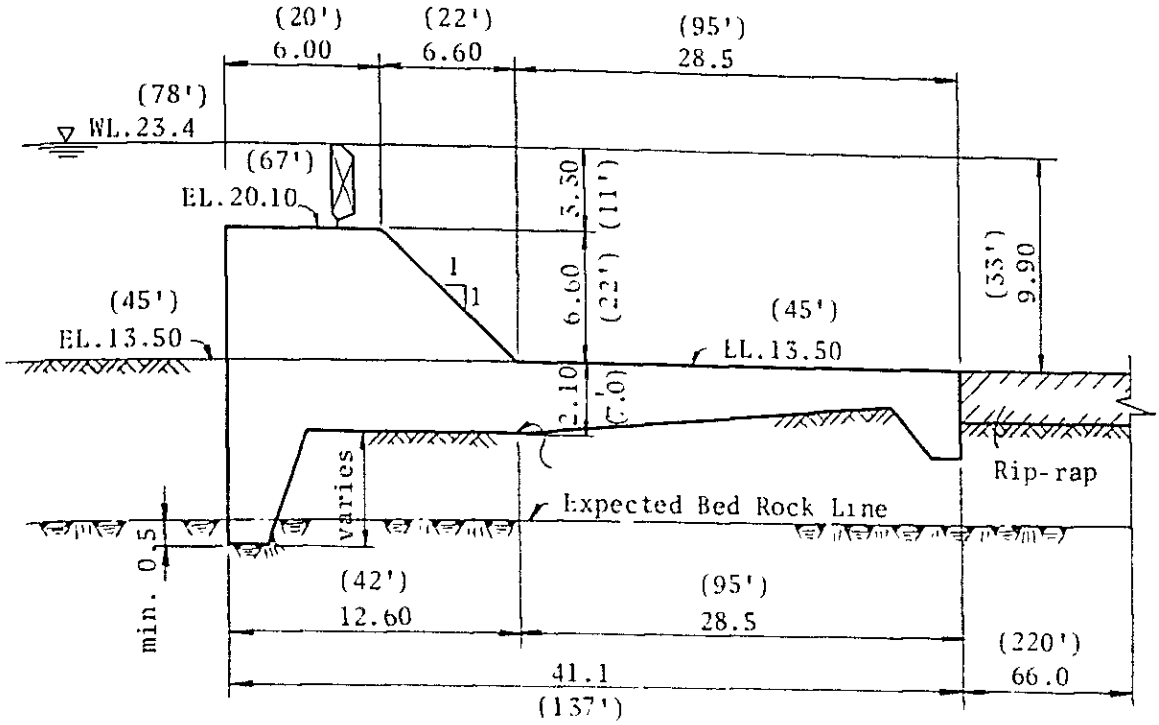
Design of Movable Portion



(1) Determination of Apron Length

Bligh's formula

$$La = 0.6 \cdot C \cdot \sqrt{H}$$

Where, C: Bligh's Coefficient (medium particle sand) 15

H: Maximum water level difference between the upstream and the downstream

WL.23.40 - EL.13.50 = 9.9 m

$\therefore$ La = 0.6 x 15 x $\sqrt{9.9}$ = 28.3 m < 28.5 m $\therefore$ OK

(2) Piping

The proposed weir will not cause piping because the cutoff walls can directly contact with the rocks.

(3) Study on apron thickness

The apron-thickness was determined by 2.1 m (7.0 ft), the same as that of the piers, in taking into consideration of the fact that no uplifting pressures will work upon the body.

(4) Rip-rap length

The proposed rip-rap length was calculated as follows by Bligh's formula.

$$L = LB - La$$

$$LB = 0.67.C \cdot \sqrt{Ha \cdot q \cdot f}$$

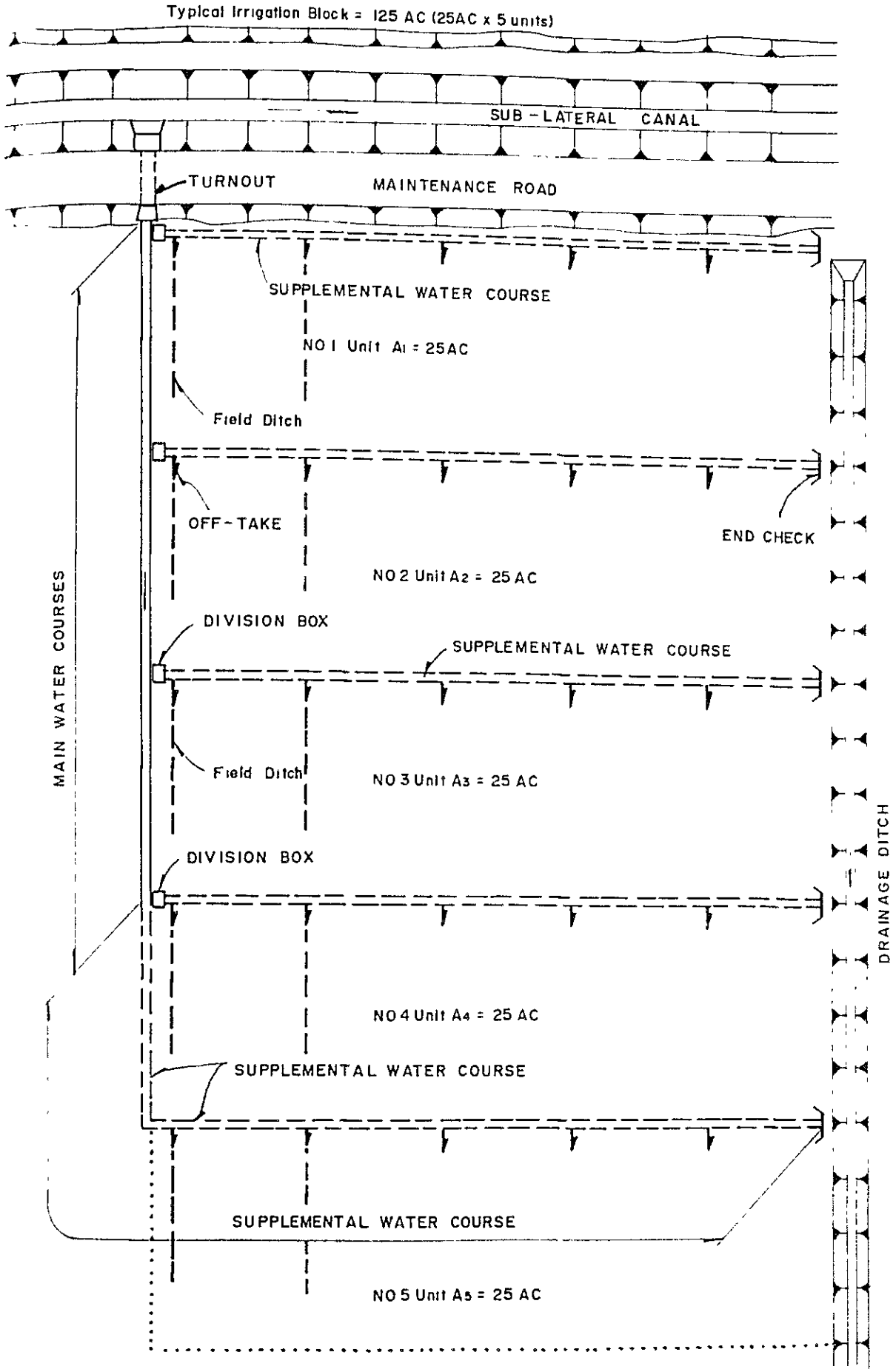
L ; Rip-rap length required (m)
La ; Downstream apron length 28.5 m
C ; Bligh's coefficient
Ha ; Max. water level difference 9.9 m
q ; Flood discharge per unit width
370/42.6 = 8.69 $m^3/s/m$
f ; Safety factor 1.0

$$\therefore \quad LB = 0.67 \times 15 \times \sqrt{9.9 \times 8.69} \times 1.0 = 93.2 \text{ m}$$

$$\therefore \quad L = 93.2 - 28.5 = 64.7 \text{ m}$$

Therefore, the rip-rap length required was determined by 66.0 m (220.0 ft) including some allowance.

FIGURE 4D-10 IRRIGATION BLOCK & UNIT



Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depreciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
1.	Civil Works										
1.1.	Preparation										
	Okkan dam	1	L.S.		3,790	-	-	-	2,080	1,710	3,790
	Diversion dam	1	"		1,480	490	90	580	270	630	900
	Irrigation & Drainage canals	1	"		2,160	70	490	560	650	950	1,600
	Hydropower plant	1	"		860	-	80	80	390	390	780
	Total				8,290	560	660	1,220	3,390	3,680	7,070
	excluding depreciation cost				7,730						
1.2.	Main Dam										
(1)	Diversion Facility										
a.	Bypass canal										
	Stripping	2,900	cu.m	10.3	29.9	19.4	-	19.4	7.0	3.5	10.5
	Common excavation	8,500	"	10.0	85.0	51.0	-	51.0	18.7	15.3	34.0
	Soft rock excavation	4,400	"	14.0	61.6	29.0	-	29.0	11.0	21.6	32.6
	Sound rock excavation	4,200	"	53.3	223.9	64.3	122.6	186.9	16.0	21.0	37.0
	Miscellaneous works	1	L.S.		7.6	0.3	0.4	0.7	3.3	3.6	6.9
	Sub-total				408.0	164.0	123.0	287.0	56.0	65.0	121.0

Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depre-ciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
b.	Coffer dam										
	Stripping	4,800	cu.m	10.3	49.4	32.2	-	32.2	11.5	5.7	17.2
	Common excavation	1,000	"	10.0	10.0	6.0	-	6.0	2.2	1.8	4.0
	Soft rock excavation	3,300	"	14.0	46.2	21.8	-	21.8	7.9	16.5	24.4
	Embankment zone 1	12,200	"	18.2	222.0	147.6	-	147.6	52.5	21.9	74.4
	" zone 2	15,200	"	16.3	247.8	162.6	-	162.6	59.3	25.9	85.2
	" zone 2'	7,600	"	4.7	35.7	21.3	-	21.3	7.6	6.8	14.4
	Riprap (t = 0.15m)	4,800	sq.m	7.5	36.0	10.1	18.7	28.8	2.9	4.3	7.2
	D/S closing dike	1	L.S.		30.0	-	-	-	15.0	15.0	30.0
	Miscellaneous works	1	"		13.9	0.4	0.3	0.7	8.1	5.1	13.2
	Sub-total				691.0	402.0	19.0	421.0	167.0	103.0	270.0
	Total				1,099.0	566.0	142.0	708.0	223.0	168.0	391.0
(2)	Grouting Works										
	Drilling pilot holes	1,500	m	122.2	183.3	27.5	117.0	144.5	20.9	17.9	38.8
	" grout holes	7,300	"	94.1	686.9	102.9	438.0	540.9	78.1	67.4	146.0
	Grouting	7,300	"	60.1	438.7	151.1	-	151.1	176.7	110.9	287.6
	Miscellaneous works	1	L.S.		48.1	0.5	1.0	1.5	27.3	19.3	46.6
	Total				1,357.0	282.0	556.0	838.0	303.0	216.0	519.0

Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depre-ciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
(3)	Dam Body										
	Stripping	43,500	cu.m	10.3	448.1	291.5	-	291.5	104.4	52.2	156.6
	Common excavation	11,100	"	10.0	111.0	66.6	-	66.6	24.4	20.0	44.4
	Soft rock excavation	26,800	"	14.0	375.2	176.9	-	176.9	64.3	134.0	198.3
	Sound rock excavation	15,500	"	53.3	826.2	237.2	452.6	689.8	58.9	77.5	136.4
	Embankment zone 1	111,000	"	18.2	2,020.2	1,343.1	-	1,343.1	477.3	199.8	677.1
	" zone 2	250,000	"	16.3	4,075.0	2,675.0	-	2,675.0	975.0	425.0	1,400.0
	" zone 2'	118,000	"	4.7	554.6	330.4	-	330.4	118.0	106.2	224.2
	" zone 3	2,500	"	47.2	118.0	34.3	64.5	98.8	10.5	8.7	19.2
	Filter & drain	9,500	"	43.9	417.1	281.2	-	281.2	92.2	43.7	135.9
	Riprap (t = 0.80m)	17,200	sq.m	38.7	665.6	246.0	266.6	512.6	77.4	75.6	153.0
	Sodding	17,100	"	2.4	41.0	-	-	-	17.1	23.9	41.0
	Wet masonry	700	"	114.2	79.9	35.5	6.3	41.8	30.0	8.1	38.1
	Observatory devices	1	L.S.		90.0	-	88.0	88.0	-	2.0	2.0
	Miscellaneous works	1	L.S.		162.1	0.3	1.0	1.3	102.5	58.3	160.8
	Total				9,984.0	5,718.0	879.0	6,597.0	2,152.0	1,235.0	3,387.0
(4)	Spillway										
	Stripping	8,100	cu.m	10.3	83.4	54.3	-	54.3	19.4	9.7	29.1
	Common excavation	24,500	"	10.5	257.3	154.4	-	154.4	56.4	46.5	102.9

Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depre-ciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
	Soft rock excavation	27,000	cu.m	14.6	394.2	189.0	-	189.0	70.2	135.0	205.2
	Sound rock excavation	38,900	"	53.8	2,092.8	606.8	1,135.9	1,742.7	155.6	194.5	350.1
	Back-fill	8,200	"	7.8	64.0	37.7	-	37.7	13.1	13.2	26.3
	Reinforced concrete	5,900	"	262.0	1,545.8	501.5	-	501.5	945.8	98.5	1,044.3
	Formwork	3,500	sq.m	37.6	131.6	-	-	-	107.1	24.5	131.6
	Reinforcing bars	300	ton	7,210.0	2,163.0	-	1,800.0	1,800.0	330.0	33.0	363.0
	Riprap (t = 0.50m)	4,400	sq.m	24.9	109.6	30.8	56.8	87.6	9.2	12.8	22.0
	Steel girder (H-beam)	1	L.S.	-	75.0	-	60.0	60.0	-	15.0*	15.0
	Scaffold	1	"	-	15.0	-	-	-	7.0	8.0	15.0
	Miscellaneous works	1	"		115.3	0.5	0.3	0.8	85.2	29.3	114.5
	Total				7,047.0	1,575.0	3,053.4	1,628.0	1,799.0	620.0	2,419.0
(5)	Irrigation Outlet										
	Stripping	2,100	cu.m	10.3	21.6	14.1	-	14.1	5.0	2.5	7.5
	Common excavation	6,300	"	10.0	63.0	37.8	-	37.8	13.9	11.3	25.2
	Soft rock excavation	8,800	"	14.0	123.2	58.1	-	58.1	21.1	44.0	65.1
	Sound rock excavation	18,600	"	53.3	991.4	284.6	543.1	827.7	70.7	93.0	163.7
	Back-fill	5,600	"	7.8	43.7	25.8	-	25.8	9.0	8.9	17.9
	Reinforced concrete	4,600	"	262.0	1,205.2	391.0	-	391.0	737.4	76.8	814.2
	Formwork	2,000	sq.m	37.6	75.2	-	-	-	61.2	14.0	75.2
	Reinforcing bars	230	ton	7,210.0	1,658.3	-	1,380.0	1,380.0	253.0	25.3	278.3

Note: * include taxes/duties

Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depreciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
	Riprap (t = 0.50m)	100	sq.m	24.9	2.5	0.7	1.3	2.0	0.2	0.3	0.5
	Wet masonry	20	"	114.2	2.3	1.0	0.2	1.2	0.9	0.2	1.1
	Screen	1	L.S.		168.8	-	135.0	135.0	-	33.8*	33.8
	Steel pipe (ø 2.4m)	210	m	7,500.0	1,575.0	-	1,260.0	1,260.0	-	315.0*	315.0
	" (ø 1.6m)	10	"	5,000.0	50.0	-	40.0	40.0	-	10.0*	10.0
	Butterfly valve (ø 1.6m)	1	L.S.		550.0	-	440.0	440.0	-	110.0*	110.0
	Corn valve (ø 1.43m)	1	"		2,500.0	-	2,000.0	2,000.0	-	500.0*	500.0
	Control house	1	"		51.0	-	-	-	47.0	4.0	51.0
	Scaffold	1	"		9.0	-	-	-	4.0	5.0	9.0
	Miscellaneous works	1	"		119.8	0.9	0.4	1.3	61.6	56.9	118.5
	Total				9,210.0	814.0	5,800.0	6,614.0	1,285.0	1,311.0	2,596.0
	Total of Main Dam				28,697.0	8,955.0	10,430.0	19,385.0	5,762.0	3,550.0	9,312.0
	excluding depreciation cost				19,742.0						
	Note: * include taxes/duties										
1.3.	Division Dam										
	Common excavation	38,200	cu.m	3.4	129.9	91.7	-	91.7	30.6	7.6	38.2
	Back-fill	8,400	"	7.0	58.8	42.0	-	42.0	15.2	1.6	16.8
	Embankment	25,800	"	7.0	180.6	129.0	-	129.0	46.4	5.2	51.6

Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depre-ciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
	Spokl bank	4,000	cu.m	12.9	51.6	32.0	-	32.0	18.0	1.6	19.6
	Reinforced concrete	10,940	"	262.0	2,866.3	929.9	-	929.0	1,753.7	182.7	1,936.4
	Formwork	12,550	sq.m	37.6	471.9	-	-	-	384.0	87.9	471.9
	Reinforcing bar	274	ton	7,210.0	1,975.5	-	1,644.0	1,644.0	301.4	30.1	331.5
	Riprap	2,640	sq.m	439.8	1,161.1	334.8	-	334.8	733.4	92.9	826.3
	Sheet pile (L = 3.0m)	110	P.C.S.	716.0	78.8	5.9	71.1	77.0	1.7	0.1	1.8
	" (L = 6.0m)	170	"	1,402.9	238.5	14.5	219.6	234.1	4.1	0.3	4.4
	Wet masonry	990	sq.m	120.8	119.6	54.5	9.6	64.1	43.4	12.1	55.5
	Machine room	150	"	1,200.0	180.0	15.5	92.5	108.0	63.6	8.4	72.0
	Operation bridge	47	m	7,368.0	346.3	-	310.9	310.9	31.5	3.9	35.4
	Roller gate	77	ton	17,500.0	1,347.5	-	1,001.0	1,001.0	-	346.5*	346.5
	Slide gate	17	"	18,800.0	319.6	-	238.0	238.0	-	81.6*	81.6
	Transhrack	11	"	11,200.0	123.2	-	88.0	88.0	-	35.2*	35.2
	Total of Diversion Dam				9,649.2	1,649.8	3,674.7	5,324.5	3,427.0	897.7	4,324.7
	excluding depreciation cost				7,999.4						

Note: * include taxes/duties

Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depre-ciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
1.4.	Irrigation & Drainage Canal										
(1)	Main Irrigation Canal										
	Canal type A	12,500	m	619.7	7,746.3	241.3	-	241.3	3,968.8	3,536.2	7,505.0
	" B	8,650	"	644.4	5,574.1	166.9	-	166.9	2,746.4	2,660.8	5,407.2
	" C	9,980	"	619.6	6,183.6	192.6	-	192.6	3,168.7	2,822.3	5,911.0
	" D	6,670	"	578.6	3,859.3	128.7	-	128.7	2,094.4	1,636.2	3,730.6
	" E	4,000	"	358.1	1,432.4	77.2	-	77.2	833.6	521.6	1,355.2
	Head regulator type A	5	places		704.0	9.2	648.8	658.0	38.0	8.0	46.0
	" B	3	"		360.0	-	336.6	336.6	19.2	4.2	23.4
	" C	3	"		301.9	4.7	277.6	282.3	16.2	3.4	19.6
	" F	11	"		389.4	4.6	355.3	359.9	24.2	5.3	29.5
	Parshall flume type A	1	"		93.9	8.2	46.5	54.7	34.3	4.9	39.2
	Check gate A	1	"		659.3	7.8	614.0	621.8	32.8	4.7	37.5
	" B	1	"		485.2	6.6	445.6	452.2	28.8	4 2	33.0
	Drop A	3	"		349.2	29.3	165.8	195.1	134.2	19.9	154.1
	" B	2	"		70.2	5.6	31.8	37.4	28.4	4.4	32.8
	Aqueduct	10	"		4,902.5	435.5	2,459.4	2,894.9	1,676.3	331.3	2,007.6
	Bridge (service road)	10	"		2,399.1	84.5	1,826.3	1,910.8	434.3	54.0	488.3
	Railway crossing	1	"		163.4	13.9	78.4	92.3	57.2	13.9	71.1

Item	Description		Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
							Depre-ciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
	Road corssing type	A	5	Places		701.0	59.9	338.0	397.9	264.7	38.4	303.1
	Spillway	A	5	"		354.5	27.6	155.7	183.3	131.7	39.5	171.2
	Sub-total					36,729.3	1,504.1	7,779.8	9,283.9	15,732.2	11,713.2	27,445.4
(2)	Lateral Irrigation Canal											
	Canal type	F	7,300	m	296.1	2,161.5	140.9	-	140.9	1,264.4	756.2	2,020.6
	"	G	19,100	"	284.1	5,426.3	368.6	-	368.6	3,172.5	1,885.2	5,057.7
	"	H	41,800	"	301.9	12,619.4	806.7	-	806.7	6,796.7	5,016.0	11,812.7
	Head regulator	D	46	Places		2,626.5	32.1	2,252.2	2,284.3	310.9	31.3	342.2
	"	E	17	"		803.8	9.2	689.5	698.7	95.8	9.3	105.1
	"	F	25	"		885.0	10.5	808.5	819.0	55.0	11.0	66.0
	Parshall flume	B	11	"		143.0	11.8	66.7	78.5	56.2	8.3	64.5
	Drop	D	27	"		573.6	46.4	262.4	308.8	227.9	36.9	264.8
	Check	C	39	"		161.3	10.7	60.8	71.5	81.2	8.6	89.8
	Road crossing	B	7	"		316.1	26.2	147.8	174.0	123.5	18.6	142.1
	Drainage crossing	A	8	"		202.9	13.6	76.8	90.4	71.6	40.9	112.5
	Bridge		8	"		1,919.2	67.6	1,460.8	1,528.4	347.2	43.6	390.8
	Spillway	B	13	"		250.2	19.4	109.2	128.6	93.1	28.5	121.6
	Sub-total					28,088.8	1,563.7	5,934.7	7,498.4	12,696.0	7,894.4	20,590.4

Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depreciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
(3)	Sub-lateral Irrigation Canal										
	Canal type I	107,100	m	45.3	4,851.6	-	-	-	-	4,851.6	4,851.6
	" J	35,100	"	34.7	1,218.0	-	-	-	-	1,218.0	1,218.0
	" K	3,400	"	23.6	80.2	-	-	-	-	80.2	80.2
	Turnout	370	places		9,705.1	54.4	8,635.8	8,690.2	908.4	106.5	1,014.9
	Check type D	93	"		335.7	22.4	128.3	150.7	167.4	17.6	185.0
	Road crossing C	6	"		234.8	19.1	108.0	127.1	93.3	14.4	107.7
	Drainage crossing B	9	"		313.1	10.9	61.6	72.5	199.9	40.7	240.6
	Bridge	9	"		2,159.1	76.0	1,643.4	1,719.4	391.0	48.7	439.7
	Sub-total				18,897.6	182.8	10,577.1	10,759.9	1,760.0	6,377.7	8,137.7
(4)	Drainage Canal										
	Main drainage canal	22,700	m	206.0	4,676.2	-	-	-	-	4,676.2	4,676.2
	Lateral drainage canal	99,800	"	103.0	10,279.4	-	-	-	-	10,279.4	10,279.4
	" (LDC6)	3,500	"	19.8	69.3	-	-	-	-	69.3	69.3
	" (LDC9-1)	6,500	"	84.1	546.7	-	-	-	-	546.7	546.7
	" (LDC9-2)	3,000	"	108.5	325.5	-	-	-	-	325.5	325.5
	Sub-lateral drainage	145,600	"	18.8	2,737.3	-	-	-	-	2,737.3	2,737.3
	Sub-total				18,634.4	-	-	-	-	18,634.4	18,634.4
	Total of Canals				102,350.1	3,250.6	24,291.6	27,542.2	30,188.2	44,619.7	74,807.9
	excluding depreciation cost				99,099.5						

Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depreciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
1.5.	On-farm										
	Main water course	252,000	m	1.5	378.0	-	-	-	-	378.0	378.0
	Supplemental water course	1,174,320	"	1.3	1,526.6	-	-	-	-	1,526.6	1,526.6
	Drainage ditch	236,880	"	3.1	734.3	-	-	-	-	734.3	734.3
	Division box	3,360	Places	121.8	409.2	25.2	80.0	105.2	254.0	50.0	304.0
	End check	2,100	"	121.8	255.8	15.8	50.0	65.8	158.7	31.3	190.0
	Off-take	10,500	"	38.8	407.4	-	-	-	405.3	2.1	407.4
	Total of On-farm				3,711.3	41.0	130.0	171.0	818.0	2,722.3	3,540.3
	excluding depreciation cost				3,670.3						
1.6.	Road										
	Improvement of existing road	14,000	m	170.2	2,383.0	354.2	-	354.2	1,545.6	483.2	2,028.8
	excluding depreciation cost				2,028.8						
1.7.	Hydropower Plant										
(1)	Penstock										
	Stripping	204	cu.m	10.3	2.1	1.4	-	1.4	0.3	0.2	0.7
	Sound rock excavation	1,224	"	53.3	65.2	18.7	35.7	54.4	4.7	6.1	10.8
	Back-fill	1,100	"	7.8	8.6	5.1	-	5.1	1.8	1.7	3.5

Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depre-ciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
	Reinforced concret	255	cu.m	262.0	66.8	21.7	-	21.7	40.9	4.2	45.1
	Reinforcing bars	3	ton	7,210.0	21.6	-	18.0	18.0	3.3	0.3	3.6
	Steel penstock	19	m		320.0	-	232.0	232.0			88.0*
	Sub-total				484.3	46.9	285.7	332.6	51.2	12.5	151.7
(2)	House and Foundation										
	Excavation	3,000	cu.m	36.0	108.0	42.0	-	42.0	-	-	66.0
	Concrete	1,100	"	590.0	664.0	209.0	-	209.0	-	-	455.0
	Reinforcing bars	58	ton	7,210.0	418.0	-	348.0	348.0	63.8	6.2	70.0
	Building & Staff House	1	L.S.		3,335.0	-	-	-	-	-	3,335.0
	Sub-total				4,525.0	251.0	348.0	599.0	63.8	6.2	3,926.0
(3)	Tailrace										
	Stripping	170	cu.m	10.3	1.8	1.1	-	1.1	0.4	0.3	0.7
	Sound rock excavation	1,278	"	53.3	68.1	19.6	37.3	56.9	4.9	6.3	11.2
	Reinforced concrete	600	"	262.0	157.2	51.0	-	51.0	96.2	10.0	106.2
	Reinforcing bars	15	ton	7,210.0	108.2	-	90.0	90.0	16.5	1.7	18.2
	Gate	2	sets		338.0	-	251.0	251.0	-	-	87.0*
	Sub-total				673.3	71.7	378.3	450.0	118.0	18.3	223.3
(4)	Machine Equipment										
	Turbine	1	L.S.	10,415.0	-	17,648.0	7,648.0	-	-		2,767.7*
	Generator	1	"	8,078.0	-	5,916.0	5,916.0	-	-		2,162.0*

Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depre-ciation (K'000)	Matieral (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
	Main transformer	1	L.S.		432.0	-	313.0	313.0			119.0*
	Control & switching equip.	1	"		2,535.0	-	1,882.0	1,882.0			653.0
	Extension of switchyard at tharrawaddy	1	"		230	-	200.0	200.0			30.0
	Miscellaneous equip.	1	"		1,648.0	-	1,221.0	1,221.0			427.0*
	Sub-total				23,338.0	-	17,180.0	17,180.0			6,158.0
(5)	33KV Transmission Line	20.3	mile		2,396.0	-	1,259.0	1,259.0			1,137.0*
	Total of Hydropower Plant				31,416.6	369.6	19,451.0	19,820.6			11,596.0
	excluding depreciation cost				31,047.0						
	Note: * include taxes/duties										
1.8.	Pre-Engineering										
(1)	Survey Works										
a.	Topographic surveying and mapping										
	Main dam	32	ha	190	6.1						6.1
	Diversion dam	27	"	190	5.1						5.1
b.	Longitudinal & cross-sectional surveying										
	Main dam	54.9	km	450	24.7						24.7
	Diversion dam	1.5	"	450	0.7						0.7
	Irrigation and drainage canal	256	"	450	115.2						115.2
	Sub-total				140.6						140.6

Item	Description	Quantity	Unit	Rate (Kyat)	Total Cost (K'000)	Foreign Currency			Local Currency		
						Depreciation (K'000)	Material (K'000)	Total (K'000)	Fuel, Repair & Material (K'000)	Labor (K'000)	Total (K'000)
(2)	Geological Survey										
a.	Seismic prospecting										
	Main dam	4.4	km	L.S.	66.0						66.0
b.	Borehole drilling and others										
	Main dam	480	m	70	33.6						33.6
	Diversion dam	40	"	70	2.8						2.8
c.	Material investigation										
	Main dam	1	L.S.		79.5						79.5
	Diversion dam	1	L.S.		53.5						53.5
	Sub-total				235.4						235.4
	Total				376.0						376.0

2. Construction Equipment

Equipment	Specification	No.	Unit Price (K'000)	Amount (K'000)
Bulldozer	32 ton, 300 PS	1	845	845
	21 ton, 183 PS	8	550	4,400
	11 ton, 109 PS	1	430	430
Ripperdozer	32 ton, 317 PS	1	1,000	1,000
Rakedozer	21 ton, 190 PS	4	560	2,240
Front loader	Wheel type 2.1 m^3, 135 PS	5	400	2,000
"	Crawller type 1.8 m^3, 140 PS	1	350	350
Backhoe	0.6 m^3, 94 PS	1	500	3,000
Dump truck	11 ton, 281 PS	24	240	5,760
Water truck	5,500 ℓ, 135 PS	4	140	560
Fuel truck	8 ton, 190 PS	3	160	480
Agitator truck	3.2 m^3, 198 PS	2	210	420
Tamping roller	17.5 ton, 170 PS	1	950	950
Tire roller	30 ton, 95 PS	3	340	1,020
Vibrating roller	0.6 ton, 6.5 PS	4	40	160
Rammer	100 kg	5	10	50
Diesel rammer	1 .35 ton, 98 PS	1	1,080	1,080
Boring machine	7.5 PS	6	60	360
Grouting mixer	10 PS	5	43	215
Grouting pump	200 ℓ x 2, 5 PS	5	27	135
Mixing plant	12 m^3/hr	2	400	800
Screening plant	40 ton/hr	1	250	250
Crawller crane	16 ton, 96 PS	1	750	750
Concrete conveyor	L = 10 m, 3 PS	3	43	129
Belt conveyor	L = 7 m, 3 PS	3	7	21
Vibrator	4.5 PS	14	12	168
Concrete mixer	0.5 m^3	1	35	35
Soil compactor	0.5 ton	4	40	160
Crawller drill	10 m^3/min	4	250	1,000
Air compressor	10.5 m^3/min, 105 PS	4	150	600
Diesel Generator	100 KVA	1	150	150
"	45 KVA	2	80	160
"	20 KVA	6	50	300

Equipment	Specification	No.	Unit Price (K'000)	Amount (K'000)
Pump	ø 150 m/m	10	20	20
"	ø 100 m/m	3	18	54
Motor grader	3.7 m, 125 PS	1	400	400
Jeep		8	60	480
Sub-total				31,112
Space parts (20% of Sub-total)				6,218
Total			(F.C.)	37,330
Taxes/duties (25% of total)			(L.C.)	9,330
Transportation & others			(L.C.)	370
Grand Total				47,030

(Unit: K'000)

		1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	Total
		Final Design & Preparation			Construction			
3.1.	Project Implementation Schedule							
3.2.	Disbursement Schedule of Supporting Services							
(1)	SLRD							
	Survey and office equipment (F.C.)	250	250	250				750
(2)	AC							
a.	Salary wages for incremental extension staff (L.C.)	70	70	70	70	70	70	70
b.	Overseas - Training (F.C.)					100	100	200
c.	Equipment for trial farm and extension services, transport (F.C.)	300	300	300	300	300	300	1,800
d.	Buildings (L.C.)	500	500	500				1,500
e.	Operation and expenses (L.C.)	50	50	50	50	50	50	300
	(Sub-total)	(920)	(920)	(920)	(420)	(520)	(520)	(4,220)
	Total ((1) to (2))	1,170	1,170	1,170	420	520	520	4,970
	Foreign Currency	550	550	550	300	400	400	2,750
	Local Currency	620	620	620	120	120	120	2,220

(Unit: K'000)

Item	FY1985/86	1986/87	1987/88	1988/89	Total
4.1. Salaries and Wages (L.C.)					
Project Office	65	130	130	130	455
Okkan dam operation office	-	55	60	60	175
Diversion dam operation office	-	20	25	25	70
Sub-total	65	205	215	215	700
4.2. Equipment Operation					
Depreciation cost (F.C.)					
Project office	120	200	280	400	1,000
Okkan dam operation office	55	100	110	110	375
Diversion dam operation office	-	15	20	20	55
Fuel and oil cost (L.C.)	50	95	120	160	425
Sub-total	225	410	530	690	1,855
4.3. Materials and Supplies (L.C.)					
Irrigation, drainage and road systems					
Maintenance of canals	160	280	380	550	1,370
Maintenance of road	5	10	10	15	40
Building	30	30	30	30	120
Sub-total	195	320	420	595	1,530
4.4. Administration and General (L.C.)					
Expenditure (4.1.) x 30%	20	60	65	65	210
Total	505	995	1,230	1,565	4,295
(F.C.)	(175)	(315)	(410)	(530)	(1,430)
(L.C.)	(330)	(680)	(820)	(1,035)	(2,865)

5. Project Facilities

Description	Quantity	Unit	Rate (Kyats)	Amount (K'000)
5.1. Building and Facilities				
(a) Building				
Project Office	500	sq.m	1,500	750
Okkan dam operation office	100	sq.m	1,000	100
Diversion dam operation office	100	sq.m	1,000	100
(b) Housing				
Government staff	1,000	sq.m	900	900
Guest house	200	sq.m	900	180
Consultant staff	250	sq.m	900	225
Equipment shed	1,000	sq.m	500	500
(c) Furniture	L.S.			300
Sub-total				3,055 (L.C.)
5.2. Equipment				
Leveling and transit instrument with staff and steel tape	2	set	30,000	60
Copy machine	1	unit	15,000	15
Xerox machine	1	unit	20,000	20
Copy and Xerox paper		L.S.		50
Sub-total				145 (F.C.)
Total				3,200

7. Consulting Services

	Description	Quantity	Unit	Rate (Kyat)	Amount (K'000)
7.1.	Final Design				
(1)	Foreign Currency				
	Consultants remuneration	54	man-month	65,000	3,510
	International travel expense	12	travels	8,910	107
	Miscellaneous & communication		L.S.		189
	Sub-total				3,806
(2)	Local Currency				
	Consultant per diem & others		L.S.		486
	Total (7.1.)				4,292
7.2.	Construction Supervision				
(1)	Foreign Currency				
	Consultants remuneration	90	man-month	45,000	4,050
	International travel expense	19	travels	8,910	169
	Miscellaneous & communication		L.S.		315
	Sub-total				4,534
(2)	Local Currency				
	Consultant per diem & others		L.S.		810
	Total (7.2.)				5,344
7.3.	Supporting Services				
(1)	Foreign Currency				
	Consultants remuneration	20	man-month	50,000	1,000
	International travel expense	2	travels	8,910	18
	Miscellaneous & communication		L.S.		105
	Sub-total				1,123
(2)	Local Currency				
	Consultant per diem & others		L.S.		270
	Total (7.3.)				1,393
	Total (7.1. to 7.3.)				11,029

(Unit: K'000)

Description	Total		1983/84		1984/85		1985/86		1986/87		1987/88		1988/89	
	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C
A. Final Design	3,806	486	3,806	486	-	-	-	-	-	-	-	-	-	-
B. Implementation														
1. Civil Works														
1.1 Preparation	660	7,070	-	-	98	520	196	4,430	366	2,320	-	-	-	-
1.2. Main Dam	10,450	9,512	-	-	-	-	2,398	2,142	2,608	2,328	4,381	3,911	1,043	931
1.3. Diversion Dam	3,675	4,525	-	-	-	-	-	-	1,103	1,298	2,205	2,595	367	432
1.4. Irrigation & Drainage Canal	21,292	71,808	-	-	3,644	11,221	4,858	14,962	4,858	14,962	4,858	14,962	6,074	18,701
1.5 On-farm	130	3,540		-	20	551	26	708	26	708	26	708	32	885
1.6 Road	-	2,029	-		-	301	-	406	-	406	-	406	-	507
1.7 Hydropower Plant	19,451	11,596				-	1,359	1,137	4,518	2,615	11,825	6,798	1,819	1,046
1.8 Pre-Engineering		376	-	301		75	-	-	-	-	-	-	-	-
Sub-total	58,638	115,056	-	301	3,762	12,451	8,737	23,785	13,509	21,637	23,295	29,380	9,335	22,502
2 Construction Equipment	37,350	9,700			3,733	970	33,597	8,730	-	-	-	-	-	-
3 Agricultural Development	2,750	2,220	550	620	550	620	550	620	300	120	400	120	400	120
4 Operation & Maintenance	1,150	2,865	-		-		175	550	315	680	410	820	550	1,035
5 Project Facilities	145	5,055	145	1,500		3,555				-	-	-	-	-
6 Project Administration	-	13,138		1,311	-	1,311		2,628		2,628	-	3,941	-	1,315
7 Consulting Services	5,657	1,080			339	65	849	162	1,131	216	1,754	335	1,584	302
Sub-total (A to 7)	109,756	145,600	1,501	4,221	8,381	16,975	15,905	36,255	15,255	28,281	25,859	34,596	11,849	25,272
Physical Contingency	16,164	21,840	675	633	1,258	2,546	6,586	5,438	2,288	4,242	3,879	5,189	1,778	3,792
Sub-total	126,220	167,440	5,176	4,854	9,642	19,521	30,491	41,693	17,543	32,523	29,738	39,785	13,627	29,064
Price Escalation	47,920	30,871	807	369	2,246	2,186	15,805	6,171	6,947	5,952	14,334	8,753	7,781	7,440
Total	174,140	198,311	5,983	5,223	11,888	21,707	66,299	47,864	24,490	38,475	44,072	48,538	21,408	36,504

CHAPTER VI. PROJECT JUSTIFICATION

Study on Prices of Farm Outputs and Inputs

1. Principles

a) All prices should be adjusted to 1981 levels.

b) All farm outputs and inputs should be evaluated at the normal current farm gate prices.

c) As regards financial prices, they will be derived from their local market prices.

d) Regarding economic prices, they should be derived from their world market prices in case of internationally traded commodities, whereas in case of domestically traded commodities, their economic prices will be derived from their local market prices, which will be the same as their financial prices in most cases. Moreover, if a financial price is a subsidized price, this subsidy should be included in its economic price, because subsidy should be the cost for national economy, and if financial price includes tax, this tax should not be included in its economic price, because it is nothing but transfer payment for national economy.

2. Financial Prices of Farm Products Concerned

Out of farm products concerned, paddy, maize (feed grains), mat'pe (mung bean) and jute are the Government controlled commodities. They can be sold only at the Government purchasing depots at the Government controlled prices. In order to get their farm gate prices, the transportation costs from farm gates to depots should be deducted from the gov't controlled prices at the gov't depots.

For example, in case of paddy, the majority of paddy produced in the Area is graded to "ordinary grade of Emata Group", the price of which is 955 Ks/100 basket at the Governmental Paddy Purchasing Depots, if their moisture content is less than 14%. If moisture content exceeds 14%, its price is deducted at the rate of five Ks/100

baskets in every one percent. According to Taikkyi AFPTC Tsp Office, moisture contents of the paddy collectdd at the Governmental Depots in the Area are classified as follows:

Moisture Content	Price/bskt of Ordinary grade of Emata group	% of Collected Quantity	Weighted Value
18%	KS 9.35	6	56.1
16%	KS 9.45	86	812.7
14%	KS 9.55	8	76.4
∴ 16%	KS 9.45 (average)	100	945.2

As such, it is understood that the paddy price received by farmers at depots in the area is Ks 9.45 per basket on an average. On the other hand, the distance from farm gates to depots is estimated at around two miles on an average. And one cart load is 25 baskets and one time carting cost is estimated at Ks ten. In other words, carting cost/basket is estimated at 0.4 Ks (Ks 10 ÷ 25). Therefore, the financial farm gate price of paddy is estimated at 9.05 Ks/basket (Ks 9.45 - Ks 0.4).

In the same way, financial farm gate prices of the other Government controlled crops concerned are estimated at follows:

	Government Controlled Price at depots	Transportation cost from farm gates to depots	Financial farm gate price
Maize	Ks 20/bskt (55 lbs)	0.5 Ks/kskt	Ks 19.5/bskt
Mat'pe	Ks 50/bskt (72 lbs)	0.6 Ks/bskt	Ks 49.4/bskt
Jute* Presnt	Ks 2.65/viss (3.6 lbs)	0.03 Ks/viss	Ks 2.62/viss
after project	Ks 3.55/viss (3.6 lbs)	0.03 Ks/viss	Ks 3.52/viss

* At present, the quality of jute produced in the area is graded at the second grade mainly because of muddy water for dipping of jute stem and for washing of jute bark. But after completion of the proposed Irrigation Project, enough clean water will be

available for dipping of jute stem and for washing of jute bark, which will make the quality of jute good enough for special grade. The Government controlled price of the second grade jute is Ks 2.65/viss at depots whereas that of the special grade jute Ks 3.55/viss.

As regards other crops than Government controlled crops, i.e. groundnuts, sesame, gram, bocate and sunflower, they would be classified into the following three types from the viewpoint of their marketing. Namely, a) In case of groundnuts and sesame, middle men come to the farm gates to collect them, although a small quantity of groundnuts are collected by the Tsp Cooperative Society for the purpose of distribution of seeds. b) In case of gram and bocate, farmers have to carry them to local markets located at Taikkyi town and Okkan town. And c) In case of sunflower, no market is available so far, because sunflower cultivation is now still on trial stage in the Area and moreover its taste is not still acceptable for consumers although the Government is very keen to promote this cultivation.

Therefore, in case of a), financial farm gate price is realized by middle men at the farm gate. As a matter of course, their prices have seasonal fluctuation. Usually, their price is low in season and high in off-season. As a matter of fact, the farm gate price of groundnuts varies from 60 Ks/bskt (in season) to 125 Ks/bskt (in off-season) in terms of pod, although a small quantity is collected by the Tsp Cooperative Society at the rate of 55 Ks/bskt for seed purpose. On the other hand, the farm gate price of sesame fluctuates from 180 Ks/bskt (in season) to 210 Ks/bskt (in off-season) in terms of dry seed. However, most farmers cannot keep them up to off-season, and most crops are sold in season due to need of money. As such, the farm gate prices of groundnuts and sesame are estimated at 70 Ks/bskt and 185 Ks/bskt, respectively, on an average.

In case of b), farm gate prices can be gotten by deducting the transportation cost (from farm gate to local market) from the market

prices, which are 87 Ks/bskt in case of gram and 65 Ks/bskt in case of bocate on an average. For transportation of them from farm gates to the local markets, usually a bus is used, because the quantity of them to be sold is usually small. The bus charge is 1 Ks on an average and two baskets can be carried at a time. And for this baggage, 0.5 Ks of extra fee is charged. Therefore, the transportation cost can be estimated at around Ks. 3/basket including transportation up to a bus stop from farm gate. So, the financial farm gate prices of them can be estimated as follows:

	Market Price	Transportation Cost	Farm Gate Price
Gram	87 Ks/bskt(56 lbs)	3 Ks/bskt	84 Ks/bskt
Bocate	65 Ks/bskt(79 lbs)	3 Ks/bskt	62 Ks/bskt

In case of c), sunflower seeds are not marketable so far, because their taste is not accepted for consumers. Therefore, its farm gate price can be estimated only from the case that farmers provide it to the other farmers for seed purpose, which is around 65 Ks/bskt (32 lbs) at their farm gates.

3. Economic Prices of Farm Products Concerned

Out of farm products concerned, paddy, mat'pe, maize and jute are internationally traded commodities in this country. As regards gram, it was an exporting commodity up to 1973, but since 1974, its export has not been seen (although a small amount of gram was exported in 1978/79) because of a great increase of its domestic demand (especially army demand). Export of bocate is also now negligibly small. And it is understood that such a situation will continue for the time being. Therefore, gram and bocate are regarded as the domestically traded commodities in this study, together with the other crops concerned such as groundnuts, sesame and sunflower. And as mentioned above (1-d), the economic prices of them will be the same as their financial prices.

As regards internationally traded commodities, their world market prices should be referred. In this connection, IBRD projection of 1990 world market prices in 1981 constant dollar level can be referred for paddy, maize and jute. As for mat'pe, however, IBRD projection is not available because of its small marketing amount in the world market. Therefore, the actual exporting price should be referred in this case.

Economic Price of Paddy

		(per m. ton)
1)	IBRD projection price [1] 1990, in 1980 constant dollars. (5% broken, milled rice, f.o.b., Bangkok)	$ 551.00
2)	Converted to "in 1981 constant dollars" (x 1.104)[2]	$ 608.30
3)	Burma is a rice exporting country, but this price should be revised downwards to account for low quality of the rice locally produced in the project area, and it can be assumed at 70% of the above (because the rice produced in the area is mostly 35/broken). And this price can be assumed as the f.o.b. price of Burmese rice. (35% broken, milled rice, f.o.b., Rangoon)	$ 425.81
4)	Converted to Burmese Kyat (1$ = 11 Ks)[3]	Ks.4,683.91
5)	Handling charge at harbor	Ks. 29.00
6)	Harbor storage charge (around 1 week)(5 Ks/100 bskt)	Ks. 1.40
7)	Transportation cost (from the project area to Rangoon harbor, 50 miles, by railway and truck)[4]	Ks. 22.00
8)	Packing and handling at the mills in the area	Ks. 115.60
9)	Price of milled rice at the mills in the area	Ks.4,515.71
10)	Conversion price of paddy at the mills in the area (x 0.652)[5]	Ks.2,944.24

11)	Milling charge (Ks.37.60/100 bskt)[6/]	Ks. 18.02
12)	Paddy price at the mills in the area	Ks.2,926.22
13)	Transportation costs (inc.loading & unloading)	
	a) from gov't. depots to milles (by truck) (inc. bagging)	Ks. 15.00
	b) from farm gates to gov't. depots(by cart)	Ks. 20.00
14)	Farm gate price of paddy in the area	Ks.2,891.22
15)	Farm gate price of paddy converted to "per 100 bskt"	Ks.6,032.70
	∴ Ks.60.32/bskt	
16)	Taking the by-products into account(x 1,035)[7/]	
	∴ Ks.62.43/bskt	

Note: 1/ Document of the World Bank titled "Price prospect for Major Primary Commodities" (Jan. 1980).

2/ "International Price Index" in the above document.

3/ This rate is the shadow foreign exchange rate. (Ref: A-12)

4/ Weighted average (inc. loading & unloading). Distance is 50 miles. 80% by railway, 20% by truck.

5/ Average milling efficiency of 3 representative rice mills dealing with the Government paddy in Taikkyi.

Milling Efficienty (35% broken rice from 100 bskt of paddy)

	Ex.1	Ex.2	Ex.3
Milled rice (35% broken)	3,000 lbs	2,962.5 lbs	3,037.5 lbs
(Efficiency)	(65.2%)	(64.5%)	(66.0%)
Small broken	144	180	108
Fine bran	256	257.5	254.5
Coarse bran	90	90	90
Point	20	20	20

Cyclon	15	15	15
Impurity & dust	75	75	75
Husk	1,000	1,000	1,000

* Average efficiency

= (3,000 + 2,962.5 + 3,037.5) ÷ (4,600 x 3) x 100

= 65.2%

6/ This milling charge is the Government paddy milling charge for Emata Group, because the majority of paddy produced in the Area is Shwe-Ta-Soke variety, which is classified into Emata Group from the view point of paddy grading.

7/ In the above table (Note 5/), small broken rice, fine bran and coarse bran can be regarded as the by-products in rice processing, the value of which is estimated at around 3.5 percent of the value of paddy processed on an average. In this case, straw has not been taken into account, because it is usually used as the fodder of cattle, but it is an intermediate product in farming, and it is understood that it will be evaluated ultimately in termas of cattle power and farm yard manure.

Economic Price of Maize

		(per m. ton)
1)	IBRD Projection price 1/ 1990, in 1980 constant dollars (U.S. No.2, yellow, f.o.b. Gulf port)	$ 196.00
2)	Converted to "in 1981 constant dollars" (x 1.104) 2/	$ 216.38
3)	The Burmese Government is intending to promote maize (feed grains) production for the purpose of export as well as domestic poultry farming. Therefore, this crop is regarded as an exporting commodity. And the above price can be assumed at	Ks.2,380.22

	f.o.b. price at Rangoon harbor, converting to "in Burmese Kyats" (1$ = 11 Ks)[3/]	
4)	Handling charge at harbor	Ks. 29.00
5)	Harbor storage charge (around 1 week)(5 Ks/100 bskt)	Ks. 2.00
6)	Transportation cost (from the Project Area to Rangoon harbor, 50 miles, by railway and truck)	Ks. 22.20
7)	Price at Government depots in the Area	Ks.2,327.02
8)	Transportation costs (inc. loading and unloading) from farm gates to Government depots (2 miles, by cart)[4/]	Ks. 20.00
9)	Farm gate price of maize in the Area	Ks.2,307.02
10)	Converted to "per 100 baskets" (5,500 lbs)	Ks.5,756.00

∴ Ks.57.56/bskt

Note: 1/, 2/, 3/, and 4/ ..... ditto

Economic Price of Mat'pe

		(per ton)
1)	IBRD projection price is not available in IBRD document, because its marketing volume is not so much in the world market. In such case, actual f.o.b. price should be referred to derive its economic price. According to MEIC (Myanma Export and Import Corporation, Mininstry of Trade), it is understood that its f.o.b. price has been recently stabilized at $ 450/ton, although it had been extremely fluctuated in the last few years due to the extreme fluctuation of its production in the other exporting countries. So, f.o.b. price at Rangoon, 1981 can be regarded at $450/ton.	$ 450.00

2)	Converted to "in Burmese Kyat" (1$ = 11 Ks)[1/]	Ks.4,950.00
3)	Handling charge at harbor	Ks. 29.00
4)	Harbor storage charge (around 1 week)(5 Ks/100 bskt)	Ks. 1.50
5)	Transportation cost (from the project area to Rangoon harbor, 50 miles, by railway and truck)	Ks. 22.20
6)	Price at Government depots in the area	Ks.4,897.30
7)	Transportation costs (inc. loading and unloading) from farm gates to Government depots (2 miles, by cart)	Ks. 20.00
8)	Farm gate price in the area	Ks.4,877.30
9)	Converted to per "100 bskt" (7,200 lbs)	Ks.15,907.80

∴ Ks.159.08/bskt

Note: 1/ Shadow Foreign Exchange Rate (Ref.: A-12)

Economic Price of Jute

		(per m. ton)
1)	IBRD Projection price[1/] 1990, in 1980 constant dollars (Bangladesh, white, f.o.b. Chittagong/Chalna)	$ 552.00
2)	Converted to "in 1981 constant dollars" (x 1.104)[2/]	$ 576.29
3)	Converted to "Burmese Kyat" (1$ = 11 Ks)[3/], which can be assumed at f.o.b. price at Rangoon harbor	Ks.6,339.19
4)	Handling charge at harbor	Ks. 29.00
5)	Transportation cost (from mills to harbor, Ks.4/bale) (loading Ks.2/bale and unloading Ks.2/bale)[4/]	Ks. 44.00
6)	Grading and baling at mill (350 lb/day/head for grading)(248 bales/day/12 member team for baling) (Kyats 5.4/head)[5/]	Ks. 48.40

7)	Price of raw jute at grading and baling mills	Ks.6,217.70
8)	Transportation costs from govt. depots (in the area) to Rangoon mills (13.5 Ks/100 viss by truck, 2 Ks/100 viss for loading and 2 Ks/100 viss for unloading) 6/	Ks. 107.00
9)	Price of raw jute at gov't. depots in the area	Ks.6,110.70
10)	Transportation costs from farm gates to gov't. depots (by cart)	Ks. 20.00
11)	Farm gate price of Raw Jute	Ks.6,090.70
12)	Converted to "per viss" Ks.9.95/viss (with project case)	

Note: 1/, 2/, and 3/ - ditto
4/, 5/, and 6/ - source : T I C

13) This price can be applied in the case of with the project, but in case of without the project, this price should be revised downwards to account for low quality of the jute locally produced at present in the project area, and it can be assumed at Kyats 7.40/viss ($\because$ 9.95 Ks x $\frac{2.62}{3.52}$ = 7.40 Ks)

4. Prices of Seeds Concerned

As regards seed multiplication system in this country, under the agircultural Research Institute at Yezin (which has Breeder's seed), there are 21 seed farms in the country (which multiply certified seeds from foundation seeds). One seed farm usually covers around 10 townships. Every Township AC office receives certified seeds from the seed farms based on the instructions of the Division Office and multiplies quality seeds from certified seeds through registered farmers. Quality seeds are distributed to the farmers in the area.

At Hmawbi, there is one Central (Seed) Farm which covers 12 townships in 2 divisions (10 townships in Rangoon Division and 2 townships in Pegu Division) including the Project Area. In this

seed farm, the main job is to multiply high yielding varieties (7 HYV varieties) of paddy, although it is now undertaking to multiply sesame seeds and sunflower seeds, and moreover, just started to multiply green gram seeds, bocate seeds and sugar cane seeds from this year (1980).

Taikkyi township is the birth place of so-called Whole Township Paddy Production Program. And accordingly, AC Tsp. Office is very keen to promote HYV cultivation through multiplication of quality seeds which are produced by 280 registered farmers and the other 300 good quality farmers, and at the same time to promote double cropping cultivation through demonstration farms under supervision of the Peoples' Council. And for the latter purpose, AC office is now undertaking to distribute new variety seeds of groundnuts, sesame and sunflower. However, they have not any seed renewal program so far, and moreover, especially in case of groundnuts seeds, their supply can not meet the demands of farmers.

As regards groundnuts seeds, therefore, Tiakkyi Township Cooperative Society is also trying to collect and distribute them through V.T. Cooperative Societies. But the supply of groundnut seeds is still insufficient. So, most farmers are trying to get their seeds directly from Upper Burma Area.

Under such situation, prices of seeds are as follows:

Prices of Seeds Concerned

(Ks./bskt)

	Tsp. AC	Tsp. Coop.	Other	Average
Paddy (SHYV)	13.00	-	-	13.00
(HYV)	13.00	-	-	13.00
(LIV)	13.00	-	-	13.00
Groundnuts	70.00	70.00	100.00	90.00
Sesame	288.00	288.00	-	288.00

Sunflower	96.00	-	-	96.00
Maize	40.00	-	-	40.00
Gram	128.00	-	-	128.00
Mat'pe	-	-	160.00	160.00
Bocate	-	-	96.00	96.00
Jute	64.00	-	-	64.00

Needless to say, especially AC office prices are subsidized prices. To create new varieties, many efforts might be made by many qualified experts. To multiply these seeds, many staff might be mobilized. But such costs might be not included in the above prices. In order to find out their economic prices, therefore, these subsidized portions should be eliminated from the above financial prices. But this works may be impossible, and on the other hand, the weight of seed in the farm costs is not so much. Therefore, it can be allowed to apply the above prices as their economic prices as well as their financial prices.

5. Prices of Fertilizers

In this country, Urea, TSP and Potassium Chloride are popular. And their procurement and distribution are made by the Government, that is by AC. At present, TSP and Potassium Chloride are importing commodities, whereas in case of Urea, around a half of the national requirements is supplied by domestic production (2 factories' production) and another half is supplied by imports. As far as Urea is concerned, however, one more factory will start operation in 1984, and the Government is trying to construct more factories. So, self-sufficiency of Urea will be achieved in near future, and furthermore, it is expected that some amount may be exported. Therefore, Urea can be regarded as an exporting commodity in this study. As such, their economic prices can be derived from IBRD projection prices in the world market as follows:

Economic Price of Urea

		(Per m. ton)
1)	IBRD projection price[1/], 1990, in 1980 constant dollars (f.o.b. Europe, bagged)	$ 270.00
2)	Converted to "in 1981 constant dollars" (x 1.104)[2/]	$ 298.08
3)	Converted to "in Burmese Kyats" ($1 = Ks.11/-)[3/] This can be assumed at f.o.b. price at Rangoon harbor.	Ks.3,278.88
4)	Service charge (10%)[4/]	these are transfer payment
5)	Port due (12 Ks/m.ton)[5/]	
6)	Handling charge at harbor[6/]	Ks. 57.90
7)	Transportation cost from factories to harbor[7/]	Ks. 200.00
8)	Ex-factory price	Ks.3,019.98
9)	Transportation cost from factories to Tsp. AC godown[8/]	Ks. 200.00
10)	Price of Urea at Tsp. AC godown level in the Area	Ks.3,219.98
11)	Converted to "per bag" (56 lb/bag)	Ks. 82/bag
12)	Transportation cost per bag from Tsp. AC godown to farm gate	Ks. 3/bag
13)	Farm gate price of Urea	Ks. 85/bag (56 lbs)

Note: 1/, 2/, and 3/ ..... ditto
4/, 5/, 6/, 7/ and 8/..... Source: AC.

Economic Price of T S P

		(per m. ton)
1)	IBRD Projection price[1/], 1990, in 1980 constant dollars (f.o.b. US Gulf, bulk)	$ 221.00
2)	Converted to "in 1981 constant dollar" (x 1.104)[2/]	$ 243.98

3)	Freight charge[3/]	$ 70.00
4)	Insurance charge[4/] (2 percent of f.o.b. price)	$ 4.88
5)	c.i.f. price at Rangoon harbor	$ 318.86
6)	Converted to "in Burmese Kyats" ($ = K 11/-)	Ks.3,507.46
7)	Service charge (10%)[6/]	these are transfer payment
8)	Port due (12 Ks/ton)	
9)	Handling charges at harbor[8/]	Ks. 57.90
10)	Habor storage charge (around 5 days, Ks.02/ton/day)[9/]	Ks. 1.00
11)	Transportation cost from harbor Tsp. AC godown in the project area (50 miles, by railway and by truck)[10/]	Ks. 52.00
12)	Price at Tsp. AC godown in the area	Ks.3,618.36
13)	Converted to "per bag (112 lbs)"	Ks. 183.82/bag
14)	Farm gate price of T.S.P.	Ks. 189/bag

Note: 1/, 2/, and 4/ ..... ditto
3/, 5/, 6/, 7/, 8/, 9/ and 10/..... Source: AC.

Economic Price of Potassium Chloride

		(per m. ton)
1)	IBRD projection price[1/], 1990, in 1980 constant dollars (f.o.b., bulk, Vancouver)	$ 109.00
2)	Converted to "in 1981 constant dollars" (x 1.104)[2/]	$ 120.34
3)	Freight charge[3/]	$ 70.00
4)	Insurance charge[4/] (2% of f.o.b. price)	$ 2.41
5)	c.i.f. price at Rangoon harbor	$ 192.75
6)	Converted to "in Burmese Kyat" (1$ = Ks 11)[5/]	Ks.2,120.25

7)	Service charge (10%)[6/] }	
8)	Port due (12 Ks/ton)[7/] } these are transfer payment	
9)	Handling charge at harbor[8/]	Ks. 57.9
10)	Harbor storage charge (around 5 days, Ks. 0.2/day/ton)[9/]	Ks. 1.0
11)	Transportation cost from harbor to Tsp AC godown in the project area (50 miles, by railway and by truck)[10/]	Ks. 52.0
12)	Price at Tsp AC godown in the area	Ks.2,179.67
13)	Converted to "per bag (112 lb)"	Ks. 110,73/bag
14)	Farm gate price of Potassium Chloride	Ks. 116/bag

Note: 1/, 2/ and 4/..... ditto
3/, 5/, 6/, 7/, 8/, 9/ and 10/ ..... Source: AC

On the other hand, as for their financial prices, every farmer can get these fertilizers at the controlled prices at the every Tsp. AC godown level. These prices are so-called subsidized prices, and accordingly their price level is very low compared with world market prices. These prices are shown below together with their farm gate prices which can be gotten by adding the transportation costs (from Tsp. AC godown to farm gates) to their Tsp. AC prices.

Financial Prices of Fertilizers

	Tsp AC godown level	Farm gate level
Urea	(56 lb/bag) 9 Ks/bag	12 Ks/bag
TSP	(112 lb/bag) 62 Ks/bag	67 Ks/bag
KCL	(112 lb/bag) 29 Ks/bag	34 Ks/bag

6. Price of Manure

In the Project Area, most farmers have little understanding of manuring, and accordingly, they are not skilful in preparing farm yard manure (FYM) compared with farmers in the other areas in Burma, in spite of that most of them are holding one to two pairs of cattle respectively. As far as interview survey is concerned, manuring to transplanting fields could not be found, although they apply manure only to nursery beds.

Anyway, from the view point of farm budget analysis (i.e. financial analysis of the Project), manure need not be evaluated because of self-supplying material. But from the viewpoint of economic analysis of the Project it should be evaluated as one item of the farming costs. As a matter of course, it is not marketable, but it is understood by farmers that manure will be evaluated at Ks. 10/cart (0.5 ton), if it is sold. Therefore, this price has been employed as the economic price, although any farmer does not apply manure with cash payment.

7. Prices of Agricultural Chemical

As far as interview survey is concerned, application of agricultural chemiclas could not be found. But after completion of the Project, modernized farming practices will be recommended. According to the Agronomist, the following agricultural chemicals will be recommended to be used crop by crop after completion of the proposed Irrigation Project:

Crops	Agricultural Chemicals
Paddy	Diazinon 40% E.C, Elsan 50% E.C.
G'nuts	Diazinon 40% E.C, Malathion 50% E.C.
Sesame	Malathion 50% E.C.
Sunflower	Diazinon 40% E.C, Malathion 50% E.C.
Mat'pe	Diazinon 40% E.C, Malathion 50% E.C.
Maize	Diazinon 40% E.C, Malathion 50% E.C.
Jute	Diazinon 40% E.C.

These agricultural chemicals are also procured and distributed by AC at the controlled prices at the AC Tsp godown level. Of course, most of agricultural chemicals are imported in this country. In order to get their economic prices, therefore, the same analysis as in case of fertilizers should be made theoritically. However, required quantities for individual farmers are not so much, and accordingly its weight in the farm costs is very small. Moreover, any subsidy is not found. For the convenience, therefore, the following financial prices can be also employed as their economic prices:

Prices of Agricultural Chemicals

Agri-Chemicals	Unit	Price
Diazinon	ounce	1.20 Ks.
Malathion	ounce	1.06 Ks.
Elsan	ounce	1.20 Ks.

8. Analysis of Farming Labor Wage Rate

8.1. In principle, the financial farming wage rate can be found in the on going labor markets. In the Project Area, it seems that, in case of temporary day labor, the rate is mostly 6 Ks per day regardless of sex and kind of operation, although 8 Ks/day is found in a rare case.

Besides above, the seasonal labor employment prevails in this Area, because on the one hand farm size is rather large compared with that in the other area, and on the other hand there are found so many landless laborers in this Area. In the monsoon peak season usually three months employment is made, whereas in the dry peak season tow months employment is usually made. For this employment, 50 baskets of paddy are paid per laborer in kind in case of the monsoon season, and 30 baskets of paddy are paid per laborer in kind in case of the dry season. If this payment is converted to Kyat, their wage rate can be calculated as follows:

In monsoon season:

wage rate/day = 9.05 Ks x 50 bskt ÷ 90 days
= 5.03 Kyats

In dry season:

wage rate/day = 9.05 Ks x 30 bskt ÷ 60 days
= 4.53 Kyats

They usually live out, but everyday come to the employer's house to work. Their jobs are not only farming operation but also miscellaneous works. Their farming operation is found mainly in driving draught animals and sometimes in case of up-rooting of paddy seedlings or harvesting. As such, they can be categorized to a kind of farm laborers.

8.2. Anyway, it seems that the above wage rates do not reflect the real social wage rates, because these wage rates are realized only in the peak seasons of farming, and in other seasons their labor is left in the situation of under-employment. As a matter of fact, there are found so many landless laborers in the Project Area. For example, the number and percentage of landless laborer's families in 16 village tracts where interview surveys were made were as follows:

Number and Percentage of Landless Laborer's Household

Name of V.T.	Total Household	Famers Household	Landless Laborer's Household	(%)	Other Household
Kun Gyan Gone	250	135	115	(46)	-
Okkan-Kan-Gone	250	145	105	(42)	-
Okkan-Myoma *	2,500	240	300	(12)	1,960
Thabye Gone	205	125	80	(39)	-
Phalon-Buta	554	290	239	(43)	25
Phalon Kan Gone	225	102	108	(48)	15
Pholon Ywa Ma	183	127	44	(24)	12
Kyaik-Sa-Going	420	298	113	(27)	9
Tha-nut-chaung	750	230	465	(62)	55
U-to	720	287	398	(55)	35

Yin-daik-kwin	498	257	232	(47)	9
Taikkyi Myoma**	4,000	505	650	(16)	2,845
Targwa	653	303	335	(51)	15
Patta	400	336	54	(14)	10
Tha-yet-chaung	600	500	70	(12)	30
Lautlag chaung	580	530	38	(7)	12
Total (excluding * and **)	6,288	3,665	2,396	(38)	227

In the above table, Okkan Myoma (marked*) and Taikkyi Myoma (marked**) are town urban area. So, in calculation of the total on the above table, these two village tracts were excluded. Then, the percentage of landless laborers' households is 38% in total. Such under-employment situations disturb the normal competition in the labor markets. So, the shadow wage rates should be applied in the economic analysis of the Project. In this connection, the Government minimum wage rate should be referred, because it is Ks. 5.4 per man day for 8 hours working, and it is regarded as the opportunity cost of labor in this country.

Therefore, it may be reasonable to apply this Government wage rate as the shadow wage rate of unskilled farming labor. In this case, however, it should be taken into consideration that in case of government laborers, their working hours are 8 hours, whereas in case of farming labor, their working hours are usually 6 hours on an average even in case of whole day work. Therefore, 4 Ks/man. day (= 5.4 Ks ÷ 8 x 6) can be regarded as the shadow wage rate of unskilled farming labor.

As such, not only hired labor but also family labor and mutual helping labor will be evaluated by this shadow wage rate in the economic analysis in this study, as far as unskilled labor is concerned.

9. Cost of Draught Cattle and Cartage

Most farmers hold their own draught cattles. But sometimes hired cattle are also found. In this case, however, seasonal hire system is prevailing in the area. For example, for the monsoon peak season(i.e. around 3 months), a pair of bullocks can be hired at the rate of 55 baskets of paddy in kind. And if these cattle die during their hired period, no compensation is made in spite of that they have not any cattle insurance system.

Anyway, if the above payment is converted to "Kyat", this hire fee will be Ks.498 (Ks.9.05 x 55 bskt) per one season. In other words the per day cost can be estimated at Ks.5.53/pair cattle day, if they are used everyday during their hired period. Moreover, farmers have to keep them in good condition during this period, although mostly fooder is straw which can be supplied by themselves. Therefore, financial cost of draught cattle would be 13 Ks./pair cattle day (= 6 Ks. for cattle, 6 Ks. for driver and 1 Ks. for implement), although in usual causes, farmers' owned cattle will be employed without any payment. And the economic cost of draught cattle can be estimated at 10 Ks./pair cattle day (= 5 Ks. for cattle, 4 Ks. for driver and 1 Ks. for implement).

10. Farm Machinery Cost

There is one tractor station (No.77) in the Project Area, located in Taikkyi township under the Agricultural Mechanization Department (AMD) which covers two townships (i.e. Taikkyi Tsp and Tantabin Tsp). There are 62 tractors (50 HP each) in this Station, out of which 37 are working propoerly, and their servi ce area was 29,763 acres in gross in the last year. These tractors have been used mainly by big size farmers, and mostly in land preparation for the second crops (i.e. groundnut cultivation and sesame cultivation). Farmers in the Area have interest in double cropping recently, the users of tractor are gradually extending. In the Project Area, therefore, temporary sub-station is set up in each of the whole township paddy production program camps for farmers' convenience.

On the other hand, 15 Village Tract Cooperative Societies in the Area have 42 tractors (50 HP), out of which 10 tractors are running properly. But tractor charges are different between AMD and Coop. as follows:

Tractor Charge (with driver and diesel oil)

	AMD (tractor station)	Coop. Society
Plowing	18 Ks/ac	18 Kc/ac
Harrowing	12 Ks/ac	18 Ks/ac

For the convenience of farm cost calculation, however, an average tractor fee for harrowing should be made, which can be calculated by weighting the respective numbers of tractors as follows:

AMD	12 Ks x 37 = 444
Coop.	18 Ks x 10 = 180
Average	13 Ks x (47) = (624)

As such, financial tractor rental fees are 18 Ks/ac for plowing and 13 Ks/ac for harrowing. But these fees have not been revised for past 10 years, although oil price has been going up extremely in this period. In other words, it is understood that these fees are subsidized fees. According to the manager of this station, the real costs might be around double. As a matter of fact, according to the calculation by the Agronomist, these real costs should be 35.8 Ks/ac for plowing and 23.8 Ks/ac for harrowing respectively. (See - Appendix, Farm Mechanization Plan) Therefore the above real fees are regarded as the economic fees.

As regards water pump, it has been necessary to provide supplemental water for paddy cultivation in some limited area or some drought years, but for pre-monsoon jute cultivation, pumping irrigation has been an essential factor under the present conditions. Under such situations, there are 82 pieces of cooperative-owned

pumps and 949 peices of privately owned pumps in Taikkyi Township. Due to the shortage of cooperative-owned pumps, many pumpless farmers hire privately owned pumps at a rate of 5 Ks/hr., i.e. 30 Ks/ac or 30 Kc/day without operator and diesel oil, whereas in case of cooperative owned pumps its rate is 20 Ks/ac or day without operator and diesel oil. The weighted average rate of the above two kinds of rates can be, therefore, calculated at 29.2 Ks/ac or per day. And the required quantity of diesel oil is 2 gallons per acre, the price of which is 3.05 Ks/gallon. Therefore water pump cost per acre becomes 35.3 Ks/ac or day with diesel oil and without operator, which can be regarded as its financial cost. And 36.1 Ks/ac would be its economic cost, because in case of privately owned pumps, any subsidy can not be considered.

Besides above, AMD is now trying to start to provide power thresher at a rate of 30 Ks/ac. although its real cost has been worked by the Agronomist at 36.5 Ks/ac (with diesel oil and without operator) (See-Appendix, Farm Mechanization). Namely, the former is financial cost and the latter is economic cost.

Furthermore, power sprayer will be introduced to a large extent, after completion of the Project. And it is told that plant protection machineries will be held by Tsp AC Office and farmers can use them on free, although farmers should operate by themselves at their own expense of necessary fuel and oil. According to the calculation of the Agronomist, the real cost of power thresher is 9 Ks/ac (with fuel and without operator), which can be regarded as its economic cost. And only fuel cost would be its financial cost (without operator), which has been worked out at 2.3 Ks/ac. (See - Farm Mechanization in Appendix).

11. Land Revenue and Water Charge

As well known and stated in 1-d, taxes and duties should be left out of consideration in the economic analysis of a project,

because they are considered as the transfer payment for national economy in the project costs. In the financial analysis or farm budget analysis, however, they should be taken into consideration, because actual cash flow should be pursued in the financial analysis. For farm budget analysis, therefore, taxation for farmers should be studied. As a matter of course, all lands belong to the Government in this country, and accordingly, all farmers have not any ownership on their farm lands. They have only the cultivating right on their farm lands.

Therefore, land taxes cannot exist in this country in the real meaning, but for the cultivating right of farmers, the land revenue is imposed every year, although the income tax is not imposed to farming.

According to Land Record Office, the standard of imposition of land revenue is classified by the kind of land firstly, and next, in case of paddy land, every field has been assessed and further classified into four grades by assessment tracts. In Taikkyi township, the above classification is as follows:

Paddy Land		
	1st grade	Ks.7.00 - Ks.4.25/ac
	2nd grade	Ks.5.50 - Ks.3.00/ac
	3rd grade	Ks.3.50 - Ks.1.00/ac
	4th grade	Ks.1.50 - Ks.1.00/ac
Garden Land		Ks.3.00 - Ks.2.00/ac
Kaing Land		Ks.5.00 - Ks.5.00/ac
	etc.	

Note: Indication by assessment tract was omitted to simplify.

In the Project Area, most lands are paddy lands and the standard of imposition is Ks.5/ac on an average.

And it is told that even if double cropping is made, the above standard will not be changed. After completion of the proposed Irrigation Project, howeve, every paddy field may be graded up. Actual grading up will be made after actual assessment, but judging from the examples of Kyaukse, Mandalay and Minbu, it may be reasonable to assume that the standard will be graded up to Ks.6/ac after the Project implementation, which will be applied in farm budget analysis with the project.

In this connection, an issue of water charge may be brought out after completion of the Irrigation Project. As well known, any water charge has not been so far imposed to the beneficial farmers in this country even after the implementation of large scale irrigation projects, although in most developed countries it is common to impose it more or less. In some cases, it will be charged for the purpose of maintenance of constructed irrigation facilities, but also for the purpose of recovery of investment costs. However, deep considerations should be paid to this matter in connection with repayment capacity of beneficial farmers. At the same time, the price level of paddy should be also considered, because if its price level is so low compared with world market level, farmers' repayment capacity can not be created.

Any way, at present, it is very difficult to assume at what rate water charge will be collected after the implementation of the proposed irrigation Project. So, in this study, the issue of water charge will be left out of consideration.

12. Foreign Exchange Rate

As regards the foreign exchange rate, a float system has been adopted in this country. Exactly speaking, therefore, the foreign exchange rate is fluctuating day by day, although so much fluctuation can not be found. Anyway, according to certified average rates calcualted by Myanma Foreign Trade Bank (which is the last one month average), they are as follows as of 3rd of March, 1981:

Certified Average Rate
Serial No. (12)

1.	Stg.£	1/-	K 15.9273
2.	DM	1/-	K 3.2202
3.	F.F.	1/-	K 1.3912
4.	S.F.	1/-	K 3.5476
5.	J.¥	100/-	K 3.3572
6.	US$	1/-	K 6.8955

Dated 3.3.81

Source: Myanma Foreign Trade Bank

This rate can be used as the financial foreign exchange rate. But they say that this rate does not reflect the real value of Kyat. But it is very difficult to find out the real value of Kyat. So, taking into consideration the recent IBRD Feasibility Studies and the discussion with an ADB mission, the shadow foreign exchange rate has been assumed at 11 Ks/US$1.00. This rate will be employed to value the internationally traded commodities and the foreign currency component of farm costs as well as construction costs in the economic analysis.

13. Summary

In conclusion, the following summarized table has been arranged:

Summarized Farm Gate Prices Concerned

(Unit: Ks.)

Farm Outputs	Unit	Financial Price	Economic Price
Paddy	(basket = 46 lbs)	9.05	62.43
Groundnuts (pod)	(basket = 25 lbs)	70.00	70.00
Sesame	(basket = 54 lbs)	185.00	185.00
Sunflower	(basket = 32 lbs)	65.00	65.00

Farm Outputs	Unit		Financial Price	Economic Price
Maize	(basket = 55 lbs)		19.50	57.56
Gram	(basket = 56 lbs)		84.00	84.00
Mat'pe	(basket = 72 lbs)		49.40	159.08
Bocate	(basket = 72 lbs)		62.00	62.00
Jute	(viss =3.6 lbs)	Present	2.62	7.40
		Future	3.52	9.95
Seeds				
Paddy	(bskt)		13.00	13.00
Groundnuts	(bskt)		90.00	90.00
Sesame	(")		288.00	288.00
Sunflower	(")		96.00	96.00
Maize	(")		40.00	40.00
Gram	(")		128.00	128.00
Mat'pe	(")		160.00	160.00
Bocate	(")		96.00	96.00
Jute	(bskt = 57.6 lbs)		64.00	64.00
Fertilizers				
Urea	(bag = 56 lbs)		12.00	85.00
TSP	(bag =112 lbs)		67.00	189.00
Potassium Chloride	(bag =112 lbs)		34.00	116.00
Manure	(cart = 0.5 ton)		-	10.00
Agricultural Chemicals				
Diazinon 40% EC	(ounce)		1.20	1.20
Elsan 50% EC	(ounce)			
Malathion 50% EC	(ounce)		1.06	1.06
Wage Rate				
Day labor	(man day)		6.00	4.00
Seasonal labor	(man day)		5.00	4.00

Draught Cattle Rate (pair day)	13.00	10.00
Agricultural Machinery Cost (per ac)		
Tractor { for plowing	18.00	35.80
Tractor { for harrowing	13.00	23.80
Water Pump (without operator)	35.30	36.10
Thresher (without operator)	30.00	36.50
Power Sprayer (without operator)	2.30	9.00
Land Revenue (per ac)		
Paddy Land { without project	5.00	-
Paddy Land { with project	6.00	-
Kaing Land	5.00	-
Foreign Exchange Rate (per $)	6.89	11.00

Study on Farm Inputs (Labor & Materials) Requirements
- through farming practices -

In principle, farm costs can be calculated in accordance with farming practices. For this purpose, interview surveys with 30 farmers in 16 village tracts were conducted. Of course, strictly speaking, their farming practices were different in accordance with not only their farming conditions but also their farming abilities. In order to simplify the project analysis, however, the detailed average farming practices should be examined, although its academic aspects has been studied by the Agronomist.

Through the above interview surveys and in consultation with the Agronomist, the details of the average farming practices for each crop in the area, accordingly, the average input labor requirements and input material requirements per acre per each crop have been decided as follows:

1. Farming Practices of Paddy Cultivation
   - in connection with inputs requirements -

1.1. Paddy is the main crop in the Area which is located in the granary area in this country. And this Area is well known as the birth place of the Whole Township Paddy Production Program. The majority of the growing variety is "Shwe-Ta-Soke" which is the special high yielding variety and belongs to Emata Group from the standpoint of paddy quality grading. As such, HYV cultivation area is estimated at around 70 percent of the total paddy growing area. And through the experiences of the whole township paddy production program, their farming practices of paddy cultivation are relatively standardized.

1.2. The size of a nursery bed is almost one tenth of the transplanting area and after uprooting it is also used as transplanting

field. And seeds requirement is 1.5 baskets/acre in case of HYV and one basket/acre in case of local variety. But they have not any seed renewal program or seed exchange program. It will be recommended after completion of the Project.

1.3. As for seed preparation, even one night soaking could not be found. Some seed preparation will be recommended after completion of the Project.

1.4. In general, manuring is not so popular in this area, but in case of nursery preparation, 0.5 cart of manure is usually applied to the nursery bed for one acre of transplanting field (i.e. 5 carts per/acre of nursery bed) before nursery land preparation, and some farmers apply urea at the rate of one fourth of a bag. Land preparation on nursery bed is usually carefully made. Especially for the purpose of shallow tillage, some farmers make 15 times of harrowing. Any way, for nursery works including land preparation and sowing, a pair day of bullocks (driver will make manuring and sowing) will be required on an average for one acre of transplanting field. After the Project, watering will be required, but labor requirement for watering will be studied together with total watering to transplanting fields.

In this area, most farmers have at least a pair of bullocks. And usually family labor or seasonal labor is the driver, who also makes sowing after land preparation in this case. Therefore, the actual labor requirement is one man day and a pair of bullocks. Such calculation may be necessary for actual labor planning. But from the view point of farm costs estimation, only the cost of a pair of bullocks with driver will be calculated. In the following tables, therefore, a man day labor requirement will be shown in parentheses for the convenience of labor planning.

1.5. As for land preparation of transplanting field, firstly, one time of plowing is made by two pairs days of bullocks, and after that, mending of the field bunds, ditches, etc., is made by the cattle driver on the same day.

Harrowing is usually made four times - eight times and two times of levelling is made. For these purposes, five pair days of bullocks with driver will be required.

According to the agronomist, however, farm mechanization will be introduced in land preparation after completion of the Project, which will occupy 30 percent of paddy cultivation area in plowing, although harrowing and levelling will be made by bullocks as they are. For the convenience of average farm cost calculation, therefore, it can be assumed that 1.3 pair days of bullocks and 0.3 times of tractor will be required for one acre plowing on an average.

1.6. In this area, manuring is not made for transplanting field as mentioned above, but application of T.S.P. and Potassium Chloride is common before transplanting in case of HYV cultivation. The doeses of them are 0.5 bag/ac in T.S.P. and 0.125 bag/ac in KCL, although in case of L.V. cultivation their application is not made.

1.7. For transplanting, firstly, uprooting is made usually by two man day/ac (one family labor and one more hired laborer), but in some village tracts, contract system is also applied, under which usually 25 Ks is paid for uprooting of 100 bundles of seedlings, although it is a rare case.

1.8. Transplanting will be made after counter lining which will be made by the rope to apply rectangle transplanting method, the spacing of which is 6 inch x 8 inch in case of HYV and 8 inch x 10 inch in case of local variety. For this transplanting operation

including counter lining, usually 10 man days of labor are required per acre on an average, out of which one man day is family labor and other are hired labor.

1.9. As plant caring, fertilizering, weeding and trap-lighting are usually made. Regarding fertilizer application, 1.5 bags of urea will be applied per acre, dividing into three times (i.e. 1/3 15 days after transplanting, 1/3 45 days after transplanting and another 1/3 60 days after transplanting) in case of HYV, although in case of L.V. Urea application is only 0.5 bag in total. Weeding is usually made one time by footing inter plants (which regarded as a kind of inter-cultivation). For trap-lighting, three bottles of diesel oil will be required per acre. And for the above operation, three man days of family labor will be required per acre.

In some low land area, farmers sometimes are suffered from flood. But any countermeasure is not made against flood.

After completion of the Project, application of agricultural chemicals may be recommended, and watering should be made systematically.

As regards watering, it is recommended that the first watering should be made six days before plowing (during this time land soaking will be made), and the second watering will be made at the time of plowing. 16 days after the first watering, the third watering will be made and followed by harrowing and puddling. And 26 days after the first watering (about 35 days after sowing), the fourth watering will be made for the purpose of transplanting. For these waterings (including watering for nursery bed), one man day of family labor and two man days of mutual helping labor will be required per acre.

In irrigation farming, watering will become one of the important operations. But this work will be usually carried out in the form of mutual helping which needs not to be paid. Therefore, such labor needs not to be taken into account in case of financial analysis, but in case of economic analysis, it should be taken into account at the rate of opportunity cost of labor. Therefore, this labor requirement will be shown in bracket in the column of hired labor in the following tables.

1.10. As regards harvesting, before reaping, bamboo pushing operation (pushing paddy plants with bamboo pole to one side to make reaping easy) is usually made only in case of local variety cultivation. For this work, one man day of family labor is required per acre.

Reaping is made by sickles. After reaping, paddy plants will be spreaded in the field for the purpose of drying for three to four days. For these works five man days of labor in case of local variety and eight man days of labor in case of HYV are required per acre, out of which hired labor is four man days and seven man days respectively.

Three to four days after reaping, bundling of the plants is made to carry them to the threshing floor, which is prepared in the famer's compound or sometimes in the fields, by bullock-tamping after mixing cow-dung with the ground. For bundling and carting a pair day of bullocks and one man day of hired labor (besides driver who also works for bundling), and for preparation of threshing floor, 0.5 more pair day of bullocks will be required.

On this floor, bundles of paddy plants are placed at the hight of 1.5 feet, on which bullock treading will be made. And after treading, replacing of the paddy bundles will be made to make treading again. As such, bullock treading will be usually repeated four times in total. For the above operation, two pair days of bullocks are required.

After threshing, winnowing and pilling (for drying) are made. For this operation two man days of family labor are required.

According to the Agronomist, however, farm mechanization will be further introduced in threshing to an extent of 30 percent of paddy cultivation area after completion of the Project. For the convenience of average farm cost calculation, therefore, it can be assumed that out of 2.8 pair days of bullocks per acre required for treading, about 0.8 pair days of bullocks will be substituted by 0.3 times of thresher employment. Moverover, by using thresher, labour requirement for winnowing will be also saved to some extent.

Summarized above, the following table can be arranged.

Labor Requirement/ac for Paddy Cultivation

- Without Project Case -

	L.V.				H.Y.V.			
	Family Labor (m.day)	Hired Labor (m.day)	Bullock (pair)		Family Labor (m.day)	Hired Labor (m.day)	Bullock (pair)	
1. Nursery Works	(1)	-	-	1	(1)	-	-	1
2. Land Preparation								
Clearing, mending etc. Plowing (1 time)	(2)	-	-	2	(2)	-	-	2
Harrowing (8 times)	(2)	-	-	2	(2)	-	-	2
Levelling (2 times) Fertilizering	(1)	-	-	1	(1)	-	-	1
3. Transplanting								
Uprooting		1	1	-		1	1	-
Carrying seedlings		1	1	-		1	1	-
Counter-lining Transplanting		1	9	-		1	9	-
4. Plant Caring								
Fertilizering (3 times) Weeding Trap lighting		2	-	-		3	-	-
5. Harvesting								
Bamboo-Pushing		1	-	-		-	-	-
Reaping & spreading		1	4	-		1	7	-
Preparation of threshing floor	(0.5)	-	-	0.5	(0.5)	-	-	0.5
Bundling carting to threshing floor	(0.5)	-	1	0.5	(1)	-	1	1
Treading (4 times)	(2)	-	-	2	(2.5)	-	-	2.5
Winnowing, piling & storing		2	-	-		2	-	-
Total	(9)	8	15	9	(10)	8	18	10

Labor Requirement/ac for Paddy Cultivation
- With Project Case -

	Family Labor (m.day)	Hired Labor (m.day)	Bullock (pair)	Machinery (times)
1. Nursery Works	(1) -	-	1	-
2. Land Preparation				
Clearing & mending	2	-	-	-
Manuring (8 carts)	(2) -	-	2	-
Watering (4 times)	1	[2]	-	-
Plowing (1 time)	(1.3) -	-	1.3	0.3
Harrowing(8 times)	(2) -	-	2	-
Levelling(2 times) / Fertilizering	(1) -	-	1	-
3. Transplanting				
Uprooting	1	1	-	-
Carrying seedlings / Counter lining / Transplanting	1	9	-	-
4. Plant Caring				
Weeding	2	4	-	-
Fertilizering / Plant protection / Water caring	3	[1]	-	3
5. Harvesting				
Reaping & spreading	1	9	-	-
Preparation of threshing floor	(0.5) -	-	0.5	-
Bundling / Carting to floor	(1.7) -	1	1.7	-
Treading/threshing	(2) -	-	2	0.3
Winnowing, piling & storing	2	1	-	-
6. Total	(11.5)13	25+[3]	11.5	3.6

2. Farming Practices of Groundnuts Cultivation
- in connection with inputs requirement -

In the Project Area, upland fields can be hardly found, but in accordance with an increase of HYV cultivation, the growth period of which is relatively short, the farmers in the Area are taking a growing interest in double cropping cultivation after paddy cultivation. And at present, it seems that the farmers most like to select ground nuts as the second crop, because of its taste, although the Government is trying to promote other oil seeds cultivation such as sesame and sunflower due to difficulties of collection of ground nuts seeds.

2.1. Any way, land preparation is very carefully carried out. Firstly, land clearing is made by cutting and removing stubbles. For this opperation, five to six man days of family labor are required.

Plowing is usually made one time by using two pair days of bullocks, but four times of harrowing is made not only by bullocks but also by tructor. In case of bullocks two pair days of bullocks are required, and in case of tractor, 52 Ks/ac will be required. In case of tractor, of course, harrowing cost is higher compared with the case of bullocks, but tractor utilization is gradually increasing, because on the one hand tractor harrowing is rather effective to hold soil moisture and it is effective to break labor peak in double cropping especially in case of large scale farmers.

In order to simplify the Project analysis, average harrowing cost should be assumed. In this meaning, it is assumed that two times bullock harrowing and two times tractor harrowing are made.

After harrowing, two times of levelling are usually made by a pair day of bullocks.

The above operation (one time plowing, four times harrowing and two times levelling) will be repeated three times.

According to the Agronomist, however, farm mechanization will be recommended in land preparation of groundnuts caltivation to a large extent after completion of the Project. (i.e. in all groundnuts cultivation area). And in this case, 1 time of tractor plowing, 4 times of tractor harrowing, further 4 times bullock harrowing and two times of bullock levelling are recommend to be enough for groundnuts land preparation.

2.2. Manuring is not applied, but 0.5 bag of urea and are applied before sowing. And it is made by the driver of sowing line making.

2.3. For sowing, firstly, sowing line is made with plow, the interval of which is around six inches. And for this operation, a pair of bullocks is required, including fertilizer application.

2.4. Sowing is made by hand, and it is followed by levelling to cover seeds with soil. For these operation one man day of family labor and a pair of bullocks are required. Seed requirement is six baskets per acre.

2.5. Around 25 days after sowing, intercultivation is made with hand hoe for the purpose of weeding. For this operation, one man days of family labor and seven man days of hired labor are required. And after that, any other plant caring can not be seen until harvesting time.

After the Project implementation, however, plant protection and watering will be recommended. And for plant protection, one mand day of family labor, and for watering one family labor and two mutual helping labor are required, respectively.

2.6. Harvesting is made by pulling plants by hand, and they are carted to the compound. For these operation eight man days of labor (out of whom one man day labor is family labor and the others are hired labor) and two pair days of bullocks (i.e. six carts loads) are required.

2.7. At the compound, separating pods from the plants is made by hand, and they are spreaded for the purpose of drying for three to four days. For this operation, further eight man days of labor will be required, out of whom one man day is family labor and the other seven man days are hired labor.

2.8. After drying, bagging will be made for storing. For this two man days of family labor are required in without Project case and three man days of family labor in with Project case.

As such, labor requirements per acre in for groundnuts cultivation can be arranged as follows:

Labor Requirement/ac for Groundnuts Cultivation

	Without Project				With Project			
	Family Labor (m.day)	Hired Labor (m.day)	Bullock (pair)	Tractor (times)	Family Labor (m.day)	Hired Labor (m.day)	Bullock (pair)	Machinery (times)
1. Land Preparation								
Clearing the field	5	-	-	-	5	-	-	-
Watering	-	-	-	-	0.5	[1]	-	-
1st land preparation								
1st plowing	(2) -	-	2	-	-	-	-	1
1st harrowing	(1) -	-	1	2	(2) -	-	2	4
1st levelling	(1) -	-	1	-	(1) -	-	1	-
2nd land preparation	(4) -	-	4	2	-	-	-	-
3rd land preparation	(4) -	-	4	2	-	-	-	-
2. Sowing								
Fertilizering Sowing line making	(1) -	-	1	-	(1) -	-	1	-
Sowing & soil covering	(1) -	-	1	-	(1) 1	-	1	-
3. Plant Caring								
Intercultivation	1	7	-	-	1	7	-	-
Watering	-	-	-	-	0.5	[1]	-	-
Plant protection	-	-	-	-	1	-	-	2
4. Harvesting								
Reaping & carting	(2) 1	7	2	-	(4) 2	12	4	-
Separating pod & spreading	1	7	-	-	2	12	-	-
Bagging & storing	2	-	-	-	4	-	-	-
5. Total	(16)10	21	16	6	(9)17	31+[2]	9	7

3. Farming Practices of Sesame Cultivation
- in connection with inputs requirement -

In general, sesame is also an important crop in this country as the oil crop, but it is said that sesame is a gambling crop, because its price is relatively good, but the fluctuation of its yield is so sharp, depending on weather conditions especially soil moisture condition. So, generally, monsoon cultivation shows good yield, compared with winter cultivation. But only winter cultivation can be done as the second crop cultivation after paddy in the Project Area, because upland field can be hardly found in the Area. As such, its farming practices are rather extensive.

3.1. For clearing of the field, some farmers make burning of stubbles in the paddy fields before plowing, for which one man day of family labor is required per acre, but some farmers make plowing without burning of stubbles. So it can be assumed that labor requirement for land clearing may be 0.5 man day of family labor on an average in the Area, although it will be recommended to every farmer after completion of the Project.

3.2. Plowing is made usually one time by bullocks, for which two pair days of bullocks are required. Harrowing is made two times. For this operation, some farmers use a pair day of bullocks and other farmers employ tractor. For the convenience of farm cost estimation, therefore, it is assumed that one time harrowing will be made by 0.5 pair day of bullocks and another one time harrowing will be made by tractor. After harrowing, one time of levelling is made by 0.5 pair day of bullocks. After completion of the Project, sesame cultivation will be pre-monsoon cultivation, according to the proposed cropping pattern. Therefore its sowing season is not the labor peak season. But from the view point of deep cultivation, farm mechanization is recommended by the Agronomist to be

introduced at a rate of 1 time in every three years. And in this case, 1 time plowing and 2 times of harrowing will be made with tractor, and 2 times of levelling will follow them by bullocks. In order to simplify average farm cost calculation, therefore, it can be assumed that in terms of three years, 1 time of tractor plowing and 2 times of bullock plowing, 2 times of tractor harrowing and 4 times of bullock harrowing, and 6 times of bullock levelling will be required for land preparation of one acre sesame cultivation. Accordingly, one third of the above should be per year requirement.

3.3. Sowing is made by broad casting of seeds, which is followed by levelling for the purpose of soil covering, although line sowing will be recommended after the Project. And the above broadcasting is made by the driver of bullocks. So, for the above operation a pair day of bullocks are required per acre, and the quantity of seeds used by farmers is around one eighth of basket, although one fourth of basket is recommended by the Government.

3.4. Instead, thinning is not made. Moreover, any weeding, fertilizerling and plant protection also are not made until harvest time, although they will be recommended to be carried out after completion of the Project. And needless to say, watering also will be recommended.

3.5. Reaping is made by pulling plants, which are bundled and carted to the compound. Then, in the compound they are set up for drying, but some farmers do not make the above bundles. Any way, for reaping, bundling and carting, one man day of family labor and five hired labor are required, and for setting up bundles, further one more man day of family labor is required.

3.6. Threshing is made by hand shaking of two man days of family labor, and winnowing also is made by the same labor on the same day. And they are spreaded for drying again.

The above labor requirement can be summarized as the following table.

Labor Requirement/ac for Sesame Cultivation

	Without Project				With Project			
	Family Labor (m.day)	Hired Labor (m.day)	Bullock (pair)	Tractor (times)	Family Labor (m.day)	Hired Labor (m.day)	Bullock (pair)	Machinery (times)
1. Land Preparation								
Clearing the field	0.5	-	-	-	1	-	-	-
Watering	-	-	-	-	0.5	[1]	-	-
Plowing	(2) -	-	2	-	(4/3) -	-	4/3	1/3
Harrowing	(0.5) -	-	0.5	1	(4/3) -	-	4/3	2/3
Levelling	-	-	-	-	(1) -	-	1	-
2. Sowing								
Sowing line making	-	-	-	-				
Fertilizering	-	-	-	-	(1) 1	2	1	-
Sowing & soil covering	(1) -	-	1	-				
3. Plant Caring								
Thinning & weeding	-	-	-	-	2	6	-	-
Watering	-	-	-	-	0.5	[1]	-	-
Plant protection	-	-	-	-	1	-	-	2
4. Harvesting								
Reaping & bundling	1	5	-	-	1	10	-	-
Carting to compound	(0.5) -	-	0.5	-	(1) -	-	1	-
Setting up bundles for drying	1	-	-	-	2	-	-	-
Threshing & winnowing Spreading seeds & storing	2.5	-	-	-	4	-	-	-
5. Total	(4) 5	5	4	1	(6) 13	18+[2]	6	3

4. Farming Practices of Mat'pe Cultivation
- in connection with inputs requirement -

Mat'pe (mung bean) is an important crop as an exporting commodity in this country, and it is one of the Government controlled commodities accordingly. Its selling price is fixed by the Government, and they are collected at the Government purchasing depots. Under such situations farmers are having interest in its cultivation in the Area, although they do not know even how to eat. But their farming practices are also extremely extensive.

4.1. Without any land clearing, only one time ploughing is made by two pair days of bullocks as land preparation.

4.2. After ploughing, broadcasting of seeds is made and one time levelling follows it to make soil covering. Requirement of seeds per acre is one half basket, although it varies in accordance with their germination abilities.

4.3. After sowing, any plant caring is not made until harvesting. But after the Irrigation Project, line sowing, watering, fertilizering, intercultivation cum weeding, plant protections etc. will be recommended.

4.4. Reaping is made by pulling the plants (i.e. uprooting). And they are carted to the compound, and in the compound they are spreaded for drying. For the above operation, one man day of family labor, four man days of hired labor and one pair of bullocks are required.

4.5. After drying, threshing is made by treading of bullocks, and winnowing is made by one more man day of family labor. So one pair of bullocks and one man day of family labor are required for this operation. As such, labor requirement/ac for Mat'pe cultivation can be arranged as follows:-

Labor Requirement/ac for Mat'pe Cultivation

	Without Project			With Project			
	Family Labor (m.day)	Hired Labor (m.day)	Bullock (pair)	Family Labor (m.day)	Hired Labor (m.day)	Bullock (pair)	Machinery (times)
1. Land Preparation							
Clearing & mending	-	-	-	1	-	-	-
Watering	-	-	-	0.5	[1]	-	-
Ploughing (1 time)	(2) -	-	2	(2) -	-	2	-
Harrowing (2 times)	-	-	-	(1) -	-	1	-
2. Sowing							
Broadcasting followed by levelling	(1) -	-	1	-	-	-	-
Fertilizering							
sowing line making	-	-	-	(1) -	-	1	-
sowing & soil covering	-	-	-	(1) -	-	1	-
3. Plant Caring							
Intercultivation cum weeding	-	-	-	-	7	-	-
Watering	-	-	-	0.5	[1]	-	-
Plant protection	-	-	-	1	-	-	2
4. Harvesting							
Uprooting							
Carting to compound							
Spreading plants	(1) 1	4	1	(2) 2	6	2	-
Threshing by treading	(1) -	-	1	(2) -	-	2	-
Winnowing							
Storing	1	-	-	2	-	-	-
5. Total	(5) 2	4	5	(9) 7	13+[2]	9	2

5. Farming Practices of Maize Cultivation
- in connection with inputs requirements -

In this Area, maize cultivation for feed purpose has been negligible. And a few have planted for eating purpose. But recently modern poultry farming has increased, and demands for feed maize has increased in this country accordingly especially near Rangoon. In this connection, the Government is now keen to promote feed maize farming. Moreover, they are considering even its export. Under such situations, AC tried to introduce this crop (the variety of which is Guatemala) to this Area from this year. Therefore, its farming practices will be mentioned only in case of with the Project.

5.1. Seed requirement/ac is one fourth basket, and sowing method is pit sowing method in rectangle spacing in which furrow interval is one to two feet and plant interval is six inches. And one to two plants per pit is recommended. For such sowing, three man days of labor/ac are required.

5.2. In order to make this sowing, paddy field should be prepared as follows: First of all, clearing and mending of the field should be made for effective irrigation. For these operation, one man day of family labor will be required.

5.3. Before ploughing, the first irrigation is made by 0.5 man day of family labor and one man day of mutual helping labor.

5.4. In case of land preparation, it is recommended by the Agronomist that in 50 percent of maize cultivation area, mechanization should be introduced, whereas in another 50 percent area non-mechanization will be made. And in case of non-mechanization method, 2 times of land preparation will be repeated by bullocks, and in each time of land preparation, 1 time of plowing, 4 times of harrowing

and 2 times of levelling will be made. For these operation, therefore, 5 pair days of bullocks will be required per acre in total. (i.e. 2 pair days of bullocks for 1 time of plowing and 2 pair days of bullocks for 4 times of harrowing). On the other hand, in case of mechanization method, 1 time of tractor plowing, 2 times tractor harrowing, further 2 times cattle harrowing and 2 times cattle levelling are recommended.

In order to simplify average farm cost calculation, therefore, it can be assumed that 0.5 time of tractor plowing, 1 time tractor harrowing and 4 pair days of bullocks will be required on an average for one acre of land preparation of maize cultivation.

5.5. Next, sowing line and pit are made by bullock plow and its driver, and fertilizering and sowing are followed by levelling for the purpose of soil covering. For these operation, a pair day of bullocks and 3 man days of labor (out of which 2 man days of labor are hired) are required.

5.6. As plant caring, 2 times of intercultivation, watering, fertilizering and plant protection will be recommended. In this case, intercultivation will function not only for weeding, but also for ridge making.

5.7. Harvesting is made by hand day by day in accordance with the maturity of the cobs. As such, it will take 10 mornings for reaping. Reaped corn-cobs are carried to the compound on the shoulder in every morning. (Therefore this labor requirement should be calculated at a rate of half day. In other words 5 days of family labor will be required in net).

5.8. After drying in the compound, seed separation is made by hands of six man days of family labor per acre. As regards seed separation machinery, it is not available at present, although it is said that its trial manufacturing is now being undertaken under AFPTC. So, in future, this machinery may be available, but its efficiency is not clear. In this study, therefore, labor requirement is considered under the situation of hand operation.

As such, the following table has been arranged:

Labor Requirement/ac for Maize Cultivation

- in case of with the project -

	Family Labor (m.day)	Hired Labor (m.day)	Bullocks (pair)	Machinery (times)
1. Land Preparation				
Land clearing & mending	1	-	-	-
Watering	0.5	[1]	-	-
Plowing	(1) -	-	1	0.5
Harrowing	(2) -	-	2	1
Levelling	(1) -	-	1	-
2. Sowing	(1) -	-	1	-
Sowing line and pit making Sowing & soil covering Fertilizering	(1) 1	2	1	-
3. Plant Caring				
Intercultivation	2	6	-	-
Watering	0.5	[1]	-	-
Fertilizering plant protection	1	-	-	2
4. Harvesting				
Reaping cobs from plants carrying them to compond	5	-	-	-
Separating seeds from cobs Storing	6	-	-	-
5. Total	(5) 17	8+[2]	5	3.5

6. Farming Practices of Sunflower Cultivation
- in connection with inputs requirement -

Sunflower is a recently introduced crop in this country, and the Government is now making their efforts to promote this cultivation for the purpose to secure food oil resources. But so far its cultivation is not so popular compared with sesame and groundnuts in this Area. Moreover, most consumers do not like to use sunflower oil, so in the markets, sunflower seeds cannot be found. At least at present, therefore, it can be said that this crop is an un-marketable crop, as far as the Project Area is concerned.

However, the Government is promoting this cultivation. So, the recommended farming method will be mentioned here.

6.1. Seed requirement/ac is one fourth basket, which will be sown by pit sowing method in rectangle spacing. In this case, furrow interval is three to two feet and plant interval is two feet to one foot respectively, and two plants/pit is recommended as plant population.

6.2. In order to make this sowing, paddy field should be prepared as follows: First of all, clearing and mending of the field should be made for effective irrigation.

6.3. Before ploughing, the first watering will be made. And after that, one time ploughing and two times harrowing will be made.

6.4. Next, sowing line and pits will be made by bullocks' plough, and the above mentioned sowing will be followed by bullock levelling for the purpose of soil covering.

6.5. As plant caring, intercultivation cum weeding, watering, fertilizering and plant protection will be recommended. Thinning is also recommended so that two plants might be in each pit.

6.5. Reaping is made day by day in accordance with their maturity. For this operation, therefore, it takes 10-13 mornings. And in each time, reaped crops are carried on the shoulder to the compound and spreaded for drying.

6.6. After drying, seed separation is made usually by children hired labor.

As such, labor requirement/ac in sunflower cultivation can be arranged as follows:

Labor Requirement/ac for Sunflower Cultivation

- in case of with the project -

	Family Labor (m.day)	Hired Labor (m.day)	Bullocks (pair)	Machinery (times)
1. Land Preparation				
Clearing & mending	(1) 1	-	1	-
Watering	0.5	[1]	-	-
Plowing (1 time)	(2) -	-	2	-
Harrowing (2 times)	(1) -	-	1	-
Levelling (2 times)	(1) -	-	1	-
2. Sowing				
Sowing pit making Sowing & soil covering 1st fertilizering	(1) 1	2	1	-
3. Plant Caring				
1st intercultivation cum weeding	(1) -	-	1	-
2nd intercultivation cum weeding	(1) -	-	1	-
Thinning by hand	6	6	-	-
Watering	1.5	[3]	-	-
2nd fertilizering plant protection	1	-	-	2
4. Harvesting				
Reaping & carrying	20*	-	-	-
Seperation of seeds collecting & storing	4	40**	-	-
5. Total	(8) 35	48+[4]	8	2

* This operation will be made only in the morning only.

** 40 days of hired labor may include children labor.
So, in case of farm cost calculation, these labor costs should be devaluated at half.

7. Farming Practices of Jute Cultivation
- in connection with inputs requirement -

Jute is also one of the Government controlled commodities and one of the exporting commodities in this country. All products are obliged to be sold to the Government purchasing depots, and there are three depots in Taikkyi township. But this Area is not so-called jute production area due to shortage of available water for jute cultivation. But some farmers are trying to cultivate jute, because it is a pre-monsoon crop, and moreover from the viewpoint of its growth period, even triple-cropping may be possible by introducing jute cultivation.

7.1. In this Area, therefore, before plowing, not only burning and mending of the field but also pumping irrigation is essentical in order to carry out jute cultivation.

7.2. Seven days after pumping irrigation, one time ploughing followed by three times harrowing are made as land preparation. For these operation, two pairs of bullocks and one pair of bullocks are required respectively. After completion of the Project, however, farm mechanization is recommended for the same reason and in the same way as in case of sesame cultivation. Accordingly, average labor requirement can be assumed in the same way as sesame cultivation. Namely, in terms of three years, 1 time tractor plowing and 2 times of bullock plowing, 2 times of tractor harrowing and 4 times of bullock harrowing, and 6 times of bullock levelling will be required for land preparation of one acre jute cultivation. And one third of the above will be the requirement per year.

7.3. After that, broadcasting of seeds is made and followed by levelling to make soil covering. For this operation, a pair of bullocks are required. (In this case, broad casting is made by

the cattle driver). Seed requirement is one eighth of basket per acre.

After the Project, this broad-casting method will be changed to rectangle sowing method, spacing of which is 2 feet x 4 inches or 2.5 feet x 4 inches.

7.4. Then, any plant caring is not made until harvesting time in case of without project, although after the project, watering, fertilizering, intercultivation cum weeding and plant protection, etc. will be recommended.

7.5. Harvesting is made by cutting with sickles, and harvested stems are dipped in the water to make barking easy. After dipping, barking and washing are made. The above operation is carried out usually by hired labour, namely, eight man days for cutting, five mand days for dipping and 10 man days for barking and washing respectively.

7.6. After washing, drying is made by two man days of family labor, and further two man days of family labor are required to bundle them.

Quality of jute produced locally in this Area is usually the second grade, because broacasting method usually cannot make good quality due to un-equality of spacing of plants, and moreover, available water is so muddy that especially washing of barks cannot be effective in grading up the jute. After the Irrigation Project, it will be extremely improved.

Anyway, from the above, labour requirement for jute cultivation can be arranged as follows:

Labor Requirement/ac for Jute Cultivation

	Without Project			With Project				
	Family Labor (m.day)	Hired Labor (m.day)	Bullock (pair)	Pump (day)	Family Labor (m.day)	Hired Labor (m.day)	Bullock (pair)	Machinery (times)
1. Land Preparation								
Clearing, mending	1	-	-	-	1	-	-	-
Watering	1	-	-	1	1	[2]	-	-
Plowing	(2) -	-	2	-	(4/3) -	-	4/3	1/3
Harrowing	(1) -	-	1	-	(4/3) -	-	4/3	2/3
Levelling	-	-	-	-	(1) -	-	1	-
2. Sowing								
Broad casting & soil covering	(1) -	-	1	-	-	-	-	-
Fertilizering, sowing line making	-	-	-	-	(1) 1	1	1	-
Sowing & soil covering	-	-	-	-				
3. Plant Caring								
Intercultivation cum weeding thinning	-	-	-	-	1	7	-	-
Watering (2 times)	-	-	-	-	1	[2]	-	-
Fertilizering and plant production	-	-	-	-	1	-	-	2
4. Harvesting								
Reaping	-	8	-	-	-	12	-	-
Dipping	-	5	-	-	-	8	-	-
Barking Washing	-	10	-	-	-	15	-	-
Dry	2	-	-	-	3	-	-	-
Bundling	2	-	-	-	3	-	-	-
5. Total	(4) 6	23	4	1	(5) 12	43+[4]	5	3

8. Inputs Materials Requirements/ac/Crop.

After consultation with the Agronomist, the following inputs doses have been decided for the farming with the Project, which will be shown below together with present actual doses:

Seed Requirement/ac		Without Project	With Project
Paddy	HYV	1.5 bskt	1.5 bskt
	LV	1.0 "	-
Groundnuts		6.0 "	6.0 "
Sesame		0.125"	0.25 "
Mat'pe		0.5 "	0.25 "
Maize (feed seeds)		-----	0.25 "
Sunflower		-----	0.25 "
Jute		0.125"	0.0625"

Fertilizer Requirement/ac (without project case)

		Urea	T.S.P.	Kcl	F.Y.M.
Paddy	HYV	1.5 bag	0.5 bag	0.125 bag	0.5 carts
	LV	-	-	-	-
Groundnuts		0.5 "	-	-	-
Other crops		-	-	-	-

Fertilizer Requirement/ac (with project case)

	Urea	T.S.P.	Kcl	F.Y.M.
Paddy (HYV)	2.0 bag	0.5 bag	0.25 bag	8 carts
Groundnuts	0.5 "	0.5 "	-	-
Sesame	1.5 "	0.5 "	-	-
Gram	1.0 "	0.25 "	-	-
Mat'pe	1.0 "	0.25 "	-	-
Bocate	1.0 "	0.25 "	-	-
Maize (feed seed)	2.0 "	0.5 "	0.25 "	-
Sunflower	1.5 "	0.5 "	0.25 "	-
Jute	2.0 "	-	0.25 "	-

Agri-Chemicals application is nearly 0 in case of without project

Agri-Chemicals Requirement/ac (with project case)

Paddy	Diazinon 40% EC	60 ounce/ac
	Elsan 50% EC	30 ounce/ac
Groundnuts	Diazinon 40% EC	30 ounce/ac
	Malathion 50% EC	30 ounce/ac
Sesame	Malathion 50% EC	60 ounce/ac
Mat'pe	Diazinon 40% EC	30 ounce/ac
	Malathion 50% EC	30 ounce/ac
Maize	Diazinon 40% EC	30 ounce/ac
	Malathion 50% EC	30 ounce/ac
Sunflower	Diazinon 40% EC	30 ounce/ac
	Malathion 50% FC	30 ounce/ac
Jute	Diazinon 40% EC	30 ounce/ac

Study on Crop Economy

In principle, crop economy can be expresed by Economic Net Production Value per acre of each crop from the viewpoint of national economy, and by Farm Income per acre of each crop from the viewpoint of farmers' individual economy. The former can be calculated by deducting each economic farm cost from each economic gross production value, and the latter by deducting each financial (cash) farm cost from each financial gross production value.

1. Calculation of Gross Production Value Per Acre

Gross production value per acre of each crop can be calculated by multiplying each farm gate price to each yield per acre. The former has been studied and shown in Appendix 6A, and the latter has been given by the Agronomist as shown below, therefore, GPV per acre can be calculated easily.

Yield per Acre by Agricultural Development Stage (basket)

	Without Project	With Project				
		1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.
Paddy HYV (S)	75.0	91	94	97	99	100
" " (M)	70.0	81	84	87	89	90
" LV	49.0	-	-	-	-	-
Groundnuts	36.4	45	46	47	49	50
Sesame	3.5	7	8	9	9	10
Sunflower	-	30	32	34	36	40
Mat'pe	4.4	8	9	10	12	15
Maize	-	30	35	40	45	50
Jute (viss)	198.2	289	305	319	335	350 (viss)

Note: 5th year is the agricultural full development stage

Economic Gross Production Value per Acre (Ks)

	Without Project	With Project				
		1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.
Paddy HYV (S)	4,682.25	5,681.13	5,868.42	6,055.71	6,180.57	6,243.00
" (M)	4,370.10	5,056.83	5,244.12	5,431.41	5,556.27	5,618.70
" LV	3,059.07	-	-	-	-	-
Groundnuts	2,548.00	3,150.00	3,220.00	3,290.00	3,430.00	3,500.00
Sesame	647.50	1,295.00	1,480.00	1,665.00	1,665.00	1,850.00
Sunflower	-	1,950.00	2,080.00	2,210.00	2,340.00	2,600.00
Mat'pe	699.96	1,272.64	1,421.72	1,590.80	1,908.96	2,386.20
Maize	-	1,726.80	2,014.60	2,302.40	2,590.20	2,878.00
Jute	1,467.00	2,875.55	3,034.75	3,174.05	3,333.25	3,482.50

Financial Gross Production Value per Acre (Ks)

	Without Project	With Project				
		1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.
Paddy HYV (S)	678.75	823.55	850.70	877.85	895.95	905.00
" (M)	633.50	753.05	760.20	787.35	805.45	814.50
" LV	443.45	-	-	-	-	-
Groundnuts	2,548.00	3,150.00	3,220.00	3,290.00	3,430.00	3,500.00
Sesame	647.50	1,295.00	1,480.50	1,665.00	1,665.00	1,850.00
Sunflower	-	1,950.00	2,080.00	2,210.00	2,340.00	2,600.00
Mat'pe	217.36	395.20	444.60	494.00	592.80	741.00
Maize	-	585.00	682.50	78.00	877.50	975.00
Jute	519.20	1,017.28	1,073.60	1,122.88	1,179.20	1,232.00

2. Calculation of Farm Costs per Acre

Farm cost can be calculated by applying farm gate prices to inputs (labor & materials) requirements per acre of each crop, which have been worked out in Appendix 6B. In this case, however, needless to say that in case of financial farm costs, only cash (paid) costs will be evaluated by financial prices, whereas in case of economic farm costs, all inputs should be evaluated by economic prices in principle. For example, in case of labor costs, financial costs will include only hired (paid) labor costs, whereas economic costs will include not only hired (paid) labor costs, but also family labor costs and mutual helping labor costs. In case of self-supporting inputs like manure, they are not included in financial farm costs, but they should be

included in economic farm costs. Furthermore, governmental subsidies should not be included in financial farm costs, whereas they should be included in economic farm costs, because these subsidies should be the cost for national economy, but are not the cost for farmers' individual economy.

On the other hand, taxes and duties should be included in the financial farm costs, whereas they should not be included in the economic farm costs, because they are actual costs for farmers' individual economy, and they are only transfer payments for national economy.

As such, financial farm costs can be employed to find out farm income from the viewpoint of farmers' individual economy, and economic farm costs can be employed to find out real (social) agricultural benefits from the viewpoint of national economy.

Under such consideration, respective farm costs have been worked out in the succeeding two pages.

Economic (Social) Farm Costs per Acre (Ks)

			Labor Cost	Cattle Cost	Machinery Cost[2]	Seed Cost	Fertilizers Cost[3]	Agri.Chemicals Cost[4]	Total
Paddy	Without[1]	L.V.	92	90	-	13.0	37.5	3.0	235.5
		H.Y.V.	104	100	-	19.5	226.5	3.0	505.0
	With	(HYV)	164	115	48.7	19.5	353.5	103.8	804.5
Groundnuts	Without		124	160	71.4	540.0	37.5	-	932.9
	With		200	90	149.0	540.0	132.0	67.8	1,178.8
Sesame	Without		40	40	23.8	36.0	-	-	139.8
	With		132	60	45.8	72.0	207.0	63.6	580.4
Sunflower	With		228	80	18.0	24.0	207.0	67.8	624.8
Mat'pe	Without		24	50	-	80.0	-	-	154.0
	With		92	90	18.0	40.0	122.3	67.8	430.1
Maize	With		108	50	59.7	10.0	273.5	67.8	569.0
Jute	Without		116	40	36.1	8.0	-	-	272.1
	With		228	50	45.8	4.0	179.0	36.0	542.8

Note: 1/ "Without" means "in case of without project", and "with" means "in case of with project".
2/ In case of tractor, operator cost is included. In other cases, operator cost is not included. But fuel cost and oil cost are included in both cases.
3/ Manure cost is included in fertilizers cost for the convenience.
4/ Trap-lighting cost is included in agri-chemicals cost.

Financial Cash Farm Costs per Acre (Ks)

			Labor Cost	Machinery Cost[2]	Seed Cost	Fertilizer Cost	Agri.Chemicals Cost[3]	Land Tenure[4]	Total[5]
Paddy	Without[1]	L.V.	90	-	13.0	6.0	3.0	5.0	117.0
		HYV	108	-	19.5	55.8	3.0	5.0	191.3
	With	(HYV)	150	21.3	19.5	66.0	103.8	6.0	366.6
Groundnuts	Without		126	39.0	540.0	6.0	-	-	711.0
	With		186	74.6	540.0	39.5	67.8	-	907.9
Sesame	Without		30	13.0	36.0	-	-	-	79.0
	With		108	19.3	72.0	51.5	63.6	-	314.4
Sunflower	With		168	4.6	24.0	60.0	67.8	-	324.4
Mat'pe	Without		24	-	80.0	-	-	-	104.0
	With		78	4.6	40.0	28.8	67.8	-	219.2
Maize	With		48	26.6	10.0	66.0	67.8	-	218.4
Jute	Without		138	35.1	8.0	-	-	-	181.1
	With		252	19.3	4.0	32.5	36.0	-	343.8

Note: 1/ "Without" means "in case of without project", and "with" means "in case of with project".
2/ In case of tractor, operator cost is included. In other cases, operator cost is not included. But fuel cost and oil cost are included in both cases.
3/ Trap-lighting cost is included in Agri-chemicals costs.
4/ Land Revenue is calculated only in paddy farming cost for the convenience.
5/ Almost all cattle labor is regarded as self-supporting labor. So, it has not been taken into account in financial farm costs.

3. Calculation of Economic NPV per Acre and Financial Farm Income per Acre of Each Crop

From the above two results, economic NPV (net production value) per acre and financial farm income per acre can be calculated as follows:

1) Crop Economy of Paddy Cultivation (Ks/ac)

	Economic GPV (1)	Financial GPV (2)	Economic Farm Cost (3)	Financial Farm Cost (4)	Economic NPV (1)-(3)	Financial Farm Income (2)-(4)
Without case of paddy cultivation						
HYV (S)	4,682	679	453	191	4,229	488
HYV (M)	4,370	634	453	191	3,917	443
L.V.	3,059	443	236	117	2,823	326
With case of paddy cultivation						
HYV (S)						
1st yr.	5,681	824	805	367	4,876	457
2nd yr.	5,868	851	805	367	5,063	484
3rd yr.	6,056	878	805	367	5,253	511
4th yr.	6,181	896	805	367	5,376	529
5th yr.	6,243	905	805	367	5,438	538
HYV (M)						
1st yr.	5,057	733	805	367	4,252	366
2nd yr.	5,244	760	805	367	4,439	393
3rd yr.	5,431	787	805	367	4,626	420
4th yr.	5,556	805	805	367	4,751	438
5th yr.	5,619	815	805	367	4,804	448

2) Crop Economy of Groundnuts Cultivation (Ks/ac)

Without stage	2,548	2,548	933	711	1,615	1,837
1st yr.	3,150	3,150	1,179	908	1,971	2,242
2nd yr.	3,220	3,220	1,179	908	2,041	2,312
3rd yr.	3,290	3,290	1,179	908	2,111	2,382
4th yr.	3,430	3,430	1,179	908	2,251	2,522
5th yr.	3,500	3,500	1,179	908	2,321	2,592

3) Crop Economy of Sesame Cultivation (Ks/ac)

	Economic GPV (1)	Financial GPV (2)	Economic Farm Cost (3)	Financial Farm Cost (4)	Economic NPV (1)-(3)	Financial Farm Income (2)-(4)
Without stage	648	648	140	79	508	569
1st yr.	1,295	1,295	580	314	715	981
2nd yr.	1,480	1,480	580	314	900	1,166
3rd yr.	1,665	1,665	580	314	1,085	1,351
4th yr.	1,665	1,665	580	314	1,085	1,351
5th yr.	1,850	1,850	580	314	1,270	1,536

4) Crop Economy of Sunflower Cultivation (Ks/ac)

Without stage	-	-	-	-	-	
1st yr.	1,950	1,950	625	324	1,325	1,626
2nd yr.	2,080	2,080	625	324	1,455	1,759
3rd yr.	2,210	2,210	625	324	1,585	1,886
4th yr.	2,340	2,340	625	324	1,715	2,016
5th yr.	2,600	2,600	625	324	1,975	2,276

5) Crop Economy of Mat'pe Cultivation (Ks/ac)

	Economic GPV (1)	Financial GPV (2)	Economic Farm Cost (3)	Financial Farm Cost (4)	Economic NPV (5)	Financial Farm Income (6)
Without stage	700	217	154	104	546	113
1st yr.	1,273	395	430	219	843	176
2nd yr.	1,420	445	430	219	992	226
3rd yr.	1,591	494	430	219	1,161	275
4th yr.	1,909	593	430	219	1,479	374
5th yr.	2,386	741	430	219	1,956	522

6) Crop Economy of Maize Cultivation (Ks/ac)

Without stage	-	-	-	-	-	-
1st yr.	1,727	585	569	218	1,158	367
2nd yr.	2,015	683	569	218	1,446	465
3rd yr.	2,302	780	569	218	1,733	562
4th yr.	2,590	878	569	218	2,021	660
5th yr.	2,878	975	569	218	2,309	757

7) Crop Economy of Jute Cultivation (Ks/ac)

	Economic GPV (1)	Financial GPV (2)	Economic Farm Cost (3)	Financial Farm Cost (4)	Economic NPV (5)	Financial Farm Income (6)
Without stage	1,467	519	272	181	1,195	338
1st yr.	2,876	1,017	543	344	2,333	673
2nd yr.	3,035	1,074	543	344	2,492	730
3rd yr.	3,174	1,123	543	344	2,631	779
4th yr.	3,333	1,179	543	344	2,790	835
5th yr.	3,483	1,232	543	344	2,940	888

Study on Economic Project Benefits

1. General

This project includes not only irrigation project, but also hydro-power project. So, the project benefits also will consist of agricultural benefits and hydro-power benefits. And agricultural benefits are given as the difference of the total NPV (net production value) in the project area between with the project and without the project, and hydro-power benefit is given as the value of the costs of an alternative thermal plant with the capacity to generate the power equivalent to the average firm peak by the proposed hydro-power project. And, actual benefits will be accrued in accordance with construction schedule of the project.

2. Agricultural Benefits

Economic NPV/ac of each crop have been worked out in Appendix 6C and cropping pattern has been given by the agronomist in both cases of without and with the project.

According to the construction schedule, construction works will be started in 1983/84 and completed in the end of 1988/89. However, the proposed dam construction will be completed in March of 1988. Accordingly, this dam can be utilized from November of 1988. But paddy cultivatioin in the wet season of 1988 will be carried out under the traditional way. Even if dam irrigation water is available, therefore, the proposed cropping pattern can not be made in the dry season of 1088/89. As such, the proposed cropping pattern can be made from 1989/90.

Of course, in the dry season of 1988/89, the dam water can be used for irrigation farming of double cropping. And needless to say that during this season double cropping should be recommended as much as possible in the Area where the proposed canals and on farm works will be completed until this time. But this cropping pattern may

be different from the proposed one, because in the preceding wet season paddy cultivation will be carried out in traditional way. Moreover, it may be desirable to have a trial and training period before start the proposed farming not only for the purpose of double cropping but also for the purpose of water management, in order to make success in the proposed dam-irrigation project.

The dry season of 1989/90 will be, therefore, treated as the trial and training period in this study, and the benefits which may be accrued during this season will be conservatively left out of consideration in calculation of the agricultural benefits in this study.

Therefore, the agricultural benefits can be calculated as follows:

2.1. Total Economic NPV in case of without the Project

	NPV/ac (Ks)	Cropping Acreage (ac)	Total NPV ('000 Ks)
Paddy HYV (S)	4,229	19,800	83,734
Paddy HYV (M)	3,917	12,400	48,571
Paddy LV	2,823	17,400	49,120
Groundnuts	1,615	2,200	3,530
Sesame	508	500	254
Pea & Beans	546	300	164
Jute	1,195	2,000	2,300
Total	-	54,600	187,763

2.2. Total Economic NPV in case of with Project

	Cropping Acreage (ac)	1st Year NPV/ac (Ks)	1st Year Total NPV ('000 Ks)	2nd Year NPV/ac (Ks)	2nd Year Total NPV ('000 Ks)
Paddy HYV (S)	22,200	4,876	108,247	5,063	112,399
Paddy HYV (M)	29,700	4,252	126,284	4,439	131,838
Groundnuts	8,200	1,971	16,162	2,041	16,736
Sesame	14,800	715	10,582	900	13,320
Sunflower	4,700	1,325	6,228	1,455	6,839
Pea & Beans	14,000	843	11,802	992	13,888
Maize	4,700	1,158	5,443	1,446	6,796
Jute	3,500	2,333	8,166	2,492	8,722
Total	101,800	-	292,864	-	310,538

	3rd Year NPV/ac (Ks)	3rd Year Total NPV ('000 Ks)	4th Year NPV/ac (Ks)	4th Year Total NPV ('000 Ks)	5th Year NPV/ac (Ks)	5th Year Total NPV ('000 Ks)
HYV (S)	5,253	116,617	5,376	119,347	5,438	120,724
HYV (M)	4,626	137,392	4,751	141,105	4,804	142,679
G'nuts	2,111	17,310	2,251	18,458	2,321	19,032
Sesame	1,085	6,058	1,085	16,058	1,270	18,796
S. flower	1,585	7,450	1,715	8,061	1,975	9,283
P & B	1,161	16,254	1,479	20,706	1,956	27,384
Maize	1,733	8,145	2,021	9,499	2,309	10,852
Jute	2,631	9,209	2,791	9,769	2,940	10,290
Total		328,435		343,003		359,040

2.3. Agricultural Benefits ('000 Ks)

After Complesion of the Project	Total NPV (with Project)	Total NPV (without Project)	Agricultural Benefits
1st year	292,864	187,763	105,101
2nd year	310,538	187,763	122,775
3rd year	328,435	187,763	140,672
4th year	343,003	187,763	155,240
5th year	359,040	187,763	171,277

In the above table, the 1st year would be 1989/90, as mentioned in para 1. And the 5th year is the agricultural full development stage. In other words, from the 5th year the same benefits as the 5th year will be accrued every year constantly.

3. Benefit from Hydro-power Generation

Benefit from hydro-power generation will be usually studied on the assumption that an alternative thermal power plant with the capacity to generate the power equivalent to the average firm peak by the proposed hydro-power project would be provided in the almost same place, and its construction cost and O & M cost would be regarded as the amount equivalent to the benefit accrued from the proposed hydro-power project. And this amount has been worked out by the hydro-power Expert at 6,729,000 Ks in usual year. (Details can be seen in Appendix 6F-1)

According to the construction schedule, dam and hydro-power station will be completed in May of 1988. Accordingly, this station can be operated from November of 1988 (when dam water will be available for power generation). And according to the Hydro-Power Expert, during the period from November of 1988 to March of 1989 (i.e. five months), 60 percent of annual benefit can be accrued. In other words, the benefit in the 1st year would be 4,037,000 Ks. On the other hand, in the last year (i.e. from April to October of the 25 year) only 40 percent of the annual benefit (i.e. 2,692,000 Ks) will be accrued.

4. Over-all Economic Project Benefits

Summarized the above, the over-all economic project benefits can be arranged annually as seen in the next page.

5. Present Worth Value of the Project Benefits

In the economic analysis, the above project benefits should be converted to the present worth value to compare with the project costs. In this case, various discount factors will be employed for the purpose of IRR calculation.

Besides the original case, it may be convenient to further calculate another present worth value here for the purpose of sensitivity analysis, namely, in case of delay in construction works and in case of decrease in agricultural benefits.

And they have been worked out in the succeeding pages.

Annual Over-all Benefits ('000 Ks)

Calendar year	Project year	Agricultural Benefits	Power Benefit	Over-all Benefits
1981/82	--			
1982/83	0			
1983/84	1			
1984/85	2			
1985/86	3			
1986/87	4			
1987/88	5			
1988/89	6		4,037	4,037
1989/90	7	105,101	6,729	111,830
1990/91	8	122,775	6,729	129,504
1991/92	9	140,672	6,729	147,401
1992/93	10	155,240	6,729	161,969
1993/94	11	171,277	6,729	178,006
	.	.		.
	.	.	.	.
	.	.	.	.
	.	.	.	.
2012/13	30	171,277	6,729	178,006
2013/14	31	171,277	2,692	173,969
2014/15	32	171,277	.	171,277
	.	.	.	.
	.	.	.	.
	.	.	.	.
2032/33	50	171,277	.	171,277
Total		7,374,868	168,225	7,543,093

Present Worth Value of the Economic Project Benefits
(Original Case)

('000 Ks)

Project Year	Discount Factors 0%	10%	12.5%	15%	17.5%	20%	22.5%	25%	27.5%	30%
1	.									
2	.									
.	.									
.	.									
6	4,037	2,279	1,991	1,745	1,534	1,352	1,195	1,058	940	836
7	111,830	57,391	49,037	42,037	36,166	31,212	27,018	23,451	20,420	17,826
8	129,504	60,414	50,468	42,335	35,640	30,123	25,538	21,731	18,545	15,877
9	147,401	62,513	51,060	41,906	34,521	28,566	23,732	19,781	16,553	13,900
10	161,969	62,439	49,870	40,039	32,297	26,158	21,283	17,395	14,269	11,743
11	178,006									
.	.									
.	.	584,214	396,887	275,433	194,765	139,991	102,160	75,590	56,583	42,792
.	.									
.	.									
30	178,006									
31	173,969	9,064	4,523	2,279	1,166	608	331	174	87	52
32	171,277									
.	.									
.	.	74,645	31,825	13,907	6,251	2,904	1,416	675	308	170
.	.									
.	.									
50	171,277									
Total	7,543,093	912,959	635,688	459,681	342,340	260,914	202,773	159,855	127,405	103,196

Present Worth Value of the Economic Project Benefits

- in case of 2 years delay in construction works -

('000 Ks)

Project Year	0%	10%	12.5%	15%	17.5%	20%	22.5%	25%	27.5%	30%
1										
2										
.										
.										
.										
8	4,037	1,883	1,537	1,320	1,111	939	796	677	578	495
9	111,830	47,427	38,738	31,793	26,191	21,675	18,005	15,008	12,559	10,546
10	129,504	49,924	39,874	32,013	25,823	20,915	17,017	11,124	11,409	9,389
11	147,401	51,664	40,314	31,676	25,014	19,840	15,816	12,662	10,185	8,225
12	161,969	51,603	39,407	30,272	23,388	18,173	14,188	11,127	8,779	6,948
13	178,006									
.	.									
.	.	482,829	313,617	208,246	141,043	97,257	68,107	48,352	34,811	25,321
.	.									
.	.									
32	178,006									
33	173,969	7,498	3,566	1,722	731	348	289	104	52	35
34	171,277									
.	.									
.	.	59,216	24,297	10,254	4,487	1,963	885	402	184	123
.	.									
.	.									
50	171,277									
Total	7,200,539	752,044	501,350	347,296	247,788	188,108	135,103	99,456	78,557	61,082

From the above tables, present worth value of the economic project benefits in various cases can be arranged as follows:

Summarized Present Worth Value of
the Economic Project Benefits
(in various cases)

('000,000 Ks)

Discount Facot	Original Case	In case of Decrease in Target Benefits			In case of 2 years delay in construction works		
						Moreover Benefit Decrease	
		10%	20%	30%	Delay only	10%	20%
0%	7,543	6,789	6,034	5,280	7,201	6,481	5,761
10.0%	915	822	730	639	752	677	602
12.5%	636	572	509	445	501	451	401
15.0%	460	414	368	322	347	312	278
17.5%	342	308	274	239	248	223	198
20.0%	261	235	209	183	181	163	145
22.5%	203	183	162	142	135	122	108
25.0%	160	144	128	112	99	89	80
27.5%	127	114	102	89	79	71	63
30.0%	103	93	82	72	61	55	49

Study on Economic Project Costs

1. General

In general project costs consist of initial investment cost and O & M (Operation and Maintenance) cost, which is further devided into recurrent cost and replacement cost. And the financial project costs have been worked out in Chapter IV.

Here, one point should be noted, regarding replacement cost, because there are two ways in treatment of replacement cost. In the first way, it will be mentioned in every replacement year, but in the second way, its depreciation cost will be included in the recurrent cost and replacement cost will be not specially mentioned in every replacement year. In this study, the replacement cost only for the gates and valves has been specially mentioned in their replacement year, because their replacement costs are rather expensive. As regards other replacement costs, however, their depreciation costs have been included in the recurrent costs for the convenience.

Anyway, in order to make economic analysis of the Project, the above financial project costs should be adjusted to the economic project costs as follows:

- taxes and duties should not be included in the economic costs, whereas they should be included in the financial cost.

- subsidies should be included in the economic cost, whereas they should not be included in the financial cost, if subsidies are found.

- price contingensy (on price escalation) should not be included in the economic cost, whereas it should be included in the financial cost.

- unskilled labor should be evaluated by the opportunity cost of labor. (But in this connection no adjustment has been made, because in the financial cost of the unskilled labor was evaluated by the government minimum wage rate (i.e. 5.4 Ks/day), which is regarded as the opportunity cost of labor in this country.

- foreign component portion in the project cost should be re-evaluated by the shadow foreign exchange rate (i.e. US$1 = 11 Ks) in the economic cost, whereas it should be evaluated by the current foreign exchange rate, (the certified average rate of which is Ks. 6.89/$) in the financial cost.

- as regards construction equipment cost, its procurement cost should be included in the financial costs, if these equipment have to be newly purchased for this project. But even after completion of the Project, these equipment can be usually used for the other purposes. In the economic costs, therefore, these residual value should not be included. In order to get this economic cost, there are two ways. One is to deduct the residual value from the procurement cost, and the other is to calculate its depreciation cost during the construction period. In this study, the latter method has been employed.

- in treatment of farm mechanization cost also, there are two ways in economic analysis of the Project. In the first way, the procurement cost and O & M cost of necessary farm machineries will be taken into consideration in the project costs and will be left out of consideration in the farm cost calcultion. In the other way, farm mechanization cost will be considered in farm cost calculation, and instead, will be not taken into consideration in the project cost. Any way, double accounting should be avoided in economic analysis of the Project. And in this study, the latter method has been applied.

- on the other hand, besides the financial project costs, some farmers' own expenses will be required to complete the Project. For example, from the main canals to water courses, they will be constructed by the financial costs. But in order to complete the Project, farmers should arrange their farm ditches etc. by their own expenses. And these cost should be included in the economic cost, although these cost need not to be included in the financial cost.

2. Economic Initial Investment Costs

After the above adjustment, the economic initial investment costs have been worked out, which will be shown below in comparison with the financial costs.

Initial Investment Costs (000 Ks)

Description	Financial Costs	Economic Costs
A. Final Design	4,562	6,995
B. Implementation		
1. Civil Works	(171,694)	(224,857)
1.1. Preparation	7,730	9,018
1.2. Main Dam	19,742	39,684
1.3. Diversion Dam	8,000	12,384
1.4. Irrigation & Drainage Canal	99,100	118,793
1.5. On-farm by the Gov't	3,670	3,813
1.6. Road	2,029	2,594
1.7. Hydro-Power Plant	31,047	38,195
1.8. Pre-Engineering	376	376
2. Construction Equipment	47,030	330
3. Agricultural Development	4,970	6,612
4. O & M during construction	4,295	5,149
5. Project Facilities	3,200	3,287
6. Project Administration	13,138	13,138
7. Consulting Services	6,737	10,114
Sub-total (A-B.7)	255,356	270,051

(cont'd)

8. Physical Contingency	38,304	40,508
Sub-total (A-B. 8)	293,660	310,559
9. Price Contingency	78,791	-
10. On-farm by Farmers	-	29,990
Total	372,451	340,549

2.2. Annual Economic Project Costs

In accordance with the disbursement schedule of the financial costs, the above economic costs can be broken down annually, which will be shown below together with O & M costs.

(unit: 000 Ks)

Fiscal year	Project year	Initial Investment Cost	O & M Cost		Total Cost
			Recurrent Cost	Replacement Cost	
1983/84	1	13,120	-	-	13,120
1984/85	2	32,640	-	-	32,640
1985/86	3	61,409	-	-	61,409
1986/87	4	72,059	-	-	72,059
1987/88	5	99,929	-	-	99,929
1988/89	6	61,392	206	-	61,598
1989/90	7	-	6,100	-	6,100
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
2012/13	30	-	6,100	-	6,100
2013/14	31	-	5,894	-	5,894
2014/15	32	-	5,606	-	5,606
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
2018/19	36	-	5,606	-	5,606
2019/20	37	-	5,606	3,679	9,285
2021/22	38	-	-	-	5,606
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	
2032/33	50	-	5,606	-	5,606
		340,549	259,014	3,679	603,242

2.3. Present Worth of Economic Project Costs

The above economic project costs should be converted to its present worth value at various discount factors in order to compare it with the economic project benefits in the economic analysis. This work will be done in the next page. And by the way, the present worth value of the economic project costs in case of 2 years delay in construction works also will be worked out in the succeeding page for the purpose of sensitivity analysis. In this case, however, various cases can be considered. So, the following two cases have been taken up. Namely, in case of 2 years delay in every construction works, and in case of 2 years delay mainly in farmers' own on-farm works, because it is a common case in developing countries.

Present Worth Value of Economic Project Costs (000 Ks)

(Original Case)

Project Year	Discount Factor 0.0%	10.0%	12.5%	15.0%	17.5%	20.0%	22.5%	25.0%	27.5%	30.0%
1	13,120	11,927	11,662	11,409	11,166	10,933	10,710	10,496	10,290	10,092
2	32,640	26,974	25,789	24,679	23,641	22,665	21,751	20,890	20,077	19,313
3	61,409	46,137	43,128	40,376	37,853	35,537	33,406	31,441	29,630	27,953
4	72,059	49,216	44,686	41,203	37,802	34,754	32,001	29,515	27,267	25,228
5	99,929	62,046	55,451	49,685	44,618	40,161	36,224	32,747	29,659	26,911
6	61,598	34,772	30,386	26,629	23,407	20,629	18,227	16,145	14,340	12,763
7	6,100									
.	.									
.	.	30,939	22,648	16,966	12,970	10,086	7,961	6,365	5,148	4,205
.	.									
.	.									
30	6,100									
31	5,894	307	153	77	39	21	11	6	5	2
32	5,606									
.	.									
.	.									
.	.	1,205	565	268	129	64	33	16	8	5
.	.									
.	.									
36	5,606									
37	9,285	273	119	53	24	11	5	3	1	1
38	5,606									
.	.									
.	.									
.	.	1,171	450	178	73	30	12	6	2	0
.	.									
50	5,606									
Total	603,242	264,967	235,037	211,523	191,722	174,891	160,341	147,630	136,457	126,473

Present Worth Value of Economic Project Costs (000 Ks)

- in case of 2 years delay in every construction works (A case) -

(000 Ks)

Project Year	Discount Factor 0.0%	10.0%	12.5%	15.0%	17.5%	20.0%	22.5%	25.0%	27.5%	30.0%
1	12,365	11,241	10,991	10,753	10,524	10,304	10,094	9,892	9,698	9,511
2	24,997	20,658	19,750	18,900	18,083	17,358	16,658	15,998	15,376	14,971
3	46,314	34,796	32,526	30,451	28,548	26,801	25,195	23,713	22,347	21,082
4	52,261	35,694	32,627	29,883	27,416	25,205	23,209	21,406	19,776	18,297
5	53,637	33,303	29,763	26,668	23,949	21,557	19,443	17,577	15,919	14,444
6	67,313	37,998	33,206	29,099	25,579	22,543	19,918	17,623	15,670	13,947
7	58,846	30,200	25,804	22,120	19,266	16,424	14,217	12,340	10,745	9,380
8	25,022	11,673	9,751	8,177	6,886	5,820	4,934	4,199	3,583	3,068
9	6,100									
.	.									
.	.	25,568	17,892	12,830	9,393	7,005	5,305	4,075	3,167	2.488
.	.									
32	6,100									
33	5,894	254	121	58	29	14	7	4	2	1
34	5,606									
.	.									
.	.	916	409	186	87	40	19	9	4	1
.	.									
38	5,606									
39	9,285	226	94	40	18	7	4	2	1	0
40	5,606									
.	.									
.	.	796	336	144	51	19	8	4	2	0
.	.									
50	5,606									
Total	592,030	243,323	213,270	189,309	169,829	153,097	139,011	126,842	116,290	107,190

Present Worth Value of Economic Project Costs (000 Ks)

- in case of 2 years delay mainly in on-farm works by farmers (B case) -

(000 Ks)

Project Year	Discount Factor									
	0.0%	10.0%	12.5%	15.0%	17.5%	20.0%	22.5%	25.0%	27.5%	30.0%
1	13,120	11,927	11,662	11,409	11,166	10,933	10,710	10,496	10,290	10,092
2	28,141	23,256	22,234	21,297	20,401	19,559	18,770	18,027	17,326	16,666
3	55,411	41,630	38,915	36,433	34,155	32,066	30,144	28,370	26,736	25,218
4	66,061	45,120	41,252	37,774	34,656	31,861	29,338	27,059	24,997	23,128
5	93,931	58,322	52,122	46,702	41,940	37,751	34,050	30,781	27,879	25,296
6	54,101	30,540	26,688	23,388	20,558	18,118	16,008	14,180	12,595	11,210
7	21,095	10,826	9,250	7,930	6,822	5,888	5,097	4,424	3,852	3,358
8	21,095	9,841	8,221	6,896	5,805	4,907	4,160	3,540	3,021	2,586
9	6,100									
.	.									
.	.	24,961	17,592	12,680	9,317	6,966	5,285	4,064	3,161	2,485
.	.									
30	6,100									
31	5,894	307	153	77	39	21	11	6	3	2
32	5,606									
.	.									
.	.	1,205	565	268	129	64	33	16	8	5
.	.									
36	5,606									
37	9,285	273	189	53	24	11	5	3	1	1
38	5,606									
.	.									
.	.	1,171	450	178	73	30	12	6	2	0
.	.									
.	.									
50	5,606									
Total	603,242	259,379	229,283	205,085	185,085	168,175	153,623	140,972	129,871	120,047

4. Summarized Present Worth of Economic Project Costs

From the above tables, present worth value of the economic project costs in various cases can be arranged as follows:

Summarized Present Worth Value of
the Economic Project Costs
(in various cases)

(000 Ks)

Discount Factor	Original Case	In case of over-run in project costs		In case of 2 years delay in construction works	
		10%	20%	Case A*	Case B**
0.0%	603,242	663,566	723,890	592,030	603,242
10.0%	264,967	291,464	317,960	243,323	259,379
12.5%	235,037	258,541	282,044	213,270	229,283
15.0%	211,523	232,675	253,828	189,309	205,085
17.5%	191,722	210,894	230,066	169,829	185,085
20.0%	174,891	192,380	209,869	153,097	168,175
22.5%	160,341	176,375	192,409	139,011	153,623
25.0%	147,630	162,393	177,156	126,842	140,972
27.5%	136,457	150,103	163,748	116,290	129,871
30.0%	126,473	139,120	151,768	107,190	120,047

Note: * Case A means "in case of 2 years delay in every construction works.

** Case B means "in case of 2 years delay mainly in farmers' own on-farm works.

Economic Evaluation of the Hydro-Power Project

1. Cost Benefit of Electric Power

In general, the economic evaluation of a hydroelectric power plant is made by comparing the annual cost of the hydroelectric power plant with the benefit from a thermal power plant capable of producing the output equivalent to the mean firm peak output to be produced by the hydroelectric power plant.

The economic evaluation of the hydroelectric power plant proposed in this Project was executed at the mean firm peak output of 1,590 kW and the annual generated energy of 8,623 MWH. The cost benefit calculation is shown hereinafter in which the benefit cost ratio, i.e. B/C is 0.98 in case of the discount rate of 12 percent and the balance between benefit and cost, B-C, is minus 144,100 Kyats. These values indicate that the cost of the hydroelectric power plant is a little larger than that of the thermal power plant.

However, if oil price in the year 1990 rises above 57,013 Pyas/kwH estimated in this cost benefit study, then the construction of the hydroelectric power plant will be encouraged with advantage.

This study was carried out on the basis of the following views and values:

1.1. The construction cost of the hydroelectric power plant proposed herein is estimated in Table 6F-2, calculated at the conversion rate of 11 Kyats to the U.S. dollar.

1.2. The construction cost of a thermal power plant having the output almost similar to that of the hydroelectric power plant is estimated at the rate of 6,842 Kyats per kW according to the data given by EPC.

1.3. The life of the hydroelectric power plant is determined at twenty-five (25) years excluding the dam and the other structures to be used concurrently for the irrigation purpose. The annual discount rate of twelve percent (12%) is adopted for the study of the hydroelectric power plant.

1.4. The world market price of fuel oil was given as 43.655 Pyas per kwH in the year 1981 from the EPC's data, but is estimated by the World Bank to rise by 30.6% of this in the year 1990 EPC's price.

Accordingly, the price of 57.013 Pyas/kwH (= 43.655 Pyas/kwH x 1.306) is adopted in this study.

1.5. The annual operation and maintenance cost on a thermal power plant is considered at two percent (2%) of its construction cost, and that on the hydroelectric power plant at one percent (1%) of its construction cost.

Cost Benefit Calculation at a Discount Rate of 12%

(Unit: 1,000 Kyats)

1. Cost	
(a) Construction Cost	
Power station	47,157
Transmission Facilities	2,825
Total	49,982
(b) Annual Capital Cost (n=25 years capital recovery factor 0.1275)	6,373
(c) Annual O.M Cost (1%)	500
(d) Total Annual Cost (b + c)	6,873

(cont'd)

2. Benefits from An Alternative Thermal Power Plant

(a) Construction Cost for a 1,590 kw thermal power plant

6,842 Kyats x 1,590 kw = 10,878.78

≒ 10,880

(b) Fixed Value

(Firm hydro power output x kw equivalent factor* Thermal power plant construction cost x capital recovery factor)

where, kw equivalent factor: 1.15

Thermal power plant construction cost: 6,842 Kyats

Capital recovery factor: 0.1275 at 25 years.

1,590kw x 1.15 x 6,842 x 10^3Kyats x 0.1275 = 1,595.1

(c) KWH Value

(KWH x KWH equivalent factor** x fuel cost/KWH)

where, KWH: 8,623 MWH

KWH equivalent factor: 1

Fuel cost: 57.013 Pyas/KWH

8,623 x 10^3 x 0.57013 = 4,916.25 x 10^3 Kyats

≒ 4,916.2

(d) O and M (2% of KW cost)

10,880 x 0.02 = 217.6

3. Benefit-cost Ratio (B/C)

$$\frac{1,595.1 + 4,916.2 + 217.6}{6,873} = \frac{6,728.9}{6,873} = 0.98$$

4. B-C

6,728.9 - 6,873 = - 144.1

Note: Equivalent Factors

The equivalent factors are specified as follows:

*. KW equivalent factor (K_{KW})

$$K_{KW} = \frac{(1 - K1H)(1 - K2H)(1 - K3H)(1 - K4H)}{(1 - K1T)(1 - K2T)(1 - K3T)(1 - K4T)}$$

where, K_{KW}; KW equivalent factor

K1H; transmission loss rate from hydro power station to the receiving end (3%)

K1T; transmission loss rate from the alternative thermal plant to the receiving end (2%)

K2H; forced outage rate of hydro (1%)

K2T; forced outage rate of the alternative thermal plant (4%)

K3H; scheduled outage rate of hydro (3.8%)

K3T; scheduled outage rate of the alternative thermal plant (10.5%)

K4H; station use rate of hydro (0.3%)

K4T; station use rate of the alternative thermal plant (5%)

Input the numericals shown in the brackets above into the given equation, equivalent factor will be

$$K_{KW} = 1.15$$

**. KWH equivalent factor (K_{KWH})

The KWH equivalent factor is expressed as follows:

$$K_{KWH} = \frac{(1 - IH)}{(1 - IT)}$$

where, IH; transmission energy loss rate from hydro power station to the receiving end

IT; transmission energy loss rate from the alternative thermal plant to the receiving end

Eventually the energy loss may be expressed empirically as follows:

Energy loss = If x L x h

where, If; loss factor

L; power loss at maximum load

h; operating house of transmission line

and practicaly If may be expressed as:

$$If = 0.\ (LF) + 0.7\ (LF)^2$$

where, LF; load factor

For example, assuming the load factor as 36.7%, the KWH equivalent factor will be:

$$K_{KWH} = 0.99 \doteq 1$$

Table 6F-1 (1) Economic Internal Rate of Return

(Unit: 1,000 Kyats)

No.	Year	Cost					Benefit			
		Investment		O & M						
		P/S	T/L	P/S	T/L	Total	Investment	Fuel	O & M	Total
1	1985	0	2,825	0	0	2,825	0	0	0	0
2	1986	4,716	0	0	0	4,716	1,088	0	0	1,088
3	1987	28,294	0	0	0	28,294	6,528	0	0	6,528
4	1988	14,147	0	203	12	14,362	3,264	2,950	91	6,305
5	1989	0	0	472	28	500	0	4,916	218	5,134
6	1990	0	0	472	28	500	0	4,916	218	5,134
7	1991	0	0	472	28	500	0	4,916	218	5,134
8	1992	0	0	472	28	500	0	4,916	218	5,134
9	1993	0	0	472	28	500	0	4,916	218	5,134
10	1994	0	0	472	28	500	0	4,916	218	5,134
11	1995	0	0	472	28	500	0	4,916	218	5,134
12	1996	0	0	472	28	500	0	4,916	218	5,134
13	1997	0	0	472	28	500	0	4,916	218	5,134
14	1998	0	0	472	28	500	0	4,916	218	5,134
15	1999	0	0	472	28	500	0	4,916	218	5,134
16	2000	0	0	472	28	500	0	4,916	218	5,134
17	2001	0	0	472	28	500	0	4,916	218	5,134
18	2002	0	0	472	28	500	0	4,916	218	5,134
19	2003	0	0	472	28	500	0	4,916	218	5,134
20	2004	0	0	472	28	500	0	4,916	218	5,134
21	2005	0	0	472	28	500	0	4,916	218	5,134
22	2006	0	0	472	28	500	0	4,916	218	5,134
23	2007	0	0	472	28	500	0	4,916	218	5,134
24	2008	0	0	472	28	500	0	4,916	218	5,134
25	2009	0	0	472	28	500	0	4,916	218	5,134
26	2010	0	0	472	28	500	0	4,916	218	5,134
27	2011	0	0	472	28	500	0	4,916	218	5,134
28	2012	0	0	472	28	500	0	4,916	218	5,134
29	2013	0	0	269	16	285	0	1,966	127	2,093
1985-2013		47,157	2,825	11,800	700	62,482	10,880	122,900	5,450	139,230

(2) Present Worth Value of Economic Cost and Benefit

(Unit: K'000)

Project Year	Cost				Cost			
	Discount Factor				Discount Factor			
	0%	8%	10%	12%	0%	8%	10%	12%
1	2,825	2,616	2,568	2,522	-	-	-	-
2	4,716	4,043	3,897	3,760	1,088	933	899	867
3	28,294	23,254	21,257	20,140	6,528	5,182	4,904	4,647
4	14,362	10,556	9,809	9,127	6,305	4,634	4,306	4,007
5	500				5,134			
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.	.	3,811	3,034	2,453	.	39,135	31,149	25,182
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28	500				5,134			
29	285	31	18	11	2,095	225	132	78
Total	62,482	44,311	40,583	38,013	139,230	50,109	41,390	34,781

The intersection point of the above cost and benefit curves which are drawn on the same section paper shows 10.53 percent of EIRR.

Table 6F-2 Construction Cost

(Unit: 1,000 Kyats)

Works	Estimated Construction Cost		
	Foreign Currency	Local Currency	Total
1. Penstock	532	93	625
Excavation	97	14	111
Concrete	35	45	80
Iron Bar	29	4	33
Steel Penstock	371	30	401
2. House and Foundation	956	3,926	4,882
Excavation	67	66	133
Concrete	334	455	789
Iron Bar	555	70	625
Building		2,000	2,000
Residence House		1,335	1,335
3. Tailrace	718	161	879
Excavation	93	12	105
Concrete	81	106	187
Iron Bar	144	18	162
Gate	400	25	425
4. Machine Equipment	27,424	3,035	30,464
Turbine	12,210	1,365	13,575
Generator	9,445	1,090	10,535
Main Transformer	500	65	565
Controling and Switching Equipment	3,005	290	3,295
Extension of Switchyard Tharrawaddy	319	30	349
Miscellaneous Equipment	1,950	195	2,145
5. Temporary Facilities	130	765	895
Total (1 to 5)	29,765	7,980	37,745
(a) Administration			1,864
(b) Consulting Services			3,774
(c) Contingency			3,774
Total (1 to 5 + a to c)			47,157
6. 33 KV Transmission Line	2,010	447	2,457
(d) Administration			123
(e) Contingency			245
Total (1 to 6 + d, e)			2,825
Grand Total	31,775	8,427	49,982

Farm Budget Analysis

1. Selection of the Representative Farmer

In farm budget analysis, what kind of farmer should be selected as the representative farmer ? This is one of the main points. As seen in Chapter III-A-3, it was estimated that the average farm size in the project area was 9.2 acres. So, it may be reasonable to take up a farmer with 9.2 acres land as the representative farmer in the farm budget analysis. After completion of the Project his farm size will be decreased to 8.74 acres, because around 5 percent of farm lands will be used as the right-of-way for the water canals, farm roads, farm ditches and so on, under the project implementation.

Moreover, if this representative farmer should represent the representative farm budget status in the Project Area, his cropping pattern, farming practices, yields, etc. (accordingly, GPV, farm costs, farm income/acre, etc.) also should be the same as those of the whole project area. Therefore, his cropping acreage can be assumed as follows:

Cropping Acreage of the Representative Farmer

	Without Project Case	With Project Case
Farm Size	9.2 ac.	8.74 ac.
Cropping Intensity	110.0%	196.0%
Total Cropping Acreage:	10.12 ac.	17.13 ac.
Paddy HYV (S)	3.67 "	3.77 "
Paddy HYV (M)	2.30 "	4.97 "
Paddy LV	3.23 "	-
Groundnuts	0.41 "	1.37 "
Sesame	0.09	2.50 "
Sunflower	-	0.79 "
Maize	-	2.36 "
Beans & Peas	0.05 "	0.79 "
Jute	0.37 "	0.58 "

2. Calculation of His Farm Income

His farm income can be calculated by multiplying the above respective acreages to the respective farm income per acre (refer to "Crop Economy" in Appendix 6D), as follows:

Farm Income of the Representative Farmer (Ks)

	Without Project			1st year		
	Cropping Acreage (ac)	FI/ac (Ks)	Farm Income (Ks)	Cropping Acreage (ac)	FI/ac (Ks)	Farm Income (Ks)
Paddy HYV (S)	3.67	488	1,791	3.77	457	1,723
Paddy HYV (M)	2.30	443	1,019	4.97	366	1,819
Paddy L.V.	3.23	326	1,053	-	-	-
Groundnuts	0.40	1,873	735	1.37	2,242	3,072
Sesame	0.09	569	51	2.50	981	2,453
Sunflower	-	-	-	0.79	1,626	1,285
Maize	-	-	-	2.36	367	866
Pea & Beans	0.05	113	6	0.79	176	139
Jute	0.37	338	125	0.58	675	390
Total	10.12	-	4,780	17.13	-	11,750
Seasonal Labor[1/]	(-)		453			725
Farm Income:			4,327			11,025

	2nd Year		3rd Year		4th Year		5th Year	
	FI/ac (Ks)	Farm Income (Ks)	FI/ac (Ks)	Farm Income (Ks)	FI/ac (Ks)	Farm Income (Ks)	FI/ac (Ks)	Farm Income (Ks)
Paddy HYV (S)	484	1,825	511	1,926	529	1,994	538	2,028
Paddy HYV (M)	393	1,953	420	2,087	438	2,177	448	2,267
Groundnuts	2,312	3,167	2,382	3,263	2,522	3,455	2,592	3,551
Sesame	1,166	2,915	1,351	3,378	1,351	3,378	1,536	3,840
Sunflower	1,759	1,390	1,886	1,490	2,016	1,593	2,276	1,798
Maize	465	1,097	562	1,326	660	1,558	760	1,794
Pea & Beans	226	179	275	217	374	295	522	412
Jute	730	423	779	452	835	484	888	515
Total	-	2,949	-	14,139	-	14,934	-	16,205
Seasonal Labor[1/]	(-)	725		725		725		725
Farm Income:		12,224		13,414		14,209		15,480

1/ Seasonal labor is prevailing in this area, which reflects a large existence of landless laborers, as seen in Appendix 6A. And in case of farmers whose farm size is more or less 9 acres, they usually employ one seasonal laborer in wet peak season on an average, although in dry season they usually do not employ any landless laborer at present. But after completion of the Project, it is assumed that they will employ one more seasonal laborer in dry peak season, because their cropping intensity will increase from 110% to 196%.

In the analysis of crop economy, however, their labor has been treated as family labor for the purpose of convenience, because it was very difficult to allocate the labor for each crop. This treatment is not a problem in the economic analysis, because this seasonal labor will be evaluated by the opportunity cost of labor together with family labor. But in case of farm budget analysis, their cost should be taken into account, although family labor need not to be taken into account.

Namely, in calculation of FI/ac (farm income per acre), seasonal labor cost has not been taken into account. In order to get the real farm income of the representative farmer, therefore, this point should be adjusted as seen in the above table. In this case, seasonal labor cost was estimated at a rate of 453 Ks/wet peak season and 272 Ks/dry peak season, because their payment will be made in terms of paddy at a rate of 50 baskets/man-wet peak season and 30 baskets/man-dry peak season, as seen in Appendix 6A.

3. Estimation of Famers' Living Standard

In the interview-survey with 30 farmers in 18 village tracts, it was very difficult to know the farmers' real living costs, because it seemed that their answers are sometimes exaggerated about their poorness and at the same time emphasized about their good appearance. Through the above interview survey, however, some tendencies of their living cost have been derived in light.

Anyway, their land holding size (or farm size) of the farmers in the Project Area is relatively large compared with the other area in Burma (which is estimated at around 5.56 acres per farmers' household, as seen in Main Report, Chapter II-2). Accordingly, it seems that their living standard is also higher than that of the farmers in the other area. And roughly speaking, the living costs in the Project Area can be classified into the following five classes.

Classification of Living Costs/Year in the Area (Ks)

	Class I	Class II	Class III	Class IV	Class V
Family Size[1/]	6 persons	6 persons	6 persons	6 persons	6 persons
Rice[2/]	1,500	1,500	1,500	1,500	1,500
Other Foods	5,500	3,600	2,500	1,800	1,100
Clothing	1,000	600	400	300	200
Housing	600	300	200	150	100
Light & Fuels	400	300	200	150	100
Others	2,000	1,000	700	300	100
Total	11,000	7,300	5,500	4,200	3,100

1/ According to the table in the Main Report, Chater III-C-3, the average family size can be calculated at 5 persons in the Project Area, but there are found so many landless laborers' families in this area, the family size of which is relatively small compared with that of farmers. As such, the family size of farmers has been assumed at six persons.

2/ In this area, most farmers are paddy cultivation farmers. As regards their rice consumption, 25 baskets of paddy are regarded as the consumption per head. In case of 6 members-family, therefore, 150 baskets of paddy can be kept in farmers' hand for their home consumption. In this table, the above 150 baskets of paddy have been converted to the value of rice by adding the milling charge, etc. to the value of paddy.

According to the farm income analysis, the farm income of the representative farmer is 4,327 Ks per year at present. Therefore, it is considered that this farmer is living at the living standard of Class IV. In other words, it can be said that most farmers belong to this class, and most landless laborer's families belong to Class V. But some big farm size farmers are enjoying the living standards of Class III and/or Class II. Class I is a very rare case, but it was found that a few families are enjoying this living standard.

After completion of the Project, however, the farm income of the representative farmer will increase to 11,052 Ks in the first year, and reach to 15,480 Ks in the full agricultural development stage. In other words, he can enjoy the Class I living standard even in the first year after completion of the Project, and in the full agricultural development stage (i.e. from the fifth year) he can even save his surplus of 4,480 Ks per year from his farm income, even after enjoying Class I living standard.

4. Conclusion

Through the above farm budget analysis, it is quite clear that the proposed dam irrigation project is feasible from the viewpoint of individual economy of beneficial farmers.

Financial Analysis of Hydro-Power Project

The revenue of energy to be generated by Okkan Hydroelectric Power Plant largely depends upon the rates per kwH of sold energy. The electric power tariff rates of the Electric Power Corporation (EPC) are classified into the categories of "General use", "Small-power use", "Industrial use", "Bulk-power use", "Street-lighting use", etc.

It is very difficult to forecast the electric power demand in the future twenty-five years by the classification of the said categories, though in the areas of Tharrawaddy and Okkan the power demand for the general and residential use is expected to increase steadily under the agricultural development plan.

The revenue from Okkan Hydroelectric power plant proposed herein is valued from the EPC's tariff rate of 42 Pyas/kwH charged on the "General use" and the loss rate of 16 percent on the power transmission lines, as follows:

$$8{,}623{,}085 \text{ kwH} \times 0.84 \times 0.42 = 3{,}042{,}224 \text{ Kyats/year}$$
$$\doteqdot 3{,}042{,}000 \text{ Kyats/year}$$

Based on this amount of revenue, the financial analysis of the hydroelectric power plant was carried out. As a result, the financial internal rate of return (FIRR) is given, as shown in Table 6H-1, as 4.44 percent, which is a value unfeasible from the financial viewpoint.

That is attributable to the low electricity rate laid down by the policy of the Government of Burma. Under the circumstances, it seems necessary for the Government to give a certain amount of subsidy for the realization of the construction plan of the electric power plant.

The views and values adopted in the financial analysis are as follows:

(1) The construction cost of the hydroelectric power plant is indicated in Table 6H-2. The calculation is worked at the conversion rate of 6.89 kyats to the U.S. dollar.

(2) The construction period for the electric power plant is estimated at two years, and the electric power generation is scheduled to be started in November, 1988. The 33 kV electtic power transmission line is planned to be completed prior to the start of construction works of the dam in view of the supply of electric power to be consumed for the dam construction works.

(3) The rate of import duties levied on electric equipments are estimated at twenty-five percent.

(4) The construction cost of the electric power transmission line is based on the data given by EPC.
33 kV single circuit transmission line:
Construction cost per mile -

Foreign Currency	62,000 Kyats
Local Currency	22,000 Kyats
Taxes and Duties	34,000 Kyats
Total	118,000 Kyats

Table 6H-1 (1) Financial Internal Rate of Return

(Unit: 1,000 Kyats)

No.	Year	Cost					Benefit	
		Investment		O & M				
		P/S	T/L	P/S	T/L	Total	KWH	Total
1	1985	0	2,652	0	0	2,652	0	0
2	1986	3,615	0	0	0	3,615	0	0
3	1987	21,691	0	0	0	21,691	0	0
4	1988	10,845	0	131	8	10,984	1,825	1,825
5	1989	0	0	314	20	334	3,042	3,042
6	1990	0	0	314	20	334	3,042	3,042
7	1991	0	0	314	20	334	3,042	3,042
8	1992	0	0	314	20	334	3,042	3,042
9	1993	0	0	314	20	334	3,042	3,042
10	1994	0	0	314	20	334	3,042	3,042
11	1995	0	0	314	20	334	3,042	3,042
12	1996	0	0	314	20	334	3,042	3,042
13	1997	0	0	314	20	334	3,042	3,042
14	1998	0	0	314	20	334	3,042	3,042
15	1999	0	0	314	20	334	3,042	3,042
16	2000	0	0	314	20	334	3,042	3,042
17	2001	0	0	314	20	334	3,042	3,042
18	2002	0	0	314	20	334	3,042	3,042
19	2003	0	0	314	20	334	3,042	3,042
20	2004	0	0	314	20	334	3,042	3,042
21	2005	0	0	314	20	334	3,042	3,042
22	2006	0	0	314	20	334	3,042	3,042
23	2007	0	0	314	20	334	3,042	3,042
24	2008	0	0	314	20	334	3,042	3,042
25	2009	0	0	314	20	334	3,012	3,042
26	2010	0	0	314	20	334	3,042	3,042
27	2011	0	0	314	20	334	3,042	3,042
28	2012	0	0	314	20	331	3,042	3,042
29	2013	0	0	183	12	195	1,217	1,217
1985-2013		36,151	2,652	7,850	500	47,153	76,050	76,050

(2) Present Worth Value of Financial Cost and Benefit

(Unit: K'000)

Project Year	Cost Discount Factor 0%	3%	5%	8%	Benefit Discount Factor 0%	3%	5%	8%
1	2,652	2,575	2,526	2,455	-	-	-	-
2	3,615	3,375	3,289	3,099	-	-	-	-
3	21,691	19,849	18,737	17,218	-	-	-	-
4	10,984	9,759	9,037	8,073	1,825	1,622	1,501	1,341
5	334				3,042			
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.	.	4,880	3,706	2,546	.	44,444	33,758	23,188
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28	334				3,042			
29	195	83	47	21	1,217	516	296	131
Total	47,153	40,521	37,342	33,412	76,050	46,582	35,555	24,660

The intersection point of the above cost and benefit curves which are drawn on the same section paper shows 4.44 percent of FIRR.

Table 6H-2 Construction Cost

(Unit: 1,000 Kyats)

Works	Estimated Construction Cost			
	Foreign Currency	Local Currency		
		Material & Others	Tax and Duty	Total
1. Penstock	333	93	58	484
Excavation	61	16		75
Concrete	22	45		67
Iron Bar	18	4		22
Steel Penstock	232	30	58	320
2. House and Foundation	599	3,926	-	4,525
Excavation	42	66		108
Concrete	209	455		664
Iron Bar	348	70		418
Bulding		2,000		2,000
Residence House		1,335		1,335
3. Tailrace	450	161	62	673
Excavation	58	12		70
Concrete	51	106		157
Iron Bar	90	18		108
Gate	251	25	62	338
4. Machine Equipment	17,180	1,913	4,245	23,338
Turbine	7,618	855	1,912	10,415
Generator	5,916	683	1,479	8,078
Main Transformer	313	41	78	432
Controling and Switching Equipment	1.882	182	471	2,535
Extension of Switchyard at Tharrawaddy	200	30		230
Miscellaneous Equipment	1,221	122	305	1,648
5. Temporary,Facilities	81	759	20	860
Total (1 to 5)	18,643	6,852	4,385	29,880
(a) Administration				1,254
(b) Consulting Services				2,509
(c) Contingency				2,509
Total (1 to 5 + a to c)				36,152
6. 33 KV Transmission Line	1,259	447	690	2,396
(d) Administration				85.3
(c) Contingency				170.7
Total (1 to 6 + d, e)				2,652
Grand Total	19,902	7,299	5,075	38,804