D.2. Infiltration Test, Hydraulic Conductivity Measurement and Leaching Test

INFILTRATION TEST, HYDRAULIC CONDUCTIVITY MEASUREMENT AND LEACHING TEST

1. General

During the field work from October to December 1988, the field investigation and measurement of intake rates, hydraulic conductivity and leaching test were carried out in the Project Area by the Irrigation Engineer of the Study Team.

The purpose of the infiltration test is to obtain a basic intake rate for determination of the irrigation method and irrigation intensity, while the hydraulic conductivity measurements are mostly used in connection with the design of the drainage system. The leaching test aims to estimate the leaching water requirement in the top soil at the initial stage of the reclamation.

2. Infiltration Test

2.1. Location and Number of Places

The infiltration tests were conducted at 18 places in total, 16 places in the uncultivated land and two places in the farming land. The locations of test sites are shown in Figure D.2-1.

2.2. Method of Test

The cylinder intake rate method using a double ring infiltrometer was applied. Two steel cylinders, with 30 cm diameter for the inner one and 55 cm for the outer one, were filled with water to a depth of about 10 cm and the time was recorded by a stop watch. Water surface in the cylinders was kept at the same level during the measurement by adding water from the water tank. The amount of water added to the inner cylinder was measured at the certain elapsed time, such as after 1, 2, 5, 10, 20, 30, 45, 60 minutes and every one hour after 60 minutes.

2.3. Measurement and Results

The test was run for four hours at most places and the replication was conducted at some places. After completion of the field test, the amount of accumulated infiltration water in depth and the elapsed time were plotted on a log-paper to obtain the infiltration curve.

Among 18 places tested, the basic intake rates (Ib) at 17 places, except No. T-1 which is located in the part of the Tina Plain, are higher than 200 mm/hr, and 12 places are over 500 mm/hr. The highest is 1,194 mm/hr at No. T-4. The basic intake rate at T-1, where the soil feature is mostly clay soil, is 8.6 mm/hr and 17.4 mm/hr. These results are shown in Table D.2-1 and Figures D.2-2 to D.2-11.

2.4. Soil Sampling and Analysis

Soil samples was taken from each infiltration test site for soil moisture analysis, and from several sites for the analysis of the moisture holding capacity after 24 hours. Soil moisture ratio to 40 cm depth is very low in the natural condition, mostly below two percent. The moisture holding capacity after 24 hours ranges between only 4.8 and 14.3 percent. Mechanical improvement of soil on the field capacity in the farming land is slightly observed. The results are shown in Table D.2-2.

3. Hydraulic Conductivity Measurement

3.1. Location and Number of Places

The auger-hole tests for the hydraulic conductivity measurement were conducted at 10 places as shown in Figure D.2-1.

3.2. Method of Test

The auger-hole method, that is a rapid, simple and reliable method for measuring hydraulic conductivity of soil below a water table, was used. After drilling of the auger-hole with 8 cm diameter auger, the perforated tube casing was placed into the hole. The static groundwater surface depth from the reference point was measured using float. Then groundwater was pumped up from the hole and water surface was measured quickly as possible. As the water table rose up, the rate of rise was measured at every 5 seconds.

3.3. Results

A coefficient of water conductivity (k value: cm/sec) was computed from the measurement data using the computation sheet.

K-value of clay soil at T-1 is 8.3×10^{-4} cm/sec. The soil type at all other test sites is generally sand soil and K-value ranges between 3.4×10^{-3} and 3.1×10^{-2} cm/sec, while the majority ranges between 9.7×10^{-3} and 1.7×10^{-2} cm/sec. The results are shown in Table D.2-3 and Figures D.2-12 to D.2-22.

4. Leaching Test

4.1. Location and Number of Places

The leaching tests were conducted at four places and their locations are shown in Figure D.2-1. Two places, T-1 and T-2, are located in the Tina Plain where salts are strongly accumulated in the clay soil. Other two places, T-6 and T-7, are located in the Rabaa/Qatia area with ground elevation of between 4.0 and 5.0 meters.

4.2. Method of Test

The field leaching tests were carried out providing a polyvinyl sheet frame of 2.0 meters long, 1.0 meter wide and 0.5 meters deep. When the frame was set, soil samples were taken for analysis, and then leaching water with the depth of the frame. After 24 hours or after complete filtration of leaching water was supplied into the frame for the 2nd leaching test. The same manner was taken up to 3 or 4 times, or untill EC value of soil went down to the low figure. Arrangement of the leaching test at four sites is shown in Table D.2-4.

4.3. Sampling and analysis

Soil samples were taken from four points at each test site and from three layers at each point, i.e. 0 - 5 cm, 15 - 20 cm and 35 - 40 cm depth. Water sample was also taken from each leaching water. The results of analysis are shown in Tables D.2-5 and D.2-6.

Based on the results of EC analysis, leaching curves of soil salinity (ECe) vs cumulative leaching water in depth were plotted on a log-paper, as shown in Figures D.2-23 and D.2-24. These leaching curves will provide the practical estimation of the leaching water requirement in the top soil at the initial stage of the reclamation.

Figure D.2-1 Location of Field Tests

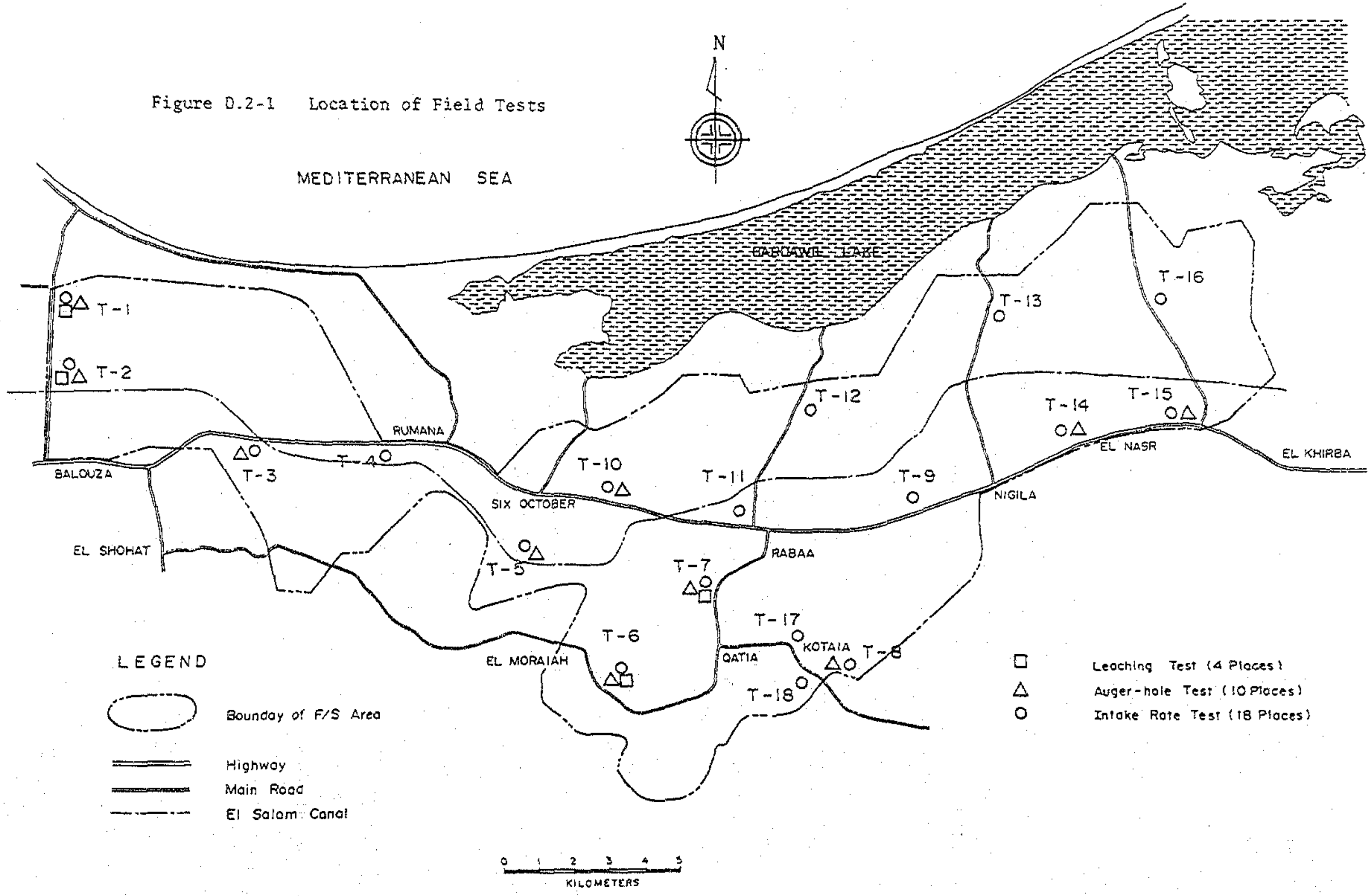


Table D.2-1 **RESULTS OF CYLINDER INFILTRATION TESTS**

Site No.	Accumulated Intake (D) (mm)	Intake Rate (I) mm/hr	Basic Intake rate (Ib) mm/hr
T - 1 (1)	$D = 10.326 \times T^{0.418}$	$I = 259 \times T^{-0.582}$	8.6
T - 1 (2)	$D = 7.095 \times T^{0.541}$	$I = 230 \times T^{-0.459}$	17.4
T - 2	$D = 10.440 \times T^{0.832}$	$I = 521 \times T^{-0.168}$	240
T - 3	$D = 18.982 \times T^{0.921}$	$I = 1049 \times T^{-0.079}$	773
T - 4 (1)	$D = 26.852 \times T^{0.936}$	$I = 1508 \times T^{-0.064}$	1194
T - 4 (2)	$D = 20.674 \times T^{0.954}$	$I = 1183 \times T^{-0.046}$	984
T - 5	$D = 16.367 \times T^{0.936}$	$I = 919 \times T^{-0.064}$	727
T - 6	$D = 5.997 \times T^{0.888}$	$I = 320 \times T^{-0.112}$	200
T - 7	$D = 11.132 \times T^{0.953}$	$I = 637 \times T^{-0.047}$	544
T - 8	$D = 17.492 \times T^{0.901}$	$I = 946 \times T^{-0.099}$	631
T - 9	$D = 16.794 \times T^{0.941}$	$I = 948 \times T^{-0.059}$	768
T -10	$D = 11.422 \times T^{0.969}$	$I = 664 \times T^{-0.031}$	606
T -11	$D = 11.977 \times T^{0.968}$	$I = 696 \times T^{-0.032}$	633
T -12	$D = 20.695 \times T^{0.961}$	$I = 1193 \times T^{-0.039}$	1055
T -13	$D = 13.407 \times T^{0.963}$	$I = 775 \times T^{-0.037}$	691
T -14	$D = 16.362 \times T^{0.948}$	$I = 931 \times T^{-0.052}$	778
T -15	$D = 14.728 \times T^{0.954}$	$I = 843 \times T^{-0.046}$	724
T -16	$D = 6.611 \times T^{0.946}$	$I = 375 \times T^{-0.054}$	311
T -17	$D = 7.426 \times T^{0.981}$	$I = 437 \times T^{-0.019}$	417
T -18	$D = 5.678 \times T^{0.988}$	$I = 337 \times T^{-0.012}$	329

Note; T-1 - T-16 .... Uncultivated land,
T-17 .... Olive plantation with drip irrigation for 7 years, and
T-18 .... Vegitable field with drip irrigation for 6 years.

Table D.2-2 **MOISTURE RATIO AT INFILTRATION TEST SITES**

Site No.	Moisture Ratio Before Test 0 - 5 cm %	15 - 20 cm %	35 - 40 cm %	Moisture Holding Capacity After 24 Hours %
T- 1 (1)	6.07	17.75	24.50	-
T- 1 (2)	8.02	17.00	19.09	-
T- 2	1.63	3.95	5.71	-
T- 3	0.81	1.01	1.63	-
T- 4 (1)	0.33	0.41	0.92	-
T- 4 (2)	0.31	0.70	0.84	6.83
T- 5	0.09	0.98	2.45	-
T- 6	1.67	1.88	3.02	-
T- 7	0.54	0.19	0.23	-
T- 8	0.10	0.46	0.82	9.60
T- 9	0.39	1.27	1.44	5.85
T-10	0.08	0.22	0.44	-
T-11	0.08	0.19	0.62	-
T-12	0.13	0.29	0.50	4.82
T-13	0.11	0.31	0.37	-
T-14	0.25	0.35	0.40	11.09
T-15	0.13	0.36	0.45	6.72
T-16	0.13	0.24	0.59	6.72
T-17	0.50	1.50	1.50	14.30
T-18	1.15	1.90	2.10	9.71

Note; Moistrure holding capacity after 24 hours shows moisture ratio by volume at 15 - 20 cms depth.

Table D.2-3 **HYDRAULIC CONDUCTIVITY BY AUGER-HOLE METHOD**

Test Site	Coefficient of Water Conductivity (K) m/hr	cm/sec	Remarks
T- 1	0.030	8.3×10^{-4}	
T- 2	0.123	3.4×10^{-3}	
T- 3	0.600	1.7×10^{-2}	
T- 5 (1)	1.100	3.1×10^{-2}	
T- 5 (2)	0.029	8.1×10^{-4}	
T- 6	0.513	1.4×10^{-2}	
T- 7	0.137	3.8×10^{-3}	
T- 8	0.494	1.4×10^{-2}	
T-10	0.504	1.4×10^{-2}	
T-14	0.350	9.7×10^{-3}	
T-15	0.977	2.7×10^{-2}	

Note; Refer to Figure C-3 for details of computation at each test site.

Table D.2-4 Arrangement of Leaching Test

Site No.		T-1	T-2	T-6	T-7
Preparation					
Frame size	:	2 m x 1 m	2 m x 1 m	2 m x 1 m	2 m x 1 m
Date	:	Nov. 13	Nov. 8	Nov. 19	Nov. 21
Sample Depth	:	5,20,30cm	5,20,40cm	5,20,40cm	5,20,40cm
1st Leaching					
Leaching Water	:				
Amount in Depth	:	250 mm	250 mm	150 mm	200 mm
EC(mmhos/cm)	:	0.67	0.61	0.72	0.73
Period	:	1 day	1 day	1 day	1 day
Sample Depth	:	5,20,30cm	5,20,40cm	5,20,40cm	5,20,40cm
2nd Leaching					
Leaching Water	:				
Amount in Depth	:	250 mm	250 mm		150 mm
EC(mmhos/cm)	:	0.71	0.67		0.77
Period	:	2 days	1 day		1 day
Sample Depth	:	5,20,30cm	5,20,40cm		5,20,40cm
3rd Leaching					
Leaching Water	:				
Amount in Depth	:	225 mm	250 mm		
EC(mmhos/cm)	:	0.73	0.67		
Period	:	3 days	1 day		
Sample Depth	:	5,20,30cm	5,20,40cm		
4th Leaching					
Leaching Water	:				
Amount in Depth	:	150 mm			
EC(mmhos/cm)	:	0.72			
Period	:	2 days			
Sample Depth	:	5,20,30cm			

mmhos/cm = mS/cm

Table D.2-5 Results of Leaching Tests

Site No.	Sample Depth -No. (cm)	EC_e (mmho/cm) Before Leach.	1st Leach.	2nd Leach.	3rd Leach.	4th Leach.	pH Before Leach.	1st Leach.	2nd Leach.	3rd Leach.	4th Leach.
T-1	5-1	38.32	3.66	3.34	3.42	3.18	7.13	7.25	7.60	7.56	7.44
	2	48.40	3.76	5.18	4.30	3.98	7.07	7.32	7.27	7.15	7.37
	3	49.20	3.28	**	2.54	3.50	6.95	7.32	7.30	7.52	7.44
	4	37.86	3.50	**	3.30	4.48	6.81	7.70	7.20	7.52	7.31
	(Ave.)	43.45	3.55	4.26	3.39	3.78	6.99	7.40	7.34	7.44	7.39
	20-1	59.00	32.16	15.12	3.40	3.64	7.04	6.88	7.14	7.30	7.59
	2	28.56	22.34	10.22	3.46	4.04	7.38	6.95	7.42	7.38	7.24
	3	**	12.84	10.86	3.42	3.42	7.43	6.26	7.35	7.61	7.24
	4	**	**	**	4.46	**	7.44	6.52	7.90	7.12	6.26
	(Ave.)	43.78	22.45	12.01	3.69	3.70	7.32	6.65	7.45	7.35	7.08
	30-1	135.20	69.80	81.20		11.78	7.06	6.91	6.56		7.41
	2	69.80	101.60	92.80		14.22	7.00	6.85	6.81		7.08
	3	124.00	94.20	57.60		6.34	6.87	6.98	7.10		7.12
	4	**	92.40	**		**	7.74	7.00	6.49		6.77
	(Ave.)	109.67	89.50	77.20		10.78	7.16	6.94	6.74		7.10
T-2	5-1	12.22	2.88	3.68	2.68		7.40	8.26	7.37	7.46	
	2	8.82	2.84	3.40	2.54		7.62	7.88	7.62	7.46	
	3	11.28	2.86	2.44	2.56		7.54	7.78	7.42	7.70	
	4	6.66	3.28	3.24	3.02		7.77	7.90	7.62	7.62	
	(Ave.)	9.75	2.97	3.19	2.70		7.58	7.96	7.51	7.56	
	20-1	8.62	3.18	3.10	2.72		7.63	7.62	7.30	7.50	
	2	8.72	4.74	2.74	2.68		7.58	7.50	7.21	6.54	
	3	8.00	3.38	2.58	2.68		7.60	7.84	7.33	7.58	
	4	8.42	3.52	3.52	2.32		7.63	7.86	7.49	7.46	
	(Ave.)	8.44	3.71	2.99	2.60		7.61	7.71	7.33	7.27	
	40-1	9.96	4.92	3.88	3.08		7.61	7.40	7.46	7.59	
	2	9.30	5.82	3.66	2.68		7.64	7.46	7.16	7.56	
	3	9.94	5.84	3.32	2.90		7.73	7.81	7.27	7.57	
	4	8.68	5.86	3.92	2.86		7.77	7.81	7.33	7.52	
	(Ave.)	9.47	5.61	3.70	2.88		7.69	7.62	7.31	7.56	
T-6	5-1	2.10	0.72				8.05	8.50			
	2	1.68	0.78				7.85	8.50			
	3	1.80	0.66				7.88	8.35			
	4	2.04	0.66				8.22	8.42			
	(Ave.)	1.91	0.71				8.43	8.44			
	20-1	1.56	0.90				8.56	8.58			
	2	1.32	0.78				8.40	8.65			
	3	1.50	0.84				8.75	8.75			
	4	1.92	0.72				8.50	8.70			
	(Ave.)	1.58	0.81				8.55	8.67			
	40-1	1.68	0.96				8.34	8.82			
	2	1.74	0.90				8.46	8.82			
	3	1.80	0.90				8.40	8.80			
	4	2.04	0.96				8.32	8.76			
	(Ave.)	1.82	0.93				8.38	8.80			
T-7	5-1	4.24	1.60	1.56			7.52	7.15	7.63		
	2	4.44	1.62	1.62			7.38	7.16	6.93		
	3	5.12	1.60	1.24			7.23	7.12	7.57		
	4	4.56	1.52	1.58			7.24	7.20	7.30		
	(Ave.)	4.59	1.59	1.50			7.34	7.16	7.36		
	20-1	5.50	1.90	1.84			7.56	7.18	7.65		
	2	4.20	1.86	2.36			7.30	7.05	7.15		
	3	4.64	2.38	2.58			7.19	7.20	7.45		
	(Ave.)	4.78	2.05	2.26			7.35	7.16	7.42		
	40-1	4.84	2.44	2.70			7.17	7.16	7.42		
	2	4.82	3.26	2.92			7.16	7.18	7.45		
	3	4.06	4.06	3.18			7.17	7.14	7.36		
	(Ave.)	4.57	3.25	2.93			7.17	7.16	7.41		

Figure D.2-2 Cylinder Infiltration Test (1 /10)

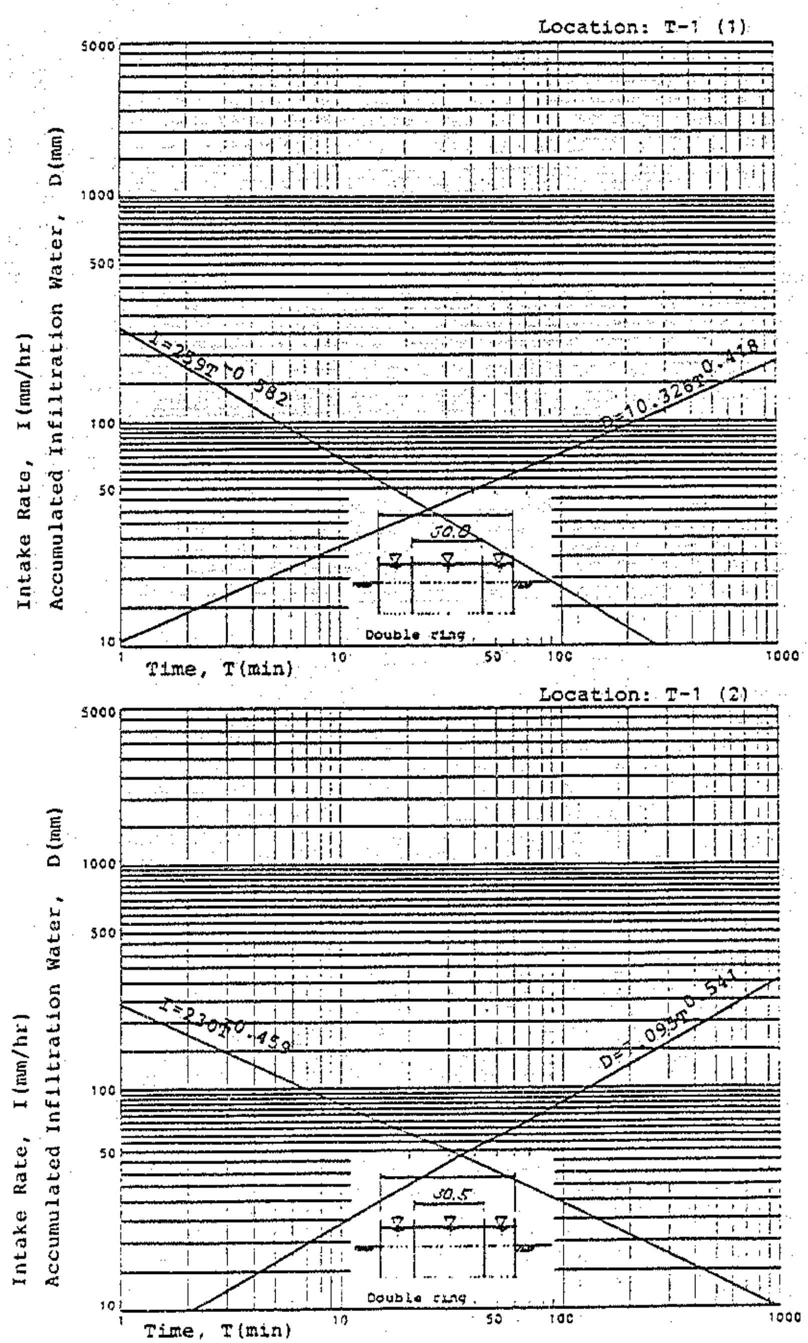


Figure D.2-3 Cylinder Infiltration Test (2 /10)

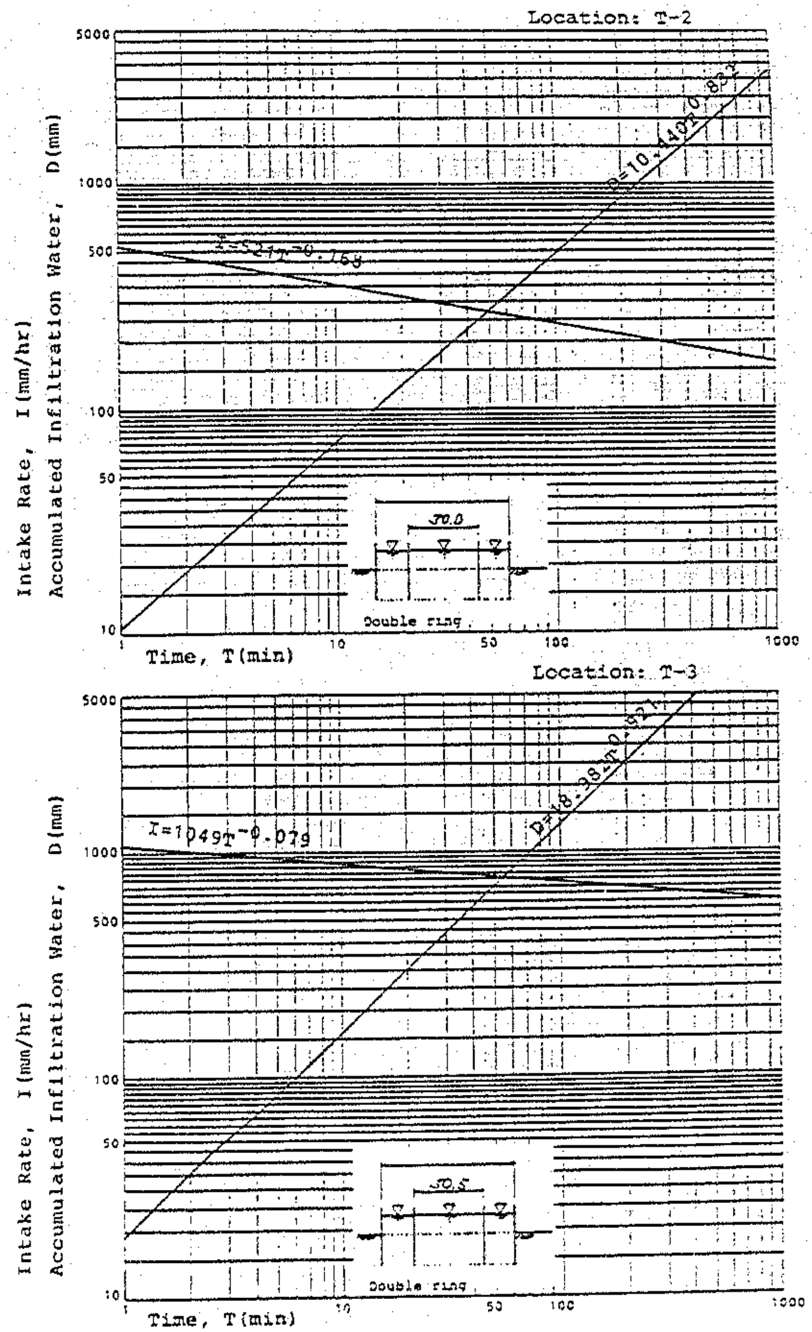
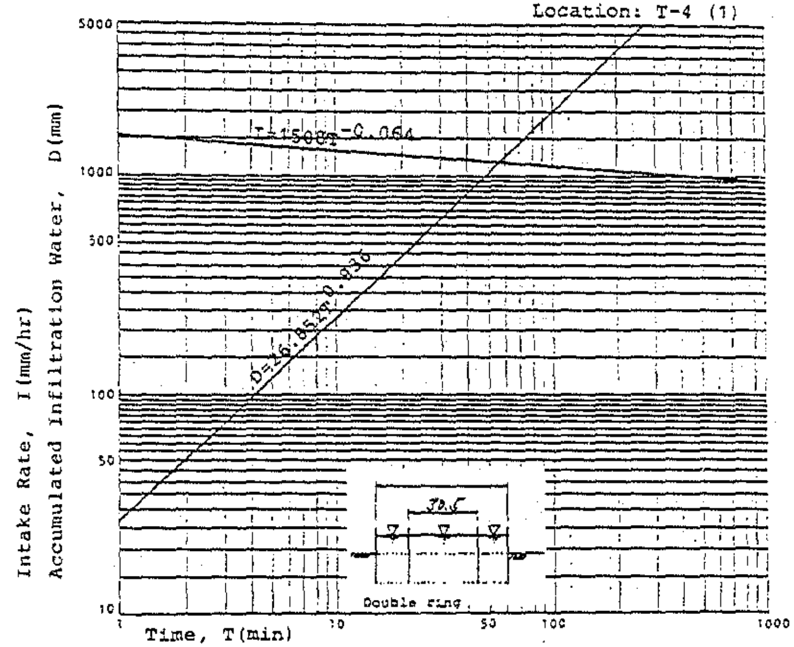


Figure D.2-4 Cylinder Infiltration Test (3/10)



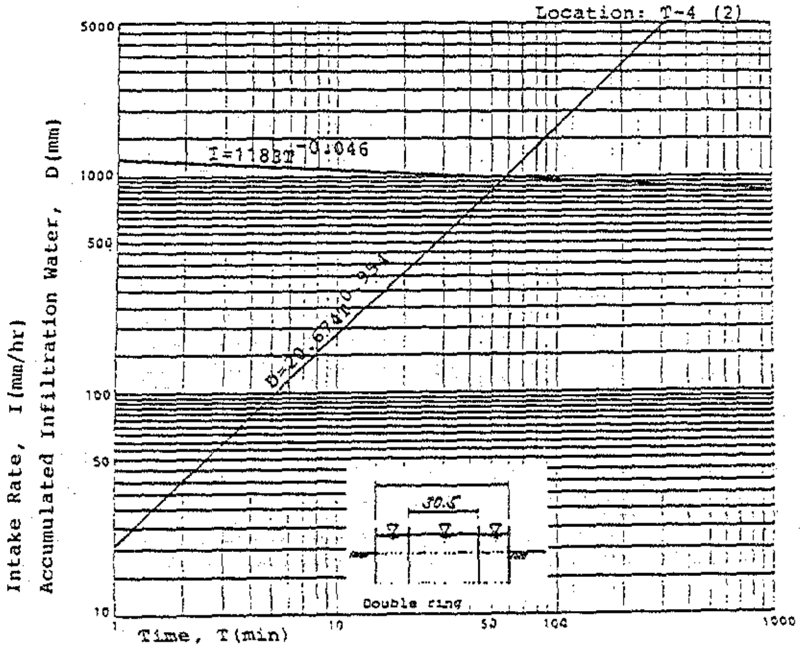
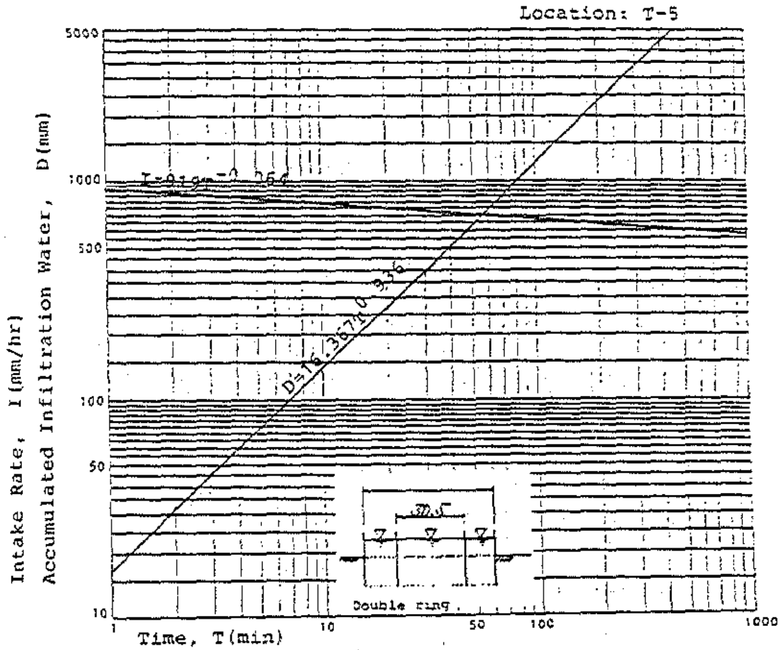


Figure D.2-5 Cylinder Infiltration Test (4 /10)



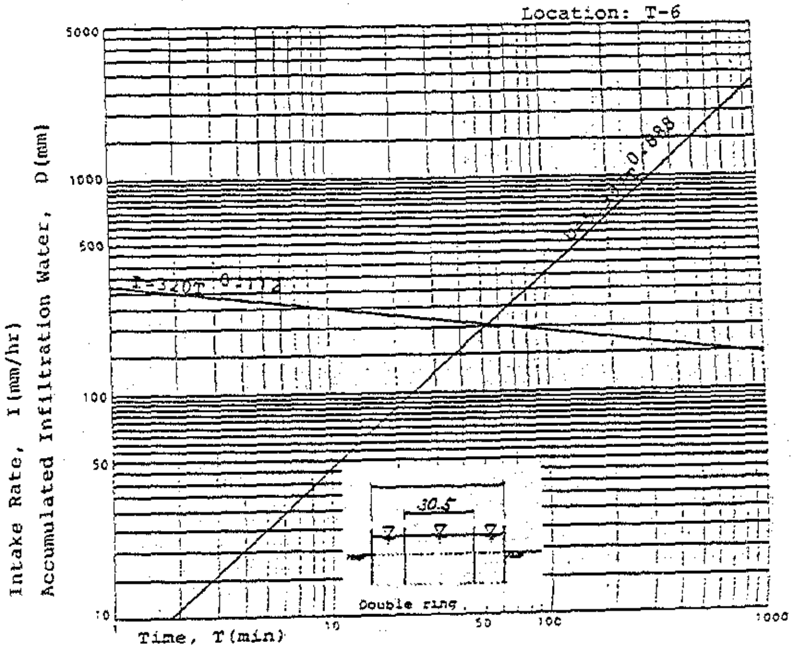
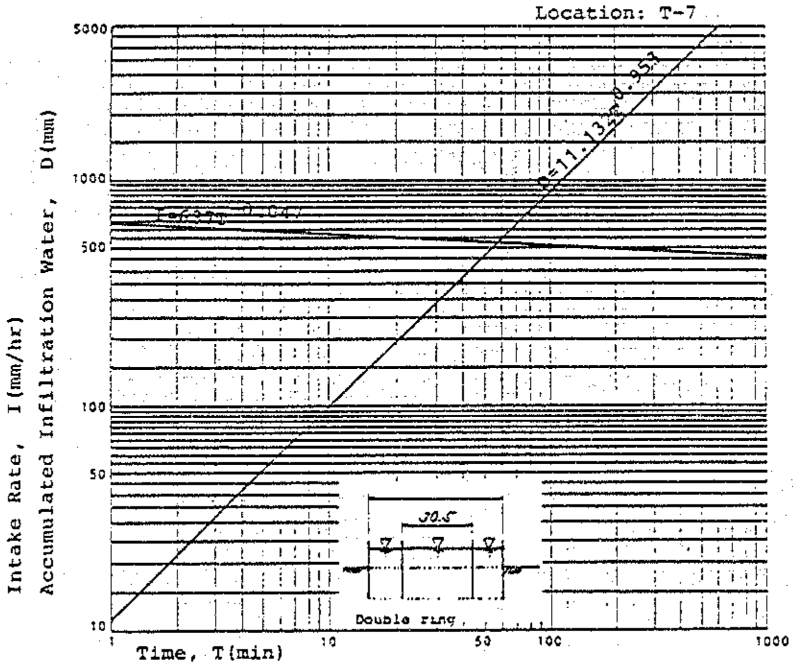


Figure D.2-6 Cylinder Infiltration Test (5/10)



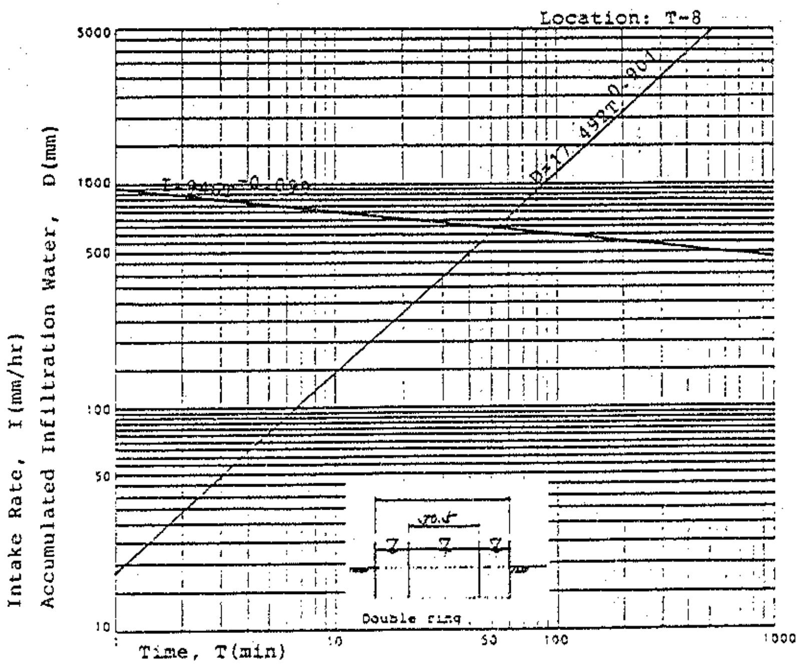
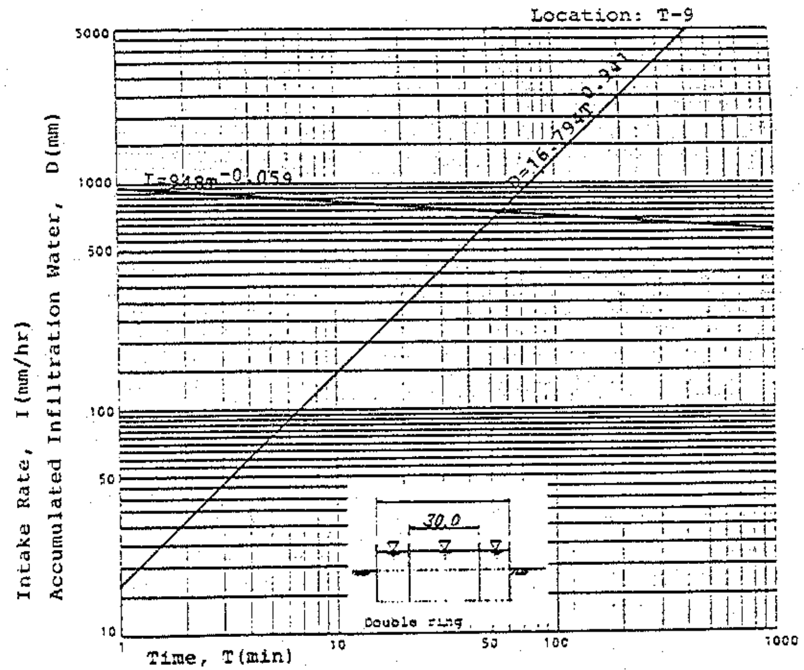


Figure D.2-7 Cylinder Infiltration Test (6/10)



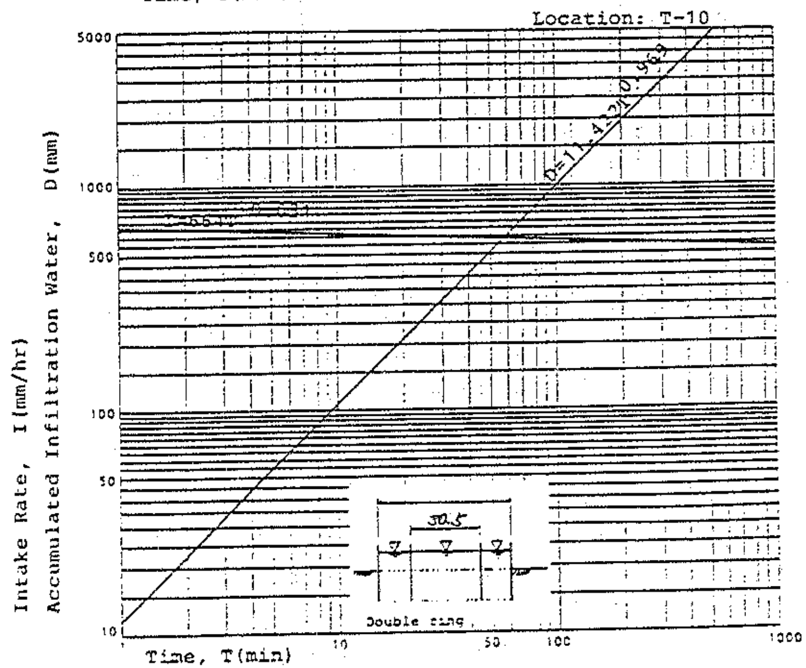
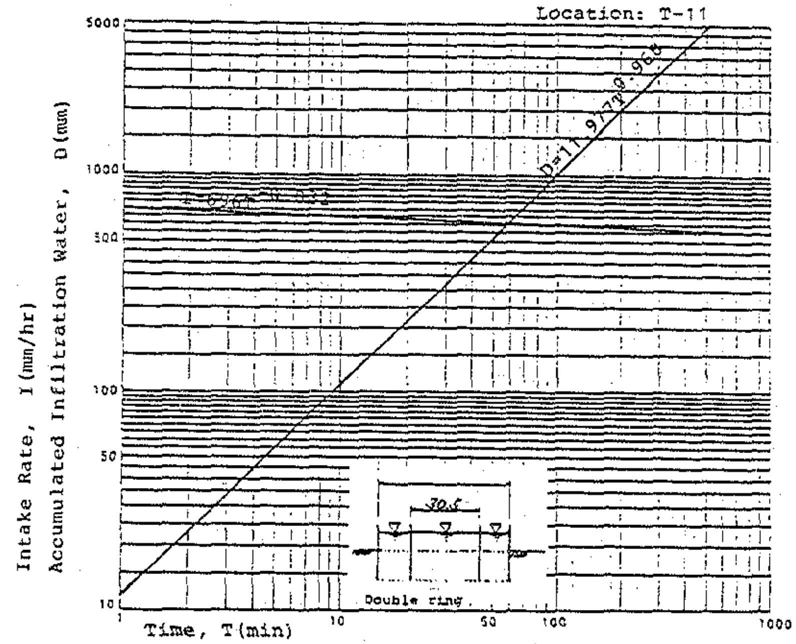


Figure D.2-8 Cylinder Infiltration Test (7/10)



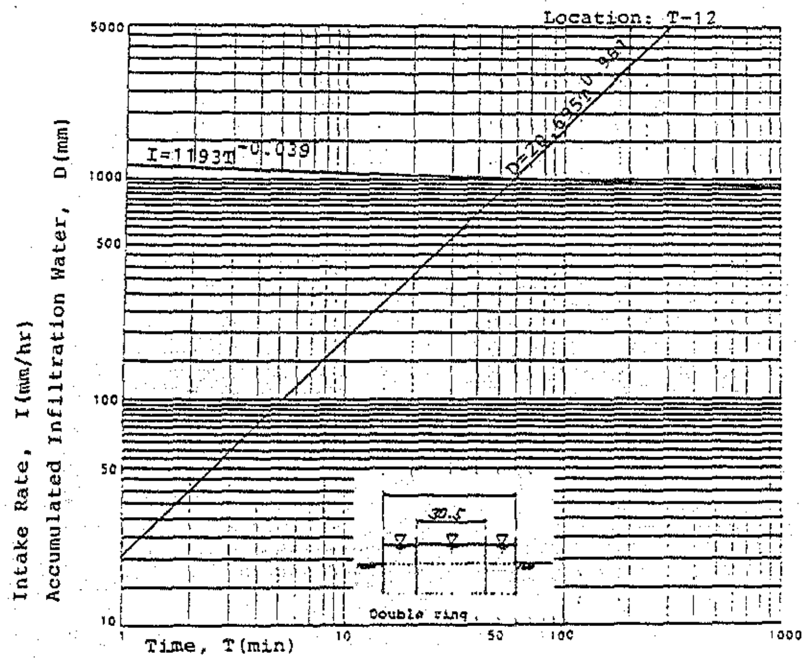
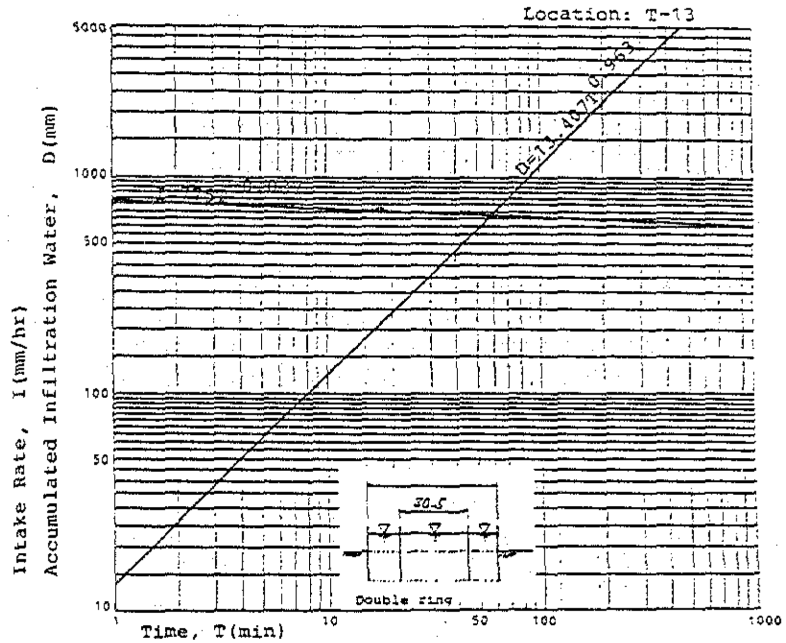


Figure D.2-9 Cylinder Infiltration Test (8/10)



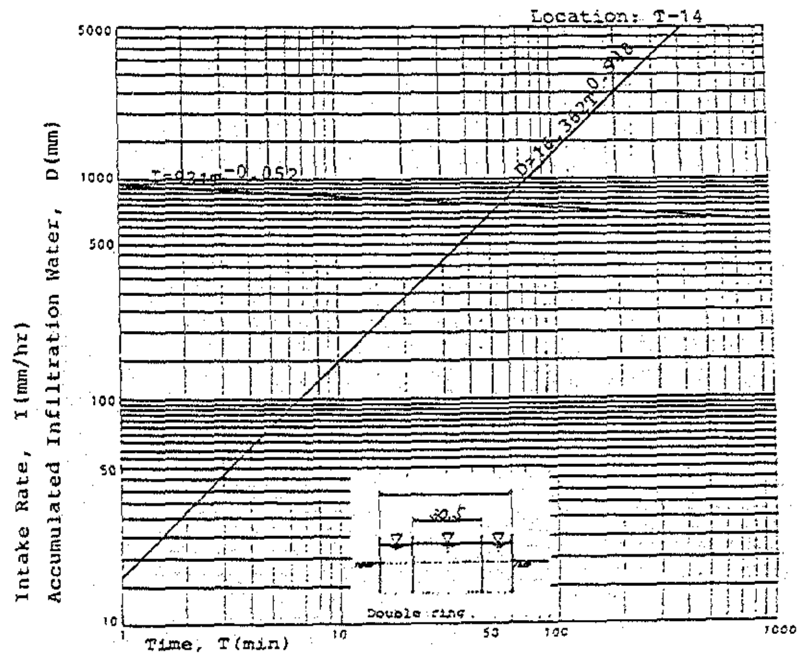
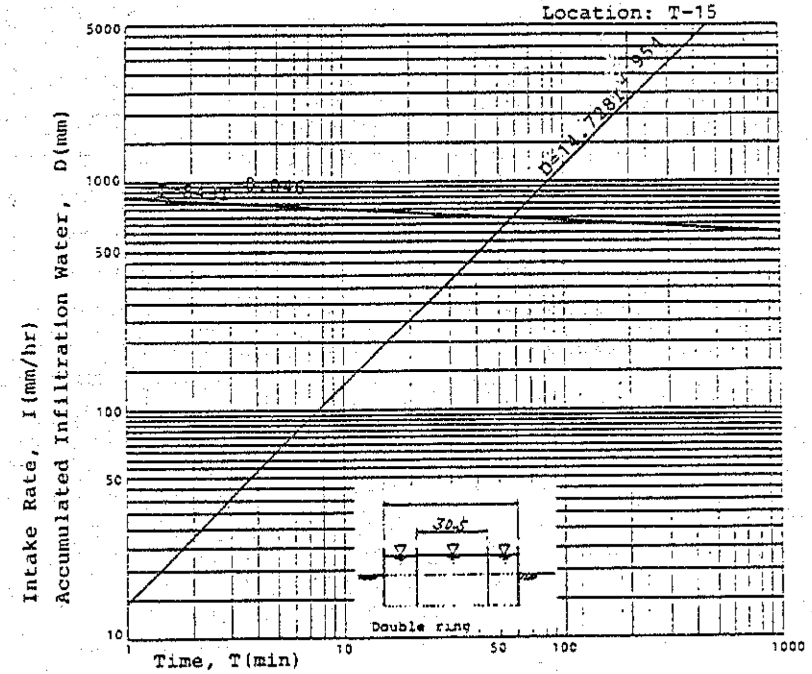


Figure D.2-10 Cylinder Infiltration Test (9/10)



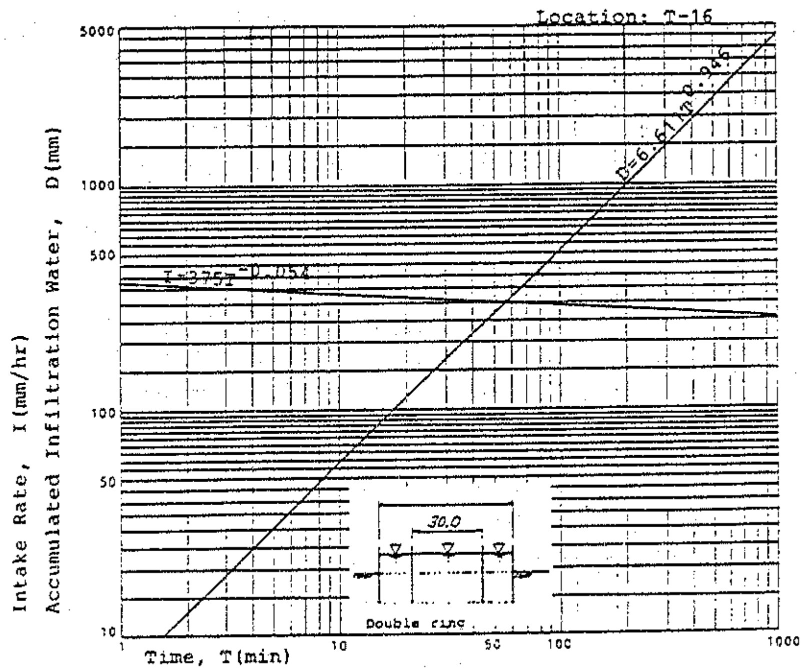
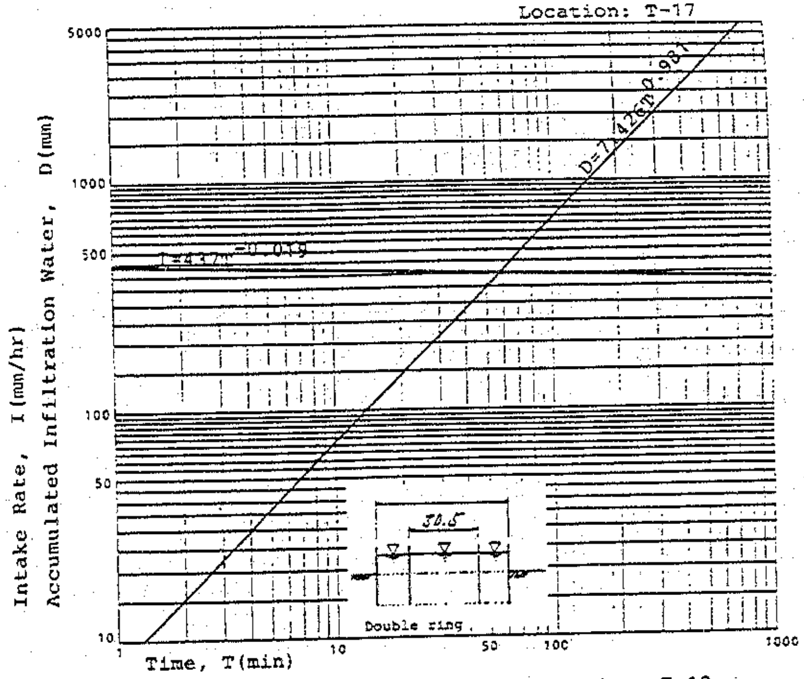


Figure D.2-11 Cylinder Infiltration Test (10/10)



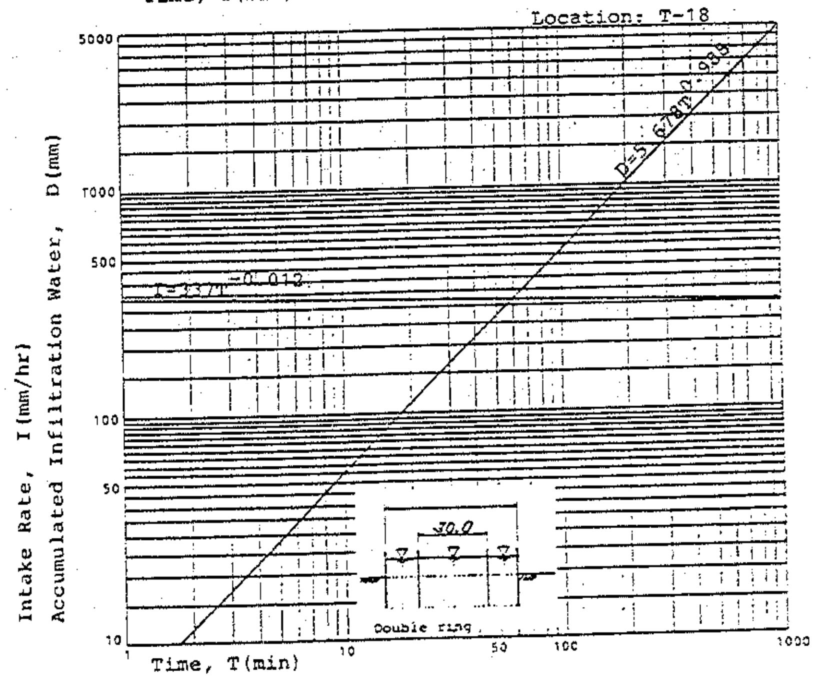
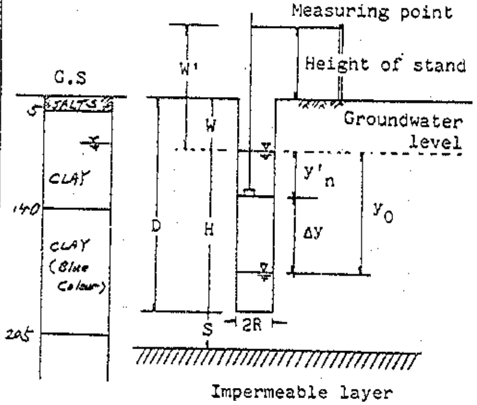


Figure D.2-12 Auger-hole Test for Hydraulic Conductivity (1/11)

Location	:	
NO	:	T-1
Date	:	10/11/88
Observer	:	
R	:	4 cm
S	:	~~0 or~~ > 1/2 H
Depth (D)	:	205 cm
G. Water Level(W)	:	50 cm
Layer Measured	:	cm
K	:	0.68 m/day
		(0.03 m/hr)
		(8.3×10^{-4} cm/sec)



W' = 85 cm
Height = 35 cm −
W = 50 cm

D = 205 cm
W = 50 cm −
H = 155 cm

Time (t) Sec.	Water Table after Pumping (y'_t) cm	Δy_t cm
0	216.0	−
10	211.5	4.5
20	207.5	4.0
30	203.5	4.0
40	199.8	3.7
50	196.0	3.8
60	192.5	3.5
70	189.4	3.1
80	186.0	3.4
1/4 Y0 90	184.0	2.0
100	182.8	1.2
110	181.1	1.7
120	179.5	1.6

$y_0 = y'_0 - W' = 216 - 85.0 = 131$

$\Delta y = y'_0 - y'_n = 216 - 184.0 = 32$

$\overline{y} = y_0 - 1/2\,\Delta y = 131 - 32/2 = 115$

$H = 155$, $\overline{y} = 115$ } C = 1.9 (From graph)

$\frac{\Delta y}{\Delta t} = \frac{32}{90} = 0.36$ cm/sec

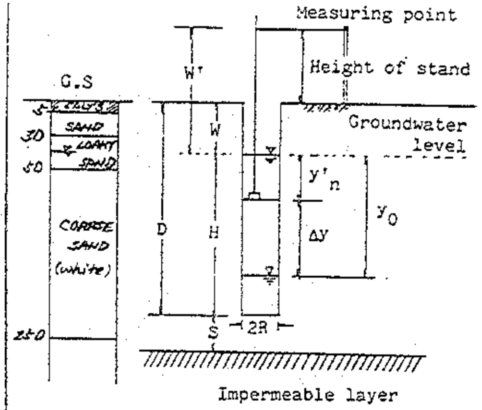
$K = C \times \frac{\Delta y}{\Delta t} = 1.9 \times 0.36 = 0.68$ m/day

Conditions:

1: $y_t > 3/4 \times y_0$ or $\Delta y < 1/4 \times y_0$
2: $20 < H < 200$ cm
3: $3 < R < 7$ cm
4: $y_0 > 0.2$ H

Figure D.2-13 Auger-hole Test for Hydraulic Conductivity (2/11)

Location	:	
NO	:	T-2
Date	:	1/11/88
Observer	:	
R	:	4 cm
S	:	~~0 or~~ > 1/2 H
Depth (D)	:	230 cm
G. Water Level(W)	:	47 cm
Layer Measured	:	cm
K	:	2.96 m/day
		(0.123 m/hr)
		(3.4×10^{-3} cm/sec)



W' = 82 cm
Height = 35 cm −
W = 47 cm

D = 230 cm
W = 47 cm −
H = 183 cm

Time (t) Sec.	Water Table after Pumping (y'_t) cm	Δy_t cm
0	122	−
5	118	4
1/4 Y0 10	114	4
15	110	4
20	107.6	3.4
25	106.2	1.4
30	105.1	1.1

$y_0 = y'_0 - W' = 122 - 82 = 40$

$\Delta y = y'_0 - y'_n = 122 - 114 = 8$

$\overline{y} = y_0 - 1/2\,\Delta y = 40 - 8/2 = 36$

$H = 183$, $\overline{y} = 36$ } C = 3.7 (From graph)

$\frac{\Delta y}{\Delta t} = \frac{8}{10} = 0.8$ cm/sec

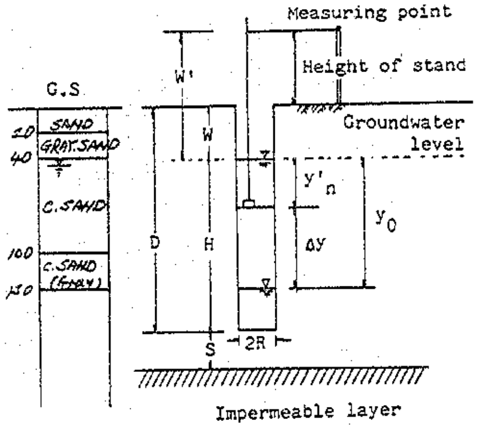
$K = C \times \frac{\Delta y}{\Delta t} = 3.7 \times 0.8 = 2.96$ m/day

Conditions:

1: $y_t > 3/4 \times y_0$ or $\Delta y < 1/4 \times y_0$
2: $20 < H < 200$ cm
3: $3 < R < 7$ cm
4: $y_0 > 0.2$ H

Figure D.2-14 Auger-hole Test for Hydraulic Conductivity (3/11)

Location :
NO : T-3
Date : 10/11/88
Observer :
R : 4 cm
S : ~~0 or~~ > 1/2 H
Depth (D) : 130 cm
G. Water Level(W): 44 cm
Layer Measured : cm
K : 14.4 m/day
(0.6 m/hr)
(1.7×10^{-2} cm/sec)



W' = 79 cm
Height = 35 cm −
W = 44 cm

D = 130 cm
W = 44 cm −
H = 86 cm

Time (t) sec		Water Table after Pumping (y'_t) cm	Δy_t cm
	0	114	−
1/4 y_0	5	105	9
	10	95.2	9.8
	15	90.0	5.2
	20	86.5	3.5
	25	84.0	1.5

$y_0 = y'_0 - W' = 114 - 79 = 35$
$\Delta y = y'_0 - y'_n = 114 - 105 = 9$
$\overline{y} = y_0 - 1/2\,\Delta y = 35 - 9/2 = 30.5$

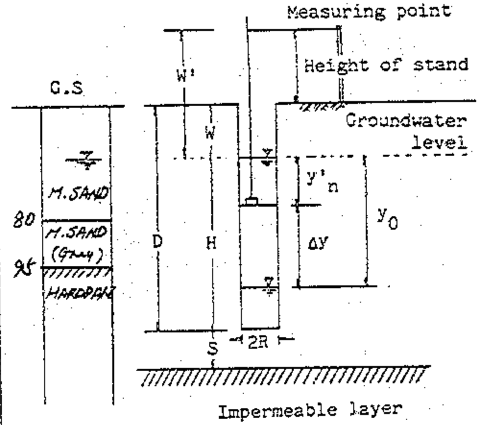
H = 86
$\overline{y}$ = 30.5
} C = 8.0 (From graph)

$\frac{\Delta y}{\Delta t} = \frac{9}{5} = 1.8$ cm/sec
$K = C \times \frac{\Delta y}{\Delta t} = 8.0 \times 1.8 = 14.4$ m/day

Conditions:
1: $y_t > 3/4 \times y_0$ or $\Delta y < 1/4 \times y_0$
2: 20 < H < 200 cm
3: 3 < R < 7 cm
4: $y_0 > 0.2$ H

Figure D.2-15 Auger-hole Test for Hydraulic Conductivity (4/11)

Location :
NO : T-5 (1)
Date : 5/11/88
Observer :
R : 4 cm
S : 0 or > ~~1/2 H~~
Depth (D) : 95 cm
G. Water Level(W): 68 cm
Layer Measured : cm
K : 26.4 m/day
(1.1 m/hr)
(3.1×10^{-2} cm/sec)



W' = 103 cm
Height = 35 cm −
W = 68 cm

D = 95 cm
W = 68 cm −
H = 27 cm

Time (t) sec		Water Table after Pumping (y'_t) cm	Δy_t cm
	0	120	−
1/4 y_0	5	117	3
	10	114.5	2.5
	15	112.5	2
	20	111	1.5
	25	109.6	1.4

$y_0 = y'_0 - W' = 120 - 103 = 17$
$\Delta y = y'_0 - y'_n = 120 - 117 = 3$
$\overline{y} = y_0 - 1/2\,\Delta y = 17 - 3/2 = 15.5$

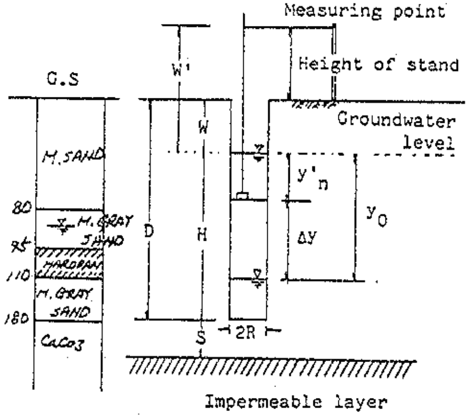
H = 27
$\overline{y}$ = 15.5
} C = 44 (S=0) (From graph)

$\frac{\Delta y}{\Delta t} = \frac{3}{5} = 0.6$ cm/sec
$K = C \times \frac{\Delta y}{\Delta t} = 44 \times 0.6 = 26.4$ m/day

Conditions:
1: $y_t > 3/4 \times y_0$ or $\Delta y < 1/4 \times y_0$
2: 20 < H < 200 cm
3: 3 < R < 7 cm
4: $y_0 > 0.2$ H

Figure D.2-16 Auger-hole Test for Hydraulic Conductivity (5/11)

Location :
NO : T-5 (2)
Date : 3/11/88
Observer :
R : 4 cm
S : ~~0 or~~ > 1/2 H
Depth (D) : 192 cm
G. Water Level(W) : 88 cm
Layer Measured : cm
K : 0.713 m/day
(0.029 m/hr)
(8.1×10^{-4} cm/sec)



W' = 103 cm
Height = 35 cm –
W = 68 cm

D = 192 cm
W = 68 cm –
H = 124 cm

Time (t) sec	Water Table after Pumping (y'_t) cm	Δy_t cm
0	135	–
10	133.6	1.4
20	132.3	1.3
30	131.1	1.2
40	130.0	1.1
50	129.0	1.0
$^1/_4 y_0$ 60	128.1	0.8

$y_0 = y'_0 - W' = 135 - 103 = 32$
$\Delta y = y'_0 - y'_n = 135 - 128.1 = 6.9$
$\overline{y} = y_0 - 1/2\,\Delta y = 32 - 6.9/2 = 28.55$

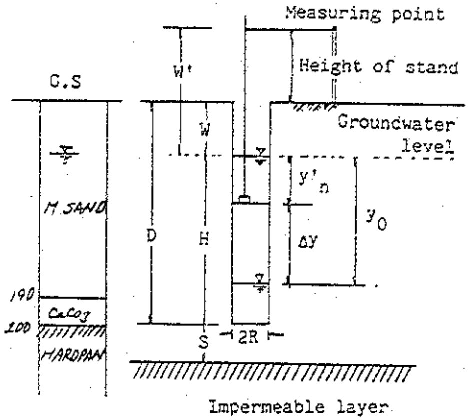
H = 124
$\overline{y}$ = 28.55
C = 6.2 (From graph)

$\frac{\Delta y}{\Delta t} = \frac{6.9}{60} = 0.115$ cm/sec
$K = C \times \frac{\Delta y}{\Delta t} = 6.2 \times 0.115 = 0.71$ m/day

Conditions:
1: $y_t > 3/4 \times y_0$ or $\Delta y < 1/4 \times y_0$
2: 20 < H < 200 cm
3: 3 < R < 7 cm
4: $y_0 > 0.2$ H

Figure D.2-17 Auger-hole Test for Hydraulic Conductivity (6/11)

Location :
NO : T-6
Date : 2/11/88
Observer :
R : 4 cm
S : 0 or > ~~1/2 H~~
Depth (D) : 180 cm
G. Water Level(W) : 66 cm
Layer Measured : cm
K : 12.32 m/day
(0.513 m/hr)
(1.4×10^{-2} cm/sec)



W' = 101 cm
Height = 35 cm –
W = 66 cm

D = 180 cm
W = 66 cm –
H = 114 cm

Time (t) sec	Water Table after Pumping (y'_t) cm	Δy_t cm
0	125	–
$^1/_4 y_0$ 5	118	7.0
10	113.2	4.8
15	109.6	3.6
20	107.0	2.6
25	105.5	1.5

$y_0 = y'_0 - W' = 125 - 101 = 24$
$\Delta y = y'_0 - y'_n = 125 - 118 = 7$
$\overline{y} = y_0 - 1/2\,\Delta y = 24 - 7/2 = 20.5$

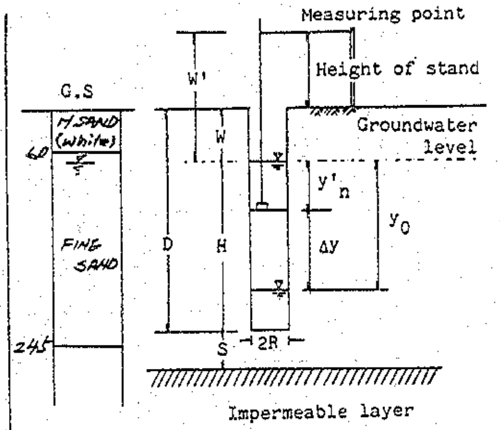
H = 114
$\overline{y}$ = 20.5
C = 8.8 (S=0) (From graph)

$\frac{\Delta y}{\Delta t} = \frac{7}{5} = 1.4$ cm/sec
$K = C \times \frac{\Delta y}{\Delta t} = 8.8 \times 1.4 = 12.32$ m/day

Conditions:
1: $y_t > 3/4 \times y_0$ or $\Delta y < 1/4 \times y_0$
2: 20 < H < 200 cm
3: 3 < R < 7 cm
4: $y_0 > 0.2$ H

Figure D.2-18 Auger-hole Test for Hydraulic Conductivity (7/11)

Location :
NO : T-7
Date : 2/11/88
Observer :
R : 4 cm
S : ~~0 or~~ > 1/2 H
Depth (D) : 245 cm
G. Water Level (W) : 75 cm
Layer Measured : cm
K : 3.28 m/day
(0.137 m/hr)
(3.8×10^{-3} cm/sec)



W' = 110 cm
Height = 35 cm −
W = 75 cm

D = 245 cm
W = 75 cm −
H = 170 cm

Time (t) sec	Water Table after Pumping (y'_t) cm	Δy_t cm
0	148	−
5	144	3.5
1/4 y_0 10	140.0	4.5
15	135.5	4.5
20	132.5	3.0
25	130.0	2.5

$y_0 = y'_0 - W' = 148 - 110 = 38$
$\Delta y = y'_0 - y'_n = 148 - 140 = 8$
$\overline{y} = y_0 - 1/2\,\Delta y = 38 - 8/2 = 34$

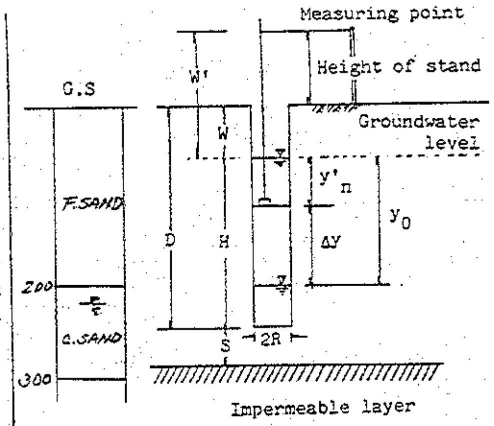
H = 170, $\overline{y}$ = 34 } C = 4.1 (From graph)

$\frac{\Delta y}{\Delta t} = \frac{8}{10} = 0.8$ cm/sec
$K = C \times \frac{\Delta y}{\Delta t} = 4.1 \times 0.8 = 3.28$ m/day

Conditions:
1: $y_t > 3/4 \times y_0$ or $\Delta y < 1/4 \times y_0$
2: 20 < H < 200 cm
3: 3 < R < 7 cm
4: $y_0 > 0.2$ H

Figure D.2-19 Auger-hole Test for Hydraulic Conductivity (8/11)

Location :
NO : T-8
Date : 31/10/88
Observer :
R : 4 cm
S : ~~0 or~~ > 1/2 H
Depth (D) : 300 cm
G. Water Level (W) : 237 cm
Layer Measured : cm
K : 11.85 m/day
(0.494 m/hr)
(1.4×10^{-2} cm/sec)



W' = 272 cm
Height = 35 cm −
W = 237 cm

D = 300 cm
W = 237 cm −
H = 63 cm

Time (t) sec	Water Table after Pumping (y'_t) cm	Δy_t cm
0	286	−
1/4 y_0 5	283	3.0
10	281.5	1.5
15	280.0	1.5
20	278.8	1.2
25	277.5	1.3

$y_0 = y'_0 - W' = 286 - 272 = 14$
$\Delta y = y'_0 - y'_n = 286 - 283 = 3$
$\overline{y} = y_0 - 1/2\,\Delta y = 14 - 3/2 = 12.5$

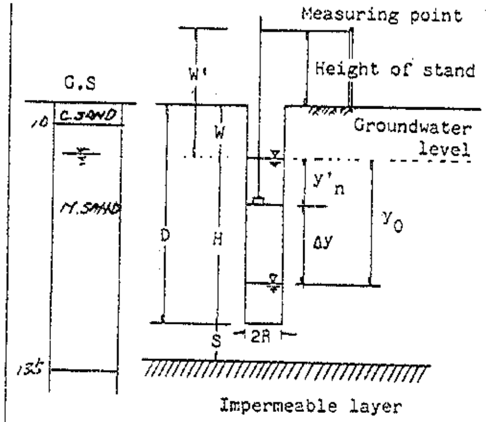
H = 63, $\overline{y}$ = 12.5 } C = 19.75 (From graph)

$\frac{\Delta y}{\Delta t} = \frac{3}{5} = 0.6$ cm/sec
$K = C \times \frac{\Delta y}{\Delta t} = 19.75 \times 0.6 = 11.86$ m/day

Conditions:
1: $y_t > 3/4 \times y_0$ or $\Delta y < 1/4 \times y_0$
2: 20 < H < 200 cm
3: 3 < R < 7 cm
4: $y_0 > 0.2$ H

Figure D.2-20 Auger-hole Test for Hydraulic Conductivity (9/11)

Location	:	
NO	:	T-10
Date	:	3/11/88
Observer	:	
R	:	4 cm
S	:	~~0 or~~ > 1/2 H
Depth (D)	:	135 cm
G. Water Level (W)	:	27 cm
Layer Measured	:	cm
K	:	12.1 m/day
		(0.504 m/hr)
		(1.4×10^{-2} cm/sec)



W' = 62 cm
Height = 35 cm −
W = 27 cm

D = 135 cm
W = 27 cm −
H = 108 cm

Time (t) sec	Water Table after Pumping (y'_t) cm	Δy_t cm
0	107	−
1/4 y_0 5	96.0	11.0
10	88.5	7.5
15	82.7	5.8
20	78.0	4.7
25	74.5	3.5

$y_0 = y'_0 - W' = 107 - 62 = 45$

$\Delta y = y'_0 - y'_n = 107 - 96 = 11$

$\overline{y} = y_0 - 1/2\,\Delta y = 45 - 11/2 = 39.5$

H = 108, $\overline{y}$ = 39.5 } C = 5.5 (From graph)

$\frac{\Delta y}{\Delta t} = \frac{11}{5} = 2.2$ cm/sec

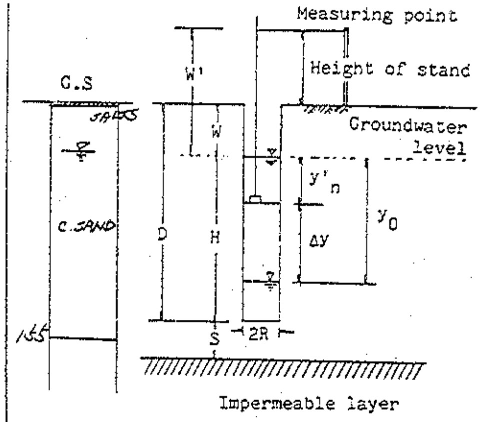
$K = C \times \frac{\Delta y}{\Delta t} = 5.5 \times 2.2 = 12.1$ m/day

Conditions:

1: $y_t > 3/4 \times y_0$ or $\Delta y < 1/4 \times y_0$
2: $20 < H < 200$ cm
3: $3 < R < 7$ cm
4: $y_0 > 0.2\,H$

Figure D.2-21 Auger-hole Test for Hydraulic Conductivity (10/11)

Location	:	
NO	:	T-14
Date	:	3/11/88
Observer	:	
R	:	4 cm
S	:	~~0 or~~ > 1/2 H
Depth (D)	:	155 cm
G. Water Level (W)	:	39 cm
Layer Measured	:	cm
K	:	8.4 m/day
		(0.35 m/hr)
		(9.7×10^{-3} cm/sec)



W' = 74 cm
Height = 35 cm −
W = 39 cm

D = 155 cm
W = 39 cm −
H = 116 cm

Time (t) sec	Water Table after Pumping (y'_t) cm	Δy_t cm
0	103	−
1/4 y_0 5	97.0	6.0
10	92.0	5.0
15	87.8	4.2
20	86.0	1.8
25	85.2	0.8

$y_0 = y'_0 - W' = 103 - 74 = 29$

$\Delta y = y'_0 - y'_n = 103 - 97 = 6$

$\overline{y} = y_0 - 1/2\,\Delta y = 29 - 6/2 = 26$

H = 116, $\overline{y}$ = 26 } C = 7 (From graph)

$\frac{\Delta y}{\Delta t} = \frac{6}{5} = 1.2$ cm/sec

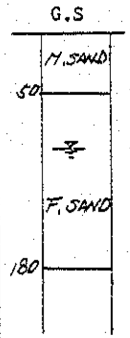
$K = C \times \frac{\Delta y}{\Delta t} = 7 \times 1.2 = 8.4$ m/day

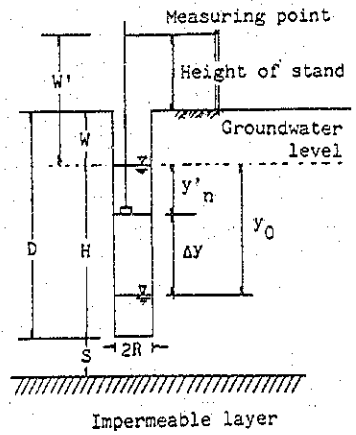
Conditions:

1: $y_t > 3/4 \times y_0$ or $\Delta y < 1/4 \times y_0$
2: $20 < H < 200$ cm
3: $3 < R < 7$ cm
4: $y_0 > 0.2\,H$

Figure D.2-22 Auger-hole Test for Hydraulic Conductivity (11/11)

Location :
NO : T-15
Date : 3/11/88
Observer :
R : 4 cm
S : ~~0 or~~ > 1/2 H
Depth (D) : 181 cm
G. Water Level(W) : 109 cm
Layer Measured : cm
K : 23.45 m/day
(0.977 m/hr)
(2.7×10^{-2} cm/sec)





W' = 144 cm
Height = 35 cm −
W = 109 cm

D = 181 cm
W = 109 cm −
H = 72 cm

Time (t) sec		Water Table after Pumping (y'_t) cm	Δy_t cm
	0	160	−
1/40	5	153.3	6.7
	10	149.0	4.3
	15	147.5	1.5
	20	146.3	1.2
	25	145.6	0.7

$y_0 = y'_0 - W' = 160 - 144 = 16$
$\Delta y = y'_0 - y'_n = 160 - 153.3 = 6.7$
$\overline{y} = y_0 - 1/2\,\Delta y = 16 - 6.7/2 = 12.65$

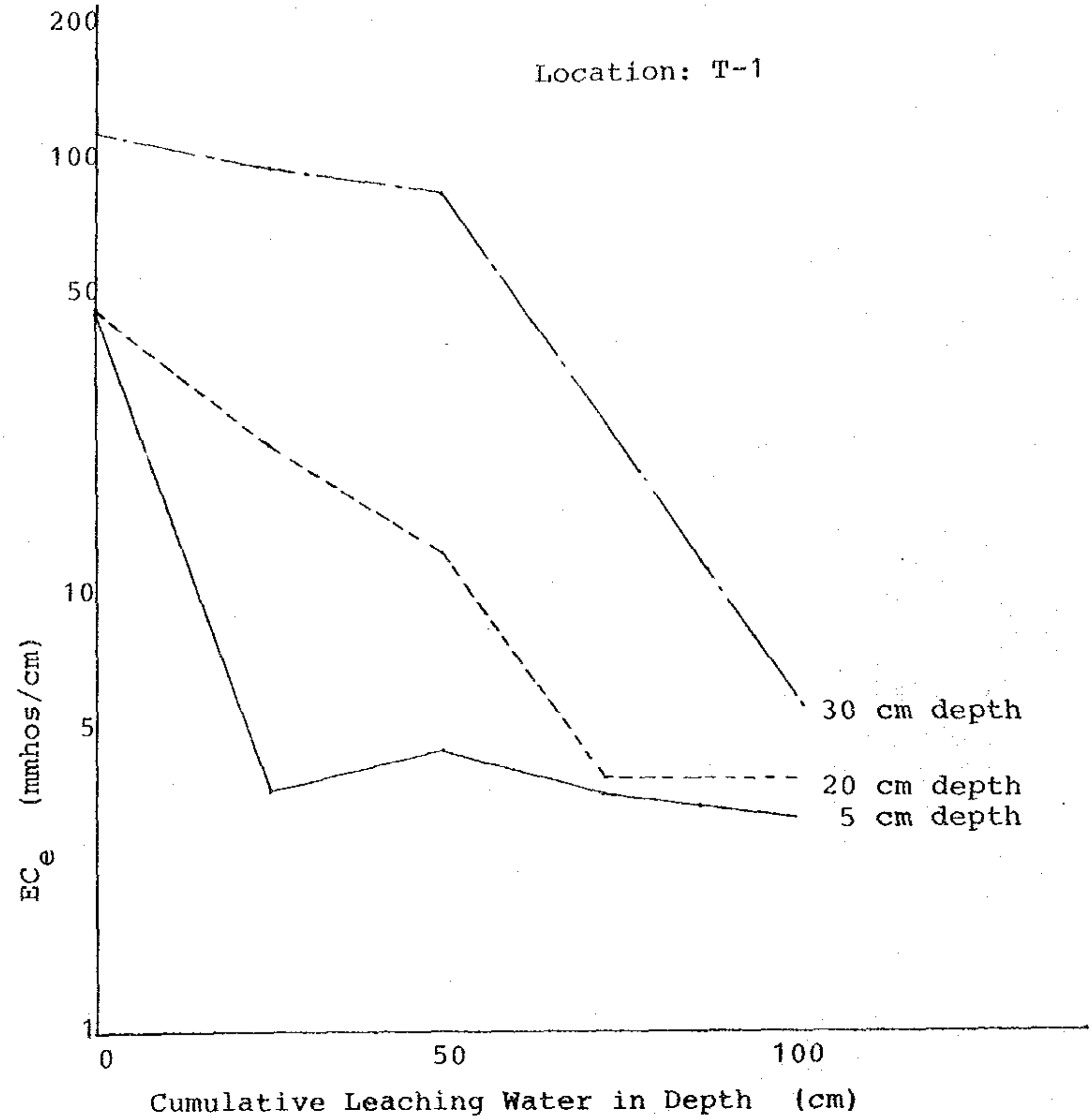
$H = 72$
$\overline{y} = 12.65$
} C = 17.5 (From graph)

$\frac{\Delta y}{\Delta t} = \frac{6.7}{5} = 1.34$ cm/sec
$K = C \times \frac{\Delta y}{\Delta t} = 17.5 \times 1.34 = 23.45$ m/day

Conditions:

1: $y_t > 3/4 \times y_0$ or $\Delta y < 1/4 \times y_0$
2: $20 < H < 200$ cm
3: $3 < R < 7$ cm
4: $y_0 > 0.2\,H$

Figure D.2-23 Relation between Soil Salinity and Leaching Water (1/2)



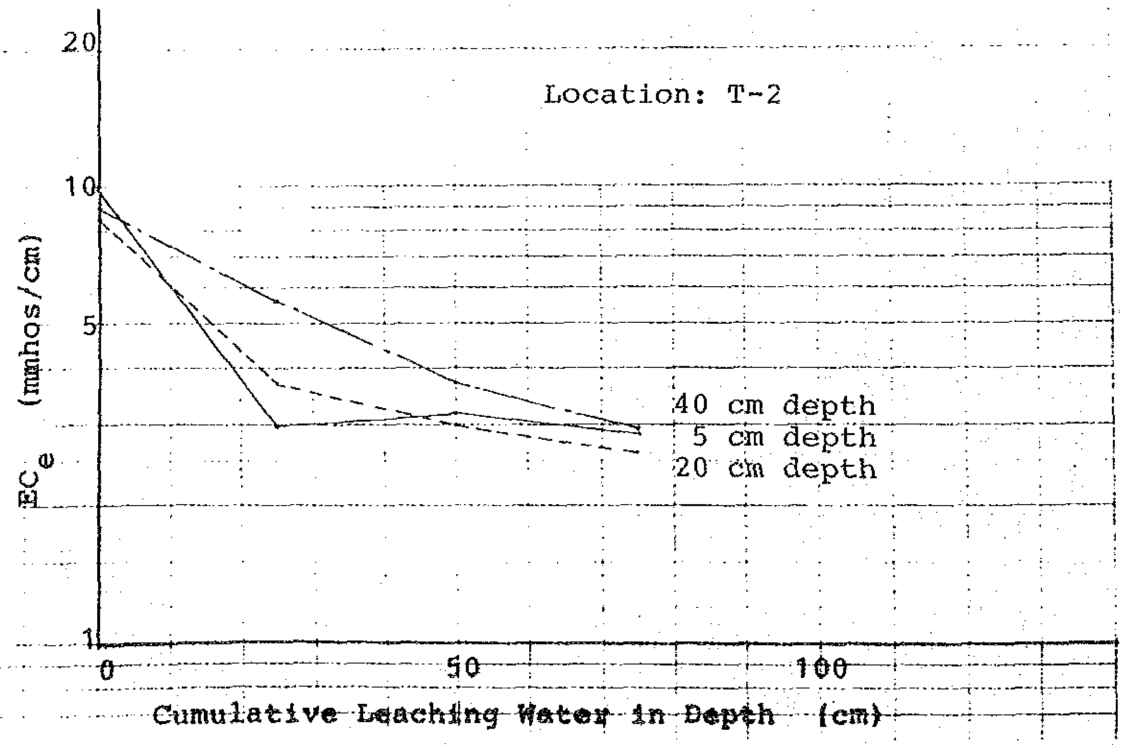
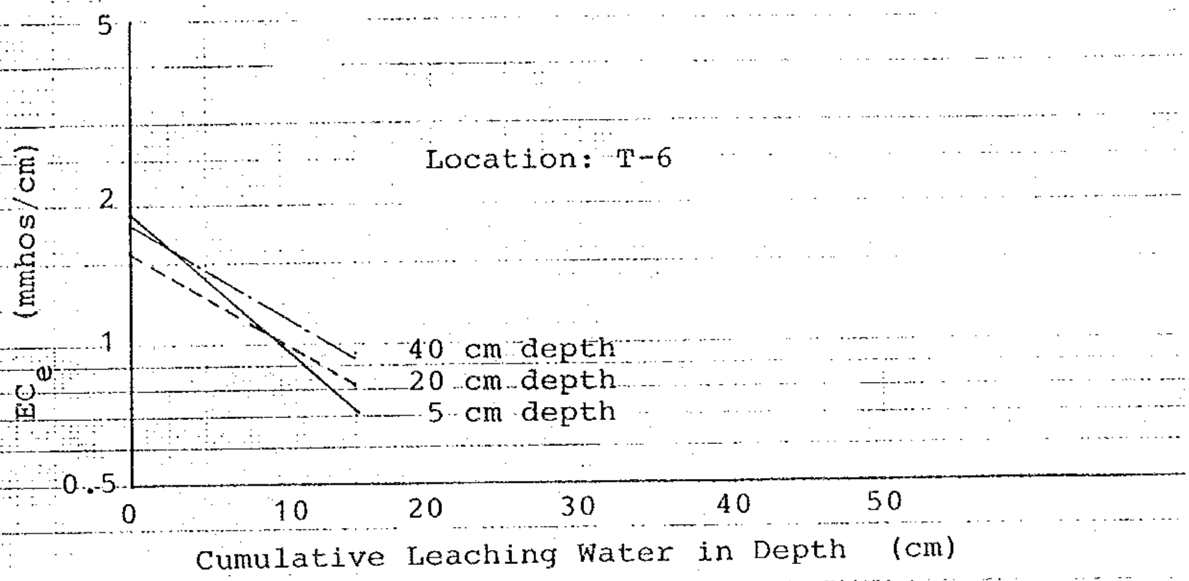
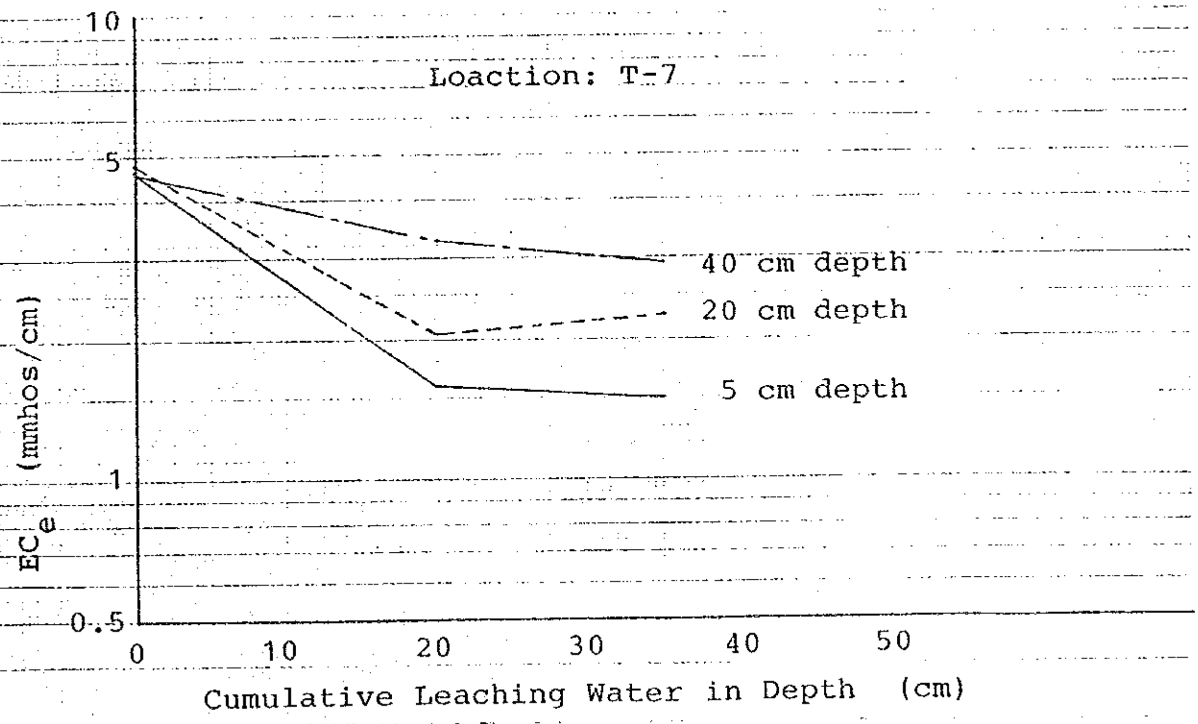


Figure D.2-24 Relation between Soil Salinity and Leaching Water (2/2)





D.3. Available Water from River Nile, Bahr Hadous Drain and El Sirw Drain

Table D.3-1 Calculation Procedure of Required Amounts of Water from Nile River, Hadous Drain and El Sirw Drain

Calculation Procedure

Q	:	Required irrigation water, cu.m/sec,
Qn	:	Water amount to be taken from Nile river, cu.m/sec,
Qh	:	Discharge of Hadous drain, cu.m/sec,
Qhi	:	Water amount to be taken from Hadous drain ($Qhi \leq 0.8 \cdot Qh$), cu.m/sec,
Qs	:	Discharge of El Sirw drain, cu.m/sec,
Qsi	:	Water amount to be taken from El Sirw drain ($Qsi \leq 0.9 \cdot Qs$), cu.m/sec,
S	:	Upper limit of salinity of irrigation water, ppm,
Sn	:	Salinity of Nile water, ppm,
Sh	:	Salinity of drainage water of Hadous drain, ppm,
Ss	:	Salinity of drainage water of El Sirw drain, ppm, and
Sc	:	Salinity of irrigation water ($Sc \leq S$), ppm,

$$Sc = (Qn \cdot Sn + Qhi \cdot Sh + Qsi \cdot Ss) / Q$$

$$Qn1 = Q - 0.9 \cdot Qs$$

↓

$Qn = Qn1$
$Qhi = 0.0$
$Qsi = 0.9 \cdot Qs$

↓

$Sc = S$	$Sc < S$	$Sc > S$
$Qn = Qn1$ $Qhi = 0.0$ $Qsi = 0.9 \cdot Qs$	1/ $Qn = \frac{(S-Sh) \cdot Q + 0.9 \cdot (Sh-Ss) \cdot Qs}{Sn - Sh}$ $Qhi = Q - Qn - Qsi$ $Qsi = 0.9 \cdot Qs$	2/ $Qn = \frac{(S-Ss) \cdot Q}{Sn-Ss}$ $Qhi = 0.0$ $Qsi = Q - Qn$

1/

$$Qsi = 0.9 \cdot Qs$$
$$S \cdot Q = Qn \cdot Sn + Qhi \cdot Sh + 0.9 \cdot Qs \cdot Ss$$
$$Q = Qn + Qhi + 0.9 \cdot Qs$$

$$Qn = \frac{(S-Sh) \cdot Q + 0.9 \cdot (Sh-Ss) \cdot Qs}{Sn - Sh}$$

2/

$$Qhi = 0.0$$
$$S \cdot Q = Qn \cdot Sn + Qsi \cdot Ss$$
$$Q = Qn + Qsi$$

$$Qn = \frac{(S-Ss) \cdot Q}{Sn-Ss}$$

Table D.3-2 Discharge and Salinity Data of Hadous Drain and El Sirw Drain

		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP	OCT.	NOV.	DEC.	TOTAL
1985														
EL SIRW	Q	37.94	27.07	44.42	39.98	46.76	64.93	75.99	77.02	70.95	48.98	46.96	44.30	625.30
-	S	2035	960	1318	1017	870	947	960	979	915	902	819	1024	
BAHR HADOUS	Q	183.45	88.43	0.00	155.87	153.00	173.32	249.91	271.32	278.02	243.45	172.94	217.91	2350.64
-	S	1695	1785	0	1215	1427	1638	1606	1440	1375	1375	1459	1375	
TOTAL	Q	221.39	115.50	44.42	195.85	199.76	238.25	325.90	348.34	348.97	292.43	219.90	262.21	2975.94
1986														
EL SIRW	Q	37.12	25.91	40.33	43.66	49.53	56.21	70.68	67.33	73.00	54.73	45.57	41.61	605.68
-	S	1375	2118	1030	992	966	1152	1184	1004	934	857	857	2400	
BAHR HADOUS	Q	186.54	103.65	170.74	177.65	150.64	162.63	245.88	230.33	282.05	247.21	194.54	195.27	2347.13
-	S	1625	2796	1587	1382	1484	1836	1715	1779	1593	1337	1401	1260	
TOTAL	Q	223.66	129.56	211.07	221.31	200.17	218.84	316.56	297.66	355.05	301.94	240.11	236.88	2952.81
1987														
EL SIRW	Q	37.13	20.55	47.86	42.76	48.93	75.40	76.87	69.21	67.31	46.77	32.82	38.72	604.33
-	S	787	1254	857	966	800	819	921	960	966	934	960	864	
BAHR HADOUS	Q	177.97	62.24	190.38	138.17	128.49	207.28	247.33	225.33	257.08	241.66	163.70	201.11	2240.73
-	S	2112	3116	1561	1638	1593	1664	1555	1804	1606	1459	1734	1567	
TOTAL	Q	215.10	82.79	238.24	180.93	177.42	282.68	324.20	294.54	324.39	288.43	196.52	239.83	2845.06
1988														
EL SIRW	Q	36.32	17.16	44.55	35.48	48.54	65.58	0.00	0.00	0.00	0.00	0.00	0.00	247.63
-	S	1107	2483	1215	1254	902	1113	0	0	0	0	0	0	
BAHR HADOUS	Q	212.18	69.11	168.86	116.50	111.08	113.47	0.00	0.00	0.00	0.00	0.00	0.00	791.20
-	S	1644	2611	1587	2009	1798	2470	0	0	0	0	0	0	
TOTAL	Q	248.50	86.27	213.41	151.98	159.62	179.05	0.00	0.00	0.00	0.00	0.00	0.00	1038.83

Q : DISCHARGE IN MCM
S : SALINITY IN PPM

Table D.3-3 Required Amount of Water from Nile River, Hadous Drain and El Sirw Drain

(Nile Water; 250ppm, Upper Limit of Salinity; 800ppm)

(SALINITY OF NILE WATER : 250 PPM)
(UPPER LIMIT OF SALINITY : 800 PPM)

		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP	OCT.	NOV.	DEC.	TOTAL
1985														
EL SIRW	Q	34.15	24.36	0.00	35.98	42.08	58.44	68.39	69.32	63.85	44.08	42.26	39.87	522.79
BAHR HADOUS	Q	38.75	70.74	0.00	109.53	79.21	123.13	164.23	158.57	99.83	38.35	56.70	58.90	997.94
NILE RIVER	Q	139.81	160.09	0.00	97.08	95.71	203.33	260.68	207.11	117.92	48.37	69.43	77.93	1477.47
TOTAL	Q	212.70	255.20	0.00	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	2998.20
SALINITY	PPM	800	743	0	800	800	800	800	800	800	800	800	800	
1986														
EL SIRW	Q	33.41	23.32	36.30	39.29	44.58	50.59	63.61	60.60	65.70	49.26	41.01	37.45	545.11
BAHR HADOUS	Q	57.70	38.00	109.04	92.08	70.79	104.65	144.62	126.54	81.81	38.63	58.79	16.49	939.15
NILE RIVER	Q	121.60	193.88	171.27	111.22	101.63	229.66	285.07	247.86	134.09	42.92	68.60	122.76	1830.54
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	3314.80
SALINITY	PPM	800	800	800	800	800	800	800	800	800	800	800	800	
1987														
EL SIRW	Q	33.42	18.49	43.07	38.48	44.04	67.86	69.18	62.29	60.58	42.09	29.54	34.85	543.90
BAHR HADOUS	Q	53.19	42.48	112.81	76.25	70.80	122.40	172.27	125.43	82.19	35.67	48.27	57.50	999.25
NILE RIVER	Q	126.10	194.22	160.72	127.87	102.16	194.64	251.84	247.28	138.83	53.04	90.59	84.35	1771.65
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	3314.80
SALINITY	PPM	800	800	800	800	800	800	800	800	800	800	800	800	
1988														
EL SIRW	Q	32.69	15.44	40.10	31.93	43.69	59.02	0.00	0.00	0.00	0.00	0.00	0.00	222.87
BAHR HADOUS	Q	63.78	44.84	101.26	57.60	58.67	72.38	0.00	0.00	0.00	0.00	0.00	0.00	398.54
NILE RIVER	Q	116.23	194.92	175.25	153.07	114.64	253.49	0.00	0.00	0.00	0.00	0.00	0.00	1007.60
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	0.00	0.00	0.00	0.00	0.00	0.00	1629.00
SALINITY	PPM	800	800	800	800	800	800	0	0	0	0	0	0	

Table D.3-4 Required Amount of Water from Nile River, Hadous Drain and El Sirw Drain

(Nile Water; 370ppm, Upper Limit of Salinity; 800ppm)

(SALINITY OF NILE WATER : 370 PPM)
(UPPER LIMIT OF SALINITY : 800 PPM)

		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP	OCT.	NOV.	DEC.	TOTAL
1985														
EL SIRW	Q	34.15	24.36	0.00	35.98	42.08	58.44	68.39	69.32	63.85	44.08	42.26	39.87	522.79
BAHR HADOUS	Q	26.09	67.36	0.00	95.76	68.34	103.89	138.93	135.35	85.76	32.58	49.05	49.61	852.73
NILE RIVER	Q	152.46	163.47	0.00	110.85	106.57	222.57	285.98	230.33	131.99	54.14	77.08	87.22	1622.68
TOTAL	Q	212.70	255.20	0.00	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	2998.20
SALINITY	PPM	800	800	0	800	800	800	800	800	800	800	800	800	
1986														
EL SIRW	Q	33.41	23.32	36.30	39.29	44.58	50.59	63.61	60.60	65.70	49.26	41.01	37.43	545.09
BAHR HADOUS	Q	46.08	28.42	92.15	78.90	59.85	85.86	119.19	105.44	68.66	33.31	50.81	0.00	768.66
NILE RIVER	Q	133.22	203.46	188.15	124.41	112.57	248.45	310.49	268.96	147.24	48.24	76.58	139.27	2001.04
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	3314.80
SALINITY	PPM	800	800	800	800	800	800	800	800	800	800	800	800	
1987														
EL SIRW	Q	33.42	18.49	43.07	38.48	44.04	67.86	69.18	62.29	60.58	42.09	29.54	34.85	543.90
BAHR HADOUS	Q	44.50	34.00	96.62	64.15	60.78	104.35	146.77	104.75	68.71	29.83	40.30	49.05	843.82
NILE RIVER	Q	134.78	202.71	176.90	139.97	112.18	212.69	277.34	267.96	152.31	58.88	98.56	92.80	1927.08
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	3314.80
SALINITY	PPM	800	800	800	800	800	800	800	800	800	800	800	800	
1988														
EL SIRW	Q	32.69	15.44	40.10	31.93	43.69	59.02	0.00	0.00	0.00	0.00	0.00	0.00	222.87
BAHR HADOUS	Q	52.84	34.40	83.98	46.40	49.04	57.90	0.00	0.00	0.00	0.00	0.00	0.00	324.57
NILE RIVER	Q	127.17	205.35	192.53	164.27	124.27	267.98	0.00	0.00	0.00	0.00	0.00	0.00	1081.57
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	0.00	0.00	0.00	0.00	0.00	0.00	1629.00
SALINITY	PPM	800	800	800	800	800	800	0	0	0	0	0	0	

Table D.3-5 Required Amount of Water from Nile River, Hadous Drain and El Sirw Drain

(Nile Water; 250ppm, Upper Limit of Salinity; 1,000ppm)

(SALINITY OF NILE WATER : 250 PPM)
(UPPER LIMIT OF SALINITY : 1000 PPM)

		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP	OCT.	NOV.	DEC.	TOTAL
1985														
EL SIRW	Q	34.15	24.36	0.00	35.98	42.08	58.44	68.39	69.32	63.85	44.08	42.26	39.87	522.79
BAHR HADOUS	Q	68.17	70.74	0.00	124.70	116.07	138.66	199.93	217.06	149.84	61.58	84.55	90.29	1321.59
NILE RIVER	Q	110.39	160.09	0.00	81.92	58.84	187.81	224.98	148.63	67.90	25.14	41.58	46.54	1153.82
TOTAL	Q	212.70	255.20	0.00	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	2998.20
SALINITY	PPM	1000	743	0	860	1000	856	898	959	1000	1000	1000	1000	
1986														
EL SIRW	Q	33.41	23.32	36.30	39.29	44.58	50.59	63.61	60.60	65.70	49.26	41.01	37.45	545.11
BAHR HADOUS	Q	88.62	58.05	136.59	134.93	105.94	130.10	196.70	183.44	123.72	62.68	88.03	51.45	1360.26
NILE RIVER	Q	90.67	173.84	143.71	68.38	66.48	204.21	232.98	190.97	92.18	18.86	39.35	87.80	1409.42
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	3314.80
SALINITY	PPM	1000	1000	916	1000	1000	904	954	1000	1000	1000	1000	1000	
1987														
EL SIRW	Q	33.42	18.49	43.07	38.48	44.04	67.86	69.18	62.29	60.58	42.09	29.54	34.85	543.90
BAHR HADOUS	Q	76.03	49.79	152.30	110.54	102.79	165.82	197.86	180.26	123.71	57.30	70.96	84.32	1371.69
NILE RIVER	Q	103.25	186.91	121.22	93.58	70.17	151.22	226.25	192.45	97.31	31.40	67.91	57.54	1399.21
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	3314.80
SALINITY	PPM	1000	882	963	996	998	959	867	995	1000	1000	1000	1000	
1988														
EL SIRW	Q	32.69	15.44	40.10	31.93	43.69	59.02	0.00	0.00	0.00	0.00	0.00	0.00	222.87
BAHR HADOUS	Q	94.28	55.29	135.09	85.18	86.70	90.78	0.00	0.00	0.00	0.00	0.00	0.00	547.31
NILE RIVER	Q	85.73	184.47	141.42	125.49	86.61	235.10	0.00	0.00	0.00	0.00	0.00	0.00	858.82
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	0.00	0.00	0.00	0.00	0.00	0.00	1629.00
SALINITY	PPM	1000	896	942	1000	1000	906	0	0	0	0	0	0	

Table D.3-6 Required Amount of Water from Nile River, Hadous Drain and El Sirw Drain

(Nile Water; 370ppm, Upper Limit of Salinity; 1,000ppm)

(SALINITY OF NILE WATER : 370 PPM)
(UPPER LIMIT OF SALINITY : 1000 PPM)

		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP	OCT.	NOV.	DEC.	TOTAL
1985														
EL SIRW	Q	34.15	24.36	0.00	35.98	42.08	58.44	68.39	69.32	63.85	44.08	42.26	39.87	522.79
BAHR HADOUS	Q	58.18	70.74	0.00	124.70	109.39	138.66	199.93	216.66	141.74	58.58	79.97	84.74	1283.29
NILE RIVER	Q	120.38	160.09	0.00	81.92	65.52	187.81	224.98	149.03	76.00	28.13	46.16	52.09	1192.12
TOTAL	Q	212.70	255.20	0.00	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	2998.20
SALINITY	PPM	1000	818	0	900	1000	914	952	1000	1000	1000	1000	1000	
1986														
EL SIRW	Q	33.41	23.32	36.30	39.29	44.58	50.59	63.61	60.60	65.70	49.26	41.01	37.45	545.11
BAHR HADOUS	Q	79.96	49.45	136.59	126.82	98.78	130.10	192.54	167.18	114.68	60.34	83.46	39.63	1279.53
NILE RIVER	Q	99.34	182.43	143.71	76.48	73.64	204.21	237.15	207.23	101.22	21.20	43.93	99.62	1490.16
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	3314.80
SALINITY	PPM	1000	1000	970	1000	1000	968	1000	1000	1000	1000	1000	1000	
1987														
EL SIRW	Q	33.42	18.49	43.07	38.48	44.04	67.86	69.18	62.29	60.58	42.09	29.54	34.85	543.90
BAHR HADOUS	Q	68.92	49.79	149.76	102.40	96.25	163.84	197.86	165.39	114.27	53.84	64.98	78.55	1305.86
NILE RIVER	Q	110.36	186.91	123.76	101.71	76.71	153.20	226.25	207.32	106.75	34.86	73.88	63.30	1465.04
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	493.30	435.00	281.60	130.80	168.40	176.70	3314.80
SALINITY	PPM	1000	970	1000	1000	1000	1000	922	1000	1000	1000	1000	1000	
1988														
EL SIRW	Q	32.69	15.44	40.10	31.93	43.69	59.02	0.00	0.00	0.00	0.00	0.00	0.00	222.87
BAHR HADOUS	Q	86.21	55.29	135.09	75.99	79.43	90.78	0.00	0.00	0.00	0.00	0.00	0.00	522.78
NILE RIVER	Q	93.80	184.47	141.42	134.68	93.89	235.10	0.00	0.00	0.00	0.00	0.00	0.00	883.35
TOTAL	Q	212.70	255.20	316.60	242.60	217.00	384.90	0.00	0.00	0.00	0.00	0.00	0.00	1629.00
SALINITY	PPM	1000	983	996	1000	1000	979	0	0	0	0	0	0	

APPENDIX-E. Land Reclamation

E.1 Estimate of Direct Cost on Land Reclamation

Estimate is arranged in two classes. Class No.1 is mainly related to the earth work (hauling soil) for the amendment of slopes on the lay of the land and land grading. Class No.2 is related to the improvement to the soil on lower land (polder regions in Nile Delta).

1) Step. of Class No.1

① Earth work
↓
② Road work
↓
③ Planting for wind-break trees

2) Step of Class No.2

① Leaching work
↓
② Earth work
↓
③ Road work
↓
④ Planting for wind-break trees

E.2 Earth and Road Work

E.2.1 Earth Work

E.2.1.1 Excavation

There are dozing, scraping, land grading, cutting and digging in excavation works. F/S Area is mainly located on undulating sand dune regions, and the towed scraper with bulldozer is applied to amendment of land slope. On scraping work, combined machines are a bowl size 17 m^3 class scraper and a 32 ton class bulldozer. Swamp bulldozer and back hoe are applied to weak ground on cutting or digging. A 11 ton or 21 ton class bulldozer is applied to normal land or sandy land on excavation.

E.2.1.2 Loading and Hauling Machine

On Loading machine, a bowl size 1.8 m^3 class tractor shovel is used.

On Hauling machine, a loading quantity 8 ton class dump truck is used.

E.2.1.3 Cutting or Digging Machine

On cutting or digging, back boe is mainly used.

E.3 Initial Leaching Work

E.3.1 Design of Leaching for Standard Farm Block (1,120 feddan)

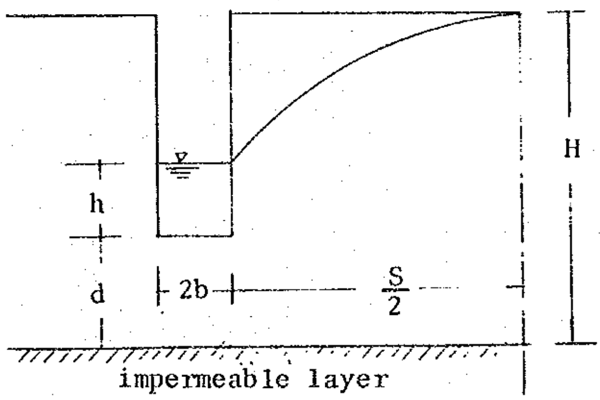
This method will be applied for the initial leaching works in Tina Plain.

E.3.1.1 Design Condition

1) Permeability of soil : 8.3×10^{-4} cm/sec.
2) Leaching water requirement : 1,200 mm.
3) Depth of soil for leaching : 0.6 m.
4) Soil salinity before leaching : 50 mm.hos/cm.
5) Soil salinity after leaching : 4 mm.hos/cm.
(by Field Leaching Test)
6) Existing water table : 0.5 m.
7) Design Water table in leaching : 0.0 m.

E.3.1.2 Interval of open channel and Section of Leaching Work

(by Hooghodt Equation)



$$\frac{Q_1}{k} = \frac{4(H^2 - h^2)}{S + \frac{d(b+d)}{h}} \quad (1)$$

$$\frac{Q_{max}}{k} = \frac{4H^2}{S} \quad (2)$$

S : interval of open channel

k : coefficient of permeability

H : height of ground-water level at the center of between open channel from impermeable layer

d : distance from impermeable layer to bottom of open channel

b : half width of open channel h : depth of water in open channel

Q_1: half-drainage discharge of open channel per unit length

$Q - 2Q_1$: sub surface drainage discharge

In the application of equation 2 , H - 3.5 m, S - 69 m.

$$Q_{max} = \frac{8.3 \times 10^{-6} m/s \times 4 \times 3.5^2}{69} - 5.89 \times 10^{-6} m/sec. \doteqdot 0.5\ m^3/day/m.$$

and then $Q = 2Q_{max} \doteqdot 1.0\ m^3/day/m.$

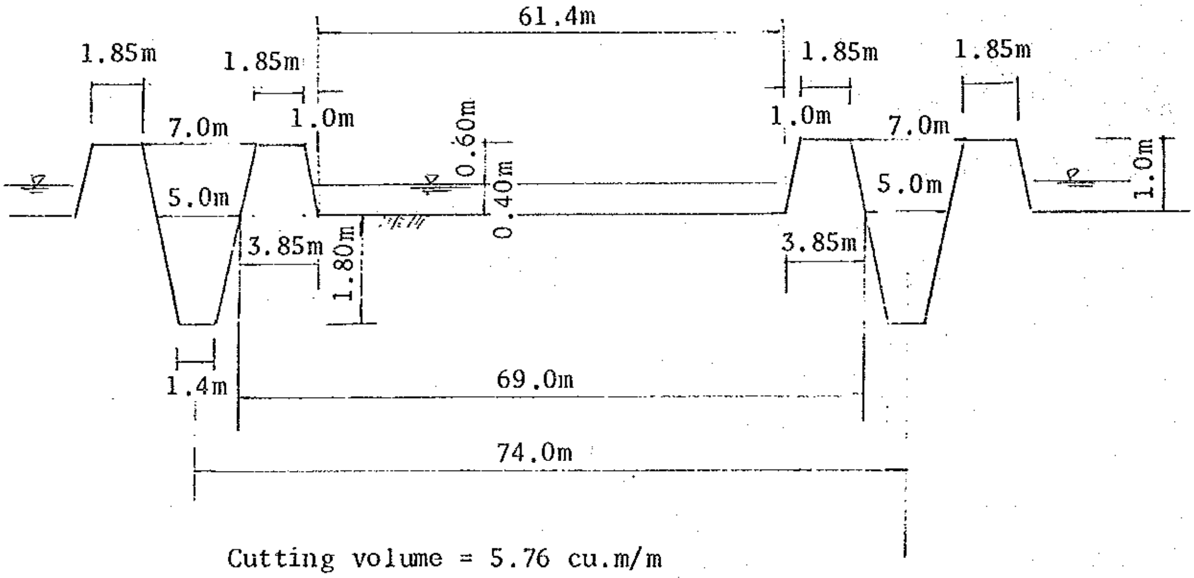
but, design Q should be a value of 0.9 m^3/day/m. for freedom to risk.

If allowable inundation depth is 1,200 mm., the inundation volume is as follows;

$$V = 61.4\ m. \times 1.2\ m. \times 1.0\ m. = 74\ m^3/day\ /m$$

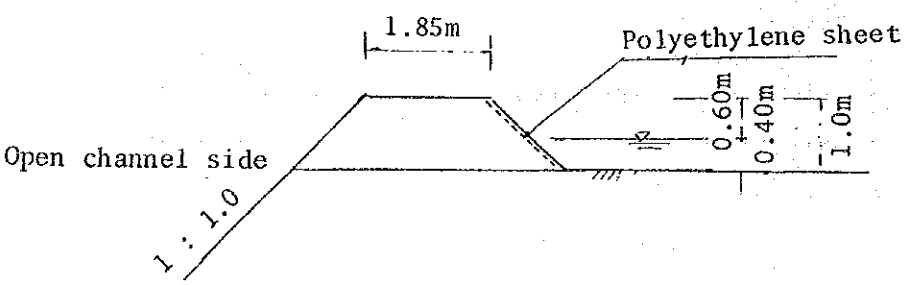
A term of leaching work is calculated as about 90 days

Section of leaching work is as follows,



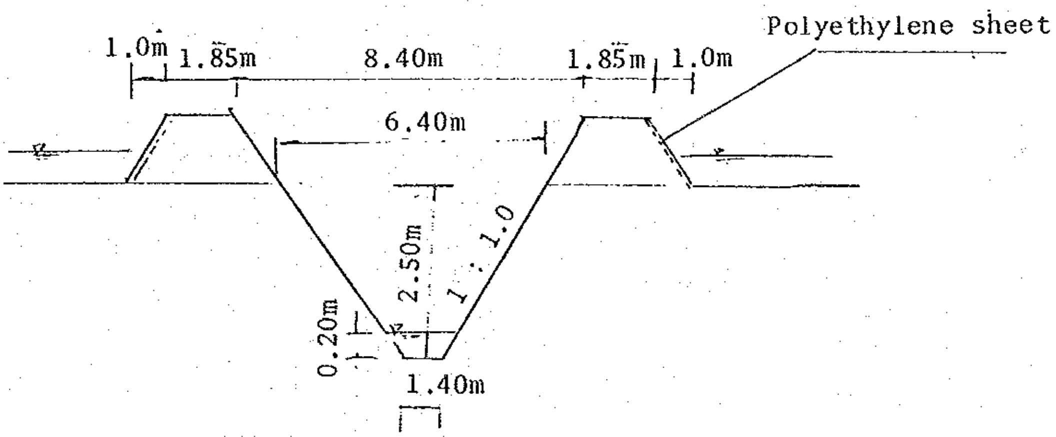
Cutting volume = 5.76 cu.m/m

Banking volume = 5.70 cu.m/m



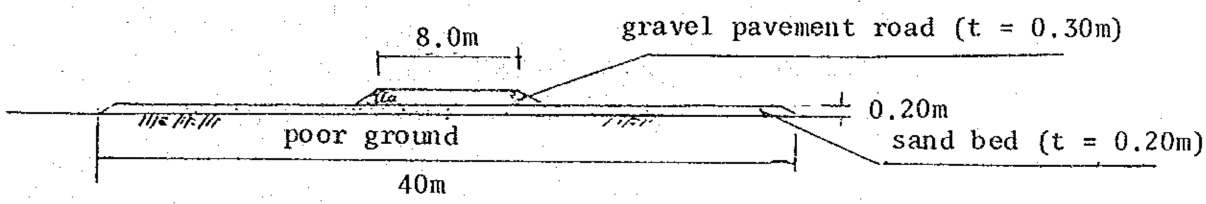
Open channel discharge reaches to 360 m^3/day (0.9 m^3/day/m. x 400 m.) from standard farm block concerned with C.P. 2 Block (Cropping Pattern No.2). All discharge reach to about 62,000 m^3 per day (360 m^3/day x 43 channel x 4 Rows) for leaching work

E.3.1.4 Collector Open Drain (Discharge, Q = 4 m^3/min.)

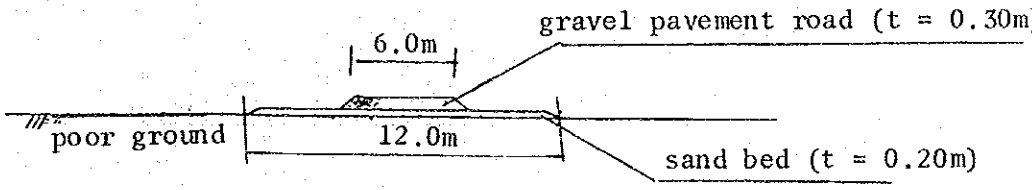


E.3.1.5 Provisionary Road

1) Main Provisionary Road



2) Normal Provisionary Road



3) Boundary Provisionary Road

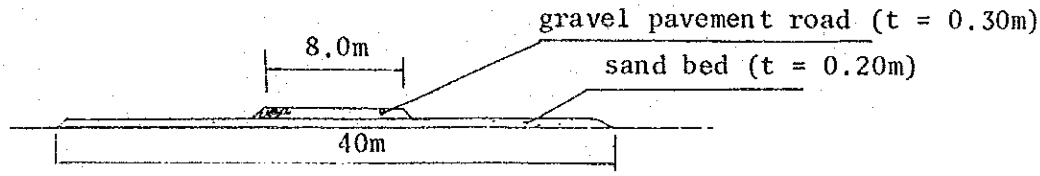
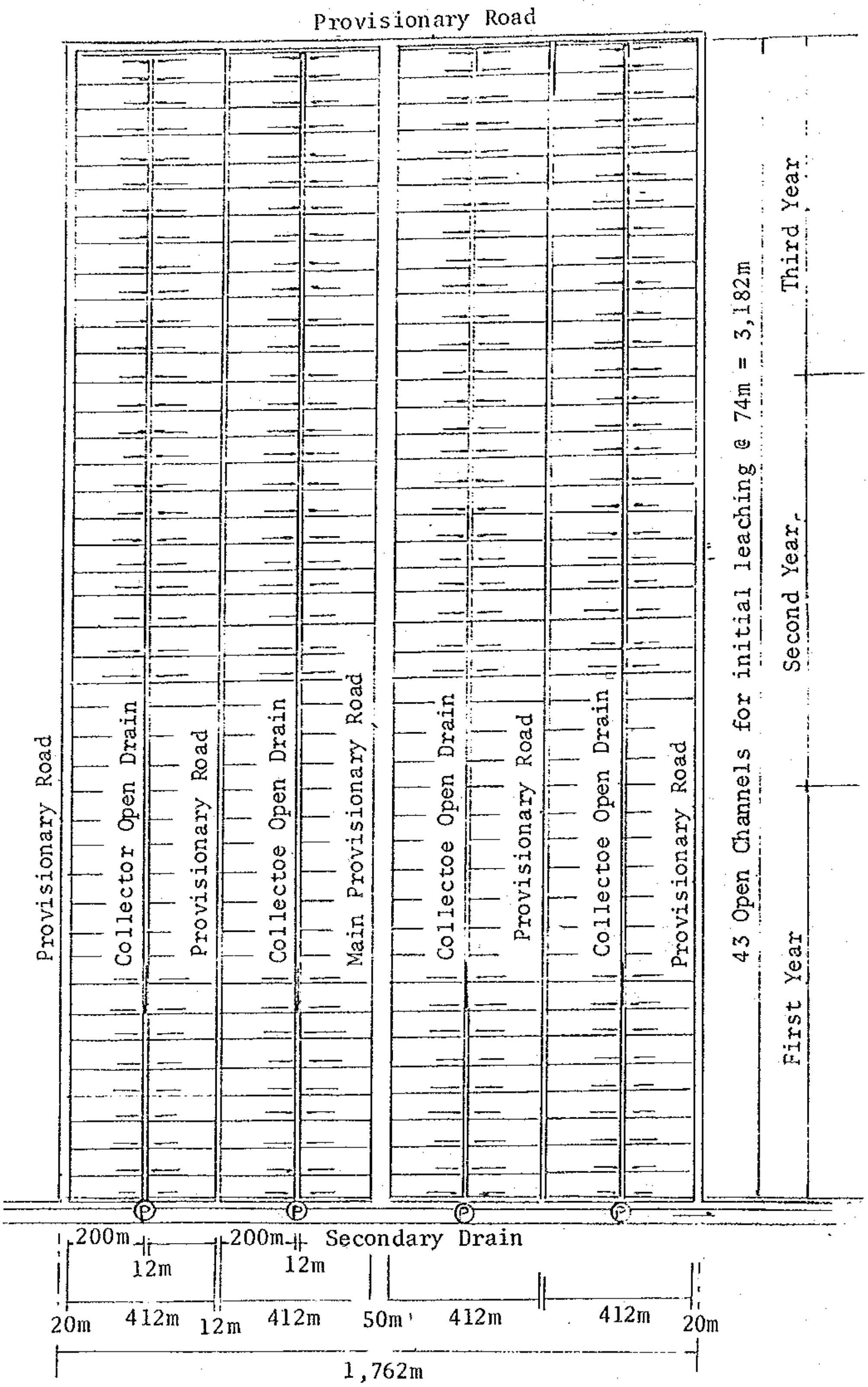


Figure E.3-1. Plan of Initial Leaching (Area: 1,120 feddan)



E.4. Construction by Towed Scraper

Construction of land reclamation is almost amendment of land slope and earthfilling on depression by towed scraper. And then cost estimate of land reclamation is mainly controlled by excavation quantity on amendment for slope of land.

E.4.1. Working Method by Towed Scraper Concerned with Amendment for Slope of Land (See Figure E.4-1 Cutting Off Slope by Towed Scraper)

This working method consists of two steps;

The primary step is as follows;

Excavation is executed in a level manner along side of 2 contour line on slope, and then formed slope with steps by excavating down in order from top of slope.

The Secondary step is as follow:

Slope if formed according to cutting off the steps by inclined scraping based on tractor running with putting one side caterpillar an upper step and the other side caterpillar on a lower step.

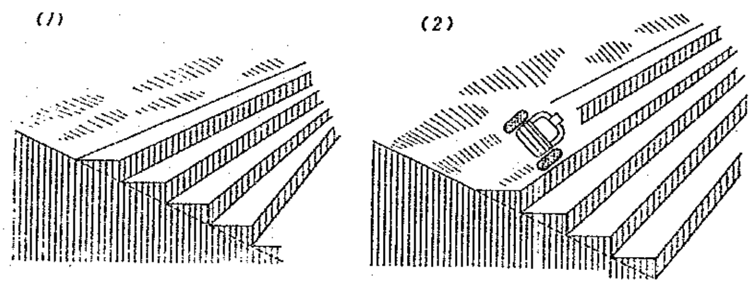


Figure E.4-1 cutting Off Slope by Towed Scraper

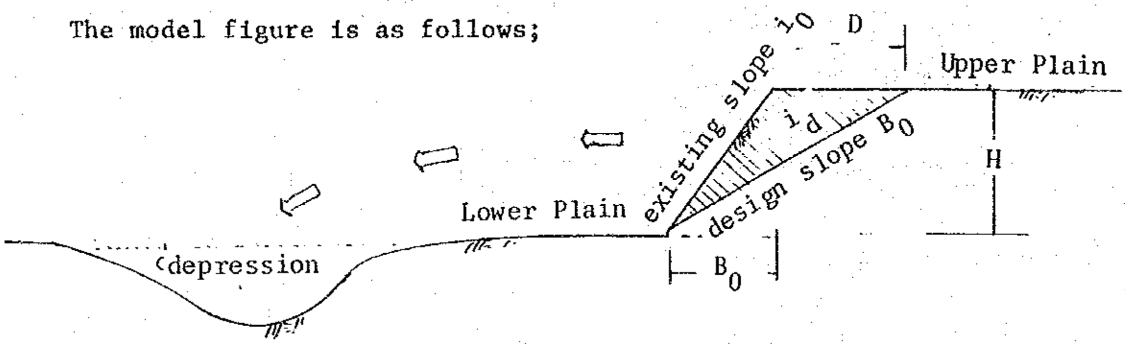
E.4.2 Topographical Conditions and Calculation Formula on Slope Cutting

This condition is classified into two cases, as follows.

(1) Case No.1 (all section is cut)

This case is applied to the case on condition that there is a depression in the neighborhood of slope.

The model figure is as follows;



here, i_o = existing slope (%),

i_d = design slope (5%),

B_o = slope width in lower plain,

(is determined by a topographical map),

D = Distance from existing top to design top of slope,

$$(= B_o \times \frac{i_o - i_d}{i_d})$$

H = hill height ($= i_o \times B_o$)

$i_o > i_d$ (= 5%)

And then, unit section area is calculated as follows;

$$A = B_o \times \frac{i_o - i_d}{i_d} \times i_o\ B_o \times 1/2 \quad (m^2/m)$$

and hauling quantity (Q) is as follows;

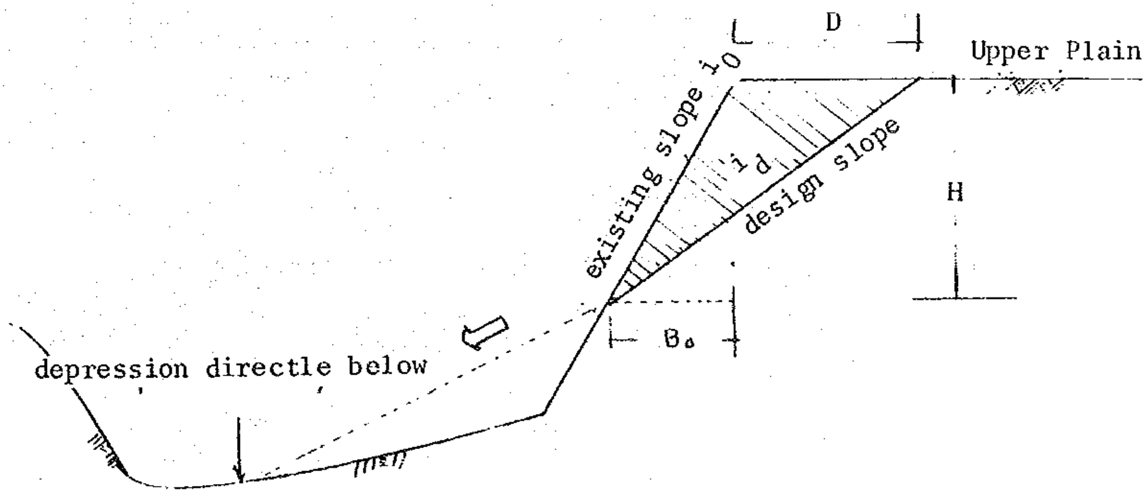
$$Q = A \times L \quad (cu.m)$$

here, A = Unit section area, L = Cutting distance on slope

(2) Case No.2 (partial section is cut)

This case is applied to the case on condition that a depression directly below.

The model figure is as follows;



The calculation formula is similar to the former, case No.1.

$$A = B_o \times \frac{i_o - i_d}{i_d} \times i_o\ B_o \times 1/2 \quad (m^2/m)$$

here, A = Unit section area, L= Cutting distance on slope

E.4.3 Calculation Model and Method on Cutting of Slope land (See Figure E.4.2)

Calculation model and method are classified into five types (A,B,C,D,E).

Steps of calculation based on a topographical map is as follows.

1) Existing slope cutting area in design place is measured by using a topographical map,

2) An average slope width is calculated,

3) Unit section area on slope cutting is calculated,

4) Distance on slope cutting is calculated, it's method is as follows;

$$L = \frac{\text{Existing slope cutting area in design place}}{\text{average slope width}}$$

5) Hauling quantity is calculated, as follows;

Q = Unit section area x Distance on slope cutting (cu.m)

(1) A Type

This type is applieded to the case on condition that distance on slope cutting is not more than 200 meters, and measure point for slope wide is three points. Existing slope (gradient), i_o is almost 10 percentage.

(2) B Type

This type is applied to the case on condition that distance on slope cutting is not more than 500 meters, and measure point for slope wide is five points. Existing slope (gradient), i_o is almost 10 percentage.

(3) C Type

This type is applied to the case on condition that existing slope (gradient), i_o is full of variety, 10 ~ 15 percentage. But, existing slope width is not more than 50 meters.

(4) D Type

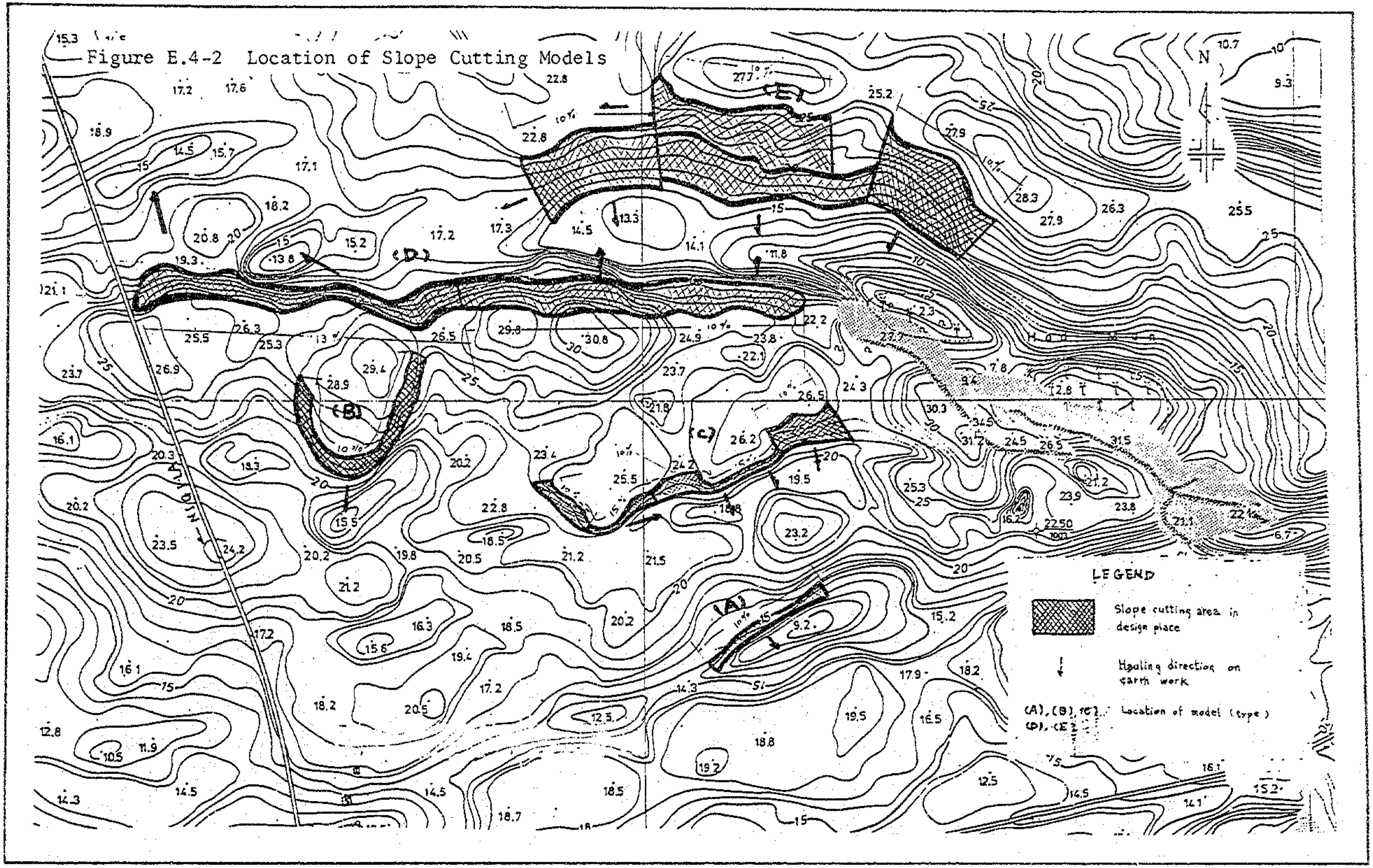
This type is applied to the case on condition that existing distance on cutting of slope land is 1000 meters or more than 1000 meters, and existing slope (gradient), i_o is full of variety.

About this type, distance of construction execution block on cutting of slope land should be some blocks, and each block distance should be 500 meters or not more than 500 meters.

(5) E Type

This type is aplied to the case on condition that existing slope width is more than 100 meters, construction execution block on cutting of slope land should be devided some blocks, and each block width should be 100 meter or not more than 100 meters.

Figure E.4-2 Location of Slope Cutting Models



E.5 Estimate on Rental Cost per Hour of the Construction Machinery

With regard to estimate on rental cost per hour of the construction machinery, Declining Balance Method is applicable to estimate in Egypt,

This method is carried out by rental cost factor per hour (Declining Balance Method) based on a economical useful life of construction machinery. And then the middle of useful life line factor is applicable to calculation on rental cost.

Basic price of the construction machinery is as follows:

$$\text{Basic Price} = \frac{\text{CIF}}{\text{Japanese Basic Price}} \times \text{Japanese Domestic Price}$$

i) Case of 21 ton Ripper Bulldozer

CIF (in Egypt) = ¥41,650,000 (Dec 6, 1988)
Japanese Basic Price = ¥25,800,000 (Japanese Domestic Price)

accordingly,

$$f = \frac{\text{CIF}}{\text{Japanese Basic Price}} = 1.61$$

ii) Case of 32 ton Ripper Bulldozer

CIF (in Egypt) = ¥56,080,000 (Dec 6, 1988)
Japanese Basic Price = ¥39,500,000 (Japanese Domestic Price)

accordingly

$$f = \frac{\text{CIF}}{\text{Japanese Basic Price}} = 1.42$$

And then,

$$\text{Basic Price} = \frac{1.4 \times \text{Japanese Basic Price (¥)}}{\text{¥}56} = \quad (\text{LE}1.0 = \text{¥}56)$$

Table E.5-1 Economical Useful Life of Construction Machinery

No.	Item	Useful Life Year	Useful Life Hour	Maintenance and Repair Rate (%)
1.	Bulldozer	5	10,000	90
2.	Grader	5	10,000	90
3.	Loader	5	10,000	90
4.	Excavator	5	10,000	90
5.	Towed Scraper	6	12,000	65
6.	Self propelled scraper	5	10,000	90
7.	Crawler tractor	5	10,000	90
8.	Wheel tractor	5	10,000	90
9.	Crane	5	10,000	65
10.	Pile Hammer	4	4,000	90
11.	Non Vibrating Rollers			
	- Self Propelled	5	10,000	65
	- Towed (excl. tractor)	6	12,000	65
12.	Vibrating Rollers			
	- Self propelled: 2 ton	4	8,000	90
	- Towed (excl. tractor)	4	8,000	90
13.	Tamper			
	- mechanical/pheumatic	4	4,000	65
	- vibrating plate tamper	4	4,000	65
14.	Dump. Truck s/d 8 ton	5	10,000	90
15.	Dump. Truck superior 8 s/d 20 ton	8	16,000	90
16.	Cargo Truck	5	10,000	90
17.	Tank Truck	5	10,000	90
18.	Trailer with tractor	10	10,000	90
19.	Asphalt Distributor	5	10,000	90
20.	Asphalt Sprayer	5	10,000	65
21.	Asphalt Finisher	6	12,000	90
22.	Asphalt Mixing Plant	10	15,000	90
23.	Batching Mixing Plant	15	30,000	90
24.	Chip spreader	4	4,000	65
25.	Soil stabilizer	4	4,000	65
26.	Soil Mixing Plant	5	10,000	65
27.	Stone crusher	5	10,000	90
28.	Harrow	4	4,000	65
29.	Plow	4	4,000	65
30.	Chain saw	2	2,000	65
31.	Compressor	5	10,000	90
32.	Concrete Mixer s/d 250 liter	2	4,000	65
33.	Water Pump s/d 4"	2	4,000	65
34.	Water Pump supperior 4"	3	6,000	65
35.	Generator Set 30 KVA superior	5	10,000	65

Table E.5-2. Rental Cost Factor per Hour (Declining Balance Method)

Item (Year x Hour)	Maintenance and Repair Rate(%)	Useful Year Factor 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
15Y.	90	123.05	112.22	101.91	92.14	82.98	74.18	65.95	58.28	51.23	44.50	38.39	32.81	27.16	23.24	19.23
15x2000	65	122.95	111.67	101.09	91.05	81.52	72.51	64.05	56.09	45.65	41.00	35.34	29.53	24.20	19.40	15.13
10Y.	90	151.08	133.16	125.90	100.09	86.33	73.01	60.84	49.35	38.94	33.15					
10x2000	65	150.47	131.96	124.51	98.41	83.31	69.43	50.65	45.03	34.58	25.24					
10Y.	90	214.14	188.99	165.38	143.31	123.76	103.73	86.24	70.26	55.81	42.55					
10x1500	65	213.34	187.40	162.99	140.13	119.38	88.96	80.65	62.89	43.53	34.93					
10Y.	90	302.11	266.31	232.51	201.59	172.67	146.06	121.21	99.66	79.91	62.11					
10x1000	65	300.89	263.93	229.23	189.47	166.71	138.80	113.38	90.11	63.16	50.49					
8Y	90	171.29	147.44	125.35	105.00	86.43	69.56	52.21	41.35							
8x2000	65	170.37	145.61	122.61	101.56	81.55	64.09	45.09	33.84							
6Y.	90	205.63	168.75	136.87	107.99	82.33	59.25									
6x2000	65	202.06	165.63	132.18	101.75	74.32	49.38									
5Y.	90	228.38	183.75	143.33	107.10	75.03										
5x2000	65	226.19	179.37	136.76	98.35	64.13										
4Y.	90	263.81	203.81	148.84	100.50											
4x2000	65	260.54	190.61	139.00	87.68											
4Y.	90	527.63	406.39	297.65	201.60											
4x1000	65	521.06	393.23	287.99	175.35											
3Y.	90	318.94	228.35	148.31												
3x2000	65	313.47	217.43	131.90												
2Y.	90	417.38	257.25													
2x2000	65	406.43	235.38													
2Y.	90	729.75	514.57													
2x1000	65	707.85	470.75													

Table E.5-3. Calculation on Rental Cost per Hour (Declining Balance Method)

Equipment Name	Equipment Description	Useful Life Year	Useful Life Hour	(1) Basic Price (CIF Price)	(2) Mauling Expenses (domestic) (fH = 6%)	(3) Initial Cost (1)+(2)	Mainte-nance Rate	(4) Factor on the Middle of Life Line	(5) Rental Cost (3)x(4)
				(x ₤10^6)	(x ₤10^6)	(x ₤10^6)	(%)	(%)	(₤)*
Bulldozer	11 ton	5	10,000	0.295	0.018	0.313	90	143.33	44.9
"	15 ton	5	10,000	0.365	0.022	0.387	"	"	55.5
"	21 ton	5	10,000	0.575	0.035	0.610	"	"	87.4
"	32 ton	5	10,000	0.898	0.054	0.952	"	"	136.5
Towed Scraper	8.2 ton, 8.0 m^3	6	12,000	0.168	0.010	0.178	65	132.18	23.5
"	10.8 ton, 9.0 m^3	6	12,000	0.185	0.011	0.196	"	"	25.9
"	13.1 ton, 12.0 m^3	6	12,000	0.298	0.018	0.316	"	"	41.8
"	18.0 ton, 17.0 m^3	6	12,000	0.355	0.021	0.376	"	"	49.7
Scrapdozer	SR 2000, 8.0 m^3	5	10,000	0.981	0.059	1.040	90	143.33	149.1
"	25 ton, 6.4 m^3	5	10,000	0.920	0.055	0.975	"	"	139.8
Grawler Type Tractor Shovel	1.3 m^3	5	10,000	0.243	0.015	0.258	"	"	37.0
"	1.8 m^3	5	10,000	0.390	0.023	0.413	"	"	59.2
Crawler Type Back Hoe	0.35 m^3	5	10,000	0.253	0.015	0.268	"	"	38.4
	0.60 m^3	5	10,000	0.383	0.023	0.406	"	"	58.2
Dump Truck	8 ton	5	10,000	0.118	0.007	0.125	"	"	17.9

(*) Notice: ₤1.0 = ¥56 ₤ = Egyptian Pounds

Table E.5-4. Hourly Operation Cost on Construction Machinery

£(L.E) = ¥56. (1989.1)

Name		Labor Cost (L.E) Foreman	Labor Cost (L.E) Operater	Labor Cost (L.E) Assistant	Labor Cost (L.E) Subtotal (1)	Fuel Cost (L.E) Main Fuel	Fuel Cost (L.E) Machine Oils and others	Fuel Cost (L.E) Subtotal (2)	Rental Cost of Machinery (3)	Total Cost (1)+(2)+(3)	Total (£)
Rate Cost		15	20	8		G: 0.35/ℓ D: 0.10/ℓ	(%)				
	F/C	–	–	–	–	18%	10%		100%		
	L/C	100%	100%	100%		90%	90%		–		
Bulldozer		0.04	0.20	0.07		13ℓ	20%		1.0 hour	–	
11 ton		–	–	–	F/C –	0.13	0.03	F/C 0.16	F/C 44.9	F/C 45.06	
		0.60	4.00	0.56	L/C 5.16	1.17	0.23	L/C 1.40	L/C –	L/C 6.56	51.62
Bulldozer		0.04	0.20	0.07		18ℓ	20%		1.0 hour	–	
15 ton	F/C	–	–	–	F/C –	0.18	0.04	F/C 0.22	F/C 55.50	F/C 55.72	
	L/C	0.60	4.00	0.56	L/C 5.16	1.52	0.30	L/C 1.82	L/C –	L/C 6.98	62.70
Bulldozer		0.04	0.20	0.07		26ℓ	20%		1.0 hour		
21 ton	F/C	–	–	–	F/C –	0.26	0.05	F/C 0.31	87.40	F/C 87.71	
	L/C	0.60	4.00	0.56	L/C 5.16	2.34	0.47	L/C 2.81	–	L/C 7.97	95.68
Bulldozer		0.04	0.19	0.06		39ℓ	20%		1.0 hour	–	
32 ton	F/C	–	–	–	F/C –	0.39	0.08	F/C 0.47	F/C 136.5	F/C 136.97	
	L/C	0.60	3.80	0.48	L/C 4.88	3.51	0.70	L/C 4.21	L/C –	L/C 9.09	146.06
Towed Scraper									1.0	–	
12 m^3 Class									F/C 41.8	F/C 41.80	
									L/C 0	L/C 0	41.80
Towed Scraper									1.0 hour	–	
17 m^3 Class									F/C 49.7	F/C 49.70	
									L/C 0	L/C 0	49.70

Table E.5-5. Hauling Soil Quanty by Soil Classification on Amendment for Stope of Land

Model Zone: CP-1 Block

Class	Block	Area		Soil Quantity	Existing Unit Quantity		Design Unit Quantity	
		hectare	feddan	Unit: 1,000 m^3	c.u.m./ha	c.u.m./feddan	c.u.m./ha	c.u.m./feddan
3sd	-	249	590	163	655	276	700	300
2s	-	668	1,590	633	948	398	900	400
3st	A*	3,165	7,540	5,339	1,687	708	-	-
	B**	3,337	7,950	4,280	1,282	538	-	-
	A + B	6,502	15,480	9,619	1,464	621	1,500	630
4st	A	2,128	5,070	11,451	5,381	2,259	-	-
	B	1,182	2,814	5,655	4,784	2,010	-	-
	A + B	3,310	7,880	17,106	5,168	2,171	5,200	2,200

Note: * North side parts from Main Road
** South side parts from Main Road

Design amendment value is as follows
3sd or 2s class: 3% slope
3st or 4st class: 5% slope

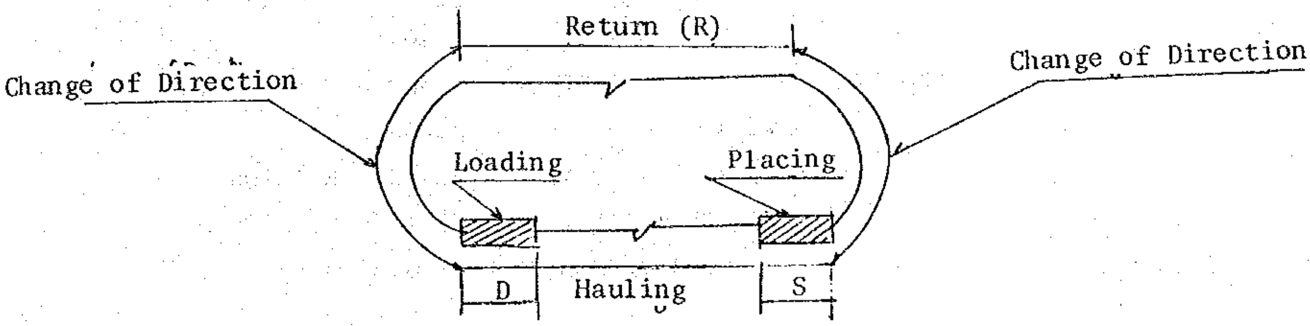
Calculation of Working Capacity per Hour on Towed Scraper

Calculation formula is as follows:

Q = Earthwork Quantity per Hour = $\frac{60\ qfE}{cm}$ (m^3/Hour)

Here,

Q ; Hauling Capacity , q = Bowl Capacity
f ; Soil Conversion factor
E ; Operating efficiency
Cm; A cycle time (min)
Operating cycle on towed scraper



$$Cm = \frac{D}{Vd} + \frac{H}{Vh} + \frac{S}{Vs} + \frac{R}{Vr} + tq \ (min)$$

Here,
Cm; Cycle time (min)
D ; Distance of loading (m)
H ; Hauling distance (m)
S ; Placing distance (m)
Vd; Velocity of loading (m/min), Vs; Velocity of placing (m/min)
Vr; Velocity of returning (m/min)
R ; Distance of returning
tg; Time of gearing up a machinery

Formula of Cm on towed scraper

1. Hauling Distance: L > 100 m

$$Cm = \frac{D}{Vd} + \frac{100}{Vh_1} + \frac{H - 100}{Vh_2} + \frac{s}{V_3} + \frac{100}{Vr_1} + \frac{R - 100}{Vr_2} + tg$$

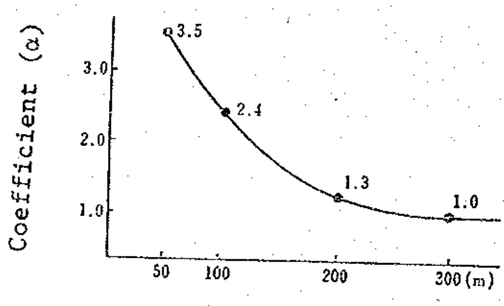
2. Hauling Distance: L < 100 m

$$Cm = \frac{D}{Vd} + \frac{H}{Vh_1} + \frac{s}{Vs} + \frac{100}{Vr_1} + \frac{R - 100}{Vr_2} + tg$$

Table E.5-6. Dimension for Calculation of a Cycle Time

Item	Standard Size of Scraper	Operating Condition Good	Standard	No Good	Remarks
D (m)	6-9 m^3	30-40	40-50	50-60	
	12-17 "	40-50	50-60	60-70	
Vd (m/min)		52-58	35-40	30-35	L-(D + s)x1/2
Vh_1 (m/min)		70-85	55-70	40-55	H < 100 m
Vh_2 (m/min)		125-165	95-125	55-95	H > 100 m
S (m)	6-9 m^3	20	30	40	
	12-17 m^3	30	40	50	
Vs		75-85	55-60	55-60	
Vr_1 (m/min)		75-85	60-75	40-60	R < 100 m
Vr_2 (m/min)		140-165	115-140	85-115	R > 100 m
tq (min)		0.25-0.33	0.25-0.33	0.25-0.33	

Supplementary Coefficient concerned Hauling Distance (L m)



Hauling Distance (L)

Table E.5-7. Basic Item for Towed Scraper

Standard Size	Bowl Capacity (qo)	Empty Weight	Power (Ps)	Excavation Breadth	Standard Combine Machinery
5 m^3	4.8	5.5	-	2.00	21 ton class
6	6.1	7.5	-	2.67	"
9	9.2	10.2	-	2.60	"
12	11.9	12.2	-	2.91	32 ton Class
15	15.8	16.5	-	3.08	"
17	17.3	17.2	-	3.11	"

Calculation of Unit Direct Cost

(1) Item and Calculation

Hauling Distance: L = 300 m

Soil Texture: Sand

Site Condition: Good

Bowl Capacity: 17.3 m^3 (17 m^3 class)

f = 1/L = 1.25

D = 50 m, s = 30 m

$$H = L - \frac{D + S}{2} = 300 - \frac{50 + 30}{2} = 260 \text{ (m)}$$

$\alpha = 1.0$, $R = L \times \alpha = 300 \times 1.0 = 300$ (m)

Vs = 80 m/min, Vri = 80 m/min Vr_2 = 153 m/min, tq = 0

Cm = 6.23 (min)

E = 0.75 , q = qo x k = 17.2 x 1.05 =18.1

(without Pusher: k=1.05)

$$Q = \frac{60\ q\ f\ E}{Cm} + \frac{60 \times 18.1 \times 1/125 \times 0.75}{6.23} = 104.6\ m^3/\text{Hour}$$

(2) Hourly operating cost and Unit Direct Cost

(i) Hourly operating Cost on Towed Scraper

17 m^3 class Scraper + 32 ton Class Bulldozer:

49.70 + 146.06 = 195.76 (৳)

(ii) Unit Direct Cost $= \frac{195.76}{104.6}$ = ৳ 1.9 /m^3

Table E.5-8. Calculation of Working Capacity per Hour on Consolidation by Bulldozer

Hourly Consolidation Capacity

Standard size	:	11 ton class Bulldozer
Velocity on Consolidation	:	V = 3,500 m/hour
Effective consolidation breadth	:	w = 0.7 m
Thickness on carrying out by bulldozer	:	D = 0.30 m
Consolidation times	:	N = 5
Operating efficiency	:	E = 0.6
Consolidation Capacity per Hour	:	Q = 88.2 m^3/h

Hourly Operating Cost for 11 ton Bulldozer

from hourly operation cost on construction machinery;

Hourly Cost = 51.62 (L.E)

Unit Direct Cost

$$\text{Unit Direct Cost} = \frac{51.62}{88.2} = 0.6\ (\text{L.E})/m^3$$

Unit Direct Cost on Excavation and Consolidation

Unit Direct Cost = ₤ 1.9/m^3 + ₤ 0.6/m^3 = ₤ 2.5/m^3

APPENDIX-F. Crop and Livestock Production

Table F.1-1. Crop Selection Procedure

Characteristics	Description		Score
Adaptability to Desert	Drought resistance, sand adaptability	Sand preference	2
		Moderately susceptible,	1
		Poor growth on sand	0
Demand Situation	Supply tightness, tendency of price hike	Infinite demand	3
		Estimated, 10,000-ton	2
		Estimated, 10,000-ton	1
		Demand saturated	0
Export/Import	Exportable or import substitutable	Import substitutable	3
		Currently exporting	2
		Overseas market aspect	1
		No trade expected	0
Crop Economy	Gross margin/feddan	Over LE 1,000	3
		500 - 1,000	2
		200 - 500	1
		Below LE 200	0
Current Existence	Observed in ...	Farms in North Sinai	2
		Trials plot	1
		None	0
Processibility	Storable by processing	Valuable material	2
		Low profit if processed	1
		Not processable	0
By-product Utilization	Value of by-products	Useful by-product	2
		Conditionally useful	1
		Not usable	0
Water Requirement	Daily consumption in June/July (in mm)	No crop in summer	3
		0 - 3 mm/day	2
		3 - 10 mm/day	1
		More than 10 mm/day	0
Labour Utilization	Return to labour input (LE/manday)	Higher than LE 10	3
		LE 5 - LE 10	2
		LE 2 - LE 5	1
		Not labour intensive	0
Salinity Tolerance	ECe level causing yield drop (to a half)	ECe 16	3
		12 - 16	2
		8 - 12	1
		8	0

Table F.1-2. Crop Selection

Crop	Season	Adaptability to desert	Demand Situation	Export / Import	Crop Economy	Current Existence	Processable or not	By Product Utilizability	Water Requirement	Importance on food balance	Labour utilization	Salinity tolerance	Total Point
Alfalfa	perennial	1	3	3	1	1	2	0	0	3	1	1	16
Amshoot	〃	2	3	3	0	0	0	0	0	3	2	3	13
Berseem	winter	0	3	3	1	0	2	0	3	3	1	1	17
Fodderbeet	〃	1	3	3	2	1	0	0	3	3	2	2	20
Napiergrass	summer	1	3	3	1	0	0	0	0	3	1	1	13
Sordan	〃	0	3	3	2	0	0	0	0	3	2	2	15
Bermudagrass	〃	2	3	3	1	1	0	0	0	3	2	3	18
Fodder maize	〃	0	3	3	1	2	0	0	1	3	2	1	16
Feedbarley	winter	2	3	3	1	2	0	0	3	3	1	3	21
Flax	〃	0	2	3	2	1	2	2	3	—	2	1	18
Safflower	〃	1	3	3	1	0	2	0	3	3	1	3	17
Sunflower	summer	2	3	3	1	2	2	0	0	3	1	0	17
<u>Sesame</u>	〃	2	2	1	0	1	1	0	0	2	0	0	<u>9</u>
Rice	〃	0	2	3	1	0	0	2	0	1	3	1	13
Wheat	winter	1	3	3	0	1	0	2	3	3	1	2	19
Barley	〃	2	2	3	0	2	1	2	3	1	1	3	20
Groundnut	summer	2	2	3	1	1	1	2	0	3	1	0	16
Maize	〃	1	1	3	1	2	0	2	0	3	1	0	14
Oil Olive	perennial	2	3	2	3	2	2	2	1	—	3	1	21
<u>Garlic</u>	summer	0	1	2	1	1	0	0	3	1	2	0	<u>9</u>
<u>Onion</u>	〃	1	1	2	0	2	0	0	3	1	1	0	<u>11</u>

Crop	Season	Adaptability to desert	Demand Situation	Export / Import	Crop Economy	Current Existence	Processable or not	By Product Utilizability	Water Requirement	Importance on food balance	Labour utilization	Salinity torelance	Total Point
Greenpepper	winter	0	2	2	2	1	0	0	3	1	3	0	14
Greenpeas	〃	0	2	1	2	1	1	1	3	2	3	0	13
French bean	nily	0	2	3	2	1	1	1	2	2	3	0	17
Cabbage	winter	0	1	0	2	0	0	0	2	1	2	0	8
Okra	summer	0	1	0	2	0	0	0	1	1	1	0	6
Eggplant	〃	0	1	0	2	1	0	0	0	1	1	0	6
Cantalope	〃	2	2	0	3	2	0	0	0	1	2	0	12
〃	winter	2	2	0	1	2	0	0	3	1	2	0	13
Watermelon	summer	2	1	0	2	2	0	0	2	1	1	0	11
Squash	winter	2	2	2	2	2	0	0	3	2	2	0	17
Cucumber	〃	1	1	2	2	2	0	0	3	1	3	0	15
Potato	〃	1	1	2	2	1	1	0	3	1	2	0	14
Broadbean	〃	1	1	1	0	1	1	1	3	1	1	0	11
Tomato	〃	1	2	1	3	2	2	0	3	1	3	1	16
〃	nily	1	3	0	3	2	2	0	2	1	3	1	18
〃	summer	1	2	0	2	2	2	0	0	0	2	1	12
Strawberry	winter	1	1	0	2	0	1	0	3	0	3	0	11
Apple	perennial	1	2	3	3	1	2	0	0	1	3	0	16
Orange	〃	1	1	3	2	1	2	0	1	1	3	0	15
Guava	〃	1	1	1	1	2	2	0	1	1	3	0	13
Grape	〃	1	1	1	1	2	2	0	2	1	3	1	15
Fig	〃	1	1	0	3	1	2	0	0	1	3	1	13
Dates	〃	1	1	1	1	1	2	0	0	1	2	0	10
Peach	〃	1	0	0	2	1	1	0	0	1	3	0	9
Pomgranate	〃	1	1	1	2	1	1	0	0	1	2	1	11

Table F.1-3.

Estimated Crop Yield Development (1)

unit : ton / feddan

crop	season (soil)	year after reclamation											
		1	2	3	4	5	6	7	8	9	10	11	stabilized year
rice	summer	.2	.4	.6	.8	1.0	1.2	1.5	1.8	2.0	2.0	2.0	2.0
wheat	winter	.2	.3	.5	.7	.9	1.1	1.3	1.3	1.3	1.3	1.3	1.3
barley	〃	.5	.8	–	–	–	–	–	–	–	–	–	–
grain maize	summer	.6	.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.5	1.5
groundnut	〃	.3	.4	.5	.6	.6	.7	.7	.8	.8	.8	.8	.8
sunflower	〃	.3	.4	.5	.6	.7	.8	.9	.9	.9	.9	.9	.9
flax seed	winter	.2	.2	.3	.3	.4	.4	.4	.5	.5	.5	.5	.5
flax stalk	〃	.7	.8	1.0	1.2	1.4	1.6	1.8	1.9	2.2	2.3	2.3	2.3
safflower	〃	.2	.3	.3	.4	.4	.5	.5	.5	.5	.5	.5	.5
oil olive	peren.	–	–	–	–	.5	1.0	1.8	2.4	2.8	3.0	3.0	3.0
tomato	nily (clay)	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0	8.0	8.0	8.0	8.0
tomato	〃 (sand)	3.0	4.0	5.0	5.5	6.0	6.5	7.0	7.0	7.0	7.0	7.0	7.0
tomato	winter	3.0	4.0	4.5	5.0	6.0	6.5	6.5	7.0	7.0	7.0	7.0	7.0
squash	〃 (clay)	–	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	7.5	8.0	8.0
squash	〃 (sand)	0.5	1.0	2.0	3.0	4.0	5.0	5.5	6.0	6.5	7.0	7.0	7.0
cucumber	〃	3.0	3.5	4.0	4.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
potato	〃	2.0	3.0	3.5	4.0	4.5	5.0	5.5	5.5	6.0	6.0	6.0	6.0
french bean	nily	0.5	1.5	2.5	3.0	3.5	4.0	4.5	4.5	5.0	5.0	5.0	5.0
green pepper	winter	0.5	1.0	2.0	2.5	2.5	3.0	3.5	3.5	4.0	4.0	4.0	4.0
green pea	〃	1.0	2.0	3.0	3.0	3.0	3.5	4.0	4.5	5.0	5.0	5.0	5.0
cantaloupe	summer	3.0	4.5	5.0	5.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
berseem	winter	3	7	11	15	18	21	24	26	28	28	28	28
amshoot	peren.	20	–	–	–	–	–	–	–	–	–	–	–
sordan(clay)	summer	1	2	4	7	12	18	20	23	28	32	35	35
sordan	〃 (sand)	4	7	9	11	15	19	23	28	30	32	32	32
bermuda grass	〃 (clay)	1	2	–	–	–	–	–	–	–	–	–	–
napier grass	〃 (clay)	1	2	5	9	14	19	24	27	30	30	30	30
napier grass	〃 (sand)	4	6	8	10	14	18	22	24	25	26	27	27
alfalfa	peren.	7	10	13	15	18	21	22	25	27	28	29	30
alfalfa(short)	winter	5	7	9	11	13	15	16	18	19	20	20	20
fodder beet	〃 (clay)	2	5	9	14	19	24	28	31	33	35	35	35
fodder beet	〃 (sand)	5	8	11	14	17	20	22	25	28	30	32	32
feed barley	〃	.2	.5	.8	.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
f. barley straw	〃	.5	.7	1.0	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
fodder maize	summer	5	6	8	10	13	15	18	20	22	24	25	25
apple	peren.	–	–	–	.3	.5	.8	1.0	1.3	1.5	1.8	2.0	2.0
orange	〃	–	–	–	–	1	2	4	6	7	8	8	8
grape	〃	–	–	.5	1.0	1.5	2.0	3	4	5	6	6	6
fig	〃	–	–	.5	1.0	2.0	2.5	3.5	4.0	4.5	5.0	5	5
guava	〃	–	–	–	1	2	3	4	5	6	7	7	7

Estimated Crop Yield Development (2)

unit : ton / feddan

crop	season (soil)	year after reclamation											
		1	2	3	4	5	6	7	8	9	10	11	stabilized year
rice straw	summer	.5	.8	1.2	1.5	1.8	2.1	2.2	2.2	2.2	2.2	2.2	2.2
barley strc v	winter	.5	.8	–	–	–	–	–	–	–	–	–	–
wheat straw	〃	.6	.6	.9	1.1	1.2	1.3	1.4	1.4	1.4	1.4	1.4	1.4
gr. maizw stover	summer	.3	.4	.5	.7	.9	1.1	1.1	1.5	1.5	1.5	1.5	1.5
french bean stalk	winter	.3	.3	.4	.5	.6	.6	.6	.6	.6	.6	.6	.6
groundnut stalk	summer	.3	.4	.4	.4	.5	.5	.6	.6	.6	.6	.6	.6
sunflower stalk	〃	.2	.3	.4	.5	.6	.7	.8	.8	.8	.8	.8	.8
sunflower cake	〃	.1	.2	.2	.2	.3	.3	.4	.4	.4	.4	.4	.4
flax cake	winter	–	–	.1	.1	.1	.2	.2	.2	.2	.2	.2	.2
safflower cake	〃	–	–	.1	.2	.2	.3	.3	.3	.3	.3	.3	.3
olive cake	winter	–	–	–	–	.2	.4	.8	1.0	1.2	1.3	1.3	1.3

Table F.1-4. Reference for Yield Estimation

Crop	ARC* Ismailia	Ismailia** Agricultural Statistics	East Bitter Lake Farms	Qatia	Eastern N.Sinai	*** R.D.P.	**** L.M.P.
Rice	-	2.3 - 2.7	-	-	-	2.5-3.4	1.6-2.0
Wheat	1.5(2.1)	1.3 - 1.5	1.1	-	1.7	1.0-1.5	1.2-1.5
Maize			1.5				
Groundnut	2.5	0.8 - 0.4	0.3	-	-	1.5-1.9	
Barley		0.6 - 1.0			0.6		
Flax	2.0	0.5 - 0.7	0.9				
Safflower	1.5			-	-	0.5-0.6	
Sesame	0.6	0.2 - 0.4	0.3	-	-	0.3	
Amshoot	(17.4)						
Alfalfa	45(60)					22 - 28	
Berseem	45	11 - 13	4.9			20 - 40	20 - 25
Fodderbeet	(80)				20		
Winter Vegetables							
Tomato			3.3 - 6.0				
Pepper			3.0				
Cucumber			5.0				
Cantaloupe			1.5 - 2.0				
Green bean		2.0 - 5.3	0.9 - 2.5			2 - 3	
Potato		5.3 - 4.8					
Summer Vegetables							
Tomato		8.0 - 9.7	5.1	5	20	15 - 20	
Pepper		5.1 - 7.2			4.0		
Squash		6.3 - 8.9	3.6	10	8.0	10	
Cucumber		5.5 - 5.6	2.9 - 5.0	5	2.5		
Cantaloupe			2,5	6	3.0		
Grape		2.3 - 4.8			0.5	6.3-12.6	
Guava		5.4 - 7.9	2.5	0.5	6.0		

note ; * figures in brackets given from nearby experiment stations.
** in 1984 *** Records in reclaimed desert land

**** Land Master Plan

Table F.1-5. CROP VARIETIES

crop	common varieties	new or recommended varieties
rice paddy	Giza 172 Reiho	Giza 175
sesame		Giza 25
maize	Giza 2 Pioneer Baladi	El Cairo
wheat	Giza 155 Giza 147 Sakha 61	Giza 155 Sakha 68 Sakha 8 Giza 145 Yokla (Saudi var.)
groundnut	Early bunch	Giza 5 Giza 4
Flax	var. for fiber---	Raina Blinka
	var. for oilseed---	Giza 4 Giza 5 Giza 6
Safflower		thornless canadian varieties
Sunflower	russian tall vars.	american semi-dwarf vars.
Alfalfa	CAFF 101 (USA var.)	Seewa
Berseem	Fahl Saka3 Saka 4	Sakha 8 Giza 10
Fodderbeet		Roota Brajadaal
Summer Tomato	UC 84 (ISRAEL) P286 (USA)	Dambo Rio-Grande New wonder
Winter Tomato		Super marmand (France) Naama
Sweet Pepper		Abundance(FRANCE)
Cucumber	Corridilo(HOLLAND)	Ramar Katia Dinaki
Cantaloupe		Zaratoo juice
Watermelon		Giza 1
Oil Olive	Fayuum	SkimulariTunisia) Manzatello(ITALIA)
Grape	Saltanina seedless	
Apple		Anna (fig) Sortani

Table F.1-6. Crop Production Schedule (Unit: 1000 Feddan, 1000 Ton)

Year	1		2		3		4		5		6		7		8		9		10		Stabilized	
Crop	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P
C.P.1																						
Alfalfa	6	41	12	100	6	53	6	65	5	61	9	169	5	75	5	118	5	127	9	226	9	282
Fodderbeet	6	30	12	94	6	65	6	82	5	80	9	188	5	103	5	118	5	132	30	141	7	226
Sordan	6	24	-	-	6	47	-	-	5	71	-	-	5	108	-	-	5	141	-	-	2	75
Napiergrass	-	-	6	35	6	47	-	-	-	-	5	84	5	103	-	-	-	-	5	122	2	63
Safflower	-	-	-	-	6	2	6	2	-	-	-	-	5	2	5	2	-	-	-	-	2	1
Flax Grain	-	-	-	-	6	2	6	2	-	-	-	-	5	2	5	2	-	-	-	-	2	2
Flax Stalk	-	-	-	-	-	6	-	7	-	-	-	-	-	8	-	9	-	-	-	-	-	5
Sunflower	6	2	-	-	-	-	6	4	5	3	-	-	-	-	5	4	5	4	-	-	2	4
Cucumber	6	18	-	-	-	-	-	-	5	24	-	-	-	-	-	-	5	24	-	-	1	3
Tomato	-	-	-	-	6	30	6	32	-	-	-	-	5	33	5	33	-	-	-	-	2	16
Camtalope	-	-	6	26	-	-	-	-	-	-	5	28	-	-	-	-	-	-	5	28	1	7
Potato	6	12	-	-	-	-	-	-	5	21	-	-	-	-	-	-	5	28	-	-	1	4
Olive	-	-	-	-	-	-	-	-	5	24	5	5	5	8	5	11	5	13	5	14	5	14
C.P.2																						
Berseem	-	-	-	-	-	-	-	-	1	16	-	-	1	22	1	23	-	-	1	25	0	13
Fodderbeet	-	-	1	5	1	8	-	-	-	-	1	22	-	-	-	-	1	30	-	-	1	17
Sordam	-	-	-	-	1	4	-	-	1	6	0	8	-	-	0	11	0	13	-	-	0	10
Napiergrass	-	-	-	-	-	-	-	-	1	6	-	-	-	-	0	12	-	-	-	-	0	4
Bermudagrass	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amshoot	2	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	2	0	-	-	-	-	2	1	-	-	-	-	2	3	-	-	-	-	2	4	1	1
Wheat	-	-	-	-	-	-	1	1	1	1	-	-	1	1	1	1	-	-	1	1	0	1
Barley	-	-	1	1	-	-	1	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Squash	-	-	-	-	1	1	-	-	-	-	1	5	-	-	-	-	1	6	-	-	0	2
Tomato	-	-	1	2	-	-	-	-	1	5	-	-	-	-	1	7	-	-	-	-	0	2
Frenchbean	-	-	-	-	1	2	-	-	-	-	1	4	-	-	-	-	1	5	-	-	0	1

(Cont'd) Crop Production Schedule (Unit: 1000 Feddan, 1000 Ton)

Year	1		2		3		4		5		6		7		8		9		10		Stabilized	
Crop	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P
C.P.3																						
Alfalfa	-	-	1	9	1	8	-	-	1	12	1	10	-	-	1	17	1	13	-	-	1	21
Fodderbeet	2	9	1	7	1	10	2	26	1	12	1	14	1	30	1	17	1	19	1	41	1	29
Sordan	-	-	1	6	1	8	-	-	1	10	1	13	-	-	1	19	1	21	-	-	0	15
Napiergrass	-	-	-	-	1	7	-	-	-	-	1	12	-	-	-	-	1	17	-	-	0	6
Maize	1	1	-	-	-	-	1	1	-	-	-	-	1	1	-	-	-	-	1	1	0	0
Groundnut	1	0	-	-	-	-	1	0	-	-	-	-	1	1	-	-	-	-	1	1	0	0
Greenpepea	-	-	-	-	1	3	-	-	-	-	1	2	-	-	-	-	1	3	-	-	0	1
Greenpepper	-	-	-	-	1	2	-	-	-	-	1	2	-	-	-	-	1	3	-	-	0	1
Tomato	-	-	1	4	-	-	-	-	1	4	-	-	-	-	1	5	-	-	-	-	0	2
Squash	-	-	1	1	-	-	-	-	1	3	-	-	-	-	1	4	-	-	-	-	0	2
Sunflower	1	0	1	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Safflower	0	0	-	-	-	-	1	0	-	-	-	-	1	0	-	-	-	-	1	0	0	0
Flax Grain	1	0	-	-	-	-	1	0	-	-	-	-	1	0	-	-	-	-	1	0	0	0
Flax Stalk	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	1
Apple	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1
Orange	-	-	-	-	-	-	-	-	0	0	0	1	0	2	0	3	0	3	0	4	0	4
Grape	-	-	-	-	0	0	0	0	0	1	0	1	0	1	0	2	0	2	0	3	0	3
Fig	-	-	-	-	0	0	0	0	0	1	0	1	0	2	0	2	0	2	0	2	0	2

(Cont'd) Crop Production Schedule (Unit: 1000 Feddan, 1000 Ton)

Year	1		2		3		4		5		6		7		8		9		10		Stabilized	
Crop	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P
C.P.4																						
Alfalfa	4	25	4	36	4	47	4	54	4	65	4	76	4	79	4	90	4	97	4	101	4	108
Fodderbeet	2	12	-	-	2	26	-	-	2	41	-	-	2	53	-	-	2	67	-	-	1	38
Feedbarley-grain	-	-	2	1	-	-	2	2	-	-	2	2	-	-	2	2	-	-	2	2	1	1
Feedbarley-stalk	1	5	-	2	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	4	-	2
Foddermaize	1	6	1	7	1	10	1	12	1	16	1	18	1	22	1	24	1	26	1	29	1	30
Sordan	1	5	1	8	1	11	1	13	1	18	1	23	1	28	1	32	1	36	1	38	1	38
Sunflower	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C.P.5																						
Apple	2	0	2	0	2	0	2	1	2	1	2	2	2	2	2	3	2	3	2	4	1	5
Orange	1	0	1	0	1	0	1	0	1	1	1	1	1	2	1	3	1	4	1	5	1	5
Grape	1	0	1	0	1	1	1	1	1	1	1	2	1	3	1	5	1	6	1	7	1	7
Fig	1	0	1	0	1	1	1	1	1	2	1	3	1	4	1	5	1	5	1	6	1	6
Guava	1	0	1	0	1	0	1	1	1	2	1	2	1	2	1	3	1	3	1	4	1	4

Note: A; area in 1000 feddan
P; production in 1000 tons
where 0 indicates figures less than 500

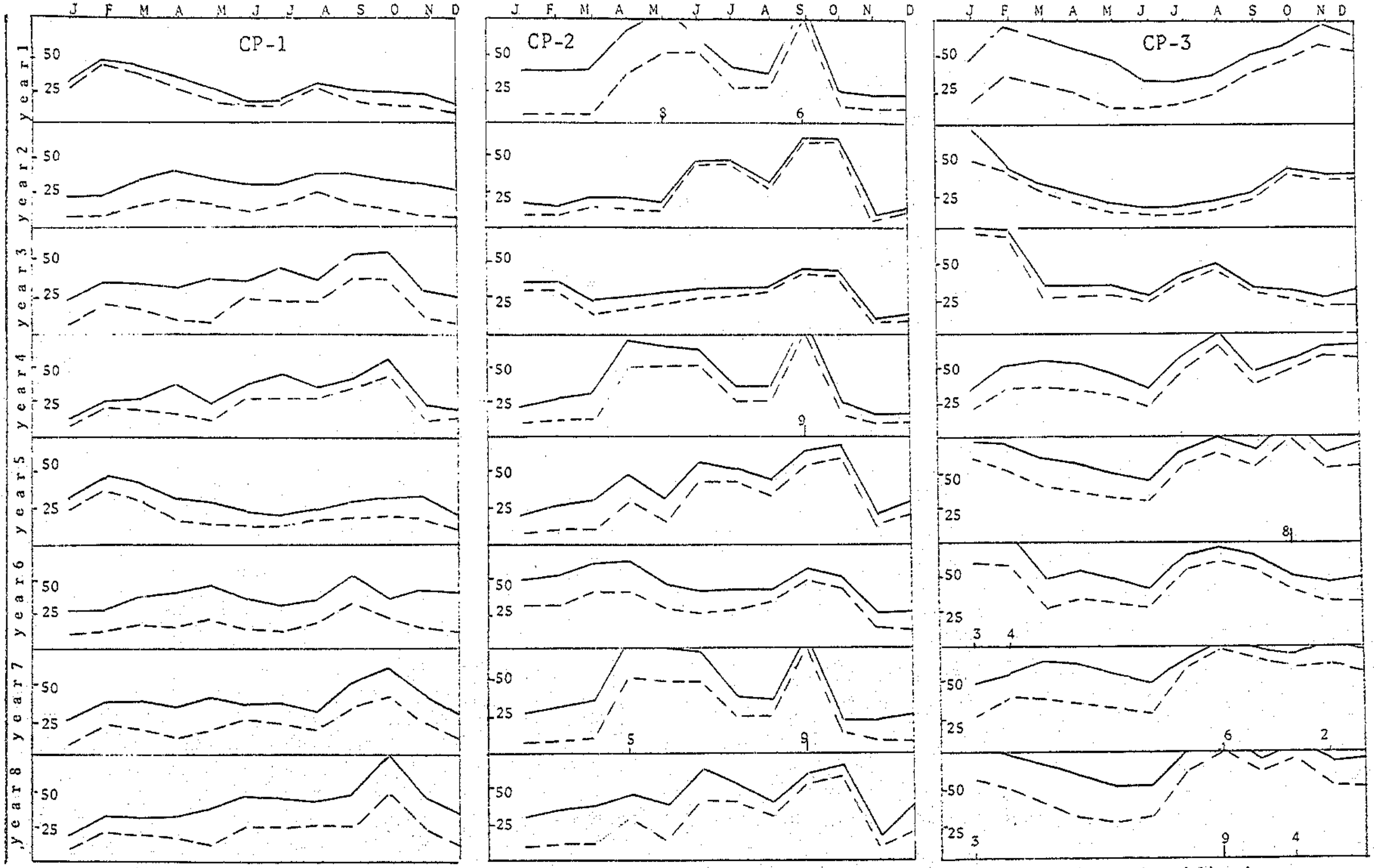
Table F.1-7. Annual Agricultural Inputs at the Stabilized Stage

Cropping Pattern		C.P.1	C.P.2	C.P.3	C.P.4	C.P.5
net Cropping Area	feddan	23,500	1,800	4,600	6,000	5,700
seed	ton	272*	39	53*	120	0
manure	1000ton	301	16	62	41	95
fertilizer (N)	ton	4,780	340	1,005	945	1,650
" (P_2O_5)	ton	3,615	395	1,740	795	680
" (K_2O)	ton	2,505	135	515	630	680
chemicals	ton	108	11	28	14	45
machinery hours	1000hrs	(255.8)	19.6	(59.9)	66.9	108.9
agricultural labor	1000mandays	2,605	207	408	184	274
self-supplied feeds	1000tons	647	44	71	119	0
purchased feeds	1000tons	0	0	(2)	5	0
replacement stock	heads	7,050	54	92	375	0

note : * except potatoes, ** thousand seedlings
( ) indicate only potential demand.

Figure F.1-1. LABOUR INPUT SCHEDULE

(Unit: man-day)



Note : solid line shows total monthly labour input, whereas dotted line does that required for crop production only. Figures on the base line indicate extra man-days above the level of 75 man-days per month.

LABOUR INPUT SCHEDULE (continued (Unit: man-day)

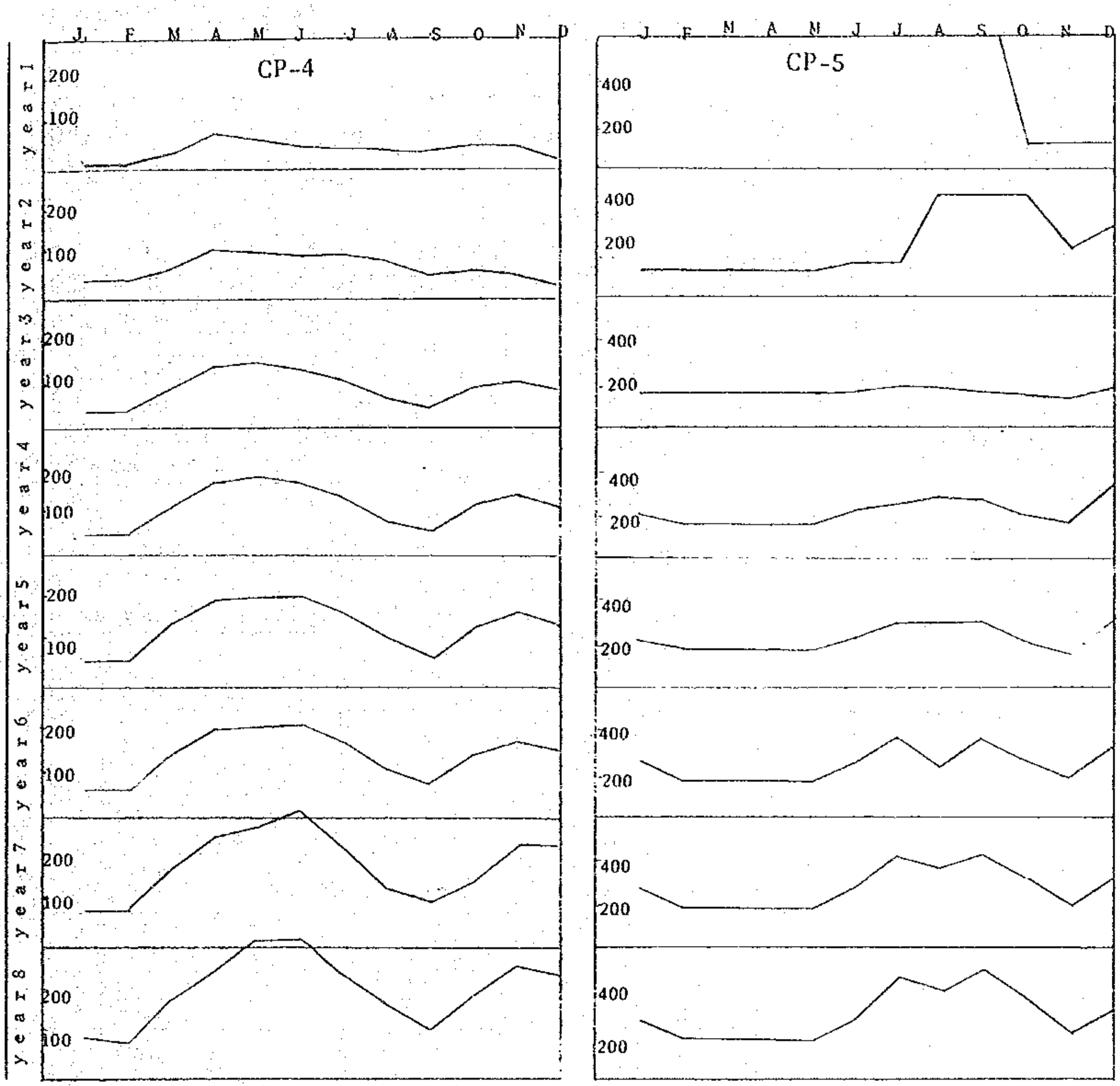


Table F.1-8.

Labour Requirement/Farm at the Stabilized Stage

Month	J	F	M	A	M	J	J	A	S	O	N	D	year to	per feddan (head)
C.P.1 (4.24 feddan)														
Crop	8	19	17	15	15	23	24	23	28	45	19	11	247	58
Livestock	9	10	13	17	26	21	19	21	21	24	21	21	223	(6.2)
											Total		470 mandays	
C.P.2 (3.75 feddan)														
Crop	12	15	30	23	29	29	23	22	44	29	7	9	272	73
Livestock	17	17	19	15	19	19	11	8	8	8	8	11	160	(20)
											Total		432 mandays	
C.P.3 (8.52 feddan)														
Crop	48	48	34	32	28	28	58	69	60	57	48	46	556	65
Livestock	22	23	24	22	20	18	12	10	10	10	13	16	200	(20)
											Total		756 mandays	
C.P.4 (80 feddan)														
Crop	16	16	48	96	96	80	80	96	48	40	32	8	656	8
Livestock	75	60	135	150	225	240	150	75	67	150	225	240	1,792	(7)
											Total		2,448 mandays	
C.P.5 (80 feddan)														
Crop	272	176	176	176	176	288	532	444	596	440	230	308	3,814	48
Livestock	0	0	0	0	0	0	0	0	0	0	0	0	0	0
											Total		3,814 mandays	

Table F.1-9. Labour Requirement

mandays per feddan

Crop	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
W.N -	-	-	-	-	-	-	-	-	-	-	-	-	-
W.O Water melon	0	0	0	10	5	5	15	13	0	0	0	0	48
W.N Tomato Nily	0	0	0	0	0	15	15	10	15	20	0	0	75
" Winter	15	15	10	0	0	0	0	0	4	7	10	10	71
W.O " Winter	15	10	0	0	0	0	0	0	4	7	10	10	56
W.N Cantaloupe	0	0	0	7	5	5	10	15	4	0	0	0	46
W.O "	0	0	0	7	5	5	10	10	4	0	0	0	41
W.N Squash Spring	10	10	12	12	6	0	0	0	0	0	0	5	55
W.N " Winter	10	5	0	0	0	0	0	0	5	7	10	10	47
W.O " Winter	7	2	0	0	0	0	0	0	5	7	7	7	35
W.N Cucumber Winter	15	15	5	0	0	0	0	0	2	3	2	2	43
W.O " Summer	0	0	2	3	2	2	10	10	5	0	0	0	34
W.N Fig	4	4	4	4	4	4	12	12	4	4	4	4	64
W.M "	2	2	2	2	2	2	8	9	2	2	2	2	37
W.O "	3	3	3	3	3	3	6	6	3	3	3	3	42
W.N Olive	3	3	3	3	3	3	3	3	3	12	12	3	54
W.O "	3	3	3	3	3	3	3	3	3	8	8	3	46
W.N Citrus	4	3	3	3	4	4	5	6	14	14	6	6	72
W.M "	4	3	2	2	3	3	4	5	12	13	6	6	63
W.O "	3	3	3	3	3	3	3	3	6	6	3	3	42
W.N Guava	4	4	4	3	3	3	3	3	3	14	14	4	62
W.M "	4	4	3	2	2	2	2	2	2	10	11	4	48
W.O "	3	3	3	3	3	3	3	3	3	6	6	3	42
W.N Grape	4	4	3	3	3	4	16	12	4	4	4	6	67
W.M "	3	3	2	2	2	2	13	10	3	3	3	5	51
W.O "	3	3	3	3	3	8	8	6	3	3	3	3	49
W.N -	-	-	-	-	-	-	-	-	-	-	-	-	-
W.O Date Palm	0	0	0	0	0	0	0	0	0	10	10	0	20
W.N Apple	4	3	3	4	5	6	10	12	12	4	6	5	74
W.M "	3	1	1	2	2	2	8	9	9	2	5	4	48
W.N Alfalfa	1	1	2	2	2	2	2	2	2	2	1	1	20
W.M "	0	0	0.5	0.5	1	1.5	1.5	1	1	0.5	0.5	0	8
W.N Alfalfa (S)	1	2	2	2	0	0	0	0	0	0	0	0	7
W.M "	0	0.5	0.5	0.5	0	0	0	0	0	0	0	0	1.5
W.N Fodderbeet	2	2	4	3	2	0	0	0	4	3	3	2	25
W.M "	1	1	1.5	1.5	1	0	0	0	1.5	0.5	0.5	0.5	9
W.N Berseem	1	2	2	4	3	0	0	0	0	2	1	1	16
W.N Amshoot	1	1	1	1	1	1	1	1	1	1	1	1	12
W.N Napiergrass	0	0	0	0	2	2	1	1	4	0	0	0	10
W.N Bermudagrass	0	0	0	0	2	2	1	1	4	0	0	0	10
W.N Sordan	0	0	0	2	2	1	1	4	0	0	0	0	10
W.M "	0	0	0	1	1	1	1	2	0	0	0	0	6
W.M Fodder Maize	0	0	0	0	0	0	2	2	2	4	0	0	10
W.M Feed barley	0.5	0.5	1	2	0	0	0	0	0	1	0.5	0.5	6
W.M Rice	0	0	0	2	10	10	5	5	20	0	0	0	52
W.N Wheat	2	2	2	6	0	0	0	0	0	4	2	2	20
W.N Basley	1	1	2	2	0	0	0	0	0	1	1	1	9
W.N Groundnut	0	0	0	0	2	1	1	1	1	2	3	0	11
W.N Maize	0	0	0	2	1	1	2	4	0	0	0	0	10
W.N Sunflower	0	0	0	6	3	3	4	8	0	0	0	0	24
W.M "	0	0	0	2	1	1	1	2	0	0	0	0	7
W.N Green pea	12	10	3	0	0	0	0	0	2	12	8	8	55
" Green pepper	15	15	0	0	0	0	0	0	5	15	10	10	70
" Potato	2	15	15	0	0	0	0	0	2	5	2	2	43
" French bean	0	0	0	0	0	9	10	11	15	10	0	0	55
" Safflower	1	1	3	1	0	0	0	0	1	2	1	1	11
" Flax	1	12	5	0	0	0	0	0	1	3	1	1	24

Note: W.N. With project non-mechanized
W.M. With project mechanized
W.O. Without project

Table F.2-1. Mechanization Plan (Stabilized Stage)

C.P.	MONTH	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
4	mechanization	fertilizer applying	manuring	harvesting	harvesting grass cutting	harvesting d. o. hay making	d. o. d. o.	d. o. d. o.	d. o. d. o.	plowing manuring sowing	sowing fertilizer application	spraying	spraying
	machinery attachment	Lime sower	m. loader r. wagon spreader	beetdigger r. wagon	d. o. r. wagon r. mower	d. o. d. o. d. o. gyrotedder	d. o. d. o. d. o.	d. o. d. o. d. o.	d. o. d. o. d. o.	rotabator t. harrow c. packer h. sower	h. sower lime sower	s. spraying (s. p.)	s. spraying (s. p.)
5	mechanization	pruning manuring	fertilizer * application	dusting	spraying dusting	spraying d. o.	d. o. fertilizer * application	d. o. harvesting	d. o.	d. o.	d. o.	d. o.	plowing
	machinery attachment	m. loader m. Spreder	Limesower h. spreader	duster	s. sprayer (s. p.) duster	d. o. d. o.	d. o. limesower h. spreader	d. o. r. wagon	r. wagon	d. o.	d. o.	d. o.	b. plow
2	mechanization (mainly paddy)			w. cron- harvesting	prep. of nursery bed	plowing paddling	transplant' fertilizer application	weeding Spraying	weeding spraying	harvesting	d. o. plowing manuring	plowing manuring leveling	
	machinery attachment			r. wagon	paddyroter	paddyroter	planter knapsack sprayer	h. weeder d. o.	h. weeder d. o.	reaper r. wagon	d. o. rotabator		
3	machinery hire	w. crop harvesting b. digger wagon	d. o. d. o. d. o.				plowing b. plow						manure application m. loader m. spreader

note : tractor attachment except (s.p.) which indicates self propelled machinery.
* mostly applied through dripping with liquid fertilizer.

Table F.2-2. Machinery cost by practice

unit : LE hour

machinery	price of new machine L. E.	Share of total working	hour coverage feddan hrs / feddan	working hours / year	share of depreciation cost / year	d. o. per hour	fuel oil per hour	d. o. cost per hour	oporator per hour	parts cost per hour	Total cost /hr	D. P. per feddan
Tractor 30 P.S.	13,000											
rotabator	1,550	0.1	0.7	144	684	4.8	4.2	0.8	0.7	0.1	6.4	4.5
leveller	450	0.05	1.0	72	420	5.8	6.0	1.2	1.0	0.2	8.2	8.2
tooth harrow	2,400	0.1	0.5	144	888	6.2	3.0	0.6	0.5	0.2	7.5	3.7
bottom plow	750	0.1	1.0	144	492	3.4	6.0	1.2	1.0	0.1	6.6	6.6
mower	2,800	0.25	0.8	360	984	2.7	4.8	1.0	0.8	0.1	4.6	3.7
hay conditioner	1,350	0.1	0.4	144	136	0.9	2.4	0.5	0.4	0	1.8	0.7
rake	900	0.05	0.4	72	582	7.3	2.4	0.5	0.4	0.2	8.4	3.3
seed drill	2,500	0.05	1.5	72	912	6.4	9.0	1.8	1.5	0.4	10.1	15.2
manure spreader	1,500	0.1	2.0	144	684	4.8	12.0	2.4	2.0	0.1	9.3	18.6
road wagon	700	0.1	0.5	144	480	3.3	3.0	0.6	0.5	0.1	4.5	2.3
paddy reaper	3,200	0.17	1.0	240	770	3.2	4.8	1.0	2.0	0.5	6.7	6.7
Speed Sprayer 20 P. S.	2,750	-	0.6	960	660	0.7	4.0	0.8	6.0	0.1	2.2	1.3
Thresher / blower	5,900	-	3 ton / hr	320	1,416	4.4	0.8	0.2	-	0.1	4.7	-
Small thresher	1,500	-	1 ton / hr	240	360	1.5	0.4	0.1	-	-	1.6	-
Grain crusher	2,750	-	0.5 ton / hr	240	660	2.8	0.4	0.1	-	0.1	2.9	-

Table F.2-3. Mechanization by C. P.

C. P.		C. P. 1		C. P. 2		C. P. 3		C. P. 4		C. P. 5	
feddan		23,500		1,800		4,600		6,000		5,700	
hectare equivalent		9,870		756		1,932		2,520		2,394	
crop composition	fodder	8,883 ha		567 ha		966 ha		3,528 ha		0 ha	
	orchard	1,974 ha		0 ha		773 ha		0 ha		2,394 ha	
	field	2,961 ha		252 ha		676 ha		504 ha		0 ha	
(in hectare)	vegetables	1,974 ha		378 ha		386 ha		0 ha		0 ha	
		1,000 hrs.	sets.	1,000 hrs.	sets.	1,000 hrs.	sets.	1,000 hrs.	sets.	1,000 hrs.	sets.
fodder	plowing	–		0.85		1.44		5.29		–	
	sowing	–		–		–		–	45	–	
	m. spreading	–		0.96		1.63		6.00		–	
	spraying	–		0.40		0.68		2.50		–	
	tedding (hay)	–		(40%) 0.40		(40%) 0.68		(25%) 1.59		–	
	harvesting	(20%) 2.50		0.81	8	1.38	(14)	5.04		–	
	carrying	–		8.50		14.29		52.92		–	
orchard	plowing	–		–		1.16		–		3.59	
	m. spreading	–		–		1.31		–		4.07	
	spraying	–		–		0.62		–		1.92	
	dusting	–		–		0.66	(17)	–		2.03	
	harvest carrying	–		–		1.93		–		5.99	18
paddy	puddling /hounding	–		0.48		–		–		–	
	transplanting	–		1.39	18	–		–		–	
	reaper harvesting	–		1.52		–		–		–	

Figure F.2-1. AGRICULTURAL MACHINERY SHED

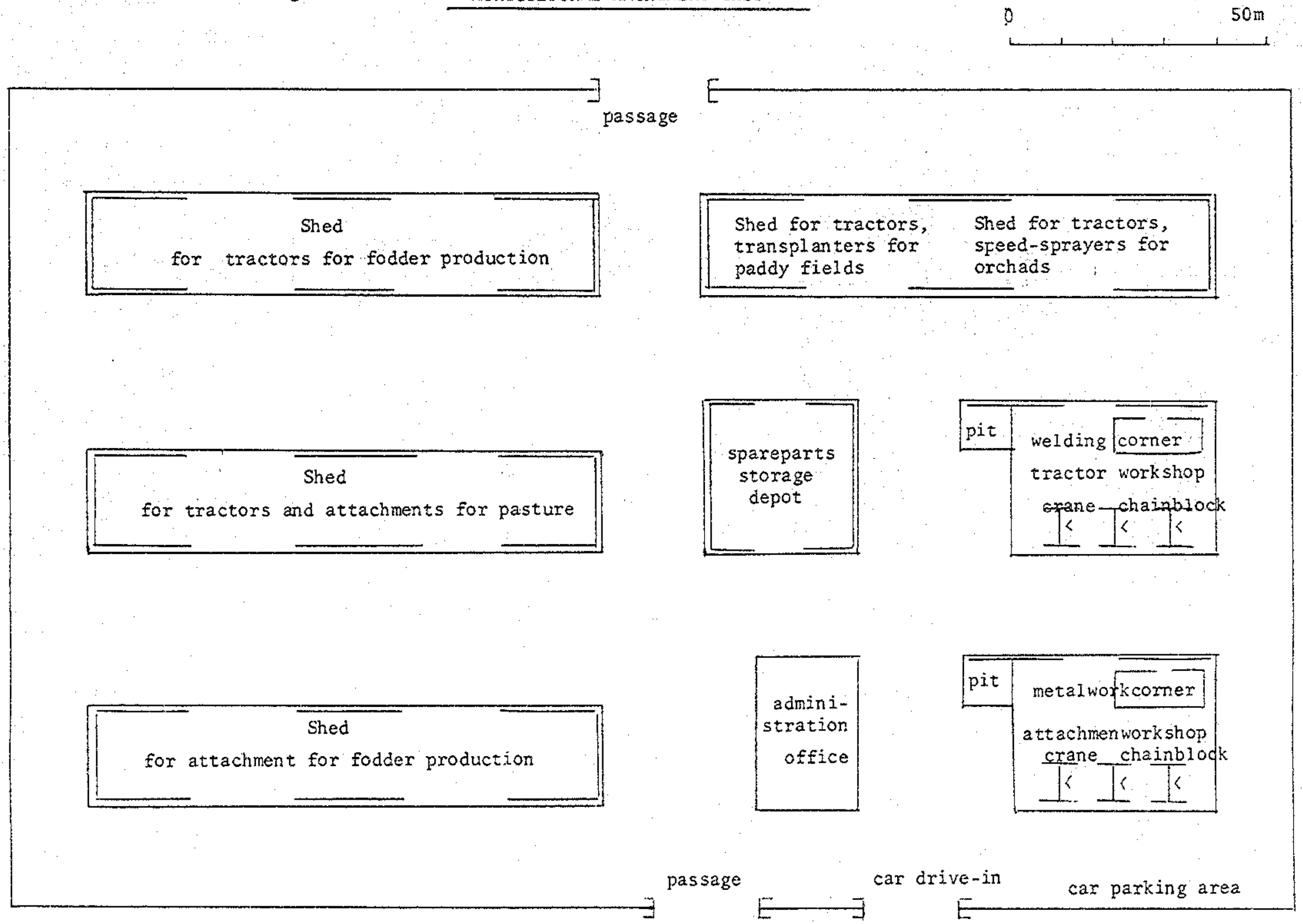


Table F.2-4. Operation and Maintenance of Machinery Center

Starting Year	3rd year of cropping
Capacity	98 tractor sets, 24 self propelled-speed sprayers, three machinery sheds and two work shops
Working days	300 days for hiring service and work shop
Financing system	hired out by collecting fees from users (LE 23/day or LE 12/half a day with operators, if self operated, LE 5 deduced)
Expected Users	Investers in C.P.4 and C.P.5, small holders in C.P. 2 but only for paddy practices
Numbers of staff	50 operators, mechanics and managing staff with some occasional employees

Operation and Maintenance Costs

item	unit	unit price	quantity	annual cost (1000 LE)
staff salary	person	1,800	50	90
electricity	mwh	150	7	1
machinery fuel	kl.	400	784	314
maintenance of buildings etc.	%	-	2	40
repairing materials etc.	%	-	1	33
temporary employee	person/day	5	1,000	5
Annual Running Cost				483
Depreciation				223
Total Annual Cost				706

Table F.3-1. Livestok Herd Building Plan

unit : t ; ton, h ; head

C.P.,Specy	item		year 1	2	3	4	5	6	7	8	9	10	Stabil.
	annual D.C.P. production	(t)	1,410	3,290	3,290	2,820	2,820	6,580	5,170	4,230	7,050	9,400	12,220
C.P.1	〃 T.D.N. 〃	(t)	8,460	19,270	18,800	13,630	20,210	37,130	34,780	21,150	40,420	54,520	61,100
sheep &	kid and lamb	(1000h)	9.4	103.4	112.8	47.0	75.2	131.6	103.4	75.2	131.6	131.6	131.6
goats	ewe and she-goats	(1000h)	51.7	51.7	56.4	42.3	37.6	65.8	51.7	37.6	65.8	65.8	65.8
	Slaughter head	(〃)	0	0	75.2	112.8	28.2	42.3	206.8	108.1	42.3	141.0	141.0
	annual D.C.P. production	(t)	830	70	150	290	430	290	470	690	430	510	510
C.P.2	〃 T.D.N. 〃	(t)	3,170	690	1,150	580	2,770	2,700	3,170	5,000	3,960	3,530	4,000
beef	calf	(h)	2,520	0	360	720	360	720	720	1,440	1,080	720	1,080
cattle	yearling	(h)	0	360	0	360	720	360	720	720	0	720	720
	stock cow	(h)	0	0	360	360	360	720	720	1,440	1,080	1,080	1,080
	slaughtering	(h)	0	2,160	0	360	360	360	360	0	1,080	360	720
	annual D.C.P. production	(t)	90	830	410	140	460	600	320	320	780	420	970
C.P.3	〃 T.D.N. 〃	(t)	830	2,480	3,450	1,660	3,630	4,830	2,580	5,520	6,900	3,450	6,620
beef	calf	(h)	0	1,380	460	460	1,380	920	460	920	2,760	920	1,840
cattle	yearling	(h)	460	0	1,380	460	460	1,380	920	460	1,380	920	920
	stock cow	(h)	0	460	460	460	460	920	460	920	1,380	920	1,840
	slaughtering	(h)	0	0	1,380	1,380	460	1,380	460	460	920	2,300	920
	annual D.C.P. production	(t)	780	1,090	1,490	1,650	2,150	2,320	2,730	2,820	3,380	3,160	3,550
C.P.4	〃 T.D.N. 〃	(t)	5,250	6,900	9,150	11,250	13,880	15,530	18,230	18,900	22,280	21,530	23,780
beef	calf ※	(h)	1,875	1,950	2,550	2,850	3,380	3,980	4,650	5,400	6,380	6,380	6,380
cattle	yearling ※	(h)	3,000	1,800	1,875	2,480	2,780	3,300	3,825	4,500	5,250	5,330	5,400
	stock cow ※	(h)	0	2,250	3,000	3,380	3,980	4,650	5,480	6,380	7,430	7,500	7,500
	slaughtering	(h)	0	675	900	1,350	1,730	1,950	2,250	2,700	5,150	5,700	5,850

※ 16~33% of produced T.D.N to be purchased as rice straw.

Table F.3-2. Nutritional Gradient Content of Livestock Feedstuff

unit : w/w %

crop/ feed	moisture	D.M.	D.C.P.	T.D.N.	applicable livestock	D.E.	M. E.	S. E.
berseem/fresh	79.0	21	2.1	12.1			7.9	
Berseem/hay	30.8	70	9.0	51.9				
alfalfa/fresh	78.0	22	2.6	11.6		0.54	9.4	
alfalfa/meal	9.4	91	11.6	50.3	finishing	2.21		
bermuda grass	74.7	25	2.6	15.6		0.69		
napier grass	84.7	15	1.1	8.0		0.35		
sordan	74.8	15	1.1	12.1		0.46		12.0
fodder beet	89.8	11	0.9	8.6		0.38	12.5	
amshoot	85.0	15	2.6	10.o	beef cattle			
barley straw	14.7	85	0.8	39.6		1.75		
dry ricestraw	12.2	88	1.2	15.5		1.58		
freshrice "	67.4	33	0.9	14.3		0.63		
maize stover	60.8	39	1.2	15.5		1.58		
wheat straw	14.2	86	1.0	38.0		1.68		
broadbean "	84.9	15	4.5	45.8		2.02		
frenchbean "	80.7	19	5.6	48.6		1.98		
groundnut "	79.5	21	1.6	11.8		0.52		
fodder maize	72.9	27	1.2	19.1		0.84		
sunflowercake	10.2	90	24.6	42.0	dairy, beef	1.94		
sesame cake	8.5	92	37.5	62.2	"	2.74		
flax cake	11.3	89	29.3	66.2	"	3.14		
safflowercake	8.5	91	15.9	31.6	"	1.80		
olive cake	17.0	83	35.0	75.0	sheep & goats			
feed maize	12.0	88	12.7	62.9	dairy, beef	3.52	10.8	82.0
concentrate (for beef c.)	12.0	88	17.0	65.0				55.0

Table F.3-3. Nutrition Availability and Carrying Capacity

Cropping pattern		C.P.1	C.P.2	C.P.3	C.P.4
Nutritional output at the stabilized stage					
D.C.P. basis (1000ton)		12.2	0.5	1.0	3.5
T.D.N. basis (")		61.1	4.0	6.6	23.8
Carrying capacity (adult heads per feddan)					
beef cattle	(DCP basis)	2.2	1.2	0.9	2.5
"	(TDN basis)	0.9	0.8	0.5	1.4
goats/sheep	(DCP basis)	23.6	12.7	9.5	26.8
"	(TDN basis)	19.0	16.2	10.5	28.9
dairy cow	(DCP basis)	0.9	0.5	0.4	1.1
"	(TDN basis)	0.4	0.3	0.2	0.5

Table F.3-4. Livestock Herd Development and Slaughtering Schedule

(Unit: 1,000 heads)

year	1	2	3	4	5	6	7	8	9	10	stabi-lized
C. P. specy stage											
1 Goats/Sheep											
lamb	9.4	18.8	18.8	9.4	18.8	18.8	9.4	9.4	18.8	18.8	18.8
ewe	0	9.4	9.4	4.7	9.4	9.4	4.7	4.7	9.4	9.4	4.7
kids	51.7	84.6	94.0	37.6	56.4	113	94.0	65.8	113	113	112.8
she-goats	0	42.3	47.0	18.8	28.2	56.4	47.0	32.9	56.4	56.4	56.4
sheep/slaughter	0	0	18.8	23.5	4.7	18.8	23.5	9.4	4.7	18.8	18.8
goat/slaughter	0	0	75.2	113	23.5	23.5	113	98.7	37.6	122	122.2
2 Beef Cattle											
calves	2.5	0	0.4	0.7	0.4	0.7	0.7	1.4	1.1	0.7	1.1
yearling	0	0.4	0	0.4	0.7	0.4	0.7	0.7	0	0.7	0.7
stock	0	0	0.4	0.4	0.4	0.7	0.7	1.4	1.1	1.1	1.1
yearling/slaughter	0	2.2	0	0.4	0.4	0.4	0.4	0	0.7	0.4	0.7
culled/slaughter	0	0	0	0	0.4	0	0	0	0.4	0	0.1
3 Beef Cattle											
calves	0	1.4	0.5	0.5	1.4	0.9	0.5	0.5	2.8	0.9	1.8
yearling	0.5	0	1.4	0.5	0.5	1.4	0.9	0.5	0	0.9	0.9
stock	0	0.5	0.5	0.5	0.5	0.9	0.5	0.9	1.4	0.9	1.8
yearling/slaughter	0	0	0.9	1.4	0	1.4	0	0.9	1.4	0.9	1.8
culled/slaughter	0	0	0.5	0	0.5	0	0.5	0	0	0.5	0.5
4 Beef Cattle											
calves	1.9	2.0	2.6	2.9	3.4	4.0	4.7	5.4	6.4	6.4	6.4
yearling	3.0	1.8	1.9	2.5	2.8	3.3	3.8	4.5	5.3	5.3	5.4
stock k	0	2.3	3.0	3.4	4.0	4.7	5.5	6.4	7.4	7.5	7.5
yearling/slaughter	0	0.3	0.8	0.9	1.2	1.4	1.6	1.9	2.2	4 6	4.7
culled/slaughter	0	0.4	0.1	0.5	0.5	0.6	0	0.8	1.0	1.1	1.1

Figure F.3-1. LIVESTOCK CENTRE FOR MATING SERVICES

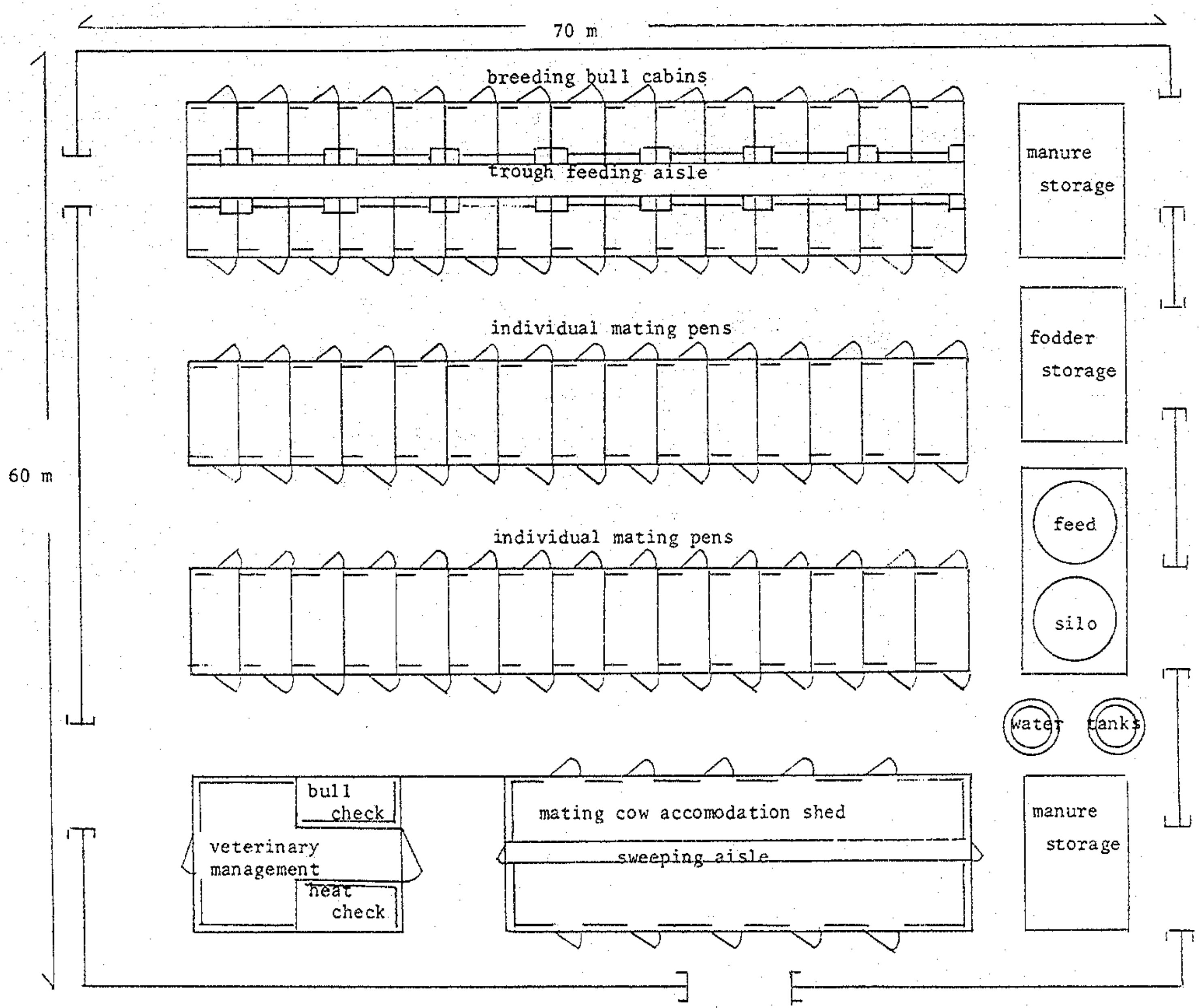


Table F.3-5. Operation and Maintenance of Livestock Center

Starting Year	3rd year of cropping
Number of Bulls	30 baladibulls or hybrid bulls
Total Mating	scheduled at 97 - 130 matings/bull/annum
Expected Users	cattle owners in C.P.2, C.P.3 and a part of livestock investors in C.P.4
Financing System	mating fee collection (LE 25/ mating)
Number of Staff	15 veter'narians (cooperative members)

Operation and Maintenence Costs

Item	Unit	Unit Price	Quantity	Annual Cost (1000 LE)
managing staff salary	person	1,800	15	27
concentrate feeds	ton	210	21	4
purchased fodders	ton	30	510	15
bulls for replacement	heads	6	1,200	7
water, electricity	per year	-	-	1
maintenance total	"	-	-	1
Annual Running Cost				55
Depreciation				20
Total Annual Cost				75

APPENDIX-G. Farm Economic Survey

G.1. Explanation of Farm Economic Survey

(1) Farming Experience

Averaged farming experiences after settlement is six years. the oldest farmer in farming experience settled in 1958 but others in comparatively recent years.

(2) Family Size

Average family size of sampled farmer is 10.8 persons (female 5.1 persons, male 5.7 persons).

(3) Own Farm Occupation

1) Labour Force

Among the above mentioned 10.8 persons, 4.4 persons are engaged in their own farm works. Items of 4.4 persons are 2.7 persons (61%) and 1.7 persons (39%), respectively, and daily farm works have been done by men. Meanwhile, female works mainly in harvesting season.

2) Total Days Worked

Males work during 168 days on an average, which means they work a half of a year on farm.

3) Non-farm Occupation

About 16 percent of male is engaged in off-farm works to get off-farm incomes. Averaged off-farm income is estimated at 1,530 LE/year. As far as sampled farmers, there is no off-farm income by female.

(4) Land Holding

Averaged farm size per farm household is 6.8 feddan, that is, 3.6 feddan of upland and 1.7 feddan of orchard, and 1.5 feddan of others. It is noted that all of sampled farmer is so called squatters.

(5) Main Crops

The most popular crops in F/S Area are tomato and other crops such as melon, cucumber, squash are also planted. As for fruit trees, olive and dates are popular and fig, grape, guava, pomegranate are also observed, however, planted area for fruit is very limited and trees age is ordinary young.

(6) Source of Irrigation Water

All of irrigation water source is groundwater.

(7) Irrigation Method

Drip irrigation is prevailing.

(8) Use of Products

More than 90 percents is sold for marketing and remainder is for home consumption, stock and distribution for relatives, and so on.

(9) Farm Gate Prices of the Main Crops

In order of good prices, 771 LE/ton for olive, 728 LE/ton for cantaloupe, 455 LE/ton for cucumber, 248 LE/ton for tomato, respectively, however, as compared with the data of Ministry of Agriculture, prices for olive and cantaloupe have to be said considerably higher.

(10) Annual Gross Income per Farm Household

Gross income per farm is estimated at 7,612 LE/year, of which 6,387 LE (84%) is farm income and 1,225 LE (16%) is off-farm income, respectively.

(11) Annual Expenditure

Annual expenditure for living per farm household is 3,358 LE, of which 1,572 LE (47%) is spent for foods.

G.2. Summary of Farm Economic Survey

1. Farming Experience	Average 6 years
2. Family Member	
2.1. Total	Average 10.8 persons (100)
2.2. Male	" 5.7 " (53)
2.3. Female	" 5.1 " (47)
3. Own Farm Occupation	
3.1. Labour Force	
3.1.1. Male	Average 2.7 persons
3.1.2. Female	" 1.7 "
3.1.3. Total	" 4.4 "
3.2. Total Days Worked	
3.2.1. Male	" 168 days/person/year
3.2.2. Female	" 55 "
3.3. Non-farm Occupation	
3.3.1. Labour Force	
- Male	16% of the total male
- Female	-
3.3.2. Gross Income	Average 1,530 LE/person/year
4. Area of Land Holding	
4.1. Farm Size	Average 6.8 feddan/farm household
4.2. Out of Averaged Farm Size, Squat	" 6.6 "
5. Main Crops Tomato, Cantaloupe (yellow Melon), Cucumber, Olive, Pepper, Dates etc.	
6. Source of Irrigation Water	Groundwater
7. Irrigaiton Method	Drip Irrigation
8. Use of Products	
8.1. Sold	
8.1.1. Tomato	Average 90.4% of production
8.1.2. Cantaloupe	" 92.0 "
8.1.3. Cucumber	" 90.7 "
8.1.4. Olive	" 91.1 "

8.2. Family Consumption

8.2.1. Tomato	Average	2.1% of production
8.2.2. Cantaloupe	"	3.6 "
8.2.3. Cucumber	"	9.3 "
8.2.4. Olive	"	4.8 "

8.3. Seeds

8.3.1. Tomato	Average	- % of production
8.3.2. Cantaloupe	"	- "
8.3.3. Cucumber	"	- "
8.3.4. Olive	"	- "

8.4. Payment for Farm Works

8.4.1. Tomato	Average	0.4% of production
8.4.2. Cantaloupe	"	- "
8.4.3. Cucumber	"	- "
8.4.4. Olive	"	- "

8.5. Stock

8.5.1. Tomato	Average	- % of production
8.5.2. Cantaloupe	"	- "
8.5.3. Cucumber	"	- "
8.5.4. Olive (in oil)	"	3.5 "

8.6. Others (distribution to relatives etc.)

8.6.1. Tomato	Average	1.1 % of production
8.6.2. Cantaloupe	"	0.6 "
8.6.3. Cucumber	"	- "
8.6.4. Olive	"	- "

9. Farm-Gate Prices of the Main Crops

9.1. Tomato	Average	248 LE/ton
9.2. Cantaloupe	"	728 "
9.3. Cucumber	"	455 "
9.4. Olive	"	771 "

10. Annual Gross Income per Farm-household

10.1. Farm Income	Average	6,387 LE/year	(84)
10.2. Off-Farm Income	"	1,225 "	(16)
10.3. Total	"	7,612 "	(100)

11. Annual Expenditure

11.1. Expenditure for Food	Average	1,572 LE/year	(47)
11.2. Others	"	1,786 "	(53)
11.3. Annual Total	"	3,358 "	(100)

G.3. Informal Survey for Bedouin

Date : 14th November, 1988
Place : Qatia
Answerer: Chief of Village

1. Estimated population of Bedouin in Bir EL Abd.

   1,500 Persons

2. Out of them, how many % are nomadic? 25 %

   " % are semi-nomadic? 30 %

   " % are settled? 45 %

3. Major income source of Bedouin people and its annual amount.

   Major income source: Dates, Melon, Sheep

   Annual income : 500 LE/family

4. What kind of crops have been planted by settled Bedouin?

   Summer: Melon, Cataloupe, Tomato

   Winter: Tomato, Cantaloupe, Pepper, Barley, Wheat

   Note: Barley and wheat are cropped in rain-fed.

   Tree Crops: Olive, Guava, Pomegranate

5. What kind of livestock has been mainly kept and which animal are profitable?

   1st-Sheep, 2nd-Goat, 3rd-Camel, 4th-Chicken

6. If irrigation water of El Salam Canal will be available, Bedouin people could be settled? Yes

   Why yes? It will be better for them.

7. In case of EL Salam Canal's water will be available, do you want to consolidate your existing farm? Yes

8. How can be settle Bedouin people and what is the best way for that purpose?

   - Extension of EL Salam Canal for irrigating this area
   - Establishing of houses for Bedouin people
   - Five (5) feddans of land for each family of Bedouin
   - One cow and five sheep for each family
   - Crediting for pump and irrigation facilities

APPENDIX-H. Agro-Industry and Marketing

H.1. Agricultural Products Processing

1) Processing Flow, Cost and Staffing

Processing plants are operated and managed by the processing cooperatives. Staff and costs required are estimated as follows :

<u>Oil Processing Plant</u>

Starting Year	4th year of cropping
Capacity / working days	oilseed 20 ton/day, 16 hours/day, 300days olive 250 ton/day, 16 hours/day, 90days
Number of employee	50 workers
Managing staff	10 cooperative members (engineers)
Processing lines	3 lines for oilseed processing 1 line for olive processing 1 boiled oil equipment for lineseed oil

Operation/Maintenance Costs	unit	unit price LE	quantity	annual costs (1000 LE)
wage of employee	person	1,440	50	72
managing staff salary	"	1,800	10	18
electricity	mwh.	150	900	135
diesel oil etc.	kl.	60	400	24
water	1000t	100	15	2
equipment maintenance	%	-	3	169
building maintenance	%	-	1	56
packaging materials	nos	150	1,000	150
packaging containers	1,000 nos.	100	4,000	400
cleaning detergent	ton	3,000	5	15
Annual Running Cost				1,041
Plant Depreciation				502
Total Annual Cost				1,543

Slaughtering Cut Meat Plant

Starting Year	4th year of cropping
Capacity / working days	beef 20 ton/day goatmeat/mutton 40 t/d 300 - 350 days according to herd sizes
Number of employee	64 workers
Managing staff	10 cooperative members (engineers)
Processing lines	slaghtering line 1 for beef, 1 for goats/mutton
	cutmeat lines the same as above
	refrigerating line 1 line for all

Operation/Maintenence Costs	unit	unit price	quantity	annual cost (1000 LE)
wage of employee	person	1,440	64	92
managing staff salary	person	1,800	10	18
electricity	mwh.	150	1,600	240
diesel oil etc.	kl.	60	700	42
fuel for vihicles	kl.	50	400	20
chemicals	ton	5,000	4	20
water	1000t	100	12	1
equipment maintenance	%		3	436
building maintenance	%		1	27
packaging material	ton	2,500	92	230
cleaning detergent	ton	3,000	10	30
water treating chemicals	"	3,000	15	45
replenished pallet	%		6	48
salt				1
Annual Running Cost				1,250
Plant Depreciation				857
Total Annual Cost				2,107

2) Establishing Period of Plants, Capacities

Oilseeds are readily cropped by farmers owing to little deprivation of soil fertility and availability of oil cakes in livestock sector. The processors should however ensure steady procuring of materials by means of price guarantee and purchase contract with producers of oilseeds, thus securing the necessary level of delivery to their plants.

In terms of the availability of processing materials, timely construction of the plant would fall in the fourth year of cropping, coinciding with the need from the farmers' side to feed oil cakes for the fattening of their expanded livestock herds.

The same timing can be applied to the slaughtering/cutmeat plant to produce and market cut meat packages for supermarkets in the urban areas. As these plants require effluent treatment, it is proposed to establish them on the same site from the aspect of economizing water treatment.

Storability of materials and shelf life of packed oil allow to save the plant capacity and operation period of oil refinery, whereas high perishability of meat material and products entails to higher capacity for the plant, though slaughtering can be adjusted throughout the year.

3) Demand and Outlet of the Agro-industrial Produce

As to vegetable oil, linseed oil can either be delivered to export market as is currently done, or to the domestic industries. Olive oil is also exportable, but other cooking oil packs are bound to the domestic markets as a substitute for imported oil.

In turn, meats production is hardly catch up with domestic demand growth and such trend is also prevailing among markets outside Egypt. It follows that the best marketing policy lies in increased slaughtering during between-season and bullish priced period with lower supply/higher demand. In this context, North Sinai will never fail to take windfall advantage of better feed availability during summer than the potentially competing areas in western governorates.

Table H.1-1. Projected Production in the Processing Sector

Unit: ton, 1000LE (Unit: ton, 1,000LE)

Year Item	1	2	3	4	5	6	7	8	9	10	Stabi-lized
Beef											
Liveweight Ton	0	1,172	1,180	970	1,540	1,580	1,410	1,360	1,860	3,080	3,370
Cut Meat Ton	90	530	520	430	680	700	620	600	820	1,350	1,490
" Value	540	4,770	4,680	3,870	6,120	6,300	5,580	5,400	7,380	12,150	13,410
Goats/Sheep Meat											
Liveweight Ton	0	0	4,700	6,635	1,410	2,115	6,635	5,405	2,055	6,345	6,400
Cut Meat Ton	0	0	2,070	3,000	620	930	3,000	2,380	930	3,100	3,100
" Value	0	0	15,525	22,500	17,850	6,975	22,500	17,850	6,975	23,250	23,250
Flax Seed Ton	92	1,002	1,002	1,018	1,018	1,018	1,032	1,032	1,032	1,290	1,290
Boiled Oil Ton	23	251	251	255	255	255	258	258	258	323	323
" " Value	52	572	572	581	581	581	588	588	588	736	736
Safflower Seed Ton	92	679	711	1,298	1,297	1,298	1,298	1,297	1,305	1,310	1,310
Edible Oilton	29	210	220	402	402	402	402	402	405	406	406
" Value	151	1,092	1,144	2,090	2,090	2,090	2,090	2,090	2,106	2,111	2,111
Sunflower Seed Ton	1,576	1,908	2,940	3,014	2,991	3,157	3,839	3,839	3,839	3,839	3,840
Edibleoil Ton	520	630	970	995	987	1,042	1,267	1,267	1,267	1,267	1,267
" Value	1,217	1,474	2,270	2,328	2,310	2,438	2,965	2,965	2,965	2,965	2,965
Oil Oive Fruit Ton	0	0	0	0	2,350	4,700	8,460	11,280	13,160	14,100	14,100
Olive Oil Ton	0	0	0	0	376	752	1,354	1,805	2,105	2,256	2,256
" Value	0	0	0	0	1,804	3,610	6,499	8,664	10,104	10,820	10,829

Table H.1-2 Major Agricultural Commodities Imported by Neighbor Countries (1986)

(Unit: head, ton)

Commodity	Saudi Arabia	Kuwait	U. A Emirates	other	
cattle meat	44,107	10,500	6,000	Jordan	16,315
sheep meat	17,583	6,000	24,000	〃	16,767
live cattle	455,450	250,000	100,000	Lebanon	1,300,000
live sheep/goat	1,490,540	2,400,000	80,000	Lebanon	200,000
tomato(fresh)	92,965	57,000	12,000	Jordan	20,000
potato	39,659	35,000	27,000	Lebanon	42,000
orange	103,005	65,000	90,000	Jordan	112,000
onion(fresh)	61,653	35,000	80,000	Jordan	11,000

of which, exported from Egypt (1987)

white cheese	465	114	74		—
sheep/goats heads	898	—	—		—
onion(fresh)	4,453	872	—		—
tomato(〃)	17,957	3,576	332	Baherain	346
potato(〃)	33,783	4,400	1,894	Jordan	780
beans(〃)	1,299	205	724		—
green pepper(〃)	45	49	—		—
orange(〃)	27,975	—	—		—
guava(〃)	1,117	370	155	Jordan	20
watermelon(〃)	8,138	2,453	—	Qatar	543
pomgranate(〃)	383	129	—	Qatar	23
groundnut(unshelled)	227	—	—	Lebanon	47
brown rice	—	—	—	Jordan	19,284
dry beans	383	—	47		—

Figure H.1-1 OIL EXTRACTION / REFINERY PLANT

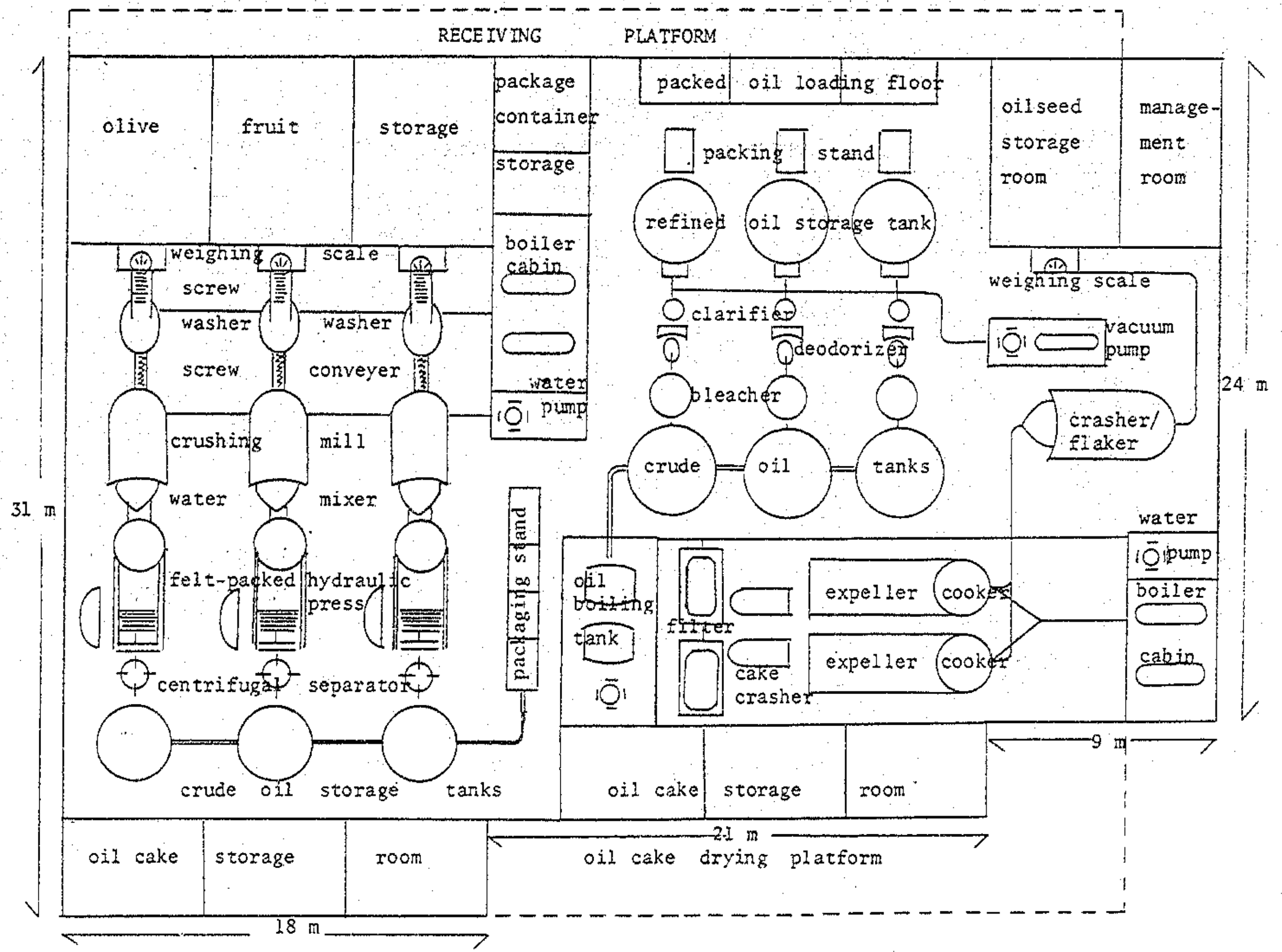


Table H.1-3 PROJECT COST AND BENEFITS , AGRO. INDUSTRIAL PROJECT , OIL SEEDS PROCESSING , FINANCIAL (UNIT : MILLION LE.)

YEAR	PROJECT COST			BENEFITS	RETURN	PRESENT WORTH VALUE BY DISCOUNT RATE 15 %		20 %		25 %	
	CAPITAL	O & M	TOTAL			(COST)	(BENEFITS)	(COST)	(BENEFITS)	(COST)	(BENEFITS)
1 1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 1993	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 1994	11.15	0.00	11.15	0.00	-11.15	4.19	0.00	3.11	0.00	2.34	0.00
8 1995	0.00	0.57	0.57	5.69	5.12	0.19	1.86	0.13	1.32	0.10	0.95
9 1996	0.00	0.64	0.64	6.41	5.77	0.18	1.82	0.12	1.24	0.09	0.86
10 1997	0.00	0.70	0.70	7.18	6.48	0.17	1.77	0.11	1.16	0.08	0.77
11 1998	0.00	0.81	0.81	8.08	7.27	0.17	1.74	0.11	1.09	0.07	0.69
12 1999	0.00	0.91	0.91	8.34	7.43	0.17	1.56	0.10	0.94	0.06	0.57
13 2000	0.00	0.96	0.96	8.83	7.87	0.16	1.44	0.09	0.83	0.05	0.49
14 2001	0.00	1.04	1.04	9.15	8.11	0.15	1.29	0.08	0.71	0.05	0.40
15 2002	0.00	1.04	1.04	9.15	8.11	0.13	1.12	0.07	0.59	0.04	0.32
16 2003	0.00	1.04	1.04	9.15	8.11	0.11	0.98	0.06	0.49	0.03	0.26
17 2004	0.00	1.04	1.04	9.15	8.11	0.10	0.85	0.05	0.41	0.02	0.21
18 2005	0.00	1.04	1.04	9.15	8.11	0.08	0.74	0.04	0.34	0.02	0.16
19 2006	0.00	1.04	1.04	9.15	8.11	0.07	0.64	0.03	0.29	0.01	0.13
20 2007	0.00	1.04	1.04	9.15	8.11	0.06	0.56	0.03	0.24	0.01	0.11
TOTAL	11.15	11.87	23.02	108.58	85.56	5.94	16.37	4.13	9.66	2.96	5.93

BENEFIT COST RATIO BY DISCOUNT RATE (B/C) = 2.76 (15%), 2.34 (20%), 2.00 (25%)
INTERNAL RATE OF RETURN (IRR) = 54.9 %

Figure H.1-2 SLAUGHTERING AND CUT MEAT PLANT

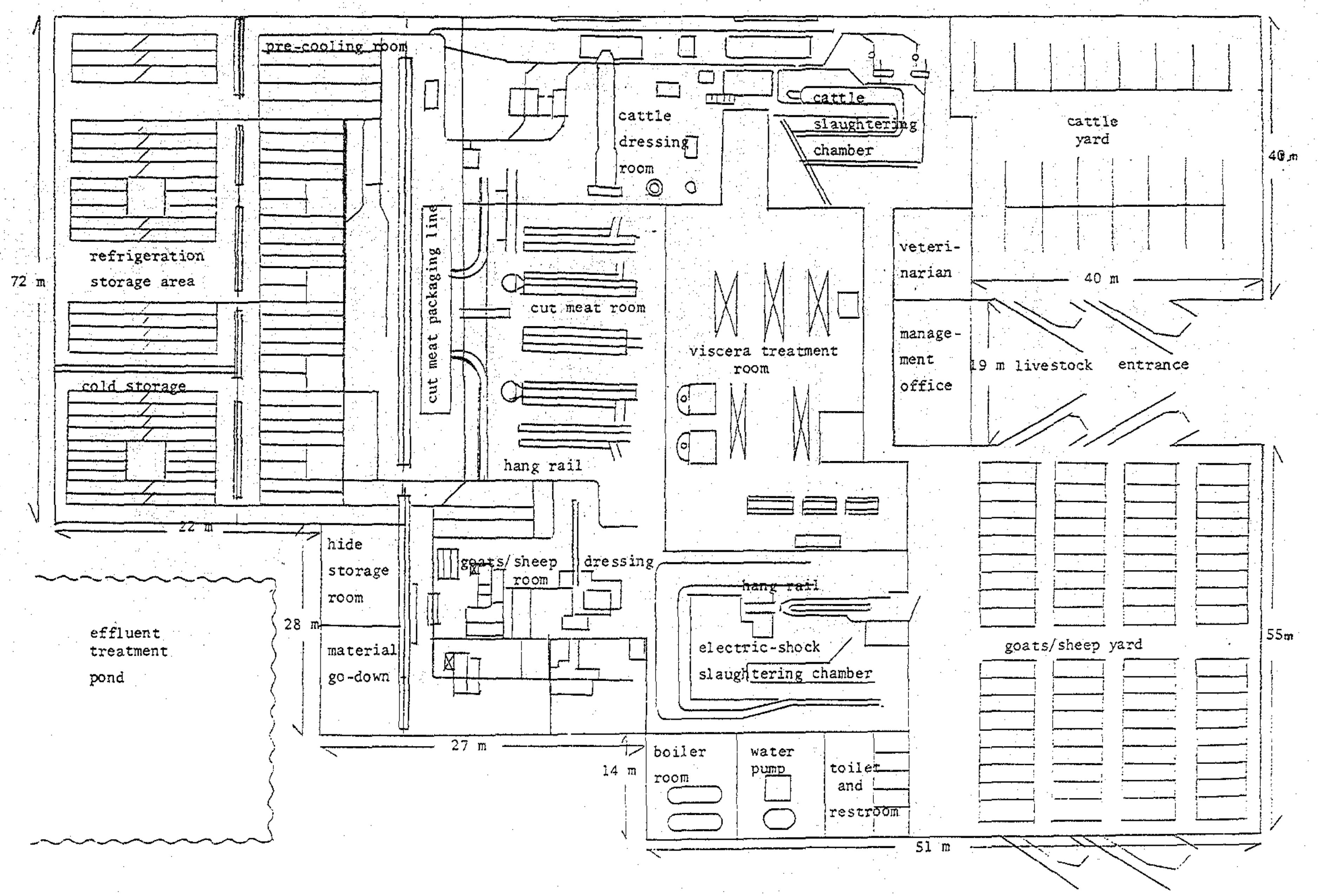


Table H.1-4. PROJECT COST AND BENEFITS , AGRO. INDUSTRIAL PROJECT , MEAT PROCESSING , FINANCIAL

(UNIT : MILLION LE.)

YEAR	PROJECT COST			BENEFITS	RETURN	PRESENT WORTH VALUE BY DISCOUNT RATE					
						15 %		20 %		25 %	
	CAPITAL	O & M	TOTAL			(COST)	(BENEFITS)	(COST)	(BENEFITS)	(COST)	(BENEFITS)
1 1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 1993	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 1994	18.81	0.00	18.81	0.00	-18.81	7.07	0.00	5.25	0.00	3.94	0.00
8 1995	0.00	2.11	2.11	3.85	1.74	0.69	1.26	0.49	0.90	0.35	0.65
9 1996	0.00	2.11	2.11	5.19	3.08	0.60	1.48	0.41	1.01	0.28	0.70
10 1997	0.00	2.11	2.11	6.53	4.42	0.52	1.61	0.34	1.05	0.23	0.70
11 1998	0.00	2.11	2.11	7.87	5.76	0.45	1.69	0.28	1.06	0.18	0.68
12 1999	0.00	2.11	2.11	9.21	7.10	0.39	1.72	0.24	1.03	0.14	0.63
13 2000	0.00	2.11	2.11	10.55	8.44	0.34	1.71	0.20	0.99	0.12	0.58
14 2001	0.00	2.11	2.11	11.89	9.78	0.30	1.68	0.16	0.93	0.09	0.52
15 2002	0.00	2.11	2.11	13.23	11.12	0.26	1.63	0.14	0.86	0.07	0.47
16 2003	0.00	2.11	2.11	13.23	11.12	0.23	1.41	0.11	0.72	0.06	0.37
17 2004	0.00	2.11	2.11	13.23	11.12	0.20	1.23	0.10	0.60	0.05	0.30
18 2005	0.00	2.11	2.11	13.23	11.12	0.17	1.07	0.08	0.50	0.04	0.24
19 2006	0.00	2.11	2.11	13.23	11.12	0.15	0.93	0.07	0.41	0.03	0.19
20 2007	0.00	2.11	2.11	13.23	11.12	0.13	0.81	0.06	0.35	0.02	0.15
TOTAL	18.81	27.43	46.24	134.47	88.23	11.50	18.23	7.92	10.39	5.62	6.17

BENEFIT COST RATIO BY DISCOUNT RATE (B/C) = 1.59 (15%), 1.31 (20%), 1.10 (25%)
INTERNAL RATE OF RETURN (IRR) = 27.8 %

H.2 Marketing

Operation and Maintenance of Marketing Center

Starting year 6th year of cropping

Handling Capacity half of fruits harvested in the area and some winter vegetables exported

Capacity	apple	orange	grape	fig	guava	frenchbean etc.
(tons)	2,700	4,100	4,800	4,000	2,000	2,000 - 6,000

Working days 183 days for fruits (July - Nov.) 90 days for others

Receiving Capacity 64 - 128 tons/day 12tons/line, 0.7 ton/hr./line

Number of employee 64 workers

Managing staff 10 cooperative members (engineers)

Processing lines 8 rotary grading and packaging lines

Operation/Maintenence Costs

item	unit	unit price	quantity	annual cost(1000LE)
wage of employee	person	1,440	64	92
managing staff salary	"	1,800	6	11
electricity	mwh.	150	28	42
petrol	kl.	400	20	8
water	1,000t	100	250	25
packaging boxes	1,000	200	2,825	565
label etc.	kg.	10	200	2
maintenence total	%	-	1	41
Annual Running Cost				786
Depreciation				174
Total Annual Cost				960

Figure H.2-1 M A R K E T I N G   C E N T R E