Attachment G.5

Measurement of loss of water due to percolation

G.A.5.1 Objective

The objective of water-loss measurement is to quantify water loss through earth ditches, in order to determine the improvement renovation intensity of on-farm development.

G.A.5.2 Measuring method

Water-loss is measured by the following tow(2) methods; flow method and ponding method.

(1) Flow method

This method is to measure, by the measuring weirs, the difference of discharge at both sides, the inflow and outflow, of a ditch section of 100m and more.

(2) Ponding method

This method is to measure the amount of water loss in the ponding ditch which is made by constructing a 2.0 m long section of the ditch partitioning it with steel plates.

G.A.5.3 Field work

Eight (8) oases, four (4) new and four (4) traditional oases in the four governorates Gafsa, Tozeur, Kebili and Gabes in the South, were selected in cooperation with CRDA officials concerned. The measurement was carried out by the tow (2) methods at each measuring site. The work was carried out during the period of one (1) month commencing from September 18. 1995. In the first half of working period, the measurements conducted by ponding method, and in the second half of the period, by flow method.

G.A.5.4 Analysis of data

It is a common practice to adopt the flow method to obtain the average amount of percolated water from the difference between the inflow and outflow measured by weirs. Because this method is measured under the same condition as the actual conveyance of water, the obtained result seems to be the most reliable one.

However, it should be noted that water-loss varies with time, during transition period and steady period. To estimate such water-loss, the ponding method was supplementarily employed.

Table G.A.5.1 (1) to table G.A.5.1 (13) show the measurement of water-loss in 13 locations. For instance, measurement at Kasba oasis is seen in Table G.A.5.1 (1), in which is equivalent to 378 liters/120 min. (Converted to 2.6/sec/100m), and that constant water-loss is 108.7 liter in 60 minutes (from 60 min. to 120 min.) which is equivalent to 108 liters/60 min. (Converted to 1.5 l/sec/100m). Therefor, the ratio in constant loss to total loss is estimated at 0.52 (or opprox. 60%).

Likewise, correlation between the constant loss and total loss was worked out as tabulated below. It is seen in the table that the ratio in constant loss to total loss ranges between 0.6 and 0.9; which is interpreted that the average ratio is approx. 70% or the additional loss during the transition period is approx. 30% of the total (see table G.A.5.2).

Table G.A.5.3 (1) to table G.A.5.3 (8) show the measurement of water-loss by employing the flow method in eight locations. The upper table shows the amount of flow at the upper strech of the irrigation ditch (right below the hydrant). The middle table shows the amount of flow at the lower strech of the irrigation ditch (115 m 200m frown the upper weir). The lower table shows the balance of the amount of flow at the upper strech and the lower strech.

For instance, measurement at Kasba oasis is seen in table G.A.5.3 (1). It is seen in the upper table that the amount of inflow becomes constant at around 25 minutes, which is estimated at approx. 26.6 l/sec,and hat in the lower table the amount of outflow becomes steady at around 80 minuets after the commencement of

experiment, which is estimated at approx. 15.8T/sec. The balance between the amount of inflow and out flow is shown in the lower table, in which it is understood that the balance becomes steady at around 80 minutes and estimated at approx. 15.8 l/sec. Therefore, the loss rates at steady stage is estimated at 41%. Since the length between the upper weir and the lower weir is 155m, the loss rate is converted to 26%/100m.

Likewise the water-loss at the steady stage in the eight cases are tabulated below. It is seen in the table that the water-loss rate in the new oases ranges from 18%/100 m to 25%/100 m, and averages approx. 20%/100M, whereas the water-loss rate in the traditional oases ranges from 9%/100m ti 26/100m and averages 17%/100m (see table G.A.5.4).

as discussed in the foregoing paragraphs, ratio between the constant loss and total loss including additional loss during the transition stage is estimated at 70%. The total loss in 100 m in new oases is estimated at 29% and in traditional oases is at 24% as tabulated in table G.A.5.5.

Table G. A. 5. 1 (1) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

Date 19/9 1995 Time: 10:35 ~ 12:35

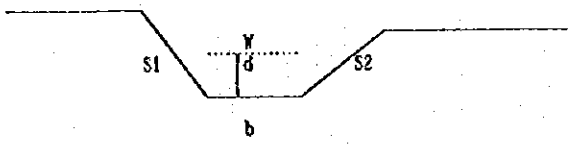
2. Location

Name of Oasis(AIC): Kasba
Type of Oasis: Traditional
Name of hydrant: Khara

3. Conditions

Designed Irrigation Int 6 (days)
Designed Systea Capacit 30 (lit/sec)
Last Irrigation: 6 (days before)
Climate: Fine
Temperature: 30 (℃)

4. Cross Section of Earth Ditch



b = 40 cm
W = 130 cm
d = 27 cm
S1 = 60 cm
S2 = 55 cm
L = 2.00 m

5. Record of Observation

① Time passed (t min)	② Interval of time (min)	Water supply (WS)	③ Amount of Water supplied (lit)	Water depth (d cm)	④ Water loss (l mm)	⑤=Σ④ Accumu. amount of water loss (WL mm)	⑥=Σ③ Accumu. amount of water supply (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t)-⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=⑧/② (lit/min)	Water loss rate ⑪=⑨/((①+60)/L*100) (lit/s/100m)
0		after WS	270.3	19.0				270.3				
		before WS		16.2	28	28	270.3	207.4	62.9	62.9	12.6	10.5
5	5	after WS	31.8	17.8				239.2				
		before WS		16.8	10	38	302.1	218.4	20.8	83.7	4.2	7.0
10	5	after WS	31.8	18.4				250.2				
		before WS		17.3	11	49	333.9	227.8	22.4	106.1	4.5	5.9
15	5	after WS	15.9	17.4				243.7				
		before WS		17.2	2	51	349.8	225.9	17.8	123.9	3.6	5.2
20	5	after WS	15.9	17.9				241.8				
		before WS		17.0	9	60	365.7	222.2	19.6	143.5	3.9	4.8
25	5	after WS	15.9	17.8				238.1				
		before WS		16.2	16	76	381.6	207.4	30.7	174.2	6.1	4.8
30	5	after WS	15.9	17.3				223.3				
		before WS		15.6	17	93	397.5	197.6	25.7	199.9	2.6	4.2
40	10	after WS	15.9	16.4				213.5				
		before WS		15.2	12	105	413.4	194.6	18.9	218.8	1.9	3.6
50	10	after WS	15.9	15.7				210.5				
		before WS		13.0	27	132	429.3	159.7	50.8	269.6	5.1	3.7
60	10	after WS	15.9	14.7				175.6				
		before WS		12.1	26	158	445.2	145.2	30.4	300.0	1.5	3.1
80	20	after WS	31.8	14.7				177.0				
		before WS		12.1	26	184	477.0	145.2	31.8	331.8	1.6	2.8
100	20	after WS	47.7	14.7				192.9				
		before WS		12.2	25	209	524.7	146.4	46.5	378.3	2.3	2.6
120	20	after WS										

Observation time (min) : 120

Total water supplied (lit): 525
Remaining amount of water (lit): 146
Consumed amount of water (lit): 378

Total Water loss (mm): 209
Converted to (liter): 378.3 in (0-120 min)
Converted to (lit./sec/100 m): 2.6
Constant water loss
Converted to (liter): 108.7 in (60-120 min)
Converted to (lit./sec/100 m): 1.5
Ratio in constant loss to total loss : 0.57

Regressional expression: WL=8.130T^(0.6656)

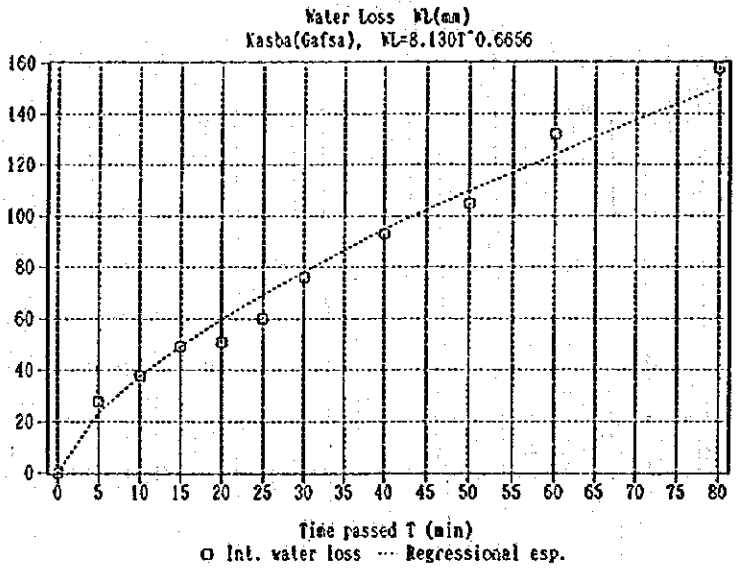

Water Loss WL(mm)
Kasba(Gafsa), WL=8.130T^0.6656
160
140
120
100
80
60
40
20
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Time passed T (min)
o Int. water loss ··· Regressional esp.

Table G. A. 5. 1 (2) Measuremont of Water-Loss by Ponding Method

1. Observation Date and Time

Date 20/9 1995 Time: 13:00 ~ 14:20

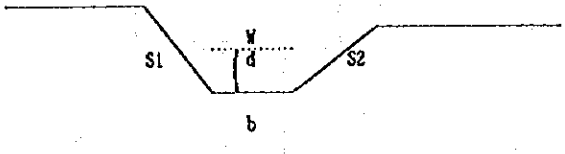
2. Location

Name of Oasis(AIC): Oued Shili
Type of Oasis: New
Name of hydrant: 1-5

3. Conditions

Designed Irrigation Int 5 (days)
Designed System Capacit 20 (lit/sec)
Last Irrigation: 1 (days before by rainfall)
Climate: Fine
Temperature: 33-34 (℃)

4. Cross Section of Earth Ditch



b = 40 cm
W = 152 cm
d = 28 cm
S1 = 56 cm
S2 = 63 cm
L = 1.98 m

5. Record of Observation

① Time passed (t min)	② Interval of time (min)	Water supply (WS)	③ Amount of Water supplied (lit)	Water depth (d cm)	④ Water loss (l mm)	⑤=Σ④ Accumu. amount of water loss (WL mm)	⑥=Σ③ Accumu. amount of water supply (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t)-⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=③/② (lit/min)	Water loss rate ⑪=⑨/(①*50)/L*100) (lit/s/100m)
0		after WS	222.6	15.1				222.6				
		before WS		12.6	25	25	222.6	153.4	69.2	69.2	13.8	11.6
5	5	after WS	31.8	13.7				185.2				
		before WS		12.1	16	41	254.4	144.2	41.0	110.2	8.2	9.3
10	5	after WS	31.8	13.4				176.0				
		before WS		11.8	16	57	286.2	138.9	37.1	147.3	7.4	8.3
15	5	after WS	31.8	12.9				170.7				
		before WS		11.4	15	72	318.0	131.9	38.8	186.1	7.8	7.8
20	5	after WS	31.8	12.6				163.7				
		before WS		11.2	14	86	349.8	128.4	35.3	221.4	7.1	7.5
25	5	after WS	31.8	12.6				160.2				
		before WS		10.9	17	103	381.6	123.1	37.1	258.5	7.4	7.3
30	5	after WS	31.8	12.3				154.9				
		before WS		8.9	34	137	413.4	91.1	63.8	322.3	6.4	6.8
40	10	after WS	31.8	10.4				122.9				
		before WS		7.9	25	162	445.2	77.2	45.7	368.0	4.6	6.2
50	10	after WS	47.7	9.6				124.9				
		before WS		7.9	17	179	492.9	77.2	47.7	415.7	4.8	5.8
60	10	after WS	47.7	9.6				124.9				
		before WS		8.2	14	193	540.6	81.4	43.5	459.2	4.4	5.5
70	10	after WS	47.7	9.8				129.1				
		before WS		8.4	14	207	588.3	84.2	44.9	504.1	4.5	5.3
80	10	after WS										

Observation time (min) : 80

Total water supplied (lit): 588
Remaining amount of water (lit): 84
Consumed amount of water (lit): 504

Total Water loss (mm): 207
Converted to (liter): 504 (in 0-80 min)
Converted to (lit./sec/100 m): 5.3

Constant water loss
Converted to (liter): 143.1 (in 40-80 min)
Converted to (lit./sec/100 m): 4.0

Ratio in constant loss to total loss : 0.76

Regressional expression: WL=6.802T^(0.7914)

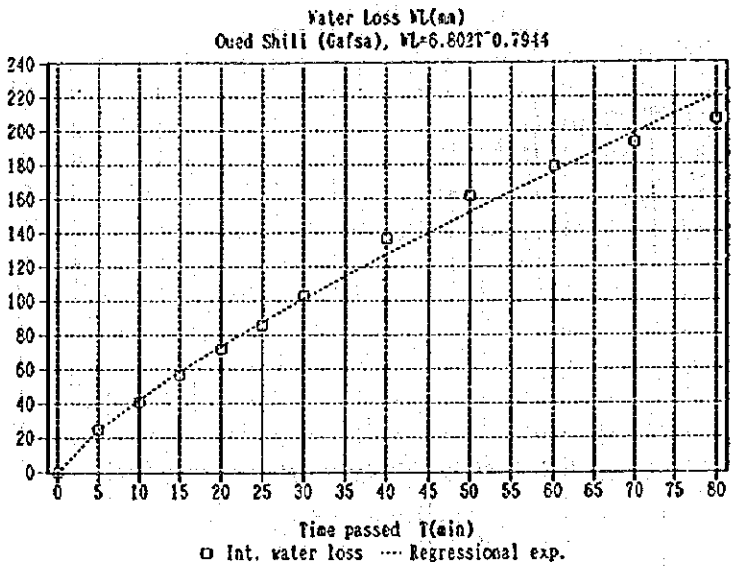

Water Loss WL(mm)
Oued Shili (Gafsa), WL=6.802T^0.7944
240
220
200
180
160
140
120
100
80
60
40
20
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Time passed T(min)
Int. water loss
Regressional exp.

Table G. A. 5. 1 (3) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

Date 21/9 1995 Time: 13:00 ~ 14:20

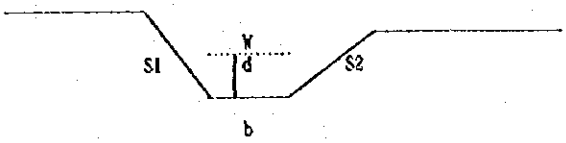
2. Location

Name of Oasis(AIC): Oasis Tozeur
Type of Oasis: Traditional
Name of hydrant: 01-7

3. Conditions

Designed Irrigation Int 7 (days)
Designed System Capacit 30 (lit/sec)
Last Irrigation: 3 (days before by rainfall)
Climate: Cloudy
Temperature: 28 (℃)

4. Cross Section of Earth Ditch



b = 35 cm
W = 118 cm
d = 22.5 cm
S1 = 45 cm
S2 = 44 cm
L = 1.84 m

5. Record of Observation

① Time passed (t min)	② Interval of time (min)	Water supply (WS)	③ Amount of Water supplied (lit)	Water depth (d cm)	④ Water loss (l mm)	⑤=Σ④ Accumu. amount of water loss (ΣL mm)	⑥=Σ③ Accumu. amount of water supply (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t)-⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=⑧/② (lit/min)	⑪=⑨/(①•60)/L•100) (lit/s/100m)
0		after WS	190.8	16.8				190.8				
		before WS		16.5	3	3	190.8	182.5	8.3	8.3	1.7	1.5
5	5	after WS	31.8	18.7				214.3				
		before WS		18.0	7	10	222.6	208.1	6.2	14.5	1.2	1.3
10	5	after WS	0.0	18.0				208.1				
		before WS		17.5	5	15	222.6	199.3	8.8	23.3	1.8	1.4
15	5	after WS	0.0	17.5				199.3				
		before WS		17.4	1	16	222.6	197.6	1.7	25.0	0.3	1.1
20	5	after WS	0.0	17.4				197.6				
		before WS		17.0	4	20	222.6	190.9	6.7	31.7	1.3	1.1
25	5	after WS	15.9	17.7				206.8				
		before WS		17.5	2	22	238.5	199.3	7.5	39.2	1.5	1.2
30	5	after WS	0.0	17.5				199.3				
		before WS		17.0	5	27	238.5	190.9	8.4	47.6	0.8	1.1
40	10	after WS	0.0	17.0				190.9				
		before WS		16.5	5	32	238.5	182.5	8.4	56.0	0.8	1.0
50	10	after WS	15.9	17.5				198.4				
		before WS		16.8	7	39	254.4	187.6	10.8	66.8	1.1	1.0
60	10	after WS	15.9	17.6				203.5				
		before WS		16.9	7	46	270.3	189.2	14.3	81.1	0.7	0.9
80	20	after WS										

Observation time (min) : 80

Total water supplied (lit): 270
Remaining amount of water (lit): 189
Consumed amount of water (lit): 81

Total Water loss (mm): 46
Converted to (liter): 81 (in 0-80 min)
Converted to (lit./sec/100 m): 0.9

Constant water loss
Converted to (liter): 33.5 (in 40-80 min)
Converted to (lit./sec/100 m): 0.8

Ratio in constant loss to total loss : 0.83

Regressional expression: WL=1.0150T^(0.8997)

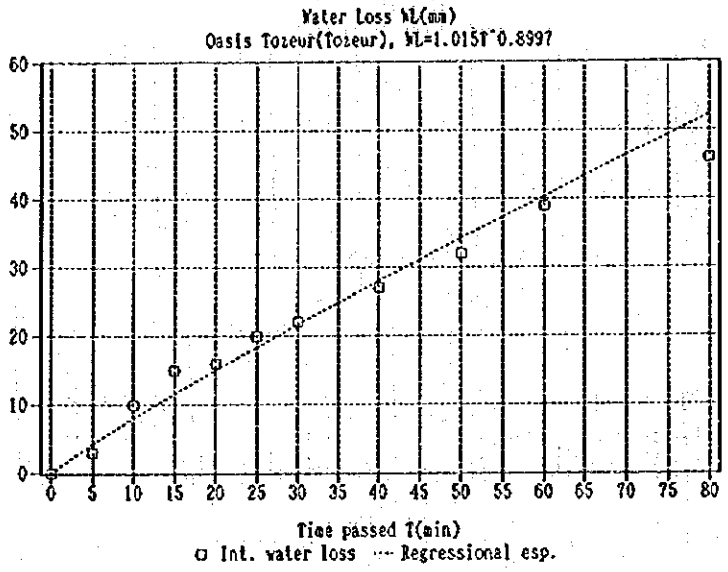

Water Loss WL(mm)
Oasis Tozeur(Tozeur), WL=1.015T^0.8997
60
50
40
30
20
10
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Time passed T(min)
Int. water loss
Regressional esp.

Table G. A. 5. 1 (4) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

Date 22/9 1995 Time: 9:12 ~ 10:32

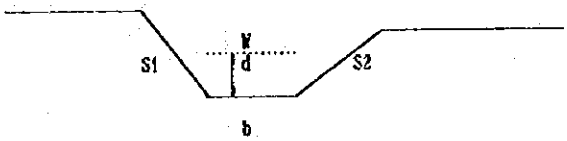
2. Location

Name of Oasis(AIC): Draa Sud(1)
Type of Oasis: New
Name of hydrant: B-45

3. Conditions

Designed Irrigation Int 5 (days)
Designed System Capacit 20 (lit/sec)
Last Irrigation: 3 (days before by rainfall)
Climate: Cloudy
Temperature: 27 (℃)

4. Cross Section of Earth Ditch



b = 40 cm
W = 130 cm
d = 27 cm
S1 = 60 cm
S2 = 55 cm
L = 2.00 m

5. Record of Observation

① Time passed (t min)	② Interval of time (min)	Water supply (WS)	③ Amount of Water supplied (lit)	Water depth (d cm)	④ Water loss (l mm)	⑤=Σ④ Accumu. amount of water loss (WL mm)	⑥=Σ③ Accumu. amount of water supply (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t) -⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=⑨/② (lit/min)	⑪=⑨/(①×60)/L×100) (lit/s/100m)
0		after WS	159.0	12.1				159.0				
		before WS		6.4	57	57	159.0	68.8	90.2	90.2	18.0	15.0
5	5	after WS	47.7	8.9				116.5				
		before WS		5.8	31	88	206.7	61.8	54.7	144.9	10.9	12.1
10	5	after WS	47.7	8.4				109.5				
		before WS		5.4	30	118	254.4	57.1	52.4	197.3	10.5	11.0
15	5	after WS	47.7	8.2				104.8				
		before WS		5.3	29	147	302.1	56.0	48.8	246.1	9.8	10.3
20	5	after WS	47.7	7.9				103.7				
		before WS		5.2	27	174	349.8	54.8	48.9	295.0	9.8	9.8
25	5	after WS	47.7	7.6				102.5				
		before WS		5.3	23	197	397.5	56.0	46.5	341.5	9.3	9.5
30	5	after WS	47.7	8.0				103.7				
		before WS		6.3	17	214	445.2					
35	5	after WS	47.7	8.7				151.4				
		before WS		5.9	28	242	492.9	63.0	88.4	429.9	17.7	9.0
40	5	after WS	47.7	8.1				110.7				
		before WS		5.8	23	265	540.6	61.8	48.9	478.8	9.8	8.9
45	5	after WS	31.8	7.8				93.6				
		before WS		4.9	29	294	572.4	51.6	42.0	520.8	8.4	8.7
50	5	after WS	47.7	7.6				99.3				
		before WS		5.3	23	317	620.1	56	43.3	564.1	8.7	8.5
55	5	after WS	31.8	6.9				87.8				
		before WS		4.4	25	342	651.9	46.2	41.6	605.7	8.3	8.4
60	5	after WS	47.7	7.1				93.9				
		before WS		0.0	71	413	699.6					
70	10	after WS	31.8	4.7				125.7				
		before WS		2.1	26	439	731.4	22.1	103.6	709.3	20.7	7.9
75	5	after WS	47.7	5.2				69.8				
		before WS		2.9	23	462	779.1	30.5	39.3	748.6	7.9	7.8
80	5	after WS										

Observation time (min) : 80
Total water supplied (lit): 779
Remaining amount of water (lit): 31
Consumed amount of water (lit): 749
Total Water loss (mm):
Converted to (liter): 749 in (0-80 min)
Converted to (lit./sec/100 m): 7.8
Constant water loss
Converted to (liter): 215 in (50-80 min)
Converted to (lit./sec/100 m): 6.0
Ratio in constant loss to total loss : 0.77

Regressional expression: $WL=15.401T^{(0.7591)}$

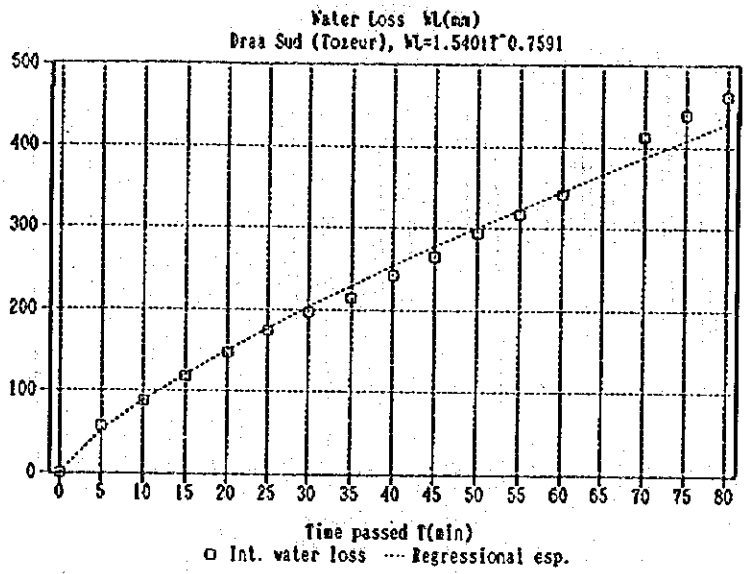

Water Loss WL(mm)
Draa Sud (Tozeur), WL=1.5401T^0.7591
500
400
300
200
100
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Time passed T(min)
o Int. water loss ···· Regressional esp.

Table G. A. 5. 1 (5) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

Dat 22/9 , 1995 Time 11:04 ~ 12:14

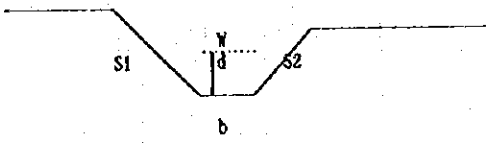
2. Location

Name of Oasis(AIC): Draa Sud (2)
Type of Oasis: New
Name of hydrant: B-45

3. Conditions

Designed Irrigation Interval: 5 (days)
Designed System Capacity: 20 (lit/sec)
Last Irrigated Day: 3 (days before)
Climate: Cloudy
Temperature: 26 (℃)

4. Cross Section of Earth Ditch



b = 62 cm
B = 136 cm
d = 29 cm
S1 = 45 cm
S2 = 45 cm
L = 2.00 m

5. Record of Observation

① Time passed (t min)	② Interval of time (min)	Water supply (WS)	③ Amount of Water supplied (lit)	Water Depth (d cm)	④ Water loss (1 mm)	⑤=Σ④ Accumu. amount of water loss (WL mm)	⑥=Σ③ Accumu. amount of water supplied (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t) -⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=⑧/② (lit/min)	⑪=⑨/(①*60)/L*100) (lit/s/100m)
0		after WS	222.6	13.6		0		222.6				
		before WS		8.9	47	47	222.6	124.1	98.5	98.5	19.7	16.4
5	5	after WS	63.6	11.3				187.7				
		before WS		9.1	22	69	286.2	127.4	60.3	158.8	12.1	13.2
10	5	after WS	63.6	11.3				191.0				
		before WS		9.3	20	89	349.8	130.7	60.3	219.1	12.1	12.2
15	5	after WS	63.6	11.8				194.3				
		before WS		9.8	20	109	413.4	138.9	55.4	274.5	11.1	11.4
20	5	after WS	63.6	11.9				202.5				
		before WS		10.1	18	127	477.0	143.9	58.6	333.1	11.7	11.1
25	5	after WS	63.6	12.4				207.5				
		before WS		10.5	19	146	540.6	150.5	57	390.1	11.4	10.8
30	5	after WS	47.7	12.2				198.2				
		before WS		10.4	18	164	588.3	148.8	49.4	439.5	9.9	10.5
35	5	after WS	47.7	11.9				196.5				
		before WS		9.9	20	184	636.0	140.6	55.9	495.4	11.2	10.3
40	5	after WS	63.6	12.2				204.2				
		before WS		8.4	38	222	699.6	116.2	88	583.4	8.8	9.7
50	10	after WS	63.6	10.6				179.8				
		before WS		6.6	40	262	763.2	90.5	89.3	672.7	8.9	9.3
60	10	after WS	63.6	8.7				154.1				
		before WS		5.0	37	299	826.8	68.5	85.6	758.3	8.6	9.0
70	10	after WS										

Obsevation period (min) : 70

Total water supplied (lit): 827
Remaining amount of water (lit): 69
Consumed amount of water (lit): 758

Total Water loss (mm): 299
Converted to (liter): 758 in (0-70 min)
Converted to (lit./sec/100 m): 9.0

Constant water loss
Converted to (liter): 262.9 in (40-70 min)
Converted to (lit./sec/100 m): 7.3

Ratio in constant loss to total loss : 0.81

Regressional expression: WL=13.65211^(0.7087)

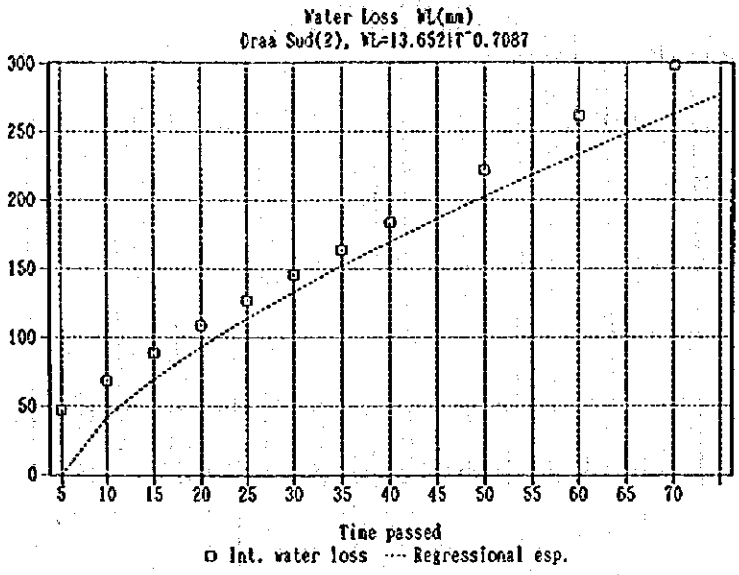

Water Loss WL(mm)
Draa Sud(2), WL=13.6521t^0.7087
300
250
200
150
100
50
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Time passed
Int. water loss
Regressional esp.

Table G. A. 5. 1 (6) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

Dat 26/9 , 1995 Time 12:00 ~ 13:00

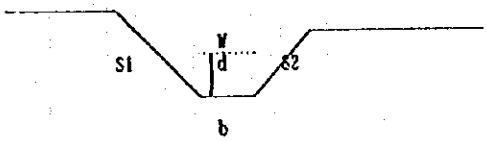
2. Location

Name of Oasis(AIC): Babta (1)
Type of Oasis: Traditonal
Name of Hydrant: B-34

3. Conditions

Designed Irrigation Interval: (days)
Designed System Capacity: (lit/sec)
Last Irrigated Day: 7 (days before)
Climate: Cloudy
Temperature: 27 (℃)

4. Cross Section of Earth Ditch



b = 69 cm
B = 152 cm
d = 25.5 cm
S1 = 56 cm
S2 = 42 cm
L = 2.01 m

5. Record of Observation

① Time passed (t min)	② Interval of time (min)	Water supply (WS)	③ Amount of Water supplied (lit)	Water Depth (d cm)	④ Water loss (l mm)	⑤=Σ④ Accumu. amount of water loss (WL mm)	⑥=Σ③ Accumu. amount of water supplied (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t)-⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=⑧/② (lit /min)	Water loss rate ⑪=⑨/(①÷60)/(L÷100) (lit/s /100m)
0		after WS	222.6	11.6		0		222.6				
		before WS		9.8	18	18	222.6	152.9	69.7	69.7	13.9	11.6
5	5	after WS	31.8	11.8				184.7				
		before WS		10.6	12	30	254.4	165.4	19.3	89.0	3.9	7.4
10	5	after WS	31.8	12.3				197.2				
		before WS		11.7	6	36	286.2	182.8	14.4	103.4	2.9	5.7
15	5	after WS	31.8	12.9				214.6				
		before WS		12.5	4	40	318.0	198.2	16.4	119.8	3.3	5.0
20	5	after WS	31.8	13.8				230.0				
		before WS		13.5	3	43	349.8	226.9	3.1	122.9	0.6	4.1
25	5	after WS	15.9	13.9				242.8				
		before WS		13.8	1	44	365.7	237.4	5.4	128.3	1.1	3.5
30	5	after WS	15.9	14.2				253.3				
		before WS		13.6	6	50	381.6	230.4	22.9	151.2	2.3	3.1
40	10	after WS	15.9	14.3				246.3				
		before WS		13.6	7	57	397.5	230.4	15.9	167.1	1.6	2.8
50	10	after WS	15.9	14.2				246.3				
		before WS		13.6	6	63	413.4	230.4	15.9	183.0	1.6	2.5
60	10	after WS										

Obsevation period (min) : 60

Total water supplied (lit): 413
Remaining amount of water (lit): 230
Consumed amount of water (lit): 183

Total Water loss (mm): 63
Converted to (liter): 183 in (0-60 min)
Converted to (lit./sec/100 m): 2.5

Constant water loss
Converted to (liter): 54.7 in (40-60 min)
Converted to (lit./sec/100 m): 1.5

Ratio in constant loss to total loss : 0.60

Regressional expression: WL=9.5290T^(0.4625)

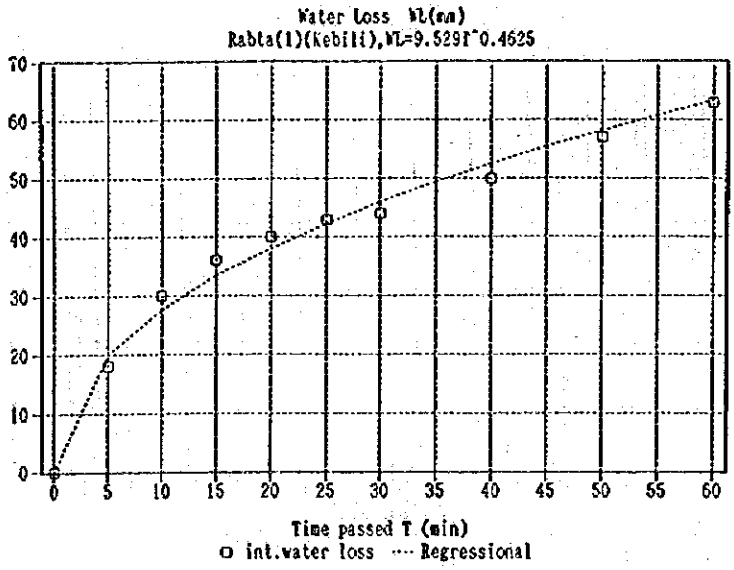

Water Loss WL(mm)
Rabta(1)(Kebili),WL=9.529T^0.4625
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
45
50
55
60
Time passed T (min)
o Int.water loss ···· Regressional

Table G. A. 5. 1 (7) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

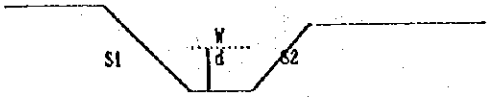
Dat 26/9 , 1995 Time 14:34 ~ 15:24

2. Observed Place

Name of Oasis(AIC): Rabta(2)
Type of Oasis: Traditional
Name of Borne: B-34

Designed Irrigation Interval: 5 (days)
Designed System Capacity: 20 (lit/sec)
Last Irrigated Day: 7 (days before)
Climate: Cloudy
Temperature: 27 (℃)

3. Cross Section of Earth Ditch



b = 29 cm
B = 88 cm
d = 18 cm
S1 = 41 cm
S2 = 31 cm
L = 2.00 m

5. Record of Observation

① Time Passed (t min)	② Interval of time (min)	Water supply (WS)	③ Amount of Water supplied (lit)	Water depth (d cm)	④ Water loss (1 mm)	⑤=Σ④ Accumu. amount of water loss (WL mm)	⑥=Σ③ Accumu. amount of water supplied (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t)-⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=⑧/② (lit/min)	⑪=⑨/(①+60)/L+100) (lit/s/100m)
0		after WS	159.0	15.7		0		159.0				
		before WS		14.6	11	11	159.0	137.2	21.8	21.8	4.4	3.6
5	5	after WS	31.8	16.9				169.0				
		before WS		16.5	4	15	190.8	159.2	9.8	31.6	2.0	2.6
10	5	after WS	15.9	17.5				175.1				
		before WS		16.8	7	22	206.7	163.2	11.9	43.5	2.4	2.4
15	5	after WS	15.9	17.9				179.1				
		before WS		17.4	5	27	222.6	171.8	7.3	50.8	1.5	2.1
20	5	after WS	15.9	18.3				187.7				
		before WS		18.0	3	30	238.5	180.6	7.1	57.9	1.4	1.9
25	5	after WS	0.0	-				180.6				
		before WS		17.5	5	35	238.5	173.2	7.4	65.3	1.5	1.8
30	5	after WS	0.0	-				173.2				
		before WS		16.5	10	45	238.5	159.2	14	79.3	1.4	1.7
40	10	after WS	0.0	-				159.2				
		before WS		15.5	10	55	238.5	145.7	13.5	92.8	1.4	1.5
50	10	after WS	0.0	-								

Obsevation period (min) : 50

Total water supplied (lit): 239
Remaining amount of water (lit): 146
Consumed amount of water (lit): 93

Total Water loss (mm): 55
Converted to (liter): 238.5 in (0-50 min)
Converted to (lit./sec/100 m): 1.5

Constant water loss
Converted to (liter): 34.9 in (25-50 min)
Converted to (lit./sec/100 m): 1.2

Ratio in constant loss to total loss : 0.75

Regressional expression: WL=3.2327T^(0.7080)

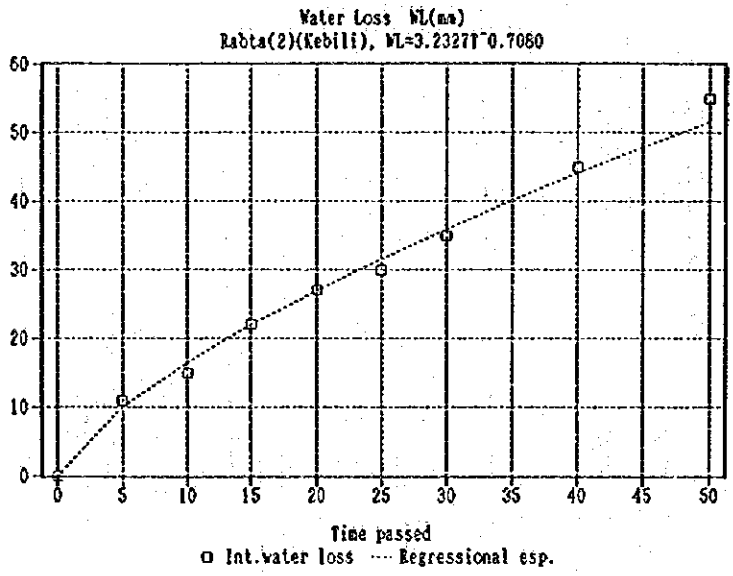

Water Loss WL(mm)
Rabta(2)(Kebili), WL=3.2327T^0.7060
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
45
50
Time passed
Int.water loss
Regressional esp.

Table G. A. 5. 1 (8) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

Dat 27/9 1995 Time: 10:10 ~ 11:20

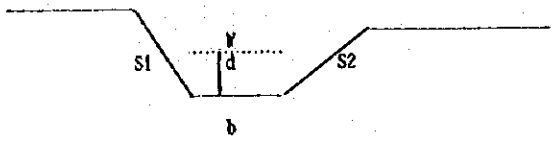
2. Location

Name of Oasis(AIC): Atilet (1)
Type of Oasis: New
Name of hydrant: B-10

3. Conditions

Designed Irrigation Interval: 21 (days)
Designed Systea Capacity: 15 (lit/sec)
Last Irrigation: 5 (days before)
Climate: Fine
Temperature: 29 (℃)

4. Cross Section of Earth Ditch



b = 57 cm
W = 122 cm
d = 17 cm
S1 = 35 cm
S2 = 40 cm
L = 2.00 m

5. Record of Observation

① Time passed (t min)	② Interval of time (min)	Water supply (WS)	③ Amount of Water supplied (lit)	Water depth (d cm)	④ Water loss (l mm)	⑤=Σ④ Accumu. amount of water loss (WL mm)	⑥=Σ③ Accumu. amount of water supplied (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t)-⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=⑧/② (lit/min)	Water loss rate ⑪=⑨/(①*60)/L*100) (lit/s/100m)
0		after WS	254.4	11.7		0		254.4				
		before WS		8.6	31	31	254.4	203.8	50.6	50.6	10.1	8.4
5	5	after WS	47.7	10.6				251.5				
		before WS		9.7	9	40	302.1	233.0	18.5	69.1	3.7	5.8
10	5	after WS	47.7	11.3				280.7				
		before WS		10.8	5	45	349.8	262.5	18.2	87.3	3.6	4.9
15	5	after WS	47.7	12.3				310.2				
		before WS		11.9	4	49	397.5	292.3	17.9	105.2	3.6	4.4
20	5	after WS	47.7	13.4				340.0				
		before WS		12.8	6	55	445.2	317.2	22.8	128.0	4.6	4.3
25	5	after WS	47.7	14.5				364.9				
		before WS		14.0	5	60	492.9	351.4	13.5	141.5	2.7	3.9
30	5	after WS	47.7	15.8				399.1				
		before WS		14.6	12	72	540.6	368.5	30.6	172.1	3.1	3.6
40	10	after WS	47.7	16.1				416.2				
		before WS		14.9	18	90	588.3	377.1	39.1	211.2	3.9	3.5
50	10	after WS	47.7	16.7				424.8				
		before WS		15.6	11	101	636.0	397.5	27.3	238.5	2.7	3.3
60	10	after WS	47.7	17.5				445.2				
		before WS		16.5	10	111	683.7	423.8	21.4	259.9	2.1	3.1
70	10	after WS										

Observation time (min) : 70

Total water supplied (lit): 684
Remaining amount of water (lit): 424
Consumed amount of water (lit): 260

Total Water loss (mm):
Converted to (liter): 260 in (0-70 min)
Converted to (lit./sec/100 m): 3.1

Constant water loss
Converted to (liter): 21.4 in (60-70 min)
Converted to (lit./sec/100 m): 1.8

Ratio in constant loss to total loss : 0.81

Regressional expression: WL=12.5321T^(0.4892)

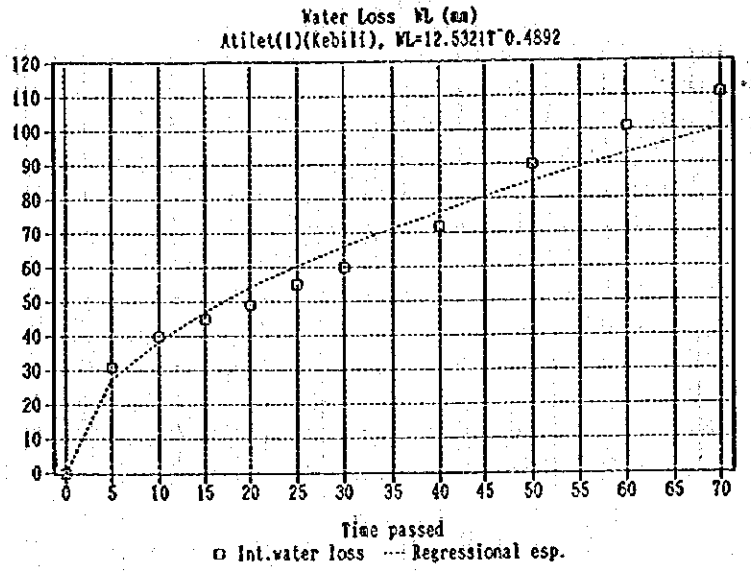

Water Loss WL (mm)
Atilet(I)(Kebili), WL=12.5321T^0.4892
120
110
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Time passed
Int.water loss
Regressional esp.

Table G. A. 5. 1 (9) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

Dat 27/9 1995 Time: 10:35 ~ 12:35

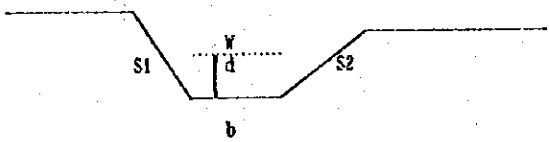
2. Location

Name of Oasis(AIC): Atilet (2)
Type of Oasis: New
Name of hydrant: B-10

3. Conditions

Designed Irrigation Interval: 21 (days)
Designed System Capacity: 15 (lit/sec)
Last Irrigation: 6 (days before)
Climate: Fine
Temperature: 28 (℃)

4. Cross Section of Earth Ditch



b = 57 cm
W = 122 cm
d = 17 cm
S1 = 35 cm
S2 = 40 cm
L = 2.00 m

5. Record of Observation

① Time passed (t min)	② Interval of time (min)	Water supply (WS)	③ Amount of Water supplied (lit)	Water Depth (d cm)	④ Water loss (1 mm)	⑤=Σ④ Accumu. amount of water loss (WL mm)	⑥=Σ③ Accumu. amount of water supplied (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t) -⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=⑨/② (lit/min)	⑪=⑨/(①*60)/L*100) (lit/s/100m)
0		after WS	159.0	13.1		0		159.0				
		before WS		7.8	53	53	159.0	109.2	49.8	49.8	10.0	8.3
5	5	after WS	47.7	10.0				156.9				
		before WS		8.2	18	71	206.7	114.8	42.1	91.9	8.4	7.7
10	5	after WS	47.7	10.5				162.5				
		before WS		9.0	15	86	254.4	128.4	34.1	126.0	6.8	7.0
15	5	after WS	47.7	11.3				176.1				
		before WS		9.5	18	104	302.1	136.9	39.2	165.2	7.8	6.9
20	5	after WS	47.7	11.7				184.6				
		before WS		10.7	10	114	349.8	158.6	26.0	191.2	5.2	6.4
25	5	after WS	47.7	12.8				206.3				
		before WS		11.6	12	126	397.5	175.5	30.8	222.0	6.2	6.2
30	5	after WS	47.7	13.5				223.2				
		before WS		10.7	28	154	445.2	158.6	64.6	286.6	6.5	6.0
40	10	after WS	47.7	13.3				206.3				
		before WS		10.7	26	180	492.9	158.6	47.7	334.3	4.8	5.6
50	10	after WS	47.7	13.3				206.3				
		before WS		10.5	28	208	540.6	155.0	51.3	385.6	5.1	5.4
60	10	after WS	47.7	12.6				202.7				
		before WS		10.2	24	232	588.3	149.6	53.1	438.7	5.3	5.2
70	10	after WS	47.7									

Observation time (min) : 70

Total water supplied (lit): 588
Remaining amount of water (lit): 150
Consumed amount of water (lit): 439

Total Water loss (mm):
Converted to (liter): 232 in (0-120 min)
Converted to (lit./sec/100 m): 5.2

Constant water loss
Converted to (liter): 152.1 in (40-70 min)
Converted to (lit./sec/100 m): 4.2

Ratio in constant loss to total loss : 0.81

Regressional expression: WL=16.511T^(0.5658)

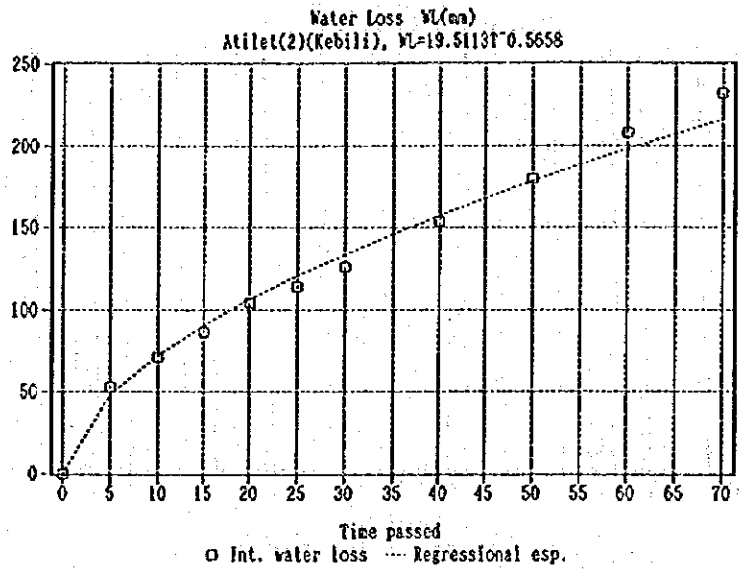

Water Loss WL(mm)
Atilet(2)(Kebili), WL=19.5113T^0.5658
250
200
150
100
50
0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Time passed
o Int. water loss ···· Regressional esp.

Table G. A. 5. 1 (10) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

Dat 28/9 , 1995 Time 12:54 ~ 13:44

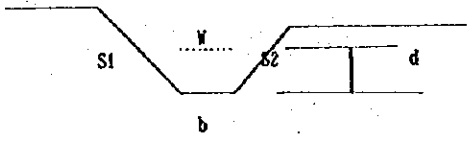
2. Observed Place

Name of Oasis(AIC): Limaoua(1)
Type of Oasis: New
Name of hydrant: A-15

3. Conditions

Designed Irrigation 20 (days)
Designed System Capa 30 (lit/sec)
Last Irrigation: 10 (days before)
Climate: Fine
Temperatur 26 ℃

4. Cross Section of Earth Ditch



b = 35 cm
B = 82 cm
d = 23 cm
S1 = 29 cm
S2 = 39 cm
L = 2.06 m

5. Record of Observation

① Time passed (t min)	② Unit time (min)	Water supply (WS)	③ Amount of water supplied (lit)	Water depth (d cm)	④ Water loss (l mm)	⑤=Σ④ Accumu. amount of water loss (WL mm)	⑥=Σ③ Accumu. amount of water supplied (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t) -⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=⑧/② (lit/min)	Water loss rate ⑪=⑨/(①×50)/L×100) (lit/s/100m)
0		after WS	174.9	18.0		0		174.9				
		before WS		16.0	20	20	174.9	168.0	6.9	6.9	1.4	1.1
5	5	after WS	15.9	17.3				183.9				
		before WS		16.4	9	29	190.8	173.5	10.4	17.3	2.1	1.4
10	5	after WS	15.9	17.4				189.4				
		before WS		17.2	2	31	206.7	184.6	4.8	22.1	1.0	1.2
15	5	after WS	15.9	18.1				200.5				
		before WS		17.7	4	35	222.6	191.6	8.9	31.0	1.8	1.3
20	5	after WS	0.0	-				191.6				
		before WS		17.2	5	40	222.6	184.6	7	38.0	1.4	1.2
25	5	after WS	0.0	-				184.6				
		before WS		16.6	6	46	222.6	176.3	8.3	46.3	1.7	1.2
30	5	after WS	15.9	17.8				192.2				
		before WS		16.8	10	56	238.5	179.1	13.1	59.4	1.3	1.2
40	10	after WS	15.9	17.9				195.0				
		before WS		17.0	9	65	254.4	181.8	13.2	72.6	1.3	1.2
50	10	after WS										

Obsevation period (min) : 50

Total water supplied (lit): 254
Remaining amount of water (lit): 182
Consumed amount of water (lit): 73

Total Water loss (mm): 65
Converted to (liter): 72.6 in (0-50 min)
Converted to (lit./sec/100 m): 1.2

Constant water loss
Converted to (liter): 50 in (25-50 min)
Converted to (lit./sec/100 m): 1.1

Ratio in constant loss to total loss : 0.95

Regressional expression: WL=8.6847T^(0.4941)

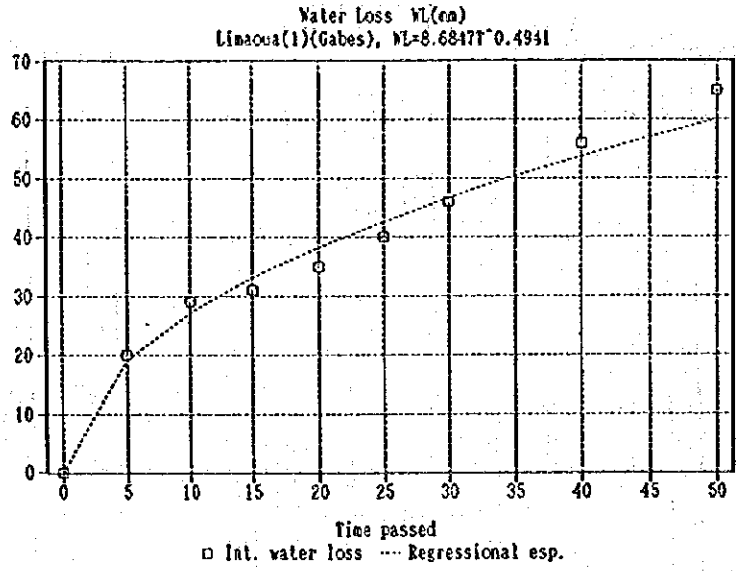

Water Loss WL(cm)
Limaosa(1)(Gabes), WL=8.6847T^0.4941
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
45
50
Time passed
Int. water loss
Regressional esp.

Table G. A. 5. 1 (11) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

Dat 28/9 , 1995 Time 14:03 ~ 14:40

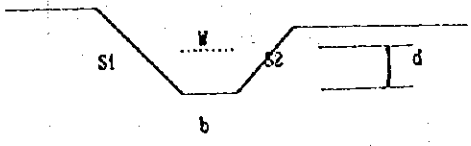
2. Location

Name of Oasis(AIC): Limaoua(2)
Type of Oasis: New
Name of hydrant: A-15

3. Conditions

Designed Irrigation 20 (days)
Designed System Capa 30 (lit/sec)
Last Irrigation: 10 (days before)
Climate: Fine
Temperature: 30 (℃)

4. Cross Section of Earth Ditch



b = 51 cm
B = 108 cm
d = 17 cm
S1 = 38 cm
S2 = 27 cm
L = 2.00 m

5. Record of Observation

① Time passed (t min)	② Unit time (min)	Water supply (WS)	③ Amount of water supplied (lit)	Water depth (d cm)	④ Water loss (l mm)	⑤=Σ④ Accumu. amount of water loss (WL mm)	⑥=Σ③ Accumu. amount of water supplied (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t)-⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=⑧/② (lit/min)	⑪=⑤/(①+60)/L*100) (lit/s/100m)
0		after WS	174.9	13.7		0		174.9				
		before WS		12.4	13	13	174.9	164.9	10.0	10.0	2.0	1.7
5	5	after WS	31.8	14.2				196.7				
		before WS		13.7	5	18	206.7	186.7	10.0	20.0	2.0	1.7
10	5	after WS	15.9	14.5				202.6				
		before WS		13.9	6	24	222.6	190.2	12.4	32.4	2.5	1.8
15	5	after WS	15.9	14.6				206.1				
		before WS		14.1	5	29	238.5	193.7	12.4	44.8	2.5	1.9
20	5	after WS	15.9	14.9				209.6				
		before WS		14.4	5	34	254.4	199.0	10.6	55.4	2.1	1.8
25	5	after WS	15.9	15.4				214.9				
		before WS		15.0	4	38	270.3	209.7	5.2	60.6	1.0	1.7
30	5	after WS	0.0	15.0				209.7				
		before WS		14.6	4	42	270.3	202.6	7.1	67.7	1.4	1.6
35	5	after WS										

Obsevation period (min) : 35

Total water supplied (lit): 270
Remaining amount of water (lit): 203
Consumed amount of water (lit): 68

Total Water loss (mm): 42
Converted to (liter): 67.7 in (0-35 min)
Converted to (lit./sec/100 m): 1.6

Constant water loss
Converted to (liter): 12.3 in (25-35 min)
Converted to (lit./sec/100 m): 1.0

Ratio in constant loss to total loss : 0.64

Regressional expression: WL=9.1926T^(0.4021)

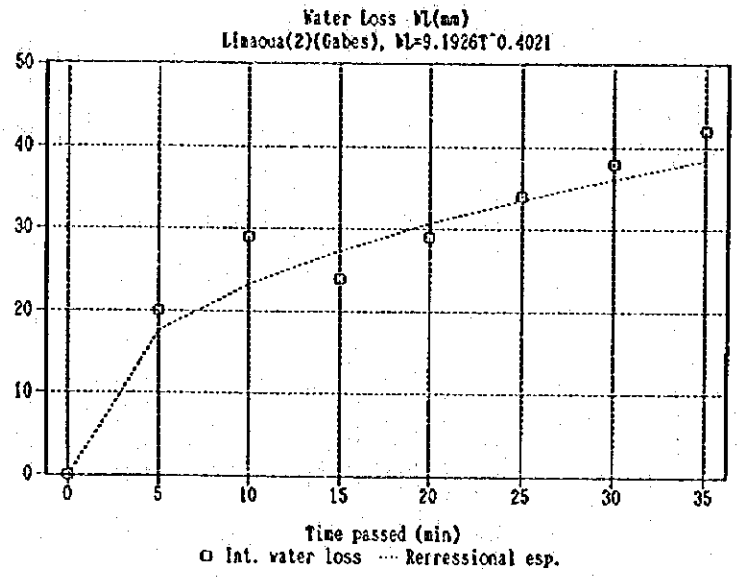

Water Loss WL(mm)
Linaoua(2)(Gabes), WL=9.1926T^0.4021
50
40
30
20
10
0
0
5
10
15
20
25
30
35
Time passed (min)
Int. water loss
Rerressional esp.

Table G. A. 5. 1 (12) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

Dat 29/9 , 1995 Time 10:16 ~ 11:01

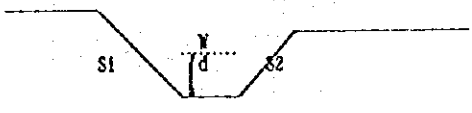
2. Location

Name of Oasis(AIC): Kethouia(1)
Type of Oasis: Traditional
Name of Hydrant: F-16

3. Conditions

Designed Irrigation Interval: not fixed (days)
Designed System Capacity: 42 (lit/sec)
Last Irrigation: 2 (days before by rainfall)
Climate: Fine
Temperature: 35 (℃)

4. Cross Section of Earth Ditch



b = 32 cm
B = 107 cm
d = 28 cm
S1 = 46 cm
S2 = 47 cm
L = 2.00 m

5. Record of Observation

① Time passed (t min)	② Unit time (min)	Water supply (WS)	③ Amount of water supplied (lit)	Water depth (d cm)	④ Water loss (1 mm)	⑤=Σ④ Accumu. amount of water loss (¥L mm)	⑥=Σ③ Accumu. amount of water supplied (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t) -⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑩=⑧/② (lit/min)	⑪=⑨/(①+60)/L+100) (lit/s/100m)
0		after WS	174.9	16.0		0		174.9				
		before WS		14.0	20	20	174.9	141.4	33.5	33.5	6.7	5.6
5	5	after WS	31.8	15.8				173.2				
		before WS		14.9	9	29	206.7	153.8	19.4	52.9	3.9	4.4
10	5	after WS	31.8	16.5				185.6				
		before WS		16.0	5	34	238.5	169.1	16.5	69.4	3.3	3.9
15	5	after WS	31.8	17.5				200.9				
		before WS		17.2	3	37	270.3	186.2	14.7	84.1	2.9	3.5
20	5	after WS	15.9	17.9				202.1				
		before WS		17.0	9	46	286.2	183.4	18.7	102.8	3.7	3.4
25	5	after WS	15.9	17.8				199.3				
		before WS		17.3	5	51	302.1	187.7	11.6	114.4	2.3	3.2
30	5	after WS	15.9	17.9				203.6				
		before WS		17.4	5	56	318.0	189.1	14.5	128.9	2.9	3.1
35	5	after WS	15.9	18.2				205.0				
		before WS		17.4	8	64	333.9	189.1	15.9	144.8	3.2	3.0
40	5	after WS	0.0	17.4				189.1				
		before WS		16.5	9	73	333.9	176.2	12.9	157.7	2.6	2.9
45	5	after WS										

Obsevation period (min) : 45

Total water supplied (lit): 334
Remaining amount of water (lit): 176
Consumed amount of water (lit): 158

Total Water loss (mm): 73
Converted to (liter): 157.7 in (0-45 min)
Converted to (lit./sec/100 m): 2.9

Constant water loss
Converted to (liter): 43.3 in (30-45 min)
Converted to (lit./sec/100 m): 2.4

Ratio in constant loss to total loss : 0.82

Regressional expression: WL=7.6302T^(0.5661)

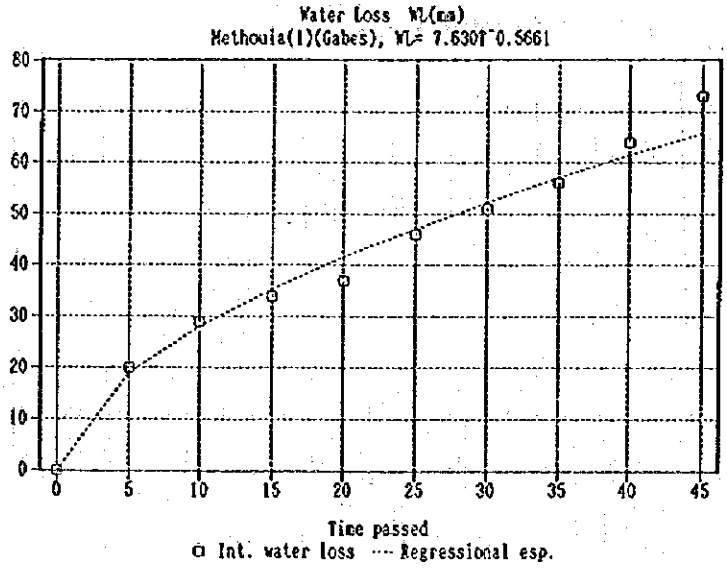

Water Loss WL(mm)
Methoula(1)(Gabes), WL= 7.630t^0.566
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
45
Time passed
Int. water loss
Regressional esp.

Table G. A. 5. 1 (13) Measurement of Water-Loss by Ponding Method

1. Observation Date and Time

Dat 29/9 , 1995 Time 11:32 ~ 12:12

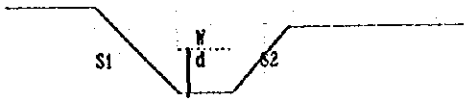
2. Location

Name of Oasis(AIC): Kethoula(2)
Type of Oasis: Traditional
Name of hydrant: F-16

3. Conditions

Designed Irrigation Interval: not fixed (days)
Designed System Capacity: 42 (lit/sec)
Last Irrigation: 2 (days before by rainfall)
Climate: Fine
Temperature: 31 (℃)

4. Cross Section of Earth Ditch



b = 33 cm
B = 66 cm
d = 24.5 cm
S1 = 33 cm
S2 = 27 cm
L = 2.00 m

5. Record of Observation

① Time passed (t min)	② Unit time (min)	Water supply (WS)	③ Amount of water supplied (lit)	Water Depth (d cm)	④ Water loss (l mm)	⑤=Σ④ Accumu. amount of water loss (WL mm)	⑥=Σ③ Accumu. amount of water supplied (lit)	⑦ Amount of ponding water (lit)	⑧=⑦(t) -⑦(t-1) Observed water loss (lit)	⑨=Σ⑧ Accumu. amount of water loss (lit)	Water loss rate ⑨=⑧/② (lit/min)	①=⑨/(①+60)/L*100) (lit/s/100m)
0		after WS	143.1	16.8		0		143.1				
		before WS		13.5	33	33	143.1	117.5	25.6	25.6	5.1	4.3
5	5	after WS	15.9	14.8				133.4				
		before WS		13.8	10	43	159.0	120.8	12.6	38.2	2.5	3.2
10	5	after WS	31.8	16.3				152.6				
		before WS		15.2	11	54	190.8	136.8	15.8	54.0	3.2	3.0
15	5	after WS	31.8	17.7				168.6				
		before WS		16.7	10	64	222.6	154.8	13.8	67.8	2.8	2.8
20	5	after WS	15.9	17.7				170.7				
		before WS		16.8	9	73	238.5	156.0	14.7	82.5	2.9	2.8
25	5	after WS	15.9	17.7				171.9				
		before WS		16.8	9	82	254.4	156.0	15.9	98.4	3.2	2.7
30	5	after WS	15.9	18.0				171.9				
		before WS		16.0	20	102	270.3	146.4	25.5	123.9	2.6	2.6
40	10	after WS										

Obsevation period (min) : 40

Total water supplied (lit): 270
Remaining amount of water (lit): 146
Consumed amount of water (lit): 124

Total Water loss (mm): 102
Converted to (liter): 124 in (0-40 min)
Converted to (lit./sec/100 m): 2.6

Constant water loss
Converted to (liter): 41.4 in (25-40 min)
Converted to (lit./sec/100 m): 2.3

Ratio in constant loss to total loss : 0.89

Regressional expression: WL=5.202118t^(0.817555)

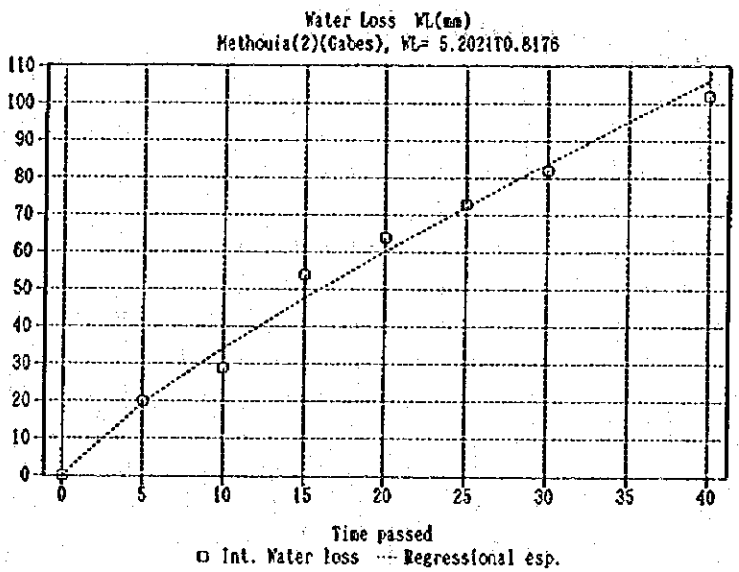

Water Loss WL(mm)
Methouia(2)(Cabes), WL= 5.202ITO.8176
110
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
Time passed
Int. Water loss
Regressional esp.

Table G.A.5.2 Result of Water-loss Measurement by Ponding Method

Observed Day: from 19,Sep. to 29,Sep.'95

Name of Oasis	Province	Type of Oasis	Observed day	Last Irri. day	Remarks
Kasba	Gafsa	Traditional	19,Sep.	-	Rainfall,10mm (after measurement)
Oued Shili	//	New	20,Sep.	one day before	-
Oasis Tozeur	Tozeur	Traditional	21,Sep.	two days before	-
Draa Sud(1)	//	New	22,Sep.	3 days before	-
Draa Sud(2)	//	New	//	3 days before	-
Rabta(1)	Kebili	Traditional	26,Sep.	5 days before	-
Rabta(2)	//	//	//	5 days before	-
Atilet(1)	//	New	27,Sep.	5 days before	Rainfall,35mm at Gabes
Atilet(2)	//	//	27,Sep.	6 days before	
Limaoua(1)	Gabes	//	28,Sep.	one day before	-
Limaoua(2)	//	//	//	//	-
Metouia(1)	//	Traditional	29,Sep.	2 day before	-
Metouia(2)	//	//	//	//	-

Name of Oasis	Outline of earth ditch			Total water -loss		Constant water-loss	Ratio of water-loss	Observation period
	Botom width (cm)	Water depth (cm)	Water surface (cm)	(l/sec /100m)	(mm)	(l/sec /100m)		(min)
				①		②	②/①	
Kasba	40	19	102	* 2.6	209	1.5	0.6	120
Oued Shili	40	15	101	* 5.3	252	3.8	0.7	80
Oasis Tozeur	35	19	98	* 0.9	45	0.8	0.9	80
Draa Sud(1)	53	12	75	7.8	502	6.2	0.8	80
Draa Sud(2)	62	14	96	9.0	299	7.3	0.8	70
Rabta(1)	69	14	106	2.5	86	1.4	0.6	60
Rabta(2)	29	18	75	1.5	55	1.2	0.8	50
Atilet(1)	105	16	148	3.1	88	1.8	0.6	70
Atilet(2)	57	12	94	5.2	232	4.3	0.8	70
Limaoua(1)	35	18	69	* 1.2	65	1.1	0.9	50
Limaoua(2)	51	15	89	* 1.2	28	1.1	0.9	35
Metouia(1)	32	17	73	* 2.9	108	2.2	0.8	45
Metouia(2)	33	17	62	* 2.4	92	2.2	0.9	40

Note) These values are infulenced by rainfall

Table G.A.5.3(1) Measurement of Water Losses by Flow Method (1/8)

(1) Location
Name of oasis: Kasba(Gafsa)
Designed system capacity: 30 (lit/sec)

(2) Amount of Inflow
Elevation of table of measuring device of upper weir : 10.487
Height conversion factor for water level (WL): -0.393
Elevation of notch of upper weir : 10.202

Time passed (t min)	at weir of upper stream: Observed water level: Water depth (cm)	level (m)	Overflow depth (d1 cm)	Inflow (q1 l/s)	Average inflow (l/sec)	Amount of inflow (Qi m3)	Accumu. amount of inflow (ΣQi m3)
0	10.80	10.202	0.0	0.0	—	—	0
5	16.40	10.258	5.6	14.6	7.3	2	2
10	18.00	10.274	7.2	21.2	17.9	5	8
15	18.50	10.279	7.7	23.8	22.5	7	14
20	19.30	10.287	8.5	27.1	25.5	8	22
25	19.20	10.286	8.4	26.6	26.9	8	30
30	19.20	10.286	8.4	26.6	26.6	8	38
40	19.30	10.287	8.5	27.1	26.9	16	54
50	19.30	10.287	8.5	27.1	27.1	16	70
60	19.30	10.287	8.5	27.1	27.1	16	87
80	19.20	10.286	8.4	26.6	26.9	32	119
100	19.20	10.286	8.4	26.6	26.6	32	151
120	19.20	10.286	8.4	26.6	26.6	32	183

Note) Dimension of approach ditch: W= 120 (cm)
Height of Notch from the bottom of ditch: H= 15 (cm)

(3) Amount of Outflow
Elevation of table of measuring device of lower weir : 9.651
Height conversion factor for water level (WL): -0.366
Elevation of notch of lower weir : 9.296
Lapse of time before overflow : 19.45 (min)

Lapse of time (t min)	at weir of lower stream: Observed water level: Water depth (cm)	level (m)	Overflow depth (d2 cm)	outflow (q2 l/s)	Average outflow (l/sec)	Amount of outflow (Qi m3)	Accumu. amount of outflow (ΣQi m3)
0	-	-	-	-	—	—	0
5	-	-	-	-	—	—	0
10	-	-	-	-	—	—	0
15	-	-	-	-	—	—	0
20	5.30	9.338	4.2	9.6	4.8	1	1
25	5.20	9.337	4.1	9.3	9.5	3	4
30	5.80	9.343	4.7	11.3	10.3	3	7
40	6.50	9.350	5.4	13.8	12.6	8	15
50	6.80	9.353	5.7	15.0	14.4	9	24
60	6.90	9.354	5.8	15.4	15.2	9	33
80	7.00	9.355	5.9	15.8	15.6	19	51
100	7.00	9.355	5.9	15.8	15.8	19	70
120	7.00	9.355	5.9	15.8	15.8	19	89

Note) Dimension of approach ditch: W= 120 (cm)
Height of Notch from the bottom of ditch: H= 15 (cm)

(3) Evaluation of water loss
Length of earth ditch : 155 m

Lapse of time (t min)	Inflow: ① Inflow (q1 l/s)	② Accumu. amount of inflow (Qi m3)	Outflow: ③ Outflow (q2 l/s)	④ Accumu. amount of outflow (Qo m3)	Water loss: ⑤= (①-③) (l/s)	Water loss rate: ⑥= ⑤/①*100 (%)	⑦= (②-④) /②*100 (%)	⑧= ⑥/L (%/100m)
0	0	0	-	0	0	-	-	-
5	14.6	2	-	0	14.6	-	-	-
10	21.2	8	-	0	21.2	-	-	-
15	23.8	14	-	0	23.8	-	-	-
20	27.1	22	9.6	1	17.5	65	93	42
25	26.6	30	9.3	4	17.3	65	86	42
30	26.6	38	11.3	7	15.3	58	81	37
40	27.1	54	13.8	15	13.3	49	72	32
50	27.1	70	15.0	24	12.1	45	67	29
60	27.1	87	15.4	33	11.7	43	62	28
80	26.6	119	15.8	51	10.8	41	57	26
100	26.6	151	15.8	70	10.8	41	53	26
120	26.6	183	15.8	89	10.8	41	51	26

Table G.A.5.3(2) Measurement of Water Losses by Flow Method (2/8)

(1) Observed Place
Name of oasis: Ksar(Gafsa)
Designed system capacity: 30 (lit/sec)

(2) Amount of Inflow
Elevation of table of measuring device of upper weir : 10.5
Height conversion factor for water level (WL): -0.393
Elevation of notch of upper weir : 10.190

Lapse of time (t min)	at weir of upper stream: Observed water level: Water depth (cm)	level (m)	Overflow depth (di cm)	Inflow (qi l/s)	Average inflow (l/sec)	Amount of inflow (Qi m3)	Accumu. amount of inflow (ΣQi m3)
0	8.70	10.194	0.4	0	-	-	0
5	15.80	10.265	7.5	22.3	11.2	3	3
10	16.80	10.275	8.5	26.8	24.6	7	11
15	17.10	10.278	8.8	28.2	27.5	8	19
20	17.10	10.278	8.8	28.2	28.2	8	27
25	17.10	10.278	8.8	28.2	28.2	8	36
30	17.10	10.278	8.8	28.2	28.2	8	44
40	17.10	10.278	8.8	28.2	28.2	17	61
50	17.10	10.278	8.8	28.2	28.2	17	78
60	17.10	10.278	8.8	28.2	28.2	17	95
80	17.10	10.278	8.8	28.2	28.2	34	129
100	17.10	10.278	8.8	28.2	28.2	34	163
120	17.10	10.278	8.8	28.2	28.2	34	197

Note) Dimension of approach ditch: W= 130 (cm)
Height of Notch from the bottom of ditch: H= 19 (cm)

(3) Amount of Outflow
Elevation of table of measuring device of lower weir : 9.941
Height conversion factor for water level (WL): -0.366
Elevation of notch of lower weir : 9.670
Lapse of time before overflow: 25.1(min)

Lapse of time (t min)	at weir of lower stream: Observed water level: Water depth (cm)	level (m)	Overflow depth (di cm)	outflow (qi l/s)	Average outflow (l/sec)	Amount of outflow (Qi m3)	Accumu. amount of outflow (ΣQi m3)
0	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
25	9.8	9.673	0.3	0	0.0	0	0
30	14.7	9.722	5.2	13.1	6.6	2	2
40	16.0	9.735	6.5	18.1	15.6	9	11
50	15.9	9.734	6.4	17.7	17.9	11	22
60	15.8	9.733	6.3	17.3	17.5	11	33
80	16.4	9.739	6.9	19.8	18.6	22	55
100	16.4	9.739	6.9	19.8	19.8	24	79
120	16.4	9.739	6.9	19.8	19.8	24	102

Note) Dimension of approach ditch: W= 114 (cm)
Height of Notch from the bottom of ditch: H= 19 (cm)

(4) Evaluation of water loss
Length of earth ditch : 200 m

Lapse of time (t min)	Inflow: ① Inflow (ql l/s)	② Accumu. amount of inflow (Qi m3)	Outflow: ③ Outflow (q2 l/s)	④ Accumu. amount of outflow (Qo m3)	Water loss: ⑤= (①-③)	Water loss rate: ⑥= (①-③)/①*100 (%)	⑦= (②-④)/②*100 (%)	⑧= ⑤/l (%/100m)
0	0	0	-	-	0	-	-	-
5	22.3	3	-	-	22.3	-	-	-
10	26.8	11	-	-	26.8	-	-	-
15	28.2	19	-	-	28.2	-	-	-
20	28.2	27	-	-	28.2	-	-	-
25	28.2	36	0.0	0	28.2	-	-	-
30	28.2	44	13.1	2	15.1	54	96	27
40	28.2	61	18.1	11	10.1	36	82	18
50	28.2	78	17.7	22	10.5	37	72	19
60	28.2	95	17.3	33	10.9	39	65	19
80	28.2	129	19.8	55	8.4	30	57	15
100	28.2	163	19.8	79	8.4	30	52	15
120	28.2	197	19.8	102	8.4	30	48	15

Table G.A.5.3(3) Measurement of Water Losses by Flow Method (3/8)

(1) Observed Place
Name of oasis: Tozeur(Tuzeur)
Designed system capacity: 30 (lit/sec)

(2) Amount of Inflow
Elevation of table of measuring device of upper weir : 10.436
Height conversion factor for water level (hL): -0.366
Elevation of notch of upper weir : 10.177

Lapse of time (t min)	at weir of upper stream: Observed water level: Water depth (cm)	level (m)	Overflow depth (d1 cm)	Inflow (q1 l/s)	Average inflow (l/sec)	Amount of inflow (Qi m3)	Accumu. amount of inflow (ΣQi m3)
0	11.25	10.183	0.5	0	-	-	0
5	20.20	10.272	9.5	31.6	15.8	5	5
10	20.20	10.272	9.5	31.6	31.6	9	14
15	20.20	10.272	9.5	31.6	31.6	9	24
20	20.20	10.272	9.5	31.6	31.6	9	33
25	20.20	10.272	9.5	31.6	31.6	9	43
30	20.20	10.272	9.5	31.6	31.6	9	52
40	20.10	10.271	9.4	31.1	31.4	19	71
50	20.20	10.272	9.5	31.6	31.4	19	90
60	20.20	10.272	9.5	31.6	31.6	19	109
80	20.25	10.273	9.5	31.6	31.6	38	147
100	20.25	10.273	9.5	31.6	31.6	38	185
120	20.25	10.273	9.5	31.6	31.6	38	222

Note) Dimension of approach ditch: W= 145 (cm)
Height of Notch from the bottom of ditch: H= 19 (cm)

(3) Amount of Outflow
Elevation of table of measuring device of lower weir : 9.019
Height conversion factor for water level (hL): -0.366
Elevation of notch of lower weir : 8.713
Lapse of time before overflow : 13.0(min)

Lapse of time (t min)	at weir of lower stream: Observed water level: Water depth (cm)	level (m)	Overflow depth (d2 cm)	outflow (q2 l/s)	Average outflow (l/sec)	Amount of outflow (Qo m3)	Accumu. amount of outflow (ΣQo m3)
0	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-
20	12.80	-	-	-	-	-	-
25	13.03	-	-	-	-	-	0
30	13.65	8.790	7.7	23.6	11.8	4	4
40	12.87	8.782	6.9	20.0	21.8	13	17
50	13.28	8.786	7.3	21.8	20.9	13	29
60	13.55	8.789	7.6	23.1	22.5	13	43
80	13.55	8.789	7.6	23.1	23.1	28	70
100	13.55	8.789	7.6	23.1	23.1	28	98
120	13.60	8.789	7.6	23.1	23.1	28	126

Note) Dimension of approach ditch: W= 94 (cm)
Height of Notch from the bottom of ditch: H= 17 (cm)

(4) Evaluation of water loss
Length of earth ditch : 150 m

Lapse of time (t min)	Inflow: ① Inflow (q1 l/s)	② Accumu. amount of inflow (Qi m3)	Outflow: ③ Outflow (q2 l/s)	④ Accumu. amount of outflow (Qo m3)	Water loss: ⑤= (①-③)	Water loss rate: ⑥= (①-③)/①*100 (%)	⑦= (②-④)/②*100 (%)	⑧= ⑤/L (%/100m)
0	0	0	-	-	0.0	-	-	-
5	31.6	5	-	-	31.6	-	-	-
10	31.6	14	-	-	31.6	-	-	-
15	31.6	24	-	-	31.6	-	-	-
20	31.6	33	-	-	31.6	-	-	-
25	31.6	43	-	-	31.6	-	-	-
30	31.6	52	23.6	4	8.0	25	93	17
40	31.1	71	20.0	17	11.1	36	77	24
50	31.6	90	21.8	29	9.8	31	68	21
60	31.6	109	23.1	43	8.5	27	61	18
80	31.6	147	23.1	70	8.5	27	52	18
100	31.6	185	23.1	98	8.5	27	47	18
120	31.6	222	23.1	126	8.5	27	43	18

Table G.A.5.3(1) Measurement of Water Losses by Flow Method (4/8)

(1) Observed Place
Name of oasis: Ghardgaya(Tuzeur)
Designed system capacity: 27 (lit/sec)

(2) Amount of Inflow
Elevation of table of measuring device of upper weir : 10.606
Height conversion factor for water level (HL): -0.366
Elevation of notch of upper weir : 10.238

Lapse of time (t min)	at weir of upper stream: Observed water level: Water depth (cm)	Observed water level: level (m)	Overflow depth (d1 cm)	Inflow (q1 l/s)	Average inflow (l/sec)	Amount of inflow (Qi m3)	Accumu. amount of inflow (ΣQi m3)
0	0.23	10.242	0.4	0.0	-	-	0
5	7.30	10.313	7.5	22.6	11.3	3	3
10	7.40	10.314	7.6	23.1	22.9	7	10
15	7.35	10.314	7.5	22.6	22.9	7	17
20	7.32	10.313	7.5	22.6	22.6	7	24
25	7.32	10.313	7.5	22.6	22.6	7	31
30	7.32	10.313	7.5	22.6	22.6	7	37
40	7.32	10.313	7.5	22.6	22.6	14	51
50	7.20	10.312	7.4	22.2	22.4	13	64
60	6.70	10.307	6.9	20.0	21.1	13	77
80	6.45	10.305	6.6	18.7	19.4	23	100
100	6.30	10.303	6.5	18.3	18.5	22	123
120	6.28	10.303	6.5	18.3	18.3	22	144

Note) Dimension of approach ditch: W= 106 (cm)
Height of Notch from the bottom of ditch: H= 15 (cm)

(3) Amount of Outflow
Elevation of table of measuring device of lower weir : 10.064
Height conversion factor for water level (HL): -0.366
Elevation of notch of lower weir : 9.708
Lapse of time before overflow : 8.3 (min)

Lapse of time (t min)	at weir of lower stream: Observed water level: Water depth (cm)	Observed water level: level (m)	Overflow depth (d2 cm)	outflow (q2 l/s)	Average outflow (l/sec)	Amount of outflow (Qo m3)	Accumu. amount of outflow (ΣQo m3)
0	-	-	-		-	-	0
5	-	-	-				
10	7.27	9.771	6.3	17.7	8.9	3	3
15	7.50	9.773	6.5	18.5	18.1	5	8
20	7.72	9.775	6.7	19.4	19.0	6	14
25	-	-	-	-	-	-	-
30	7.21	9.770	6.2	17.3	18.4	11	25
40	7.07	9.769	6.1	16.9	17.1	10	35
50	-	-	-	-	-	-	-
60	6.65	9.765	5.6	14.9	15.9	19	54
80	6.15	9.760	5.2	13.3	14.1	17	71
100	6.05	9.759	5.0	12.6	13.0	16	87
120	6.05	9.759	5.0	12.6	12.6	15	102

Note) Dimension of approach ditch: W= 83 (cm)
Height of Notch from the bottom of ditch: H= 15 (cm)

(4) Evaluation of water loss
Length of earth ditch : 118 m

Lapse of time (t min)	Inflow: ① Inflow (q1 l/s)	Inflow: ② Accumu. amount of inflow (Qi m3)	Outflow: ③ Outflow (q2 l/s)	Outflow: ④ Accumu. amount of outflow (Qo m3)	Water loss: ⑤=(①-③)	Water loss rate: ⑥=(①-③)/①*100 (%)	Water loss rate: ⑦=(②-④)/②*100 (%)	Water loss rate: ⑧=⑤/L (%/100m)
0	0.0	0	0	0	0.0			
5	22.6	3	0	0	22.6			
10	23.1	10	17.7	2.655	5.4	23	74	20
15	22.6	17	18.5	8.085	4.1	18	53	15
20	22.6	24	19.4	13.77	3.2	14	42	12
25	22.6	31	18.4	-	4.2	-	-	16
30	22.6	37	17.3	24.78	5.3	23	34	20
40	22.6	51	16.9	35.04	5.7	25	31	21
50	22.2	64	15.9	-	6.3	-	-	21
60	20.0	77	14.9	54.12	5.1	26	30	22
80	18.7	100	13.3	71.04	5.4	29	29	24
100	18.3	123	12.6	86.58	5.7	31	29	26
120	18.3	144	12.6	101.7	5.7	31	30	26

Table G.A.5.3(5) Measurement of Water Losses by Flow Method (5/8)

(1) Observed Place
Name of oasis: Rabta(Nzeur)
Designed system capacity: 32 (lit/sec)

(2) Amount of Inflow
Elevation of table of measuring device of upper weir : 10.492 10.643
Height conversion factor for water level (WL): -0.366
Elevation of notch of upper weir : 10.262 10.376

Lapse of time (t min)	at weir of upper stream: Observed water level: Water depth (cm)	Observed water level: level (m)	Overflow depth (dl cm)	Inflow (ql l/s)	Average inflow (l/sec)	Amount of inflow (Qi m3)	Accumu. amount of inflow (ΣQi m3)
0	13.60	10.262	0.0	0.0	0.0	0	0
5	20.40	10.330	6.8	19.2	9.6	3	3
10	21.90	10.345	8.3	25.8	22.5	7	10
15	22.70	10.353	9.1	29.5	27.7	8	18
20	23.15	10.358	9.6	32.1	30.8	9	27
25	23.15	10.358	9.6	32.1	32.1	10	37
30	-	-	-	30.0	-	-	-
40	-	-	-	27.8	-	-	-
50	18.23	10.459	8.3	25.7	28.9	43	80
60	18.30	10.460	8.4	26.2	26.0	16	96
80	18.65	10.464	8.8	28.0	27.1	33	128
100	18.65	10.464	8.8	28.0	28.0	34	162
120	17.80	10.455	7.9	23.9	26.0	31	193

Note) Dimension of approach ditch: W= 115 (cm)
Height of Notch from the bottom of ditch: H= 42 (cm)

(3) Amount of Outflow
Elevation of table of measuring device of lower weir : 10.274 10.447
Height conversion factor for water level (WL): -0.366
Elevation of notch of lower weir : 9.945 10.182
Lapse of time before overflow : 23.0 (min)

Lapse of time (t min)	at weir of lower stream: Observed water level: Water depth (cm)	Observed water level: level (m)	Overflow depth (dl cm)	outflow (ql l/s)	Average outflow (l/sec)	Amount of outflow (Qi m3)	Accumu. amount of outflow (ΣQi m3)
0	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
25	4.24	-	-	-	-	-	-
30	10.85	-	-	-	-	-	-
40	12.95	-	-	-	-	-	-
50	13.70	-	-	-	-	-	-
60	15.82	-	-	-	-	-	-
80	16.45	10.246	6.3	17.2	8.6	10	10
100	17.80	10.259	7.7	23.1	20.2	24	35
120	16.81	10.249	6.7	18.8	21.0	25	60

Note) Dimension of approach ditch: W= 128 (cm)
Height of Notch from the bottom of ditch: H= 24 (cm)

(4) Evaluation of water loss
Length of earth ditch : 162 m

Lapse of time (t min)	Inflow: ① Inflow (q1 l/s)	Inflow: ② Accumu. amount of inflow (Qi m3)	Outflow: ③ Outflow (q2 l/s)	Outflow: ④ Accumu. amount of outflow (Qo m3)	Water loss: ⑤= (①-③)	Water loss rate: ⑥= (①-③)/①*100 (%)	Water loss rate: ⑦= (②-④)/②*100 (%)	Water loss rate: ⑧= ⑤/L (%/100m)
0	0.0	0	-	-	0.0	-	-	-
5	19.2	3	-	-	19.2	-	-	-
10	25.8	10	-	-	25.8	-	-	-
15	29.5	18	-	-	29.5	-	-	-
20	32.1	27	-	-	32.1	-	-	-
25	32.1	37	0.0	-	32.1	-	-	-
30	30.0	-	18.4	-	11.6	-	-	-
40	27.8	-	17.1	-	10.7	-	-	-
50	25.7	80	15.8	-	9.9	-	-	-
60	26.2	96	16.1	-	10.1	-	-	-
80	28.0	128	17.2	10	10.8	39	92	24
100	28.0	162	23.1	35	4.9	17	79	11
120	23.9	193	18.8	60	5.1	21	69	13

Table G.A.5.3(6) Measurement of Water Losses by Flow Method (6/8)

(1) Observed Place
Name of oasis: Atilet(Kebili)
Designed system capacity: 30 (lit/sec)

(2) Amount of Inflow
Elevation of table of measuring device of upper weir : 10.53 10.526
Height conversion factor for water level (WL): -0.366
Elevation of notch of upper weir : 10.216 10.163

Lapse of time (t min)	at weir of upper stream: Observed water level: Water depth (cm)	level (m)	Overflow depth (d1 cm)	Inflow (q1 l/s)	Average inflow (l/sec)	Amount of inflow (Qi m3)	Accumu. amount of inflow (ΣQi m3)
0	5.80	10.222	0.6	0	0.0	0	0
5	8.55	10.250	3.4	7.1	3.6	1	1
10	11.10	10.275	5.9	15.7	11.4	3	4
15	-	-	-	15.8	15.8	5	9
20	-	-	-	15.9	15.9	5	14
25	-	-	-	16.0	16.0	5	19
30	-	-	-	16.1	16.1	5	24
40	6.16	-	-	16.1	16.1	10	33
50	6.30	10.223	6.0	16.1	15.9	58	43
60	6.41	10.224	6.1	16.5	16.3	10	52
80	6.41	10.224	6.1	16.5	16.5	20	72
100	6.47	10.225	6.2	16.9	16.7	20	92
120							

Note) Dimension of approach ditch: W= 104 (cm)
Height of Notch from the bottom of ditch: H= 20.5 (cm)

(3) Amount of Outflow
Elevation of table of measuring device of lower weir : 9.904 9.658
Height conversion factor for water level (WL): -0.366
Elevation of notch of lower weir : 9.634 9.326
Lapse of time before overflow : 16.1 (min)

Lapse of time (t min)	at weir of lower stream: Observed water level: Water depth (cm)	level (m)	Overflow depth (d2 cm)	outflow (q2 l/s)	Average outflow (l/sec)	Amount of outflow (Qo m3)	Accumu. amount of outflow (ΣQi m3)
0	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-
20	13.60	9.674	4.0	8.9	4.5	1	1
25	14.92	9.687	5.3	13.4	11.2	3	5
30	14.72	9.685	5.1	12.7	13.1	4	9
40	14.80	9.686	5.2	13.1	12.9	8	16
50	14.89	9.687	5.3	13.4	13.3	8	24
60	14.87	9.687	5.3	13.4	13.4	8	32
80	14.88	9.687	5.3	13.4	13.4	16	48
100	8.75	9.380	5.3	13.4	13.1	16	64
120							

Note) Dimension of approach ditch: W= 98 (cm)
Height of Notch from the bottom of ditch: H= 24.5 (cm)

(4) Evaluation of water loss
Length of earth ditch : 120 m

Lapse of time (t min)	Inflow: ① Inflow (q1 l/s)	② Accumu. amount of inflow (Qi m3)	Outflow: ③ Outflow (q2 l/s)	④ Accumu. amount of outflow (Qo m3)	Water loss: ⑤= (①-③)	Water loss rate: ⑥= (①-③)/①*100 (%)	⑦= (②-④)/②*100 (%)	⑧= ⑤/L (%/100m)
0	0.0	0	-	-	0	-	-	100
5	7.1	1	-	-	7.1	-	-	100
10	15.7	4	-	-	15.7	-	-	100
15	15.8	9	-	-	15.8	-	-	100
20	15.9	14	8.9	1	7	44	90	37
25	16.0	19	13.4	5	2.6	16	75	14
30	16.1	24	12.7	9	3.4	21	64	18
40	16.1	33	13.1	16	3	19	51	16
50	16.1	43	13.4	24	2.7	17	43	14
60	16.5	52	13.4	32	3.1	19	38	16
80	16.5	72	13.4	48	3.1	19	33	16
100	16.9	92	13.4	64	3.5	21	31	17
120	-	-	-	-		-	-	-

Table G.A.5.3(7) Measurement of Water Losses by Flow Method (7/8)

(1) Observed Place
Name of oasis: Limaoua(Gabes)
Designed system capacity: 35 (lit/sec)

(2) Amount of Inflow
Elevation of table of measuring device of upper weir : 10.537 10.537
Height conversion factor for water level (HL): -0.366
Elevation of notch of upper weir : 10.205 10.205

Lapse of time (t min)	at weir of upper stream: Observed water level: Water depth (cm)	Observed water level: level (m)	Overflow depth (dl cm)	Inflow (ql l/s)	Average inflow (l/sec)	Amount of inflow (Qi m3)	Accumu. amount of inflow (ΣQi m3)
0	3.55	10.207	0.2	0	0.0	0	0
5	11.15	10.283	7.8	23.6	11.8	4	4
10	11.15	10.283	7.8	23.6	23.6	7	11
15	11.15	-	-	24.1	23.9	7	18
20	11.55	-	-	24.6	24.4	7	25
25	11.52	-	-	25.2	24.9	7	33
30	11.49	-	-	25.7	25.5	8	40
40	12.05	-	-	26.7	26.2	16	56
50	12.05	10.292	8.7	27.7	27.2	16	72
60	12.51	10.295	9.1	29.6	28.7	17	89
80	12.65	10.298	9.3	30.6	30.1	36	126
100	12.71	10.298	9.3	30.6	30.6	37	162
120	12.80	10.299	9.4	31.1	30.9	37	199

Note) Dimension of approach ditch: W= 130 (cm)
Height of Notch from the bottom of ditch: H= 20 (cm)

(3) Amount of Outflow
Elevation of table of measuring device of lower weir : 10.207 10.207
Height conversion factor for water level (HL): -0.366
Elevation of notch of lower weir : 9.927 10.013
Lapse of time before overflow : 28.5 (min)

Lapse of time (t min)	at weir of lower stream: Observed water level: Water depth (cm)	Observed water level: level (m)	Overflow depth (dl cm)	outflow (ql l/s)	Average outflow (l/sec)	Amount of outflow (Qi m3)	Accumu. amount of outflow (ΣQi m3)
0	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
25	-	-	-	-	0.0	0	0
30	12.21	9.963	3.6	7.7	3.9	1	1
40	14.64	-	4.8	11.7	9.7	6	7
50	15.84	-	6.0	16.2	14.0	8	15
60	20.63	-	6.0	16.2	16.2	10	25
80	22.80	-	6.0	16.2	16.2	19	45
100	23.21	10.073	6.0	16.2	12.0	14	59
120	23.21	10.073	6.0	16.2	16.2	19	78

Note) Dimension of approach ditch: W= 93 (cm)
Height of Notch from the bottom of ditch: H= 20 (cm)

(4) Evaluation of water loss
Length of earth ditch : 190 m

Lapse of time (t min)	Inflow: ① Inflow (ql l/s)	Inflow: ② Accumu. amount of inflow (Qi m3)	Outflow: ③ Outflow (q2 l/s)	Outflow: ④ Accumu. amount of outflow (Qo m3)	Water loss: ⑤= (①-③)	Water loss rate: ⑥= (①-③)/①*100 (%)	Water loss rate: ⑦= (②-④)/②*100 (%)	Water loss rate: ⑧= ⑤/L (%/100m)
0	0.0	0	-	-	0.0	-	-	100
5	23.6	4	-	-	23.6	-	-	100
10	23.6	11	-	-	23.6	-	-	100
15	24.1	18	-	-	24.1	-	-	100
20	24.6	25	-	-	24.6	-	-	100
25	25.2	33	0.0	0	25.2	100	100	53
30	25.7	40	7.7	1	18.0	70	97	37
40	26.7	56	11.7	7	15.0	56	88	30
50	27.7	72	16.2	15	11.5	42	79	22
60	29.6	89	16.2	25	13.4	45	72	24
80	30.6	126	16.2	45	14.4	47	65	25
100	30.6	162	16.2	59	14.4	47	64	25
120	31.1	199	16.2	78	14.9	48	61	25

Table G.A.5.3(8)Measurement of Water Losses by Flow Method (8/8)

(1) Observed Place
Name of oasis: Teboulbou(Gabes)
Designed system capacity: 35 (lit/sec)

(2) Amount of Inflow
Elevation of table of measuring device of upper weir : 10.554 10.544
Height conversion factor for water level (WL): -0.366
Elevation of notch of upper weir : 10.245 10.245

Lapse of time (t min)	at weir of upper stream: Observed water level: Water depth (cm)	Observed water level: level (m)	Overflow depth (dl cm)	Inflow (ql l/s)	Average inflow (l/sec)	Amount of inflow (Qi m3)	Accumu. amount of inflow (ΣQi m3)
0	6.45	10.253	0.8	0.0	0.0	0	0
5	14.15	10.330	8.5	27.0	13.5	4	4
10	14.50	10.333	8.8	28.4	27.7	8	12
15	14.50	10.333	8.8	28.4	28.4	9	21
20	14.50	10.333	8.8	28.4	28.4	9	29
25	14.50	10.333	8.8	28.4	28.4	9	38
30	14.60	10.334	8.9	28.9	28.7	9	47
40	14.61	10.334	8.9	28.9	28.9	17	64
50	14.70	10.325	8.0	24.6	26.8	16	80
60	14.40	10.322	7.7	23.3	24.0	14	94
80	14.83	10.326	8.1	25.1	24.2	29	123
100	14.80	10.326	8.1	25.1	25.1	30	153
120	14.80	10.326	8.1	25.1	25.1	30	184

Dimension of approach ditch: W= 100 (cm)
Height of Notch from the bottom of ditch: H= 23.5 (cm)

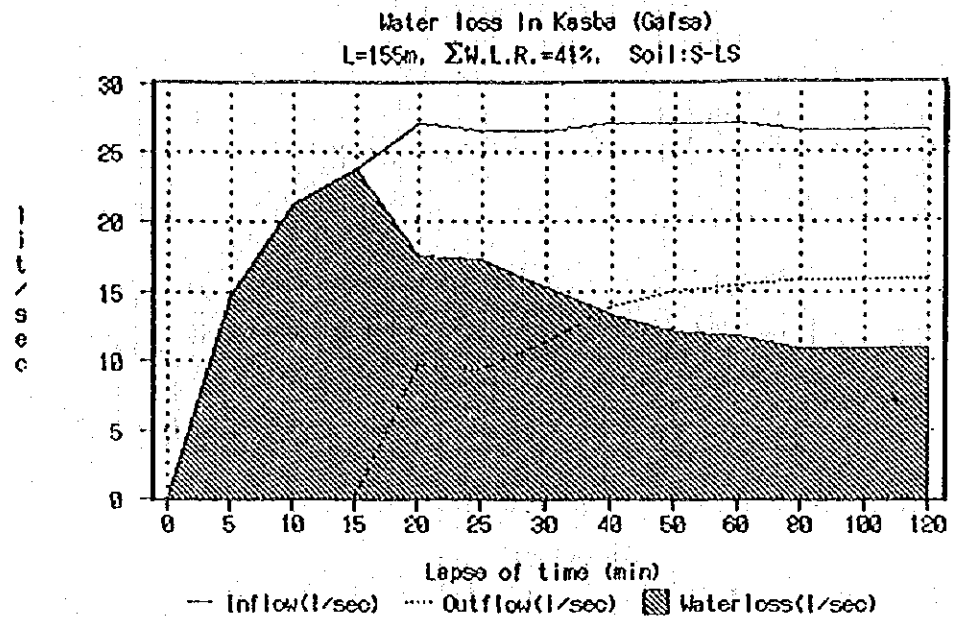
(3) Amount of Outflow
Elevation of table of measuring device of lower weir : 7.259 7.274
Height conversion factor for water level (WL): -0.366
Elevation of notch of lower weir : 6.987 6.987
Lapse of time before overflow 7.1 (min)

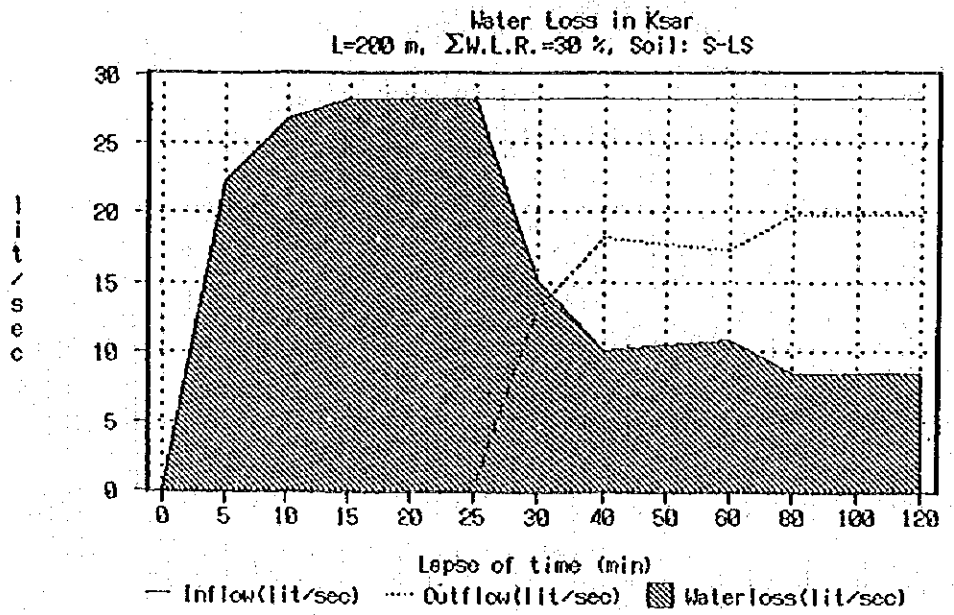
Lapse of time (t min)	at weir of lower stream: Observed water level: Water depth (cm)	Observed water level: level (m)	Overflow depth (dl cm)	outflow (ql l/s)	Average outflow (l/sec)	Amount of outflow (Qi m3)	Accumu. amount of outflow (ΣQi m3)
0	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
10	14.79	7.041	5.4	13.8	-	-	-
15	13.41	7.027	6.1	16.5	-	-	-
20	16.17	7.055	6.8	19.3	-	-	-
25	16.22	7.055	6.8	19.3	19.3	6	6
30	16.30	7.056	6.9	20.0	19.7	6	12
40	16.43	7.057	7.0	20.2	20.1	12	24
50	16.40	7.057	7.0	20.2	20.2	12	36
60	16.57	7.059	7.2	21.0	20.6	12	48
80	16.61	7.059	7.2	21.0	21.0	25	73
100	16.51	7.058	7.1	20.6	20.8	25	98
120	16.54	7.058	7.1	20.6	20.6	25	123

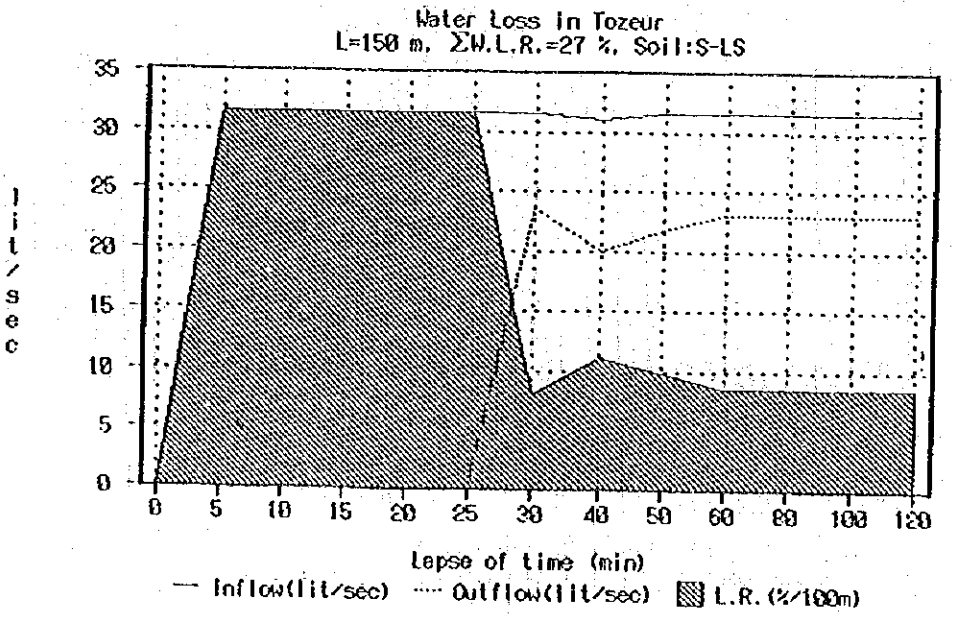
Note) Dimension of approach ditch: W= 110 (cm)
Height of Notch from the bottom of ditch: H= 23 (cm)

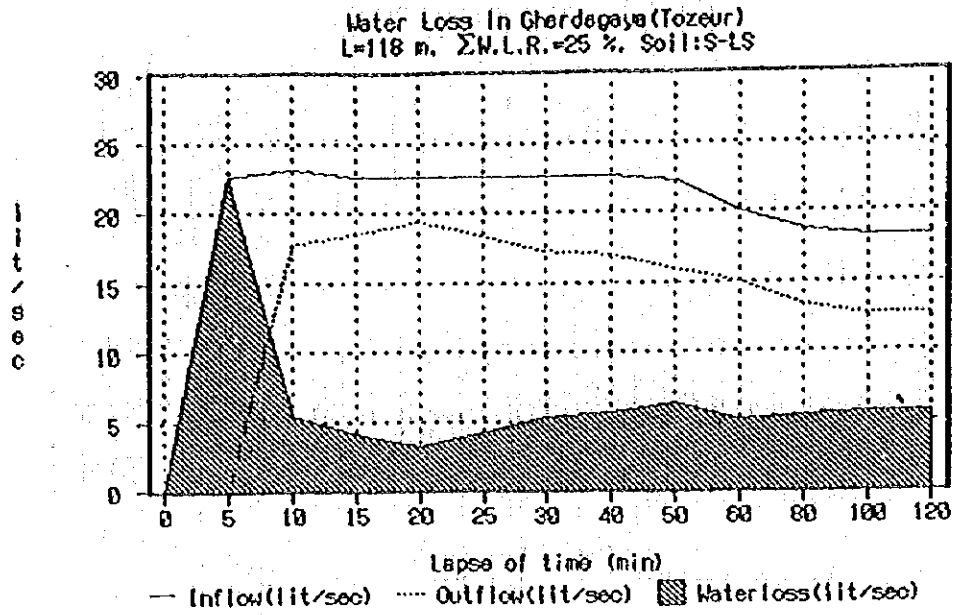
(4) Evaluation of water loss
Length of earth ditch : 200

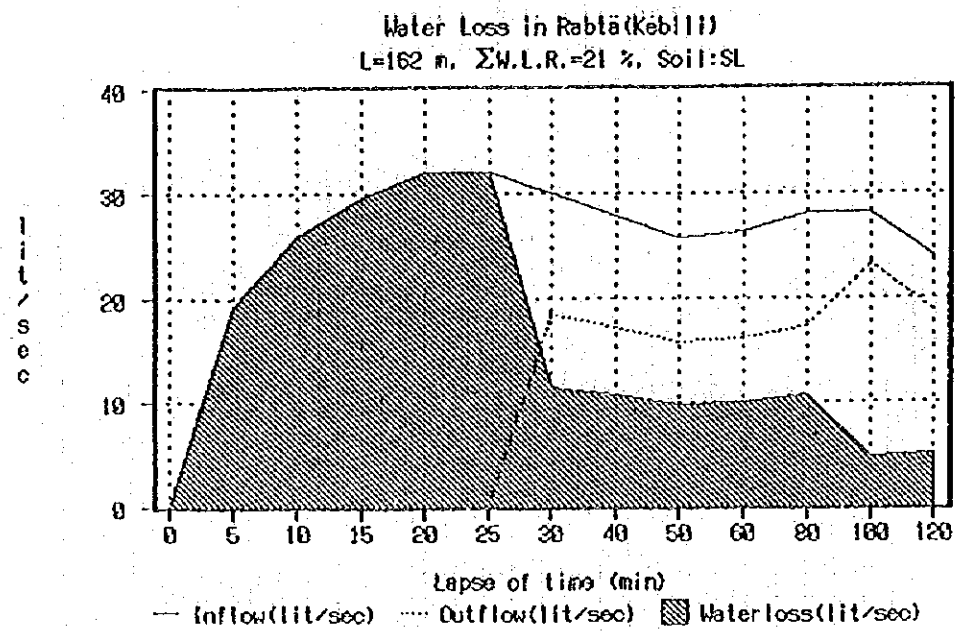
Lapse of time (t min)	Inflow: ① Inflow (ql l/s)	Inflow: ② Accumu. amount of inflow (Qi m3)	Outflow: ③ Outflow (q2 l/s)	Outflow: ④ Accumu. amount of outflow (Qo m3)	Water loss: ⑤=(①-③)	Water loss rate: ⑥=(①-③)/①*100 (%)	Water loss rate: ⑦=(②-④)/②*100 (%)	Water loss rate: ⑧=⑤/L (%/100m)
0	0	0	-	-	0.0	100	100	50
5	27	4	-	-	27.0	100	100	50
10	28.4	8	-	-	28.4	100	100	50
15	28.4	9	-	-	28.4	100	100	50
20	28.4	9	-	-	28.4	100	100	50
25	28.4	9	19.3	6	9.1	32	32	16
30	28.9	9	20.0	6	8.9	31	31	15
40	28.9	17	20.2	12	8.7	30	30	15
50	24.6	16	20.2	12	4.4	18	24	9
60	23.3	14	21.0	12	2.3	10	14	5
80	25.1	29	21.0	25	4.1	16	13	8
100	25.1	30	20.6	25	4.5	18	17	9
120	25.1	30	20.6	25	4.5	18	18	9

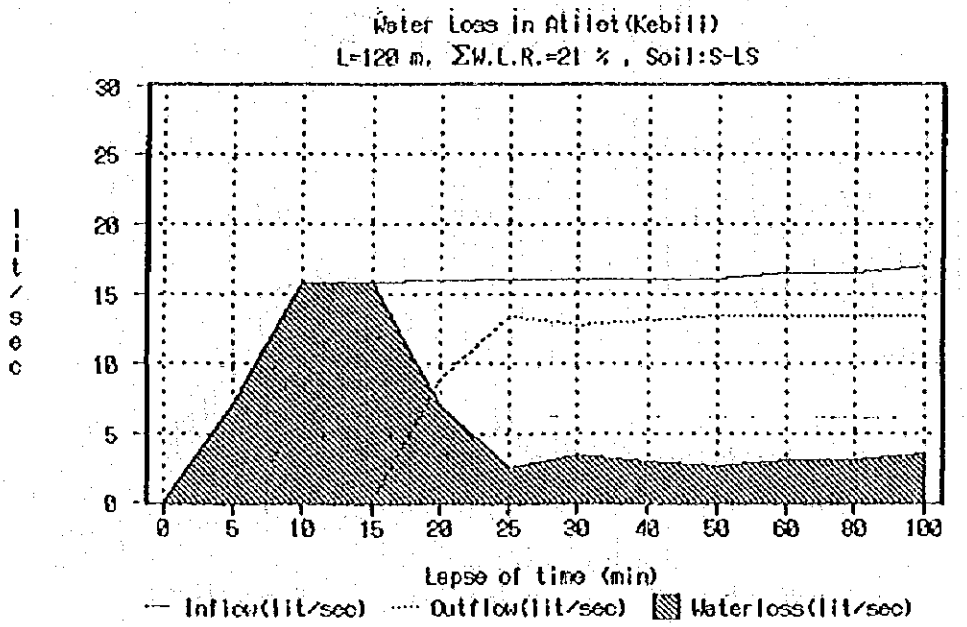

Water loss in Kasba (Gafsa)
L=155m, ΣW.L.R.=41%, Soil:S-LS
lit/sec
0 5 10 15 20 25 30
0 5 10 15 20 25 30 40 50 60 80 100 120
Lapse of time (min)
Inflow(l/sec)
Outflow(l/sec)
Waterloss(l/sec)

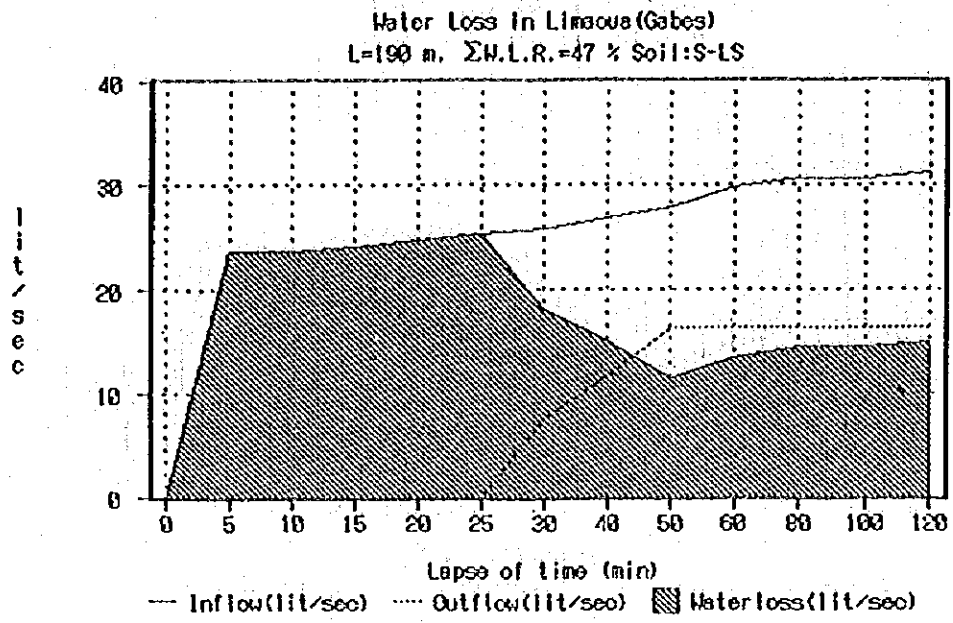

Water Loss in Ksar
L=200 m, ΣW.L.R.=30 %, Soil: S-LS
lit/sec
0 5 10 15 20 25 30
0 5 10 15 20 25 30 40 50 60 80 100 120
Lapse of time (min)
Inflow(lit/sec)
Outflow(lit/sec)
Waterloss(lit/sec)


Water Loss in Tozeur
L=150 m, ΣW.L.R.=27 %, Soil:S-LS
lit/sec
0 5 10 15 20 25 30 35
0 5 10 15 20 25 30 40 50 60 80 100 120
Lapse of time (min)
Inflow(lit/sec)
Outflow(lit/sec)
L.R.(%/100m)


Water Loss in Gherdegaya(Tozeur)
L=118 m, ΣW.L.R.=25 %, Soil:S-LS
lit/sec
0
5
10
15
20
25
30
0
5
10
15
20
25
30
40
50
60
80
100
120
Lapse of time (min)
Inflow(lit/sec)
Outflow(lit/sec)
Waterloss(lit/sec)


Water Loss in Rabta(Kebili)
L=162 m, ΣW.L.R.=21 %, Soil:SL
lit/sec
0
10
20
30
40
0
5
10
15
20
25
30
40
50
60
80
100
120
Lapse of time (min)
Inflow(lit/sec)
Outflow(lit/sec)
Waterloss(lit/sec)


Water Loss in Atilot(Kebili)
L=120 m, ΣW.L.R.=21 % , Soil:S-LS
lit/sec
0
5
10
15
20
25
30
0
5
10
15
20
25
30
40
50
60
80
100
Lapse of time (min)
Inflow(lit/sec)
Outflow(lit/sec)
Waterloss(lit/sec)


Water Loss in Limoux(Gabes)
L=190 m, ΣW.L.R.=47 % Soil:S-LS
lit/sec
40
30
20
10
0
0 5 10 15 20 25 30 40 50 60 80 100 120
Lapse of time (min)
Inflow(lit/sec)
Outflow(lit/sec)
Waterloss(lit/sec)

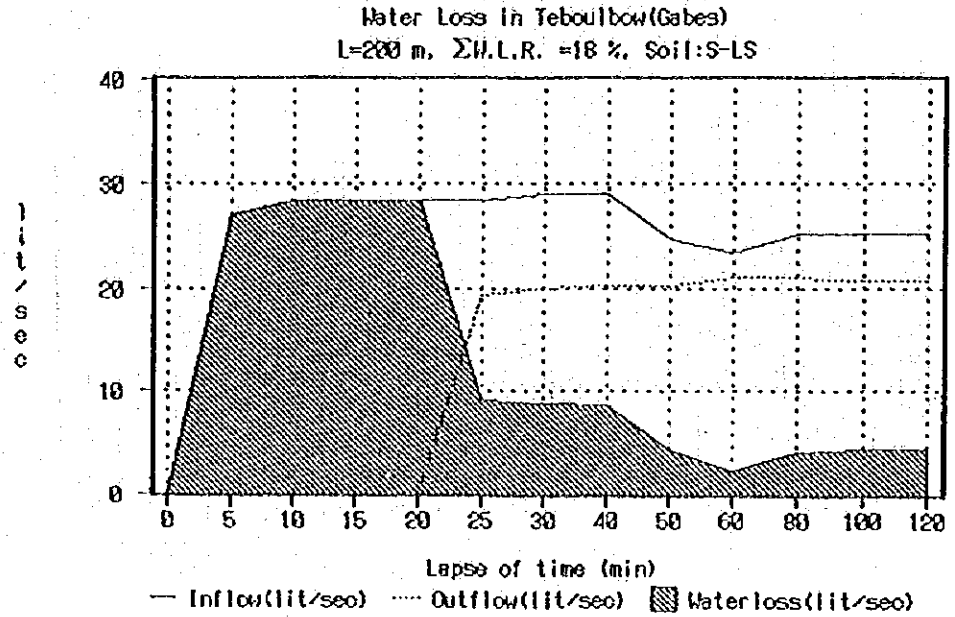

Water Loss in Teboulbou(Gabes)
L=200 m, ΣW.L.R. =18 %, Soil:S-LS
lit/sec
40
30
20
10
0
0 5 10 15 20 25 30 40 50 60 80 100 120
Lapse of time (min)
Inflow(lit/sec)
Outflow(lit/sec)
Waterloss(lit/sec)

Table G.A.5.4 Result of Water-loss Measurement by Flow Method

Observed Day:from 3,Oct. to 13,Oct.'95

Name of Oasis	Province	Type of Oasis	Observed day
Kasba	Gafsa	Traditional	3,Oct.
Ksar	//	//	4,Oct.
Oasis Tozeur	Tozeur	//	5,Oct.
Ghardgaya	//	New	6,Oct.
Rabta	Kebili	Traditional	9,Oct.
Atilet	//	New	10,Oct.
Limaoua	Gabes	New	12,Oct.
Teboulbou	//	Traditional	13,Oct.

Name of Oasis	Outline of earth ditch				Percoration loss			
	Bottom width (cm)	Top width (cm)	Depth (cm)	Length (m)	Inflow (l/sec)	Water loss (l/sec)	Water loss rate(%) per Total length	per 100 m
Kasba	55-85	100-140	18-29	155	26.6	10.8	41	26
Ksar	58-90	130-180	26-46	200	28.2	8.4	30	15
Oasis Tozeur	44-66	125-160	25-46	150	31.6	8.5	27	18
Ghardgaya	35-65	94-150	14-33	118	22.6	5.7	25	21
Rabta	51-155	90-220	24-46	162	23.9	5.1	21	13
Atilet	50-112	107-140	29-39	115	16.9	3.5	21	18
Limaoua	33-77	100-160	33-51	190	30.6	14.4	47	25
Teboulbou	33-85	90-180	22-65	200	25.1	4.5	18	9

Table G.A.5.5 Observed and Estimated Water Loss Rate

Type of Oasis	Kind of Soil	Observed average percoration rate (%/100m)	Estimated Ratio of (P.)/ (I.F.+P.)	Estimated Total loss rate (%/100m)	Recommend-able loss rate (%/100m)
New	S to LS	20	0.7	29	30
Traditional	SL	17	0.7	24	25

Attachment G.6

Present status of AIC

Table G. 6 (1) Present status of AIC in Gafsa Governorate

Code Num.	Oasis (AIC)	Irrigation area (ha)	Organization of AIC			Budget of AIC (1,000 DT /year)	OM Cost of AIC (1,000 DT /year)	Budgetary Deficit (1,000 DT /year)	**) Water Charge (payment unit: DT/m3)	
			Member	Executive	Worker				(DT/m3)	(DT/ha /year)
GF- 1	Kasba	698	660	8	5	160.8	114.2	-	0.024	164
GF- 2	Sud Ouest	703	250	8	5	82.3	73.1	-	0.024	104
GF- 3	El Guettar	450	2,400	8	7	63.0	63.3	-0.3	0.023	141
GF- 4	Lalla	700	1,272	8	5	65.0	54.1	-	0.015	77
GF- 5	* El Ksar	578	940	8	5	97.0	95.2	-	0.024	165
GF- 6	Oued Shili	56	18	8	2	8.0	11.0	-3.0	no pay	197
GF- 7	Thelja	65	65	8	2	13.6	9.3	-	0.025	144
GF- 8	Segdoud	217	500	8	5	-	46.9	(-46.9)	no pay	216
	Total	3,467	6,105	64	36	490	467.2	-3.4	0.023	135
					Ratio(%)	(105)	(100)	(0)		

Note)
*) New oases
**) Payment of water charge from water users to AIC is generally made one day before water receiving.

Table G. 6 (2) Present status of AIC in Tozeur Gorvernorate

Code Num.	Oasis (AIC)	Irrigation Area (ha)	Organization of AIC			Budget of AIC (1000 DT /year)	OM Cost of AIC (1000 DT /year)	Budgetary Deficit (1,000 DT /year)	**)Water Charge ***) (payment unit: 4 kinds)			
			Member	Executive	Worker				(DT/ha /year)	(DT/hr /year)	(DT/hr)	(DT/m3)
TZ- 1	Tozeur	(929)	-	-	-	-	-	-	-	-	-	-
	(Abbes)	285	362	9	2	88.0	47.9	-	218	-	-	-
	(Hafir)	85	93	6	1	17.4	9.2	-	303	91	-	-
	(Rabbat)	274	294	6	2	68.8	53.8	-	510	102	-	-
	(Wassat)	285	225	6	2	113.9	23.6	-	(?)	55	-	-
TZ- 2	Kastilia	50	35	6	-	32.4	29.9	-	591	-	-	-
TZ- 3	Oued El Koucha	62	18	3	-	18.5	16.7	-	258	129	-	-
TZ- 4	Neflayette	72	49	6	1	37.0	24.7	-	514	-	-	-
TZ- 5	Chemsa	90	60	6	1	28.9	25.1	-	321	-	-	-
TZ- 6	Helba Est	75	17	6	1	15.0	11.7	-	209	-	2.00	-
TZ- 7	Helba Ouest	50	52	6	1	17.9	15.3	-	318	-	2.44	-
TZ- 8	Jhim 1	40	61	6	1	7.7	5.1	-	252	-	1.50	-
TZ- 9	*) Jhim 2	167	144	2	2	35.0	12.7	-	202	-	2.00	-
TZ-10	○ Ibn Chabbat 3	325	155	0	-	No AIC	78.3	(-78.3)	404	-	-	0.025
TZ-11	Nefta	(852)	-	-	-	-	-	-	-	-	-	-
	(Remada)	342	511	9	3	84.8	85.0	-0.2	248	-	-	-
	(Beni Ali)	210	224	9	1	53.5	41.2	-	255	-	-	-
	(Fatnassa)	300	316	9	2	76.3	68.5	-	255	-	-	-
TZ-12	Ghardgaya	40	33	3	0	13.5	10.3	-	338	-	-	-
TZ-13	○ Ibn Chabbat 1	240	120	0	0	No AIC	55.7	(-55.7)	404	-	-	0.025
TZ-14	○ Ibn Chabbat 2	272	149	0	0	No AIC	64.2	(-64.2)	404	-	-	0.025
TZ-15	○ Draa Sud	198	98	0	0	No AIC	49.1	(-49.1)	404	-	-	0.025
TZ-16	Hazoua 1	72	69	6	1	26.5	14.2	-	367	-	-	-
TZ-17	○ Hazoua 2	48	108	9	1	18.1	23.8	-5.7	377	-	-	-
TZ-18	○ Hazoua 3	(238)				12.2	42.6	-30.4	185	-	-	-
	(Hazoua BM4)	66	66	6	1	-	(12.7)	-	-	-	-	-
	(Hazoua BM6)	54	53	6	1	-	(9.8)	-	-	-	-	-
	(Hazoua BM5)	64	64	6	1	-	(11.4)	-	-	-	-	-
	(Hazoua BM2)	54	54	6	1	-	(8.7)	-	-	-	-	-
TZ-19	Oued Loghrissi	78	78	9	1	14.4	15.6	-1.2	184	-	-	-
TZ-20	Tazrarit	48	96	9	1	22.8	22.5	-	470	-	-	-
TZ-21	Cedada	55	302	6	1	11.0	11.3	-0.3	200	-	-	-
TZ-22	Dghoumes	104	168	9	1	32.5	38.3	-5.8	313	-	-	-
TZ-23	Degache	(822)				-	-	-	-	-	-	-
	(El Manachi)	56	7	3	1	New AIC	15.7	(-15.7)	390	120	-	-
	(Ouled Hmida)	57	182	9	1	New AIC	30.1	(-30.1)	351	108	-	-
	(Sidi Addallah)	90	22	2	1	New AIC	15.9	(-15.9)	351	108	-	-
	(Ain Rebeh)	89	373	9	2	New AIC	28.3	(-28.3)	518	-	3.50	-
	(Ouled Majed)	324	920	9	5	New AIC	120.8	(-120.8)	390	120	-	-
	(Zeoulf El Arab)	42	189	6	1	New AIC	19.5	(-19.5)	338	104	-	-
	(El Mahassen)	164	657	9	1	New AIC	33.4	(-33.4)	377	-	3.50	-
TZ-24	Chatmou	90	59	6	1	18.0	9.4	-	200	-	-	-
TZ-25	El Hamma	400	524	9	6	105.0	90.0	-	270	-	-	-
TZ-26	Tamerza	80	123	6	0	New AIC	-	-	-	-	-	-
TZ-27	Chebika	23	97	6	0	No AIC	-	-	-	-	-	-
TZ-28	Foum El Khanga	48	70	3	0	No AIC	-	-	-	-	-	-
TZ-29	Nides	29	59	6	1	New AIC	8.8	(-8.8)	-	-	-	-
TZ-30	Ain El Karma	25	?	?	0	No AIC	-	-	(?)	-	1.00	-
	Total	5,622	7,356	253	50	969.1	1,268.4	-43.7	334	104	2.28	0.025
					Ratio(%)	(76)	(100)	(3)				

Note)

*) New cases

**) Payment of water charge from water users to AIC is generally made in annual base after receiving water

***) All unit price can be converted in accordance with a definite irrigation plan. Then all unit prices are converted into the unit of DT/ha/year

Table G. 6 (3) Present status of AIC in Kebili Governorate

Code Num.	Oasis (AIC)	Irrigation Area (ha)	Organization of AIC			Budget of AIC (1,000DT /year)	O/M Cost of AIC (1,000DT /year)	Budgetary deficit (1,000DT /year)	**)Water Charge (payment unit:3kinds)		
			Member	Executer	Worker				(DT/ha /year)	(DT/hr)	(DT/m3)
KB- 1	Bechri	162	350	6	2	32.8	14.2	-	243	1.480	0.005
KB- 2	Bouabdallah	270	2293	6	7	43.8	36.0	-	156	3.000	0.010
KB- 3	Faînassa	205	820	9	5	55.0	16.7	-	268	2.743	0.006
KB- 4	El Gliaa	94	400	6	5	35.4	29.5	-	256	5.940	0.022
KB- 5	Menchia	140	582	6	4	18.8	5.9	-	128	0.648	0.002
KB- 6	Nagga	181	863	6	4	26.5	30.5	-4.0	168	9.147	0.021
KB- 7	Oum Somaa	(162)									
	O.Somaa Nord	90	360	6	4	77.5	17.1	-	309	3.510	0.015
	O.Somaa Sud	72	520	6	4	(77.5)	27.1	-	267	5.608	0.019
KB- 8	Oued Zira	175	435	6	4	40.0	32.3	-	177	6.750	0.015
KB- 9	Ouled Touati	62	172	6	3	14.9	15.4	-0.6	220	4.895	0.017
KB-10	Tenchig	54	550	6	2	13.1	6.2	-	187	1.152	0.008
KB-11	Zaoulet El Anes	125	910	9	4	26.6	9.6	-	196	2.045	0.008
KB-12	Zaoulet El Harth	81	408	12	4	27.0	14.3	-	197	1.566	0.010
KB-13	*)Ziret Louhichi	86	548	6	3	25.4	18.2	-	290	3.780	0.015
KB-14	○Chouchet Nagga	26	50	6	2	9.1	10.7	-	364	3.150	0.035
KB-15	Guataya	150	699	6	3	23.5	3.2	-	101	0.360	0.001
KB-16	Jedida	133	503	6	3	16.5	9.0	-	194	2.376	0.004
KB-17	Mansoura	86	343	6	3	(16.5)	5.8	-	194	2.376	0.004
KB-18	Rabta	162	774	6	4	53.5	19.2	-	277	10.944	0.032
KB-19	Telmine	240	323	6	8	44.2	44.2	-0.1	184	2.286	0.005
KB-20	Tembib	118	774	6	4	14.3	16.5	-2.2	120	7.452	0.023
KB-21	Tombar	127	729	3	5	32.6	28.3	-	256	5.288	0.013
KB-22	Limagues	57	245	3	3	10.0	4.0	-	87	0.540	0.003
KB-23	Mazraa Neji	66	84	3	2	11.8	12.3	-0.5	200	2.680	0.010
KB-24	Oum El Farth 1et2	55	56	3	2	13.2	14.9	-1.7	330	1.224	0.008
KB-25	Stiftini	82	391	6	4	11.8	4.5	-	163	0.468	0.002
KB-26	○Saidane	30	20	3	1	-	-	-	-	-	-
KB-27	Barghouthia	52	210	6	3	19.1	14.9	-	331	3.780	0.021
KB-28	Bazma	146	728	6	4	39.5	28.1	-	216	4.968	0.012
KB-29	B'chelli	135	667	6	2	31.5	14.0	-	238	2.376	0.011
KB-30	Blidette	75	454	6	3	8.1	1.9	-	106	1.296	0.008
KB-31	Zarcine	70	230	6	3	6.9	2.2	-	86	0.162	0.001
KB-32	Jemna	112	828	6	3	5.4	15.9	-10.5	48	5.544	0.014
KB-33	Mtouria	81	209	3	2	6.4	2.2	-	80	0.144	0.001
KB-34	Msaid	95	578	6	4	21.3	15.0	-	224	3.456	0.012
KB-35	Rahmat	85	508	3	3	39.8	25.0	-	414	4.896	0.017
KB-36	Ras El Ain	268	693	9	12	151.2	78.8	-	330	10.528	0.012
KB-37	Souk El Baiez	65	202	6	4	29.2	30.3	-1.1	301	5.400	0.025
KB-38	Ben Zitoun 1 et 2	147	744	12	8	41.3	17.6	-	298	1.663	0.009
KB-39	Bourzine	94	194	6	2	23.4	2.1	-	250	0.576	0.002
KB-40	Gueliada	103	329	6	1	12.6	14.7	-2.1	100	2.430	0.009
KB-41	Kelwamen	47	185	3	1	6.5	12.5	-6.0	173	1.656	0.023
KB-42	Klibia	92	193	6	3	10.1	1.8	-	109	0.252	0.001
KB-43	Sidi Hamed	100	100	3	3	-	13.5	(-13.5		4.536	0.014
KB-44	○Atilet	220	296	6	4	41.4	23.2	-	187	4.320	0.008
KB-45	Bou	280	1807	9	8	54.1	55.3	-1.2	191	9.900	0.005
KB-46	El Ghoula	75	282	3	3	20.9	18.5	-	280	4.284	0.005
KB-47	El Golaa	65	523	3	3	17.4	16.5	-	262	4.320	0.020
KB-48	Grad	111	475	3	4	24.2	15.4	-	220	3.078	0.009
KB-49	El H'say	90	387	6	3	24.1	26.5	-2.5	266	13.284	0.041
KB-50	Koufel	97	811	3	2	19.2	1.7	-	200	0.252	0.001
KB-51	Zaafrane	101	616	6	2	12.1	1.9	-	121	0.316	0.001
KB-52	Bouhamza	80	285	3	3	18.0	14.3	-	226	2.304	0.008
KB-53	Ksar Ghilane	100	100	3	0	-	1.4	(-1.4		0.306	0.001
KB-54	Sakkouma	80	240	6	3	21.0	17.3	-	263	2.880	0.010
KB-55	Tarfaya	77	237	3	2	20.2	14.5	-	262	3.780	0.014
KB-56	○Dhomrana	45	90	3	2	10.7	16.9	-6.2	237	3.888	0.027
KB-57	○Saida	64	67	6	1	3.9	1.7	-	60	0.468	0.002
KB-58	Ghidma	80	463	6	3	10.9	1.7	-	135	0.702	0.003
KB-59	Sabria	60	403	6	3	15.6	2.9	-	178	0.360	0.002
KB-60	El Faouar 1	87	692	6	2	12.3	1.6	-	60	0.648	0.003
KB-61	El Faouar 2	80	614	6	2	21.4	1.8	-	161	0.306	0.001
KB-62	○Bechni	100	230	6	2	8.2	2.3	-	82	0.306	0.001
KB-63	○Dargine	72	152	3	2	6.3	1.7	-	88	0.648	0.003
KB-64	Matrouha	100	78	3	0	0.0	0.0		-	-	-
KB-65	○Regim Maatoug 1	104	100	6	2	0.0	2.2	-2.2	-	0.252	0.001
KB-66	○Regim Maatoug 2	96	100	(6)	(2)	0.0	1.6	-1.6	-	0.252	0.001
KB-67	○Tarfayet Elma	52	162	6	4	16.3	17.1	-0.8	842	4.140	0.023
-	Total	7,213	30,464	369	220	1,507.6	994.0	-58.2	212	3.128	0.011
					Ratio(%)	(152)	(100)	(6)			

Note) *) New oasis

**) Payment of water charge from water users to AIC is generally made before receiving water.

Table G. 6 (4) Present status of AIC in Gabes Governorate

Code Num.	Name of AIC	Irrigation Area (ha)	Organization of AIC			Budget of AIC (1000 DT /year)	OM Cost of AIC (1000 DT /year)	Budgetary Deficit (1,000 DT /year)	**)Water Charge (payment unit: 3 kinds)		
			Member	Executive	Worker				(DT/ha /year)	(DT/hr /year)	(DT/hr)
GB- 1	Ain Zrig	140	210	6	3	26.0	18.4	-	185	19	-
GB- 2	Temoula 1	40	79	3	2	7.8	5.0	-	195	39	-
GB- 3	Temoula 2	20	17	3	2	4.5	4.5	-	225	45	2.5
GB- 4	Zrig Dakhlania	30	189	3	2	8.0	6.2	-	265	33	2.2
GB- 5	Teboulbou	520	1,012	6	8	64.3	58.7	-	124	31	-
GB- 6	Oasis de Gabes	734	1,710	9	28	110.6	109.7	-	151	15	-
GB- 7	Limaoua 1 et 2	148	118	6	4	28.8	28.9	-0.1	225	45	-
GB- 8	M'dou	40	211	9	2	11.1	10.2	-	277	55	-
GB- 9	Chott El Ferik	31	103	6	2	10.0	6.0	-	323	40	-
GB-10	Bouchamma	143	802	9	5	34.0	30.5	-	238	24	1.8
GB-11	Mahjoub	374	578	3	9	48.4	48.4	-	129	22	-
GB-12	Salem	99	170	3	3	21.8	21.8	-	220	37	-
GB-13	Sboui	72	107	3	3	12.6	11.2	-	175	29	-
GB-14	Faycal	260	447	3	4	23.5	20.5	-	90	15	-
GB-15	M'siraa Ghannouch	280	491	3	2	24.9	22.5	-	89	15	-
GB-16	Methoula	268	1,878	3	7	45.3	37.7	-	169	15	2.5
GB-17	Ouedhref	263	1,112	3	6	43.0	39.9	-	163	16	2.1
GB-18	Aouinette	232	67	6	3	31.7	-	-	136	11	2.1
GB-19	Chenchou 1	57	26	3	2	19.2	14.0	-	337	67	-
GB-20	○ Chenchou 2	40	20	3	1	9.0	8.4	-	225	16	2.0
GB-21	Tekouri	32	87	6	2	7.4	6.8	-	233	19	1.5
GB-22	Hamma Oasis	400	2,580	6	10	38.2	30.8	-	96	10	1.5
GB-23	Msiraa Hamma	80	212	6	3	16.2	12.0	-	203	14	1.5
GB-24	Bechima 1	280	1,062	6	7	50.0	25.2	-	179	12	2.0
GB-25	Bechima 2	290	895	3	3	10.0	3.9	-	34	2	-
GB-26	Khebayet	96	167	3	3	7.5	4.2	-	78	5	-
GB-27	Ben Ghilouf	180	250	6	4	16.5	14.5	-	92	11	-
GB-28	Glib Dokhane	70	81	3	3	4.9	4.9	-	71	6	-
GB-29	Oued Nekhla	30	20	3	1	2.5	2.6	-0.1	83	21	-
GB-30	Arram	163	156	3	3	21.3	20.5	-	130	33	-
GB-31	Mareth 1	100	356	3	2	25.0	21.2	-	250	50	2.5
GB-32	Mareth 2	180	556	3	4	26.0	21.6	-	144	29	-
GB-33	Mareth 3	30	220	3	1	7.0	6.0	-	233	39	2.0
GB-34	Mareth 5	115	127	3	2	23.6	27.6	-4.0	205	51	-
GB-35	Mareth 6	88	79	3	2	11.0	11.0	-	125	42	-
GB-36	Zarat 2	174	317	6	2	10.5	7.0	-	61	12	-
GB-37	Zerkine 1 et 3	116	212	6	4	21.5	19.0	-	185	37	-
GB-38	Zerkine 2	156	155	6	3	25.0	25.0	-	160	40	-
GB-39	Ayoune Zerkine	30	42	3	2	8.0	5.6	-	267	33	1.7
GB-40	Madssia	58	81	3	2	10.0	3.3	-	172	43	-
GB-41	Kettana 1	98	76	3	2	13.8	13.3	-	141	47	-
GB-42	Kettana 3	140	222	3	1	7.0	7.0	-	50	13	-
GB-43	Kettana 4	125	125	3	1	6.0	6.0	-	48	12	-
GB-44	○ Sidi Sellam	120	62	3	2	12.0	12.0	-	100	17	1.5
GB-45	Zrig Barrania	71	138	3	3	17.1	14.7	-	241	40	-
GB-46	○ Ghandri	30	44	6	2	6.8	5.8	-	225	38	2.5
GB-47	○ Laaradh 1	35	56	3	2	5.9	5.1	-	169	28	2.8
GB-48	○ Laaradh 3	55	52	3	2	10.5	8.0	-	191	32	3.3
	Total	7,133	17,777	204	176	1,005.7	846.9	-4.2	169	28	2.1
					Ratio(%)	(118)	(100)	(0)			

Note)
*) New cases
**) Payment of water charge from water users to AIC is generally made in annual base after receiving water

Attachment G.7

OM cost for irrigation system

Table G.A.7(1) OM Cost for Irrigation System in Gafsa Governorate

1) Total OM cost

Code Num.	Oasis (AIC)	Irrigated Area (ha)	Personnel Charges (DT/year)	Electric Charges for Pump (DT/year)	Cost for Carburant & lubricating oils (DT/year)	Reparing Cost (DT/year)	Miscellaneous expenses (DT/year)	①=③+④-② Total OM Cost (DT/year)	Consumed water volume (1,000m3)	Unit OM cost (DT/ha)	Unit OM cost (DT/m3)
GF- 1	Kasba	698	28,500	96,029	1,665	35,468	661	162,323	5,685	233	0.029
GF- 2	Sud Ouest	703	28,290	79,134	1,677	17,640	666	127,407	4,016	181	0.032
GF- 3	El Guettar	450	26,864	49,816	1,073	21,259	426	99,438	3,294	221	0.030
GF- 4	Lalla	700	28,583	45,350	1,669	5,835	662	82,099	7,784	117	0.011
GF- 5	El Ksar	578	26,805	72,671	1,379	22,657	547	124,059	4,712	215	0.026
GF- 6	Oued Shili	56	3,349	9,102	133	2,374	53	15,010	600	268	0.025
GF- 7	Thelja	65	3,656	4,894	155	10,651	61	19,417	444	299	0.044
GF- 8	Segdoud	217	28,999	25,316	516	13,968	205	69,004	1,841	318	0.037
	Total/Ave.	3,467	175,046	382,312	8,267	129,851	3,281	698,757	28,376	202	0.025
	Ratio(%)	-	25	55	1	19	0	100			
	Sharing ratio of OM cost and supplied water amount(%)										
		AIC	32	57	0	13	0	67	69	53	-
		CRDA	68	43	100	87	100	33	31	47	-
		Total	100	100	100	100	100	100	100	100	-

2) OM Cost of AIC

Code Num.	Oasis (AIC)	Irrigated Area (ha)	Personnel charges (DT/year)	Electric charges for Pump (DT/year)	②Water purchase from CRDA (DT/year)	Small reparing Cost (DT/year)	Miscellaneous expenses (DT/year)	③ OM Cost of AIC (DT/year)	Consumed water volume (1,000m3)	Unit OM cost (DT/ha)	Unit OM cost (DT/m3)
GF- 1	Kasba	698	4,700	37,922	66,582	5,000	0	114,203	5,685	164	0.020
GF- 2	Sud Ouest	703	4,320	20,610	47,847	300	0	73,077	4,016	104	0.018
GF- 3	El Guettar	450	11,520	49,816	-	2,000	0	63,336	3,294	141	0.019
GF- 4	Lalla	700	4,714	45,350	-	4,000	0	54,064	7,784	77	0.007
GF- 5	El Ksar	578	7,096	24,554	61,589	2,000	0	95,238	4,712	165	0.020
GF- 6	Oued Shili	56	1,440	9,102	-	500	0	11,042	600	197	0.018
GF- 7	Thelja	65	1,440	4,894	-	3,000	0	9,334	444	144	0.021
GF- 8	Segdoud	217	21,600	25,316	-	-	0	46,916	1,841	216	0.025
	Total/Ave.	3,467	56,830	217,564	176,017	16,800	0	467,211	28,376	135	0.016
	Ratio(%)	-	12	47	38	4	0	100			

3) OM Cost of CRDA

Code Num.	Oasis (AIC)	Irrigated Area (ha)	Personnel charges (DT/year)	Electric charges for Pump (DT/year)	Cost for Carburant & lubricating oils (DT/year)	Big reparing Cost (DT/year)	Miscellaneous expenses (DT/year)	④ OM Cost of CRDA (DT/year)	Consumed water volume (1,000m3)	Unit OM cost (DT/ha)	Unit OM cost (DT/m3)
GF- 1	Kasba	698	23,800	58,107	1,665	30,468	661	114,701	3,286	164	0.035
GF- 2	Sud Ouest	703	23,970	58,524	1,677	17,340	666	102,177	2,392	145	0.043
GF- 3	El Guettar	450	15,344	-	1,073	19,259	426	36,102	0	80	-
GF- 4	Lalla	700	23,869	-	1,669	1,835	662	28,035	0	40	-
GF- 5	El Ksar	578	19,709	48,117	1,379	20,657	547	90,409	3,079	156	0.029
GF- 6	Oued Shili	56	1,909	-	133	1,874	53	3,969	0	71	-
GF- 7	Thelja	65	2,216	-	155	7,651	61	10,083	0	155	-
GF- 8	Segdoud	217	7,399	-	516	13,968	205	22,088	0	102	-
	Total/Ave.	3,467	118,216	164,748	8,267	113,051	3,281	407,563	8,757	118	0.035
	Ratio(%)	-	29	40	2	28	1	100			

Table G. A. 7 (2) OM Cost for Irrigation System in Tozeur Governorate

1) Total OM cost (CRDA + AIC)

Code Num.	Oasis (AIC)	Irrigated area in 1993 (ha)	Personnel charges			Electric Charges for Pump (DT/year)	Cost for Carburant & lubricating oils (DT/year)	Repairing cost			Miscellaneous expenses (DT/year)	Total OM cost			Consumed water volume (1,000m3)	Unit OM cost	
			by CRDA (DT/year)	by AIC (DT/year)	Sub-total (DT/year)			by CRDA (DT/year)	by AIC (DT/year)	Total (DT/year)		by CRDA (DT/year)	by AIC (DT/year)	Total (DT/year)		(DT/ha)	(DT/m3)
TZ- 1	Tozeur	(929)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	(Abbes)	285	6,290	2,400	8,690	45,119	1,189	9,187	400	9,587	1,790	18,456	47,919	66,375	6,594	233	0.010
	(Hafir)	85	2,209	1,200	3,409	7,876	299	1,479	150	1,629	382	4,368	9,226	13,595	1,386	161	0.010
	(Rabbat)	274	4,090	2,400	6,490	51,153	843	9,590	250	9,840	1,268	15,791	53,803	69,594	5,816	254	0.012
	(Wassat)	285	2,296	2,400	4,696	20,913	920	6,763	250	7,013	1,386	11,354	23,563	34,918	4,230	122	0.008
TZ- 2	Kastilia	56	1,550	1,200	2,750	20,170	166	880	8,551	9,432	227	2,824	29,922	32,745	2,633	555	0.012
TZ- 3	Oued El Koucha	62	2,100	1,200	3,300	11,246	206	1,811	4,276	6,087	273	4,390	16,721	21,111	1,277	340	0.017
TZ- 4	Lafayette	72	2,008	1,200	3,208	23,240	166	6,650	300	6,950	327	9,151	24,740	33,891	1,699	471	0.020
TZ- 5	Chemaa	90	2,660	1,200	3,860	23,001	299	3,094	300	3,394	450	6,503	25,101	31,603	2,142	351	0.015
TZ- 6	Helba Est	75	184	1,200	1,384	10,303	249	1,321	150	1,471	341	2,094	11,653	13,747	1,551	183	0.009
TZ- 7	Helba Ouest	50	1,639	1,200	2,839	13,921	279	3,455	150	3,605	227	5,600	15,271	20,871	1,554	417	0.013
TZ- 8	Jhim 1	40	1,737	1,200	2,937	3,750	133	704	150	854	14,364	16,938	5,100	22,039	914	551	0.024
TZ- 9	Jhim 2	167	4,081	1,200	5,281	11,323	554	3,936	150	4,086	1,336	9,907	12,973	22,580	935	135	0.024
TZ-10	* Ibn Chabbat 3	325	13,770	0	13,770	78,311	996	52,287	0	52,287	1,487	68,540	78,311	146,851	5,250	452	0.028
TZ-11	Nefta	(852)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	(Kenada)	342	13,787	3,600	17,387	64,346	973	14,862	17,102	31,964	1553.7	31,176	85,049	116,224	3,297	340	0.035
	(Beni Ali)	210	8,306	2,400	10,706	25,572	564	12,153	10,261	23,415	954	22,977	41,233	64,211	2,986	306	0.022
	(Fatnassa)	300	11,663	3,600	15,263	45,232	805	14,817	19,666	34,485	1,303	28,648	68,500	97,148	4,292	324	0.023
TZ-12	Ghardaya	40	2,570	1,200	3,770	9,074	239	1,401	0	1,401	200	4,409	10,274	14,683	903	367	0.016
TZ-13	* Ibn Chabbat 1	240	13,770	0	13,770	55,710	706	37,197	0	37,197	1,058	52,733	55,710	108,443	3,840	452	0.028
TZ-14	* Ibn Chabbat 2	272	13,770	0	13,770	64,219	816	42,878	0	42,878	1,220	58,684	64,219	122,903	4,400	452	0.028
TZ-15	* Draa Sud	198	6,885	0	6,885	49,126	625	32,801	0	32,801	933	41,244	49,126	90,370	2,240	456	0.040
TZ-16	Hazoua 1	72	493	1,200	1,693	12,985	172	835	0	835	327	1,827	14,185	16,012	986	222	0.017
TZ-17	Hazoua 2	48	0	1,135	1,135	22,648	115	164	0	164	218	498	23,783	24,281	1,143	506	0.021
TZ-18	Hazoua 3	(234)	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hazoua (2 et 3 eme)	66	1,029	600	1,629	7,794	165	306	4,276	4,582	300	1,801	12,670	14,470	1,376	219	0.011
	Hazoua (4 eme)	54	729	600	1,329	4,942	135	0	4,276	4,276	245	1,109	9,818	10,927	860	202	0.013
	Hazoua (5 eme)	64	842	600	1,442	6,524	161	33	4,276	4,308	245	1,281	11,399	12,680	875	198	0.014
	Hazoua (6 eme)	54	608	600	1,208	3,779	135	0	4,276	4,276	245	989	8,655	9,643	815	179	0.012
TZ-19	Oued Loghrisa	78	476	1,200	1,676	10,113	187	0	4,276	4,276	354	1,017	15,589	16,606	947	213	0.018
TZ-20	Tazarit	48	3,420	1,200	4,620	12,792	117	352	8,551	8,903	241	4,129	22,543	26,672	971	556	0.027
TZ-21	Cedada	55	1,440	1,200	2,640	5,844	134	1,302	4,276	5,578	250	3,126	11,220	14,446	599	263	0.024
TZ-22	Dghoumes	104	2,793	1,200	3,993	24,295	229	450	12,827	13,307	518	4,020	38,322	42,341	1,493	407	0.028
TZ-23	Degache	(822)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	(El Manachi)	56	2,092	1,200	3,292	10,225	239	1,401	4,276	5,676	200	3,932	15,701	19,633	849	351	0.023
	(Ouled Haida)	57	2,092	1,200	3,292	24,579	239	1,401	4,276	5,676	200	3,932	30,055	33,986	840	596	0.040
	(Sidi Addallah)	90	2,092	1,200	3,292	10,460	239	1,401	4,276	5,676	200	3,932	15,936	19,868	1,214	221	0.016
	(Ain Rebeh)	89	2,092	1,200	3,292	18,502	239	1,401	8,551	9,952	200	3,932	28,254	32,185	1,440	362	0.022
	(Ouled Majod)	324	11,661	4,800	16,461	94,588	239	1,401	21,378	22,778	200	13,500	120,766	134,266	4,350	414	0.031
	(Zaouit El Arab)	42	2,092	1,200	3,292	14,047	239	1,401	4,276	5,676	200	3,932	19,523	23,454	726	558	0.032
	(El Mahassen)	164	4,184	2,400	6,584	26,759	239	1,401	4,276	5,676	200	6,024	33,435	39,459	2,170	241	0.018
TZ-24	Chamou	90	1,913	1,200	3,113	8,226	198	174	0	174	450	2,734	9,438	12,172	2,403	135	0.005
TZ-25	El Hamma	400	1,900	3,600	5,500	70,590	940	24,271	12,827	37,098	1,944	29,056	90,016	119,072	6,831	238	0.017
TZ-26	** Tameras	(80)	0	0	-	-	-	-	-	-	-	-	-	-	(2,350)	-	-
TZ-27	** Chebika	(23)	0	0	-	-	-	-	-	-	-	-	-	-	(441)	-	-
TZ-28	** Koum El Khanga	(46)	0	0	-	-	-	-	-	-	-	-	-	-	(645)	-	-
TZ-29	Midas	29	6,300	1,200	7,500	3,361	239	1,401	4,276	5,676	200	8,130	8,837	16,976	653	585	0.026
TZ-30	** Ain El Karma	(25)	0	0	-	-	-	-	-	-	-	-	-	-	(224)	-	-
	Total/Ave.	5,446	160,604	57,535	221,139	1,030,271	15,628	297,390	177,549	474,938	36,075	514,805	1,268,355	1,783,050	89,529	327	0.020
	Ratio(%)	-	9	3	12	58	1	17	10	27	2	29	71	100	-	-	-
	Sharing ratio of OM cost and supplied water amount(%)																
		AIC	0	100	25	75	0	0	100	37	0	0	100	71	-	-	-
		CRDA	100	0	74	24	100	100	0	63	100	100	0	29	-	-	-
		Total	100	100	100	100	100	100	100	100	100	100	100	100	-	-	-

Note) *: Operation costs of irrigation water for Ibn Chabbat 1,2,3 and Draa Sud are beared
**: Water resources of these oases are artesian and/or shallow well

2) OM Cost of special projects of CRDA

Code Num.	Oasis (AIC)	Irrigated area in 1993 (ha)	OM Cost of CRDA (DT/year)	Consumed water volume (1,000m3)	Cost of water	
					(DT/ha)	(DT/m3)
TZ-10	Ibn Chabbat 3	325	146,851	5,250	452	0.028
TZ-13	Ibn Chabbat 1	240	108,433	3,840	452	0.028
TZ-14	Ibn Chabbat 2	272	122,903	4,400	452	0.028
TZ-15	Draa Sud	200	90,370	2,240	452	0.040
	Total	1,037	468,557	15,770	452	0.030

Table G. A. 7 (3) OM Cost for Irrigation System in Kebili Governorate

1) OM Cost of AIC

Code Num.	Oasis (AIC)	Irrigated Area in 1994 (ha)	Personnel Charges for Pump (DT/year)	Electric Charges for Pump (DT/year)	Cost of oils (DT/year)	Cost of spare part (DT/year)	Miscellaneous expenses (DT/year)	Repairing cost (DT/year)	OM Cost of AIC (DT/year)	Consumed water volume (1,000 m3)	Unit OM cost (DT/ha)	Unit OM cost (DT/m3)
KB- 1	Bechri	135	4,800	8,500	-	150	-	765	14,215	2,755	105	0.005
KB- 2	Bouabdallah	270	9,840	25,000	-	340	-	830	36,010	3,359	133	0.011
KB- 3	Fatnassa	205	5,040	8,300	-	150	2,500	665	16,655	2,473	81	0.007
KB- 4	El Gliaa	94	5,040	22,500	-	320	-	1665	29,525	1,356	314	0.022
KB- 5	Menchia	140	5,280	-	-	-	-	665	5,945	2,622	42	0.002
KB- 6	Nagga	118	5,400	24,000	-	220	-	895	30,515	1,437	259	0.021
KB- 7	Oum Somaa	(162)										
	(O.S.Nord)	90	5,280	11,200	-	120	-	465	17,065	1,089	190	0.016
	(O.S.Sud)	72	4,500	17,300	-	300	3,500	1465	27,065	1,104	376	0.025
KB- 8	Oued Zira	170	7,920	23,500	-	450	-	475	32,345	2,113	190	0.015
KB- 9	Ouled Touati	62	3,840	11,200	-	125	-	265	15,430	907	249	0.017
KB-10	Tenchig	54	2,160	-	-	-	4,000	-	6,160	700	114	0.009
KB-11	Zaouiet El Anes	135	6,840	-	-	-	425	2300	9,565	1,166	71	0.008
KB-12	Zaouiet El Harth	85	11,520	-	-	-	265	2500	14,285	1,335	168	0.011
KB-13	Ziret Louhichi	86	4,200	13,500	-	200	-	265	18,165	1,179	211	0.015
KB-14	Chouchet Nagga	26	10,300	-	-	150	-	265	10,715	363	412	0.030
KB-15	Guataya	150	2,520	-	-	150	-	550	3,220	2,940	21	0.001
KB-16	Jedida	230	2,760	11,200	-	230	-	565	14,755	3,305	64	0.004
KB-17	Mansoura	(230)	-	-	-	-	-	-	-	-	-	-
KB-18	Rabta	162	6,900	11,200	-	340	-	780	19,220	598	119	0.032
KB-19	Telmine	240	7,920	33,600	-	250	-	2465	44,235	2,922	184	0.015
KB-20	Tembib	118	4,800	11,200	-	250	-	265	16,515	705	140	0.023
KB-21	Tombar	127	5,460	22,400	-	150	-	265	28,275	2,234	223	0.013
KB-22	Limagues	80	3,120	-	-	-	-	905	4,025	1,259	50	0.003
KB-23	Mazraa Keji	59	720	11,200	-	108	-	265	12,293	1,192	208	0.010
KB-24	Oum El Farth											
	1 et 2											
	(Oum El Farth 1)	40	1,920	9,600	-	320	-	265	12,105	1,124	303	0.011
	(Oum El Farth 2)	15	1,920	-	657	-	-	200	2,777	459	185	0.006
KB-25	Stiftimi	72	3,840	-	-	-	-	620	4,460	2,159	62	0.002
KB-26	Saidane	30	-	-	-	-	-	-	-	805	-	0.000
KB-27	Barghouthia	55	3,240	11,200	-	200	-	265	14,905	726	271	0.021
KB-28	Bazma	146	4,800	22,400	-	320	-	530	28,050	2,374	192	0.012
KB-29	B'chelli	125	1,440	11,200	-	150	-	1250	14,040	1,270	112	0.011
KB-30	Blidette	75	1,800	-	-	-	-	120	1,920	2,492	26	0.001
KB-31	Zarcine	80	2,160	-	-	-	-	-	2,160	2,333	27	0.001
KB-32	Jemna	112	4,080	11,200	-	350	-	265	15,895	1,099	142	0.014
KB-33	Mtouria	90	1,920	-	-	-	-	265	2,185	1,555	24	0.001
KB-34	Msaid	95	3,360	11,200	-	130	-	265	14,955	1,270	157	0.012
KB-35	Rahmat	85	2,160	22,400	-	160	-	265	24,985	1,466	294	0.017
KB-36	Ras El Ain	268	21,600	56,000	-	420	-	825	78,845	5,460	294	0.014
KB-37	Souk El Baiez	65	7,200	22,400	-	170	-	530	30,300	1,201	466	0.025
KB-38	Ben Zitoun 1et2	170	5,640	11,200	-	260	-	545	17,635	2,359	104	0.007
KB-39	Bourzine	94	1,800	-	-	-	-	265	2,065	1,089	22	0.002
KB-40	Guelileda	100	1,800	12,500	-	100	-	265	14,665	1,679	147	0.009
KB-41	Kelwamen	47	960	11,200	-	120	-	265	12,545	544	267	0.023
KB-42	Klibia	94	1,800	-	-	-	-	-	1,800	2,488	19	0.001
KB-43	Sidi Hamed	100	1,920	11,200	-	120	-	265	13,505	998	135	0.014
KB-44	Atilet	222	22,400	-	-	250	-	530	23,180	3,337	104	0.007
KB-45	Douz	280	8,400	44800	-	560	-	1560	55,320	5,216	198	0.011
KB-46	El Ghoula	75	3,600	14500	-	150	-	265	18,515	1,089	247	0.017
KB-47	El Golaa	67	3,120	12500	-	320	-	550	16,490	816	246	0.020
KB-48	Grad	110	3,600	11300	-	200	-	265	15,365	1,633	140	0.009
KB-49	El H'say	90	3,240	22700	-	340	-	265	26,545	643	295	0.041
KB-50	Nouiel	97	1,680	-	-	-	-	-	1,680	1,840	17	0.001
KB-51	Zaafrane	101	1,680	-	-	-	-	220	1,900	2,488	19	0.001
KB-52	Bouhamza	80	2,580	11,200	-	220	-	265	14,265	1,680	178	0.008
KB-53	Ksar Ghilane	100	1,440	-	-	-	-	-	1,440	2,955	14	0.000
KB-54	Sakkouma	80	3,600	13,200	-	260	-	265	17,325	1,814	217	0.010
KB-55	Tarfaya	80	3,600	10,500	-	150	-	265	14,515	1,016	181	0.014
KB-56	Dhomrana	45	3,240	13,200	-	160	-	265	16,865	636	375	0.027
KB-57	Saida	74	1,680	-	-	-	-	-	1,680	1,089	23	0.002
KB-58	Ghidma	85	1,080	-	-	-	-	660	1,740	632	20	0.003
KB-59	Sabria	60	2,660	-	-	-	-	280	2,940	1,190	49	0.002
KB-60	El Faouar 1	87	1,440	-	-	-	-	200	1,640	532	19	0.003
KB-61	El Faouar 2	136	1,560	-	-	-	-	240	1,800	1,474	13	0.001
KB-62	Bechni	100	2,160	-	-	-	-	120	2,280	1,854	23	0.001
KB-63	Dargine	72	1,440	-	-	-	-	210	1,650	643	23	0.003
KB-64	Matrouha	104	-	-	-	-	-	-	-	1,874	-	0.000
KB-65	Regia Maatoug 1	104	1,920	-	-	-	-	320	2,240	1,823	22	0.001
KB-66	Regia Maatoug 2	100	1,440	-	-	-	-	110	1,550	2,216	16	0.001
KB-67	Tarfayet Elma	52	4,370	12,300	-	160	-	265	17,095	726	329	0.024
	Total	5,908	249,240	595,300	657	8,633	10,690	30,470	894,990	91,126	151	-
	Ratio(%)	1	28	67	0	1	1	3	100	-	-	-

2) OM Cost of CRDA (1995)

Code Num.	Item	OM Budget of CRDA (1,000DT /year)	Ratio (%)
1	Cooling system for 10 AICs	50	11
2	Drainage system	120	27
3	Irrigation (P.I.K) system	130	29
4	New equipment and electric tranmision line	150	33
	Total	450	100

(Note) 1. P.I.K.(Kebili Island Pipeline Irrigation System)
The following Oasis are receiving the irrigation water through above system:
KB-2 Bou Abdellah, KB-3 Faïnassa, KB-7 Oum Somaa, KB-10 Tenchig, KB-11 Z.El Ane
KB-12 Z.El Harth, KB-16 Jdida, KB-17 Mansoura, KB-29 Bechri ouest

Table G.7(4) OM Cost for Irrigation System in Gabes Governorate

1) Total OM Cost

Code Num.	Name of Oasis (AIC)	Irrigated area in 1994 (ha)	Personnel Charges (DT/year)	Electric Charges for Pump (DT/year)	Cost of sparepart and equipment (DT/year)	Reparing cost of AIC (DT/year)	Miscellaneous expenses (DT/year)	Total OM Cost (DT/year)	Consumed Water Volume (1,000m3)	Cost of Water (DT/ha)	(DT/m3)
GB- 1	Ain Zrig	110	15,257	3,648	750	840	1,505	22,000	665	200	0.033
GB- 2	Temoula 1	40	2,749	2,591	0	200	236	5,776	134	144	0.043
GB- 3	Temoula 2	20	2,595	1,962	0	150	334	5,041	262	252	0.019
GB- 4	Zrig Dakhlania	30	3,647	2,731	0	600	259	7,237	260	241	0.028
GB- 5	Teboulbou	520	26,032	18,670	0	15,835	11,370	71,907	5,447	138	0.013
GB- 6	Oasis de Gabes	730	90,266	54,000	1,700	15,000	8,852	169,818	8,434	233	0.020
GB- 7	Limaoua 1 et 2	143	12,973	14,986	0	2,560	1,129	31,648	1,325	221	0.024
GB- 8	M'dou	40	4,329	5,677	0	800	402	11,208	467	280	0.024
GB- 9	Chott El Ferik	27	3,497	2,993	0	700	187	7,383	282	273	0.026
GB-10	Bouchamma	140	14,648	16,500	200	3,500	2,226	37,074	1,388	265	0.027
GB-11	Mahjoub	374	21,864	31,166	1,000	4,000	1,876	59,906	3,172	160	0.019
GB-12	Salem	99	8,908	15,098	0	1,200	704	25,909	925	262	0.028
GB-13	Sboui	72	3,677	8,698	350	300	511	13,536	720	188	0.019
GB-14	Faycal	260	16,646	8,799	450	1,400	1,948	29,443	2,508	113	0.012
GB-15	M'ziraa Ghannouch	270	20,312	8,410	0	400	2,222	31,344	1,862	116	0.017
GB-16	Methouia	210	19,549	21,587	3,434	1,586	1,679	47,836	1,669	228	0.029
GB-17	Ouedhref	210	17,539	23,329	9,180	3,619	2,288	55,946	2,054	266	0.027
GB-18	Aouinette	180	2,000	0	0	0	0	2,000	0	11	0.000
GB-19	Chenchou 1	55	5,940	7,825	0	1,421	510	15,695	802	285	0.020
GB-20	Chenchou 2	40	3,137	5,017	0	0	1,054	9,208	411	230	0.022
GB-21	Tekouri	30	3,407	3,301	3,718	350	382	11,158	314	372	0.036
GB-22	Hamma Oasis	350	27,317	4,797	1,000	1,000	14,878	48,992	2,697	140	0.018
GB-23	Mairaa Hamma	75	4,275	9,707	0	500	420	14,902	728	199	0.020
GB-24	Bechima 1	270	15,752	16,380	0	1,596	736	34,464	866	128	0.040
GB-25	Bechima 2	260	9,391	169	0	1,044	1,676	12,280	2,901	47	0.004
GB-26	Khebayet	96	9,164	0	500	680	1,403	11,746	2,466	122	0.005
GB-27	Ben Ghilouf	180	15,977	2,300	0	2,450	1,770	22,497	2,833	125	0.008
GB-28	Glib Dokhane	70	7,452	595	1,000	1,223	1,093	11,362	1,790	162	0.006
GB-29	Oued Nekhla	20	2,746	43	6,248	0	400	9,437	276	472	0.034
GB-30	Arram	163	6,388	15,134	0	1,273	691	23,486	1,339	144	0.018
GB-31	Mareth 1	100	12,966	7,857	0	700	1,542	23,065	904	231	0.026
GB-32	Mareth 2	180	11,035	13,845	0	1,890	1,158	27,928	2,097	155	0.013
GB-33	Mareth 3	30	2,810	2,878	4,446	301	264	10,698	122	357	0.088
GB-34	Mareth 5	115	13,499	13,686	0	1,260	1,515	29,960	1,144	261	0.026
GB-35	Mareth 6	88	3,640	7,304	0	711	360	12,015	492	137	0.024
GB-36	Zarat 2	174	10,083	0	0	1,995	1,274	13,352	2,372	77	0.006
GB-37	Zerkine 1 et 3	116	12,383	9,966	0	1,400	1,097	24,846	1,379	214	0.018
GB-38	Zerkine 2	156	9,351	17,710	0	1,400	1,102	29,562	1,726	190	0.017
GB-39	Ayoune Zerkine	30	2,705	2,843	0	280	214	6,042	197	201	0.031
GB-40	Madssia	40	688	1,620	0	1,000	513	3,822	251	96	0.015
GB-41	Kettana 1	98	10,440	5,671	0	700	1,183	17,994	1,323	184	0.014
GB-42	Kettana 3	140	7,856	0	0	1,500	979	10,335	1,616	74	0.006
GB-43	Kettana 4	125	6,470	0	500	1,200	765	8,935	1,180	71	0.008
GB-44	Sidi Sellaa	120	5,586	8,164	4,000	1,029	826	19,605	1,020	163	0.019
GB-45	Zrig Barrania	71	6,439	9,862	0	961	610	17,872	811	252	0.022
GB-46	Ghandri	30	1,706	3,884	0	300	239	6,129	172	204	0.036
GB-47	Laaradh 1	25	1,798	2,975	0	490	106	5,368	154	215	0.035
GB-48	Laaradh 3	30	2,016	5,946	0	315	211	8,488	236	283	0.036
	total/Ave.	6,752	619,098	420,328	38,476	81,658	76,695	1,136,254	66,193	168	0.017
	Ratio(%)	-	46	37	3	7	7	100	-	-	-
	Sharing ratio of OM cost(%)										
	AIC		58	100	0	100	55	75	-	75	75
	CRDA		42	0	100	0	45	25	-		
	Total		100	100	100	100	100	100	-	25	25
										100	100

2) OM Cost of AIC

Code Num.	Name of Oasis	Irrigated area in 1994 (ha)	Personnel Charges (DT/year)	Electric Charges for Pump (DT/year)	Cost of sparepart and equipment (DT/year)	Reparing cost of AIC (DT/year)	Miscellaneous expenses (DT/year)	OM Cost of AIC (DT/year)	Consumed Water Volume (1,000m3)	Cost of Water (DT/ha)	(DT/m3)
GB- 1	Ain Zrig	110	12,727	3,648		840	1,162	18,377	665	167	0.028
GB- 2	Temoula 1	40	2,042	2,591		200	167	5,000	134	125	0.037
GB- 3	Temoula 2	20	2,190	1,962		150	198	4,500	262	225	0.017
GB- 4	Zrig Dakhlania	30	2,744	2,731		600	125	6,200	260	207	0.024
GB- 5	Teboulbou	520	15,600	18,670		15,835	8,559	58,664	5,447	113	0.011
GB- 6	Oasis de Gabes	730	36,210	54,000		15,000	4,500	109,710	8,434	150	0.013
GB- 7	Limaoua 1 et 2	143	10,922	14,986		2,560	446	28,913	1,325	202	0.022
GB- 8	N'dou	40	3,606	5,677		800	161	10,244	457	256	0.022
GB- 9	Chott El Ferik	27	2,260	2,999		700	41	6,000	282	222	0.021
GB-10	Bouchamma	140	9,000	16,500		3,500	1,510	30,510	1,388	218	0.022
GB-11	Mahjoub	374	12,954	31,166		4,000	239	48,360	3,172	129	0.015
GB-12	Salem	99	5,276	15,098		1,200	226	21,800	925	220	0.024
GB-13	Sboui	72	2,063	8,698		300	139	11,200	720	156	0.016
GB-14	Faycal	260	9,664	8,799		1,400	654	20,517	2,508	79	0.008
GB-15	M'ziraa Ghannouch	270	12,430	8,410		400	1,261	22,500	1,862	83	0.012
GB-16	Methoula	210	13,725	21,587		1,586	818	37,716	1,669	180	0.023
GB-17	Ouedhref	210	11,730	23,329		3,619	1,228	39,906	2,054	190	0.019
GB-18	Aoulnette	180	0	0		0	0	0	0	0	-
GB-19	Chenchou 1	55	4,699	7,825		1,421	96	14,040	802	255	0.018
GB-20	Chenchou 2	40	2,501	5,017		0	842	8,360	411	209	0.020
GB-21	Tekouri	30	2,921	3,301		350	220	6,792	314	226	0.022
GB-22	Hamma Oasis	350	11,541	4,797		1,000	13,487	30,825	2,697	88	0.011
GB-23	Mziraa Hamma	75	1,749	9,707		500	44	12,000	728	160	0.016
GB-24	Bechima 1	270	6,912	16,380		1,596	289	25,177	866	93	0.029
GB-25	Bechima 2	260	2,520	169		1,044	179	3,912	2,901	15	0.001
GB-26	Khebayet	96	3,361	0		680	130	4,171	2,466	43	0.002
GB-27	Ben Ghilouf	180	9,392	2,300		2,450	309	14,450	2,833	80	0.005
GB-28	Glib Dokhane	70	2,911	595		1,223	169	4,898	1,790	70	0.003
GB-29	Oued Kekhla	20	2,319	43		0	258	2,620	276	131	0.009
GB-30	Arram	163	4,080	15,134		1,273	0	20,487	1,339	126	0.015
GB-31	Mareth 1	100	11,567	7,857		700	1,075	21,200	904	212	0.023
GB-32	Mareth 2	180	5,788	13,845		1,890	76	21,600	2,097	120	0.010
GB-33	Mareth 3	30	2,621	2,878		301	201	6,000	122	200	0.049
GB-34	Mareth 5	115	11,729	13,686		1,260	925	27,600	1,144	240	0.024
GB-35	Mareth 6	88	2,879	7,304		711	107	11,000	492	125	0.022
GB-36	Zarat 2	174	4,912	0		1,995	50	6,957	2,372	40	0.003
GB-37	Zerkine 1 et 3	116	7,249	9,966		1,400	385	19,000	1,379	164	0.014
GB-38	Zerkine 2	156	5,679	17,710		1,400	211	25,000	1,726	160	0.014
GB-39	Ayoune Zerkine	30	2,400	2,843		280	112	5,635	197	188	0.029
GB-40	Madssia	40	300	1620.1		1,000	384	3,304	251	83	0.013
GB-41	Kettana 1	98	6,392	5,671		700	500	13,263	1,323	135	0.010
GB-42	Kettana 3	140	5,355	0		1,500	145	7,000	1,616	50	0.004
GB-43	Kettana 4	125	4,644	0		1,200	156	6,000	1,160	48	0.005
GB-44	Sidi Sellam	120	2,507	8,164		1,029	300	12,000	1,020	100	0.012
GB-45	Zrig Barrania	71	3,684	9,862		961	191	14,698	811	207	0.018
GB-46	Ghandri	30	1,440	3,684		300	150	5,774	172	192	0.034
GB-47	Laaradh 1	25	1,559	2,975		490	26	5,050	154	202	0.033
GB-48	Laaradh 3	30	1,651	5,946		315	89	8,000	236	267	0.034
	Total	6,752	302,403	420,328	0	81,658	42,540	846,928	66,193	125	0.013
	Ratio(%)	-	36	50	0	10	5	100	-	-	-

3) OM Cost of CRDA

Code Num.	Name of Oasis	Irrigated area in 1994 (ha)	Personnel Charges (DT/year)	Electric Charges for Pump (DT/year)	Cost of sparepart and equipment (DT/year)	Reparing cost of CRDA (DT/year)	Miscellaneous expenses (DT/year)	OM Cost of AIC (DT/year)	Consumed Water Volume (1,000m3)	Cost of Water (DT/ha)	Cost of Water (DT/m3)
GB- 1	Ain Zrig	110	2,530	0	750	0	343	3,624	665	33	0.005
GB- 2	Temoula 1	40	707	6	0	0	69	776	134	19	0.006
GB- 3	Temoula 2	20	406	0	0	0	135	541	262	27	0.002
GB- 4	Zrig Dakhlania	30	903	0	0	0	134	1,037	260	35	0.004
GB- 5	Teboulbou	520	10,432	0	0	0	2,811	13,243	5,447	25	0.002
GB- 6	Oasis de Gabes	730	54,056	0	1,700	0	4,352	60,108	8,434	82	0.007
GB- 7	Limaoua 1 et 2	143	2,052	0	0	0	684	2,736	1,325	19	0.002
GB- 8	M'dou	40	723	0	0	0	241	964	467	24	0.002
GB- 9	Chott El Ferik	27	1,237	0	0	0	146	1,383	282	51	0.005
GB-10	Bouchamma	140	5,648	0	200	0	716	6,564	1,388	47	0.005
GB-11	Mahjoub	374	8,910	0	1,000	0	1,637	11,546	3,172	31	0.004
GB-12	Salem	99	3,632	0	0	0	477	4,109	925	42	0.004
GB-13	Sboui	72	1,615	0	350	0	372	2,336	720	32	0.003
GB-14	Faycal	260	7,182	0	450	0	1,294	8,926	2,508	34	0.004
GB-15	M'ziraa Ghannouch	270	7,883	0	0	0	961	8,844	1,862	33	0.005
GB-16	Methouia	210	5,824	0	3,434	0	861	10,120	1,669	48	0.006
GB-17	Ouedhref	210	5,800	0	9,189	0	1,060	16,049	2,054	76	0.008
GB-18	Aouinette	180	2,000	0	0	0	0	2,000	0	11	-
GB-19	Chenchou 1	55	1,241	0	0	0	414	1,655	802	30	0.002
GB-20	Chenchou 2	40	636	0	0	0	212	848	411	21	0.002
GB-21	Tebouri	30	486	0	3,718	0	162	4,366	314	146	0.014
GB-22	Hamma Oasis	350	15,775	0	1,000	0	1,392	18,167	2,697	52	0.007
GB-23	Mziraa Hamma	75	2,526	0	0	0	375	2,902	728	39	0.004
GB-24	Bechima 1	270	8,849	0	0	0	447	9,287	866	34	0.011
GB-25	Bechima 2	260	6,871	0	0	0	1,497	8,368	2,901	32	0.003
GB-26	Khebayet	95	5,803	0	500	0	1,273	7,575	2,466	79	0.003
GB-27	Ben Ghilouf	180	6,585	0	0	0	1,462	8,047	2,833	45	0.003
GB-28	Glib Dokhane	70	4,541	0	1,000	0	924	6,464	1,790	92	0.004
GB-29	Oued Nekhla	20	427	0	6,248	0	142	6,817	276	341	0.025
GB-30	Arram	163	2,308	0	0	0	691	2,999	1,339	18	0.002
GB-31	Mareth 1	100	1,399	0	0	0	466	1,865	904	19	0.002
GB-32	Mareth 2	180	5,246	0	0	0	1,082	6,328	2,097	35	0.003
GB-33	Mareth 3	30	189	0	4,446	0	63	4,698	122	157	0.039
GB-34	Mareth 5	115	1,770	0	0	0	590	2,360	1,144	21	0.002
GB-35	Mareth 6	88	761	0	0	0	254	1,015	492	12	0.002
GB-36	Zarat 2	174	5,171	0	0	0	1,224	6,395	2,372	37	0.003
GB-37	Zerkine 1 et 3	116	5,135	0	0	0	712	5,846	1,379	50	0.004
GB-38	Zerkine 2	156	3,672	0	0	0	891	4,562	1,726	29	0.003
GB-39	Ayoune Zerkine	30	305	0	0	0	102	406	197	14	0.002
GB-40	Madssia	40	388	0	0	0	129	518	251	13	0.002
GB-41	Kettana 1	98	4,048	0	0	0	683	4,731	1,323	48	0.004
GB-42	Kettana 3	140	2,501	0	0	0	834	3,335	1,616	24	0.002
GB-43	Kettana 4	125	1,826	0	500	0	609	2,935	1,180	23	0.002
GB-44	Sidi Sellam	120	3,079	0	4,000	0	526	7,605	1,020	63	0.007
GB-45	Zrig Barrania	71	2,755	0	0	0	419	3,174	811	45	0.004
GB-46	Ghandri	30	266	0	0	0	89	355	172	12	0.002
GB-47	Laaradh 1	25	239	0	0	0	80	318	154	13	0.002
GB-48	Laaradh 3	30	366	0	0	0	122	488	236	16	0.002
	Total	6,752	216,695	0	38,476	0	34,155	289,326	66,193	43	0.004
	Ratio(%)	-	75	0	13	0	12	100	-	-	-

Attachment G.8

Planned OM cost for proposed facilities

Table G.A.8 OM cost of irrigation and drainage facilities

(1) Gafsa Governorate

Cord No.	Name of Oasis	Planned Area(ha)	OM cost('000 DT)			
			Facilities	Staff	Equip. and materials	Total
GF- 1	Kasba	698	8.6	3.4	2.5	14.5
GF- 2	Sud Ouest	703	11.4	3.4	2.5	17.3
GF- 3	El Guettar	450	9.3	2.2	1.6	13.1
GF- 4	Lalla	700	11.2	3.4	2.5	17.1
GF- 5	El Ksar	578	7.8	2.8	2.1	12.6
GF- 6	Oued Shili	56	1.2	0.3	0.2	1.7
GF- 7	Thelja	65	2.7	0.3	0.2	3.2
GF- 8	Segdoud	217	6.3	1.1	0.8	8.2
	Total	3,467	58.4	16.8	12.3	87.6

(2) Tozeur Governorate

Cord No.	Name of Oasis	Planned Area(ha)	OM cost('000 DT)			
			Facilities	Staff	Equip. and materials	Total
TZ- 1	Tozeur	929	21.0	5.1	3.4	29.5
TZ- 2	Kastilia	50	1.0	0.3	0.2	1.5
TZ- 3	Oued El Koucha	62	1.4	0.3	0.2	2.0
TZ- 4	Keflayette	72	1.5	0.4	0.3	2.1
TZ- 5	Chemsa	90	1.9	0.5	0.3	2.7
TZ- 6	Helba Est	75	2.7	0.4	0.3	3.4
TZ- 7	Helba Ouest	50	0.8	0.3	0.2	1.3
TZ- 8	Ihim 1	40	1.2	0.2	0.1	1.5
TZ- 9	Ihim 2	167	5.0	0.9	0.6	6.5
TZ- 10	Ibn Chabbat 3(*)	325	12.0	1.8	1.2	15.0
TZ- 11	Nefta	852	15.4	4.7	3.1	23.2
TZ- 12	Ghardgaya	40	1.2	0.2	0.1	1.6
TZ- 13	Ibn Chabbat 1 (*)	240	5.1	1.3	0.9	7.3
TZ- 14	Ibn Chabbat 2 (*)	272	9.1	1.5	1.0	11.6
TZ- 15	Draa Sud	198	0.3	1.1	0.7	2.1
TZ- 16	Hazoua 1	72	3.0	0.4	0.3	3.6
TZ- 17	Hazoua 2	48	1.5	0.3	0.2	1.9
TZ- 18	Hazoua 3	238	6.9	1.3	0.9	9.1
TZ- 19	Oued Loghrissi	78	2.7	0.4	0.3	3.4
TZ- 20	Tazrarit	48	1.4	0.3	0.2	1.9
TZ- 21	Cedada	55	2.3	0.3	0.2	2.8
TZ- 22	Oghoumes	104	3.3	0.6	0.4	4.2
TZ- 23	Degache	822	19.9	4.5	3.0	27.4
TZ- 24	Chaksou	90	1.6	0.5	0.3	2.4
TZ- 25	El Hamma	400	8.1	2.2	1.5	11.7
TZ- 26	Tamerza	80	3.7	0.4	0.3	4.5
TZ- 27	Chebika	23	0.7	0.1	0.1	0.9
TZ- 28	Foum El Khanga	48	1.6	0.3	0.2	2.0
TZ- 29	Midès	29	0.6	0.2	0.1	0.8
TZ- 30	Ain El Karma	25	0.9	0.1	0.1	1.1
	Total	5,622	137.6	30.8	20.6	188.9

(3) Kebii Governorate

Cord No.	Name of Oasis	Planned Area(ha)	O/M cost('000 DT) Facilities	Staff	Equip. and materials	Total
KB- 1	Bechri	162	6.0	0.8	0.7	7.5
KB- 2	Bouabdallah	270	7.6	1.4	1.2	10.1
KB- 3	Fatnassa	205	4.6	1.0	0.9	6.5
KB- 4	El Gliaa	94	3.3	0.5	0.4	4.2
KB- 5	Menchia	140	6.0	0.7	0.6	7.3
KB- 6	Nagga	181	3.3	0.9	0.8	5.0
KB- 7	Oum Somaa	162	6.3	0.8	0.7	7.9
KB- 8	Oued Zira	176	4.1	0.9	0.8	5.8
KB- 9	Ouled Touati	62	1.7	0.3	0.3	2.3
KB- 10	Tenchig	54	1.6	0.3	0.2	2.1
KB- 11	Zaoulet El Anes	125	1.9	0.6	0.5	3.1
KB- 12	Zaoulet El Harth	81	2.5	0.4	0.3	3.2
KB- 13	Ziret Louhichi	86	2.1	0.4	0.4	2.9
KB- 14	Chouchet Nagga	26	0.6	0.1	0.1	0.9
KB- 15	Guataya	150	2.1	0.8	0.6	3.5
KB- 16	Jedida	133	5.6	0.7	0.6	6.8
KB- 17	Mansoura	86	3.8	0.4	0.4	4.6
KB- 18	Rabta	162	5.1	0.8	0.7	6.6
KB- 19	Telmine	240	8.2	1.2	1.0	10.5
KB- 20	Tembib	118	2.5	0.6	0.5	3.6
KB- 21	Tombar	127	4.4	0.6	0.5	5.6
KB- 22	Limagues	57	1.5	0.3	0.2	2.0
KB- 23	Masraa Neji	66	2.6	0.3	0.3	3.3
KB- 24	Oum El Farth Ier2	55	0.5	0.3	0.2	1.0
KB- 25	Stiftimi	82	1.1	0.4	0.4	1.8
KB- 26	Saidane	30	0.6	0.2	0.1	0.9
KB- 27	Barghouthia	52	0.9	0.3	0.2	1.4
KB- 28	Bazma	146	3.5	0.7	0.6	4.8
KB- 29	B'chelli	135	3.8	0.7	0.6	5.1
KB- 30	Blidette	75	1.5	0.4	0.3	2.2
KB- 31	Zarcine	70	1.3	0.4	0.3	2.0
KB- 32	Jemna	112	0.7	0.6	0.5	1.7
KB- 33	Ktouria	81	1.1	0.4	0.3	1.8
KB- 34	Msaid	95	2.3	0.5	0.4	3.2
KB- 35	Rahmat	85	2.2	0.4	0.4	3.0
KB- 36	Ras El Ain	268	6.8	1.4	1.1	9.3
KB- 37	Souk El Baiez	65	1.4	0.3	0.3	2.0
KB- 38	Ben Zitoun Ier2	147	3.5	0.7	0.6	4.8
KB- 39	Bouraine	94	2.0	0.5	0.4	2.9
KB- 40	Gueliada	103	1.8	0.5	0.4	2.8
KB- 41	Kelwamen	47	1.7	0.2	0.2	2.1
KB- 42	Klibia	92	1.9	0.5	0.4	2.8
KB- 43	Sidi Hamed	100	1.7	0.5	0.4	2.6
KB- 44	Atilet	220	6.5	1.1	0.9	8.5
KB- 45	Douz	280	5.6	1.4	1.2	8.2
KB- 46	El Ghoula (*)	75	2.2	0.4	0.3	2.9
KB- 47	El Golaa (*)	65	2.1	0.3	0.3	2.7
KB- 48	Erad (*)	111	5.4	0.6	0.5	6.5
KB- 49	El H'say	90	0.9	0.5	0.4	1.7
KB- 50	Kouiel	97	1.9	0.5	0.4	2.9
KB- 51	Zaafrane	101	0.8	0.5	0.4	1.7
KB- 52	Bouhamza	80	2.1	0.4	0.3	2.9
KB- 53	Ksar Ghilane	100	3.4	0.5	0.4	4.3
KB- 54	Sakkouma (*)	80	3.5	0.4	0.3	4.2
KB- 55	Tarfaya (*)	77	2.2	0.4	0.3	2.9
KB- 56	Dhomrana	45	1.4	0.2	0.2	1.9
KB- 57	Saida	64	1.5	0.3	0.3	2.1
KB- 58	Ghidma	80	1.2	0.4	0.3	1.9
KB- 59	Sabria	60	2.4	0.3	0.3	3.0
KB- 60	El Faouar 1	87	2.3	0.4	0.4	3.1
KB- 61	El Faouar 2	80	2.0	0.4	0.3	2.8
KB- 62	Bechni	100	2.2	0.5	0.4	3.1
KB- 63	Dargine (*)	72	2.8	0.4	0.3	3.5
KB- 64	Matrouha	100	3.0	0.5	0.4	3.9
KB- 65	Regim Maatoug 1	104	3.3	0.5	0.4	4.3
KB- 66	Regim Maatoug 2	96	2.1	0,5	0.4	3.0
KB- 67	Tarfayet Elma	52	1.4	0.3	0.2	1.9
	Total	7,213	190.0	36.6	30.9	257.5

(4) Gabes Governorate

Cord No.	Name of Oasis	Planned Area(ha)	O/M cost('000 DT)			
			Facilities	Staff	Equip. and materials	Total
GB- 1	Ain Zrig	140	1.9	0.8	0.6	3.4
GB- 2	Temoula 1	40	0.7	0.2	0.2	1.1
GB- 3	Temoula 2	20	0.9	0.1	0.1	1.1
GB- 4	Zrig Dakhlania	30	0.9	0.2	0.1	1.2
GB- 5	Teboulbou	520	16.1	3.0	2.3	21.3
GB- 6	Oasis de Gabes	734	13.5	4.2	3.2	20.8
GB- 7	Limaoua 1 et 2	148	4.7	0.8	0.6	6.2
GB- 8	M'dou	40	1.5	0.2	0.2	1.9
GB- 9	Chott El Ferik	31	0.3	0.2	0.1	0.7
GB- 10	Bouchamma	143	1.7	0.8	0.6	3.1
GB- 11	Mahjoub	374	9.3	2.1	1.6	13.1
GB- 12	Salem	99	2.8	0.6	0.4	3.8
GB- 13	Sboui	72	2.5	0.4	0.3	3.3
GB- 14	Faycal	260	7.3	1.5	1.1	9.9
GB- 15	M'ziraa Channouch	280	10.3	1.6	1.2	13.1
GB- 16	Methouia	268	5.7	1.5	1.2	8.4
GB- 17	Ouedhref	263	7.7	1.5	1.1	10.3
GB- 18	Aouinette	232	5.5	1.3	1.0	7.8
GB- 19	Chenchou 1	57	1.8	0.3	0.2	2.4
GB- 20	Chenchou 2	40	1.4	0.2	0.2	1.8
GB- 21	Tekouri	32	1.4	0.2	0.1	1.8
GB- 22	Hamma Oasis	400	10.2	2.3	1.7	14.2
GB- 23	Mairaa Hamma	80	2.6	0.5	0.3	3.4
GB- 24	Bechima 1	280	7.5	1.6	1.2	10.4
GB- 25	Bechima 2	290	8.9	1.7	1.3	11.8
GB- 26	Khebayet	96	1.3	0.5	0.4	2.3
GB- 27	Ben Ghilouf	180	1.4	1.0	0.8	3.2
GB- 28	Glib Dokhane	70	1.2	0.4	0.3	1.9
GB- 29	Oued Nekhla	30	0.5	0.2	0.1	0.8
GB- 30	Arram	163	6.6	0.9	0.7	8.2
GB- 31	Mareth 1	100	3.4	0.6	0.4	4.4
GB- 32	Mareth 2	180	6.6	1.0	0.8	8.4
GB- 33	Mareth 3	30	1.0	0.2	0.1	1.3
GB- 34	Mareth 5	115	6.3	0.7	0.5	7.5
GB- 35	Mareth 6	88	2.2	0.5	0.4	3.1
GB- 36	Zarat 2	174	6.4	1.0	0.8	8.2
GB- 37	Zerkine 1 et 3	116	1.7	0.7	0.5	2.9
GB- 38	Zerkine 2	156	4.7	0.9	0.7	6.3
GB- 39	Ayoune Zerkine	30	0.7	0.2	0.1	1.0
GB- 40	Madssia	58	1.6	0.3	0.3	2.2
GB- 41	Kettana 1	98	3.2	0.6	0.4	4.2
GB- 42	Kettana 3	140	4.3	0.8	0.6	5.8
GB- 43	Kettana 4	125	3.6	0.7	0.5	4.8
GB- 44	Sidi Sellam	120	2.4	0.7	0.5	3.7
GB- 45	Zrig Barrania	71	1.6	0.4	0.3	2.3
GB- 46	Ghandri	30	0.9	0.2	0.1	1.2
GB- 47	Laaradh 1	35	1.4	0.2	0.2	1.7
GB- 48	Laaradh 3	55	1.8	0.3	0.2	2.3
	Total	7,133	191.9	40.8	30.9	263.6

ANNEX - H

PROJECT FACILITIES AND COST ESTIMATE

ANNEX - II

PROJECT FACILITIES AND COST ESTIMATES

TABLE OF CONTENTS

ANNEX - H

PROJECT FACILITIES AND COST ESTIMATE

LIST OF TABLES

II.1 Proposed Project Facilities

II.1.1 General

The basic concept of the Project is envisaged, (1) to prepare planning criteria for the on-farm development, improvement and/or renovation for saving water by evaluating the present condition, (2) to prepare planning criteria for the drainage system for the prevention of salt hazard, and (3) to work out the most appropriate irrigation practices, water management system, and operation and maintenance method for saving water.

To cope with the above, detailed sample survey for all the oases was conducted to cover approximately 5% of total area of 23,453 ha based on the plans showing the present alignment of irrigation and drainage systems, structures, roads and others. Sample survey was carried out by the local consultants with assistance of CRDA by using the plans on a scale of 1/2,000 most of which were collected in Phase 1 period. Number of samples and area are as follows:

Name of Oases	Planned Area	Nos. of Samples	Surveyed Area	Percentage
(1) Gafsa	3,467 ha	19	248 ha	7.2%
(2) Tozeur	5,622 ha	47	239 ha	4.2%
(3) Kebili	7,213 ha	86	438 ha	6.1%
(4) Gabes	7,133 ha	81	448 ha	6.3%
Total	23,435 ha	233	1,373 ha	5.9%

The survey results were analyzed and evaluated, and planning criteria for on-farm development was established.

II.1.2 Irrigation facilities

II.1.2.1 Irrigation efficiency at present condition

To account for losses of water incurred during conveyance and application to the field, an efficiency factor will has to be included when calculating the gross irrigation requirements. Efficiency is normally subdivided into three stages, each of which is affected by a different set of conditions.

Conveyance efficiency (Ec) is defined as ratio between water produced at tube-wells to a block of fields and that released at the end of system (hydrant). Field canal efficiency (Eb) is defined as ratio between water received at dissipating basin and that received at the inlet of the block of fields (basins in case of basin irrigation). Field application efficiency (Ea) is defined as ratio between water directly available to the crop and that received at the field inlet. Project efficiency (Ep) is defined as ratio between water made directly available to the crop and that released at tube-wells, or $Ep = Ea \cdot Eb \cdot Ec$.

As discussed in ANNEX F, Ec was estimated at 0.9. Eb was estimated based on the sample survey results of each oases by measuring the length of unimproved ditch (earth ditch). For instance, if average length of unimproved ditch length is 200 m in traditional oases, loss rate is 44% or Eb is 0.56, whereas if 100 m has been improved already by means of concrete canal and/or pipeline, loss rate is 25% or Eb is 0.75 because the length of unimproved ditch depending on field layout, land grading and size of basin. Irrigation efficiency in the new oases seems to be rather high than that in the traditional oases since irrigation practice in the former is improved by constructing temporary small basins and that in the latter needs improvement in operation and technical control (size of basin). In this regard, Ea is estimated at 0.80 in the traditional oases and 0.85 in the new oases.

Irrigation efficiencies of the all the 153 oases at the present conditions are calculated as shown in Table H.1.2.1.

H.1.2.2 Irrigation efficiency with Project

Design of canalization/pipelining was made on the standardized field plot of 2.25 ha (150m x 150m) to estimate construction costs in four cases of (1) canalization up to last 100m, (2) canalization up to last 75m, (3) canalization up to last 50m, (4) canalization up to last 25m as discussed in ANNEX F. The ratios between the saved water loss and construction costs are almost same among Cases (1), (2) and (3), and abruptly falls down in Case (4). In other words, the amount of benefit generated by saved water loss is proportional to the construction cost in Cases (1), (2) and (3). However increment of benefit to the increment of cost become smaller in Case (4), which means efficiency of investment of construction cost is lower than other 3 cases. It is therefore understood that the most efficient canalization is up to last 50 m leaving unimproved ditch of 50 m long.

It is noted, however, that canalization has been made more than up to last 500 m already in some oases. In these oases, it is assumed that the canalization could be made up to last 25 m for further evaluation in terms of EIRR.

Irrigation efficiencies of all the 153 oases with Project are calculated as shown in Table H.1.2.2. The oases with (*) show that the canalization has been made exceeding last 50 m already.

II.1.2.3 Irrigation facilities

As discussed in the foregoing, the optimum length of improved canal is up to last 50 m leaving unimproved ditch of 50 m. In an oases, where canalization has been already made more than last 50 m or the length of unimproved ditch is shorter than 50 m, canalization up to last 25 m is to be practiced.

In an oases, where no canalization is made or canalization is made by PVC pipes to some extent, establishment and/or extension of canalization is to be made by using PVC pipes. Whilst in an oases, where canalization is made by open concrete and/or asbestos cemented canals, extension of canalization is to be made by using concrete open canal.

As seen in DRAWINGS, lining is to be made directly from the hydrant, for instance, Tozeur oases in Tozeur because no canalization has been made, and also, for instance, Oued Shili oases in Gafsa because pipelining is made to certain extent. Whilst, lining is to be made by concrete canals up to last 50 m, for instance, in Kasba oases in Gafsa because open canal lining has been made to some extent, and also lining is to be made by concrete canals up to last 25 m, for instance, in Ibn Chabbat oases in Tozeur, because open canal lining has been made up to more than last 50 m.

Based on the canal alignment thus designed, selection of dimension of pipes and open canals is made depending on the system capacity. Table H.1.2.3 shows the relation between the system capacity and inner diameter of pipes. As seen in the table, diameter 200 mm pipes are to selected for system capacity of 40 l/sec, 160 mm pipes for 30 l/sec and 140 mm pipes for 20 l/sec. Table H.1.2.4 also shows the relation between the system capacity and dimension of concrete flume. As seen in the table, 300 mm x 250 mm (B x H) flumes are to be selected for system capacity of 40 l/sec, 250 mm x 250 mm for 30 l/sec, 250 mm x 200 mm for 26 l/sec, 200 mm x 200 mm for 20 l/sec. Typical cross section of PVC pipe and division device are shown in Fig. H.1.2.1 and Fig. H.1.2.2 and typical cross section of concrete flame and diversion device are shown in Fig. H.1.2.1 and Fig. H.1.2.2, respectively.

H.1.3 Drainage facilities

E.1.3.1 Necessity of drainage

Basically the estimate of drainage need consists of comparing the supply of groundwater originating from leaching, irrigation losses, seepage and rainfall with the capacity of the natural drainage. Then three classes can be distinguished, namely :

(1) Areas in which natural drainage characteristics are highly favorable and experience in similar irrigated areas has shown that little or no artificial drainage will be required.

(2) Areas in which natural drainage characteristics are generally favorable but, because of various specific deficiencies of some characteristics, experience in similar irrigated areas has shown that need for some artificial drainage in combination with natural drainage.

(3) Areas in which natural drainage characteristics are unfavorable and experience in, similar irrigated areas has shown that extensive artificial drainage will be required.

Most of the oases located around Gafsa city are distinctly characterized by areas in category (1). As discussed in ANNEX B, the vast Sidi Aich basin is constricted at just upstream of Gafsa city by two ranges of Jebel Bay Younes and Jebel Orbata. The narrow path in between the said two ranges causes a huge alluvial fan at the immediate downstream, and it dams up the groundwater of the upstream basin like as a natural groundwater reservoir. Therefore, morphologic groundwater under the alluvial fan is usually 20m below the ground surface, where natural drainage is expected.

Several oases in Gafsa gouvernorat located near the border with Tozeur gouvernorat are characterized by areas in category (2), where morphologic groundwater table may fluctuate due to irrigation losses and rainfall.

All the oases located in the three gouvernorats of Tozeur, Kebili and Gabes are distinctly characterized by the areas in category (3) with relatively flat topography, few natural outlets due to high water table of Chott El Ghorsa, Chott El Jerid, Chott El Fajaj and Gulf of Gabes, almost impermeable barrier, of gypsum and clay formation below 5m which restrict the movement of groundwater downwards, and relatively large continuous areas of irrigated lands.

H.1.3.2 Present condition of drainage

It some new oases, field drains are fully equipped with either open ditch with a depth of 2.5m or closed conduit of perforated PVC pipe with an internal diameter of 58 mm, which

is located at 2.0m below the ground surface. However, in most of the traditional oases, field drains are not systematically equipped. They are not sufficiently deep and dense, and sometimes old irrigation ditches. Interval of the field drains in the new oases is 100m, whereas that in the old oases is not definite.

The collector drains, main and secondary drains are all open ditches. Some of the consolidated collector drains are excavated up to 2.5m. The depth of the main and secondary drains are indefinite.

Operation and maintenance costs of these drains are rather high for cleaning of PVC pipes which are choked with sand, reshaping of open drains which are wind eroded, and weeding of open drains.

H.1.3.3 Drainage duty (Leaching requirements)

As discussed in ANNEX F, the leaching requirements for principal crops including dates palm, olive, fruit trees, alfalfa and tomato are calculated for the oases in the four gouvernorats based on the water quality test results. It is seen in table that leaching requirements range between 20% and 40%. Generally, guidelines for estimating irrigation requirements recommend to include these drainage requirements into gross application of water.

In the foregoing paragraphs, all irrigation water including percolation and rainfall, which is not directly taken up by the plants, was considered as losses. This might not be correct because field percolation losses are considered as effective for leaching. The difficulty that percolation losses are unevenly distributed over the field can be substantially overcome by employing an irrigation technique which is adjusted in such a way that the differences in leaching over the field are offset over a number of years by shifts in irrigation units, changes in the size of basin, etc.

In order to examine the above, ratios between the water losses and the net water requirements are calculated as shown ANNEX F. It is seen in this that the water loss rate ranges between 23% and 34% in the case that canalization is practiced up to last 50m. In any of the oases, water loss exceeds leaching requirements. Therefore, normal field percolation losses may be sufficient for leaching, so that no additional leaching is necessary provided that proper artificial drainage is practiced. The reaching requirements for the respective cropping patterns are shown in Table H.1.3.1.

H.1.3.4 Proposed layout of drains

The highest groundwater table should be determined in terms of necessities for aeration of soil and limits of salt accumulation. For tree crop on sandy loam and loamy sand, it is widely reported that the average depth of 80 cm to 120 cm can be tolerated. In view of effect, which is caused by extraordinary high evapotranspiration, on waterlogging prevailing during summer, the design groundwater depth can be fixed at 100 cm for the project area.

In view of the importance of soil permeability in consideration of the design and layout of deep drains, a survey of the permeability was carried out in the areas where it is considered that deep drainage may eventually be necessary. Location and procedure are detailed in ANNEX B. The values obtained range between 350 cm/day and 8,600 cm/day.

It the calculation of the design, depth and interval of the field drains, monographic solution of the Hooghouds formula is employed, because it is commonly used in this country. The required interval of drains on the condition that the depth of the drainage pipeline is located 2.0 m below the ground surface. It is seen in the table that the interval ranges from 107 m to 590 m. As permeability test was not carried out in all oases, the drainage space of 100m was provisionally adopted in view of cost etimate.

H.1.3.5 Drainage Facilities

As discussed in the foregoing, the optimum depth and interval of the field drain are 2.0 m and 100 m, respectively. In an oases, where field drainage is not properly practiced, it is proposed to equip field drains to satisfy these requirements.

According to the sample surveys as shown in DRAWINGS, field draining is not practiced in some oases. For these oases, field drainage is to be established using perforated PVC pipes as shown in these figures. Based on the alignment thus designed, selection of diameter of pipes is to be made depending on the drainage requirements.

Typical cross section of perforated PVC pipe conduit and open drains are shown in Fig. H.1.2.3.

Existing drainage system in some oases is to be used for collector drains and principal drains by improving the existing one.

H.2 Project Cost Estimates

H.2.1 Assumptions

The construction cost of the Project is estimated based on the following assumptions:

(1) Unit prices are analyzed on the basis of average prices as of September, 1995.

(2) The exchange rate used in estimate is as follows:
US$1.00 = DT0.944 = J¥101.00

(3) The construction cost based on unit cost is divided into foreign and local currency portions. Local currency portion is estimated on the basis of the current price in the south of Tunisia and foreign currency is estimated based on the CIF prices at Tunis.

(4) Assuming a difficulty of maintenance works for proposed facilities, durability corresponding to respective facilities are considered in the proper selection of materials and in the structural designing.

(5) Implementation period inclusive of survey, design and construction is estimated at six years taking into account such relevant factors as proper quality control, construction schedule, easier maintenance and minimization of construction cost, etc.

(6) The physical contingency of ten (10) percent of the total costs of detailed design, construction, O&M equipment and administration/engineering is included in the Project cost.

(7) Price contingency is also taken into account at an annual escalation rate of four (4) percent.

H.2.2 Project Cost

Financial Project cost is comprised of the following items:

(1) Construction cost
Construction cost is composed of direct construction cost, cost for temporary and preparatory works, contractor's expenses. The unit cost and construction cost are listed in Table H.2.2.1. and Table H.2.2. respectively.

(2) Administration cost
Detailed design, construction works including pre-construction works, are undertaken by

the governmental staff with assistance and advice of the consultants. Administration cost is estimated based on the required number of governmental staff for pre-construction works, detailed design and construction supervisory works.

(3) Land acquisition cost

The cost for land aquisition of drainage canal.

(4) Engineering service cost

The cost for engineering comprises of detailed design works and construction supervisory works. The consultant(s) will technically assist and advice the governmental staff during the detailed design and construction supervision periods.

(5) Physical contingency

As described in Section H.2.1, the physical contingency is fixed at 10% of the total of the above three items.

(6) Price contingency

As also mentioned in Section H.2.1, the price contingency is fixed at 4%.

The Project cost is estimated at approx. 92,666,000 as summarized in Table H.2.2.3.

H.2.3 Annual O&M Costs

The annual operation and maintenance (O&M) costs are composed of salaries of the project staff, project office expenses, the materials and labor cost for repair and maintenance of the project facilities and O&M equipment. The detailed estimates are shown in Table H.2.3.1.

H.3 Project Implementation Program

H.3.1 Construction Management

The Executive Agency for the Project would be DGGR of the Ministry of Agriculture. The DGGR would be responsible for the planning, design, bidding and supervision of the project works, and keep close coordination with the CRDA of the four gouvernorats on the project approval, finance and project implementation. The Project would be implemented under the present organization of the CRDA and required to be of great importance in the coordination of activities among the departments concerned.