THE ISLAMIC REPUBLIC OF PAKISTAN

FEASIBILITY REPORT

ON

AGRICULTURAL DEVELOPMENT PROJECT

WITH

WIDENING OF PAT FEEDER CANAL

VOLUME III

(APPENDIX-II)

DECEMBER 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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CHAPTER IV. THE PROJECT

IV.2.1 Crop Water Requirement

1) General

For estimation of crop water requirement (ETcrop), many factors are required; climate data, crop calendar, crop character, etc., and following three-stage procedure is recommended:

First stage - to calculate the reference crop evapotranspiration based on climate data

Second stage - to determined the crop coefficient by crop calendar

Third stage - to calculate the crop water requirements based on reference crop evapotranspiration, crop coefficient, agricultural practices.

Crop water requirements are calculated with the stage procedure recommended the below:

2) Reference Crop Evapotranspiration

There are many methods to calculate the reference crop evapotranspiration (ETo), however, the following four methods are considered for the Project; Blaney - Criddle method, Radiation method, Penman method and Pan evaporation method, which are recommended by "Crop Water Requirement" Irrigation and Drainage Paper No.24, FAO.

Observed climate data are very importance for the estimation of the ETo, therefore, selection of the calculation method is based on the availability of observed climate data and the required accuracy of the ETo.

There are no climate data observed in the Project Area, however, the 10-years meteorological records were collected at the following three meteorological stations in the vicinity of the Project Area.

° Jacobabad Meteorological Station

° Usta Mohammad Meteorological Station

° Sibi Meteorological Station

But, since Sibi station is located at about 150 km north from the Project Area, the observation data of Sibi station cannot be applied for the ETo calculation of the Project. Therefore, the observation data of Jacobabad station and Usta Mohammad station will be considered for the ETo calculation of the Project and the observed data of both stations are tabulated as follows:

Data Observed by Jacobabad and Usta Mohammad Station

Station	Precipitation	Temperature	Humidity	Wind	Sunshine	Radiation	Evaporation
Jacobabad	o	o	o	x	o	x	x
Usta Mohammad	o	o	o	o	x	o	o

Note: o ---- available
x ---- not available

On the other hands, required meteorological data by the four recommended methods are as follows:

Observed Data Required by the Methods

Method	Temperature	Humidity	Wind	Sunshine	Radiation	Evaporation	Environ.
Blaney - Criddle	*	0	0	0			0
Radiation	*	0	0	*	(*)		0
Penman	*	*	*	*	(*)		0
Pan evaporation		0	0			*	*

Note: *; measured data, 0; estimated data, (*); if available, but not essential

According to the tables mentioned above, the applicable methods are Blaney - Criddle method, Radiation method and Pan evaporation method by the observed data of Usta Mohammad station. Sunshine data in Radiation method is required when solar radiation is estimated from extra terrestrial radiation which is obtained by the latitude. However, solar radi-

ation was observed at Usta Mohammad station by the unit of langley[1/], so that sunshine data is not necessary.

Note: 1/ The unit of langley (calories per square centimeter) are converted to millimeter of water per day by following formula:

$$Rs[mm/day] = Rs[langley] \times 10 \div (595.9 - 0.55T)$$

in which T = mean air temperature [°C]

Monthly reference crop evapotranspirations calculated by the above-mentioned three methods are tabulated below. (Calculation procedures of each methods are shown in Table IV.2-1 to Table IV.2-3 in this Appendix).

Monthly Reference Crop Evapotranspiration

Month	B - C Method		Radiation Method		Pan Method	
	inch/month	mm/month	inch/month	mm/month	inch/month	mm/month
January	1.95	49.6	2.57	65.2	2.28	57.9
February	2.86	72.8	3.19	81.2	2.83	71.9
March	5.36	136.4	5.61	142.6	5.66	143.8
April	6.96	177.0	6.85	174.0	7.90	200.7
May	8.90	226.3	7.82	198.4	12.31	312.7
June	9.45	240.0	7.68	195.0	10.95	278.1
July	8.90	226.3	7.19	182.9	9.35	237.5
August	6.60	167.4	6.11	155.0	8.03	204.0
September	5.67	144.0	6.15	156.0	6.66	169.2
October	4.53	114.7	5.49	139.5	5.71	145.0
November	3.06	78.0	3.66	93.0	3.37	85.6
December	2.08	52.7	2.92	74.4	2.07	52.6
Total	66.32	1,685.2	65.24	1,657.2	77.12	1,959.0

On the other hands, it is said that modified Penman method would offer the best results with minimum possible error of plus or minus 10 percent in summer, and up to 20 percent under low evaporative conditions. the Pan method can be graded next with possible error of 15 percent, depending on the location of the pan. The Radiation method, in extreme conditions,

involves a possible error of up to 20 percent in summer. The Blaney - Criddle method should only be applied for periods of one month or longer; in humid, windy, mid-latitude winter conditions an over and under prediction of up to 25 percent has been noted.

The results by Pan evaporation method are applied for the reference crop evapotranspiration, because possible error by Pan evaporation method is the lowest among three methods considered and peak monthly ETo and total (annual ETo) are the highest among three.

3) Crop Coefficient

The crop coefficients (Kc) are presented to relate ETo to crop evapotranspiration (ETcrop). The Kc value relates to evapotranspiration of a disease-free crop grown in large fields under optimum soil water and fertility condition and achieving full production potential under given growing environment. ETcrop can be found by:

$$ETcrop = Kc \times ETo$$

The factors affecting the Kc value are mainly the crop characteristics, crop planting or sowing data, rate of crop development, length of growing season and climatic conditions, specially, crop calendar and length of growing season. These important data such as crop calendar and length of growing season are given in Fig.IV.3-1 cropping calendar in Appendix IV.3-2 . According to the given cropping calendar and rate of crop development, the Kc value of 10-days period for each proposed crop are obtained and shown in Table IV.2-4 to Table IV.2-14 in this Appendix.

4) Crop Water Requirement

Taking into the consideration above condition, the crop water requirement for each crop based on the 10-day period was calculated as shown in Table IV.2-4 to Table IV.2-14 in this Appendix.

Annual water requirements were calculated based on three cropping patterns, that is, Case 1, Case 2 and Case 3, and the results are shown

in the Table IV.2-15 to Table IV.2-18 in this Appendix. The summary are as follows:

Annual Water Requirement

(Unit: MAF)

Description	Case 1	Case 2	Case 3
Water requirement at the Guddu			
Kharif Crop	2.069	1.714	2.069
Rabi Crop	1.292	1.115	0.837
Drinking Water	0.053	0.048	0.053
Total	3.414	2.877	2.959
Water requirement at Outlet			
Kharif Crop	1.422	1.180	1.422
Rabi Crop	0.885	0.813	0.575
Drinking Water	0.036	0.033	0.036
Total	2.343	2.026	2.033

Table IV.2-1 Reference Crop Evapotranspiration by Blaney-Criddle Method at Usta Mohammad

Discription \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Remarks
T.(mean daily tem. °F)	55.5	61.5	73.5	84.5	93.0	97.0	93.5	91.0	88.5	80.0	69.5	59.5	
T.(" °C)	13.1	16.4	23.1	29.2	33.9	36.1	34.2	32.8	31.4	26.7	20.8	15.3	
P(lat 28°11')	0.24	0.25	0.27	0.29	0.31	0.32	0.31	0.30	0.28	0.26	0.24	0.23	
P x (0.46+8)	3.37	3.89	5.03	6.22	7.31	7.87	7.36	6.93	6.28	5.27	4.22	3.46	mm/day
Related Humidity (min.)	54	45	37	31	34	34	47	53	60	58	61	59	%
Sunshine n/N	——— mid. ———												
Wind Velocity m/s	0.35	0.47	0.61	0.76	0.93	1.13	1.10	1.00	0.71	0.52	0.30	0.24	
Daytime 1.33u						1.50							
Blook by Fig.1 of FAO	VI-1	V-1	V-1	V-1	V-1	V-1	V-1	VI-1	VI-1	VI-1	VI-1	VI-1	
ETo mm/day	1.6	2.6	4.4	5.9	7.3	8.0	7.3	5.4	4.8	3.7	2.6	1.7	
inch/day	0.063	0.102	0.173	0.232	0.287	0.315	0.287	0.213	0.189	0.146	0.102	0.067	
days	31	28	31	30	31	30	31	31	30	31	30	31	
inch/month	1.95	2.86	5.36	6.96	8.90	9.45	8.90	6.60	5.67	4.53	3.06	2.08	66.32
mm/month	49.6	72.8	136.4	177.0	226.3	240.0	226.3	167.4	144.0	114.7	78.0	52.7	1,685.2

Table IV.2-2 Reference Crop Evapotranspiration by Radiation Method at Usta Mohammad

Discription \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Remarks
T.(°C)	13.1	16.4	23.1	29.2	33.9	36.1	34.2	32.8	31.4	26.7	20.8	15.3	
Solar Radiation	289	341	416	470	492	490	467	435	451	428	332	292	
$Rs = \frac{Ly \times 10}{(595.9-0.55T)}$	4.9	5.8	7.1	8.1	8.5	8.5	8.1	7.5	7.8	7.4	5.7	5.0	mm/day
W (Table 4)	0.60	0.64	0.72	0.78	0.82	0.83	0.82	0.80	0.99	0.77	0.69	0.63	
W. Rs	2.9	3.7	5.1	6.3	7.0	7.1	6.6	6.0	6.2	5.6	3.9	3.2	mm/day
RH mean	61.0	56.5	48.0	40.5	40.0	44.5	58.0	63.5	68.5	64.0	66.5	66.5	%
Wind Velocity	0.35	0.47	0.61	0.76	0.93	1.13	1.10	1.00	0.71	0.52	0.30	0.24	m/s
Fig.2 of FAO	III-1	III-1	II-1	II-1	II-1	II-1	III-1	III-1	III-1	III-1	III-1	III-1	
ETo mm/day	2.1	2.9	4.6	5.8	6.4	6.5	5.9	5.0	5.2	4.5	3.1	2.4	mm/day
inch/day	0.083	0.114	0.181	0.228	0.252	0.256	0.232	0.197	0.205	0.177	0.122	0.094	
days	31	28	31	30	31	30	31	31	30	31	30	31	
inch/month	2.57	3.19	5.61	6.85	7.82	7.68	7.19	6.11	6.15	5.49	3.66	2.92	65.24
mm/month	65.2	81.2	142.6	174.0	198.4	195.0	182.9	155.0	156.0	139.5	93.0	74.4	1,657.2

Table IV.2-3 Reference Crop Evapotranspiration by Pan Evaporation Method at Usta Mohammad

Discription \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Remarks
Wind Spead (km/d)	35	46	61	76	93	113	109	100	70	52	30	24	
RH mean (%)	61.0	56.5	48.0	40.5	40.0	44.5	58.0	63.5	68.5	64.0	66.5	66.5	
Wind Velocity	Wind Velocity < 175 km/d light												
RH mean	40 < RH mean < 70%												
Kp	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	
E pan (inch)	3.50	4.35	8.70	12.16	18.94	16.84	14.39	12.36	10.25	8.79	5.18	3.19	
ETo inch/month	2.28	2.83	5.66	7.90	12.31	10.95	9.35	8.03	6.66	5.71	3.37	2.07	77.12
days	31	28	31	30	31	30	31	31	30	31	30	31	
inch/day	0.074	0.101	0.183	0.263	0.397	0.365	0.302	0.259	0.222	0.184	0.112	0.067	
mm/month	57.9	71.9	143.8	200.7	312.7	278.1	237.5	204.0	169.2	145.0	85.6	52.6	1,959.0

Table IV. 2 - 4 Calculation of Unit Water Requirement for Sorghum

Month	May		Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.		
Cropping Calendar			21												20								
								31												30			
1.1																							
1.0																							
0.9																							
0.8																							
0.7																							
0.6																							
0.5																							
0.4																							
0.3					0.33																		
Crop Coefficient by Time					0.23	0.28	0.38	0.54	0.85	1.02	1.09	1.10	1.06	0.97	0.85	0.68	0.50						
						0.23	0.28	0.38	0.54	0.85	1.02	1.09	1.10	1.06	0.97	0.85	0.68	0.50					
							0.23	0.28	0.38	0.54	0.85	1.02	1.09	1.10	1.06	0.97	0.85	0.68	0.50				
								0.23	0.28	0.38	0.54	0.85	1.02	1.09	1.10	1.06	0.97	0.85	0.68	0.50			
Kc					0.06	0.13	0.22	0.36	0.51	0.70	0.88	1.02	1.07	1.06	1.00	0.89	0.75	0.50	0.30	0.13			
ETo (inch/day)			0.365			0.302			0.259			0.222			0.184			0.112					
days			10	10	10	10	10	11	10	10	11	10	10	10	10	10	11	10	10	10			
ETcrop (inch)					0.22	0.39	0.66	1.20	1.32	1.83	2.51	2.26	2.38	2.35	1.84	1.64	1.52	0.56	0.34	0.15			
Pre- irrigation				0.50	0.50	0.50	0.50																
Water Requirement				0.50	0.72	0.89	1.16	1.20	1.32	1.83	2.51	2.26	2.38	2.35	1.84	1.64	1.52	0.56	0.34	0.15			

Table IV. 2 - 5 Calculation of Unit Water Requirement for Rice

Month	May			Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.	
Cropping Calendar				1		20			10	30						30			10				
Crop Coefficient by Time				0.05	0.05	1.00	1.00	1.00	1.01	1.04	1.06	1.04	0.98	0.90	0.80	0.60							
					0.05	0.05	1.00	1.00	1.00	1.01	1.04	1.06	1.04	0.98	0.90	0.80	0.60						
						0.05	0.05	1.00	1.00	1.00	1.01	1.04	1.06	1.04	0.98	0.90	0.80	0.60					
							0.05	0.05	1.00	1.00	1.00	1.01	1.04	1.06	1.04	0.98	0.90	0.80	0.60				
Kc				0.01	0.03	0.28	0.52	0.76	1.00	1.01	1.03	1.04	1.03	1.00	0.93	0.82	0.58	0.35	0.15				
ET_o (inch/day)				0.365			0.302			0.259			0.222			0.184			0.112				
days				10	10	10	10	10	11	10	10	11	10	10	10	10	10	11	10				
ETcrop (inch)				0.07	0.11	1.03	1.58	2.30	3.31	2.58	2.63	2.95	2.26	2.24	2.15	1.59	1.14	1.34	0.17				
Percolation						0.10	0.20	0.30	0.44	0.40	0.40	0.44	0.40	0.40	0.40	0.40	0.30	0.22	0.10				
Land Preparation				0.79	2.01	2.50	2.50	1.71	0.49														
Water Requirement				0.86	2.12	3.63	4.28	4.31	4.24	2.98	3.03	3.39	2.66	2.64	2.55	1.99	1.44	1.56	0.27				

Nersery Stage

Nersery area is 1/20 of planning area.

Table IV. 2 - 6 Water Requirement for Land Preparation Stage of Rice

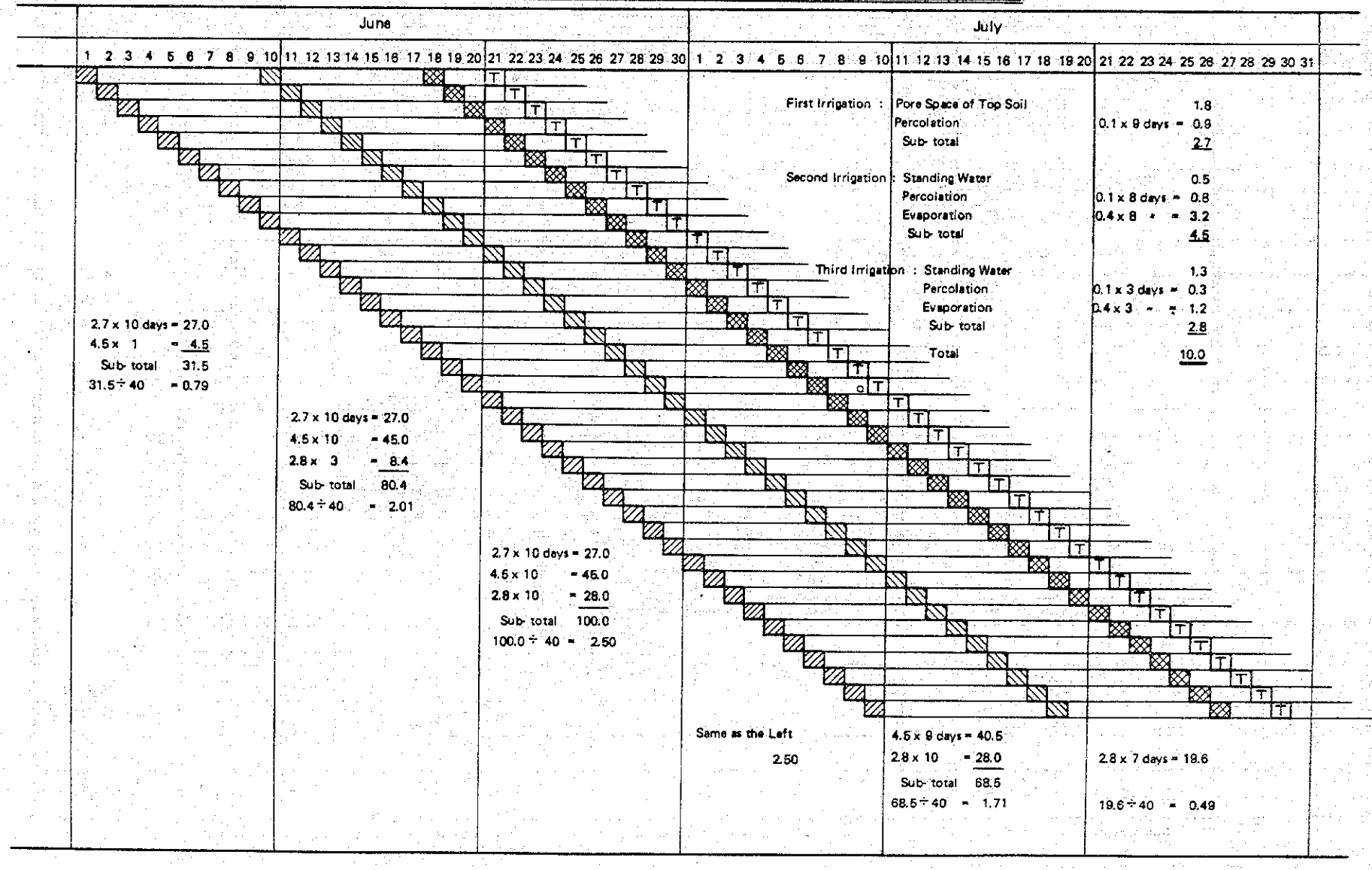


Table IV. 2 - 7 Calculation of Unit Water Requirement for Sunflower

Month	Jun.		Jul.			Aug.			Sept.			Oct.			Nov.			Dec.		
Cropping Calendar						1					16			30					15	
Crop Coefficient by Time						0.33	0.40	0.52	0.86	1.08	1.15	1.13	1.02	0.75	0.50					
							0.33	0.40	0.52	0.86	1.08	1.15	1.13	1.02	0.75	0.50				
								0.33	0.40	0.52	0.86	1.08	1.15	1.13	1.02	0.75	0.50			
									0.33	0.40	0.52	0.86	1.08	1.15	1.13	1.02	0.75	0.50		
										0.16	0.20	0.26	0.43	0.54	0.58	0.57	0.51	0.38	0.25	
Kc						0.07	0.16	0.28	0.47	0.67	0.85	1.00	1.07	1.02	0.88	0.63	0.39	0.20	0.06	
ETo (inch/day)						0.259			0.222			0.184			0.112			0.067		
days						10	10	11	10	10	11	10	10	10	10	10	11	10	5	
ETcrop (inch)						0.18	0.41	0.80	1.04	1.49	2.08	1.84	1.97	1.88	0.99	0.71	0.48	0.13	0.02	
Pre-irrigation					0.44	0.44	0.44	0.44	0.22											
Water Requirement					0.44	0.62	0.85	1.24	1.26	1.49	2.08	1.84	1.97	1.88	0.99	0.71	0.48	0.13	0.02	

Table IV. 2 - 8 Calculation of Unit Water Requirement for Pulses (Kharif)

Month	May		Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.		
Cropping Calendar					21			31						20			31						
Crop Coefficient by Time					0.24	0.33	0.47	0.85	1.07	1.15	1.13	1.01	0.70	0.40									
						0.24	0.33	0.47	0.85	1.07	1.15	1.13	1.01	0.70	0.40								
							0.24	0.33	0.47	0.85	1.07	1.15	1.13	1.01	0.70	0.40							
								0.24	0.33	0.47	0.85	1.07	1.15	1.13	1.01	0.70	0.40						
Kc					0.06	0.14	0.26	0.47	0.68	0.89	1.05	1.09	1.00	0.81	0.53	0.28	0.10						
ETo (inch/day)			0.365			0.302			0.259			0.222			0.184								
days					10	10	10	11	10	10	11	10	10	10	10	10	11						
ETcrop (inch)					0.22	0.42	0.79	1.56	1.76	2.31	2.99	2.41	2.22	1.80	0.98	0.52	0.20						
Pre irrigation				0.60	0.60	0.60	0.60																
Water Requirement				0.60	0.82	1.02	1.39	1.56	1.76	2.31	2.99	2.41	2.22	1.80	0.98	0.52	0.20						

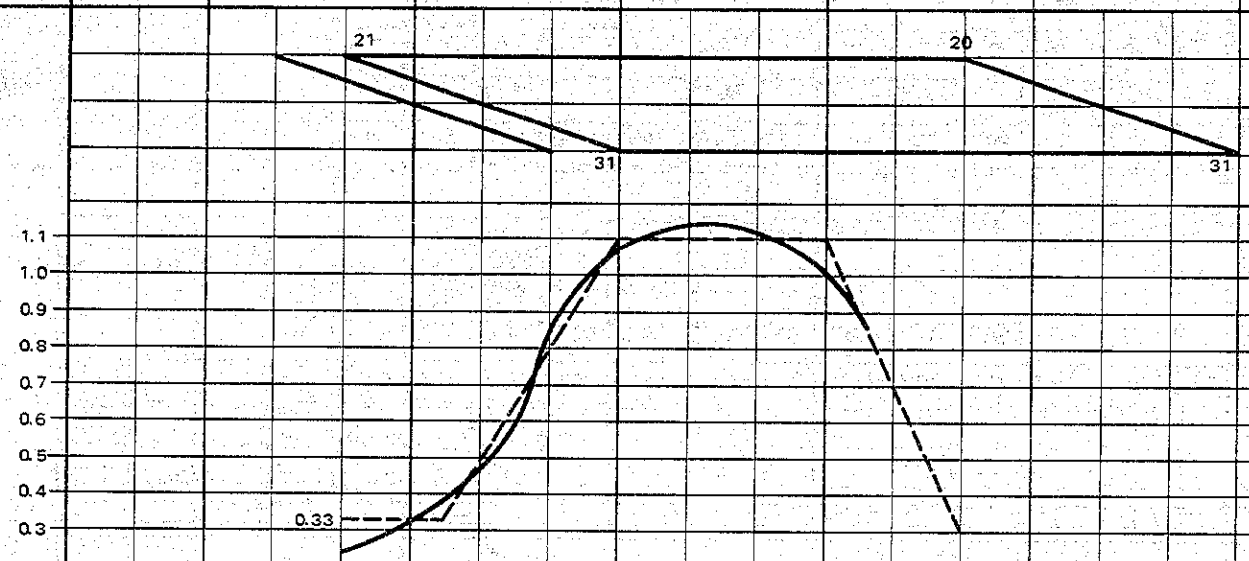
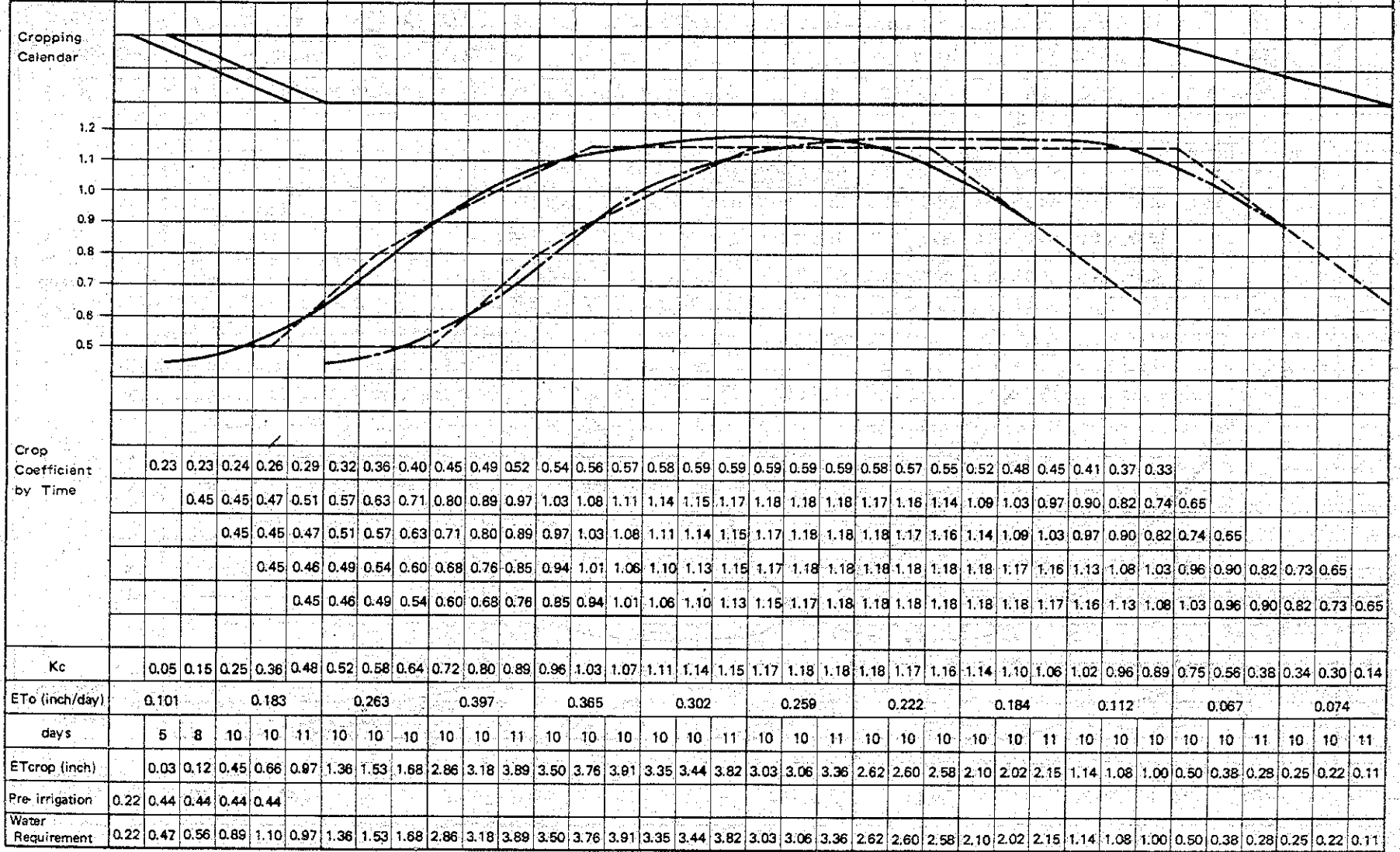


Table IV. 2 - 9 Calculation of Unit Water Requirement for Soybeans

Month	May		Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.		
Cropping Calendar					21			31								20				30			
Crop Coefficient by Time					0.25	0.30	0.39	0.57	0.91	1.03	1.09	1.10	1.08	1.02	0.90	0.70	0.45						
						0.25	0.30	0.39	0.57	0.91	1.03	1.09	1.10	1.08	1.02	0.90	0.70	0.45					
							0.25	0.30	0.39	0.57	0.91	1.03	1.09	1.10	1.08	1.02	0.90	0.70	0.45				
								0.25	0.30	0.39	0.57	0.91	1.03	1.09	1.10	1.08	1.02	0.90	0.70	0.45			
Kc					0.06	0.14	0.24	0.38	0.54	0.73	0.90	1.03	1.08	1.08	1.03	0.93	0.77	0.51	0.29	0.11			
ETo (inch/day)			0.365			0.302			0.259			0.222			0.184			0.112					
days					10	10	10	11	10	10	11	10	10	10	10	10	11	10	10	10			
ETcrop (inch)					0.22	0.42	0.72	1.26	1.40	1.89	2.56	2.29	2.40	2.40	1.90	1.71	1.56	0.57	0.32	0.12			
Pre- irrigation				0.50	0.50	0.50	0.50																
Water Requirement				0.50	0.72	0.92	1.22	1.26	1.40	1.89	2.56	2.29	2.40	2.40	1.90	1.71	1.56	0.57	0.32	0.12			

Table IV. 2 - 10 Calculation of Unit Water Requirement for Sugarcane



Month	Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.			Jan.		
Crop Coefficient by Time		0.23	0.23	0.24	0.26	0.29	0.32	0.36	0.40	0.45	0.49	0.52	0.54	0.56	0.57	0.58	0.59	0.59	0.59	0.59	0.59	0.58	0.57	0.55	0.52	0.48	0.45	0.41	0.37	0.33						
			0.45	0.45	0.47	0.51	0.57	0.63	0.71	0.80	0.89	0.97	1.03	1.08	1.11	1.14	1.15	1.17	1.18	1.18	1.18	1.17	1.16	1.14	1.09	1.03	0.97	0.90	0.82	0.74	0.65					
				0.45	0.45	0.47	0.51	0.57	0.63	0.71	0.80	0.89	0.97	1.03	1.08	1.11	1.14	1.15	1.17	1.18	1.18	1.18	1.17	1.16	1.14	1.09	1.03	0.97	0.90	0.82	0.74	0.65				
					0.45	0.46	0.49	0.54	0.60	0.68	0.76	0.85	0.94	1.01	1.06	1.10	1.13	1.15	1.17	1.18	1.18	1.18	1.18	1.18	1.18	1.17	1.16	1.13	1.08	1.03	0.96	0.90	0.82	0.73	0.65	
						0.45	0.46	0.49	0.54	0.60	0.68	0.76	0.85	0.94	1.01	1.06	1.10	1.13	1.15	1.17	1.18	1.18	1.18	1.18	1.18	1.18	1.17	1.16	1.13	1.08	1.03	0.96	0.90	0.82	0.73	0.65
Kc		0.05	0.15	0.25	0.36	0.48	0.52	0.58	0.64	0.72	0.80	0.89	0.96	1.03	1.07	1.11	1.14	1.15	1.17	1.18	1.18	1.18	1.17	1.16	1.14	1.10	1.06	1.02	0.96	0.89	0.75	0.56	0.38	0.34	0.30	0.14
ETo (inch/day)		0.101			0.183			0.263			0.397			0.365			0.302			0.259			0.222			0.184			0.112			0.067			0.074	
days		5	8	10	10	11	10	10	10	10	10	11	10	10	10	10	10	11	10	10	11	10	10	10	10	10	11	10	10	10	10	10	11	10	10	11
ETcrop (inch)		0.03	0.12	0.45	0.66	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.60	2.58	2.10	2.02	2.15	1.14	1.08	1.00	0.50	0.38	0.28	0.25	0.22	0.11
Pre-irrigation	0.22	0.44	0.44	0.44	0.44																															
Water Requirement	0.22	0.47	0.56	0.89	1.10	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.60	2.58	2.10	2.02	2.15	1.14	1.08	1.00	0.50	0.38	0.28	0.25	0.22	0.11

Table IV. 2 - 11 Calculation of Unit Water Requirement for Wheat

Month	Sept.	Oct.			Nov.			Dec.			Jan.			Feb.			Mar.			Apr.			May
Cropping Calendar																							
1.1																							
1.0																							
0.9																							
0.8																							
0.7																							
0.6																							
0.5																							
0.4																							
0.3			0.25	0.26	0.28	0.34	0.46	0.54	0.57	0.58	0.58	0.57	0.54	0.47	0.38	0.27	0.13						
0.2				0.50	0.56	0.68	0.92	1.08	1.14	1.16	1.16	1.14	1.08	0.94	0.72	0.54	0.25						
Crop Coefficient by Time					0.50	0.56	0.68	0.92	1.08	1.14	1.16	1.16	1.14	1.08	0.94	0.72	0.54	0.25					
						0.50	0.56	0.68	0.92	1.08	1.14	1.16	1.16	1.14	1.08	0.94	0.72	0.54	0.25				
							0.50	0.62	0.86	1.06	1.14	1.16	1.16	1.10	1.00	0.86	0.66	0.40	0.25				
								0.50	0.62	0.86	1.06	1.14	1.16	1.16	1.10	1.00	0.86	0.66	0.40	0.25			
									0.25	0.31	0.43	0.53	0.57	0.58	0.58	0.55	0.50	0.43	0.33	0.20	0.13		
Kc			0.04	0.13	0.22	0.35	0.52	0.72	0.91	1.04	1.11	1.14	1.14	1.08	0.97	0.81	0.61	0.38	0.21	0.08	0.02		
ETo (inch/day)		0.184			0.112			0.067			0.074			0.101			0.183			0.263			
days			5	11	10	10	10	10	10	11	10	10	11	10	10	8	10	10	11	10	5		
ETcrop (inch)			0.04	0.26	0.25	0.39	0.58	0.48	0.61	0.77	0.82	0.84	0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03		
Pre- irrigation		0.17	0.33	0.33	0.33	0.33	0.33	0.17															
Water Requirement		0.17	0.37	0.59	0.58	0.72	0.91	0.65	0.61	0.77	0.82	0.84	0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03		

Table IV. 2 - 12 Calculation of Unit Water Requirement for Rapes & Mustard

Month	Sept.			Oct.			Nov.			Dec.			Jan.			Feb.			Mar.		
Cropping Calendar				11					30						31						20
Crop Coefficient by Time					0.38	0.40	0.48	0.62	0.89	1.02	1.08	1.09	1.04	0.93	0.73	0.50					
						0.38	0.40	0.48	0.62	0.89	1.02	1.08	1.09	1.04	0.93	0.73	0.50				
							0.38	0.40	0.48	0.62	0.89	1.02	1.08	1.09	1.04	0.93	0.73	0.50			
								0.38	0.40	0.48	0.62	0.89	1.02	1.08	1.09	1.04	0.93	0.73	0.50		
									0.38	0.40	0.48	0.62	0.89	1.02	1.08	1.09	1.04	0.93	0.73	0.50	
Kc					0.08	0.16	0.25	0.38	0.55	0.68	0.96	0.94	1.02	1.03	0.97	0.86	0.64	0.43	0.25	0.10	
ETo (inch/day)					0.184			0.112			0.067			0.074			0.101			0.183	
days					10	11	10	10	10	10	10	11	10	10	11	10	10	8	10	10	
ETcrop (inch)					0.15	0.32	0.28	0.43	0.62	0.46	0.64	0.69	0.75	0.76	0.79	0.86	0.65	0.35	0.46	0.18	
Pre- irrigation				0.20	0.20	0.20	0.20	0.20													
Water Requirement				0.20	0.35	0.52	0.48	0.63	0.62	0.46	0.64	0.69	0.75	0.76	0.79	0.86	0.65	0.35	0.46	0.18	

Table IV. 2 - 13 Calculation of Unit Water Requirement for Pulses (Rabi)

Month	Sept.		Oct.			Nov.			Dec.			Jan.			Feb.			Mar.			Apr.		
Cropping Calendar			1						1								28						30
Crop Coefficient by Time			0.40	0.45	0.52	0.65	0.91	1.07	1.14	1.17	1.17	1.15	1.10	1.01	0.88	0.70	0.50	0.30					
				0.40	0.45	0.52	0.65	0.91	1.07	1.14	1.17	1.17	1.15	1.10	1.01	0.88	0.70	0.50	0.30				
					0.40	0.45	0.52	0.65	0.91	1.07	1.14	1.17	1.17	1.15	1.10	1.01	0.88	0.70	0.50	0.30			
						0.40	0.45	0.52	0.65	0.91	1.07	1.14	1.17	1.17	1.15	1.10	1.01	0.88	0.70	0.50	0.30		
							1.40	0.45	0.52	0.65	0.91	1.07	1.14	1.17	1.17	1.15	1.10	1.01	0.88	0.70	0.50	0.30	
								0.40	0.45	0.52	0.65	0.91	1.07	1.14	1.17	1.17	1.15	1.10	1.01	0.88	0.70	0.50	0.30
Kc			0.07	0.14	0.23	0.34	0.49	0.67	0.79	0.91	1.02	1.10	1.13	1.12	1.08	1.00	0.89	0.75	0.57	0.40	0.25	0.13	0.05
ETo (inch/day)	0.222		0.184			0.112			0.067			0.074			0.101			0.183			0.263		
days		10	10	10	11	10	10	10	10	10	11	10	10	11	10	10	8	10	10	11	10	10	10
ETcrop (inch)			0.13	0.26	0.47	0.38	0.55	0.75	0.53	0.61	0.75	0.81	0.84	0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13
Pre-irrigation		0.33	0.33	0.33	0.33	0.33	0.33																
Water Requirement		0.33	0.46	0.59	0.80	0.71	0.88	0.75	0.53	0.61	0.75	0.81	0.84	0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13

Table IV. 2 - 14 Calculation of Unit Water Requirement for Fodder

Month	Sept.		Oct.			Nov.			Dec.			Jan.			Feb.			Mar.			Apr.		
Cropping Calendar																							
1.2																							
1.1																							
1.0																							
0.9																							
0.8																							
0.7																							
0.6																							
0.5																							
0.4																							
Crop Coefficient by Time				0.60	0.63	0.68	0.75	0.86	0.96	1.03	1.05	0.50	0.93	1.05	0.60	0.93	1.00						
					0.60	0.63	0.68	0.75	0.86	0.96	1.03	1.05	0.50	0.93	1.05	0.60	0.93	1.00					
						0.60	0.63	0.68	0.75	0.86	0.96	1.03	1.05	0.50	0.93	1.05	0.60	0.93	1.00				
							0.60	0.63	0.68	0.75	0.86	0.96	1.03	1.05	0.50	0.93	1.05	0.60	0.93	1.00			
Kc				0.15	0.31	0.48	0.67	0.73	0.81	0.89	0.98	0.89	0.88	0.89	0.77	0.88	0.90	0.63	0.48	0.25			
ETo (inch/day)				0.184			0.112			0.067			0.074			0.101			0.183				
days				10	11	10	10	10	10	10	11	10	10	11	10	10	8	10	10	11			
ETcrop (inch)				0.28	0.63	0.54	0.75	0.82	0.54	0.60	0.72	0.66	0.65	0.72	0.78	0.89	0.73	1.15	0.88	0.50			
Pre- irrigation			0.50	0.50	0.50	0.50																	
Water Requirement			0.50	0.78	1.13	1.04	0.75	0.82	0.54	0.60	0.72	0.66	0.65	0.72	0.78	0.89	0.73	1.15	0.88	0.50			

Table IV. 4 - 15 Water Requirement (Case 1 . Q = 8,200 cusecs)

Description	Unit	Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.	
Unit Crop Water Requirement																											
· Sorghum	inch																	0.50	0.72	0.89	1.16	1.20	1.32	1.83	2.51	2.26	2.38
· Rice	"																0.86	2.12	3.63	4.28	4.31	4.24	2.98	3.03	3.39	2.66	2.64
· Oilseed (Sunflower)	"																					0.44	0.62	0.85	1.24	1.26	1.49
· Pulses (Mungbeans)	"																	0.60	0.82	1.02	1.39	1.56	1.76	2.31	2.99	2.41	2.22
· Pulses (Soybeans)	"																	0.50	0.72	0.92	1.22	1.26	1.40	1.89	2.56	2.29	2.40
· Sugarcane & Others	"	0.25	0.22	0.11	0.22	0.47	0.56	0.89	1.10	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.60
· Wheat	"	0.82	0.84	0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03	—	—													
· Oilseed (Rapes Mustard)	"	0.75	0.76	0.79	0.86	0.65	0.35	0.46	0.18	—	—	—	—	—													
· Pulses (Gram)	"	0.81	0.84	0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13	—													
· Fodder (Berseem) & Others	"	0.66	0.65	0.72	0.78	0.89	0.73	1.15	0.88	0.50	—	—	—	—													
Water Requirement																											
· Sorghum 9 %	inch	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.05	0.06	0.08	0.10	0.11	0.12	0.16	0.23	0.20	0.22
· Rice 20 %	"	—														—	0.17	0.42	0.73	0.86	0.86	0.85	0.60	0.61	0.68	0.53	0.53
· Oilseed (Sunflower) 14 %	"	—														—	—	—	—	—	—	0.06	0.09	0.12	0.17	0.18	0.21
· Pulses (Mungbeans) 3 %	"	—														—	—	0.02	0.02	0.03	0.04	0.05	0.05	0.07	0.09	0.07	0.07
· Pulses (Soybeans) 9 %	"	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.05	0.06	0.08	0.11	0.11	0.13	0.17	0.23	0.21	0.22
· Sugarcane & Others 5 %	"	0.01	0.01	0.01	0.01	0.02	0.03		0.06	0.05	0.07	0.08	0.08	0.14	0.16	0.19	0.18	0.19	0.20	0.17	0.17	0.19	0.15	0.15	0.17	0.13	0.13
· Wheat 54 %	"	0.44	0.45	0.50	0.59	0.53	0.35	0.35	0.38	0.23	0.11	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
· Oilseed (Rapes Mustard) 20 %	"	0.15	0.15	0.16	0.17	0.13	0.07	0.07	0.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
· Pulses (Gram) 13 %	"	0.11	0.11	0.12	0.14	0.13	0.09	0.09	0.14	0.11	0.09	0.04	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—	
· Fodder (Berseem) & Others 8 %	"	0.05	0.05	0.06	0.06	0.07	0.06	0.06	0.07	0.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Total	"	0.76	0.77	0.85	0.97	0.88	0.60		0.69	0.43	0.27	0.14	0.10	0.14	0.16	0.19	0.35	0.73	1.07	1.22	1.28	1.37	1.14	1.28	1.57	1.32	1.38
Water Requirement (Net)	cusecs	3.19	3.23	3.25	4.07	3.70	3.15	2.52	2.90	1.64	1.13	0.59	0.42	0.59	0.67	0.73	1.47	3.07	4.50	5.13	5.42	5.23	4.83	5.42	6.03	5.59	5.80
— do — Including Field Losses	"	3.99	4.04	4.06	5.09	4.62	3.94	3.15	3.62	2.05	1.42	0.74	0.53	0.74	0.84	0.91	1.84	3.83	5.62	6.41	6.77	6.54	6.04	6.77	7.54	6.98	7.25
Drinking Water Requirement	"	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Water Requirement Including F.L and D.W	"	4.06	4.11	4.13	5.16	4.69	4.01	3.22	3.69	2.12	1.49	0.81	0.60	0.81	0.91	0.98	1.91	3.90	5.69	6.48	6.84	6.61	6.11	6.84	7.61	7.05	7.32
— do — Including Water Course	"	4.78	4.84	4.86	6.07	5.52	4.72	3.79	4.35	2.50	1.75	0.95	0.70	0.95	1.07	1.15	2.24	4.59	6.69	7.62	8.05	7.78	7.19	8.05	8.96	8.30	8.61
— do — Including Minor	"	5.31	5.38	5.40	6.75	6.13	5.24	4.21	4.83	2.77	1.94	1.05	0.78	1.05	1.19	1.28	2.49	5.10	7.44	8.47	8.95	8.64	7.99	8.95	9.95	9.22	9.56
— do — Including Conveyance Losses	"	6.94	7.03	7.05	8.82	8.02	6.85	5.50	6.31	3.63	2.54	1.38	1.02	1.38	1.56	1.67	3.26	6.67	9.72	11.07	11.69	11.29	10.44	11.69	13.01	12.05	12.40
Total Water Requirement	"	4,247	4,301	4,316	5,400	4,906	4,192	3,368	3,862	2,220	1,556	842	622	842	952	1,022	1,995	4,082	5,949	6,773	7,157	6,912	6,388	7,157	7,961	7,377	7,664
— do —	M.A.F	0.084	0.085	0.094	0.107	0.097	0.067	0.067	0.077	0.048	0.031	0.017	0.012	0.017	0.019	0.022	0.040	0.081	0.118	0.134	0.142	0.151	0.127	0.142	0.174	0.146	0.153

er Requirement (Case 1 . Q = 8,200 cusecs)

Jan.		Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.			Total
															0.50	0.72	0.89	1.16	1.20	1.32	1.83	2.51	2.26	2.38	2.35	1.84	1.64	1.52	0.56	0.34	0.15				23.17
														0.86	2.12	3.63	4.28	4.31	4.24	2.98	3.03	3.39	2.66	2.64	2.55	1.99	1.44	1.56	0.27						41.95
																			0.44	0.62	0.85	1.24	1.26	1.49	2.08	1.84	1.97	1.88	0.99	0.71	0.48	0.13	0.02		16.00
															0.60	0.82	1.02	1.39	1.56	1.76	2.31	2.99	2.41	2.22	1.80	0.98	0.52	0.20							20.58
															0.50	0.72	0.92	1.22	1.26	1.40	1.89	2.56	2.29	2.40	2.40	1.90	1.71	1.56	0.57	0.32	0.12				23.74
0.22	0.11	0.22	0.47	0.56	0.89	1.10	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.60	2.58	2.10	2.02	2.15	1.14	1.08	1.00	0.50	0.38	0.28	68.97
0.84	0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03	–	–														–	0.17	0.37	0.59	0.58	0.72	0.91	0.65	0.61	0.77	13.16
0.76	0.79	0.86	0.65	0.35	0.46	0.18	–	–	–	–	–														–	0.20	0.35	0.52	0.48	0.63	0.62	0.46	0.64	0.69	9.39
0.84	0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13	–														0.33	0.46	0.59	0.80	0.71	0.88	0.75	0.53	0.61	0.75	16.11
0.65	0.72	0.78	0.89	0.73	1.15	0.88	0.50	–	–	–	–														–	0.50	0.78	1.13	1.04	0.75	0.82	0.54	0.60	0.72	13.84
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.05	0.06	0.08	0.10	0.11	0.12	0.16	0.23	0.20	0.22	0.22	0.17	0.15	0.14	0.05	0.03	0.01	–	–	–	2.10
													–	0.17	0.42	0.73	0.86	0.86	0.85	0.60	0.61	0.68	0.53	0.53	0.51	0.40	0.29	0.31	0.05	–	–	–	–	–	8.40
													–	–	–	–	–	–	0.06	0.09	0.12	0.17	0.18	0.21	0.30	0.26	0.28	0.26	0.14	0.10	0.07	0.02	0.00	–	2.26
													–	–	0.02	0.02	0.03	0.04	0.05	0.05	0.07	0.09	0.07	0.07	0.06	0.03	0.02	0.01	–	–	–	–	–	–	0.63
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.05	0.06	0.08	0.11	0.11	0.13	0.17	0.23	0.21	0.22	0.22	0.17	0.15	0.14	0.05	0.03	0.01	–	–	–	2.14
0.01	0.01	0.01	0.02	0.03		0.06	0.05	0.07	0.08	0.08	0.14	0.16	0.19	0.18	0.19	0.20	0.17	0.17	0.19	0.15	0.15	0.17	0.13	0.13	0.13	0.11	0.10	0.11	0.06	0.05	0.05	0.03	0.02	0.01	3.46
0.45	0.50	0.59	0.53	0.35	0.35	0.38	0.23	0.11	0.02	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.09	0.20	0.32	0.31	0.39	0.49	0.35	0.33	0.42	6.85
0.15	0.16	0.17	0.13	0.07	0.07	0.04	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.04	0.07	0.10	0.10	0.13	0.12	0.09	0.13	0.14	1.86
0.11	0.12	0.14	0.13	0.09	0.09	0.14	0.11	0.09	0.04	0.02	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.04	0.06	0.08	0.10	0.09	0.11	0.10	0.07	0.08	0.10	2.02
0.05	0.06	0.06	0.07	0.06	0.06	0.07	0.04	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.04	0.06	0.09	0.08	0.06	0.07	0.04	0.05	0.06	1.07
0.77	0.85	0.97	0.88	0.60		0.69	0.43	0.27	0.14	0.10	0.14	0.16	0.19	0.35	0.73	1.07	1.22	1.28	1.37	1.14	1.28	1.57	1.32	1.38	1.48	1.37	1.40	1.58	0.93	0.90	0.92	0.60	0.61	0.73	30.83
3.23	3.25	4.07	3.70	3.15	2.52	2.90	1.64	1.13	0.59	0.42	0.59	0.67	0.73	1.47	3.07	4.50	5.13	5.42	5.23	4.83	5.42	6.03	5.59	5.80	6.22	5.76	5.88	6.03	3.91	3.79	3.86	2.51	2.55	2.79	
4.04	4.06	5.09	4.62	3.94	3.15	3.62	2.05	1.42	0.74	0.53	0.74	0.84	0.91	1.84	3.83	5.62	6.41	6.77	6.54	6.04	6.77	7.54	6.98	7.25	7.78	7.19	7.35	7.54	4.88	4.74	4.83	3.14	3.18	3.48	
0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	
4.11	4.13	5.16	4.69	4.01	3.22	3.69	2.12	1.49	0.81	0.60	0.81	0.91	0.98	1.91	3.90	5.69	6.48	6.84	6.61	6.11	6.84	7.61	7.05	7.32	7.85	7.26	7.42	7.61	4.95	4.81	4.90	3.21	3.25	3.55	
4.84	4.86	6.07	5.52	4.72	3.79	4.35	2.50	1.75	0.95	0.70	0.95	1.07	1.15	2.24	4.59	6.69	7.62	8.05	7.78	7.19	8.05	8.96	8.30	8.61	9.23	8.55	8.73	8.96	5.83	5.65	5.77	3.78	3.83	4.18	
5.38	5.40	6.75	6.13	5.24	4.21	4.83	2.77	1.94	1.05	0.78	1.05	1.19	1.28	2.49	5.10	7.44	8.47	8.95	8.64	7.99	8.95	9.95	9.22	9.56	10.26	9.50	9.70	9.95	6.48	6.28	6.41	4.20	4.25	4.65	
7.03	7.05	8.82	8.02	6.85	5.50	6.31	3.63	2.54	1.38	1.02	1.38	1.56	1.67	3.26	6.67	9.72	11.07	11.69	11.29	10.44	11.69	13.01	12.05	12.50	13.40	12.41	12.68	13.01	8.46	8.21	8.37	5.49	5.56	6.07	
4,301	4,316	5,400	4,906	4,192	3,368	3,862	2,220	1,556	842	622	842	952	1,022	1,995	4,082	5,949	6,773	7,157	6,912	6,388	7,157	7,961	7,377	7,651	8,200	7,596	7,761	7,961	5,180	5,027	5,125	3,359	3,403	3,717	
0.085	0.094	0.107	0.097	0.067	0.067	0.077	0.048	0.031	0.017	0.012	0.017	0.019	0.022	0.040	0.081	0.118	0.134	0.142	0.151	0.127	0.142	0.174	0.146	0.152	0.163	0.151	0.154	0.174	0.103	0.100	0.102	0.067	0.068	0.081	3.414

Table IV. 4 - 16 Water Requirement (Case 2, Q = 6,700 cusecs)

Description	Unit	Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sep.	
Unit Crop Water Requirement																											
· Sorghum	inch																	0.50	0.72	0.89	1.16	1.20	1.32	1.83	2.51	2.26	2.3
· Rice	"																0.86	2.12	3.63	4.28	4.31	4.24	2.98	3.03	3.39	2.66	2.6
· Oilseed (Sunflower)	"																					0.44	0.62	0.85	1.24	1.26	1.4
· Pulses (Mungbeans)	"																	0.60	0.82	1.02	1.39	1.56	1.76	2.31	2.99	2.41	2.2
· Pulses (Soybeans)	"																	0.50	0.72	0.92	1.22	1.26	1.40	1.89	2.56	2.29	2.4
· Sugarcane & Others	"	0.25	0.22	0.11	0.22	0.47	0.56	0.89	1.10	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.6
· Wheat	"	0.82	0.84	0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03															
· Oilseed (Rapes Mustard)	"	0.75	0.76	0.79	0.86	0.65	0.35	0.46	0.18																		
· Pulses (Gram)	"	0.81	0.84	0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13														
· Fodder (Berseem) & Others	"	0.66	0.65	0.72	0.78	0.89	0.73	1.15	0.88	0.50																	
Water Requirement																											
· Sorghum 7 %	inch																	0.04	0.05	0.06	0.08	0.08	0.09	0.13	0.18	0.16	0.1
· Rice 17 %	"																0.15	0.36	0.62	0.73	0.73	0.72	0.51	0.52	0.58	0.45	0.4
· Oilseed (Sunflower) 12 %	"																					0.05	0.07	0.10	0.15	0.15	0.1
· Pulses (Mungbeans) 3 %	"																	0.02	0.02	0.03	0.04	0.05	0.05	0.07	0.09	0.07	0.0
· Pulses (Soybeans) 7 %	"																	0.04	0.05	0.06	0.09	0.09	0.10	0.13	0.18	0.16	0.1
· Sugarcane & Others 4 %	"	0.01	0.01	0.00	0.01	0.02	0.02	0.04	0.04	0.04	0.05	0.06	0.07	0.11	0.13	0.16	0.14	0.15	0.16	0.13	0.14	0.15	0.12	0.12	0.13	0.10	0.1
· Wheat 45 %	"	0.37	0.38	0.42	0.49	0.44	0.29	0.50	0.32	0.19	0.09	0.01															
· Oilseed (Rapes Mustard) 17 %	"	0.13	0.13	0.13	0.15	0.11	0.06	0.08	0.03																		
· Pulses (Gram) 11 %	"	0.09	0.09	0.10	0.12	0.11	0.08	0.15	0.11	0.09	0.07	0.04	0.01														
· Fodder (Berseem) & Others 7 %	"	0.05	0.05	0.05	0.05	0.06	0.05	0.08	0.06	0.04																	
Total	"	0.65	0.66	0.70	0.82	0.74	0.50	0.85	0.56	0.36	0.21	0.11	0.08	0.11	0.13	0.16	0.29	0.61	0.90	1.01	1.08	1.14	0.94	1.07	1.31	1.09	1.1
Water Requirement (Net)	cusecs	2.73	2.77	2.67	3.44	3.11	2.63	3.57	2.35	1.37	0.88	0.46	0.34	0.46	0.55	0.61	1.22	2.56	3.78	4.24	4.54	4.35	3.95	4.50	5.00	4.58	4.7
— do — Including Field Losses	"	3.41	3.47	3.34	4.31	3.89	3.28	4.46	2.94	1.71	1.10	0.58	0.42	0.58	0.68	0.76	1.52	3.20	4.73	5.30	5.67	5.44	4.94	5.62	6.25	5.72	5.9
Drinking Water Requirement	"	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.0
Water Requirement Including F.L and D.W	"	3.47	3.53	3.40	4.37	3.95	3.34	4.52	3.00	1.78	1.16	0.64	0.48	0.64	0.74	0.82	1.58	3.26	4.79	5.36	5.73	5.50	5.00	5.68	6.31	5.78	6.0
— do — Including Water Course	"	4.09	4.15	4.00	5.14	4.64	3.93	5.31	3.53	2.09	1.37	0.75	0.56	0.75	0.87	0.97	1.86	3.84	5.63	6.31	6.74	6.47	5.88	6.68	7.43	6.80	7.1
— do — Including Minor	"	4.54	4.61	4.45	5.71	5.16	4.37	5.91	3.92	2.32	1.52	0.83	0.63	0.83	0.97	1.08	2.07	4.27	6.26	7.01	7.49	7.19	6.53	7.42	8.25	7.56	7.9
— do — Including Conveyance Losses	"	5.94	6.02	5.81	7.46	6.74	5.71	7.73	5.13	3.04	1.99	1.09	0.82	1.09	1.27	1.41	2.70	5.58	8.18	9.17	9.79	9.40	8.54	9.70	10.79	9.88	10.3
Total Water Requirement	"	3,632	3,687	3,557	4,566	4,126	3,495	4,731	3,138	1,860	1,216	667	502	667	777	861	1,655	3,413	5,005	5,609	5,993	5,754	5,225	5,939	6,602	6,048	6,32
— do —	M.A.F	0.072	0.073	0.078	0.091	0.082	0.055	0.094	0.062	0.041	0.024	0.013	0.010	0.013	0.015	0.019	0.033	0.068	0.099	0.111	0.119	0.126	0.104	0.118	0.144	0.120	0.12

Water Requirement (Case 2, Q = 6,700 cusecs)

Jan.		Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.			Total
														0.50	0.72	0.89	1.16	1.20	1.32	1.83	2.51	2.26	2.38	2.35	1.84	1.64	1.52	0.56	0.34	0.15				23.17
													0.86	2.12	3.63	4.28	4.31	4.24	2.98	3.03	3.39	2.66	2.64	2.55	1.99	1.44	1.56	0.27						41.95
																		0.44	0.62	0.85	1.24	1.26	1.49	2.08	1.84	1.97	1.88	0.99	0.71	0.48	0.13	0.02		16.00
														0.60	0.82	1.02	1.39	1.56	1.76	2.31	2.99	2.41	2.22	1.80	0.98	0.52	0.20							20.58
														0.50	0.72	0.92	1.22	1.26	1.40	1.89	2.56	2.29	2.40	2.40	1.90	1.71	1.56	0.57	0.32	0.12				23.74
0.22	0.11	0.22	0.47	0.56	0.89	1.10	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.60	2.58	2.10	2.02	2.15	1.14	1.08	1.00	0.50	0.38	0.28	68.97
0.84	0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03																0.17	0.37	0.59	0.58	0.72	0.91	0.65	0.61	0.77	13.16
0.76	0.79	0.86	0.65	0.35	0.46	0.18																			0.20	0.35	0.52	0.48	0.63	0.62	0.46	0.64	0.69	9.39
0.84	0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13														0.33	0.46	0.59	0.80	0.71	0.88	0.75	0.53	0.61	0.75	16.11
0.65	0.72	0.78	0.89	0.73	1.15	0.88	0.50																		0.50	0.78	1.13	1.04	0.75	0.82	0.54	0.60	0.72	13.84
														0.04	0.05	0.06	0.08	0.08	0.09	0.13	0.18	0.16	0.17	0.16	0.13	0.11	0.11	0.04	0.02	0.01				1.62
													0.15	0.36	0.62	0.73	0.73	0.72	0.51	0.52	0.58	0.45	0.45	0.43	0.34	0.24	0.27	0.05						7.15
																		0.05	0.07	0.10	0.15	0.15	0.18	0.25	0.22	0.24	0.22	0.12	0.09	0.06	0.02	0.00		1.92
														0.02	0.02	0.03	0.04	0.05	0.05	0.07	0.09	0.07	0.07	0.05	0.03	0.02	0.01							0.62
														0.04	0.05	0.06	0.09	0.09	0.10	0.13	0.18	0.16	0.17	0.17	0.13	0.12	0.11	0.04	0.02	0.01				1.67
0.01	0.00	0.01	0.02	0.02	0.04	0.04	0.04	0.05	0.06	0.07	0.11	0.13	0.16	0.14	0.15	0.16	0.13	0.14	0.15	0.12	0.12	0.13	0.10	0.10	0.10	0.08	0.08	0.09	0.05	0.04	0.04	0.02	0.02	0.01	2.74
0.38	0.42	0.49	0.44	0.29	0.50	0.32	0.19	0.09	0.01																0.08	0.17	0.26	0.26	0.32	0.41	0.29	0.27	0.35	5.91
0.13	0.13	0.15	0.11	0.06	0.08	0.03																			0.03	0.06	0.09	0.08	0.11	0.11	0.08	0.11	0.12	1.61
0.09	0.10	0.12	0.11	0.08	0.15	0.11	0.09	0.07	0.04	0.01														0.04	0.05	0.06	0.09	0.08	0.10	0.08	0.06	0.07	0.08	1.77
0.05	0.05	0.05	0.06	0.05	0.08	0.06	0.04																		0.04	0.05	0.08	0.07	0.05	0.06	0.04	0.04	0.05	0.97
0.66	0.70	0.82	0.74	0.50	0.85	0.56	0.36	0.21	0.11	0.08	0.11	0.13	0.16	0.29	0.61	0.90	1.01	1.08	1.14	0.94	1.07	1.31	1.09	1.14	1.20	1.13	1.15	1.33	0.79	0.75	0.78	0.51	0.51	0.61	25.98
2.77	2.67	3.44	3.11	2.63	3.57	2.35	1.37	0.88	0.46	0.34	0.46	0.55	0.61	1.22	2.56	3.78	4.24	4.54	4.35	3.95	4.50	5.00	4.58	4.79	5.08	4.75	4.83	5.08	3.32	3.15	3.28	2.14	2.14	2.33	
3.47	3.34	4.31	3.89	3.28	4.46	2.94	1.71	1.10	0.58	0.42	0.58	0.68	0.76	1.52	3.20	4.73	5.30	5.67	5.44	4.94	5.62	6.25	5.72	5.99	6.35	5.93	6.04	6.35	4.15	3.94	4.10	2.68	2.68	2.91	
0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	
3.53	3.40	4.37	3.95	3.34	4.52	3.00	1.78	1.16	0.64	0.48	0.64	0.74	0.82	1.58	3.26	4.79	5.36	5.73	5.50	5.00	5.68	6.31	5.78	6.05	6.41	5.99	6.10	6.41	4.21	4.00	4.16	2.74	2.74	2.97	
4.15	4.00	5.14	4.64	3.93	5.31	3.53	2.09	1.37	0.75	0.56	0.75	0.87	0.97	1.86	3.84	5.63	6.31	6.74	6.47	5.88	6.68	7.43	6.80	7.11	7.54	7.05	7.18	7.54	4.95	4.70	4.89	3.22	3.22	3.50	
4.61	4.45	5.71	5.16	4.37	5.91	3.92	2.32	1.52	0.83	0.63	0.83	0.97	1.08	2.07	4.27	6.26	7.01	7.49	7.19	6.53	7.42	8.25	7.56	7.90	8.38	7.84	7.97	8.38	5.50	5.23	5.43	3.58	3.58	3.88	
6.02	5.81	7.46	6.74	5.71	7.73	5.13	3.04	1.99	1.09	0.82	1.09	1.27	1.41	2.70	5.58	8.18	9.17	9.79	9.40	8.54	9.70	10.79	9.88	10.33	10.95	10.24	10.42	10.95	7.19	6.83	7.10	4.68	4.68	5.08	
3,687	3,557	4,566	4,126	3,495	4,731	3,138	1,860	1,216	667	502	667	777	861	1,655	3,413	5,005	5,609	5,993	5,754	5,225	5,939	6,602	6,048	6,323	6,700	6,268	6,378	6,700	4,401	4,181	4,346	2,863	2,863	3,108	
0.073	0.078	0.091	0.082	0.055	0.094	0.062	0.041	0.024	0.013	0.010	0.013	0.015	0.019	0.033	0.068	0.099	0.111	0.119	0.126	0.104	0.118	0.144	0.120	0.125	0.133	0.124	0.127	0.146	0.087	0.083	0.086	0.057	0.057	0.068	2.877

Table IV. 4 - 17 Water Requirement (Case 3, Q = 8,200 cusecs)

Description	Unit	Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sep.	
Unit Crop Water Requirement																											
· Sorghum	inch																	0.50	0.72	0.89	1.16	1.20	1.32	1.83	2.51	2.26	2.31
· Rice	"																0.86	2.12	3.63	4.28	4.31	4.24	2.98	3.03	3.39	2.66	2.66
· Oilseed (Sunflower)	"																					0.44	0.62	0.85	1.24	1.26	1.49
· Pulses (Mungbeans)	"																	0.60	0.82	1.02	1.39	1.56	1.76	2.31	2.99	2.41	2.22
· Pulses (Soybeans)	"																	0.50	0.72	0.92	1.22	1.26	1.40	1.89	2.56	2.29	2.40
· Sugarcane & Others	"	0.25	0.22	0.11	0.22	0.47	0.56	0.89	1.10	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.60
· Wheat	"	0.82	0.84	0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03															
· Oilseed (Rapes Mustard)	"	0.75	0.76	0.79	0.86	0.65	0.35	0.46	0.18																		
· Pulses (Gram)	"	0.81	0.84	0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13														
· Fodder (Berseem) & Others	"	0.66	0.65	0.72	0.78	0.89	0.73	1.15	0.88	0.50																	
Water Requirement																											
· Sorghum 9 %	inch																	0.05	0.06	0.08	0.10	0.11	0.12	0.16	0.23	0.20	0.22
· Rice 20 %	"																0.17	0.42	0.73	0.86	0.86	0.85	0.60	0.61	0.68	0.53	0.53
· Oilseed (Sunflower) 14 %	"																					0.06	0.09	0.12	0.17	0.18	0.21
· Pulses (Mungbeans) 3 %	"																	0.02	0.02	0.03	0.04	0.05	0.05	0.07	0.09	0.07	0.07
· Pulses (Soybeans) 9 %	"																	0.05	0.06	0.08	0.11	0.11	0.13	0.17	0.23	0.21	0.22
· Sugarcane & Others 5 %	"	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.06	0.05	0.07	0.08	0.08	0.14	0.16	0.19	0.18	0.19	0.20	0.17	0.17	0.19	0.15	0.15	0.17	0.13	0.13
· Wheat 34 %	"	0.28	0.29	0.32	0.37	0.33	0.22	0.38	0.24	0.14	0.07	0.01															
· Oilseed (Rapes Mustard) 13 %	"	0.10	0.10	0.10	0.11	0.08	0.05	0.06	0.02																		
· Pulses (Gram) 8 %	"	0.06	0.07	0.07	0.09	0.08	0.06	0.11	0.08	0.06	0.05	0.03	0.01														
· Fodder (Berseem) & Others 5 %	"	0.03	0.03	0.04	0.04	0.04	0.04	0.06	0.04	0.03																	
Total	"	0.48	0.50	0.54	0.62	0.55	0.40	0.65	0.44	0.28	0.19	0.12	0.09	0.14	0.16	0.19	0.35	0.73	1.07	1.22	1.28	1.37	1.14	1.28	1.57	1.32	1.38
Water Requirement (Net)	cusecs	2.02	2.10	2.06	2.60	2.31	2.10	2.73	1.85	1.07	0.80	0.50	0.38	0.59	0.67	0.73	1.47	3.07	4.50	5.13	5.38	5.27	4.79	5.38	6.00	5.55	5.80
— do — Including Field Losses	"	2.52	2.63	2.58	3.26	2.89	2.63	3.41	2.31	1.34	1.00	0.63	0.47	0.74	0.84	0.91	1.84	3.83	5.62	6.41	6.72	6.59	5.99	6.72	7.49	6.93	7.25
Drinking Water Requirement	"	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Water Requirement Including F.L and D.W	"	2.59	2.70	2.65	3.33	2.96	2.70	3.48	2.38	1.41	1.07	0.70	0.54	0.81	0.91	0.98	1.91	3.90	5.69	6.48	6.79	6.66	6.06	6.79	7.56	7.00	7.32
— do — Including Water Course	"	3.05	3.17	3.12	3.91	3.48	3.17	4.10	2.80	1.65	1.26	0.82	0.64	0.95	1.07	1.15	2.24	4.59	6.69	7.62	7.99	7.83	7.13	7.99	8.90	8.24	8.61
— do — Including Minor	"	3.39	3.52	3.46	4.35	3.87	3.52	4.55	3.11	1.84	1.40	0.92	0.71	1.05	1.19	1.28	2.49	5.10	7.44	8.47	8.88	8.70	7.92	8.88	9.89	9.15	9.55
— do — Including Conveyance Losses	"	4.43	4.61	4.52	5.68	5.05	4.61	5.95	4.07	2.40	1.82	1.20	0.93	1.38	1.56	1.67	3.26	6.67	9.72	11.07	11.61	11.38	10.35	11.61	12.93	11.96	12.40
Total Water Requirement	"	2,709	2,819	2,769	3,478	3,094	2,819	3,643	2,489	1,471	1,117	732	567	842	952	1,022	1,995	4,082	5,949	6,773	7,102	6,962	6,334	7,102	7,911	7,322	7,661
— do —	M.A.F	0.054	0.056	0.060	0.069	0.061	0.045	0.072	0.049	0.032	0.022	0.015	0.011	0.017	0.019	0.022	0.040	0.081	0.118	0.134	0.141	0.152	0.126	0.141	0.173	0.145	0.152

Water Requirement (Case 3, Q = 8,200 cusecs)

Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.			Total
																0.50	0.72	0.89	1.16	1.20	1.32	1.83	2.51	2.26	2.38	2.35	1.84	1.64	1.52	0.56	0.34	0.15				23.17
															0.86	2.12	3.63	4.28	4.31	4.24	2.98	3.03	3.39	2.66	2.64	2.55	1.99	1.44	1.56	0.27						41.95
																				0.44	0.62	0.85	1.24	1.26	1.49	2.08	1.84	1.97	1.88	0.99	0.71	0.48	0.13	0.02		16.00
																0.60	0.82	1.02	1.39	1.56	1.76	2.31	2.99	2.41	2.22	1.80	0.98	0.52	0.20							20.58
																0.50	0.72	0.92	1.22	1.26	1.40	1.89	2.56	2.29	2.40	2.40	1.90	1.71	1.56	0.57	0.32	0.12				23.74
25	0.22	0.11	0.22	0.47	0.56	0.89	1.10	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.60	2.58	2.10	2.02	2.15	1.14	1.08	1.00	0.50	0.38	0.28	68.97
82	0.84	0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03																	0.17	0.37	0.59	0.58	0.72	0.91	0.65	0.61	0.77	13.16
75	0.76	0.79	0.86	0.65	0.35	0.46	0.18																				0.20	0.35	0.52	0.48	0.63	0.62	0.46	0.64	0.69	9.39
81	0.84	0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13															0.33	0.46	0.59	0.80	0.71	0.88	0.75	0.53	0.61	0.75	16.11
66	0.65	0.72	0.78	0.89	0.73	1.15	0.88	0.50																			0.50	0.78	1.13	1.04	0.75	0.82	0.54	0.60	0.72	13.84
																0.05	0.06	0.08	0.10	0.11	0.12	0.16	0.23	0.20	0.22	0.22	0.17	0.15	0.14	0.05	0.03	0.01				2.10
															0.17	0.42	0.73	0.86	0.86	0.85	0.60	0.61	0.68	0.53	0.53	0.51	0.40	0.29	0.31	0.05						8.40
																				0.06	0.09	0.12	0.17	0.18	0.21	0.30	0.26	0.28	0.26	0.14	0.10	0.07	0.02	0.00		2.26
																0.02	0.02	0.03	0.04	0.05	0.05	0.07	0.09	0.07	0.07	0.06	0.03	0.02	0.01							0.63
																0.05	0.06	0.08	0.11	0.11	0.13	0.17	0.23	0.21	0.22	0.22	0.17	0.15	0.14	0.05	0.03	0.01				2.14
01	0.01	0.01	0.01	0.02	0.03	0.04	0.06	0.05	0.07	0.08	0.08	0.14	0.16	0.19	0.18	0.19	0.20	0.17	0.17	0.19	0.15	0.15	0.17	0.13	0.13	0.13	0.11	0.10	0.11	0.06	0.05	0.05	0.03	0.02	0.01	3.46
28	0.29	0.32	0.37	0.33	0.22	0.38	0.24	0.14	0.07	0.01																	0.06	0.13	0.20	0.20	0.24	0.31	0.22	0.21	0.26	4.48
10	0.10	0.10	0.11	0.08	0.05	0.06	0.02																				0.03	0.05	0.07	0.06	0.08	0.08	0.06	0.08	0.09	1.22
06	0.07	0.07	0.09	0.08	0.06	0.11	0.08	0.06	0.05	0.03	0.01															0.04	0.04	0.05	0.06	0.06	0.07	0.06	0.04	0.05	0.06	1.30
03	0.03	0.04	0.04	0.04	0.04	0.06	0.04	0.03																			0.00	0.04	0.06	0.05	0.04	0.04	0.03	0.03	0.04	0.68
48	0.50	0.54	0.62	0.55	0.40	0.65	0.44	0.28	0.19	0.12	0.09	0.14	0.16	0.19	0.35	0.73	1.07	1.22	1.28	1.37	1.14	1.28	1.57	1.32	1.38	1.48	1.27	1.24	1.36	0.72	0.64	0.63	0.40	0.39	0.46	26.67
02	2.10	2.06	2.60	2.31	2.10	2.73	1.85	1.07	0.80	0.50	0.38	0.59	0.67	0.73	1.47	3.07	4.50	5.13	5.38	5.27	4.79	5.38	6.00	5.55	5.80	6.22	5.34	5.21	5.19	3.02	2.69	2.65	1.68	1.64	1.76	
52	2.63	2.58	3.26	2.89	2.63	3.41	2.31	1.34	1.00	0.63	0.47	0.74	0.84	0.91	1.84	3.83	5.62	6.41	6.72	6.59	5.99	6.72	7.49	6.93	7.25	7.78	6.67	6.51	6.49	3.78	3.36	3.31	2.10	2.05	2.20	
07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	
59	2.70	2.65	3.33	2.96	2.70	3.48	2.38	1.41	1.07	0.70	0.54	0.81	0.91	0.98	1.91	3.90	5.69	6.48	6.79	6.66	6.06	6.79	7.56	7.00	7.32	7.85	6.74	6.58	6.56	3.85	3.43	3.38	2.17	2.12	2.27	
05	3.17	3.12	3.91	3.48	3.17	4.10	2.80	1.65	1.26	0.82	0.64	0.95	1.07	1.15	2.24	4.59	6.69	7.62	7.99	7.83	7.13	7.99	8.90	8.24	8.61	9.23	7.93	7.74	7.72	4.53	4.04	3.97	2.55	2.49	2.67	
89	3.52	3.46	4.35	3.87	3.52	4.55	3.11	1.84	1.40	0.92	0.71	1.05	1.19	1.28	2.49	5.10	7.44	8.47	8.88	8.70	7.92	8.88	9.89	9.15	9.56	10.26	8.81	8.60	8.58	5.03	4.48	4.42	2.84	2.77	2.96	
43	4.61	4.52	5.68	5.05	4.61	5.95	4.07	2.40	1.82	1.20	0.93	1.38	1.56	1.67	3.26	6.67	9.72	11.07	11.61	11.38	10.35	11.61	12.93	11.96	12.50	13.40	11.52	11.25	11.21	6.58	5.86	5.77	3.71	3.62	3.87	
09	2,819	2,769	3,478	3,094	2,819	3,643	2,489	1,471	1,117	732	567	842	952	1,022	1,995	4,082	5,949	6,773	7,102	6,962	6,334	7,102	7,911	7,322	7,651	8,200	7,047	6,883	6,863	4,027	3,588	3,533	2,270	2,215	2,370	
54	0.056	0.060	0.069	0.061	0.045	0.072	0.049	0.032	0.022	0.015	0.011	0.017	0.019	0.022	0.040	0.081	0.118	0.134	0.141	0.152	0.126	0.141	0.173	0.145	0.152	0.163	0.140	0.137	0.150	0.080	0.071	0.070	0.045	0.044	0.052	2.959

Table IV. 4 - 18 Water Requirement (Case 4 , Q = 6,700 cusecs)

Description	Unit	Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sep.	
Unit Crop Water Requirement																											
· Sorghum	inch																	0.50	0.72	0.89	1.16	1.20	1.32	1.83	2.51	2.26	2.3
· Rice	"																0.86	2.12	3.63	4.28	4.31	4.24	2.98	3.03	3.39	2.66	2.6
· Oilseed (Sunflower)	"																					0.44	0.62	0.85	1.24	1.26	1.4
· Pulses (Mungbeans)	"																	0.60	0.82	1.02	1.39	1.56	1.76	2.31	2.99	2.41	2.2
· Pulses (Soybeans)	"																	0.50	0.72	0.92	1.22	1.26	1.40	1.89	2.56	2.29	2.4
· Sugarcane & Others	"	0.25	0.22	0.11	0.22	0.47	0.56	0.89	1.10	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.6
· Wheat	"	0.82	0.84	0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03															
· Oilseed (Rapes Mustard)	"	0.75	0.76	0.79	0.86	0.65	0.35	0.46	0.18																		
· Pulses (Gram)	"	0.81	0.84	0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13														
· Fodder (Berseem) & Others	"	0.66	0.65	0.72	0.78	0.89	0.73	1.15	0.88	0.50																	
Water Requirement																											
· Sorghum 7 %	inch																	0.04	0.05	0.06	0.08	0.08	0.09	0.13	0.18	0.16	0.1
· Rice 17 %	"																0.15	0.36	0.62	0.73	0.73	0.72	0.51	0.52	0.58	0.45	0.4
· Oilseed (Sunflower) 12 %	"																					0.05	0.07	0.10	0.15	0.15	0.1
· Pulses (Mungbeans) 3 %	"																	0.02	0.02	0.03	0.04	0.05	0.05	0.07	0.09	0.07	0.0
· Pulses (Soybeans) 7 %	"																	0.04	0.05	0.06	0.09	0.09	0.10	0.13	0.18	0.16	0.1
· Sugarcane & Others 4 %	"	0.01	0.01	0.00	0.01	0.02	0.02	0.04	0.04	0.04	0.05	0.06	0.07	0.11	0.13	0.16	0.14	0.15	0.16	0.13	0.14	0.15	0.12	0.12	0.13	0.10	0.1
· Wheat 34 %	"	0.28	0.29	0.32	0.37	0.33	0.22	0.38	0.24	0.14	0.07	0.01															
· Oilseed (Rapes Mustard) 13 %	"	0.10	0.10	0.10	0.11	0.08	0.05	0.06	0.02																		
· Pulses (Gram) 8 %	"	0.06	0.07	0.07	0.09	0.08	0.06	0.11	0.08	0.06	0.05	0.03	0.01														
· Fodder (Berseem) & Others 5 %	"	0.03	0.03	0.04	0.04	0.04	0.04	0.06	0.04	0.03																	
Total	"	0.48	0.50	0.53	0.62	0.55	0.39	0.65	0.42	0.27	0.17	0.10	0.08	0.11	0.13	0.16	0.29	0.61	0.90	1.01	1.08	1.14	0.94	1.07	1.31	1.09	1.1
Water Requirement (Net)	cusecs	2.02	2.10	2.02	2.60	2.31	2.05	2.73	1.76	1.03	0.71	0.42	0.34	0.46	0.55	0.61	1.22	2.56	3.78	4.24	4.54	4.35	3.95	4.50	5.00	4.58	4.2
— do — Including Field Losses	"	2.52	2.63	2.53	3.26	2.89	2.56	3.41	2.20	1.29	0.89	0.53	0.43	0.58	0.69	0.76	1.52	3.20	4.73	5.30	5.67	5.44	4.94	5.62	6.25	5.72	5.3
Drinking Water Requirement	"	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.0
Water Requirement Including F.L and D.W	"	2.58	2.69	2.59	3.32	2.95	2.62	3.47	2.26	1.35	0.95	0.59	0.49	0.64	0.75	0.82	1.58	3.26	4.79	5.36	5.73	5.50	5.00	5.68	6.31	5.78	5.3
— do — Including Water Course	"	3.04	3.16	3.05	3.91	3.47	3.08	4.08	2.66	1.59	1.12	0.69	0.58	0.75	0.88	0.96	1.86	3.84	5.63	6.31	6.74	6.47	5.88	6.68	7.43	6.80	7.1
— do — Including Minor	"	3.38	3.51	3.39	4.34	3.86	3.42	4.53	2.96	1.77	1.24	0.77	0.64	0.83	0.98	1.07	2.07	4.27	6.26	7.01	7.49	7.19	6.53	7.42	8.25	7.56	7.1
— do — Including Conveyance Losses	"	4.42	4.59	4.43	5.67	5.05	4.47	5.92	3.87	2.31	1.62	1.01	0.84	1.08	1.28	1.40	2.70	5.58	8.18	9.17	9.79	9.40	8.54	9.70	10.79	9.88	10.
Total Water Requirement	"	2,705	2,809	2,711	3,470	3,091	2,736	3,623	2,368	1,414	991	618	514	661	783	857	1,655	3,413	5,005	5,609	5,993	5,754	5,225	5,939	6,602	6,048	6,3
— do —	M.A.F	0.054	0.056	0.059	0.069	0.061	0.043	0.072	0.047	0.031	0.020	0.012	0.010	0.013	0.016	0.019	0.033	0.068	0.099	0.111	0.119	0.126	0.104	0.118	0.144	0.120	0.1

Water Requirement (Case 4 , Q = 6,700 cusecs)

Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.			Total
																0.50	0.72	0.89	1.16	1.20	1.32	1.83	2.51	2.26	2.38	2.35	1.84	1.64	1.52	0.56	0.34	0.15				23.17
														0.86	2.12	3.63	4.28	4.31	4.24	2.98	3.03	3.39	2.66	2.64	2.55	1.99	1.44	1.56	0.27						41.95
																			0.44	0.62	0.85	1.24	1.26	1.49	2.08	1.84	1.97	1.88	0.99	0.71	0.48	0.13	0.02		16.00
															0.60	0.82	1.02	1.39	1.56	1.76	2.31	2.99	2.41	2.22	1.80	0.98	0.52	0.20							20.58
															0.50	0.72	0.92	1.22	1.26	1.40	1.89	2.56	2.29	2.40	2.40	1.90	1.71	1.56	0.57	0.32	0.12				23.74
0.25	0.22	0.11	0.22	0.47	0.56	0.89	1.10	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.60	2.58	2.10	2.02	2.15	1.14	1.08	1.00	0.50	0.38	0.28	68.97
0.82	0.84	0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03																	0.17	0.37	0.59	0.58	0.72	0.91	0.65	0.61	0.77	13.16
0.75	0.76	0.79	0.86	0.65	0.35	0.46	0.18																				0.20	0.35	0.52	0.48	0.63	0.62	0.46	0.64	0.69	9.39
0.81	0.84	0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13														0.33	0.46	0.59	0.80	0.71	0.88	0.75	0.53	0.61	0.75	16.11
0.66	0.65	0.72	0.78	0.89	0.73	1.15	0.88	0.50																		0.50	0.78	1.13	1.04	0.75	0.82	0.54	0.60	0.72	13.84
															0.04	0.05	0.06	0.08	0.08	0.09	0.13	0.18	0.16	0.17	0.16	0.13	0.11	0.11	0.04	0.02	0.01				1.62
														0.15	0.36	0.62	0.73	0.73	0.72	0.51	0.52	0.58	0.45	0.45	0.43	0.34	0.24	0.27	0.05						7.15
																			0.05	0.07	0.10	0.15	0.15	0.18	0.25	0.22	0.24	0.22	0.12	0.09	0.06	0.02	0.00		1.92
															0.02	0.02	0.03	0.04	0.05	0.05	0.07	0.09	0.07	0.07	0.05	0.03	0.02	0.01							0.62
															0.04	0.05	0.06	0.09	0.09	0.10	0.13	0.18	0.16	0.17	0.17	0.13	0.12	0.11	0.04	0.02	0.01				1.67
0.01	0.01	0.00	0.01	0.02	0.02	0.04	0.04	0.04	0.05	0.06	0.07	0.11	0.13	0.16	0.14	0.15	0.16	0.13	0.14	0.15	0.12	0.12	0.13	0.10	0.10	0.10	0.08	0.08	0.09	0.05	0.04	0.04	0.02	0.02	0.01	2.74
0.28	0.29	0.32	0.37	0.33	0.22	0.38	0.24	0.14	0.07	0.01																0.06	0.13	0.20	0.20	0.24	0.31	0.22	0.21	0.26	4.48
0.10	0.10	0.10	0.11	0.08	0.05	0.06	0.02																			0.03	0.05	0.07	0.06	0.08	0.08	0.06	0.08	0.09	1.22
0.06	0.07	0.07	0.09	0.08	0.06	0.11	0.08	0.06	0.05	0.03	0.01														0.04	0.04	0.04	0.05	0.06	0.06	0.07	0.06	0.04	0.05	0.06	1.30
0.03	0.03	0.04	0.04	0.04	0.04	0.06	0.04	0.03																		0.00	0.04	0.06	0.05	0.04	0.04	0.03	0.03	0.04	0.68
0.48	0.50	0.53	0.62	0.55	0.39	0.65	0.42	0.27	0.17	0.10	0.08	0.11	0.13	0.16	0.29	0.61	0.90	1.01	1.08	1.14	0.94	1.07	1.31	1.09	1.14	1.20	1.06	1.08	1.20	0.67	0.60	0.61	0.39	0.39	0.46	23.40
2.02	2.10	2.02	2.60	2.31	2.05	2.73	1.76	1.03	0.71	0.42	0.34	0.46	0.55	0.61	1.22	2.56	3.78	4.24	4.54	4.35	3.95	4.50	5.00	4.58	4.79	5.08	4.46	4.54	4.58	2.81	2.52	2.56	1.64	1.64	1.76	
2.52	2.63	2.53	3.26	2.89	2.56	3.41	2.20	1.29	0.89	0.53	0.43	0.58	0.69	0.76	1.52	3.20	4.73	5.30	5.67	5.44	4.94	5.62	6.25	5.72	5.99	6.35	5.58	5.68	5.73	3.51	3.15	3.20	2.05	2.05	2.20	
0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	
2.58	2.69	2.59	3.32	2.95	2.62	3.47	2.26	1.35	0.95	0.59	0.49	0.64	0.75	0.82	1.58	3.26	4.79	5.36	5.73	5.50	5.00	5.68	6.31	5.78	6.05	6.41	5.64	5.74	5.79	3.57	3.21	3.26	2.11	2.11	2.26	
3.04	3.16	3.05	3.91	3.47	3.08	4.08	2.66	1.59	1.12	0.69	0.58	0.75	0.88	0.96	1.86	3.84	5.63	6.31	6.74	6.47	5.88	6.68	7.43	6.80	7.11	7.54	6.64	6.75	6.81	4.20	3.78	3.84	2.48	2.48	2.66	
3.38	3.51	3.39	4.34	3.86	3.42	4.53	2.96	1.77	1.24	0.77	0.64	0.83	0.98	1.07	2.07	4.27	6.26	7.01	7.49	7.19	6.53	7.42	8.25	7.56	7.90	8.38	7.38	7.50	7.57	4.67	4.20	4.27	2.76	2.76	2.96	
4.42	4.59	4.43	5.67	5.05	4.47	5.92	3.87	2.31	1.62	1.01	0.84	1.08	1.28	1.40	2.70	5.58	8.18	9.17	9.79	9.40	8.54	9.70	10.79	9.88	10.33	10.95	9.65	9.80	9.90	6.10	5.49	5.58	3.61	3.61	3.87	
2,705	2,809	2,711	3,470	3,091	2,736	3,623	2,368	1,414	991	618	514	661	783	857	1,655	3,413	5,005	5,609	5,993	5,754	5,225	5,939	6,602	6,048	6,323	6,700	5,906	5,998	6,059	3,733	3,360	3,415	2,209	2,209	2,368	
0.054	0.056	0.059	0.069	0.061	0.043	0.072	0.047	0.031	0.020	0.012	0.010	0.013	0.016	0.019	0.033	0.068	0.099	0.111	0.119	0.126	0.104	0.118	0.144	0.120	0.125	0.133	0.117	0.119	0.132	0.074	0.067	0.068	0.044	0.044	0.052	2.599

Table IV.2-19 Depth of Irrigation Application & Irrigation Interval

Name of Crops	ETcrop per day [max] (1)		Available Soil Moisture (2)	Fraction of Available Soil Water (3)	Readily Available Soil Water (4)=(2)x(3)	Correction for ETcrop (5)	Rooting Depth (6)	Readily Available Soil Water (7)=(4)x(5)x(6)		Depth of Irrigation Application (8)=(7)÷0.75 or 0.80		Irrigation Interval (9)=(7)÷(1)
	inch	mm	mm/m	%	mm/m		m	mm	inch	mm	inch	day
Sorghum	0.228	5.8	160	0.55	88	1.0	1.4	123	4.8	164	6.5	21
Rice	0.347	8.8	160	0.65	104	0.7	0.8	58	2.3	72	2.8	8
Sunflower	0.208	5.3	160	0.45	72	1.0	1.1	79	3.1	105	4.1	14
Pulses (Kharif)	0.272	6.9	160	0.60	96	1.0	0.6	58	2.3	77	3.0	8
Soybeans	0.233	5.9	160	0.50	80	1.0	1.1	88	3.5	117	4.6	14
Sugarcane	0.391	9.9	160	0.65	104	0.7	1.9	138	5.4	184	7.2	14
Wheat	0.112	2.8	160	0.20	32	1.3	1.0	41	1.6	55	2.2	14
Rape,Mustard	0.108	2.7	160	0.50	80	1.3	0.6	62	2.4	83	3.3	22
Pulses(Rabi)	0.134	3.4	160	0.45	72	1.3	0.6	56	2.2	75	3.0	16
Fodder	0.115	2.9	160	0.35	56	1.3	0.9	65	2.6	87	3.4	22

IV.2.2 Leaching Water Requirement

"Crop Water Requirement" published by FAO recommends about leaching water calculation as follows:

Leaching requirement (LP) is the minimum amount of irrigation water supplied that must be drained through the root zone to control soil salinity at the given specific level. For sandy loam to clay loam soils with good drainage and where rainfall is low the leaching requirement can be obtained from:

for surface irrigation methods (including sprinklers)

$$LR = \frac{ECw}{5ECe - ECw}$$

for drip and high frequency sprinkler (near daily)

$$LR = \frac{ECw}{2Max\ ECe}$$

where: ECw = electrical conductivity of the irrigation water, mmhos/cm

ECe = electrical conductivity of the soil saturation extract for a given crop appropriate to the tolerable degree of yield reduction

MaxECe = maximum tolerable electrical conductivity of the soil saturation extract for a given crop

In this Project, the surface irrigation methods are recommended and the electrical conductivity of the irrigation water is 0.4 mmhos/cm, so that the formula is as follows:

$$LR = \frac{0.4}{5ECe - 0.4}$$

According to the ECe showing in the Table IV.3- in the Appendix and above formula, leaching requirements are calculated and the results is shown in Table IV.2-20 in the Appendix.

Table IV.2-20 Leaching Water Requirement

Name of Crop	Water Requirement for Growing Season [WR] inch	Solt Tolerance for 100% Yeild [ECe] mmho/cm	Electrical Conductivity of Irrigation water [ECw] mmho/cm	LR= $[\frac{ECw}{5xECe-ECw} x \frac{1}{0.7}]$	Leaching Water Requirement [WRxLR] inch
Sorghum	21.17	4.0	0.4	0.029	0.61
Rice	31.95	3.0	0.4	0.039	1.25
Sunflower	14.00	1.7	0.4	0.071	0.99
Mungbeans	18.18	1.0	0.4	0.124	2.25
Soybeans	21.74	5.0	0.4	0.023	0.50
Sugarcane	66.97	5.0	0.4	0.023	1.54
Wheat	11.16	6.0	0.4	0.019	0.21
Rupes	7.39	5.0	0.4	0.023	0.17
Gram	14.11	1.0	0.4	0.124	1.75
Berseem	11.84	1.5	0.4	0.080	0.95

IV.2.3 Intake Rate

Since most of the soils in the Project Area are silty clay loam, the measuring sites of intake rate are selected at the following three locations; downstream of Jhatpat distributary (disty), upstream of Umurani disty and downstream of Judher disty.

The intake rate was measured with a cylinder with 25 - 30 cm in diameter and 30 - 40 cm in height. Since as a general rule, more than two cylinder tests should be made in a given location to obtain a representative sample, two cylinder tests were made in downstream of Jhatpat disty while three tests in upstream of Umurani disty and downstream of Judher disty respectively.

Table IV.2-21 shows the observed results which are the relationship between cummulative time and cummulative intake of each test cylinder. Usually the intake rate plotted against time on a logarithmic scale will be shown in a straight line, which can be represented by the following equation:

$$I = KT^n \quad \text{[equation I]}$$

in which: I = intake rate (mm/hr)

K = a constant and the value on the ordinate when time T [min.] on the abscissa has a value of 1.0

n = constant showing the slope of the line

When a rather light and frequent irrigation is applied, the irrigation may be completed before the final intake rate is reached.

Since the initial rates considerably exceed the final rates, amount of water in the soils can best be represented by the accumulated depth (D) of water that has entered the soils. This quantity is represented by an integral of the above-mentioned equation as,

$$D = \frac{K}{n+1} T^{n+1} = CT^m \quad \text{[equation D]}$$

The constant values, C & m, can be obtained from the equation D with the accumulated depth (D) and time (T) which are observed by the field works.

Fig.IV.2-1 to Fig.IV.2-8 show the observed data and the lines showing the equation D and the equation I obtained the said data.

The basic intake rate can be obtained to put T = 600 x n value into $I = KT^n$. As shown in Table IV.2-22, the basic intake rate of each observed field and averages of each observed field and all test cylinder are as follows:

Tabulation of Basic Intake Rate

Observed Field	Basic Intake Rate
Average of Jhatpat	0.341 mm/hr
Average of Umurani	4.99 mm/hr
Average of Judher	3.08 mm/hr
Averave in all basic intake rate	3.11 mm/hr

Table IV.2-21 Intake Data Obtained from a Test Cylinder

Jhatpat No.1

Cumulative Time (min.)	Cumulative Intake (mm)
3	1.0
5	1.5
10	2.0
25	3.0
55	4.0
90	4.0

Jhatpat No.2

Cumulative Time (min.)	Cumulative Intake (mm)
1	2.0
4	3.0
10	3.0
30	4.0
60	4.0

Umurani No.1

Cumulative Time (min.)	Cumulative Intake (mm)
1	4.0
3	7.0
5	8.0
7	9.0
10	10.0
15	12.0
20	13.0
30	14.0
90	19.0

Umurani No.2

Cumulative Time (min.)	Cumulative Intake (mm)
1	2.0
2	4.0
4	6.0
6	7.5
8	9.0
10	10.0
20	15.0
30	18.5
60	24.0

Umurani No.3

Cumulative Time (min.)	Cumulative Intake (mm)
1	3.0
2	4.0
3	6.0
4	7.5
5	8.0
6	9.0
8	10.5
9	11.5
10	12.0
15	12.0
20	12.0
30	12.0

Judher No.1

Cumulative Time (min.)	Cumulative Intake (mm)
1	4.0
2	10.0
3	12.0
4	13.0
5	13.0
6	14.0
7	14.0
8	15.0
9	15.5
10	16.0
15	17.0
20	18.0
30	19.0
90	21.0

Judher No.2

Cumulative Time (min.)	Cumulative Intake (mm)
1	2.0
2	4.0
3	5.0
4	6.0
5	6.0
6	7.0
8	8.0
10	9.0
20	10.0
30	10.0
90	10.0

Judher No.3

Cumulative Time (min.)	Cumulative Intake (mm)
1	3.0
2	5.0
3	6.0
4	7.5
5	9.0
6	9.5
7	11.0
8	12.0
9	13.0
10	14.0
15	15.0
20	16.0
30	18.0
90	28.0

Table IV.2-22 Basic Intake Rate

Station	$D = CT^m$	$I = KT^n$	$Ib = K(600 \times n)^n$ (mm/hr)	
Jhatpat No.1	$D = 0.731T^{0.409}$	$I = 17.94T^{-0.591}$	$I = 17.94(600 \times 0.591)^{-0.591}$	= 0.558
No.2	$D = 2.129T^{0.169}$	$I = 21.59T^{-0.831}$	$I = 21.59(600 \times 0.831)^{-0.831}$	= 0.124
Average				0.341
Umurani No.1	$D = 4.515T^{0.339}$	$I = 91.84T^{-0.661}$	$I = 91.84(600 \times 0.661)^{-0.661}$	= 1.76
No.2	$D = 2.453T^{0.593}$	$I = 87.28T^{-0.407}$	$I = 87.28(600 \times 0.407)^{-0.407}$	= 9.31
No.3	$D = 3.592T^{0.447}$	$I = 96.34T^{-0.553}$	$I = 96.34(600 \times 0.553)^{-0.553}$	= 3.89
Average				4.99
Judher No.1	$D = 7.334T^{0.300}$	$I = 132.0T^{-0.700}$	$I = 132.0(600 \times 0.700)^{-0.700}$	= 1.92
No.2	$D = 3.275T^{0.336}$	$I = 66.02T^{-0.664}$	$I = 66.02(600 \times 0.664)^{-0.664}$	= 1.24
No.3	$D = 3.794T^{0.491}$	$I = 111.8T^{-0.509}$	$I = 111.8(600 \times 0.509)^{-0.509}$	= 6.08
Average				3.08
Average (all basic intake rate)				3.11

Figure IV.2–1 Result of Cylinder Intake Rate (Jhatpat No.1)

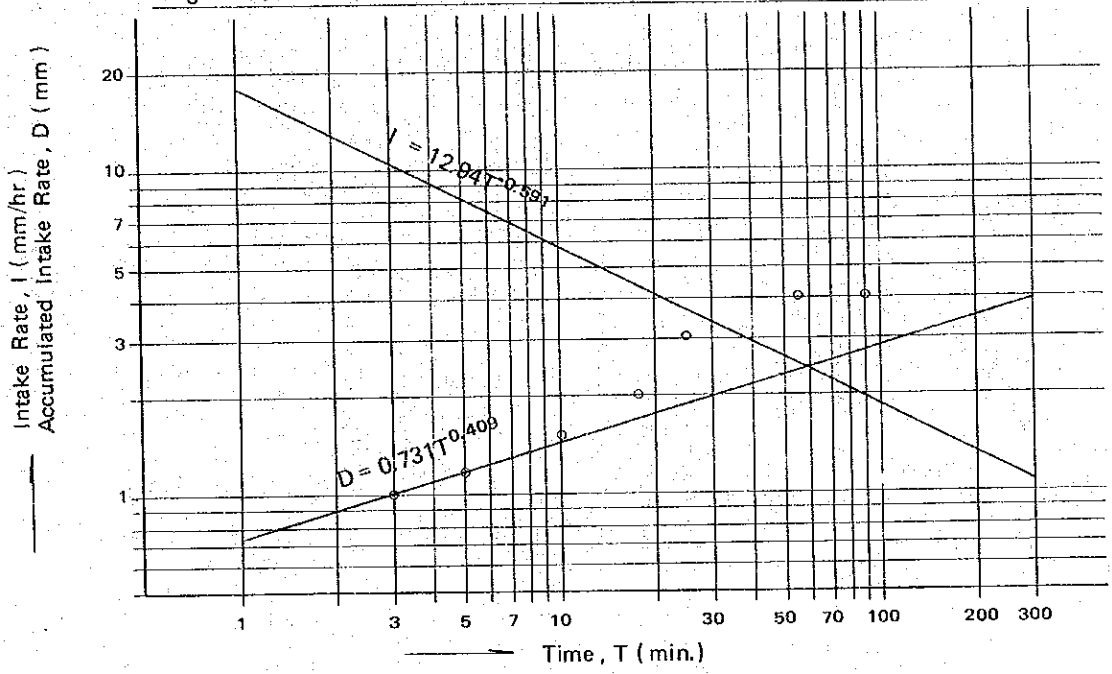


Figure IV.2–2 Result of Cylinder Intake Rate (Jhatpat No.2)

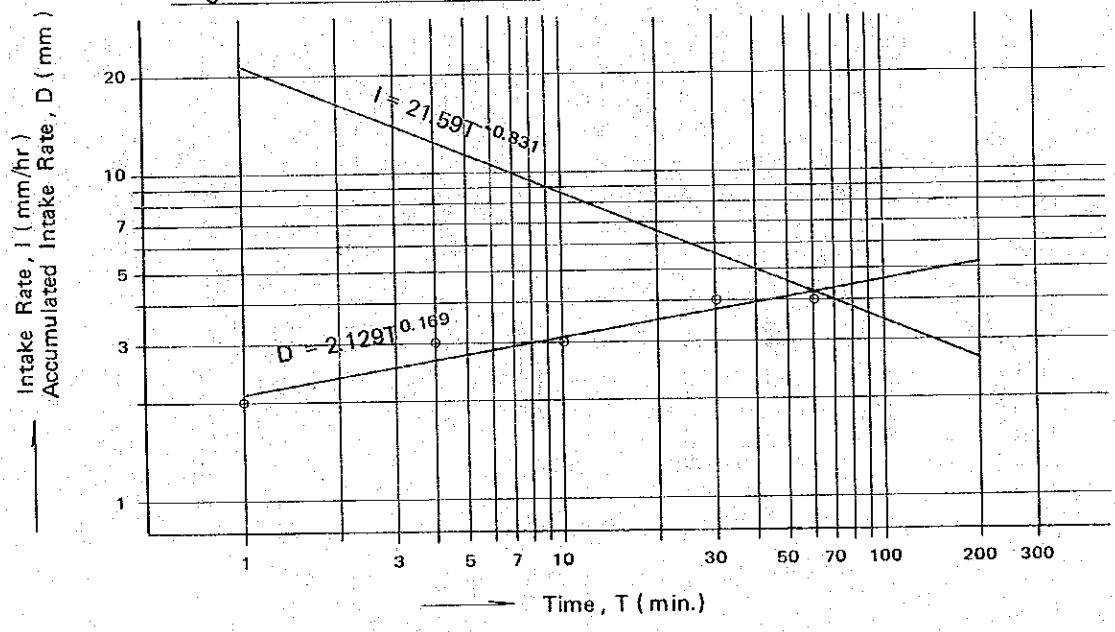


Figure IV.2--3 Result of Cylinder Intake Rate (Umurani No.1)

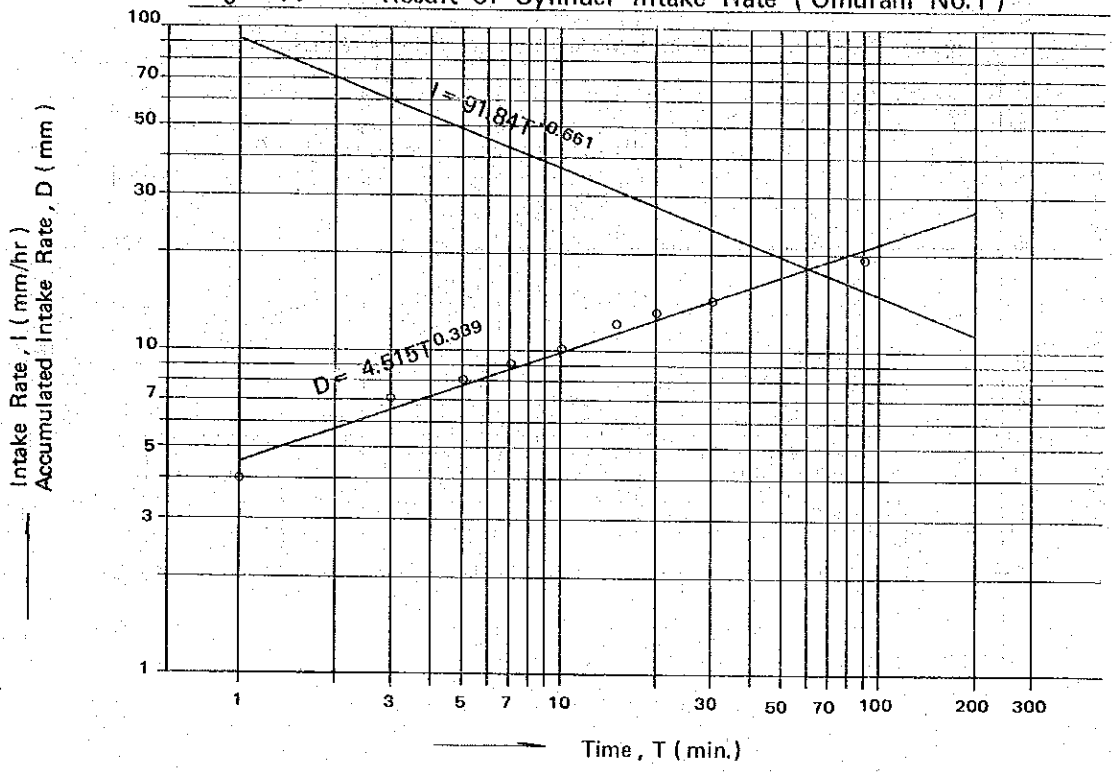


Figure IV.2--4 Result of Cylinder Intake Rate (Umurani No.2)

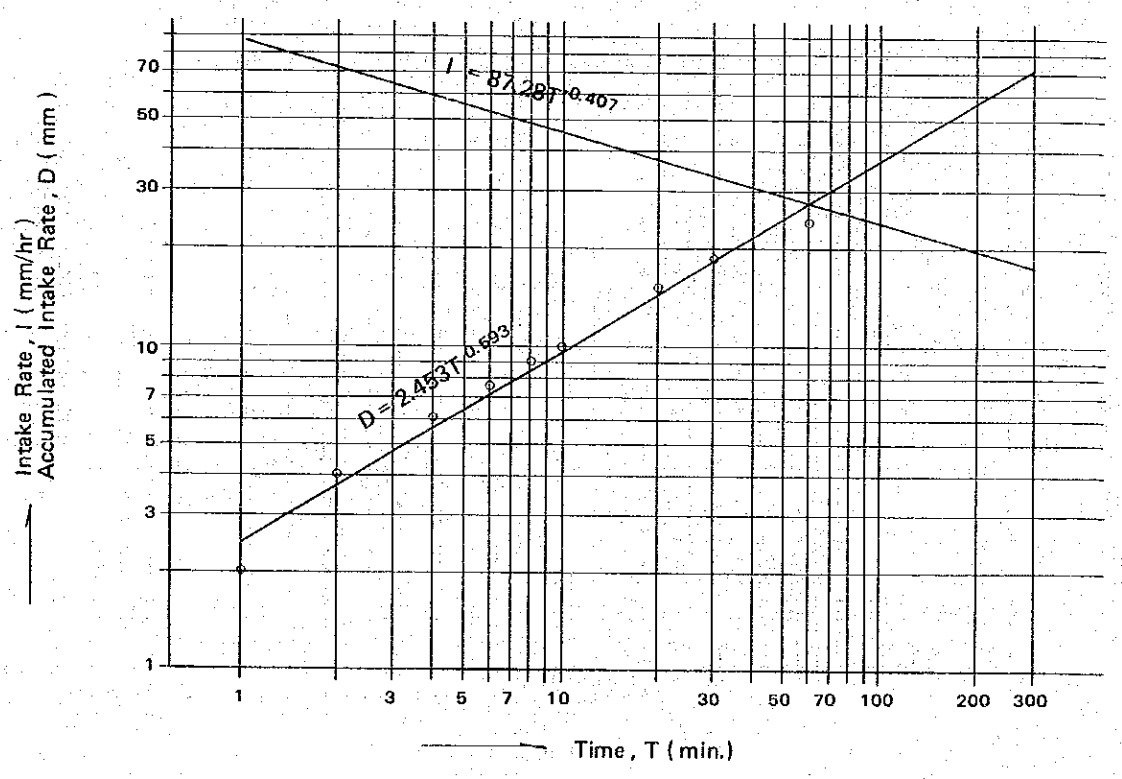


Figure IV.2–5 Result of Cylinder Intake Rate (Umurani No.3)

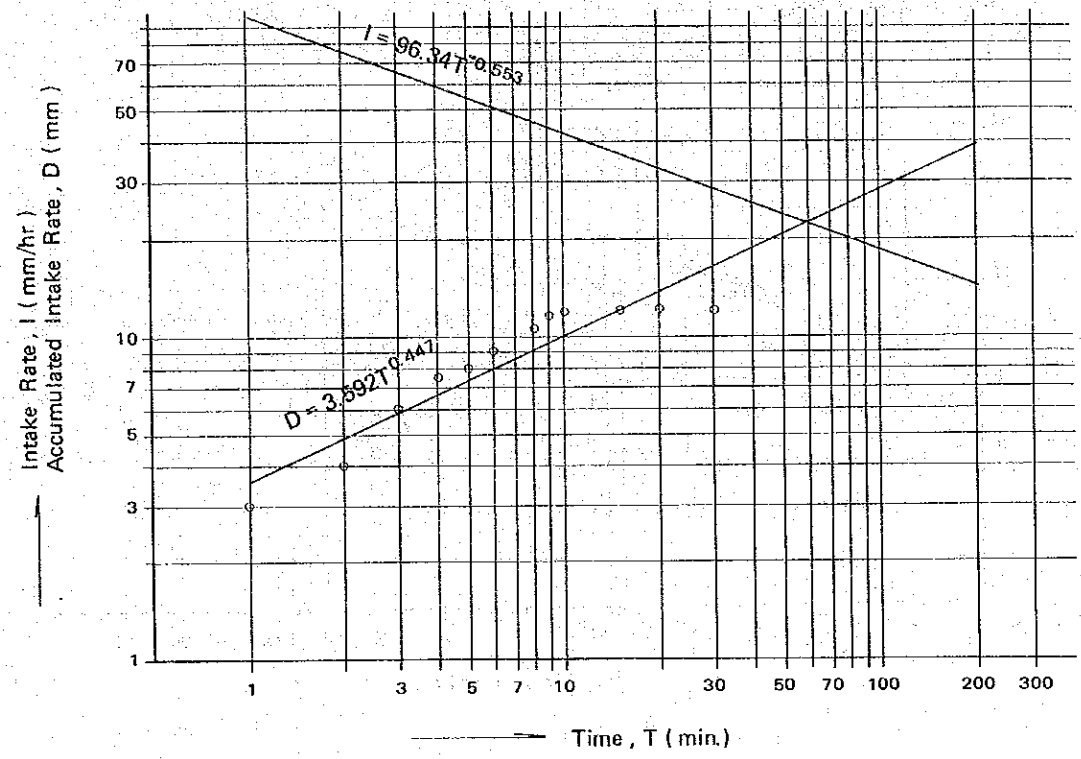


Figure IV.2–6 Result of Cylinder Intake Rate (Judher No.1)

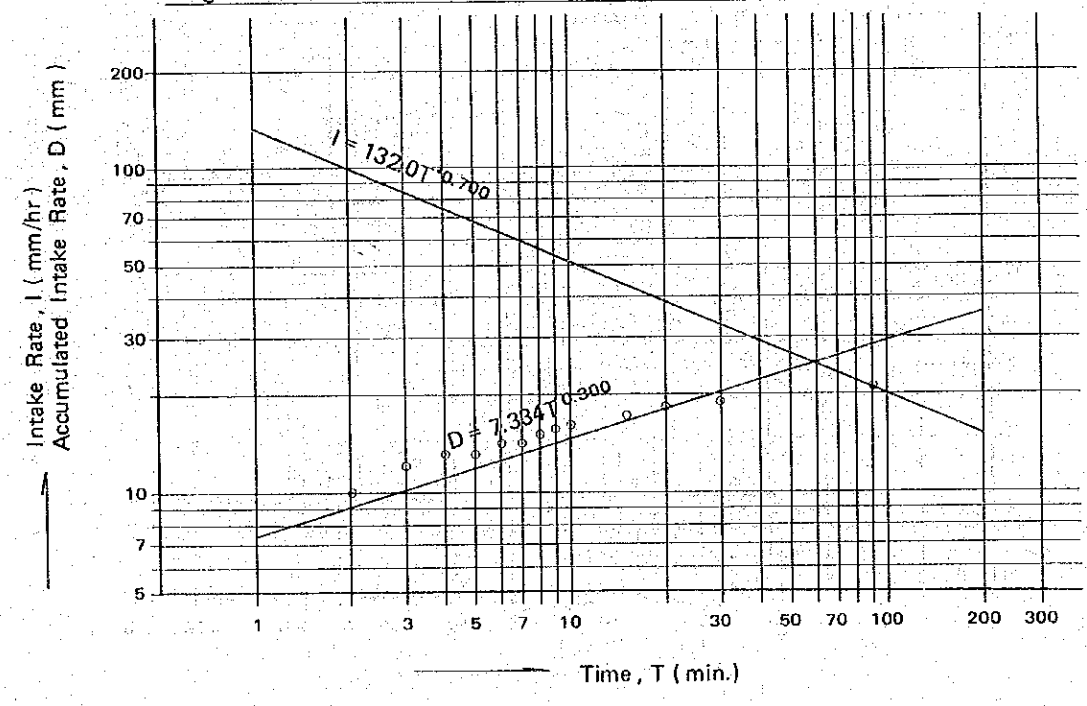


Figure IV.2–7 Result of Cylinder Intake Rate (Judher No.2)

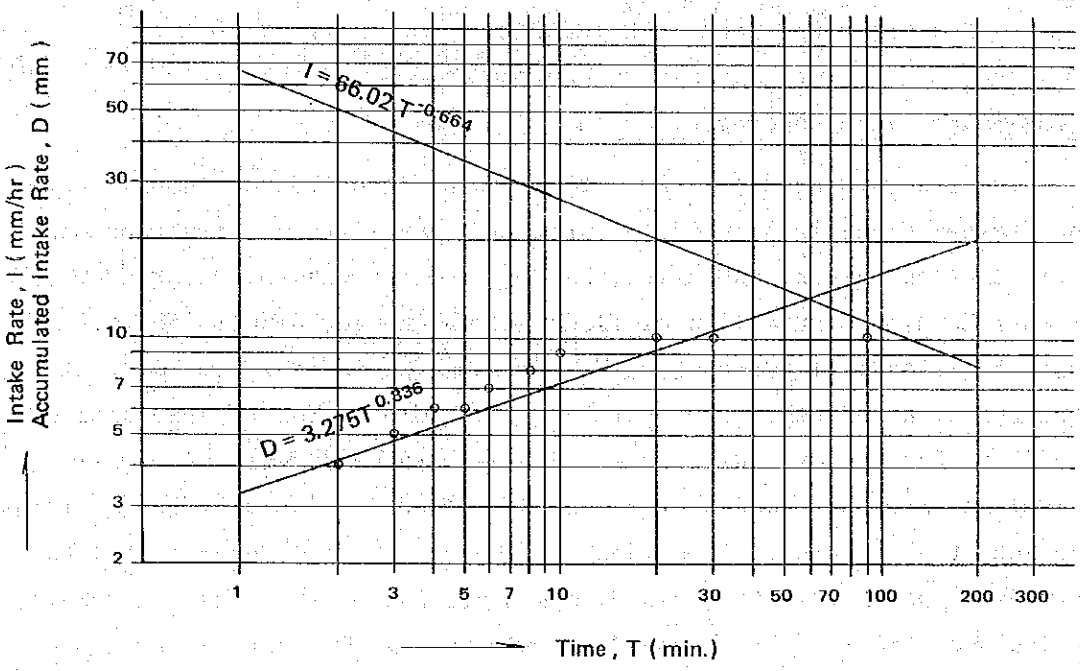


Figure IV.2–8 Result of Cylinder Intake Rate (Judher No.3)