Figure 2.2-6-2   Location Map of Ifau and Yeye Riveer Integrated Development Plan in Daoukro and Quelle Cities and Surroundig Area

|	Daoukro Barrage	Ouelle Barrage
Problems	Since constructed in 1972, it worked for urban water for Daoukro. However, sediment gate was destructed by the flood in 1995. This reservoir is not used anymore after destruction. Some water is used only for aquaculture at downstream.	This reservoir is not used not only for urban water but agriculture. It was abandoned due to higher treatment cost than groundwater for urban water.
River Name	Ifou, Comoe	Yéyé, N'zi, Bandama
Catchment Area	220 km²	110 km²
Location	7°03'N, 3°57'W	7°17'N, 4°01'W
Constructed	1972	1976
Constructed by	SODECI	SODECI
Dam type	Concrete fixed Weir	Earth-fill dam
Dam height	H= 2m	H= 6m
Dam length	L= 100m	L= 200m
Dam Capacity	40,000m³	600,000m3
Rehabilitation	- Rehabilitation of sediment gate. - Intake pump for urban water.	- Heightening dam (6m to 8m) Storage capacity will increase to 2,000,000m³. - Renewing a Spillway. - Installation of intake (Q=0.2m³/sec)
Effect	- Stabilization of downstream irrigation and aquaculture only for wet season. (about 50 ha) - Urban water supply through the year.	- Stabilization of wet season rice (100ha) and dry season rice (20ha). - Urban water supply through the year.

Location Map of the existing Daoukro and Ouelle Dams
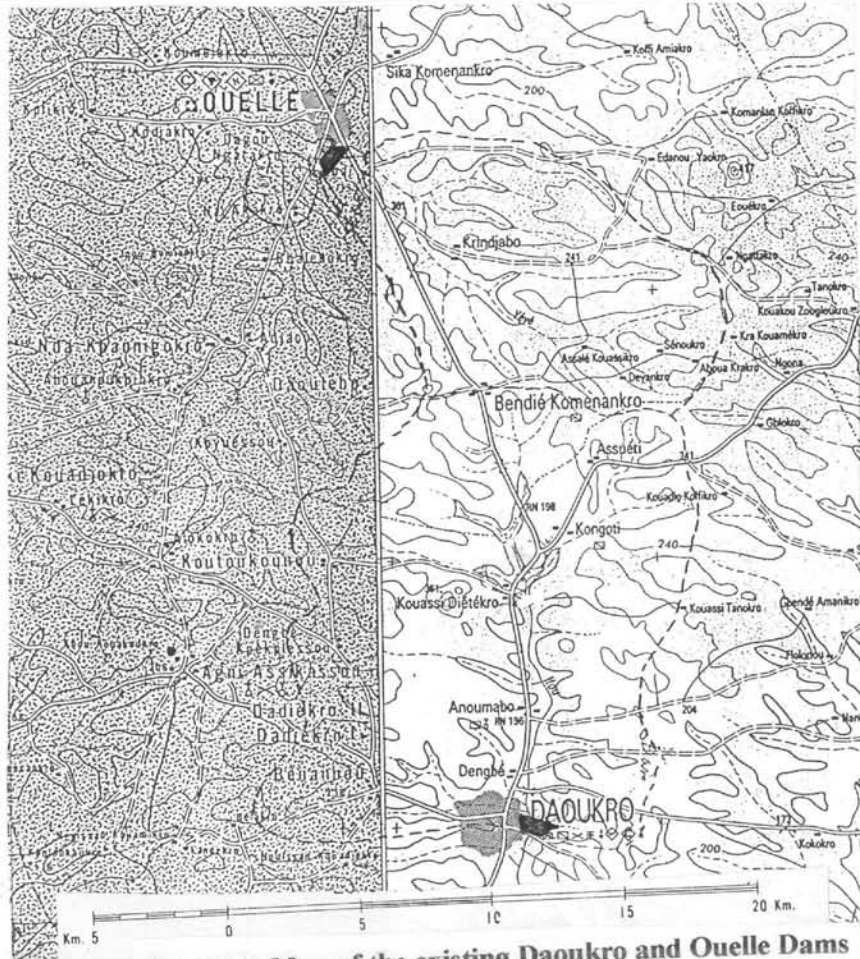
Figure 2.2-6-3　Location Map of Pump Irrigation in the Downstream Area of Taabo Dam in Tiassale

Echelle 1/200 000

Km. 5　0　5　10　15　20 Km.
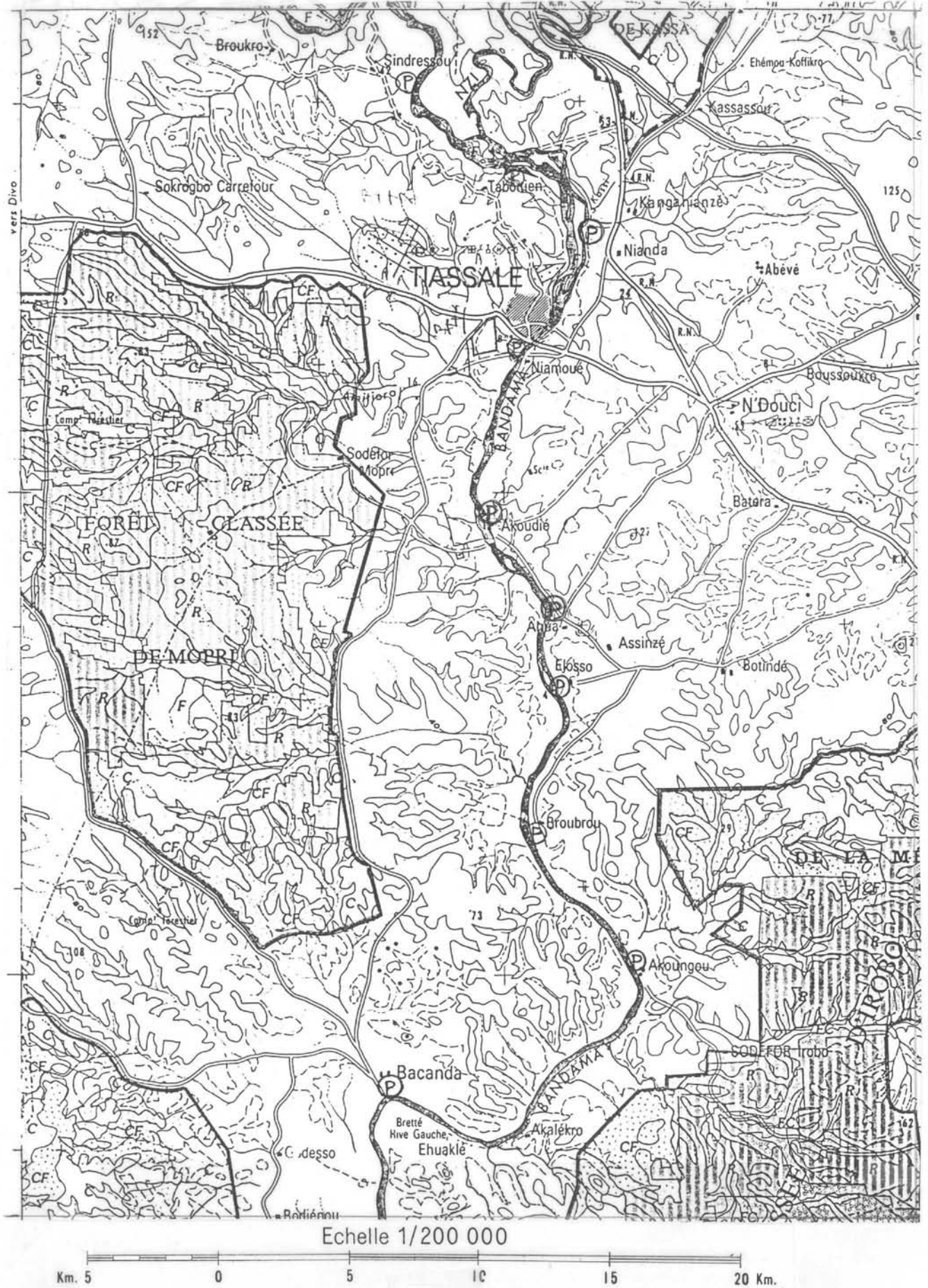
Figure 2.2-6-4 Location Map of Karangoua-Wamo Dam Irrigation Project in Bondoukou

Outline of New Construction Dam

Catchment Area	65 km²
Annual Runoff	5,813,600 m³
Design Flood	60 m³/s
Storgae Capacity	5,813,600 m³
Dam Height	11.28 m
Dam Crest Length	615 m
Dam Type	Erth-fill Dam

Location Map of Karangoua-Wamo Dam Irrigation Project in Bondoukou
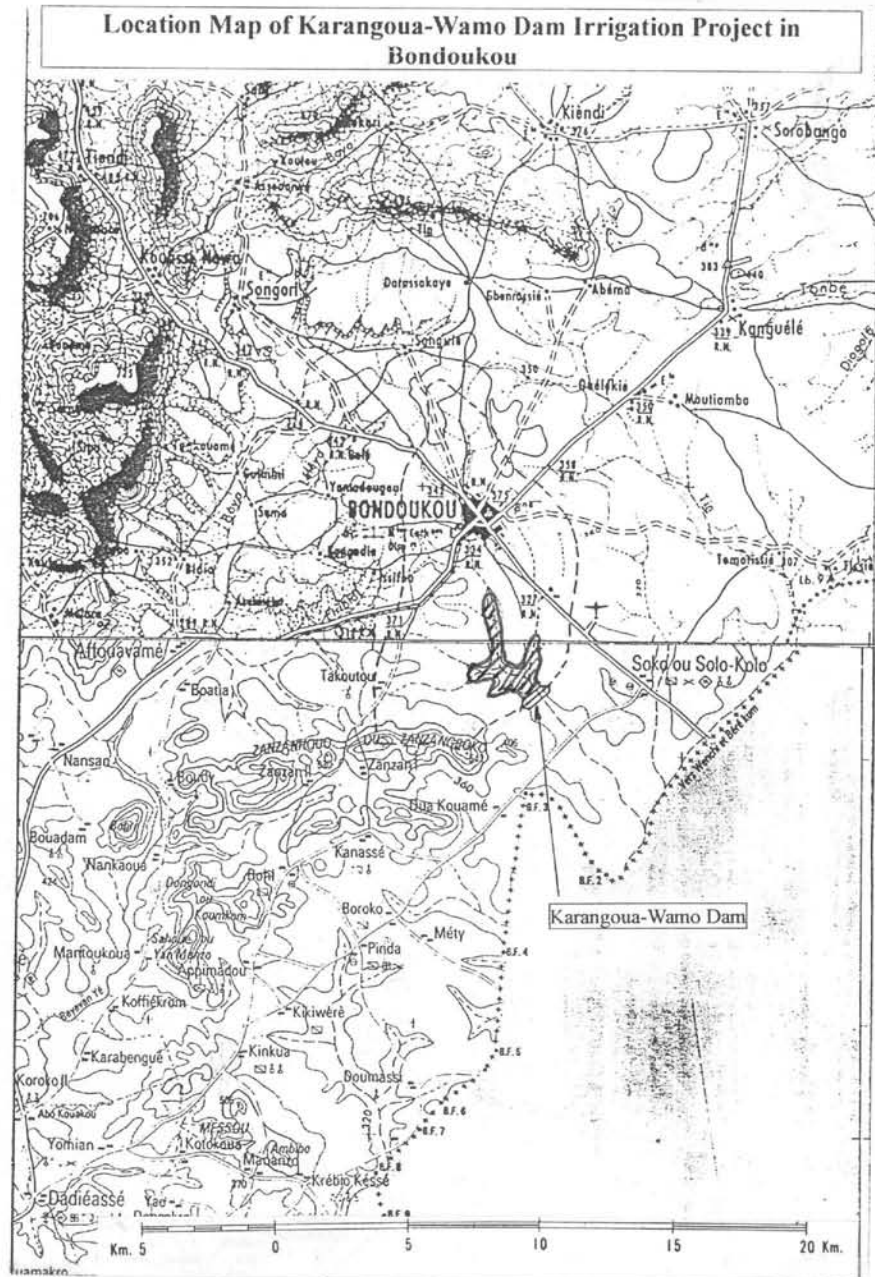
7   WATER USE AND DEMAND

7   WATER USE AND DEMAND

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CHAPTER 1 WATER USE AND DEMAND FOR AGRICULTURE

1.1 Irrigated Crops and Acreage

Irrigated area of crops has been surveyed in many sources as mentioned in Chapter 2. In this study, irrigation inventory survey has been carried out. Estimated irrigation of several source areas is summarized for several sources as shown in the table below.

Comparison of Present Irrigation Area Estimation

Irrigation Estimation	Irri. Paddy Rice (ha)	Vegetables (ha)	Sugarcane (ha)	Banana (ha)	Pineapple (ha)	Total (ha)	Remarks
Irrigation Inventory	7,147	460	11,400	4,016	117	23,140	Table 7.2-1
Cropped Area (1995)	22,000	27,000	21,310	5,600	15,500	91,410	Table 2.4-3
Irrigated Area	22,000	27,000	21,310	5,600	3,500	79,410	Table 2.4-5
Irrigation Ratio	100%	100%	100%	100%	22.6%	86.9%	

As shown in above table, it is understood that the irrigation inventory survey does not cover the whole area of irrigation because its estimation area is much less than other estimations. Integrating whole information, followings are able to be concluded in estimation of irrigation area.

(a) Irrigated paddy area of 7,147 ha can be considered to be the area of double cropping paddy rice, so that crop intensity of paddy rice can be considered to be 1.32. (1 + 7,147/22,000)

(b) Irrigation area of sugarcane is to be 21,310 ha, not 11,400 ha.

(c) Pineapple is irrigated only for 22.6% of total area of pineapple.

1.2 Premises of Irrigation Water Use

For estimating irrigation water, there are many premises on irrigation. Premises on irrigation are as follows:

(A) Climatic Zones, and Rainfall and Evapotranspiration (ETo)

Cote d'Ivoire is divided into four (4) climatic zones, namely Sundanese, Baoule, Mountainous and Attie Climatic Zones as mentioned in Section 5.1 in Chapter 5. In order to estimate irrigation demand in river basin-wise, climatic zone boundary has been arranged as shown in Figure 7.2-1. Same evapotranspiration and rainfall have been applied in same climatic zones for estimation of irrigation water as shown in Table 7.2-2.

(B) Water Use Safety Factor

Water use safety factor for agriculture will be against to the drought year for 1/5years, taking stabilization of crop production and economical investment into consideration. This safety factor is commonly applied to the agricultural projects in Cote d'Ivoire.

In order to ensure water use safety in the drought years, 1/5 year probable dry year rainfall has been applied for estimating water demand in the drought year.   Probable 1/5 year rainfalls are shown in Table 7.2-2.

(C)   Proposed Cropping Calendar of Irrigated Crops

Proposed irrigated crops are paddy rice (double or single cropping), vegetables (tomato – lettuce), sugarcane, banana and pineapples. Their cropping calendar are shown in Figure 7.2-2.

(D)   Crop Consumptive Use (U) and Crop coefficient (K)

Crop consumptive use (U), that is necessary water for crop growth, is estimated based upon the evapotranspiration (ETo) and the crop coefficient (K) in each climatic zone.

Consumptive Use (U) = Evapotranspiration (ETo) x Crop Coefficient (K)

(Note) Crop coefficients are shown in Table 7.2-3.

(E)   Land Preparation Water and Seepage Water for Paddy Rice

Land preparation water and seepage water have been considered only for paddy rice because it needs standing water to grow.   As a standard of the country, following water has been considered:

Land preparation water : 150 mm for paddling
Seepage water: 5 mm/day

(F)   Effective rainfall (Re)

Effective rainfall is a part of rainfall that is used by crops effectively for their growth. There are many methods for estimation of effective rainfall.   In this study, USBR (United State Bureau of Reclamation) method, that is commonly used in Cote d'Ivoire, is applied.   Table 7.2-4 shows the effective rainfall corresponding to the given monthly rainfall.

(G) Irrigation efficiency (E)

Irrigation efficiency is estimated at 65% for all irrigated crops as below:

Irrigation Efficiency applied in this Study

Crops	Irrigation Method	Conveyance Efficiency (Ec)	Application Efficiency (Ea)	Overall Efficiency (Eo)
Paddy Rice	Conveyance System: Open Canal Irrigation Method: Basin Irrigation (Farmers' Level)	Main = 90% Secondary=90% 81%	80%	65%
Vegetables	Conveyance System: Bucket Irrigation Method: Bucket (Farmers' Level)	90%	70%	65%
Sugarcane Banana Pineapples	Conveyance System: Pipeline Irrigation Method: Overhead (Sprinkler, Rain-gun, Center-pivot etc.) (Company Level)	90%	70%	65%

(Note) Irrigation efficiencies are decided based on irrigation condition in Cote d'Ivoire taking criteria of FAO Paper No 24 into considerations.

(H) Conversion of Department-wise Data to River Basin-wise

Agricultural data are generally compiled in the department-wise so that those data are necessary to be converted into river basin-wise.   Conversion has been carried out based on area ratio of departments in each river basin.   Area ratio is explained in Chapter 11 GIS.

Figure 7.2-1 Climatic Zone Boundary arranged taking River Basin Boundary
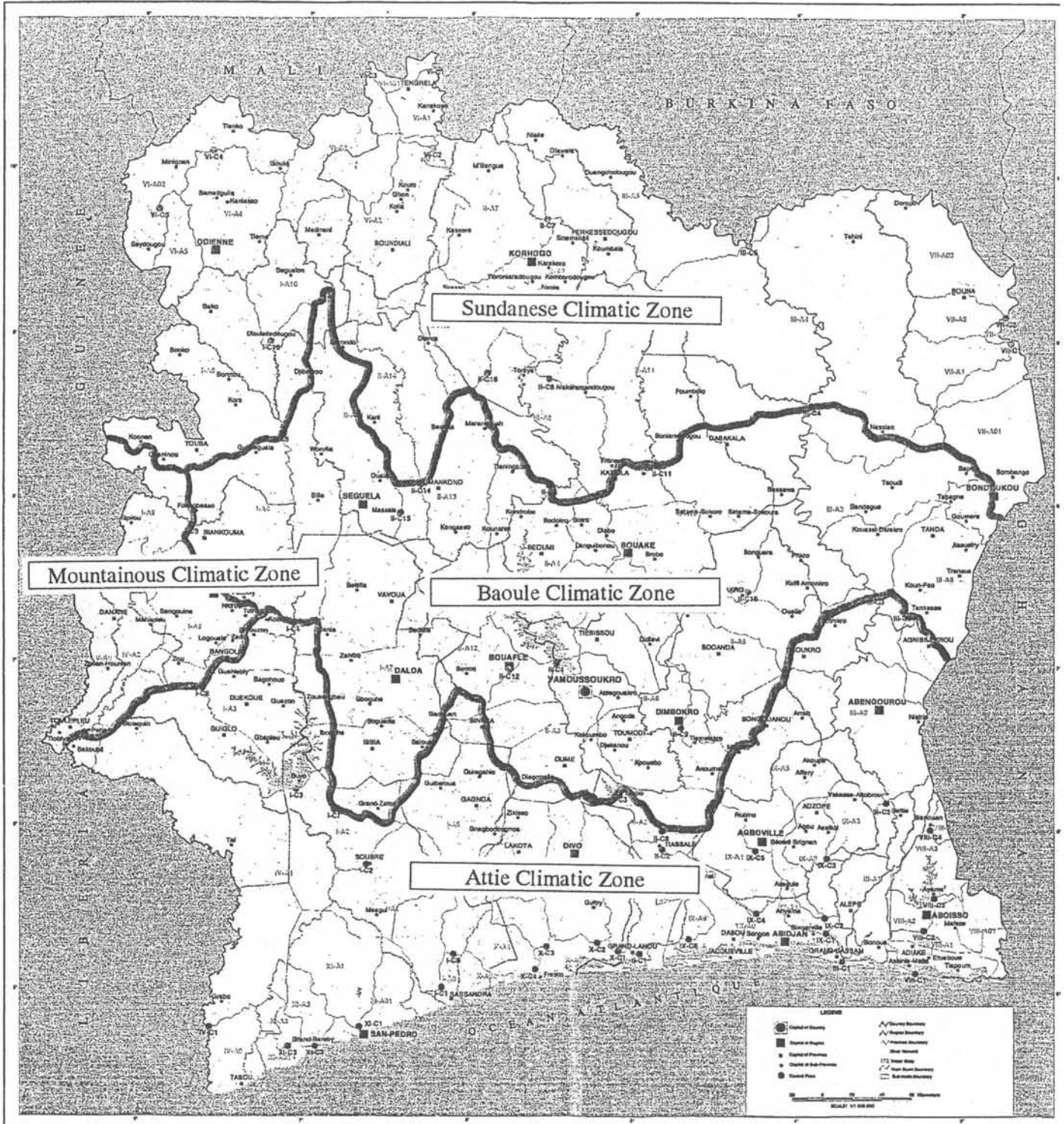
Figure 11.2-2   Proposed Cropping Calendar of Irrigated Crops and Fishpond

Table 11.2-1   Summary of Irrigation Inventory Survey

Region		Paddy Rice		Vegetables		Sugarcane		Banana		Pineapple		Other Crops		Total	
		Nos.	Area (ha)	Nos.	Area (ha)	Nos.	Area (ha)	Nos.	Area (ha)	Nos.	Area (ha)	Nos.	Area (ha)	Nos.	Area (ha)
1	Agneby	1	33	2	212			37	2,763	4	117	10	fruits	54	3,125
2	Bas Sassandra	3	270											3	270
3	Denguele													0	0
4	Haut-Sassandra	3	203											3	203
5	Lacs	32	2,349	1	48									33	2,397
6	Lagunes							12	1,253			2	papaya	14	1,253
7	Marahoue					1	3,400							1	3,400
8	Montagnes													0	0
9	Moyen-Comoe	1	27	3	125							1	coffee	5	152
10	N'zi-Comoe	3	205	1	45									4	250
11	Savanes	16	3,055			1	8,000							17	11,055
12	Sud Bandama													0	0
13	Sud Comoe													0	0
14	Vallee du Bandama	10	975											10	975
15	Worodougou			1	30									1	30
16	Zanzan	1	30											1	30
Total		70	7,147	8	460	2	11,400	49	4,016	4	117	13	0	146	23,140

(Source)   Compiled from the Irrigation Inventory Survey 1999 by JICA Study Team.

Table 11.2-2   Rainfall and Evapotranspiration in Each Climatic Zone

Climatic Zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Sundanese													
Rainfall (mm)													
Average Year	3.4	11.9	42.4	83.9	117.4	137.1	194.0	236.0	182.7	95.2	18.8	5.2	1,128.0
Year 1983	0.0	14.9	1.1	74.8	63.2	130.7	142.3	164.9	149.4	23.2	17.7	10.1	792.3
1/5 Year	0.0	18.2	1.3	91.5	77.3	159.9	174.1	201.7	182.8	28.4	21.7	12.4	969.3 *1
Evapotranspitation (Korhogo)													
Evaporation (pan-A)	175	192	210	174	162	135	118	136	136	144	174	201	1,957 *4
Evapotranspiration	140	154	168	139	130	108	94	109	109	115	139	161	1,566 *2
Baoule													
Rainfall (mm)													
Average Year	8.3	40.0	91.8	122.0	140.2	136.6	119.4	131.0	150.3	111.0	32.3	13.6	1,096.5
Year 1983	0.0	24.1	29.1	111.5	211.5	129.1	27.4	27.6	105.4	28.0	36.5	36.5	766.7
1/5 Year	0.0	29.2	35.3	135.2	256.4	156.5	33.2	33.5	127.8	33.9	44.3	44.3	929.6 *1
Evapotranspiration (Dimbokro)*5													
Penman-Monteith	118	120	133	132	127	108	96	96	102	115	111	102	1,360 *3
Mountainous													
Rainfall (mm)													
Average Year	6.8	34.5	93.1	129.2	156.2	157.6	191.0	282.4	240.9	119.6	26.2	12.1	1,449.6
Year 1983	0.0	64.4	33.5	121.2	102.5	140.9	78.4	205.7	278.2	88.6	21.5	3.1	1,138.0
1/5 Year	0.0	72.3	37.6	136.1	115.1	158.2	88.0	230.9	312.3	99.5	24.1	3.5	1,277.6 *1
Evapotranspiration (Dimbokro)*5													
Penman-Monteith	118	120	133	132	127	108	96	96	102	115	111	102	1,360 *3
Attie													
Rainfall (mm)													
Average Year	19.4	47.8	108.5	138.5	223.7	282.5	133.9	109.9	149.6	160.1	99.6	47.7	1,521.2
Year 1983	0.1	24.9	67.8	96.3	347.4	284.3	39.8	38.3	85.4	74.3	87.5	83.6	1,229.7
1/5 Year	0.1	26.1	71.2	101.1	364.8	298.5	41.8	40.2	89.7	78	91.9	87.8	1,291.2 *1
Evapotranspiration (San Pedro)*6													
Penman-Monteith	112	109	127	123	115	90	96	90	93	112	108	102	1,277 *3

(Note)
*1) Table 5.1-1 (Monthly rainfalls os 1/5Year are same proportion of 1983 Year rainfall.)
*2) Evapotranspiration = 0.80 x Evaporaation
*3) Evapotranspiration = computed based on meteorological data by Penman-Monteith Method. (FAO Irrigation and Drainage Paper 46)
(Source)
*4) Technical and Economic Feasibility Study of Bagoue Vally Rural Integrated Development Project. BADEA Nov. 1998
*5) Meteorological Data (Study of the Integrated Rural Development Project in the N'Zi Middle Vally, Aug. 1995, JICA)
   Evapotranspiration of Dimbokro has been applied to Mountainous Climatic Zone due to no preferable data in this region.
*6) Meteorological Data (Study for the Integrated Rural Development Project in the San-Pedro Plain, Aug. 1999, JICA)

Table 11.2-3   Crop Coefficients of Proposed Irrigated Crops

Crops	Paddy Rice		Tomato		Vegetables (Lettuce)	
	Duration (days)	Crop Coefficient (K)	Duration (days)	Crop Coefficient (K)	Duration (days)	Crop Coefficient (K)
Initial Stage	20	1.15	30	0.7	15	0.75
Development Stage	30	1.15 - 1.20	40	0.70 - 1.10	25	0.75 - 1.10
Mid Stage	40	1.20	45	1.1	35	1.10
Late Stage	30	1.00	30	0.6	15	0.95
Total	120	(FAO No.46)	145	(FAO No.46)	90	(FAO No.46)

Month	Industrial Crops Crop Coefficient (K) (FAO No.24)		
	Sugarcane	Banana	Pineapple (*)
Jan	0.55	1.00	0.80
Feb	0.80	0.80	0.80
Mar	0.90	0.75	0.80
Apr	1.00	0.70	0.80
May	1.05	0.70	0.80
Jun	1.05	0.75	0.80
Jul	1.05	0.90	0.80
Aug	1.05	1.05	0.80
Sep	1.05	1.05	0.80
Oct	1.05	1.05	0.80
Nov	0.80	1.00	0.80
Dec	0.60	1.00	0.80

(Source) FAO Irrigation and Drainage Paper No.24 and No.46
(Note) *: assumed taking bareness of farmland and height of plants.

Table 11.2-4 Effective Rainfall by USBR Method

Range of Monthly Rainfall (mm)	Accumulated Effective Rainfall (mm)
0.0 - 25.4	0 - 25.4
25.4 - 50.8	25.4 - 49.5
50.8 - 76.2	49.5 - 72.4
76.2 - 101.6	72.4 - 92.7
101.6 - 127.0	92.7 - 107.9
127.0 - 152.4	107.9 - 118.1
152.4 - 177.8	118.1 - 120.6
177.8 -	120.6 - 120.6

Effective Rainfall by USBR Method
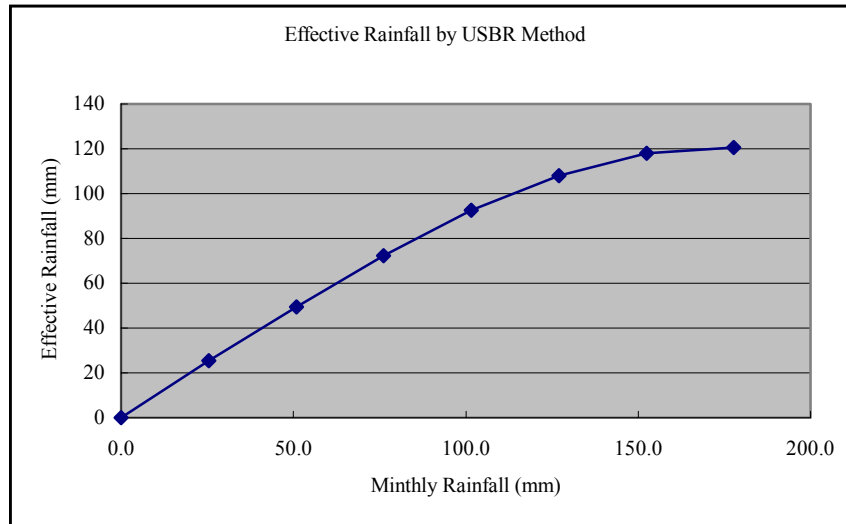
(Source) FAO Irrigation and Drainage Paper No.25 "Effective Rainfall"

1.3   Premises of Livestock Water Use

Following premises have been set for estimating livestock water use:

(A)   Livestock Unit and Acceptable Grazing Capacity

In Cote d'Ivoire, following livestock unit is applied for estimating reasonable grazing area of livestock.   One livestock unit is one cattle having a weight of 250 kg, and it is equivalent to 5 small ruminants (sheep and goat), or 5 pigs.   Acceptable grazing capacity of grassland is one (1) livestock unit per one (1) hectare in Cote d'Ivoire.   Those criteria are applied in DPE, MINAGRA.

One (1) livestock unit = one cattle (250 kg) = 5 small ruminants (sheep or goats) or 5 pigs
Acceptable grazing capacity of grassland = one (1) livestock unit/ha

(DPE, MINAGA)

(B)   Unit Water Demand of Livestock

Water demand of livestock is mainly composed of drinking water because most livestock not only cattle but small ruminants and pigs are grazed in the grassland and field. Modern pigs are only raised in cages and cages are washed periodically.   Washing water will be counted only for modern pigs, which are about 15% of total pigs in average. Table 7.2-5 shows unit water demand of livestock.

Table 11.2-5   Unit Water Demand of Livestock

Livestock	Cattle	Small Ruminant Sheep & Goat	Pig		Poultry
			Traditional	Modern	
Unit Water Demand (lit/day/head)	25	5	5	20	0.1
Comosition			85%	15%	
Integrated Demand (lit/day/head)	25	5	7.25		0.1
Annual Demand (m³/head/yr)	9.025	1.825	2.646		0.0365

(Source)   DPE, MINAGRA

(C)   Trans-border Grazing

In dry season, many herds of cattle are grazed into the northern area from Mali and Burkina Faso beyond the border.   Cattle population is estimated to increase to 1.4 times in dry season in the northern area.   It is, therefore, necessary to increase water demand in dry season in the northern area.   Water demand is assumed to increase 1.20 times of unit demand or 30 lit/head/day.   Increase of water demand will be counted in the Sundanese Climatic Zone which is located in the northern area.

25 lit/head/day x (1 wet season + 1.4 x 1 dry season)/2 = 25 lit/head/day x 1.20 = 30 lit/head/day

1.4   Premises on Aquacultural Water Use

Most premises of irrigation water use will be applied to aquacultural water use.   Different premises form irrigation water use are explained below.

(A)   Water Depth of Fishpond and Seepage Loss

In fishpond, standing water will be kept at 1.0 m depth through the period of fish growth. Water will be lost by seepage and evaporation.   Seepage loss will be 5 mm/day, that is same as seepage loss in paddy field.   Fish will be managed in water use as shown in Figure 7.2-2, and harvested twice a year.

(B)   Effective rainfall (Re)

Aquacultural field has an enough large capacity to receive rainfall so that 100% of rainfall will be

utilized effectively

CHAPTER 2 TABLES

2.1 Computation of Irrigation Requirement by Crops and Climatic Zones

Table 7.1-1-1 Irrigation Requirement of Double Cropping of Rice in Sudanese Climatic Zone

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
days	10	10	11	10	10	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	365
Rainfall (mm)																																					
Average year	3.4	0.0	0.0		11.9			42.4			83.9			117.4			137.1			194.0			236.0			182.7			95.2			18.8			5.2		1,128.0
Year 1983		0.0	0.0		14.9			1.1			74.8			63.2			130.7			142.3			164.9			149.4			23.2			17.7			10.1		792.3
1/5 year		0.0	0.0		18.2			1.3			91.5			77.3			159.9			174.1			201.7			182.8			28.4			21.7			12.4		969.3
Effective Rainfall (mm) by USBR																																					
Average year	3.4	0.0			11.9			41.6			78.6			102.2			111.9			120.6			120.6			120.6			87.6			18.8			5.2		823.0
1/5 year		0.0			18.2			1.3			84.6			73.3			118.9			120.3			120.6			120.6			28.3			21.7			12.4		720.2
Effective Rainfall by 10days (mm): Re																																					
Average year	1.10	1.10	1.21	4.25	4.25	3.40	13.42	13.42	14.76	26.20	26.20	26.20	32.97	32.97	36.26	37.30	37.30	42.79	38.90	38.90	42.79	38.90	38.90	42.79	40.20	40.20	40.20	28.26	28.26	31.08	6.27	6.27	6.27	1.68	1.68	1.85	823.0
1/5 year	0.00	0.00	0.00	6.50	6.50	5.20	0.42	0.42	0.46	28.20	28.20	28.20	23.65	23.65	26.01	39.63	39.63	42.69	38.81	38.81	42.79	40.20	40.20	40.20	40.20	40.20	40.20	9.13	9.13	10.04	7.23	7.23	7.23	4.00	4.00	4.40	720.2
Evapotranspiration (mm)																																					
Monthly ETo (mm)	140			154			168			139			130			108			94			109			109			115			139			161		1,566.0
10 days ETo (mm)	45.16	45.16	49.68	55.00	55.00	44.00	54.19	54.19	59.61	46.33	46.33	46.33	41.94	41.94	45.13	36.00	36.00	36.00	30.32	30.32	33.35	35.16	35.16	38.68	36.33	36.33	36.33	37.10	37.10	40.81	46.33	46.33	46.33	51.94	51.94	57.13	1,566.0
Cropping Calendar																																					
Crop Coefficient (K)	1.07	1.00						1.15	1.15	1.17	1.15	1.17	1.18	1.19	1.20	1.20	1.20	1.20	1.20	1.13	1.07	1.00				1.15	1.15	1.17	1.17	1.18	1.19	1.19	1.20	1.20	1.20	1.13	
	1.00				1.15	1.15	1.17	1.15	1.18	1.20	1.20	1.20	1.20	1.20	1.20	1.13	1.07	1.00						1.15	1.15	1.17	1.18	1.19	1.20	1.18	1.19	1.20	1.20	1.13	1.07	1.00	
Land Preparation & Seepage (L: Puddling Water = 150 mm, P:percolation= 5 mm/day)						150		150	50	50	50	50	50	50	50	50	50	150	50			150			50	50	50	50	50	50	50	50	50	50	55	55	1,520
	50	50			150	50	150	50	55	55	55	55	55	55	55	50	50		50	50	150				50	50	50	50	50	50	55	55	55	55	55	55	1,520
Consumptive Water Use (CU=ETo*K)	48.32	45.16			62.32	62.32	62.32	68.55	68.55	69.74	53.28	54.21	54.67	49.91	50.33	55.36	43.20	43.20	40.68	43.63	41.51	30.32	32.44	41.78	41.78	41.78	42.51	42.67	43.41	44.15	48.16	55.13	55.60	62.33	62.33	64.56	1,201.2
	45.16							63.55	54.21	54.67	50.33	50.33	40.68	38.52	36.00	40.68	30.32		34.15		41.78	41.78	43.78	43.41	43.78	48.56	51.22	58.69	58.69	61.13	1,217.0
Water Requirement (WR=L+P+CU)	98.32	95.16	0.00	0.00	0.00	0.00	0.00	103.28	123.55	123.55	103.28	104.21	104.67	99.91	100.33	110.36	93.20	93.20	90.68	82.44	83.32	80.59	82.32	91.78	91.78	92.51	92.67	93.41	93.78	94.15	103.16	110.36	112.33	112.33	119.56	2,721.2
	95.16	0.00	0.00	0.00	0.00	0.00	0.00	104.21	123.55	112.32	104.21	105.13	105.60	100.33	100.33	110.36	93.20	90.68	88.52	80.32	0.00	0.00	91.78	91.78	92.51	93.78	94.15	103.56	108.69	108.69	116.13	2,737.0
Average (WR)	64.49	31.72	0.00	0.00	0.00	50.00	87.44	124.88	123.95	104.05	105.13	110.36	92.36	90.80	88.40	54.25	26.77	13.84	93.29	93.78	103.56	105.44	105.60	2,722.2
Net Irrigation Requirement (IRn=WR-Re)																																					
Average Year	97.22	94.06	0.00	0.00	0.00	0.00	0.00	77.08	108.79	108.79	77.01	78.01	78.47	66.94	67.36	74.10	55.90	55.90	53.38	43.54	41.42	0.00	0.00	51.58	51.58	51.58	64.41	65.15	72.48	98.86	99.33	110.65	110.65	117.71	2,128.3
	94.06	0.00	0.00	0.00	0.00	146.60	98.90	98.90	78.01	78.47	78.93	67.36	67.36	74.10	55.90	53.38	51.22	41.42	0.00	0.00	51.58	51.58	65.52	65.52	72.48	99.33	99.33	107.01	107.01	114.28	2,130.5
	0.00	0.00	0.00	0.00	0.00	0.00	78.49	111.46	109.19	78.93	79.40	74.10	53.36	48.70	0.00	107.21	51.58	53.79	51.58	65.89	72.89	99.33	99.33	103.90	103.90	110.28	2,139.5
Average (IRn)	63.76	31.35	0.00	0.00	0.00	48.87	78.49	111.46	104.67	78.93	78.93	74.10	55.06	13.81	35.74	53.79	70.99	65.03	65.52	72.48	99.17	109.44	107.19	2,132.8
1/5 year	98.32	95.16	0.00	0.00	0.00	0.00	0.00	149.58	149.58	111.90	76.01	76.47	76.26	76.68	84.35	53.57	53.57	53.57	43.63	41.51	0.00	0.00	51.58	51.58	83.54	84.28	93.52	97.90	98.37	108.33	108.33	115.16	2,223.1
	95.16	0.00	0.00	0.00	0.00	144.80	111.90	111.90	76.53	76.93	76.68	76.68	84.35	51.05	48.89	41.51	0.00	0.00	51.58	51.58	84.28	84.65	93.93	98.37	98.37	104.69	104.69	114.73	2,227.1
	0.00	0.00	0.00	0.00	0.00	48.27	87.16	124.46	123.49	75.85	76.47	74.10	46.37	0.00	107.21	53.79	70.99	84.16	85.02	93.93	98.37	98.37	101.58	101.58	107.73	2,243.1
Average (IRn)	64.49	31.72	0.00	0.00	0.00	50.00	87.16	124.46	104.67	76.93	76.93	74.77	46.37	28.38	35.74	53.79	70.99	84.16	84.65	93.52	98.21	107.12	104.87	2,234.5
Utilized Rainfall (Ru=Average WR - Average IRn)																																					
Average Year	0.7	0.4	0.0		0.0	1.1	9.0	13.4	14.8	26.2	26.2	33.0	33.0	37.3	37.3	25.9	13.0	14.3	0.0	14.3	26.8	28.3	31.1	6.3	6.3	1.7	604.4
	1.1			37.2			78.6	102.3	111.9	107.2	38.9	107.2	87.7	16.9	5.2	604.4
1/5 year	0.0	0.0	0.0		0.0	1.7	0.3	0.4	0.5	28.2	28.2	23.7	25.0	39.6	39.6	25.9	12.9	14.3	0.0	14.3	26.8	9.1	10.0	7.2	7.2	4.0	502.2
	1.2			84.6	73.4	38.8	14.3	118.6	28.2	9.1	21.6	12.4	502.2
Diversion Irrigation Requirement (Ird=Irn/0.65)																																					
Average Year	98.1	48.2	0.0		0.0	75.2	120.8	171.5	168.0	120.7	119.8	103.4	114.0	103.6	43.6	21.2	55.0	0.0	82.8	109.2	111.5	100.8	152.6	152.8	168.4	175.5	3,281.1
	48.3		146.3	460.3	361.9	321.0	64.8	271.7	312.3	458.2	164.9	508.8	3,281.1
1/5 year	99.2	48.8	0.0		0.0	74.3	134.1	190.0	190.0	116.7	118.4	129.8	114.0	117.8	43.7	21.3	55.0	82.8	105.2	143.9	129.5	151.1	151.3	164.6	171.6	3,437.7
	148.0	74.3		191.5	515.6	332.7	118.0	65.0	271.7	403.6	453.7	105.8	151.3	161.3	3,437.7

Table 7.1-1-2 Irrigation Requirement of Double Cropping of Rice in Boatle Climatic Zone

Month		Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
days	10	10	11	10	10	8	10	10	11	10	10	10	10	10	11	10	10	10	10	10	11	10	10	11	10	10	10	10	10	10	10	10	11				365
Rainfall (mm)																																						
Average year	8.3	0.0	0.0	40.0	24.1	29.2	91.8	29.1	35.3	122.0	111.5	135.2	140.2	211.5	256.4	136.6	129.1	156.5	119.4	27.4	33.2	131.0	27.6	33.5	150.3	105.4	127.8	111.0	28.0	33.9	32.3	36.5	44.3	13.6	36.5	44.3	1,096.5
Year 1983																																					766.7
1/5 year																																					929.6
Effective Rainfall (mm) by USBR																																					
Average year	8.3	0.0		59.3	29.0		84.9	34.8		104.9	111.2		113.2	120.6		111.7	118.5		103.4	32.8		109.5	33.1		117.2	108.2		98.3	33.5		32.0	43.4		13.6	43.4			936.3
1/5 year																																					708.5
Effective Rainfall by 10days (mm): Re																																					
Average year	2.68	2.68	2.95	14.04	14.04	11.23	27.39	27.39	30.13	34.97	34.97	34.97	36.52	36.52	34.97	37.23	37.23	37.23	33.35	35.32	36.69	35.32	35.32	38.85	39.07	39.07	39.07	31.71	31.71	34.88	10.67	10.67	39.48	4.39	4.39	4.83	936.4
1/5 year	0.00	0.00	0.00	10.36	10.36	8.29	11.23	11.23	12.35	37.07	37.07	37.07	38.90	38.90	37.07	39.50	39.50	39.50	10.58	10.68	11.64	10.68	10.68	11.75	36.07	36.07	36.07	10.81	10.81	11.89	14.47	14.47	38.72	14.00	14.00	15.40	708.6
Evapotranspiration (mm)																																					
Monthly ETo (mm)	118			120			133			132			127			108			96			96			102			115			111			102			1,360.0
10 days ETo (mm)	38.06	38.06	41.87	42.86	42.86	34.29	42.90	42.90	47.19	44.00	44.00	44.00	40.97	40.97	45.06	36.00	36.00	36.00	30.97	30.97	34.06	30.97	30.97	34.06	34.00	34.00	34.00	37.10	37.10	40.81	37.00	37.00	35.20	32.90	32.90	36.19	1,360.0
Cropping Calendar																																					
Crop Coefficient (K)																																					
	1.07	1.00							1.15	1.15	1.17	1.18	1.19	1.20	1.20	1.20	1.13	1.07	1.00							1.15	1.15	1.17	1.15	1.17	1.18	1.19	1.20	1.20	1.20	1.13	
	1.00					1.15	1.15	1.17	1.18	1.19	1.20	1.20	1.20	1.20	1.20	1.13	1.07	1.00										1.15	1.16	1.18	1.19	1.20	1.20	1.20	1.13	1.07	
																					1.15															1.00	
Land Preparation & Seepage (L: Puddling Water = 150 mm, P:percolation= 5 mm/day)																																					
	50	50				150	150	50	50	50	50	50	50	50	50	50	55	55	50	50				150	150	50	50	50	50	55	55	55	50	50	50	55	1,520
	50							50	50	50	50	50	50	50	55	55	55	50	50	50	150	50	50					50	50	55	55	50	50	50	55		1,520
				150																			150	150											1,520
Consumptive Water Use (CU=ETo*K)																																					
	40.72							49.34	54.27	50.60	51.48	51.92	48.75	49.16	54.07	43.20	43.20	40.68	33.14						39.10	42.67	43.41	44.03	44.40	48.16	39.48	39.48	39.48				1,056.2
	38.06						49.34	54.27	51.48	51.92	52.36	49.16	49.16	54.07	40.68	40.68	38.52	30.97						39.10	43.41	43.78	44.40	44.40	48.56	37.18	39.48	38.72				1,065.7
				49.34					51.92	52.36	52.80	49.16	49.16	54.07	38.52	36.00	30.97			39.10			39.10	44.15	44.40	48.97	44.40	35.20	37.18	36.19				1,075.2
Water Requirement (WR=L+P+CU)																																					
	90.72	88.06	0.00	0.00	0.00	0.00	150.00	99.34	109.27	100.60	101.48	101.92	98.75	99.16	109.07	93.20	93.20	90.68	83.14	80.97	0.00	0.00	0.00	0.00	0.00	92.67	93.41	94.03	94.40	103.16	89.48	89.48	95.89				2,576.2
	88.06	0.00	0.00	0.00	0.00	0.00	150.00	99.34	109.27	101.48	101.92	102.36	99.16	99.16	109.07	93.20	90.68	88.52	80.97	0.00	0.00	0.00	0.00	150.00	89.10	93.41	93.78	94.40	94.40	103.56	87.18	89.48	93.72				2,585.7
	0.00	0.00	0.00	150.00	0.00	0.00	99.34	99.34	110.21	102.36	102.80	109.07	109.07	109.07	86.00	86.00	86.00	0.00	0.00	89.10			89.10	93.78	94.15	103.97	94.40	85.20	87.18	91.19				2,595.2
Average (WR)	59.59	29.35	0.00	0.00	50.00	150.00	116.23	109.58	101.33	102.36	109.07	92.36	90.80	88.40	54.70	26.99	0.00	0.00	0.00	79.70	109.40	93.29	103.56	94.28	93.60				2,585.7
Net Irrigation Requirement (IRn=WR-Re)																																					
Average Year																																					
	88.04	85.38	0.00	0.00	0.00	0.00	122.61	79.14	101.48	65.63	66.51	62.23	55.97	53.45	49.79	47.62	0.00	0.00	0.00	0.00	60.96	61.70	68.28	83.36	85.09	85.09	91.06				1,894.8
	85.38	0.00	0.00	0.00	0.00	138.77	79.14	96.92	66.51	62.64	60.26	53.45	51.29	47.62	0.00	0.00	0.00	0.00	0.00	61.70	62.07	68.68	83.73	82.97	85.09	82.79	88.89				1,873.8
	0.00	0.00	0.00	138.77	141.71	0.00	71.95	80.68	67.83	62.64	60.26	48.77	45.29	0.00	111.15	0.00	62.44	69.09	83.73	82.81	86.36				1,869.3
1/5 year	57.81	28.46	46.26	64.85	88.84	88.84	65.36	66.95	62.50	55.13	53.57	51.17	32.47	15.87	37.05	53.65	70.33	62.07	68.68	83.61	84.32	88.77				1,879.3
Utilized Rainfall (Rus=Average WR - Average IRn)																																					
Average Year	1.8	0.9	0.0	0.0	0.0	0.0	27.4	30.1	35.0	36.5	40.2	37.2	36.1	13.0	0.0	0.0	0.0	26.1	39.1	31.7	34.9	10.7	4.4	706.6
1/5 year	1.1	0.9	2.7	3.7	75.8	124	37.1	38.9	42.8	39.5	3.9	7.1	24.1	36.1	10.8	11.9	14.5	14.0	15.4	706.6
Diversion Irrigation Requirement (Ird=Irn/0.65)																																					
Average Year	88.9	43.8	0.0	0.0	71.2	99.8	136.7	122.2	103.0	96.4	106.0	82.4	84.8	50.0	24.4	82.5	108.2	94.7	95.5	128.8	127.5	136.6	2,891.2
1/5 year	91.7	45.2	0.0	0.0	72.7	116.4	161.5	149.6	100.4	92.7	102.0	78.9	75.2	73.3	74.4	85.6	112.8	126.9	123.0	114.9	393.8	123.0	2,891.2

Table 7.1-1-3 Irrigation Requirement of Double Cropping of Rice in Mountainous Climatic Zone

Month				Total
days				365
Rainfall (mm)				
Average year				1,449.6
Year 1983				1,138.0
1/5 year				1,277.6
Effective Rainfall (mm) by USBR				
Average year				976.2
1/5 year				878.5
Effective Rainfall by 10days (mm): Re				
Average year				976.2
1/5 year				878.5
Evapotranspiration (mm)				
Monthly ETo (mm)				1,360.0
10 days ETo (mm)				1,360.0
Cropping Calendar				
Crop Coefficient (K)				
Land Preparation & Seepage (L: Puddling Water=150 mm, P:percolation= 5 mm/day)				1,520 / 1,520 / 1,520
Consumptive Water Use (CU=ETo*K)				1,056.2 / 1,065.7 / 1,075.2
Water Requirement (WR=L+P+CU)				2,576.2 / 2,585.7 / 2,595.2
Average (WR)				2,585.7
Net Irrigation Requirement (IRn=WR-Re)				
Average Year				1,867.8 / 1,850.4 / 1,848.5
Average (IRn)				1,855.6
1/5 year				1,968.4 / 1,952.1 / 1,925.5
Average (Rn)				1,948.7
Utilized Rainfall (Rn=Average WR - Average IRn)				
Average Year				730.1
1/5 year				730.1 / 637.2 / 637.2
Diversion Irrigation Requirement (Ird=Irn/0.65)				
Average Year				2,854.8 / 2,854.8
1/5 year				2,980.0 / 2,998.0 / 2,998.0

Table 7.1-1-4 Irrigation Requirement of Double Cropping of Rice in Attie Climatic Zone

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
days	I 10	II 10	III 11	I 10	II 10	III 8	I 10	II 10	III 11	I 10	II 10	III 10	I 10	II 10	III 11	I 10	II 10	III 10	I 10	II 10	III 11	I 10	II 10	III 11	I 10	II 10	III 10	I 10	II 10	III 11	I 10	II 10	III 10	I 10	II 10	III 11	365
Rainfall (mm)																																					
Average year		19.4			47.8			108.5			138.5			223.7			282.5			133.9			109.9			149.6			160.1			99.6			47.7		1,521.2
Year 1983		0.1			24.9			67.8			96.3			347.4			284.3			39.8			38.3			85.4			74.3			87.5			83.6		1,229.7
1/5 year		0.1			26.1			71.2			101.1			364.8			298.5			41.8			40.2			89.7			78.0			91.9			87.8		1,291.2
Effective Rainfall (mm) by USBR																																					
Average year		19.4			46.7			96.8			112.5			120.6			120.6			110.7			97.7			116.9			118.9			91.1			46.6		1,098.5
1/5 year		0.1			26.1			67.9			92.3			120.6			120.6			41.0			39.5			83.2			73.8			85.0			81.7		831.8
Effective Rainfall by 10days (mm): Re																																					
Average year	6.26	6.26	6.88	16.68	16.68	13.34	31.23	31.23	34.35	37.50	37.50	37.50	38.90	38.90	42.79	40.20	40.20	40.20	35.71	35.71	39.28	31.52	31.52	34.67	38.97	38.97	38.35	38.35	42.19	46.89	42.84	43.20	46.69	39.48	39.48	40.89	1,098.5
1/5 year	0.03	0.03	0.04	9.32	9.32	7.46	21.90	21.90	24.09	30.77	30.77	30.77	38.90	38.90	42.79	40.20	40.20	40.20	13.23	13.23	14.55	12.74	12.74	14.02	27.73	27.73	23.81	23.81	26.19	47.23	43.20	43.20	47.23	37.18	37.18	38.72	831.8
Evapotranspiration (mm)																																					
Monthly ETo (mm)		112			109			127			123			115			90			96			90			93			112			108			102		1,277.0
10 days (mm)	36.13	36.13	39.74	38.93	38.93	31.14	40.97	40.97	45.06	41.00	41.00	41.00	37.10	37.10	40.81	30.00	30.00	30.00	30.97	30.97	34.06	29.03	29.03	31.94	31.00	31.00	36.13	36.13	39.74	42.99	43.20	43.20	46.69	35.20	35.20	36.19	1,277.0
Cropping Calendar																																					
Crop Coefficient (K)	1.07	1.00						1.15	1.15	1.17	1.15	1.17	1.18	1.19	1.20	1.20	1.20	1.13	1.07	1.00						1.15	1.15	1.17	1.15	1.17	1.18	1.19	1.20	1.20	1.20	1.13	1.07	1.00	
1.00							1.15	1.15	1.17	1.18	1.19	1.20	1.20	1.20	1.20										1.15	1.17	1.18	1.18	1.19	1.20	1.20	1.20	1.20	1.13	1.07	1.00	
Land Preparation & Seepage (L: Puddling Water = 150 mm, P:percolation= 5 mm/day)																																					

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Table 7.1-2-1 Irrigation Requirement of Wet Season Rice in Sudanese Climatic Zone

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
days	10	10	11	10	10	8	10	10	11	10	10	10	10	11	10	10	11	10	10	10	11	10	10	11	10	10	11	10	10	11	10	10	11	365

Rainfall (mm)

Average year: 3.4 / 11.9 / 42.4 / 83.9 / 117.4 / 137.1 / 194.0 / 236.0 / 182.7 / 95.2 / 18.8 / 5.2 — Total 1,128.0
Year 1983: 0.0 / 14.9 / 1.1 / 74.8 / 63.2 / 130.7 / 142.3 / 164.9 / 149.4 / 23.2 / 17.7 / 10.1 — Total 792.3
1/5 year: 0.0 / 18.2 / 1.3 / 91.5 / 77.3 / 159.9 / 174.1 / 201.7 / 182.8 / 28.4 / 21.7 / 12.4 — Total 969.3

Effective Rainfall (mm) by USBR

Average year: 3.4 / 11.9 / 41.6 / 78.6 / 102.2 / 111.9 / 120.6 / 120.6 / 120.6 / 87.6 / 18.8 / 5.2 — Total 823.0
1/5 year: 0.0 / 18.2 / 1.3 / 84.6 / 73.3 / 118.9 / 120.3 / 120.6 / 120.6 / 28.3 / 21.7 / 12.4 — Total 720.2

Effective Rainfall by 10days (mm): Re

Average year: 1.10 / 1.10 / 1.21 / 4.25 / 4.25 / 3.40 / 13.42 / 13.42 / 14.76 / 26.20 / 26.20 / 26.20 / 32.97 / 36.26 / 37.30 / 37.30 / 38.90 / 38.90 / 38.90 / 42.79 / 40.20 / 40.20 / 40.20 / 31.08 / 28.26 / 28.26 / 6.27 / 6.27 / 6.27 / 1.68 / 1.68 — Total 823.0
1/5 year: 0.00 / 0.00 / 0.00 / 6.50 / 6.50 / 5.20 / 0.42 / 0.42 / 0.46 / 28.20 / 28.20 / 23.65 / 23.65 / 26.01 / 39.63 / 39.63 / 38.81 / 38.90 / 38.90 / 42.69 / 40.20 / 40.20 / 40.20 / 10.04 / 9.13 / 9.13 / 7.23 / 7.23 / 7.23 / 4.00 / 4.00 — Total 720.2

Evapotranspiration (mm)

Monthly ETo (mm): 140 / 154 / 168 / 139 / 130 / 108 / 94 / 109 / 109 / 115 / 139 / 161 — Total 1,566.0
10 days (mm): 45.16 / 55.00 / 44.00 / 54.19 / 46.33 / 41.94 / 46.13 / 36.00 / 30.32 / 35.16 / 36.33 / 36.33 / 37.10 / 46.33 / 51.94 — Total 1,566.0
Cropping Calendar: 45.16 / 45.19 / 59.61 / 46.33 / 33.35 / 33.68 / 36.33 / 40.81 / 46.33 / 57.13

Crop Coefficient (K): 1.15 / 1.15 / 1.15 / 1.15 / 1.17 / 1.18 / 1.19 / 1.20 / 1.20 / 1.20 / 1.18 / 1.19 / 1.20 / 1.20 / 1.19 / 1.13 / 1.07 / 1.00

Land Preparation & Seepage (L: Puddling Water = 150 mm, P: percolation = 5 mm/day)

1.15 / 150 / 150 / 150 / 55 / 55 / 55 / 50 / 50 / 50 / 50 / 50 — 760
50 / 50 / 50 / 55 / 55 / 55 / 50 / 50 / 50 / 50 — 760
50 — 760

Consumptive Water Use (CU=ETo*K): 53.28 / 53.28 / 54.43 / 54.89 / 35.68 / 37.62 / 35.16 — Total 512.5 / 531.1 / 545.2

Water Requirement (WR=L+P+CU)

0.00 / 0.00 / 0.00 / 150.00 / 103.28 / 109.43 / 98.23 / 92.84 / 93.20 / 86.38 / 87.62 / 85.16 / 92.69 — 1,277.5
0.00 / 0.00 / 0.00 / 103.28 / 103.28 / 109.89 / 99.07 / 93.20 / 93.20 / 84.26 / 85.16 / 90.68 — 1,291.1
0.00 / 50.00 / 103.28 / 104.21 / 99.49 / 93.20 / 86.38 / 88.35 — 1,305.2

Average (WR): 50.00 / 118.85 / 103.59 / 98.93 / 93.08 / 84.36 / 85.67 / 90.57 — 1,291.2

Net Irrigation Requirement (IRn=WR-Re)

0.00 / 0.00 / 0.00 / 0.00 / 0.00 / 123.80 / 65.26 / 55.54 / 49.90 / 47.48 / 48.72 / 46.26 — 812.6
0.00 / 0.00 / 0.00 / 123.80 / 77.08 / 66.10 / 55.90 / 55.90 / 47.89 / 45.36 / 46.25 / 0.00 — 838.9
0.00 / 135.24 / 77.08 / 78.01 / 66.52 / 55.90 / 43.54 / 45.56 / 0.00 / 0.00 — 877.1

Average (IRn): 84.43 / 118.80 / 66.96 / 65.96 / 55.78 / 45.46 / 47.78 / 31.66 — 832.9

0.00 / 0.00 / 0.00 / 0.00 / 121.80 / 74.58 / 53.21 / 47.57 / 47.57 / 46.26 — 830.8
0.00 / 0.00 / 0.00 / 121.80 / 75.08 / 75.42 / 53.57 / 47.57 / 46.25 / 0.00 — 885.1
0.00 / 149.54 / 75.08 / 76.26 / 53.57 / 45.45 / 45.66 / 0.00 — 907.6

Average (IRn): 65.63 / 90.65 / 75.84 / 75.28 / 53.45 / 46.86 / 47.88 / 31.66 — 864.5

Utilized Rainfall (Ru=Average WR - Average IRn)

4.9 / 17.5 / 26.2 / 33.0 / 36.3 / 37.3 / 38.9 / 42.8 / 25.9 / 13.0 — 448.5
4.9 / 69.9 / 102.3 / 111.9 / 120.6 / 38.9 — 448.5
0.1 / 18.8 / 28.2 / 23.7 / 26.0 / 39.6 / 38.8 / 42.7 — 425.7
75.2 / 73.4 / 118.8 / 120.3 — 425.7

Diversion Irrigation Requirement (Ird=Irn/0.65)

69.4 / 103.0 / 142.5 / 102.3 / 113.3 / 85.5 / 72.0 / 73.5 / 48.7 — 1,295.7
0.0 / 364.6 / 317.1 / 257.8 / 215.4 — 1,295.7
76.7 / 101.0 / 139.5 / 116.7 / 116.0 / 82.4 / 70.1 / 73.7 / 48.7 — 1,330.0
76.7 / 356.5 / 361.5 / 247.0 / 215.9 — 1,330.0

Table 7.1-2-2 Irrigation Requirement of Wet Season Rice in Boaule Climatic Zone

Item	Total
Rainfall (mm)	
Average year	1,096.5
Year 1983	766.7
1/5 year	929.6
Effective Rainfall (mm) by USBR	
Average year	936.3
1/5 year	708.5
Effective Rainfall by 10days (mm) Re	
Average year	936.4
1/5 year	708.6
Evapotranspiration (mm)	
Monthly ETo (mm)	1,360.0
10 days (mm)	1,360.0
Cropping Calendar	
Crop Coefficient (K)	
Land Preparation & Seepage (L: Puddling Water = 150 mm, P:percolation= 5 mm/day)	760 / 760 / 760
Consumptive Water Use (CU=ETo*K)	503.0 / 520.3 / 535.6
Water Requirement (WR=L+P+CU)	1,265.0 / 1,280.3 / 1,295.6
Average (WR)	1,280.3
Net Irrigation Requirement (IRn=WR-Re)	
Average Year	796.1 / 811.7 / 832.3
Average (IRn)	813.4
1/5 year	897.6 / 885.5 / 900.2
Average (IRn)	884.8
Utilized Rainfall (Rnn=Average WR - Average IRn)	
Average Year	466.9
1/5 year	385.6
Diversion Irrigation Requirement (Ird=Irn/0.65)	
Average Year	1,251.3 / 1,251.3
1/5 year	1,376.4 / 1,376.4

Table 7.1-2-3 Irrigation Requirement of Wet Season Rice in Mountainous Climatic Zone

Month	Jan I	Jan II	Jan III	Feb I	Feb II	Feb III	Mar I	Mar II	Mar III	Apr I	Apr II	Apr III	May I	May II	May III	Jun I	Jun II	Jun III	Jul I	Jul II	Jul III	Aug I	Aug II	Aug III	Sep I	Sep II	Sep III	Oct I	Oct II	Oct III	Nov I	Nov II	Nov III	Dec I	Dec II	Dec III	Total
days	10	10	10	10	10	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	365
Rainfall (mm)																																					
Average year	6.8	0.0	0.0	34.5	64.4	72.3	93.1	33.5	37.6	129.2	121.2	136.1	156.2		115.1	157.6	140.9	158.2	191.0	78.4	88.0	282.4	205.7	230.9	240.9	278.2	312.3	119.6	88.6	99.5	26.2	21.5	24.1	12.1	3.1	3.5	1,449.6
Year 1983																																					1,138.0
1/5 year																																					1,277.6
Effective Rainfall (mm) by USBR																																					
Average year	6.8			34.0			85.9			106.8			118.5			118.6			120.6			120.6			120.6			103.5			26.2			12.1			976.2
1/5 year	0.0			68.9			37.0			111.5			100.8			118.7			81.8			120.6			120.6			91.0			24.1			3.5			878.5
Effective Rainfall by 10 days (mm): Re																																					
Average year	2.19	2.19	0.00	12.14	24.61		27.71	11.94		36.27	36.27	36.27	38.23	38.23	42.05	39.53	39.53	39.53	38.90	38.90	38.90	38.90	38.90	42.79	40.20	40.20	40.20	33.39	33.39	36.73	8.73	8.73	8.73	3.90	3.90	4.29	976.2
1/5 year	2.19	0.00	0.00	24.61	24.61		11.94	11.94		37.17	37.17	35.77	32.52	32.52	35.77	39.57	39.57	39.57	26.39	26.39	29.03	38.90	38.90	42.79	40.20	40.20	40.20	29.35	29.35	32.29	8.03	8.03	8.03	1.13	1.13	1.24	878.5
Evapotranspiration (mm)																																					
Monthly ETo (mm)	118			120			133			132			127			108			96			96			102			115			111			102			1,360.0
10 days (mm)	38.06	38.06		42.86	42.86	34.29	42.90	42.90	47.19	44.00	44.00	45.06	40.97	40.97	45.06	36.00	36.00	36.00	30.97	30.97	34.06	30.97	30.97	34.06	34.00	34.00	34.00	37.10	37.10	40.81	37.00	37.00	37.00	32.90	32.90	36.19	1,360.0
Cropping Calendar																																					
Crop Coefficient (Kc)										1.15	1.15	1.15	1.15	1.17	1.18	1.19	1.18	1.17	1.20	1.20	1.20	1.07	1.00	1.13													
Land Preparation & Seepage (L: Puddling Water = 150 mm, Percolation = 5 mm/day)										150	150		150	50	50	50	50	50	50	50	50	50															760
Consumptive Water Use (CU=ETo*Kc)										50.60	50.60	50.60	53.17	47.93	47.93	42.84	43.20	37.16	37.16	35.00	33.14	30.97															505.0
Water Requirement (WR=L+P+CU)																																					
										150.00	150.00	117.07	108.17	97.93	108.62	93.20	93.20	87.16	87.16	85.00	83.14	80.97															1,265.0
Average (WR)										117.07			108.62			93.20			86.44			26.99															1,280.3
Net Irrigation Requirement (IRn=WR-Re)																																					
Average Year										113.73	64.33	80.80	66.12	59.70	50.70	53.31	53.67	48.26	48.26	46.10	44.24	42.07															757.0
Average (IRn)										117.07			98.34									14.02															776.8
1/5 year										112.83	63.43	79.90	65.41	65.82	64.46	53.27	53.63	60.77	60.77	58.61	56.75	42.07															811.5
Average (IRn)																						14.02															836.6
Utilized Rainfall (Rue: Average WR - Average IRn)																																					
Average Year										36.3			38.2			39.5			38.9			13.0															503.5
1/5 year										24.8			32.5			39.6			26.4			13.0															443.9
Diversion Irrigation Requirement (IRd=IRn/0.65)																																					
Average Year										124.3			92.5			82.4			73.1			21.6															1,195.2
1/5 year										99.4			100.4			82.3			92.4			21.6															1,287.0

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Table 7.1-2-4 Irrigation Requirement of Wet Season Rice in Attie Climatic Zone

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
days	10	10	11	10	10	8	10	10	11	10	10	10	10	11	10	10	11	10	10	11	10	10	10	10	10	11	10	10	10	10	10	10	11	365
Radfall (mm)																																		
Average year	19.4			47.8	24.9	26.1	108.5	67.8	71.2	138.5	96.3	101.1	223.7	347.4	364.8	282.5	284.3	298.5	133.9	39.8	41.8				149.6	85.4	89.7	160.1	74.3	78.0	99.6	87.5	91.9	47.7	83.6	87.8	1,521.2
Year 1983	0.1																																				1,229.7
1/5 year	0.1																																				1,291.2
Effective Rainfall (mm) by USBR																																					
Average year	19.4			46.7	26.1		96.8	67.9		112.5	92.3		120.6	120.6		120.6	120.6		110.7	41.0					116.9	83.2		118.9	73.8		91.1	85.0		46.6	81.7		1,098.5
1/5 year	0.1			26.1																																	931.8
Effective Rainfall by 10 days (mm): Re																																					
Average year	6.26	6.26	6.88	16.68	16.68	13.34	31.23	31.23	34.35	37.50	37.50	37.50	42.67	43.41	35.00	40.20	40.20	40.20	35.71	35.71	39.28				38.97	38.97	38.97	38.35	38.35	42.19	30.37	30.37	30.37	15.03	15.03	16.54	1,098.5
1/5 year	0.03	0.03	0.04	9.32	9.32	7.46	21.90	21.90	24.09	30.77	30.77	30.77	43.41	43.78	36.00	40.20	40.20	40.20	13.23	13.23	14.55				27.73	27.73	27.73	23.81	23.81	26.19	28.33	28.33	28.33	26.35	26.35	28.99	931.8
Evapotranspiration (mm)																																					
Monthly ETo (mm)	112			109			127			123			115			90			96						93			112			108			102			1,277.0
10 days (mm)	36.13	36.13	36.13	38.93	38.93	31.14	40.97	40.97	45.06	41.00	41.00	41.00	37.10	40.81	30.00	30.00	30.00	30.00	30.97	30.97	34.06				31.00	31.00	31.00	36.13	36.13	39.74	36.00	36.00	36.00	32.90	32.90	36.19	1,277.0
Cropping Calendar																																					
Crop Coefficient (K)										1.15		1.07	1.15	1.18	1.19	1.20	1.20	1.20	1.20	1.20	1.13																
										1.15	1.00		1.17	1.19	1.20	1.20	1.20	1.20	1.20	1.13	1.07																
													1.18	1.20		1.20	1.20		1.13	1.07	1.00																
Land Preparation & Seepage (L: Puddling Water = 150 mm, P:percolation= 5 mm/day)																																					
									150	150	150	50	50	50	50	50	50	50	50	50	50															760
											50	50	50	50	50	50	50	50	50	50	55															760
									150	50	50		50	50	50	50	50	50	50	50	55															760
Consumptive Water Use (CU=ETo*K)										47.15			42.67	43.41	35.00	36.00	36.00	36.00	37.16	37.16	38.49																462.0
									47.15	47.15	29.03		43.41	43.78	36.00	36.00	36.00	36.00	37.16	37.16	36.44															475.7
										47.15	47.97		43.78	44.15	36.00	36.00	36.00	35.00	33.14	34.06															489.4
Water Requirement (WR=L+P+CU)										97.15	150.00	79.03	92.67	93.41	85.70	86.00	86.00	87.16	87.16	93.49															1,222.0
									150.00	97.15	0.00		93.41	93.78	86.00	86.00	86.00	87.16	85.00	91.44															1,235.7
									0.00	97.15	97.97	0.00	93.78	94.15	86.00	86.00	86.00	85.00	85.00	93.06	91.33														1,289.4
Average (WR)									50.00	82.38	114.77	53.36	93.29	93.78	85.90	86.00	86.00	85.00	86.44	93.10	91.33														1,235.7
Net Irrigation Requirement (IRn=WR-Re)																																					
Average Year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	112.50	47.51	53.77	54.51	45.50	45.80	45.80	51.45	51.45	54.21															732.1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	112.50	59.65	0.00	49.29	54.51	60.77	45.80	45.80	45.80	51.45	49.29	52.16															739.8
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	59.65	59.65	0.00	54.88	54.88	61.18	45.80	45.80	45.80	49.29	47.43	49.78															750.6
Average (IRn)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.55	57.38	77.27	32.35	54.39	54.88	45.70	45.80	45.80	50.73	49.39	52.05															740.8
1/5 year																																					
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	119.23	68.32	53.77	54.51	45.50	45.80	45.80	73.93	73.93	78.94															852.8
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	119.23	66.38	0.00	66.29	54.51	60.77	45.80	45.80	45.80	73.93	71.77	76.89															848.4
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.38	66.38	0.00	66.29	54.88	61.18	45.80	45.80	45.80	71.77	69.91	74.51															850.6
Average (IRn)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	125.91	66.65	84.00	44.87	54.39	60.77	45.70	45.80	45.80	72.21	76.78	76.78															850.7
Utilized Rainfall (Rus=Average WR - Average IRn)																																					
Average Year	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	37.5	21.0	38.9	42.8	38.9	40.2	40.2	35.7	39.3																494.9
				0.0					100.0	31.5	120.6		120.6	12.6	12.6	107.7																	494.9
1/5 year	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	30.8	8.5	38.9	42.8	38.9	40.2	40.2	13.2	14.6																385.0
				0.0					82.1		120.6		120.6	4.2	120.6	13.2																	385.0
Diversion Irrigation Requirement (IRd=IRn/0.65)																																					
Average Year	0.0	0.0	0.0	0.0	0.0	0.0	0.0	59.3	118.9	88.3	84.4	93.5	83.7	84.4	70.5	70.5	78.0	80.1	76.0	78.94															1,139.9
				0.0	59.3				299.4		261.6		261.6	211.3	70.5	70.5	234.1																1,139.9
1/5 year	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.6	129.2	95.2	84.4	93.5	83.7	38.9	70.5	70.5	112.6	112.6	76.0																1,308.7
				0.0	64.6				326.9		261.6		261.6	211.3	70.5	70.5	110.6	118.1	341.3																1,308.7

Table 7.1-3-1 Irrigation Requirement of Vegetables in Sudanese Climatic Zone

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
days	10 10 11	10 10 8	10 10 11	10 10 10	10 11 10	10 10 10	10 10 11	10 11 10	10 10 10	10 10 11	10 10 10	10 10 11	365

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average year	3.4	11.9	42.4	83.9	117.4	137.1	194.0	236.0	182.7	95.2	18.8	5.2	1,128.0
Year 1983	0.0	14.9	1.1	74.8	63.2	130.7	142.3	164.9	149.4	23.2	17.7	10.1	792.3
1/5 year	0.0	18.2	1.3	91.5	77.3	159.9	174.1	201.7	182.8	28.4	21.7	12.4	969.3

Effective Rainfall (mm) by USBR

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average year	3.4	11.9	41.6	78.6	102.2	111.9	120.6	120.6	120.6	87.6	18.8	5.2	823.0
1/5 year	0.0	18.2	1.3	84.6	73.3	118.9	120.3	120.6	120.6	28.3	21.7	12.4	720.2

Effective Rainfall by 10days (mm): Re

	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
Average year	1.10			4.25		3.40	13.42			26.20	26.20		32.97	36.26		37.30	37.30		38.90	38.90	42.79	38.90			40.20	40.20		28.26	28.26	31.08	6.27	6.27		1.68	1.68	1.85	823.0
1/5 year	0.00			6.50		5.20	0.42			28.20	28.20		23.65	26.01		39.63	39.63		38.81	38.81	42.79	38.90			40.20	40.20		9.13	9.13	10.04	7.23	7.23		4.00	4.00	4.40	720.2

Evapotranspiration (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly ETo	140	154	168	139	130	108	54	109	109	115	139	161	1,566.0
10 days ETo	45.16 45.16 49.68	55.00 55.00 44.00	54.19 54.19 59.61	46.33 46.33 46.33	41.94 41.94 46.13	36.00 36.00 36.00	30.32 30.32 33.35	35.16 35.16 38.68	36.33 36.33 36.33	37.10 37.10 40.81	46.33 46.33 46.33	51.94 51.94 57.13	1,566.0

Cropping Calendar: Tomato / Vegetables

Crop Coefficient (K) (Tomato)

	Mar I	Mar II	Apr I	Apr II	Apr III	May I	May II	May III	Jun I	Jun II	Jun III	Jul I	Jul II	Jul III	Aug I	Aug II
	0.70	0.70 0.70	0.70 0.70	0.75	0.75	0.85 0.95 1.05	0.95 1.05 1.10	1.05 1.10 1.10	1.10 1.10 1.10	1.10 1.10 1.10	1.10 1.10 1.06	1.06 0.93 0.77	1.06 0.93 0.77	0.93 0.77 0.6	0.77 0.6	

Crop Coefficient (K) (Vegetables)

	Sep I	Sep II	Sep III	Oct I	Oct II	Oct III	Nov I	Nov II	Nov III	Dec I
	0.75	0.75 0.78	0.78 0.89	0.78 0.89 1.03	0.89 1.03 1.10	1.03 1.10 1.10	1.10 1.10 1.10	1.10 1.10 1.08	1.10 1.08 1.00	1.00

Consumptive Water Use (CU=ETo*K)

| | Average (CU): 9222.7 |

Net Irrigation Requirement (IRn=WR-Re)
- Average Year — Average (IRn): 329.0
- 1/5 year

Utilized Rainfall (Run=Average WR - Average IRn)
- Average Year — Total 594.1
- 1/5 year — Total 594.1 / 495.7

Diversion Irrigation Requirement (Ird=Irn/0.65)
- Average Year — Total 506.3
- 1/5 year — Total 506.3 / 655.8

Table 7.1-3-2 Irrigation Requirement of Vegetables in Boanle Climatic Zone

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	365
days	10	10	11	10	10	8	10	11	10	10	10	10	10	11	10	10	10	10	10	11	10	10	10	11	10	10	11	10	10	11	10	10	10	10	11	11	
Rainfall (mm)																																					
Average year		8.3			40.0			91.8			122.0			140.2			136.6			119.4			131.0			150.3			111.0			32.3			13.6		1,096.5
Year 1983		0.0			24.1			29.1			111.5			211.5			129.1			27.4			27.6			105.4			28.0			36.5			36.5		766.7
1/5 year		0.0			29.2			33.3			135.2			256.4			156.5			33.2			33.5			127.8			33.9			44.3			44.3		929.6
Effective Rainfall (mm) by USBR																																					
Average year		8.3			39.3			84.9			104.9			113.2			111.7			103.4			109.5			117.2			98.3			32.0			13.6		936.3
1/5 year		0.0			29.0			34.8			111.2			120.6			118.5			32.8			33.1			108.2			33.5			43.4			43.4		708.5

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
Effective Rainfall by 10days (mm): Re																																					
Average year	2.68	2.68	2.95	14.04	14.04	11.23	27.39	27.39	30.13	34.97	34.97	34.97	36.52	40.17	37.23	37.23	37.23	36.69	33.35	33.35	35.32	38.85	39.07	39.07	31.71	34.88	10.67	10.67	34.88	4.39	4.39	4.39	4.83				936.4
1/5 year	0.00	0.00	0.00	10.36	10.36	8.29	11.23	11.23	12.35	37.07	37.07	37.07	38.90	42.79	39.50	39.50	39.50	11.64	10.58	10.58	10.68	11.75	36.07	36.07	10.81	11.89	14.47	14.47	11.89	14.00	14.00	14.00	15.40				708.6
Evapotranspiration (mm)																																					
Monthly ETo (mm)		118			120			133			132			127			108			96			96			102			115			111			102		1,360.0
10 days ETo (mm)	38.06	38.06	41.87	42.86	42.86	34.29	42.90	42.90	47.19	44.00	44.00	44.00	40.97	45.06	36.00	36.00	36.00	34.06	30.97	30.97	30.97	34.06	34.00	34.00	37.10	40.81	37.00	37.00	40.81	32.90	32.90	32.90	36.19				1,360.0

Tomato / Vegetables (Cropping Calendar)

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
Crop Coefficient (K)										0.70	0.70	0.75	0.85	1.05	1.10	1.10	1.10	0.93	1.06	0.93	0.93	0.77	0.75	0.75	0.89	1.03	1.10	1.10	1.10	1.00							
							0.70	0.70	0.70	0.70	0.75	0.85	0.95	1.10	1.10	1.10	1.10	0.77	0.93	1.10	0.93	0.6	0.78	0.78	0.89	1.10	1.08									
				0.70	0.70	0.70	0.70	0.75	0.95	1.05	1.10	1.10	1.10	0.6	0.6	1.03	1.10	1.08																			
Consumptive Water Use (CU=ETo*K)																																					
Average (CU)	0.00	10.01	0.00	0.00	0.00	0.00	20.02	1.76	33.03	31.53	33.73	37.40	38.92	48.82	39.60	39.60	39.12	26.12	29.49	31.90	14.14	6.19	17.34	27.43	33.39	43.94	40.70	22.81	10.97								843.1

Month	Total
Net Irrigation Requirement (IRn=WR-Re)	
Average Year / Average (IRn)	178.5
1/5 year / Average (IRn)	169.1 / 158.8 / 168.8
Average (IRn)	302.0 / 293.5 / 285.6 / 293.7
Utilized Rainfall (Rhu=Average WR - Average IRn)	
Average Year	674.2 / 674.2
1/5 year	549.4 / 549.4
Diversion Irrigation Requirement (Ird=Irn/0.65)	
Average Year	259.7 / 259.7
1/5 year	451.9 / 451.9

Table 7.1-3.3 Irrigation Requirement of Vegetables in Mountainous Climatic Zone

Month	Jan I	Jan II	Jan III	Feb I	Feb II	Feb III	Mar I	Mar II	Mar III	Apr I	Apr II	Apr III	May I	May II	May III	Jun I	Jun II	Jun III	Jul I	Jul II	Jul III	Sep I	Sep II	Sep III	Oct I	Oct II	Oct III	Nov I	Nov II	Nov III	Dec I	Dec II	Dec III	Total
days	10	10	11	10	8	11	10	10	11	10	10	11	10	10	11	10	10	10	10	10	11	10	10	10	10	10	11	10	10	10	10	10	11	365
Rainfall (mm)																																		
Average year	6.8			34.5			93.1	33.5	37.6	129.2	121.2	136.1	156.2	102.5	115.1	157.6	140.9	158.2	191.0	78.4	88.0	240.9	278.2	312.3	119.6	88.6	99.5	26.2	21.5	24.1	12.1	3.1	3.5	1,449.6
Year 1983	0.0			64.4			33.5			121.2			102.5			140.9			78.4			278.2			88.6			21.5			3.1			1,138.0
1/5 year	0.0			72.3			37.6			136.1			115.1			158.2			88.0			312.3			99.5			24.1			3.5			1,277.6
Effective Rainfall (mm) by USBR																																		
Average year	6.8			34.0			85.9	37.0		108.8	111.5		118.5	100.8		118.6	118.7		120.6	81.8		120.6	120.6		103.5	91.0		26.2	24.1		12.1	3.5		976.2
1/5 year	0.0			68.9			37.0			111.5			100.8			118.7			81.8			120.6			91.0			24.1			3.5			878.5
Effective Rainfall by 10 days (mm): Re																																		
Average year	2.19	2.19	2.41	12.14	9.71		27.71	11.94	30.48	36.27	36.27	42.05	38.23	38.23	42.05	39.53	39.53	38.90	38.90	42.79	42.79	40.20	40.20	33.39	33.39	36.73	8.73	8.73	3.90	3.90	4.29		976.2
1/5 year	0.00	0.00	0.00	24.61	19.69		11.94	13.13		37.17	37.17	35.77	32.52	32.52		39.57	39.57	26.39	26.39	29.03	29.03	40.20	40.20	29.35	29.35	32.29	8.03	8.03	1.13	1.13	1.24		878.5
Evapotranspiration (mm)																																		
Monthly ETo (mm)	118			120			133			132			127			108			96			102			115			111			102			1,360.0
10 days ETo (mm)	38.06	38.06	41.87	42.86	34.29		42.90	47.19		44.00	44.00	45.06	40.97	40.97		36.00	36.00	34.06	30.97	34.06	34.06	34.00	34.00	37.10	37.10	40.81	37.00	37.00	32.90	32.90	36.19		1,360.0
Cropping Calendar				Vegetables					Tomato														Vegetables											
Crop Coefficient (K)							0.70	0.70	0.70	0.70	0.77	0.6	0.85	0.95	1.05	1.10	1.10	1.10	1.06	0.93	0.77	0.75	0.78	0.89	1.03	1.10	1.08	1.00						
							0.70	0.70	0.75	0.75	0.6		0.95	1.05	1.10	1.10	1.10	1.10	0.93	0.77	0.6	0.78	0.89	1.03	1.10	1.08							
								0.70	0.85				1.05	1.10	1.10	1.06	0.93					0.89	1.03	1.10	1.08	1.00							
Consumptive Water Use (CU=ETo*K)	0.00	0.00	0.00	0.00	0.00		0.00	0.00	30.90	30.80	23.85	18.58	34.82	38.92	47.31	39.60	39.60	34.07	32.83	31.68	23.85	0.00	0.00	28.94	33.02	42.03	40.70	35.53	32.90	0.00	0.00		828.5
	0.00	0.00	0.00	0.00	0.00		33.03	30.03	33.00	33.00	18.58	0.00	38.92	43.02	49.57	39.60	39.60	32.83	28.80	26.23	18.58	25.50	26.52	33.02	38.21	44.89	40.70	39.96	0.00	0.00	0.00		843.4
	0.00	0.00	0.00	0.00	0.00		33.03	30.03	33.00	41.80	0.00		43.02	49.07	49.57	39.60	38.16	28.80	23.85	20.44	0.00	26.52	30.26	38.21	40.81	44.89	40.70	37.00	0.00	0.00	0.00		857.3
Average (CU)	0.00	0.00	0.00	0.00	0.00		10.01	20.02	33.03	35.73	14.14	6.19	38.92	42.34	48.82	39.60	39.12	31.90	28.49	26.12	14.14	17.34	27.43	33.39	37.35	43.94	40.70	39.22	10.97				843.1
Net Irrigation Requirement (IRn=WR-Re)																																		
Average Year	0.00	0.00	0.00	0.00	0.00		0.00	0.00	2.55	0.00	0.00		0.00	0.69	5.26	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.50		31.63	29.00					170.6
	0.00	0.00	0.00	0.00	0.00		2.32	2.32	2.55	0.00	0.00		0.69	4.79	7.52	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.82	8.16	31.97	31.97	31.23	0.00	0.00			154.4
	0.00	0.00	0.00	0.00	0.00		2.32	2.32	2.55	1.13			4.79	6.84	7.52	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.82	7.42	8.16	31.97	31.23	28.27	0.00	0.00	0.00		145.0
Average (IRn)	0.00	0.00	0.00	0.00	0.00		0.77	1.55	2.55	0.38	0.00		1.83	4.11	6.77	0.07	0.05	0.00	0.00	0.00	0.00	0.00	7.21	1.61	4.08	7.21	40.70	31.72	30.49	10.97				157.3
1/5 year	0.00	0.00	0.00	0.00	0.00		0.00	0.00	19.90	0.00	0.00		2.30	6.40	11.54	0.03	0.03	0.00	7.68	2.65	0.00	0.00	0.00	0.00	3.67	9.74	32.67	34.40	29.00	0.00	0.00		234.6
	0.00	0.00	0.00	0.00	0.00		18.09	18.09	19.90	0.23	0.00		6.40	10.50	13.80	0.03	0.00	0.00	6.44	0.00	0.00	0.00	3.67	4.82	8.86	12.60	32.67	31.93	31.77	0.00	0.00		232.0
	0.00	0.00	0.00	0.00	0.00		18.09	18.09	19.90	4.63			10.50	12.55	13.80	0.03	0.00	0.00	2.41	0.00	0.00	0.00	8.66	7.42	11.46	12.60	32.67	28.97		0.00	0.00	0.00		226.8
Average (IRn)	0.00	0.00	0.00	0.00	0.00		6.03	12.06	19.90	1.62	0.00		6.40	9.82	13.05	0.03	0.02	0.00	5.51	0.88	0.00	0.00	11.65	4.18	8.00	11.65	32.67	31.19	20.21				231.1
Utilized Rainfall (Rus=Average WR - Average IRn)																																		
Average Year	0.0	0.0	0.0	0.0	0.0		9.2		30.5	31.5	14.1		37.1	38.2	42.1	39.5	39.1	26.1	28.5	26.1	8.5	17.3	27.4	31.8	33.3	36.7	8.7	34.67	29.00	1.3	3.9		685.6
	0.0	0.0	0.0				4.0		13.1	31.5	14.1		32.5	117.4	35.8	39.6	39.1	25.2	86.5		8.5	53.2	27.4	101.8	101.8	32.3	26.1	8.0		3.9			685.6
1/5 year	0.0	0.0	0.0							33.7			32.5	117.4		39.6			25.5			17.3		29.4				8.0		0.4			611.9
	0.0	0.0	0.0				25.1			101.0			100.8			118.3			77.1			53.2		50.9			24.0			1.2			611.9
Diversion Irrigation Requirement (IRd=Irn/0.65)																																		
Average year	0.0	0.0	0.0	0.0	0.0		1.2		3.9	0.6			2.8	6.3	10.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2.5	6.3	11.1	49.2	44.9	31.1	14.9	46.0		242.1
							7.5			4.0			19.5			0.3			0.0			0.0		9.9	9.9		48.8	144.9		46.0			242.1
1/5 year	0.0	0.0	0.0				9.3	30.6		0.1	0.0		15.1	49.9	20.1	0.0		1.4	4.5		8.5	0.0		6.4	12.3	17.9	50.3	49.9	33.9	16.3	48.0		355.5
							58.5			2.6			45.0			0.0			14.4			0.0		36.6				148.2		50.2			355.5

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Table 7.1-3-4 Irrigation Requirement of Vegetables in Attie Climatic Zone

Item	Total
Rainfall (mm)	
Average year	1,521.2
Year 1983	1,229.7
1/5 year	1,291.2
Effective Rainfall (mm) by USBR	
Average year	1,098.5
1/5 year	831.8
Effective Rainfall by 10days (mm): Re	
Average year	1,098.5
1/5 year	831.8
Evapotranspiration (mm)	
Monthly ETo (mm)	1,277.0
10 days ETo (mm)	1,277.0
Cropping Calendar	(Tomato / Vegetables)
Crop Coefficient (K)	
Consumptive Water Use (CU=ETo*K)	778.4
	789.4
	799.2
Average	788.99
Net Irrigation Requirement (IRn=CU-Re)	
Average Year	66.1
	48.5
	31.8
Average (IRn)	48.8
1/5 year	156.4
	150.9
	145.8
Average (IRn)	151.0
Utilized Rainfall (Rut=Average WR - Average IRn)	
Average Year	740.3
	740.3
1/5 year	638.1
	638.1
Diversion Irrigation Requirement (Ird=Irn/0.65)	
Average Year	75.1
	75.1
1/5 year	232.4
	232.4

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Table 7.1-4-1 Irrigation Requirement of Sugarcane in Sudanese Climatic Zone

Item	Total
Rainfall (mm)	
Average year	1,128.0
Year 1983	792.3
1/5 year	969.3
Effective Rainfall (mm) by USBR	
Average year	823.0
1/5 year	720.2
Effective Rainfall by 10days (mm): Re	
Average year	823.0
1/5 year	720.2
Evapotranspiration (mm)	
Monthly ETo (mm)	1,566.0
10 days (mm)	1,566.0
Cropping Calendar	Harvest
Crop Coefficient (K)	
Consumptive Water Use (CU=ET*K)	1,399.2
	1,402.6
	1,406.0
Average (WR)	1,402.6
Net Irrigation Requirement (IRn=WR-Re)	
Average Year	610.4
	613.8
	617.2
Average (IRn)	613.8
1/5 year	718.4
	721.8
	725.2
Average (IRn)	721.8
Utilized Rainfall (Rus=Average WR - Average IRn)	
Average year	789.3
	789.3
1/5 year	680.7
	680.7
Diversion Irrigation Requirement (Irdiv/m/0.65)	
Average Year	944.3
	944.3
1/5 year	1,110.5
	1,110.5

Table 7.1-4-2 Irrigation Requirement of Sugarcane in Boaule Climatic Zone

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
period	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
days	10	10	11	10	10	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	365

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average year	8.3	40.0	91.8	122.0	140.2	136.6	119.4	131.0	150.3	111.0	32.3	13.6	1,096.5
Year 1983	0.0	24.1	29.1	111.5	211.5	129.1	27.4	27.6	105.4	28.0	36.5	36.5	766.7
1/5 year	0.0	29.2	33.3	135.2	256.4	156.5	33.2	33.5	127.8	33.9	44.3	44.3	929.6

Effective Rainfall (mm) by USBR

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average year	8.3	39.3	84.9	104.9	113.2	111.7	103.4	109.5	117.2	99.3	32.0	13.6	936.3
1/5 year	0.0	29.0	34.8	111.2	120.6	118.5	32.8	33.1	108.2	33.5	43.4	43.4	708.5

Effective Rainfall by 10 days (mm): Re

	Jan I	Jan II	Jan III	...	Total
Average year	2.68	2.68	2.95	...	936.4
1/5 year	0.00	0.00	0.00	...	708.6

Evapotranspiration (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly ETo (mm)	118	120	133	132	127	108	96	96	102	115	111	102	1,360.0
10 days ETo (mm)	38.06	42.86	42.90	44.00	40.97	36.00	30.97	30.97	34.00	37.10	37.00	32.90	1,360.0

Cropping Calendar — Harvest

Crop Coefficient (K) (per 10-day period)

Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec		
0.55	0.55	0.8	0.8	0.8	0.9	0.9	0.9	1.00	1.00	1.00	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	0.80	0.80	0.80	0.60	0.60	0.60	0.55	0.55

Consumptive Water Use (CU=ETo*K) — Average (WR): Total 1,242.2

Net Irrigation Requirement (IRn=WR-Re)

	Total
Average Year — Average (IRn)	327.5
	331.5
	335.5
	331.5
1/5 year — Average (IRn)	537.9
	539.8
	541.8
	539.8

Utilized Rainfall (Rm=Average WR - Average IRn)

	Total
Average Year	910.8
	910.8
1/5 year	702.7
	702.7

Diversion Irrigation Requirement (Ird=Irn/0.65)

	Total
Average Year	510.0
	510.0
1/5 year	830.5
	830.5

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Table 7.1-4-3 Irrigation Requirement of Sugarcane in Mountainous Climatic Zone

Month	Jan I	Jan II	Jan III	Feb I	Feb II	Feb III	Mar I	Mar II	Mar III	Apr I	Apr II	Apr III	May I	May II	May III	Jun I	Jun II	Jun III	Jul I	Jul II	Jul III	Aug I	Aug II	Aug III	Sep I	Sep II	Sep III	Oct I	Oct II	Oct III	Nov I	Nov II	Nov III	Dec I	Dec II	Dec III	Total
days	10	10	11	10	8	10	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	365
Rainfall (mm)																																					
Average year		6.8			34.5			93.1			129.2			156.2			157.6			191.0			282.4			240.9			119.6			26.2			12.1		1,459.6
Year 1983		0.0			64.4			33.5			121.2			102.5			140.9			78.4			205.7			278.2			88.6			21.5			3.1		1,138.0
1/5 year		0.0			72.3			37.6			136.1			115.1			158.2			88.0			230.9			312.3			99.5			24.1			3.5		1,277.6
Effective Rainfall (mm) by USBR																																					
Average year		6.8			34.0			85.9			108.8			118.5			118.6			120.6			120.6			120.6			103.5			26.2			12.1		976.2
1/5 year		0.0			68.9			37.0			111.5			100.8			118.7			81.8			120.6			120.6			91.0			24.1			3.5		878.5
Effective Rainfall by 10days (mm); Re																																					
Average year	2.19	2.19	2.41	12.14	12.14		27.71	27.71	30.48	36.27	36.27	36.27	38.23	38.23	42.05	39.53	39.53	39.53	38.90	38.90	42.79	38.90	38.90	42.79	40.20	40.20	40.20	33.39	33.39	36.73	8.73	8.73	8.73	3.90	3.90	4.29	976.2
1/5 year	0.00	0.00	0.00	24.61	24.61	19.69	11.94	11.94	13.13	37.17	37.17	37.17	32.52	32.52	35.77	39.57	39.57	39.57	26.39	26.39	29.03	38.90	38.90	42.79	40.20	40.20	40.20	29.35	29.35	32.29	8.03	8.03	8.03	1.13	1.13	1.24	878.5
Evapotranspiration (mm)																																					
Monthly ETo (mm)		118			120			133			132			127			108			96			96			102			115			111			102		1,360.0
10 days (mm)	38.06	38.06	41.87	42.86	34.29	42.86	42.90	42.90	47.19	44.00	44.00	44.00	40.97	40.97	45.06	36.00	36.00	36.00	30.97	30.97	34.06	30.97	30.97	34.06	34.00	34.00	34.00	37.10	37.10	40.81	37.00	37.00	37.00	32.90	32.90	36.19	1,360.0
Cropping Calendar																															Harvest						
Crop Coefficient (K)	0.55	0.55	0.8	0.8	0.8	0.8	0.9	0.9	1.00	1.00	1.00	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	0.80	0.80	0.80	0.60	0.60	0.60	0.55	0.55	0.55
	0.55	0.55	0.8	0.8	0.8	0.8	0.9	0.9	1.00	1.00	1.00	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	0.80	0.80	0.80	0.60	0.60	0.60	0.55	0.55	0.55	0.55
	0.8	0.8	0.8	0.9	0.9	0.9	1.00	1.00	1.00	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	0.80	0.80	0.80	0.60	0.60	0.60	0.55	0.55	0.55	0.55
Consumptive Water Use (CU=ETo*K)	20.93	20.93	33.50	34.29	34.29	34.29	38.61	38.61	47.19	44.00	44.00	46.20	43.02	43.02	47.31	37.80	37.80	37.80	32.52	32.52	35.76	32.52	32.52	35.76	35.70	35.70	35.70	38.96	38.96	32.65	29.60	22.20	22.20	19.74	18.10	18.10	1,240.2
	20.93	20.93	33.50	34.29	30.86	30.86	38.61	38.61	42.90	44.00	46.20	46.20	43.02	43.02	47.31	37.80	37.80	37.80	32.52	32.52	35.76	32.52	32.52	35.76	35.70	35.70	35.70	38.96	29.68	29.68	29.60	22.20	22.20	19.74	18.10	18.10	1,242.2
	30.45	30.45	33.50	38.57	30.86	30.86	42.90	42.90	47.19	46.20	46.20	46.20	43.02	43.02	47.31	37.80	37.80	37.80	32.52	32.52	35.76	32.52	32.52	35.76	35.70	35.70	35.70	29.68	29.68	29.68	22.20	22.20	22.20	18.10	18.10	18.10	1,244.2
Average (WR)	24.10	24.10	27.28	37.14	37.14	34.29	41.47	41.47	47.19	45.47	45.47	43.47	43.02	43.02	47.31	37.80	37.80	37.80	32.52	32.52	35.76	32.52	32.52	35.76	35.70	35.70	35.70	35.87	32.77	32.65	27.13	24.67	22.20	19.19	18.65	18.65	1,242.2
Net Irrigation Requirement (IRn=WR-Re)																																					
Average Year	18.74	18.74	31.09	22.15	22.15	21.15	10.90	10.90	16.71	7.73	7.73	9.93	4.79	4.79	5.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.57	5.57	0.00	20.87	20.87	13.47	15.84	15.84	15.84	326.4
	18.74	18.74	31.09	22.15	26.43	21.15	10.90	15.19	16.71	7.73	9.93	9.93	4.79	4.79	5.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.57	0.00	0.00	20.87	13.47	13.47	15.84	14.20	14.20	332.1
	28.26	28.26	31.09	26.43	26.43	21.15	30.96	15.19	16.71	9.93	9.93	9.93	4.79	4.79	5.26	0.00	0.00	0.00	6.13	6.13	6.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47	14.20	14.20	14.20	337.8
Average (IRn)	21.91	21.91	25.09	25.00	25.00	21.15	13.76	13.76	16.71	8.46	9.20	9.20	4.79	4.79	5.25	0.00	0.00	0.00	6.13	6.13	6.73	0.00	0.00	0.00	0.00	0.00	0.00	3.71	1.86	1.86	18.40	15.94	13.47	15.29	14.75	14.75	332.1
1/5 year	20.93	20.93	33.50	9.68	9.68	9.7	26.67	26.67	27.7	6.83	6.83	9.03	10.50	10.50	11.54	0.00	0.00	0.00	6.13	6.13	6.73	0.00	0.00	0.00	0.00	0.00	0.00	9.61	9.61	0.36	21.57	21.57	14.17	18.61	18.61	18.61	400.3
	20.93	20.93	30.45	13.96	13.96	19.7	26.67	30.96	27.7	6.83	9.03	9.03	10.50	10.50	11.54	0.00	0.00	0.00	6.13	6.13	6.73	0.00	0.00	0.00	0.00	0.00	0.00	9.61	0.33	0.36	21.57	14.17	14.17	18.61	16.97	16.97	402.3
Average (IRn)	30.45	30.45	33.50	13.96	13.96	11.17	30.96	30.96	28.10	9.03	9.03	9.03	10.50	10.50	11.54	0.00	0.00	0.00	6.13	6.13	6.73	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.33	0.36	14.17	14.17	14.17	16.97	16.97	16.97	404.2
Average (IRn)	24.10	27.28	27.28	12.53	12.53	11.11	28.10	29.53	29.53	7.56	8.30	8.30	10.50	10.50	11.54	0.00	0.00	0.00	6.13	6.13	6.73	0.00	0.00	0.00	0.00	0.00	0.00	6.52	3.42	3.42	19.10	16.64	14.17	18.06	17.52	17.52	402.3
Utilized Rainfall (Ru=Average WR - Average IRn)																																					
Average Year	2.2	2.2	2.4	12.1	12.1	9.7	27.7	27.7	30.5	36.3	36.3	36.3	38.2	38.2	42.1	37.8	37.8	37.8	32.5	32.5	35.8	32.5	32.5	35.8	35.7	35.7	35.7	32.2	32.2	32.7	8.7	8.7	8.7	3.9	3.9	3.9	910.1
1/5 year	0.0	0.0	0.0	24.6	24.6	19.7	11.9	11.9	13.1	37.2	37.2	37.2	32.5	32.5	35.8	37.8	37.8	37.8	26.4	26.4	29.0	32.5	32.5	35.8	35.7	35.7	35.7	29.4	29.4	32.3	8.0	8.0	8.0	1.1	1.1	1.2	839.8
Diversion Irrigation Requirement (Ird=Irn/0.65)																																					
Average Year	33.7		38.6	47.8	36.3			19.0	25.7	13.0	14.2		7.4	7.4	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	2.9	0.0	28.3	24.5	20.7	23.5	22.7	24.0	511.0
1/5 year	37.1		42.0	51.5	17.1		43.2	11.9	52.4	11.6	12.8		16.2	16.2	17.8	0.0	0.0	10.4	9.4	26.4	29.2	0.0	0.0	0.0	0.0	0.0	0.0	10.0	15.9	0.6	29.4	25.6	21.8	27.8	27.0	28.7	619.1

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Table 7.1-4-4 Irrigation Requirement of Sugarcane in Attie Climatic Zone

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall (mm)													
Average/year	19.4	47.8	108.5	138.5	223.7	282.5	133.9	109.9	149.6	160.1	99.6	47.7	1,521.2
Year 1983	0.1	24.9	67.8	96.3	347.4	284.3	39.8	38.3	85.4	74.3	87.5	83.6	1,229.7
1/5 year	0.1	26.1	71.2	101.1	564.8	298.5	41.8	40.2	89.7	78.0	91.9	87.8	1,291.2
Effective Rainfall (mm) by USBR													
Average/year	19.4	46.7	96.8	112.5	120.6	120.6	110.7	97.7	116.9	118.9	91.1	46.6	1,098.5
1/5 year	0.1	26.1	67.9	92.3	120.6	120.6	41.0	39.5	83.2	73.8	85.0	81.7	831.8
Effective Rainfall by 10days (mm): Re													
Average/year	6.26 / 6.26	16.68 / 16.68 / 16.68	31.23 / 31.23	37.50 / 37.50	38.90 / 38.90	40.20 / 40.20	35.71 / 35.71	31.52	38.97 / 38.97	38.35 / 38.35	30.37 / 30.37	15.03 / 15.03	1,098.5
1/5 year	0.03 / 0.03	9.32 / 9.32	21.90 / 21.90	30.77 / 30.77	38.90 / 38.90	40.20 / 40.20	13.23 / 13.23	12.74	27.73 / 27.73	23.81 / 23.81	28.33 / 28.33	26.35 / 26.35	831.8
Evapotranspiration (mm)													
Monthly ETo (mm)	112	109	127	123	115	90	96	90	93	112	108	102	1,277.0
10 days ETo (mm)	36.13	38.95	40.97	41.00	37.10	30.00	30.97	29.03	31.00	36.13	36.00	32.90	1,277.0
Cropping Calendar												Harvest	
Crop Coefficient (K)	0.55 / 0.55 / 0.8	0.8 / 0.8 / 0.8	0.9 / 0.9 / 1.00	1.00 / 1.00 / 1.05	1.05 / 1.05 / 1.05	1.05 / 1.05 / 1.05	1.05 / 1.05 / 1.05	1.05 / 1.05 / 1.05	1.05 / 1.05 / 1.05	1.05 / 1.05 / 0.80	0.80 / 0.60 / 0.60	0.60 / 0.60 / 0.55	0.55
Consumptive Water Use (CU=ETo*K)													
	19.87 / 19.87	31.14 / 31.14 / 31.14	36.87 / 36.87	41.00 / 41.00	38.96 / 38.96	31.50 / 31.50	32.52 / 32.52	30.48 / 30.48	32.55 / 32.55	37.94 / 37.94	28.80 / 28.80	19.74 / 19.74	1,160.2
	19.87 / 28.90	35.04 / 35.04	40.97 / 40.97	43.05 / 43.05	38.96 / 38.96	31.50 / 31.50	32.52 / 32.52	30.48 / 30.48	32.55 / 32.55	28.90 / 28.90	21.60 / 21.60	18.10 / 18.10	1,161.4
Average (WR)	22.88 / 25.89	32.44 / 33.74	38.24 / 39.60	41.68 / 42.37	38.96 / 38.96	31.50 / 31.50	32.52 / 32.52	30.48 / 30.48	32.55 / 32.55	34.93 / 31.91	26.40 / 24.00	19.19 / 18.65	1,161.4
Net Irrigation Requirement (IRn=WR-Re)													
Average: Year	13.61 / 13.61	14.46 / 14.46 / 14.46	5.64 / 5.64	3.50 / 3.50	0.06 / 0.06	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	4.71 / 4.71	143.2
Average (IRn)	13.61 / 22.64	18.36 / 18.36	9.74 / 9.74	5.55 / 5.55	0.06 / 0.06	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	3.07 / 3.07	160.7
	16.62 / 19.63	15.76 / 17.06	7.01 / 8.37	4.18 / 4.67	0.06 / 0.06	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	4.16 / 3.62	178.1
1/5 year	19.84 / 19.84	21.82 / 21.82 / 21.82	14.97 / 14.97	10.23 / 10.23	0.06 / 0.06	0.00 / 0.00	19.29 / 19.29	17.74 / 17.74	4.82 / 4.82	14.13 / 14.13	0.47 / 0.47	0.00 / 0.00	383.5
Average (IRn)	28.87 / 25.86	25.72 / 24.42	19.07 / 17.70	12.28 / 11.60	0.06 / 0.06	0.00 / 0.00	19.29 / 19.29	17.74 / 17.74	4.82 / 4.82	5.09 / 11.12	0.00 / 0.16	0.00 / 0.00	393.1
Utilized Rainfall (Ru=Average WR - Average IRn)													
Average Year	6.3 / 6.3	16.7 / 16.7 / 16.7	31.2 / 31.2	37.5 / 37.5	38.9 / 38.9	31.5 / 31.5	32.5 / 32.5	30.5 / 30.5	32.6 / 32.6	34.9 / 31.8	26.4 / 24.0	15.0 / 15.0	1,000.8
	19.5	46.7	96.8	112.5	120.6	94.5	100.8	94.5	97.8	98.6	72.0	46.5	1,000.8
1/5 year	0.0 / 0.0	9.3 / 9.3	21.9 / 21.9	30.8 / 30.8	38.9 / 38.9	31.5 / 31.5	13.2 / 13.2	12.7 / 12.7	27.7 / 27.7	23.8 / 26.2	23.8 / 21.6	18.7 / 19.2	768.1
	26.1	69.4	67.9	92.4	120.6	94.5	41.0	39.4	83.1	73.8	71.5	57.8	768.1
Diversion Irrigation Requirement (Ird=IRn/0.65)													
Average Year	10.8	26.2	12.9 / 40.2	7.5 / 22.4	0.1 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	5.6 / 17.2	247.2
	24.2	73.0	27.2 / 84.6	17.8 / 53.5	0.1 / 0.3	0.0	29.7 / 92.0	27.3 / 84.6	7.4 / 22.2	12.5 / 38.2	0.2 / 0.7	0.0 / 0.0	247.2
1/5 year	25.1	35.6 / 37.6	27.2 / 84.6	16.8 / 53.5	0.1 / 0.3	0.0	29.7 / 92.0	27.3 / 84.6	7.4 / 22.2	17.1 / 38.2	0.0 / 0.7	0.0 / 0.0	604.7

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Table 7.1.5-1 Irrigation Requirement of Banana in Sudanese Climatic Zone

Month	Jan I	Jan II	Jan III	Feb I	Feb II	Feb III	Mar I	Mar II	Mar III	Apr I	Apr II	Apr III	May I	May II	May III	Jun I	Jun II	Jun III	Jul I	Jul II	Jul III	Aug I	Aug II	Aug III	Sep I	Sep II	Sep III	Oct I	Oct II	Oct III	Nov I	Nov II	Nov III	Dec I	Dec II	Dec III	Total
days	10	10	11	10	10	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	365
Rainfall (mm)																																					
Average year		3.4			11.9			42.4			83.9			117.4			137.1			194.0			236.0			182.7			95.2			18.8			5.2		1,128.0
Year 1983		0.0			14.9			1.1			74.8			63.2			130.7			142.3			164.9			149.4			23.2			17.7			10.1		792.3
1/5 year		0.0			18.2			1.3			91.5			77.3			159.9			174.1			201.7			182.8			28.4			21.7			12.4		969.3
Effective Rainfall (mm) by USBR																																					
Average year		3.4			11.9			41.6			78.6			102.2			111.9			120.6			120.6			120.6			87.6			18.8			5.2		823.0
1/5 year		0.0			18.2			1.3			84.6			73.3			116.9			120.3			120.6			120.6			28.3			21.7			12.4		720.2
Effective Rainfall by 10 days: Re																																					
Average year	1.10	1.10	1.21	4.25	4.25	3.40	13.42	13.42	14.76	26.20	26.20	26.20	32.97	32.97	36.26	37.30	37.30	37.30	38.90	38.90	42.79	38.90	38.90	42.79	40.20	40.20	40.20	28.26	28.26	31.08	6.27	6.27	6.27	1.68	1.68	1.85	823.0
1/5 year	0.00	0.00	0.00	6.50	6.50	5.20	0.42	0.42	0.46	28.20	28.20	28.20	23.65	23.65	26.01	39.63	39.63	39.63	38.81	38.81	42.79	38.90	38.90	42.79	40.20	40.20	40.20	9.13	9.13	10.04	7.23	7.23	7.23	4.00	4.00	4.40	720.2
Evapotranspiration (mm)																																					
Monthly ETo (mm)		140			154			168			139			130			108			94			109			109			115			139			161		1,566.0
10 days (mm)	45.16	45.16	49.68	55.00	55.00	44.00	54.19	54.19	59.61	46.33	46.33	46.33	41.94	41.94	46.13	36.00	36.00	36.00	30.32	30.32	33.35	35.16	35.16	38.88	36.33	36.33	36.33	37.10	37.10	40.81	46.33	46.33	46.33	51.94	51.94	57.13	1,566.0
Cropping Calendar																			Harvest										Harvest									
Crop Coefficient (K)	1.00	1.00	1.00	1.00	1.00	0.80	0.80	0.80	0.75	0.75	0.75	0.75	0.70	0.70	0.70	0.70	0.70	0.75	0.75	0.75	0.90	0.90	0.90	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1.00	1.00	1.00	0.80	0.80	0.80	0.75	0.75	0.75	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.75	0.75	0.75	0.90	0.90	0.90	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1.00	1.00	1.00	0.80	0.80	0.80	0.75	0.75	0.75	0.70	0.70	0.70	0.70	0.70	0.70	0.75	0.75	0.75	0.90	0.90	0.90	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Consumptive Water Use (CU=ETo*K)	45.16	45.16	49.68	55.00	55.00	35.20	43.35	43.35	44.71	34.75	34.75	32.43	29.36	29.36	32.29	25.20	25.20	27.00	22.74	22.74	30.02	31.64	31.64	40.61	38.15	38.15	38.15	38.96	38.96	42.85	48.65	48.65	46.33	51.94	51.94	57.13	1,406.2
	45.16	45.16	49.68	55.00	44.00	35.20	43.35	40.64	44.71	34.75	32.43	32.43	29.36	29.36	32.29	25.20	27.00	27.00	27.29	27.29	30.02	36.92	36.92	40.61	38.15	38.15	38.15	38.96	38.96	42.85	48.65	46.33	46.33	51.94	51.94	57.13	1,399.5
	45.16	44.06	49.68	44.00	44.00	35.20	40.64	40.64	44.71	32.43	32.43	33.20	29.36	29.36	32.29	27.00	27.00	27.00	27.29	27.00	30.02	36.92	36.92	40.61	38.15	38.15	38.15	38.96	38.96	42.85	46.33	46.33	46.33	51.94	51.94	57.13	1,392.8
Average (WR)	45.16	45.16	49.68	51.33	47.67	35.20	42.45	41.54	44.71	33.98	33.20	33.20	29.36	29.36	32.29	25.80	26.40	27.00	24.26	25.77	30.02	35.16	35.16	40.61	38.15	38.15	38.15	38.96	38.96	42.85	47.88	47.10	46.33	51.94	51.94	57.13	1,399.5
Net Irrigation Requirement (IRn=WR-Re)																																					
Average Year	44.06	44.06	48.47	50.75	50.75	31.80	29.93	29.93	29.95	8.55	8.55	6.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.70	10.70	11.77	42.38	42.38	40.06	50.26	50.26	55.28	696.8
	44.06	44.06	48.47	50.75	39.75	31.80	29.93	27.22	29.95	8.55	6.23	6.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.70	10.70	11.77	42.38	40.06	40.06	50.26	50.26	55.28	678.5
	44.06	44.06	48.47	39.75	39.75	31.80	27.22	27.22	29.95	6.23	6.23	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.70	10.70	11.77	40.06	40.06	40.06	50.26	50.26	55.28	660.1
Average (IRn)	44.06	44.06	48.47	43.42	41.17	31.80	29.03	28.12	29.95	7.00	6.23	6.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.70	10.70	11.77	40.83	40.06	40.06	50.26	50.26	55.28	678.5
Utilized Rainfall (Run=Average WR - Average IRn)																																					
Average year	1.1	1.1	1.2	4.3	4.3	3.4	13.4	13.4	14.8	26.2	26.2	26.2	29.4	29.4	32.3	26.4	26.4	27.0	25.8	25.8	30.0	35.2	35.2	40.6	38.2	38.2	38.2	28.3	28.3	31.1	6.3	6.3	6.3	1.7	1.7	1.9	721.7
1/5 year	0.0		3.4	12.0	6.5	5.2	41.6	0.4	0.5	78.6	28.2	28.2	91.1	23.7	26.0	79.2	26.4	27.0	80.1	25.8	24.3	109.2	35.2	40.6	114.6	38.2	38.2	87.7	9.1	10.0	18.9	7.2	7.2	5.3	4.0	4.4	721.7
Diversion Irrigation Requirement (Iri=Irn/0.65)																																					
Average Year	67.8	67.8	74.6	66.8	66.8		43.3	43.3	46.1	10.8			0.0			0.0			0.0			0.0			0.0			16.5	16.5	18.1	64.0	62.8	61.6	77.3	77.3	83.0	1,043.9
1/5 year	69.5	69.5	76.4	69.0	65.3	63.3	64.7	63.3	68.1	8.9			8.8		9.7	0.0			0.0			0.0			0.0			45.9	45.9	50.5	62.5	61.3	60.2	73.8	73.8	83.1	1,195.4

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Table 7.1-5-2 Irrigation Requirement of Banana in Boaule Climatic Zone

Month	Jan I	Jan II	Jan III	Feb I	Feb II	Feb III	Mar I	Mar II	Mar III	Apr I	Apr II	Apr III	May I	May II	May III	Jun I	Jun II	Jun III	Jul I	Jul II	Jul III	Aug I	Aug II	Aug III	Sep I	Sep II	Sep III	Oct I	Oct II	Oct III	Nov I	Nov II	Nov III	Dec I	Dec II	Dec III	Total
days	10	10	11	10	10	8	10	10	11	10	10	10	10	11	10	10	10	10	10	10	11	10	10	11	10	10	10	10	10	11	10	10	10	10	10	11	365
Rainfall (mm)																																					
Average year	8.3			40.0			91.8			122.0			140.2			136.6			119.4			131.0			150.3			111.0			32.3			13.6			1,096.5
Year 1983	0.0			24.1			29.1			111.5			211.5			129.1			27.4			27.6			105.4			28.0			36.5			36.5			766.7
1/5 year	0.0			29.2			35.3			135.2			256.4			156.5			33.2			33.5			127.8			33.9			44.3			44.3			929.6
Effective Rainfall (mm) by USBR																																					
Average year	8.3			33.3			84.9			104.9			113.2			111.7			103.4			109.5			117.2			98.3			32.0			13.6			936.3
1/5 year	0.0			29.0			34.8			111.2			120.6			118.5			32.8			33.1			108.2			33.5			43.4			43.4			708.5
Effective Rainfall by 10days (mm): Re																																					
Average year	2.68	2.68	2.95	14.04	14.04	11.23	27.39	27.39	30.13	34.97	34.97	34.97	36.52	36.52	34.97	37.23	37.23	36.69	33.35	33.35	35.32	35.32	35.32	38.85	39.07	39.07	31.71	31.71	34.88	10.67	10.67	10.67	4.39	4.39	4.83	936.4
1/5 year	0.00	0.00	0.00	10.36	10.36	8.29	11.23	11.23	12.35	37.07	37.07	37.07	38.90	38.90	42.79	39.50	39.50	11.64	10.58	10.58	10.68	10.68	11.75	12.35	36.07	36.07	10.81	10.81	11.89	14.47	14.47	14.47	14.00	14.00	15.40	708.6
Evapotranspiration (mm)																																					
Monthly ETo (mm)	118			120			133			132			127			108			96			96			102			115			111			102			1,360.0
10 days (mm)	38.06	38.06	41.87	42.86	42.86	34.29	42.90	42.90	47.19	44.00	44.00	44.00	40.97	40.97	45.06	36.00	36.00	34.06	30.97	30.97	34.06	30.97	30.97	34.06	34.00	34.00	34.00	37.10	37.10	40.81	37.00	37.00	37.00	32.90	32.90	36.19	1,360.0
Cropping Calendar																								Harvest													
Crop Coefficient (Kc)																																					
	1.00	1.00	1.00	1.00	1.00	0.80	0.80	0.80	0.75	0.75	0.75	0.70	0.70	0.70	0.70	0.70	0.70	0.75	0.75	0.75	0.90	0.90	0.90	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1.00	1.00	1.00	1.00	0.80	0.80	0.80	0.75	0.75	0.70	0.70	0.70	0.70	0.70	0.70	0.75	0.75	0.90	0.90	0.90	0.90	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.80	0.80	0.75	0.75	0.70	0.70	0.70	0.70	0.70	0.75	0.75	0.90	0.90	1.05	1.05	1.05	1.05	1.05	1.00	1.00	1.00	1.00															1.00
Consumptive Water Use (CU=ETo*Kc)																																					
	38.06	38.06	41.87	42.86	42.86	27.43	34.32	34.32	35.39	33.00	33.00	30.80	28.68	28.68	31.54	27.00	27.00	30.65	23.23	27.87	30.65	27.87	32.52	35.76	35.70	35.70	35.70	38.96	38.96	42.85	38.85	37.00	37.00	32.90	32.90	36.19	1,211.4
	38.06	38.06	41.87	34.29	34.29	27.43	34.32	34.32	35.39	33.00	33.00	30.80	28.68	28.68	31.54	27.00	27.00	30.65	27.87	27.87	30.65	32.52	32.52	35.76	35.70	35.70	35.70	38.96	38.96	42.85	37.00	37.00	37.00	32.90	32.90	36.19	1,207.8
	34.29	34.29	41.87	37.15	37.15	27.43	32.18	32.18	35.39	30.80	30.80	31.53	28.68	28.68	31.54	27.00	27.00	30.65	27.87	27.87	30.65	32.52	32.52	35.76	35.70	35.70	35.70	38.96	38.96	42.85	37.00	37.00	37.00	32.90	32.90	36.19	1,204.1
Average (WR)	38.06	38.06	41.87	37.15	37.15	23.11	32.89	32.89	35.39	31.53	31.53	30.80	28.68	28.68	31.54	27.00	27.00	30.65	24.78	26.32	30.65	29.42	30.97	35.76	35.70	35.70	35.70	38.96	38.96	42.85	38.23	37.62	37.00	32.90	32.90	36.19	1,207.8
Net Irrigation Requirement (IRn=WR-Re)																																					
Average Year	35.38	35.38	38.92	28.82	28.82	16.20	6.93	6.93	5.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.25	7.25	7.97	28.18	26.33	26.33	28.51	28.51	31.36	396.2
	35.38	35.38	38.92	28.82	28.82	16.20	6.93	6.93	5.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.25	7.25	7.97	26.33	26.33	26.33	28.51	28.51	31.36	383.6
Average (IRn)	35.38	35.38	38.92	20.25	20.25	20.25	4.79	4.79	5.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.25	7.25	7.97	26.33	26.33	26.33	28.51	28.51	31.36	371.1
	35.38	35.38	38.92	23.11	23.11	16.20	5.50	5.50	5.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.25	7.25	7.97	27.56	26.33	26.95	28.51	28.51	31.36	383.6
1/5 year	38.06	38.06	41.87	32.50	32.50	19.14	23.09	23.09	23.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.65	12.65	19.01	17.19	17.19	24.01	0.00	0.00	0.00	28.15	28.15	30.96	24.38	24.38	22.53	18.90	18.90	20.79	591.2
	38.06	38.06	41.87	32.50	32.50	19.14	20.95	20.95	23.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.65	17.29	19.01	17.19	21.84	24.01	0.00	0.00	0.00	28.15	28.15	30.96	24.38	22.53	22.53	18.90	18.90	20.79	587.9
Average (IRn)	38.06	38.06	41.87	32.93	32.93	19.14	20.95	20.95	23.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.29	17.29	19.01	21.84	21.84	24.01	0.00	0.00	0.00	28.15	28.15	30.96	22.53	22.53	22.53	18.90	18.90	20.79	584.7
	38.06	38.06	41.87	29.64	29.64	19.14	22.38	22.38	23.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.20	14.20	18.74	18.74	20.29	24.01	0.00	0.00	0.00	28.15	28.15	30.96	23.76	23.15	23.15	18.90	18.90	20.79	587.9
Utilized Rainfall (Rin=Average WR - Average IRn)																																					
Average Year	2.7	2.7	3.0	14.0	14.0	11.2	27.4	27.4	30.1	31.5	31.5	30.8	28.7	28.7	31.5	25.8	26.4	27.0	24.8	26.3	30.7	29.4	31.0	33.8	35.7	35.7	34.9	31.7	31.7	34.9	10.7	10.7	10.7	4.4	4.4	4.8	824.3
	2.7	2.7	3.0	39.2	84		84.9	94.6		94.6	88.9	89	79.2	81.8	96.2	107.1	107.1	98.3	32.1	13.6																			824.3
1/5 year	0.0	0.0	0.0	10.4	10.4	8.3	11.2	11.2	12.4	31.5	31.5	30.8	28.7	28.7	25.8	25.8	26.4	27.0	10.6	10.6	11.6	10.7	10.7	11.8	35.7	35.7	11.9	10.8	10.8	11.9	14.5	14.5	14.5	14.0	14.0	15.4	620.1
	0.0	0.0	0.0	29.1			34.8			94.6			88.9	79.2	79.2				32.8			33.2			33.2			107.1			33.5			43.5			43.4		620.1
Diversion Irrigation Requirement (Irr=Irn/0.65)																																					
Average Year	54.4	54.4	59.9	39.9	24.9	9.6	8.5	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2	12.3	40.5	42.4	43.9	43.9	44.4										590.4
	54.4	167.7		100.4		26.2	33.5											24.2		34.7	34.7	43.3	124.4	136.0													590.4
1/5 year	58.6	58.6	64.4	45.6	41.2	29.4	33.3	35.4	0.0	0.0	0.0	21.8	28.8	36.9		29.2	34.4				43.3	47.6	36.6	34.7	29.1												904.3
	58.6	181.6		116.2		103.1											75.2	96.5		134.2		106.9	90.2														904.3

Table 7.1-5-3 Irrigation Requirement of Banana in Mountainous Climatic Zone

Month		Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
		I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
days		10	10	11	10	10	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	11	10	10	11	365
Rainfall (mm)																																						
Average year		6.8			34.5			93.1			129.2			155.2			157.6			191.0			282.4			240.9			119.6			26.2			12.1			1,449.6
Year 1983		0.0			64.4			33.5			121.2			102.5			140.9			78.4			205.7			278.2			88.6			21.5			3.1			1,138.0
1/5 year		0.0			72.3			37.6			136.1			115.1			158.2			88.0			230.9			312.3			99.5			24.1			3.5			1,277.6
Effective Rainfall (mm) by USBR																																						
Average year		6.8			34.0			85.9			108.8			118.5			118.6			120.6			120.6			120.6			103.5			26.2			12.1			976.2
1/5 year		0.0			68.9			37.0			111.5			100.8			118.7			81.8			120.6			120.6			91.0			24.1			3.5			878.5
Effective Rainfall by 10days (mm): Re																																						
Average year		2.19	2.19	2.41	12.14	12.14	9.71	27.71	27.71	30.48	36.27	36.27	38.23	38.23	38.23	42.05	39.53	39.53	39.53	38.90	38.90	42.79	38.90	38.90	42.79	40.20	40.20	40.20	33.39	33.39	36.73	8.73	8.73	3.90	3.90	1.13	9.76.2
1/5 year		0.00	0.00	0.00	24.61	24.61	19.69	11.94	11.94	13.13	37.17	37.17	32.52	32.52	32.52	35.77	39.57	39.57	39.57	26.39	26.39	29.03	38.90	38.90	42.79	40.20	40.20	40.20	29.35	29.35	32.29	8.03	8.03	1.13	1.13		878.5
Evapotranspiration (mm)																																						
Monthly ETo (mm)		118			120			133			132			127			108			96			96			102			115			111			102			1,360.0
10 days (mm)		38.06	38.06	41.87	42.86	42.86	34.29	42.90	42.90	47.19	44.00	44.00	44.00	40.97	40.97	45.06	36.00	36.00	36.00	30.97	30.97	34.06	30.97	30.97	34.06	34.00	34.00	34.00	37.10	37.10	40.81	37.00	37.00	32.90	32.90	36.19	1,360.0
Cropping Calendar																																	Harvest					
Crop Coefficient (K)																																						
		1.00	1.00	1.00	1.00	1.00	0.80	0.80	0.80	0.75	0.75	0.75	0.70	0.70	0.70	0.70	0.70	0.75	0.75	0.75	0.75	0.90	0.90	0.90	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.00	1.00	1.00	1.00	1.00
		1.00	1.00	1.00	0.80	0.80	0.80	0.80	0.80	0.75	0.70	0.70	0.70	0.70	0.70	0.70	0.75	0.75	0.75	0.90	0.90	0.90	1.05	1.05	1.05	1.05	1.05	1.05	1.00	1.00	1.00	1.00	1.00	1.00
		0.89			0.80			0.75			0.70			0.70			0.75			0.90			1.05			1.05			1.00			1.00			
Consumptive Water Use (CU=ETo*K)																																						
		38.06	38.06	41.87	42.86	42.86	27.43	34.32	34.32	35.39	33.00	33.00	30.80	28.68	28.68	31.54	25.20	25.20	27.00	23.23	23.23	27.87	27.87	27.87	35.76	35.70	35.70	38.96	38.96	42.85	38.85	30.82	32.90	31.77	36.19	1,211.4
		38.06	38.06	41.87	34.29	34.29	27.43	32.18	32.18	35.39	30.80	30.80	30.80	28.68	28.68	31.54	27.00	27.00	27.00	27.87	27.87	32.52	32.52	35.70	35.70	38.96	38.96	37.00	37.00	28.97	29.00	31.77	32.90	1,207.8
		38.06	38.06	41.87	34.29	34.29	27.43	32.18	33.61	32.27	28.68	30.65	26.40	24.78	29.42	26.32	24.78	35.70	38.96	38.23	37.62	29.00	32.90	31.77	1,204.1
Average (WR)		38.06	38.06	41.87	37.15	37.15	27.43	32.89	33.61	35.39	31.53	30.80	28.68	28.68	30.65	26.40	24.78	27.00	35.76	35.70	35.70	42.85	38.96	37.62	32.90	32.90	36.19	1,207.8
Net Irrigation Requirement (IRn=WR-Re)																																						
Average Year		35.87	35.87	39.46	30.72	30.72	17.72	6.61	6.61	4.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.57	5.57	6.12	30.12	30.12	29.00	29.00	31.90	404.2
		35.87	35.87	39.46	30.72	30.72	17.72	6.61	6.61	4.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.48	1.48	0.00	0.00	0.00	0.00	5.57	5.57	6.12	30.12	28.27	28.27	29.00	31.77	31.90	391.6
1/5 year		35.87	35.87	39.46	22.15	22.15	17.72	4.47	4.47	4.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.48	1.48	0.00	0.00	0.00	0.00	5.57	5.57	6.12	28.27	28.27	28.97	29.00	31.77	31.90	379.0
Average (IRn)		35.87	35.87	39.46	27.86	25.01	17.72	5.90	5.90	5.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.99	1.62	0.00	0.00	0.00	5.57	5.57	6.12	29.50	28.89	28.27	29.00	31.77	34.95	391.6
Utilized Rainfall (Rus=Average WR - Average IRn)																																						
Average Year		2.2	2.2	2.4	12.1	12.1	9.7	27.7	27.7	30.5	31.5	30.8	28.7	28.7	30.8	25.8	24.8	27.0	29.4	35.7	35.8	33.4	33.7	8.7	8.7	3.9	816.1
1/5 year		0.0	6.8	0.0	33.9	24.6	19.7	85.9	11.9	94.6	88.9	28.7	24.4	79.2	25.3	23.3	29.4	96.2	107.1	29.4	103.5	26.1	12.1	816.1
Diversion Irrigation Requirement (Irel=Irn/0.65)																																						
Average Year		55.2	55.2	60.7	38.5	27.3	9.1	8.0	7.6	0.0	0.0	0.0	0.0	0.0	8.6	9.4	43.5	44.4	44.6	602.7
		171.1		108.7	24.7		171.1						26.6	133.3	138.3	602.7
1/5 year		58.6	58.6	64.4	19.3	11.9	33.3	34.2	2.5	0.8	14.8	16.2	46.5	45.5	48.9	675.0
		181.6		54.9	99.7							45.8	136.6	151.6	675.0

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Table 7.1-5-4 Irrigation Requirement of Banana in Attie Climatic Zone

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
days (I/II/III)	10/10/11	10/8/10	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	365
Rainfall (mm)													
Average year	19.4	47.8	108.5	138.5	223.7	282.5	133.9	109.9	149.6	160.1	99.6	47.7	1,521.2
Year 1963	0.1	24.9	67.8	96.3	347.4	284.3	39.8	38.3	85.4	74.3	87.5	83.6	1,229.7
1/5 year	0.1	26.1	71.2	101.1	354.8	298.5	41.8	40.2	89.7	78.0	91.9	87.8	1,291.2
Effective Rainfall (mm) by USBR													
Average year	19.4	46.7	96.8	112.5	120.6	120.6	110.7	97.7	116.9	118.9	91.1	46.6	1,098.5
1/5 year	0.1	26.1	67.9	92.3	120.6	120.6	41.0	39.5	83.2	73.8	85.0	81.7	831.8
Effective Rainfall by 10days (mm): Re													
Average year	6.26/6.26/6.88	16.68/16.68/9.32	31.23/31.23/21.90	37.50/37.50/30.77	38.90/38.90/42.79	40.20/40.20/40.20	35.71/35.71/39.28	31.52/31.52/34.67	38.97/38.97/38.97	38.35/38.35/42.19	30.37/30.37/30.37	15.03/15.03/16.54	1,098.5
1/5 year	0.03/0.03/0.04	9.32/9.32/9.32	21.90/21.90/24.09	30.77/30.77/30.77	38.90/38.90/42.79	40.20/40.20/40.20	13.23/13.23/14.55	12.74/12.74/14.02	27.73/27.73/27.73	23.81/23.81/26.19	28.33/28.33/28.33	26.35/26.35/28.99	831.8
Evapotranspiration (mm)													
Monthly ETo (mm) Average year	112	109	127	123	115	90	96	90	93	112	108	102	1,277.0
1/5 year	112	109	127	123	115	90	96	90	93	112	108	102	1,277.0
10 days ETo (mm)	36.13/36.13/39.74	38.93/31.14/31.14	40.97/40.97/40.97	41.00/41.00/41.00	37.10/37.10/40.81	30.00/30.00/30.00	30.97/30.97/34.06	29.03/29.03/31.94	31.00/31.00/31.00	36.13/36.13/39.74	36.00/36.00/36.00	32.90/32.90/36.19	
Cropping Calendar										Harvest			
Crop Coefficient (K)	1.00/1.00/1.00	1.00/0.80/0.80	0.80/0.80/0.75	0.75/0.70/0.70	0.70/0.70/0.70	0.70/0.75/0.75	0.75/0.90/0.90	0.90/1.05/1.05	1.05/1.05/1.05	1.05/1.05/1.05	1.05/1.00/1.00	1.00/1.00/1.00	
Consumptive Water Use (CU=K*ETo)	36.13/36.13/39.74	38.93/24.91/24.91	32.78/32.78/30.73	30.75/28.70/28.70	25.97/25.97/28.57	21.00/22.50/22.50	23.23/23.23/27.87	26.13/26.13/30.48	32.55/32.55/32.55	37.94/37.94/41.73	37.80/36.00/36.00	32.90/32.90/32.90	1,141.1 / 1,137.9 / 1,134.7
Net Irrigation Requirement (IRn=WR-Re)													
Average (WR)	29.87/29.87/29.87	22.25/22.25/22.25	31.41/31.41/31.41	29.38/29.38/28.70	25.97/25.97/28.57	22.00/22.00/22.00	26.32/26.32/30.65	27.58/27.58/29.03	32.55/32.55/32.55	37.94/37.94/41.73	37.20/36.00/36.00	17.87/17.87/17.87	1,137.9
Average Year (IRn)	0.00	0.00	1.55/1.55/0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.43/7.43/6.23	6.55/6.55/6.55	227.7 / 216.5 / 205.4 / 216.5
Utilized Rainfall (Rut=Average WR - Average IRn)													
Average Year	6.3	16.7	30.9	29.4	26.0	22.0	26.3	29.0	32.6	37.9	30.4	15.0	921.7
1/5 year	0.0	9.3	21.9	28.2	26.0	22.5	13.2	12.7	27.7	23.8	28.3	26.4	732.8
Diversion Irrigation Requirement (Ird=Irn/0.65)													
Average Year	46.0	26.2	0.8/2.4/14.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	27.5	333.2
1/5 year	55.5	37.6	14.6/45.2	0.0	0.0	0.0	20.1/62.7	25.1/77.9	7.4/22.2	21.7/67.3	11.8	10.1/31.3	622.8

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Table 7.1-6-1 Irrigation Requirement of Pineapple in Sudanese Climatic Zone

Month	Jan I	Jan II	Jan III	Feb I	Feb II	Feb III	Mar I	Mar II	Mar III	Apr I	Apr II	Apr III	May I	May II	May III	Jun I	Jun II	Jun III	Jul I	Jul II	Jul III	Aug I	Aug II	Aug III	Sep I	Sep II	Sep III	Oct I	Oct II	Oct III	Nov I	Nov II	Nov III	Dec I	Dec II	Dec III	Total
days	10	10	11	10	10	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	365
Rainfall (mm)																																					
Average year		3.4			11.9			42.4			83.9			117.4			137.1			194.0			236.0			182.7			95.2			18.8			5.2		1,128.0
Year 1983		0.0			14.9			1.1			74.8			63.2			130.7			142.3			164.9			149.4			23.2			17.7			10.1		792.3
1/5 year		0.0			18.2			1.3			91.5			77.3			159.9			174.1			201.7			182.8			28.4			21.7			12.4		969.3
Effective Rainfall (mm) by USBR																																					
Average year		3.4			11.9			41.6			78.6			102.2			111.9			120.6			120.6			120.6			87.6			18.8			5.2		823.0
1/5 year		0.0			18.2			1.3			84.6			73.3			118.9			120.3			120.6			120.6			28.3			21.7			12.4		720.2
Effective Rainfall by 10 days (mm): Re																																					
Average year	1.10	1.10	1.21	4.25	4.25	3.40	13.42	13.42	14.76	26.20	26.20	26.20	32.97	32.97	36.26	37.30	37.30	40.20	38.90	38.90	42.79	38.90	38.90	42.79	40.20	40.20	40.20	28.26	28.26	31.08	6.27	6.27	6.27	1.68	1.68	1.85	
1/5 year	0.00	0.00	0.00	6.50	6.50	5.20	0.42	0.43	0.46	28.20	28.20	28.20	23.65	23.65	26.01	39.63	39.63	40.20	38.81	38.81	42.69	38.90	38.90	42.79	40.20	40.20	40.20	9.13	9.13	10.04	7.23	7.23	7.23	4.00	4.00	4.40	
Average (WR)	36.13	36.13	39.74	44.00	44.00	35.20	43.35	43.35	47.69	37.06	37.06	37.06	33.55	33.55	36.90	28.80	28.80	30.94	24.26	24.26	26.68	28.13	28.13	30.94	29.06	29.06	29.06	29.68	29.68	32.65	37.06	37.06	37.06	41.55	41.55	45.70	1,252.7
Evapotranspiration (mm)																																					
Monthly ETo (mm)		140			154			168			139			130			108			94			109			109			115			139			161		
10 days (mm)	45.16	45.16	49.68	55.00	55.00	44.00	54.19	54.19	59.61	46.33	46.33	46.33	41.94	41.94	46.13	36.00	36.00	38.68	30.32	30.32	33.35	35.16	35.16	38.68	36.33	36.33	36.33	37.10	37.10	40.81	46.33	46.33	46.33	51.94	51.94	57.13	
Crop Coefficient (K)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	
Consumptive Water Use (CU=ETo*K)	36.13	36.13	39.74	44.00	44.00	35.20	43.35	43.35	47.69	37.06	37.06	37.06	33.55	33.55	36.90	28.80	28.80	30.94	24.26	24.26	26.68	28.13	28.13	30.94	29.06	29.06	29.06	29.68	29.68	32.65	37.06	37.06	37.06	41.55	41.55	45.70	1,252.7
Average (WR)	36.13	36.13	39.74	44.00	44.00	35.20	43.35	43.35	47.69	37.06	37.06	37.06	33.55	33.55	36.90	28.80	28.80	30.94	24.26	24.26	26.68	28.13	28.13	30.94	29.06	29.06	29.06	29.68	29.68	32.65	37.06	37.06	37.06	41.55	41.55	45.70	1,252.7
Net Irrigation Requirement (IRn=WR-Re)																																					
Average Year	35.03	35.03	38.53	39.75	39.75	31.80	29.93	29.93	32.93	10.86	10.86	10.86	0.58	0.58	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.42	1.42	1.57	30.79	30.79	30.79	39.87	39.87	39.87	567.4
1/5 year	36.13	36.13	38.53	37.50	37.50	30.00	42.93	42.93	47.23	8.86	8.86	8.86	9.90	9.90	10.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.55	20.55	22.61	29.83	29.83	29.83	37.55	37.55	37.55	677.0
Average (IRn)	36.13	36.13	39.74	37.50	37.50	30.00	42.93	42.93	47.23	8.86	8.86	8.86	9.90	9.90	10.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.55	20.55	22.61	29.83	29.83	29.83	37.55	37.55	37.55	677.0
Utilized Rainfall (Rus=Average WR - Average IRn)																																					
Average Year	1.1	1.1	1.2	4.3	4.3	3.4	13.4	13.4	14.8	26.2	26.2	26.2	33.0	33.0	36.3	28.8	28.8	30.9	24.3	24.3	26.7	28.1	28.1	30.9	29.1	29.1	29.1	28.3	28.3	31.1	6.3	6.3	6.3	1.7	1.7	1.9	685.9
1/5 year	0.0	0.0	0.0	6.5	6.5	5.2	0.4	0.4	0.5	28.2	28.2	28.2	23.7	23.7	26.0	28.8	28.8	30.9	24.3	24.3	26.7	28.1	28.1	30.9	29.1	29.1	29.1	9.1	9.1	10.0	7.2	7.2	7.2	4.0	4.0	4.4	575.8
Diversion Irrigation Requirement (IRd=IRn/0.65)																																					
Average Year	53.9	53.9	59.3	61.2	61.2	48.9	46.0	46.0	50.7	16.7	16.7	16.7	0.9	0.9	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.2	2.4	47.4	47.4	47.4	61.3	61.3	67.5	873.1
1/5 year	55.6	55.6	61.1	57.7	57.7	46.2	66.0	66.0	72.7	13.6	13.6	13.6	15.2	15.2	16.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.6	31.6	34.8	45.9	45.9	45.9	57.8	57.8	63.5	1,041.4

Table 7.1-6-2 Irrigation Requirement of Pineapple in Boaule Climatic Zone

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
days	10	10	11	10	10	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	365
Rainfall (mm)																																					
Average year	8.3				40.0			91.8			122.0			140.2			136.6			119.4			131.0			150.3			111.0			32.3			13.6			1,096.5
Year 1983	0.0				24.1			29.1			111.5			211.5			129.1			27.4			27.6			105.4			28.0			36.5			36.5			765.7
1/5 year	0.0				29.2			35.3			135.2			256.4			156.5			33.2			33.5			127.8			33.9			44.3			44.3			929.6
Effective Rainfall (mm) by USBR																																					
Average year	8.3				39.3			84.9			104.9			113.2			111.7			103.4			109.5			117.2			98.3			32.0			13.6			936.3
1/5 year	0.0				29.0			34.8			111.2			120.6			118.5			32.8			33.1			108.2			33.5			43.4			43.4			708.5
Effective Rainfall by 10days (mm): Re																																					
Average year	2.68	2.68	2.95	14.04	14.04	11.23	27.39	27.39	30.13	34.97	34.97	34.97	36.52	36.52	40.17	37.23	37.23	36.69	33.35	33.35	33.35	35.32	35.32	38.85	39.07	39.07	39.07	31.71	31.71	34.88	10.67	10.67	10.67	4.39	4.39	4.83	936.4
1/5 year	0.00	0.00	0.00	10.36	10.36	8.29	11.23	11.23	12.35	37.07	37.07	37.07	38.90	38.90	42.79	39.50	39.50	11.64	10.58	10.58	10.58	10.68	10.68	11.75	36.07	36.07	36.07	10.81	10.81	11.89	14.47	14.47	14.47	14.00	14.00	15.40	708.6
Evapotranspiration (mm)																																					
Monthly ETo (mm)		118			120			133			132			127			108			96			96			102			115			111			102			1,360.0
10 days ETo (mm)	38.06	38.06	41.87	42.86	42.86	34.29	42.90	42.90	47.19	44.00	44.00	44.00	40.97	40.97	45.06	36.00	36.00	34.06	30.97	30.97	34.06	30.97	30.97	34.06	34.00	34.00	34.00	37.10	37.10	40.81	37.00	37.00	37.00	32.90	32.90	36.19	1,360.0
Cropping Calendar																																					
Crop Coefficient (K)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Consumptive Water Use (CU=ETo*K)	30.45	30.45	33.50	34.29	34.29	27.43	34.32	34.32	37.75	35.20	35.20	35.20	32.78	32.78	36.05	28.80	28.80	27.25	24.78	24.78	27.25	24.78	24.78	27.25	27.20	27.20	27.20	29.68	29.68	32.65	29.60	29.60	29.60	26.32	26.32	28.95	1,088.0
	30.45	30.45	33.50	34.29	34.29	27.43	34.32	34.32	37.75	35.20	35.20	35.20	32.78	32.78	36.05	28.80	28.80	27.25	24.78	24.78	27.25	24.78	24.78	27.25	27.20	27.20	27.20	29.68	29.68	32.65	29.60	29.60	29.60	26.32	26.32	28.95	1,088.0
Average (WR)	30.45	30.45	33.50	34.29	34.29	27.43	34.32	34.32	37.75	35.20	35.20	35.20	32.78	32.78	36.05	28.80	28.80	27.25	24.78	24.78	27.25	24.78	24.78	27.25	27.20	27.20	27.20	29.68	29.68	32.65	29.60	29.60	29.60	26.32	26.32	28.95	1,088.0
Net Irrigation Requirement (IRn=WR-Re)																																					
Average Year	27.77	27.77	30.55	20.25	20.25	16.20	6.93	6.93	7.62	0.23	0.23	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.93	18.93	18.93	21.93	21.93	24.12	289.7
1/5 year	27.77	27.77	30.55	20.25	20.25	16.20	6.93	6.93	7.62	0.23	0.23	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.93	18.93	18.93	21.93	21.93	24.12	289.7
Average (IRn)	27.77	27.77	30.55	20.25	20.25	16.20	6.93	6.93	7.62	0.23	0.23	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.93	18.93	18.93	21.93	21.93	24.12	289.7
	30.45	30.45	33.50	23.93	23.93	19.14	23.09	23.09	25.40	14.20	14.20	14.20	0.00	0.00	0.00	0.00	0.00	0.00	14.20	14.20	15.61	14.10	14.10	15.50	18.87	18.87	20.76	18.87	18.87	20.76	15.13	15.13	15.13	12.32	12.32	13.55	462.8
	30.45	30.45	33.50	23.93	23.93	19.14	23.09	23.09	25.40	14.20	14.20	14.20	0.00	0.00	0.00	0.00	0.00	0.00	14.20	14.20	15.61	14.10	14.10	15.50	18.87	18.87	20.76	18.87	18.87	20.76	15.13	15.13	15.13	12.32	12.32	13.55	462.8
Average (IRn)	30.45	30.45	33.50	23.93	23.93	19.14	23.09	23.09	25.40	14.20	14.20	14.20	0.00	0.00	0.00	0.00	0.00	0.00	14.20	14.20	15.61	14.10	14.10	15.50	18.87	18.87	20.76	18.87	18.87	20.76	15.13	15.13	15.13	12.32	12.32	13.55	462.8
	30.45	30.45	33.50	23.93	23.93	19.14	23.09	23.09	25.40	14.20	14.20	14.20	0.00	0.00	0.00	0.00	0.00	0.00	14.20	14.20	15.61	14.10	14.10	15.50	18.87	18.87	20.76	18.87	18.87	20.76	15.13	15.13	15.13	12.32	12.32	13.55	462.8
Utilized Rainfall (Run=Average WR - Average IRn)																																					
Average Year	2.7	2.7	3.0	14.0	14.0	11.2	27.4	27.4	30.1	35.0	35.0	35.0	32.8	32.8	36.1	28.8	28.8	27.3	24.8	24.8	27.3	24.8	24.8	27.3	27.2	27.2	27.2	29.7	29.7	32.7	10.7	10.7	10.7	4.4	4.4	4.8	798.8
1/5 year	0.0	8.4	0.0	10.4	10.4	8.3	11.2	11.2	12.4	35.2	35.2	35.2	32.8	32.8	36.1	28.8	28.8	11.6	10.6	10.7	11.8	10.7	10.7	11.8	10.8	10.8	10.8	10.8	10.8	11.9	14.5	14.5	14.5	14.0	14.0	15.4	798.8
		0.0			29.1			34.8			105.6			101.7			86.4			32.8			33.2			81.6			33.5			43.5			43.4			625.6
Diversion Irrigation Requirement (Ird=IRn/0.65)																																					
Average Year	42.7	42.7	47.0	31.2	31.2	24.9	10.7	10.7	11.7	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.1	29.1	29.1	33.7	33.7	37.1	445.8
		132.4			87.3			33.1			1.2			0.0			0.0			67.6			67.2			0.0			0.0			87.3			104.5			445.8
1/5 year	46.8	46.8	51.5	36.8	36.8	29.4	35.5	35.5	39.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.8	21.8	21.7	23.8	21.7	21.7	23.8	29.0	29.0	31.9	29.0	29.0	31.9	23.3	23.3	23.3	19.0	19.0	20.8	711.6
		145.1			103.0			110.1			0.0			0.0			0.0			67.6			67.2			0.0			89.9			69.9			58.8			711.6

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Table 7.1-6-3 Irrigation Requirement of Pineapple in Mountainous Climatic Zone

Monthly data

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall (mm)													
Average year	6.8	34.5	93.1	129.2	156.2	157.6	191.0	282.4	240.9	119.6	26.2	12.1	1,449.6
Year 1983	0.0	64.4	33.5	121.2	102.5	140.9	78.4	205.7	278.2	88.6	21.5	3.1	1,138.0
1/5 year	0.0	72.3	37.6	136.1	115.1	158.2	88.0	230.9	312.3	99.5	24.1	3.5	1,277.6
Effective Rainfall (mm) by USBR													
Average year	6.8	34.0	85.9	108.8	118.5	118.6	120.6	120.6	120.6	103.5	26.2	12.1	976.2
1/5 year	0.0	68.9	37.0	111.5	100.8	118.7	81.8	120.6	120.6	91.0	24.1	3.5	878.5
Evapotranspiration (mm)													
Monthly ETo (mm)	118	120	133	132	127	108	96	96	102	115	111	102	1,360.0

Cropping Calendar: [blank]

Ten-day period data

Item	Jan I	Jan II	Jan III	Feb I	Feb II	Feb III	Mar I	Mar II	Mar III	Apr I	Apr II	Apr III	May I	May II	May III	Jun I	Jun II	Jun III	Jul I	Jul II	Jul III	Aug I	Aug II	Aug III	Sep I	Sep II	Sep III	Oct I	Oct II	Oct III	Nov I	Nov II	Nov III	Dec I	Dec II	Dec III	Total
days	10	10	11	10	10	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	365
Effective Rainfall by 10days (mm): Re																																					
Average year	2.19	2.19	2.41	12.14	12.14	9.71	27.71	27.71	30.48	36.27	36.27	36.27	38.23	38.23	42.05	39.53	39.53	39.53	38.90	38.90	42.79	38.90	38.90	42.79	40.20	40.20	40.20	33.39	33.39	36.73	8.73	8.73	8.73	3.90	3.90	4.29	976.2
1/5 year	0.00	0.00	0.00	24.61	24.61	19.69	11.94	11.94	13.13	37.17	37.17	37.17	32.52	32.52	35.77	39.57	39.57	39.57	26.39	26.39	29.03	38.90	38.90	42.79	40.20	40.20	40.20	29.35	29.35	32.29	8.03	8.03	8.03	1.13	1.13	1.24	878.5
Evapotranspiration 10 days (mm)	38.06	38.06	41.87	42.86	42.86	34.29	42.90	42.90	47.19	44.00	44.00	44.00	40.97	40.97	45.06	36.00	36.00	36.00	30.97	30.97	34.06	30.97	30.97	34.06	34.00	34.00	34.00	37.10	37.10	40.81	37.00	37.00	37.00	32.90	32.90	36.19	1,360.0
Crop Coefficient (K)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Consumptive Water Use (CU=ETo*K) — Average (WR)	30.45	30.45	33.50	34.29	34.29	27.43	34.32	34.32	37.75	35.20	35.20	35.20	32.78	32.78	36.05	28.80	28.80	28.80	24.78	24.78	27.25	24.78	24.78	27.25	27.20	27.20	27.20	29.68	29.68	32.65	29.60	29.60	29.60	26.32	26.32	28.95	1,088.0
Net Irrigation Requirement (IRn=WR−Re)																																					
Average Year	28.26	28.26	31.09	22.15	22.15	17.72	6.61	6.61	7.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.87	20.87	20.87	22.42	22.42	24.66	302.2
Average (IRn)	28.26	28.26	31.09	22.15	22.15	17.72	6.61	6.61	7.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.87	20.87	20.87	22.42	22.42	24.66	302.2
1/5 year	30.45	30.45	33.50	9.68	9.68	7.74	22.38	22.38	24.62	0.00	0.00	0.00	0.26	0.26	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.33	0.36	21.57	21.57	21.57	25.19	25.19	27.71	335.5
Average (IRn)	30.45	30.45	33.50	9.68	9.68	7.74	22.38	22.38	24.62	0.00	0.00	0.00	0.26	0.26	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.33	0.36	21.57	21.57	21.57	25.19	25.19	27.71	335.5
Utilized Rainfall (Ru=Average WR − Average IRn)																																					
Average Year	2.2	2.2	2.4	12.1	12.1	9.7	27.7	27.7	30.5	35.2	35.2	35.2	32.8	32.8	36.1	28.8	28.8	28.8	24.8	24.8	27.2	24.8	24.8	27.2	27.2	27.2	27.2	29.7	29.7	32.7	8.7	8.7	8.7	3.9	3.9	4.3	786.0
1/5 year	0.0	0.0	0.0	24.6	24.6	19.7	11.9	11.9	13.1	35.2	35.2	35.2	32.5	32.5	35.8	28.8	28.8	28.8	24.8	24.8	27.2	24.8	24.8	27.2	27.2	27.2	27.2	29.4	29.4	32.3	8.0	8.0	8.0	1.1	1.1	1.2	752.5
Diversion Irrigation Requirement (IRd=Im/0.65)																																					
Average Year	43.5	43.5	47.8	34.1	34.1	27.3	10.2	10.2	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.1	32.1	32.1	34.5	34.5	37.9	465.1
1/5 year	46.8	46.8	51.5	14.9	14.9	11.9	34.4	34.4	37.9	0.0	0.0	0.0	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.6	33.2	33.2	33.2	38.8	38.8	42.6	516.1

Table 7.1-6-4 Irrigation Requirement of Pineapple in Attie Climatic Zone

(Values are given per 10-day period / decade within each month; three decades per month where applicable: I / II / III)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
days (I / II / III)	10/10/11	10/10/8	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	365
Rainfall (mm)													
Average year	19.4	47.8	108.5	138.5	223.7	282.5	133.9	109.9	149.6	160.1	99.6	47.7	1,521.2
Year 1983	0.1	24.9	67.8	96.3	347.4	284.3	39.8	38.3	85.4	74.3	87.5	83.6	1,229.7
1/5 year	0.1	26.1	71.2	101.1	364.8	298.5	41.8	40.2	83.7	78.0	91.9	87.8	1,291.2
Effective Rainfall (mm) by USBR													
Average year	19.4	46.7	96.8	112.5	120.6	120.6	110.7	97.7	116.9	118.9	91.1	46.6	1,098.5
1/5 year	0.1	26.1	67.9	92.3	120.6	120.6	41.0	39.5	83.2	73.8	85.0	81.7	831.8
Effective Rainfall by 10days (mm): Re													
Average year	6.26	16.68	31.23	37.50	38.90	40.20	35.71	31.52	38.97	38.35	30.37	15.03	1,098.5
1/5 year	0.03	9.32	21.90	30.77	38.90	40.20	13.23	12.74	27.73	23.81	28.33	26.35	831.8
Evapotranspiration (mm)													
Monthly ETo	112	109	127	123	115	90	96	90	93	112	108	102	1,277.0
10 days ETo (mm)	36.13	38.93	40.97	41.00	37.10	30.00	30.97	29.03	31.00	36.13	36.00	32.90	1,277.0
Cropping Calendar													
Crop Coefficient (K)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	
Consumptive Water Use (CU=ETo*K)	28.90	31.14	32.78	32.80	29.68	24.00	24.78	23.22	24.80	28.90	28.80	26.32	1,021.6
Average (WR)	28.87	31.14	32.78	32.80	29.68	24.00	24.78	23.22	24.80	28.90	28.80	26.32	1,021.6
Net Irrigation Requirement (IRn=WR-Re)													
Average Year	22.64	14.46	1.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.29	150.5
Average (IRn)	22.64	14.46	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.29	150.5
1/5 year	28.87	21.82	10.88	2.03	0.00	0.00	11.55	10.48	0.00	5.09	0.47	11.29	275.9
Average (IRn)	28.87	21.82	11.96	2.03	0.00	0.00	11.55	10.48	0.00	5.60	0.47	11.29	275.9
Utilized Rainfall (Rltu=Average WR - Average IRn)													
Average Year	6.3	16.7	31.2	32.8	29.7	24.0	24.8	23.2	24.8	28.9	28.8	15.0	871.3
1/5 year	0.0	9.3	21.9	30.8	29.7	24.0	13.2	12.7	24.8	23.8	28.3	26.3	745.6
Diversion Irrigation Requirement (Ird=Irn/0.65)													
Average Year	34.8	22.2	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4	231.4
Average Year (monthly)	107.9	62.2	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.9	231.4
1/5 year	44.4	33.6	16.7	3.1	0.0	0.0	17.8	16.1	0.0	7.8	0.7	0.0	424.0
1/5 year (monthly)	137.6	94.0	51.8	9.3	0.0	0.0	55.1	49.9	0.0	24.2	2.1	0.0	424.0

Table 7.1-7.1 Irrigation Requirement of Aquaculture in Sudanese Climatic Zone

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
days	10	10	11	10	10	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	11	10	10	11	365

Rainfall (mm)

																																					Total
Average year	3.4			11.9			42.4			83.9			117.4			137.1			194.0			236.0			182.7			95.2			18.8			5.2			1,128.0
Year 1983	0.0			14.9			11			74.8			63.2			130.7			142.3			164.9			149.4			23.2			17.7			10.1			792.3
1/5 year	0.0			18.2			1.3			91.5			77.3			159.9			174.1			201.7			182.8			28.4			21.7			12.4			969.3

Effective Rainfall (mm) 100% of rainfall

| Average year | 3.4 | | | 11.9 | | | 42.4 | | | 83.9 | | | 117.4 | | | 137.1 | | | 194.0 | | | 236.0 | | | 182.7 | | | 95.2 | | | 18.8 | | | 5.2 | | | 1,128.0 |
| 1/5 year | 0.0 | | | 18.2 | | | 1.3 | | | 91.5 | | | 77.3 | | | 159.9 | | | 174.1 | | | 201.7 | | | 182.8 | | | 28.4 | | | 21.7 | | | 12.4 | | | 969.3 |

Effective Rainfall by 10days (mm): Re

| Average year | 1.10 | 1.10 | 1.21 | 4.25 | 4.25 | 3.40 | 13.68 | 13.68 | 3.40 | 27.97 | 27.97 | 27.97 | 37.87 | 37.87 | 41.66 | 45.70 | 45.70 | 45.70 | 62.58 | 62.58 | 68.84 | 76.13 | 76.13 | 83.74 | 60.90 | 60.90 | 60.90 | 30.71 | 30.71 | 33.78 | 6.27 | 6.27 | 6.27 | 1.68 | 1.68 | 1.85 | 1,128.1 |
| 1/5 year | 0.00 | 0.00 | 0.00 | 6.50 | 6.50 | 5.20 | 0.42 | 0.42 | 5.20 | 30.50 | 30.50 | 30.50 | 24.94 | 24.94 | 27.43 | 53.30 | 53.30 | 53.30 | 56.16 | 56.16 | 61.78 | 65.06 | 65.06 | 71.57 | 60.93 | 60.93 | 60.93 | 9.16 | 9.16 | 10.08 | 7.23 | 7.23 | 7.23 | 4.00 | 4.00 | 4.40 | 969.3 |

Evapotranspiration (mm)

| Monthly ETo (mm) | 140 | | | 154 | | | 168 | | | 139 | | | 130 | | | 108 | | | 94 | | | 109 | | | 109 | | | 115 | | | 139 | | | 161 | | | 1,566.0 |
| 10 days (mm) | 45.16 | 45.16 | 49.68 | 55.00 | 55.00 | 44.00 | 54.19 | 54.19 | 59.61 | 46.33 | 46.33 | 46.33 | 41.94 | 41.94 | 46.13 | 36.00 | 36.00 | 36.00 | 30.32 | 30.32 | 33.35 | 35.16 | 35.16 | 38.68 | 36.33 | 36.33 | 36.33 | 37.10 | 37.10 | 40.81 | 46.33 | 46.33 | 57.13 | 51.94 | 51.94 | 57.13 | 1,566.0 |

Cropping Calendar

Crop Coefficient (K)

	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			1.00	200																								1,000
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00																												1,000

Standing Water (Hmm; incremental depth, 800mm in total)

												1.00	300	300	300	200	200																				1,000
											1.00		300			200	200																				
													300																								

Seepage (P: percolation = 5 mm/day)

	50	50	55	50	50	40	50	50	55	50		50	300	50	55	50	50	55	50	50	55	50	50	55	50	50	50	50	50	55	50	50	55	50	50	55	1,675
	50	50	55	50	50	40	50	50	55	50	50	50		50	55	50	50	55	50	50	55	50	50	55	50	50	50	50	50	55	50	50	55	50	50	55	1,675
	50	50	55	50	50	40	50	50	55																												1,675

Consumptive Water Use (CU=ETo*K)

	45.16	45.16	49.68	55.00	55.00	44.00	54.19	54.19	59.61	46.33	46.33	41.94		41.94	46.13	36.00	36.00	36.00	30.32	30.32	33.35	35.16	35.16	38.68	36.33	36.33	36.33	37.10	37.10	40.81	46.33	46.33	57.13	51.94	51.94	57.13	1,435.8
	45.16	45.16	49.68	55.00	55.00	44.00	54.19	54.19	59.61	46.33	46.33	41.94	41.94	41.94	46.13	36.00	36.00	36.00	30.32	30.32	33.35	35.16	35.16	38.68	36.33	36.33	36.33	37.10	37.10	40.81	46.33	46.33	57.13	51.94	51.94	57.13	1,431.4
	45.16	45.16	49.68	55.00	55.00	44.00	54.19	54.19	59.61	46.33	46.33				46.13	36.00	36.00	36.00	30.32	30.32	33.35	35.16	35.16	38.68	36.33	36.33	36.33	37.10	37.10	40.81	46.33	46.33	57.13	51.94	51.94	57.13	1,427.0

Water Requirement (WR=H+P+CU)

	95.16	95.16	104.68	105.00	105.00	84.00	104.19	104.19	114.61	96.33	96.33	0.00	0.00	0.00	401.13	86.00	86.00	86.00	80.32	80.32	88.35	85.16	85.16	93.68	86.33	86.33	86.33	87.10	87.10	95.81	96.33	96.33	112.13	101.94	101.94	112.13	4,110.8
	95.16	95.16	104.68	105.00	105.00	84.00	104.19	104.19	114.61	96.33	0.00	0.00	391.94	391.94	401.13	286.00	286.00	286.00	80.32	80.32	88.35	85.16	85.16	93.68	86.33	86.33	86.33	87.10	87.10	95.81	96.33	96.33	112.13	101.94	101.94	112.13	4,106.4
	95.16	95.16	104.68	105.00	105.00	84.00	104.19	104.19	114.61	0.00	0.00	391.94	391.94	286.00	301.13	86.00	86.00	86.00	80.32	80.32	88.35	85.16	85.16	93.68	86.33	86.33	86.33	87.10	87.10	95.81	96.33	96.33	112.13	101.94	101.94	112.13	4,102.0
Average (WR)	95.16	95.16	104.68	105.00	105.00	84.00	104.19	104.19	114.61	64.22	43.89	130.65	261.29	319.33	367.80	152.67	86.00	86.00	80.32	80.32	88.35	85.16	85.16	93.68	86.33	86.33	86.33	87.10	87.10	95.81	96.33	96.33	112.13	101.94	101.94	112.13	4,106.4

Net Irrigation Requirement (IRn=WR-Re)

Average Year

	94.06	94.06	103.47	100.75	100.75	80.60	90.51	90.51	99.56	68.36	68.36	0.00	0.00	359.47	359.47	240.30	240.30	240.30	17.74	17.74	19.51	9.03	9.03	9.94	25.43	25.43	25.43	56.39	56.39	62.03	90.06	90.06	110.26	100.26	100.26	110.28	3,086.4
	94.06	94.06	103.47	100.75	100.75	80.60	90.51	90.51	99.56	68.36	0.00	0.00	354.07	354.07	259.47	240.30	240.30	40.30	17.74	17.74	19.51	9.03	9.03	9.94	25.43	25.43	25.43	56.39	56.39	62.03	90.06	90.06	110.26	100.26	100.26	110.28	3,072.1
	94.06	94.06	103.47	100.75	100.75	80.60	90.51	90.51	99.56	0.00	0.00	354.07	354.07	259.47	326.14	40.30	40.30	40.30	17.74	17.74	19.51	9.03	9.03	9.94	25.43	25.43	25.43	56.39	56.39	62.03	90.06	90.06	110.26	100.26	100.26	110.28	3,057.9
Average (IRn)	94.06	94.06	103.47	100.75	100.75	80.60	90.51	90.51	99.56	45.57	22.79	118.02	236.05	326.14	173.63	106.97	40.30	40.30	17.74	17.74	19.51	9.03	9.03	9.94	25.43	25.43	25.43	56.39	56.39	62.03	90.06	90.06	110.26	100.26	100.26	110.28	3,072.1

Utilized Rainfall (IRe=Average WR - Average IRn)

	95.16	95.16	104.68	98.50	98.50	78.80	103.77	103.77	114.15	65.83	65.83	0.00	0.00	373.70	373.70	232.70	232.70	232.70	24.16	24.16	26.57	20.10	20.10	22.11	25.40	25.40	25.40	77.94	77.94	85.73	89.10	89.10	107.73	97.94	97.94	107.73	3,221.9
	95.16	95.16	104.68	98.50	98.50	78.80	103.77	103.77	114.15	65.83	0.00	0.00	367.00	373.70	273.70	232.70	232.70	32.70	24.16	24.16	26.57	20.10	20.10	22.11	25.40	25.40	25.40	77.94	77.94	85.73	89.10	89.10	107.73	97.94	97.94	107.73	3,223.0
	95.16	95.16	104.68	98.50	98.50	78.80	103.77	103.77	114.15	43.89	21.94	122.33	244.67	340.37	266.03	99.37	32.70	32.70	24.16	24.16	26.57	20.10	20.10	22.11	25.40	25.40	25.40	77.94	77.94	85.73	89.10	89.10	107.73	97.94	97.94	107.73	3,224.2
Average (IRe)	95.16	95.16	104.68	98.50	98.50	78.80	103.77	103.77	114.15						340.37																						3,223.0

Utilized Rainfall (IRe= Average WR - Average IRn)

Average Year	1.1	1.1	1.2	4.3	4.3	3.4	13.7	13.7	15.1	18.7	9.3	12.6	25.2	41.7	45.7	45.7	76.1	62.6	60.9	60.9	68.8	76.1	76.1	83.7	60.9	60.9	60.9	30.7	30.7	33.8	6.3	6.3	1.7	1.7	1.7	1.8	1,044.4
	3.4			12.0			42.5			28.0			79.5	131.7	137.1	194.0	235.9	190.0	182.7	117.3	84.6	43.1	235.9		425		95.2	194.0		42.5	18.9	5.2	5.2		1,044.4
1/5 year	0.0	0.0	0.0	6.5	6.5	5.2	0.4	0.4	0.5	20.3	10.2	8.3	16.6	27.4	53.3	53.3	65.1	56.2	60.9	60.9	61.8	65.1	65.1	71.6	60.9	60.9	9.2	9.2	10.1	7.2	7.2	4.0	4.0	883.4
	0.0			18.2			1.3			30.5			52.3	159.9	159.9	174.2	201.8	174.2	182.7	115.3	95.8		201.8		25.5		28.5	21.6	12.4	12.4			883.4

Diversion Irrigation Requirement (Ire=1-n=0.65)

Average Year	144.7	144.7	159.2	155.00	155.0	124.0	139.2	139.2	153.2	70.1	35.1	181.6	363.2	501.8	421.0	164.6	62.0	62.6	27.3	27.3	30.0	13.9	13.9	15.3	39.1	39.1	39.1	86.8	86.8	95.4	138.6	138.6	169.7	154.2	154.2	169.7	4,726.6
	144.7	448.6		434.0		121.2	431.6		105.2		1046.6	827.7	194.0	43.1	84.6	194.0		117.3			259.0		415.8		478.1		448.6		4,726.6
1/5 year	146.4	146.4	161.0	151.5		121.2	159.6	159.6	175.6	67.5	33.8	152.9	376.4	523.6	409.3	152.9	56.2	57.2	39.1	39.1	40.9	30.9	30.9	34.0	39.1	39.1	119.9	119.9	131.9	137.1	137.1	165.7	150.7	150.7	165.7	4,958.4
	453.8			424.2			494.8			101.3			1088.2	817.6			174.2		115.3			371.7		411.3		467.1		4,958.4

Harvesting

Table 7.1.7-2 Irrigation Requirement of Aquaculture in Boanle Climatic Zone

Item (Month)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
days (10-day periods)	10/10/10	10/10/8	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	365
Rainfall (mm)													
Average year	8.3	40.0	91.8	122.0	140.2	136.6	119.4	131.0	150.3	111.0	32.3	13.6	1,096.5
Year 1983	0.0	24.1	29.1	111.5	211.5	129.1	27.4	27.6	105.4	28.0	36.5	36.5	766.5
1/5 year	0.0	29.2	35.3	135.2	256.4	156.5	33.2	33.5	127.8	33.9	44.3	44.3	929.6
Effective Rainfall (mm) 100% of rainfall													
Average year	8.3	40.0	91.8	122.0	140.2	136.6	119.4	131.0	150.3	111.0	32.3	13.6	1,096.5
1/5 year	0.0	29.2	35.3	135.2	256.4	156.5	33.2	33.5	127.8	33.9	44.3	44.3	929.6
Effective Rainfall by 10 days (mm): Re													
Average year	2.68/2.68/2.95	14.29/14.29/14.29	29.61/29.61/32.57	40.67/40.67/40.67	45.23/45.23/49.75	45.53/45.53/45.53	38.52/38.52/42.37	42.26/42.26/46.48	50.10/50.10/50.10	35.81/35.81/39.39	10.77/10.77/10.77	4.39/4.39/4.83	1,096.6
1/5 year	0.00/0.00/0.00	10.43/10.43/0.00	11.39/11.39/12.53	45.07/45.07/45.07	82.71/82.71/90.98	52.17/52.17/52.17	10.71/10.71/11.78	10.81/10.81/11.89	42.60/42.60/42.60	10.94/10.94/12.03	14.77/14.77/14.77	14.29/14.29/15.72	929.7
Evapotranspiration (mm)													
Monthly ETo (mm)	118	120	133	132	127	108	96	96	102	115	111	102	1,360.0
10 days (mm)	38.06	42.86	42.90	44.00	40.97	36.00	30.97	30.97	34.00	37.10	37.00	32.90	1,360.0
Cropping Calendar					Harvesting								
Crop Coefficient (K)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Standing Water (Hmm: incremental depth, 800mm in total)				50	300/300/300	300/200/200							1,000
Seepage (P: percolation = 5 mm/day)	50/50/50	50/50/40	50/50/55	50/50/—	—/50/55	55/50/50	50/50/55	50/50/55	50/50/50	50/50/55	50/50/50	50/50/55	1,675
Consumptive Water Use (CU=ETo*K)	38.06	42.86/42.86/41.87	42.90/42.90/47.19	44.00/44.00/44.00	40.97/40.97/45.06	36.00	30.97	30.97	34.00	37.10	37.00	32.90	1,234.1
Water Requirement (WR=H+P+CU)	88.06	92.86/92.86/96.87	92.90/92.90/102.19	94.00/94.00/0.00	0.00/390.97/400.06	386.00/286.00/86.00	80.97	80.97	84.00	87.10	87.00	82.90	3,909.1
Average (WR)													3,906.0
Net Irrigation Requirement (IRn = WR − Re), Average Year	85.38	78.57	63.29	53.33/53.33/0.00	0.00/345.74/350.31	340.47/240.47/40.47	42.45	38.71	33.90	51.29	76.23	78.51	2,943.6
Average (IRn)	85.38	82.43	65.95	35.55	230.49	173.80	42.45	38.71	33.90	56.42	76.23	78.51	2,936.0
1/5 year	88.06	82.43	81.51	48.93	308.26/309.08/209.08	233.83/233.83/33.83	70.26	70.16	41.40	76.16	72.23	68.61	3,189.9
Average (IRn)	88.06	82.43	81.51	32.62	205.51	167.16	70.26	70.16	41.40	76.16	72.23	68.61	3,149.2
Utilized Rainfall (Rn = Average WR − Average IRn)													
Average Year	2.7	14.3	29.6	13.6	30.2	45.5	38.5	42.3	50.1	35.8	10.8	4.4	970.3
1/5 year	0.0	10.4	11.4	30.1	27.6	52.2	10.7	10.8	42.6	10.9	14.8	14.3	756.8
Diversion Irrigation Requirement (Ird = Irn/0.65)													
Average Year	131.4	120.9	97.4	27.4	354.6	267.4	65.3	59.6	52.2	78.9	117.3	120.8	4,517.5
1/5 year	135.5	126.8	101.5	50.2	316.2	257.2	108.1	107.9	63.7	117.2	111.1	105.6	4,845.0

Table 7.1.7-3 Irrigation Requirement of Aquaculture in Mountainous Climatic Zone

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
days	10	10	11	10	10	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	11	10	10	11	365

Rainfall (mm)

Average year ... Total 1,449.6
Year 1983 ... Total 1,138.0
1/5 year ... Total 1,277.6

Effective Rainfall (mm) 100% of rainfall
Average year ... Total 1,449.6
1/5 year ... Total 1,277.6

Effective Rainfall by 10 days (mm): Re
Average year ... Total 1,449.6
1/5 year ... Total 1,277.6

Evapotranspiration (mm)
Monthly ETo (mm) ... Total 1,360.0
10 days (mm) ... Total 1,360.0

Cropping Calendar — Harvesting

Crop Coefficient (K)

Standing Water (Hmm: incremental depth, 800mm in total) ... 1,000

Seepage (P: percolation = 5 mm/day)

Consumptive Water Use (CU=ETo×K) ... 1,675

Water Requirement (WR=H+P+CU) ... 1,234.1 / 1,231.0 / 1,228.0

Average (WR) ... 3,909.1 / 3,906.0 / 3,903.0 / 3,906.0

Net Irrigation Requirement (IRn=WR-Re)
Average Year ... 2,634.7 / 2,624.4 / 2,614.4 / 2,634.4

Average (IRn)
1/5 year ... 2,811.4 / 2,816.6 / 2,821.6 / 2,816.6

Average (IRn)
Utilized Rainfall (Rtu=Average WR - Average IRn)
Average Year ... 1,281.5 / 1,281.5 / 1,089.1 / 1,089.1

Diversion Irrigation Requirement (Ird=Irn/0.65)
Average Year ... 4,037.3 / 4,037.3
1/5 year ... 4,333.5 / 4,333.5

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Table 7.1-7-4 Irrigation Requirement of Aquaculture in Attie Climatic Zone

Month	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Total
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
days	10	10	11	10	10	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	365
Rainfall (mm)																																					
Average year		19.4			47.8			108.5			138.5			223.7			282.5			133.9			109.9			149.6			160.1			99.6			47.7		1,521.2
Year 1983		0.1			24.9			67.8			96.3			347.4			284.3			39.8			38.3			85.4			74.3			87.5			83.6		1,229.7
1/5 year		0.1			26.1			71.2			101.1			364.8			298.5			41.8			40.2			89.7			78.0			91.9			87.8		1,291.2
Effective Rainfall (mm) 100% of rainfall																																					
Average year		19.4			47.8			108.5			138.5			223.7			282.5			133.9			109.9			149.6			160.1			99.6			47.7		1,521.2
1/5 year		0.1			26.1			71.2			101.1			364.8			298.5			41.8			40.2			89.7			78.0			91.9			87.8		1,291.2
Effective Rainfall by 10days (mm): Re																																					
Average year	6.26	6.26	6.88	17.07	17.07	13.66	35.00	35.00	38.50	46.17	46.17	46.17	72.16	72.16	79.38	94.17	94.17	94.17	43.19	43.19	47.51	35.45	35.45	39.00	49.87	49.87	49.87	51.65	51.65	56.81	33.20	33.20	33.20	15.39	15.39	16.93	1,521.2
1/5 year	0.03	0.03	0.04	9.32	9.32	7.46	22.97	22.97	25.26	33.70	33.70	33.70	117.68	117.68	129.45	99.50	99.50	99.50	13.48	13.48	14.83	12.97	12.97	14.26	29.90	29.90	29.90	25.16	25.16	27.68	30.63	30.63	30.63	28.32	28.32	31.15	1,291.2
Evapotranspiration (mm)																																					
Monthly ETo (mm)		112			109			127			123			115			90			96			90			93			112			108			102		1,277.0
10 days (mm)	36.13	36.13	39.74	38.93	38.93	31.14	40.97	40.97	45.06	41.00	41.00	41.00	37.10	37.10	40.81	30.00	30.00	30.00	30.97	30.97	34.06	29.03	29.03	31.94	31.00	31.00	31.00	36.13	36.13	39.74	36.00	36.00	36.00	32.90	32.90	36.19	1,277.0
Cropping Calander	Harvesting																																				
Crop Coefficient (K)																																					
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Standing Water (Hmm: incremental depth, 800mm in total)																																					
															300	300	200	200																			1,000
														300	300	200	200																				1,000
													300	300	200	200																					1,000
Seepage (P: percolation = 5 mm/day)																																					
	50	50	55	50	50	40	50	50	55	50	50				55	50	50	50	50	50	55	50	50	55	50	50	50	50	50	55	50	50	50	50	50	55	1,675
	50	50	55	50	50	40	50	50	55	50				50	55	50	50	50	50	50	55	50	50	55	50	50	50	50	50	55	50	50	50	50	50	55	1,675
	50	50	55	50	50	40	50	50	55				50	50	55	50	50	50	50	50	55	50	50	55	50	50	50	50	50	55	50	50	50	50	50	55	1,675
Consumptive Water Use (CU=ETo*K)																																					
	36.13	36.13	39.74	38.93	38.93	31.14	40.97	40.97	45.06	41.00	41.00				40.81	30.00	30.00	30.00	30.97	30.97	34.06	29.03	29.03	31.94	31.00	31.00	31.00	36.13	36.13	39.74	36.00	36.00	36.00	32.90	32.90	36.19	1,161.8
	36.13	36.13	39.74	38.93	38.93	31.14	40.97	40.97	45.06	41.00				37.10	40.81	30.00	30.00	30.00	30.97	30.97	34.06	29.03	29.03	31.94	31.00	31.00	31.00	36.13	36.13	39.74	36.00	36.00	36.00	32.90	32.90	36.19	1,157.9
	36.13	36.13	39.74	38.93	38.93	31.14	40.97	40.97	45.06				37.10	37.10	40.81	30.00	30.00	30.00	30.97	30.97	34.06	29.03	29.03	31.94	31.00	31.00	31.00	36.13	36.13	39.74	36.00	36.00	36.00	32.90	32.90	36.19	1,154.0
Water Requirement (WR=H+P+CU)																																					
	86.13	86.13	94.74	88.93	88.93	71.14	90.97	90.97	100.06	91.00	91.00	0.00	0.00	0.00	395.81	380.00	280.00	280.00	80.97	80.97	89.06	79.03	79.03	86.94	81.00	81.00	81.00	86.13	86.13	94.74	86.00	86.00	86.00	82.90	82.90	91.19	3,836.8
	86.13	86.13	94.74	88.93	88.93	71.14	90.97	90.97	100.06	91.00	0.00	0.00	0.00	387.10	395.81	280.00	280.00	80.00	80.97	80.97	89.06	79.03	79.03	86.94	81.00	81.00	81.00	86.13	86.13	94.74	86.00	86.00	86.00	82.90	82.90	91.19	3,832.9
	86.13	86.13	94.74	88.93	88.93	71.14	90.97	90.97	100.06	0.00	0.00	0.00	387.10	387.10	295.81	280.00	80.00	80.00	80.97	80.97	89.06	79.03	79.03	86.94	81.00	81.00	81.00	86.13	86.13	94.74	86.00	86.00	86.00	82.90	82.90	91.19	3,829.0
Average (WR)	86.13	86.13	94.74	88.93	88.93	71.14	90.97	90.97	100.06	60.67	30.33	0.00	129.03	258.07	362.48	313.33	213.33	146.67	80.97	80.97	89.06	79.03	79.03	86.94	81.00	81.00	81.00	86.13	86.13	94.74	86.00	86.00	86.00	82.90	82.90	91.19	3,832.9
Net Irrigation Requirement (IRn=WR-Re)																																					
Average Year																																					
	79.87	79.87	87.86	71.86	71.86	57.48	55.97	55.97	61.56	44.83	44.83	0.00	0.00	0.00	316.43	285.83	185.83	185.83	37.78	37.78	41.55	43.58	43.58	47.94	31.13	31.13	31.13	34.48	34.48	37.93	52.80	52.80	52.80	67.51	67.51	74.26	2,506.1
	79.87	79.87	87.86	71.86	71.86	57.48	55.97	55.97	61.56	44.83	0.00	0.00	0.00	314.94	316.43	185.83	185.83	0.00	37.78	37.78	41.55	43.58	43.58	47.94	31.13	31.13	31.13	34.48	34.48	37.93	52.80	52.80	52.80	67.51	67.51	74.26	2,490.3
	79.87	79.87	87.86	71.86	71.86	57.48	55.97	55.97	61.56	0.00	0.00	0.00	314.94	314.94	216.43	185.83	0.00	0.00	37.78	37.78	41.55	43.58	43.58	47.94	31.13	31.13	31.13	34.48	34.48	37.93	52.80	52.80	52.80	67.51	67.51	74.26	2,474.6
Average (IRn)	79.87	79.87	87.86	71.86	71.86	57.48	55.97	55.97	61.56	29.89	14.94	0.00	104.98	209.96	283.10	219.16	123.89	61.94	37.78	37.78	41.55	43.58	43.58	47.94	31.13	31.13	31.13	34.48	34.48	37.93	52.80	52.80	52.80	67.51	67.51	74.26	2,490.3
1/5 year																																					
	86.10	86.10	94.70	79.61	79.61	63.68	68.00	68.00	74.80	57.30	57.30	0.00	0.00	0.00	266.36	280.50	180.50	180.50	67.49	67.49	74.23	66.06	66.06	72.68	51.10	51.10	51.10	60.97	60.97	67.06	55.37	55.37	55.37	54.58	54.58	60.04	2,814.7
	86.10	86.10	94.70	79.61	79.61	63.68	68.00	68.00	74.80	57.30	0.00	0.00	0.00	269.42	266.36	180.50	180.50	0.00	67.49	67.49	74.23	66.06	66.06	72.68	51.10	51.10	51.10	60.97	60.97	67.06	55.37	55.37	55.37	54.58	54.58	60.04	2,746.3
	86.10	86.10	94.70	79.61	79.61	63.68	68.00	68.00	74.80	0.00	0.00	0.00	269.42	269.42	166.36	180.50	0.00	0.00	67.49	67.49	74.23	66.06	66.06	72.68	51.10	51.10	51.10	60.97	60.97	67.06	55.37	55.37	55.37	54.58	54.58	60.04	2,677.9
Average (IRn)	86.10	86.10	94.70	79.61	79.61	63.68	68.00	68.00	74.80	38.20	19.10	0.00	89.81	179.61	233.03	213.83	120.33	60.17	67.49	67.49	74.23	66.06	66.06	72.68	51.10	51.10	51.10	60.97	60.97	67.06	55.37	55.37	55.37	54.58	54.58	60.04	2,746.3
Utilized Rainfall (Ru=Average WR - Average IRn)																																					
Average Year	6.3	6.3	6.9	17.1	17.1	13.7	35.0	35.0	38.5	30.8	15.4	0.0	24.1	48.1	79.4	94.2	89.4	84.7	43.2	43.2	47.5	35.5	35.5	39.0	49.9	49.9	49.9	51.7	51.7	56.8	33.2	33.2	33.2	15.4	15.4	16.9	1,343.1
		19.5			47.9			108.5			46.2			151.6			268.3			133.9			110.0			149.7			160.2			99.6			47.7		1,343.1
1/5 year	0.0	0.0	0.0	9.3	9.3	7.5	23.0	23.0	25.3	22.5	11.2	0.0	39.2	78.5	129.5	99.5	93.0	86.5	13.5	13.5	14.8	13.0	13.0	14.3	29.9	29.9	29.9	25.2	25.2	27.7	30.6	30.6	30.6	28.3	28.3	31.2	1,086.8
		0.0			26.1			71.3			33.7			247.2			279.0			41.8			40.3			89.7			78.1			91.8			87.8		1,086.8
Diversoin Irrigation Requirement (Ird=Irn/0.65)																																					
Average Year	122.9	122.9	135.2	110.6	110.6	88.4	86.1	86.1	94.7	46.0	23.0	0.0	161.5	323.0	435.5	337.2	190.6	95.3	58.1	58.1	63.9	67.0	67.0	73.8	47.9	47.9	47.9	53.0	53.0	58.4	81.2	81.2	81.2	103.9	103.9	114.2	3,831.2
		381.0			309.6			266.9			69.0			920.0			623.1			180.1			207.8			143.7			164.4			243.6			322.0		3,831.2
1/5 year	132.5	132.5	145.7	122.5	122.5	98.0	104.6	104.6	115.1	58.8	29.4	0.0	138.2	276.3	358.5	329.0	185.1	92.6	103.8	103.8	114.2	101.6	101.6	111.8	78.6	78.6	78.6	93.8	93.8	103.2	85.2	85.2	85.2	84.0	84.0	92.4	4,225.3
		410.7			343.0			324.3			88.2			773.0			606.7			321.8			315.0			235.8			290.8			255.6			260.4		4,225.3