FEASIBILITY STUDY

ON

BOHOL IRRIGATION DEVELOPMENT PROJECT

(PHASE II)

IN

THE REPUBLIC OF THE PHILIPPINES

ANNEX (II)

NOVEMBER, 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

FEASIBILITY STUDY

ON

BOHOL IRRIGATION DEVELOPMENT PROJECT

(PHASE II)

IN

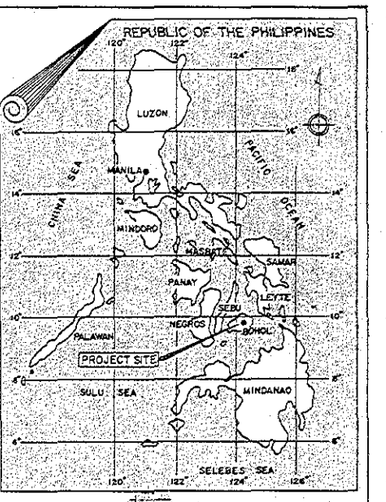
THE REPUBLIC OF THE PHILIPPINES

ANNEX (II)

NOVEMBER, 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

MAP OF BOHOL IRRIGATION DEVELOPMENT PROJECT
(PHASE-II)



CAMOTE SEA

TALIBON

To JETAFE

BIEM UNIDO

TIPIL RIVER

TRINIDAD

SOM RIVER

UBAY

PHASE-II AREA

TRINIDAD RIVER

CAPAYAS DAM

BAYANG RIVER

SAN MIGUEL

CAMBANGAY RIVER

BOYONGAN DAM

MAHAYAG

18+300

DELIVERY POINT OF SURPLUS WATER FOR PHASE-II AREA

CABAWIG RIVER

PHASE-I AREA

DAGOHOY

BATUANAN

TO KANOJAY

WAHIG RIVER

To CARMEN

MALINAO DIVERSION DAM

PILAR

SIERRA BULLONES

PAMACSARAN RIVER

WAHIG RIVER

124°15'
124°20'
124°25'
124°30'
10°10'
10°05'
10°00'
9°55'
9°50'
9°45'
N

0 1.0 2.0 3.0 4.0 5.0 km.
SCALE

CONTENT (ANNEX F - ANNEX L)

Page

ANNEX F. IRRIGATION AND DRAINAGE

ANNEX F IRRIGATION AND DRAINAGE PLAN

LIST OF TABLE

LIST OF FIGURE

CHAPTER I IRRIGATION PLAN

1.1 Irrigation for Paddy

1.1.1 Irrigation Water Requirements

a) Estimation of Potential Evapotranspiration

Potential evapotranspiration (ETo), generally recognized as fairly reliable index in calculating consumptive use, can be determined by a number of methods, such as the evaporation measurement with evaporation pan and the application of empirical formula based on the climatological data. In the project, the ETo values are estimated on the monthly basis, based on the climatological data observed at Tagbilaran observation station for the period of 25 years (1960-1984)[1/] by applying Penman Method.

The Penman Method is the most complete theoretical approach, showing that comsumptive use is inseparably connected to incoming solar energy. The formula representing the potential evapotranspiration is shown below;

$$ETo = \underbrace{C\ W.Rn}_{\text{radiation term}} + \underbrace{(1-W).f(u).(ea-ed)}_{\text{aerodynamic term}}$$

where;

- ETo = potential evapotranspiration in mm/day
- W = temperature-related weighting factor
- Rn = net radiation in equivalent evaporation in mm/day
- f(u) = wind-related function
- (ea-ed) = difference between the saturation vapour pressure at mean air temperature and the mean actual vapour pressure of the air, both in mbar
- C = adjustment factor to compensate for the effect of day and night weather conditions

According to the above equation, the monthly ETo valves are calculated and its result is tabulated in TABLE F1-1. TABLE F1-2 indicates the date arranged for the estimation of the ETPc value.

1/: Refer to TABLE B1-2 to B1-10.

TABLE F1-1 ESTIMATION OF POTENTIAL EVAPOTRANSPIRATION BY PENMAN METHOD

Station: Tagbilaran (Latitude: 10°00', Altitude: 30 m MSL)

Month	Rediation Term						Aerodynamic Term					Adjust-ment Factor	Reference Crop Evapotranspiration ETo	
	Weighting Factor	Net Radiation (mm/day)					Weighting Factor	Wind Function	Vapour Pressure (mbar)					
	W.	Ra	Rs	Rns	Rnl	Rn	1-W	f(u)	ea	ed	ea-ed	C	mm/day	mm/month
Jan.	0.75	13.2	5.9	4.44	0.78	3.66	0.25	0.59	33.80	28.02	5.78	1.00	3.60	111.6
Feb.	0.75	14.2	6.4	4.78	0.80	3.99	0.25	0.60	34.00	27.64	6.36	1.00	3.94	110.3
Mar.	0.76	15.3	7.7	5.74	0.95	4.79	0.24	0.58	35.30	27.96	7.34	1.00	4.66	144.5
Apr.	0.77	15.7	7.9	5.91	0.94	4.97	0.23	0.56	37.00	28.64	8.36	1.01	4.96	148.8
May	0.77	15.5	7.0	5.21	0.73	4.49	0.23	0.52	38.70	30.50	8.20	1.01	4.48	138.9
Jun.	0.77	15.3	5.9	4.40	0.53	3.88	0.23	0.50	38.30	31.21	7.09	1.01	3.84	115.2
Jul.	0.77	15.3	6.1	4.60	0.59	4.01	0.23	0.54	37.80	30.62	7.18	1.00	3.98	123.4
Aug.	0.77	15.5	6.2	4.64	0.59	4.05	0.23	0.57	38.50	30.42	8.09	1.00	4.18	129.6
Sep.	0.77	15.3	6.1	4.58	0.58	4.00	0.23	0.55	38.00	30.70	7.30	1.00	4.00	120.0
Oct.	0.77	14.7	5.9	4.39	0.57	3.82	0.23	0.51	37.00	30.71	6.29	1.01	3.72	115.3
Nov.	0.76	13.6	6.1	4.57	0.71	3.86	0.24	0.53	36.30	30.67	5.63	1.01	3.69	110.7
Dec.	0.76	12.9	5.2	3.89	0.61	3.28	0.24	0.55	35.10	29.45	5.65	1.00	3.24	100.4
Average	0.76	14.7	6.3	4.76	0.69	4.07	0.24	0.55	36.70	29.76	6.94	1.00	4.01	122.4

TABLE F1-2 DATA FOR ESTIMATION OF POTENTIAL EVAPOTRANSPIRATION BY PENMAN METHOD

Latitude: 10°00'
Altitude: 30 m MSL

$ETo = C[W.Rn+(1-W).f(u).(ea-ed)]$

Month	Temperature (°C)			Relative Humidity (%)			Dewpoint Temperature	Vapour Presure (mbar)	Wind Speed (km/day)	Wind Height (m)	Weighting Factor		Sunshine hour (hr)		Radiation (mm/day)	Adjustment Factor: Wind Speed (m/sec)			Adjustment Factor: Solar Radiation (mm/day)	
	Tmax	Tmin	Tmean	RHmax	RHmin	RHmean	Tdmean	ea[1]	Uz	He	(1-W)[2]	W	n	N[3]	Ra[4]	Uday	Unight	Ud/Un	Rs[5]	C[6]
Jan.	30.4	21.7	26.1	93.3	72.1	82.9	22.6	33.8	132.0	3.7	0.25	0.75	4.6	11.6	13.2	1.53	1.02	1.5	5.9	1.00
Feb.	30.8	21.6	26.2	90.8	70.3	81.3	22.4	34.0	136.8	3.7	0.25	0.75	4.7	11.8	14.2	1.58	1.05	1.5	6.4	1.00
Mar.	31.7	21.8	26.8	90.5	69.8	79.2	22.5	35.3	129.6	3.7	0.24	0.76	6.0	12.0	15.3	1.50	1.00	1.5	7.7	1.00
Apr.	32.8	22.5	27.6	86.8	68.0	77.4	23.3	37.0	120.0	3.7	0.23	0.77	6.2	12.3	15.7	1.39	0.93	1.5	7.9	1.01
May	33.1	23.6	28.4	89.1	71.3	78.8	24.3	38.7	105.6	3.7	0.23	0.77	5.0	12.6	15.5	1.22	0.81	1.5	7.0	1.01
Jun.	32.6	23.8	28.2	90.7	72.6	81.5	24.4	38.3	96.0	3.7	0.23	0.77	3.4	12.7	15.3	1.11	0.74	1.5	5.9	1.01
Jul.	32.3	23.7	28.0	91.5	71.4	81.0	24.2	37.8	112.8	3.7	0.23	0.77	3.8	12.6	15.3	1.31	0.87	1.5	6.1	1.00
Aug.	32.6	23.9	28.3	90.5	70.4	79.0	24.1	38.5	127.2	3.7	0.23	0.77	3.7	12.4	15.5	1.47	0.98	1.5	6.2	1.00
Sep.	32.5	23.7	28.1	90.8	72.7	80.8	24.1	38.0	115.2	3.7	0.23	0.77	3.6	12.1	15.3	1.33	0.89	1.5	6.1	1.00
Oct.	32.1	23.3	27.6	92.4	73.5	83.0	24.1	37.0	100.8	3.7	0.23	0.77	3.5	11.8	14.7	1.17	0.78	1.5	5.9	1.01
Nov.	31.8	22.8	27.3	93.5	75.0	84.5	24.0	36.3	108.0	3.7	0.24	0.76	4.6	11.6	13.6	1.25	0.83	1.5	6.1	1.01
Dec.	31.2	22.5	26.7	93.5	74.4	83.9	23.6	35.1	117.6	3.7	0.24	0.76	3.5	11.5	12.9	1.36	0.91	1.5	5.2	1.00
Average	32.0	22.9	27.4	91.1	71.8	81.1	23.6	36.7	116.8	3.7	0.24	0.76	4.4	12.1	14.7	1.35	0.90	1.5	6.3	1.00

Note: 1/: derived from TABLE F1-3.
2/: derived from TABLE F1-5.
3/: derived from TABLE F1-6.
4/: derived from TABLE F1-7.
5/: (0.25 + 0.50 n/N) Ra
6/: derived from TABLE F1-8.

TABLE F1-3 SATURATION VAPOR PRESSURE

(Unit: mbar)

Temperature (C°)	Saturation Vapour Pressure (mbar)	Temperature (C°)	Saturation Vapuor Pressure (mbar)
0	6.1	20	23.4
1	6.6	21	24.9
2	7.1	22	26.4
3	7.6	23	28.1
4	8.1	24	29.8
5	8.7	25	31.7
6	9.3	26	33.6
7	10.0	27	35.7
8	10.7	28	37.8
9	11.5	29	40.1
10	12.3	30	42.4
11	13.1	31	44.9
12	14.0	32	47.6
13	15.0	33	50.3
14	16.1	34	53.2
15	17.0	35	56.2
16	18.2	36	59.4
17	19.4	37	62.8
18	20.6	38	66.3
19	22.0	39	69.9

Source: FAO Irrigation and Drainage Paper 24, Crop Water Requirement

TABLE F1-4 WIND VELOCITY

Month	U3.7: Mean Velocity at 3.7 m (km/hr)	U2.0: Mean Velocity at 2.0 m 1/ (km/hr)	(km/day)
Jan.	5.5	4.86	116.6
Feb.	5.7	5.04	120.9
Mar.	5.4	4.77	114.5
Apr.	5.0	4.42	106.1
May	4.4	3.89	93.4
Jun.	4.0	3.54	84.9
Jul.	4.7	4.15	99.6
Aug.	5.3	4.69	112.6
Sept	4.8	4.24	101.8
Oct.	4.2	3.71	89.0
Nov.	4.5	3.98	95.5
Dec.	4.9	4.33	103.9
Average	4.9	4.33	103.9

Note: 1/ converted to mean velocity at 2.0 m above ground from 3.7 m with the following equation:

$$U_2 = U3.7 \cdot (2/H)^{0.2}$$

$$= U3.7 \cdot (2/3.7)^{0.2} = 0.884 \times U3.7 \text{ (km/hr)}$$

TABLE F1-5 WEIGHTING FACTOR (1-W)

Mean Air Temp.(°C)	1-W Alt.0m	1-W Alt.500m	Mean Air Temp.(°C)	1-W Alt.0m	1-W Alt.500m
20.0	0.32	0.30	28.0	0.23	0.22
22.0	0.29	0.28	30.0	0.22	0.21
24.0	0.27	0.26			
26.0	0.25	0.24			

Date source: FAO Irrigation and Drainage Paper 24.

TABLE F1-6 MEAN DAILY DURATION OF MAXIMUM POSSIBLE SUNSHINE HOUR (N)

(Unit: hr)

Month	Lat. N 10°	Month	Lat. N 10°
Jan.	11.6	Jul.	12.6
Feb.	11.8	Aug.	12.4
Mar.	12.0	Sep.	12.1
Apr.	12.3	Oct.	11.8
May	12.6	Nov.	11.6
Jun.	12.7	Dec.	11.5

Data source: FAO Irrigation and Drainage Paper 24.

TABLE F1-7 EXTRA TERRESTRIAL RADIATION (Ra)

Month	Lat. N 10°	Month	Lat. N 10°
Jan.	13.2	Jul.	15.3
Feb.	14.2	Aug.	15.5
Mar.	15.3	Sep.	15.3
Apr.	15.7	Oct.	14.7
May	15.5	Nov.	13.6
Jun.	15.3	Dec.	12.9

Date source: FAO Irrigation and Drainage Paper 24.

TABLE F1-8 ADJUSTMENT (C) IN PENMAN EQUATION

Rs(mm/day)	RHmax = 60 %				RHmax = 90 %			
Uday(m/sec)	3	6	9	12	3	6	9	12
	Uday/Unight = 4.0							
0	0.96	0.98	1.05	1.05	1.02	1.06	1.10	1.10
3	0.92	1.00	1.11	1.19	0.99	1.10	1.27	1.32
6	0.85	0.96	1.11	1.19	0.94	1.10	1.26	1.33
9	0.76	0.88	1.02	1.14	0.88	1.01	1.16	1.27
	Uday/Unight = 3.0							
0	0.96	0.98	1.05	1.05	1.02	1.06	1.10	1.10
3	0.87	0.96	1.06	1.12	0.94	1.04	1.18	1.28
6	0.77	0.88	1.02	1.10	0.86	1.01	1.15	1.22
9	0.67	0.79	0.88	1.05	0.78	0.92	1.06	1.18
	Uday/Unight = 2.0							
0	0.96	0.98	1.05	1.05	1.02	1.06	1.10	1.10
3	0.83	0.91	0.99	1.05	0.89	0.98	1.10	1.14
6	0.70	0.80	0.94	1.02	0.79	0.92	1.05	1.12
9	0.59	0.70	0.84	0.95	0.71	0.81	0.96	1.06
	Uday/Unight = 1.0							
0	0.96	0.98	1.05	1.05	1.02	1.06	1.10	1.10
3	0.78	0.86	0.94	0.99	0.85	0.92	1.01	1.05
6	0.62	0.70	0.84	0.93	0.72	0.82	0.95	1.00
9	0.50	0.60	0.75	0.87	0.62	0.72	0.87	0.96

Data source: FAO Irrigation and Drainage Paper 24.

b) Crop Growth-Stage Coefficient

The crop coefficients adopted for this study are shown in TABLE F1-9, which is based on FAO Irrigation and Drainage Paper No. 24. The values given in the table can only be used with the Penman determination of crop potential evapotranspiration.

For presentation of the crop coefficient, the crop growing season can be divided into four stages; initial growth, crop development, mid-season growth and late-season growth. The typical generalized crop coefficient curve is illustrated in the attached figure, together with planting dates, length of growing season and duration of each stage.

The four principal stages of crop development are defined as follows:

Initial Growth Stage This stage covers the initial planting, transplanting shock and early growth period when the crop only partially covers the soil. Consumptive use is low and fairly constant during this period.

Crop Development Stage This stage covers the period from the end of the initial growth stage to attainment of full ground cover, or the period of rapid leaf development. Consumptive use increases rapidly during this stage.

Mid-Season Stage This stage covers the period from attainment of effective ground cover, or full leaf development, to the start of maturing. The kc value remains fairly constant during this period.

Late-Season Stage This stage covers the maturing period of the crop and finishes with full maturity or harvest. If the crop matures and is not harvested it will continue to use water, if it is available, although at a diminishing rate.

TABLE F1-9 CROP COEFFICIENT (Kc) FOR UPLAND CROPS

Month		Mungbeans	Peanut	Corn	Vegatable
Dec.	I				
	II				
	III		0.54	0.54	
Jan.	I		0.57	0.57	
	II		0.63	0.65	
	III	0.52	0.75	0.80	0.50
Feb.	I	0.56	0.87	0.95	0.57
	II	0.70	0.95	1.05	0.70
	III	0.87	0.97	1.08	0.88
Mar.	I	0.96	0.95	1.07	0.97
	II	0.97	0.88	1.04	0.96
	III	0.91	0.55	0.95	0.50
Apr.	I	0.85			
	II				
	III				

FIGURE F1-1 CROP COEFFICIENT (Kc) FOR UPLAND CROPS

Crop : Mungbean

- Wind : Light to moderate (0-5m/sec)
- Mind-Summer RH min. : 68% - 72%
- Irrigation frequency initial period assumed : 7 days

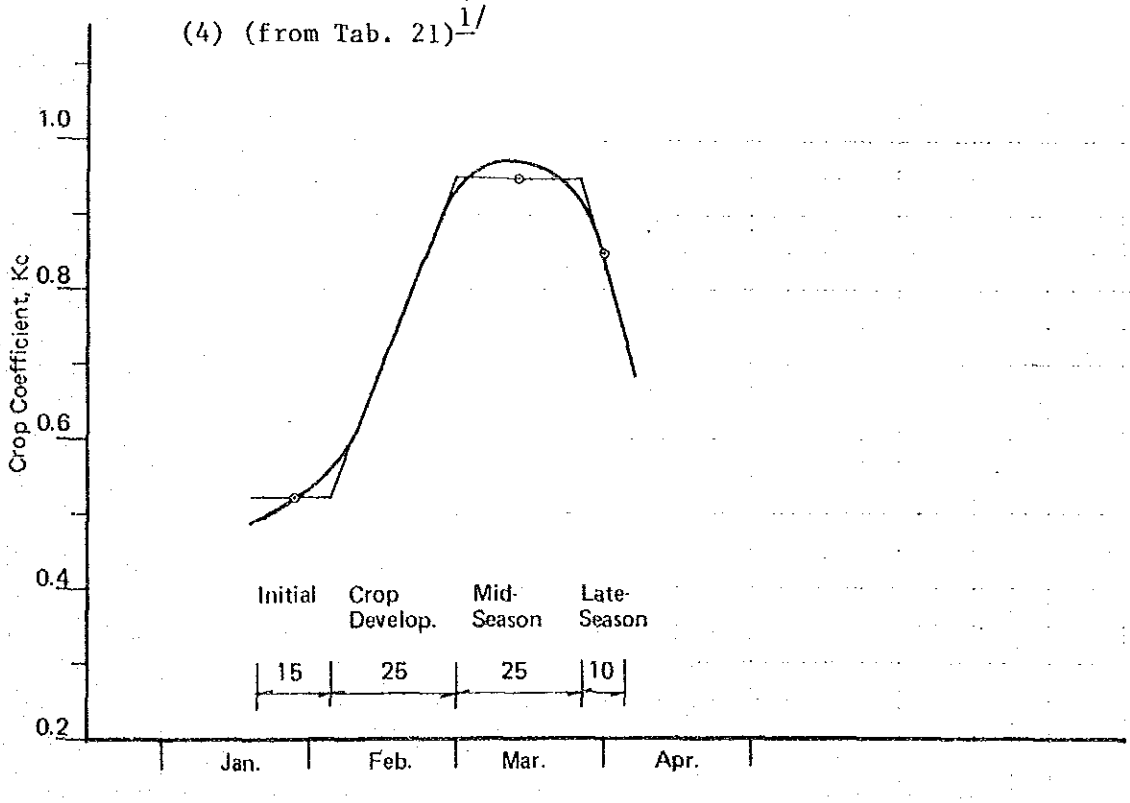
I. Planting Date : January

II. Length of Growth Stage :

- Initial : 15 days
- Crop Development : 25 days
- Mid-season : 25 days
- Late-season : 10 days 75 days (total)

III. Kc Values

- Kc initial Stage (1)
  ETO = 3.60 mm/day (from Fig. 6)[1/] Kc initial = 0.52
- Kc mid-season stage (3) (from Tab. 21)[1/] Kc mid-season = 0.95
- Kc late-season stage (end) (4) (from Tab. 21)[1/] Kc end-season = 0.85



Note : 1/: refer to FAO Irrigation and Drainage Paper 24.

Crop : Peanut

- Wind : Light to moderate (0-5m/sec)
- Mind-Summer RH min. : 68% - 74%
- Irrigation frequency initial period assumed : 7 days

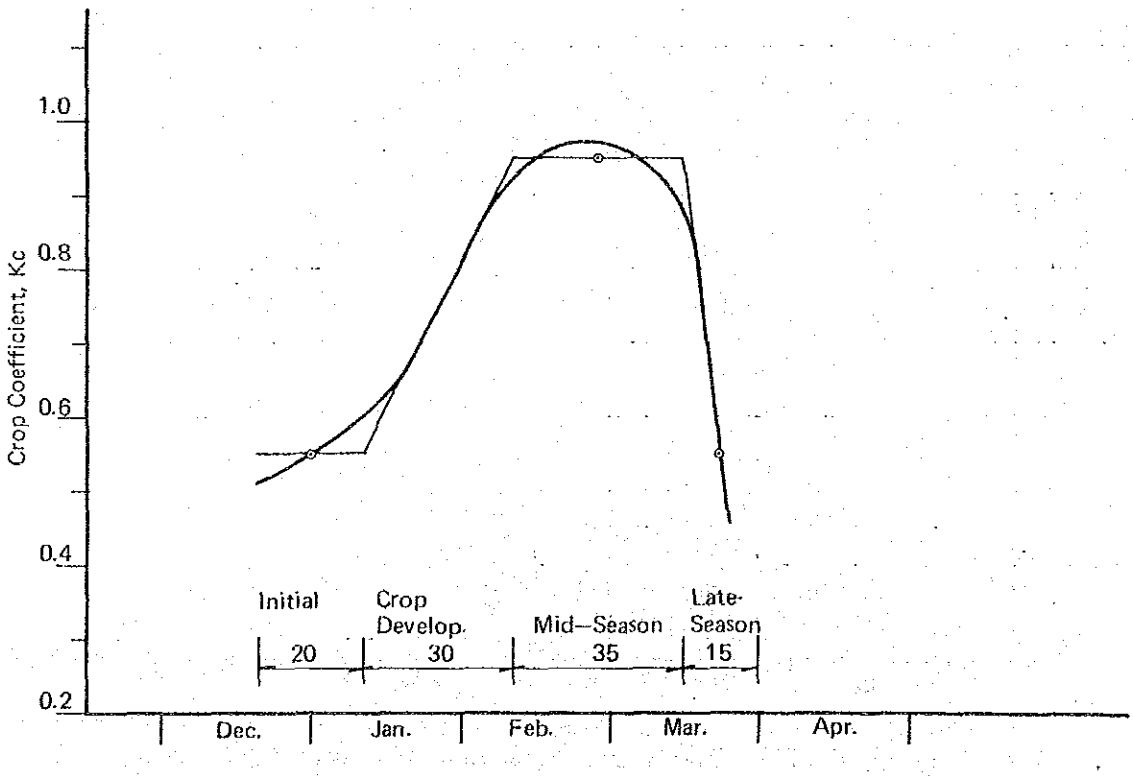
I. Planting Date : December

II. Length of Growth Stage :

- Initial : 20 days
- Crop Development : 30 days
- Mid-season : 35 days
- Late-season : 15 days 100 days (total)

III. Kc Values

- Kc initial Stage (1)
  ETO = 3.24 mm/day (from Fig. 6) Kc initial = 0.55
- Kc mid-season stage (3) (from Tab. 21) Kc mid-season = 0.95
- Kc late-season stage (end) (4) (from Tab. 21) Kc end-season = 0.55



Crop : Corn

- Wind : Light to moderate (0-5m/sec)
- Mind-Summer RH min. : 68% - 74%
- Irrigation frequency initial period assumed : 7 days

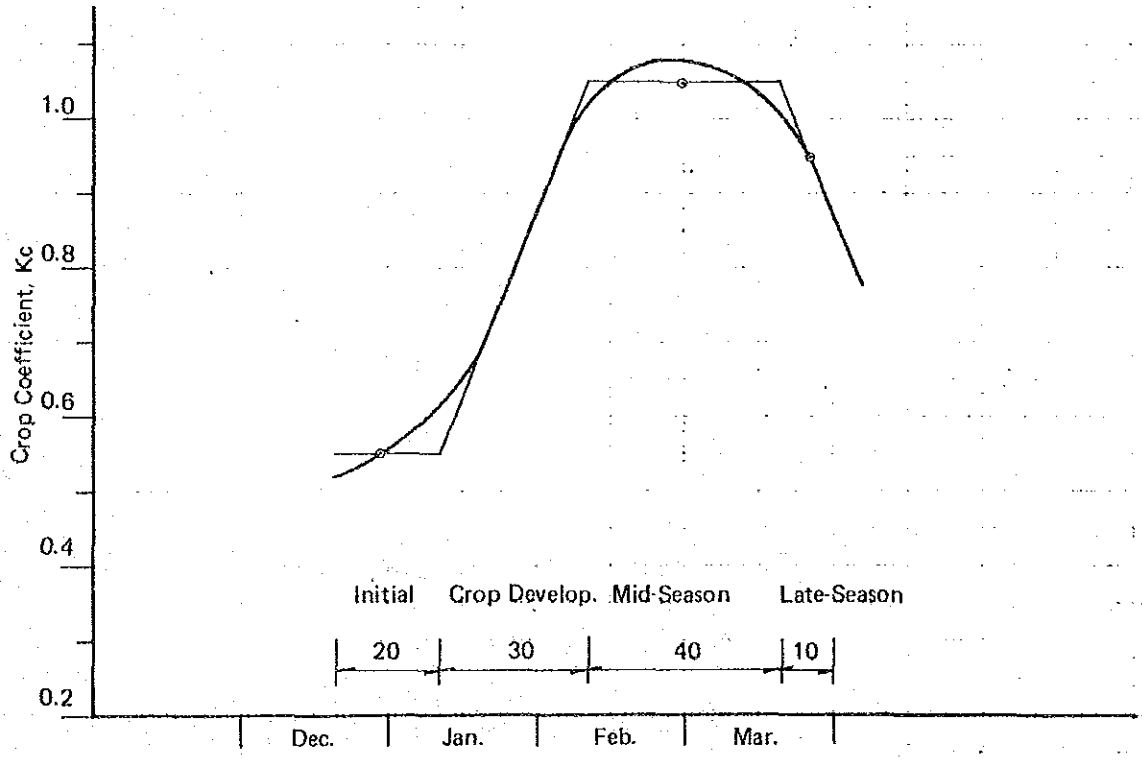
I. Planting Date : December

II. Length of Growth Stage :

- Initial : 20 days
- Crop Development : 30 days
- Mid-season : 40 days
- Late-season : 10 days 100 days (total)

III. Kc Values

- Kc initial Stage (1)
  ETO = 3.24 mm/day (from Fig. 6) Kc initial = 0.55
- Kc mid-season stage (3) (from Tab. 21) Kc mid-season = 1.05
- Kc late-season stage (end) (4) (from Tab. 21) Kc end-season = 0.95



Crop : Vegetable

- Wind : Light to moderate (0-5m/sec)
- Mind-Summer RH min. : 68% - 72%
- Irrigation frequency initial period assumed : 7 days

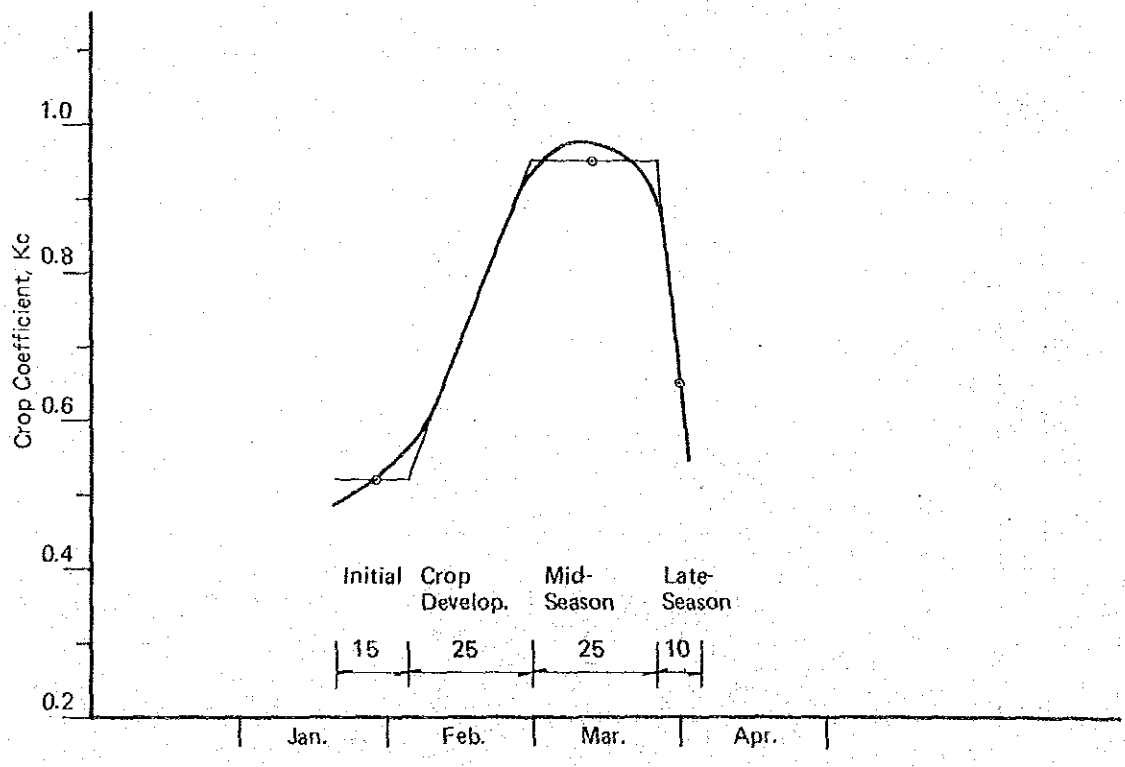
I. Planting Date : February

II. Length of Growth Stage :

- Initial : 15 days
- Crop Development : 25 days
- Mid-season : 25 days
- Late-season : 10 days 75 days (total)

III. Kc Values

- Kc initial Stage (1)
  ETO = 3.60 mm/day (from Fig. 6) Kc initial = 0.52
- Kc mid-season stage (3) (from Tab. 21) Kc mid-season = 0.95
- Kc late-season stage (end) (4) (from Tab. 21) Kc end-season = 0.65



c) Measurement of Percolation Rate

Percolation rate was measured at 16 sites in the existing paddy fields and it was found that an average percolation rate is 1.0 mm per day as shown below;

Summary of Percolation Measurement

Test No.	Location	Soil Type	Percolation Rate (mm/day)
1	Tagun sur, Trinidad	Ubay Sandy Loam	1.50
2	Camanbugan, Ubay	Ubay Sandy Loam	0.80
3	Casate, Ubay	Ubay Loam (Type-1)	0.70
4	Bayang, Ubay	Ubay Sandy Loam	0.85
5	Casate, Ubay	Ubay Sandy Loam	0.87
6	Humay-Aumay, Ubay	Ubay Sandy Loam	1.05
7	Tubog, Ubay	Ubay Loam (Type-1)	1.00
8	Corazon San Miguel	Ubay Loam (Type-2)	1.30
9	Lomngog, Ubay	Ubay Sandy Loam	1.15
10	Mabuhay, Gabi, Ubay	Ubay Sandy Loam	1.10
11	Gabi, Ubay	Ubay Sandy Loam	1.15
12	Hambabauran	Ubay Sandy Loam	1.20
13	Camalia, Ubay	Ubay Loam (Type-1)	0.95
14	Tubaran, Ubay	Ubay Loam (Type-1)	1.70
15	Tagum Sur, Trinidad	Ubay Loam (Type-1)	Negative
16	La Union, Trinidad	Ubay Loam (Type-1)	0.90
	Average		1.08 ≒ 1.0

FIGURE F1-2 shows the location of measuring sites for percolation rates.

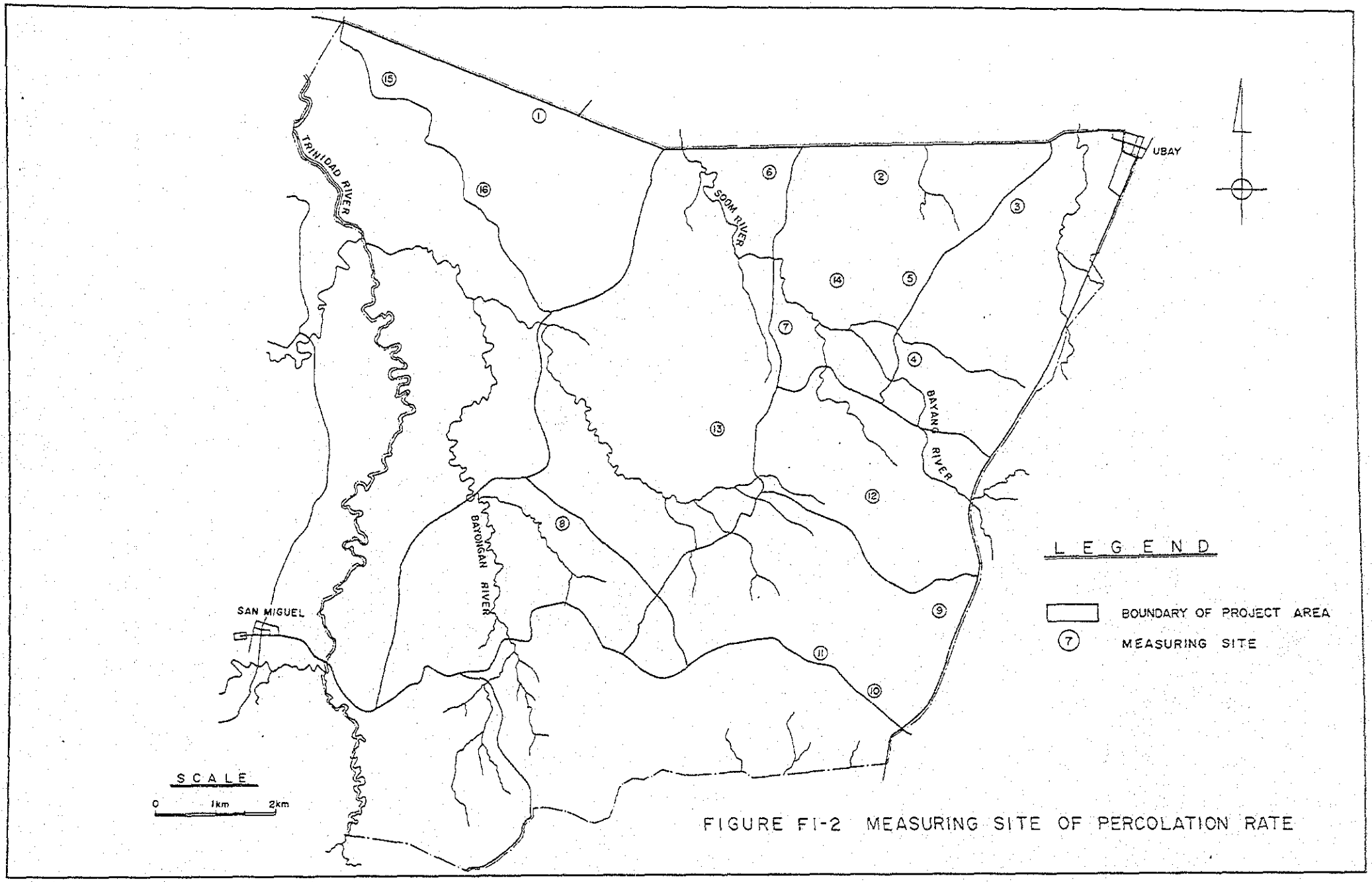


FIGURE FI-2 MEASURING SITE OF PERCOLATION RATE

d) Water supply during Land Soaking and Preparation

1) Land Soaking and Preparation

Lowland rice requires well puddled, well prepared soil to;

- provide a soil surface that is weed free, soft and level to make transplanting easier.
- mix organic matter (rice straw, stubble and weeds) with soil and encourage decomposition.
- level the field for uniform distribution of irrigation water, fertilizers and pesticides.
- prevent or minimize water seepage from the field.

If organic matter is not well decomposed by the time of transplanting, the seedlings are likely to suffer from toxic substances given off during decomposition. For these reasons, land preparation should be started at least two weeks before planting.

Plowing

- flood the field 2 to 3 days before plowing depending on the hardness of the soil. Keep the surface of the soil just covered with water; this will help keep the soil from sticking to the plow.
- keep the soil flooded with about three centimeters of water until harrowing, a duration of about seven days if possible. This provides time to soften the soil clods further and allows weeds to sprout, while plowed fresh organic materials undergo decomposition.

Harrowing

- keep enough water in the field to prevent the soil from drying and hardening. If possible, wait for 7 to 10 days between two successive harrowings to allow more weed seeds to germinate,

before they are finally turned under the soil and to give more time to plowed fresh organic matter to decompose.

Provision and Repair of Levee

Before preparing the land, levees (dikes or bunds) should be repaired to help reduce seepage from the paddy field. Paddies that are properly repaired and plastered with mud are unfavorable to rats and make it difficult for weeds and (host plants of) insects to get established.

The best time to fix levees is after the first plowing because the upturned soil near the levees can be used in the work. Levees should be repaired before harrowing so the weeds cut from the levees can be incorporated in the soil well before the rice is planted.

- Clean the Levee
  - On the top and both sides of the levee cut the weeds close to the roots. This will also trim off thick portions of the levee.

- Repair the Levee
  - Destroy all rats by placing cyanide dust in their holes, or break up and rebuild the portion of the levee containing rat holes.
  - Use soil that has been broken up by the first plowing for patching up soft spots and cracks.

- Plaster the Levee
  - Use additional mud and water, if necessary, to smooth levee with hands. Give special attention to the sides to make sure that all cracks are sealed properly, otherwise water in the plot may seep the other plots.

Irrigation Schedule during Land Preparation

In accordance with above mentioned procedures as well as current practices of land soaking and land preparation, following irrigation schedule is planned in the project (refer to FIGURE F1-3).

- 1st irrigation which is to be supplied with two times will be made at the beginning of land soaking and land preparation three to four days before plowing. Amount of water should be enough for saturation of top soil and supply for evaporation and percolation for 10 days until 2nd irrigation.
- 2nd irrigation will be made just before cleaning and reparting the levee.
- 3rd irrigation will be made just after first harrowing.

2) Water Requirement for Land Soaking and Preparation

Total water supply for land soaking and preparation periods was computed as shown in TABLE F1-10 and F1-11, in accordance with the irrigation schedule, and the results are summarized as shown below:

	Wet Season Paddy (mm)	Dry Season Paddy (mm)
1st Irrigation	132	114
2nd Irrigation	29	27
3rd Irrigation	45	33
Total	210	170
	(206)	(174)

TABLE F1-10 IRRIGATION WATER REQUIREMENT FOR LAND SOAKING AND LAND PREPARATION (WET SEASON PADDY)

1st Irrigation (P_2)		mm
Saturation of Top Soil	: 150 mm x (45 - 8 x 1.45)/100	= 50
	Drz x (Sc - Pwp x Sa)/100	
Evaporation for 10 days	: 4.2 mm x 10 days	= 42
Percolation for 10 days	: 1.0 mm x 10 days	= 10
Standing Water		= 30
Sub-Total		132

The total of 132 mm will be supplied with two times at 66 mm each time on the date of eight to three days before plowing.

2nd Irrigation (P_1)			
Evaporation for 6 days	: 3.9 mm x 6.0 days	=	23
Percolation for 6 days	: 1.0 mm x 6.0 days	=	6
Sub-Total			29

3rd Irrigation (P)			
Evaporation for 6 days	: 3.9 mm x 6.0 days	=	24
Percolation for 6 days	: 1.0 mm x 6.0 days	=	6
Supplemental Irrigation (Po)	: (3.9 + 1.0) x 3	=	15
Sub-Total			45
Total			206 ≒ 210 mm

Note: Drz: Depth of root zone (mm)
Sc : Porosity (%)
Pwp: Permanent wilting point (%)
Sa : Specific gravity (g/cm^3)
Fc : Field capacity (%)

TABLE F1-11 IRRIGATION WATER REQUIREMENT FOR LAND SOAKING AND LAND PREPARATION (DRY SEASON PADDY)

1st Irrigation (P_2)

	mm
Saturation of Top Soil : 150 mm x 45-(18+8)/2x1.45 /100	= 50
Drz x Sc - (Fc + Pwp)/2 x Sa /100	
Evaporation for 10 days : 3.5 mm x 10 days	= 35
Percolation for 10 days : 1.0 mm x 10 days	= 10
Standing Water	= 30
Sub-Total	114

The total of 114 mm will be supplied with two times at 57 mm each time on the date of eight to three days before plowing.

2nd Irrigation (P_1)

Evaporation for 6 days	: 3.5 mm x 6.0 days	= 21
Percolation for 6 days	: 1.0 mm x 6.0 days	= 6
Sub-Total		27

3rd Irrigation (P)

Evaporation for 6 days	: 3.5 mm x 6.0 days	= 18
Percolation for 6 days	: 1.0 mm x 6.0 days	= 6
Supplemental Irrigation (Po)	: (3.5 + 1.0) x 3	= 9
Sub-Total		33
Total		174 ≒ 170 mm

FIGURE F1-3 SCHEDULE OF LAND PREPARATION WORKS AND IRRIGATION IN SECTION

Block	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
I	A Unit	P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP									
	B Unit		P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP									
	C Unit			P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP								
	D Unit				P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP								
	E Unit					P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP							
II	A Unit		P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP								
	B Unit			P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP								
	C Unit				P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP								
	D Unit					P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP							
	E Unit						P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP							
III	A Unit			P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP								
	B Unit				P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP								
	C Unit					P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP							
	D Unit						P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP						
	E Unit							P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP					
IV	A Unit				P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP							
	B Unit					P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP							
	C Unit						P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP						
	D Unit							P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP					
	E Unit								P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP				
V	A Unit					P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP							
	B Unit						P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP						
	C Unit							P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP					
	D Unit								P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP				
	E Unit									P_2	P_2			PL	PL	PL				P_1	RL	L			H_1	P					H_2	P_o			TP		

Note; P_2 : 1st Irrigation
P_1 : 2nd Irrigation
P_o : 3rd Irrigation

PL: Plowing
RL: Clean and Repair of Levee
L : Plaster of Levee
H_1 : 1st Harrowing
H_2: 2nd Harrowing and Leveling
TP: Transplanting

e) Estimation of Crop Water Requirements

10-days crop water requirements for each crop were calculated based on the proposed cropping pattern, of which schematic pattern is illustrated in FIGURE F1-4, taking into account the ETPc, crop coefficient, land soaking and land preparation water. The results of calculation are shown in TABLE F1-12 to TABLE F1-15.

The subsequent presents the typical calculation of crop water requirements for each crop.

1) Water Requirements for Wet Season Paddy

Land Preparation Period (June 17 1/)

1st Area :	5.7 mm x 5 days/4 + 1.0 mm x 5 day/4 =	8.4 mm
2nd Area :	60 mm/4 =	15.0
3rd Area :	150 mm/4 =	37.5
	Total =	60.9

1/ : Refer to FIGURE F1-4.

Growing Period (Aug. 23 1/)

1st Area :	5.6 mm x 10 day/4 + 1.0 x 10 day/4 =	16.5 mm
2nd Area :	5.6 mm x 10 day/4 + 1.0 x 10 day/4 =	16.5
3rd Area :	5.6 mm x 10 day/4 + 1.0 x 10 day/4 =	16.5
4th Area :	5.6 mm x 10 day/4 + 1.0 x 10 day/4 =	16.5
	Total =	66.0

2) Water Requirements for Murgbean (Mar. 7 1/)

1st Area :	4.7 mm x 0.96 x 10 day/2 =	22.6 mm
2nd Area :	4.7 mm x 0.87 x 10 day/2 =	20.4
	Total =	43.0

1.1.2 Diversion Irrigation Water Requirements

a) Estimation of Effective Rainfall

Effective rainfall for the Phase II area is estimated based on the same procedures for estimation of Phase I area. In the estimation, areal rainfall of three stations, Ubay (Central), Ubay (Bayang) and Ubay (Gabi) was used.

TABLE F1-16 to TABLE F1-21 indicate the monthly rainfall and its effective rainfall for paddy and upland crops in the Phase II area.

TABLE F1-12. ESTIMATION OF 10-DAYS CROP WATER REQUIREMENTS

(DRY SEASON PADDY(1))

	JAN.			FEB.			MAR.			APR.			MAY.			JUN.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1ST AREA	15.8	15.8	17.1	15.0	7.5	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
2ND AREA	15.8	15.8	17.1	15.0	15.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3RD AREA	15.8	15.8	17.1	15.0	15.0	12.5	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4TH AREA	15.8	15.8	17.1	15.0	15.0	12.5	17.3	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSUMP-TIVE USE	63.0	63.0	68.3	60.0	52.5	31.3	25.9	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	JUL.			AUG.			SEP.			OCT.			NOV.			DEC.		
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
1ST AREA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	12.5	7.4	14.8	13.5	13.5	14.6
2ND AREA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	12.5	7.4	13.5	13.5	14.6
3RD AREA	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	30.0	12.5	6.8	13.5	14.6
4TH AREA	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	30.0	12.5	6.8	14.6
CONSUMP-TIVE USE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	42.5	49.9	64.6	46.3	47.3	58.4

(DRY SEASON PADDY(2))

	JAN.			FEB.			MAR.			APR.			MAY.			JUN.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1ST AREA	15.8	15.8	17.1	15.0	15.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2ND AREA	15.8	15.8	17.1	15.0	15.0	12.5	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3RD AREA	15.8	15.8	17.1	15.0	15.0	12.5	17.3	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4TH AREA	15.8	15.8	17.1	15.0	15.0	12.5	17.3	17.3	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSUMP-TIVE USE	63.0	63.0	68.3	60.0	60.0	43.8	43.1	25.9	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	JUL.			AUG.			SEP.			OCT.			NOV.			DEC.		
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
1ST AREA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	12.5	7.4	14.8	13.5	13.5	14.6
2ND AREA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	12.5	7.4	13.5	13.5	14.6
3RD AREA	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	30.0	12.5	6.8	13.5	14.6
4TH AREA	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	30.0	12.5	6.8	14.6
CONSUMP-TIVE USE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	42.5	49.9	64.6	46.3	47.3	58.4

TABLE F1-13. ESTIMATION OF 10-DAYS CROP WATER REQUIREMENTS

(WET SEASON PADDY(1))

	JAN.			FEB.			MAR.			APR.			MAY.			JUN.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1ST AREA	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	37.5	15.0	8.4	16.8
2ND AREA	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	37.5	15.0	8.4
3RD AREA	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	37.5	15.0
4TH AREA	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	37.5
CONSUMP-TIVE USE	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	37.5	52.5	60.9	77.6

	JUL.			AUG.			SEP.			OCT.			NOV.			DEC.	
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
1ST AREA	16.3	16.3	17.6	16.5	16.5	17.9	14.5	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2ND AREA	16.3	16.3	17.6	16.5	16.5	17.9	14.5	14.5	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3RD AREA	8.1	16.3	17.6	16.5	16.5	17.9	14.5	14.5	14.5	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4TH AREA	15.0	8.1	17.6	16.5	16.5	17.9	14.5	14.5	14.5	14.5	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSUMP-TIVE USE	55.6	56.9	70.5	66.0	66.0	71.6	58.0	50.8	36.3	21.8	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(WET SEASON PADDY(2))

	JAN.			FEB.			MAR.			APR.			MAY.			JUN.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1ST AREA	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	37.5	15.0	8.4	16.8
2ND AREA	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	37.5	15.0	8.4
3RD AREA	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	37.5	15.0
4TH AREA	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	37.5
CONSUMP-TIVE USE	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	37.5	52.5	60.9	77.6

	JUL.			AUG.			SEP.			OCT.			NOV.			DEC.	
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
1ST AREA	16.3	16.3	17.6	16.5	16.5	17.9	14.5	14.5	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2ND AREA	16.3	16.3	17.6	16.5	16.5	17.9	14.5	14.5	14.5	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3RD AREA	8.1	16.3	17.6	16.5	16.5	17.9	14.5	14.5	14.5	14.5	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4TH AREA	15.0	8.1	17.6	16.5	16.5	17.9	14.5	14.5	14.5	14.5	14.5	7.8	0.0	0.0	0.0	0.0	0.0	0.0
CONSUMP-TIVE USE	55.6	56.9	70.5	66.0	66.0	71.6	58.0	58.0	50.8	36.3	21.8	7.8	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F1-14. ESTIMATION OF 10-DAYS CROP WATER REQUIREMENTS

(MUNGBEAN)

	JAN. (1)	(2)	(3)	FEB. (4)	(5)	(6)	MAR. (7)	(8)	(9)	APR. (10)	(11)	(12)	MAY. (13)	(14)	(15)	JUN. (16)	(17)	(18)
1ST AREA	0.0	0.0	10.3	10.9	13.6	13.6	22.6	22.8	23.5	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2ND AREA	0.0	0.0	0.0	10.1	10.9	10.9	20.4	22.6	25.1	22.3	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSUMP-TIVE USE	0.0	0.0	10.3	21.1	24.6	24.5	43.0	45.4	48.6	32.8	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	JUL. (19)	(20)	(21)	AUG. (22)	(23)	(24)	SEP. (25)	(26)	(27)	OCT. (28)	(29)	(30)	NOV. (31)	(32)	(33)	DEC. (34)	(35)	(36)
1ST AREA	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
2ND AREA	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
CONSUMP-TIVE USE	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

(PEANUT)

	JAN. (1)	(2)	(3)	FEB. (4)	(5)	(6)	MAR. (7)	(8)	(9)	APR. (10)	(11)	(12)	MAY. (13)	(14)	(15)	JUN. (16)	(17)	(18)
1ST AREA	10.3	11.3	14.8	17.0	18.5	15.1	22.3	20.7	14.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2ND AREA	9.7	10.3	12.5	14.6	17.0	14.8	22.8	22.3	22.7	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSUMP-TIVE USE	20.0	21.6	27.3	31.6	35.5	30.0	45.1	43.0	37.0	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	JUL. (19)	(20)	(21)	AUG. (22)	(23)	(24)	SEP. (25)	(26)	(27)	OCT. (28)	(29)	(30)	NOV. (31)	(32)	(33)	DEC. (34)	(35)	(36)
1ST AREA	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	9.5
2ND AREA	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
CONSUMP-TIVE USE	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	9.5

TABLE F1-15. ESTIMATION OF 10-DAYS CROP WATER REQUIREMENTS

(CORN)

	JAN. (1)	(2)	(3)	(4)	FEB. (5)	(6)	(7)	MAR. (8)	(9)	(10)	APR. (11)	(12)	(13)	MAY. (14)	(15)	(16)	JUN. (17)	(18)
1ST AREA	10.3	11.7	15.8	18.5	20.5	16.8	25.1	24.4	24.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2ND AREA	9.7	10.3	12.9	15.6	18.5	16.4	25.4	25.1	26.9	23.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSUMPTIVE USE	20.0	22.0	28.7	34.1	39.0	33.2	50.5	49.6	51.4	23.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	JUL. (19)	(20)	(21)	(22)	AUG. (23)	(24)	(25)	SEP. (26)	(27)	(28)	OCT. (29)	(30)	(31)	NOV. (32)	(33)	(34)	DEC. (35)	(36)
1ST AREA	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	9.5
2ND AREA	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
CONSUMPTIVE USE	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	9.5

(VEGETABLE)

	JAN. (1)	(2)	(3)	(4)	FEB. (5)	(6)	(7)	MAR. (8)	(9)	(10)	APR. (11)	(12)	(13)	MAY. (14)	(15)	(16)	JUN. (17)	(18)
1ST AREA	0.0	0.0	10.1	11.1	13.6	13.7	22.8	22.6	16.8	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2ND AREA	0.0	0.0	0.0	9.9	11.1	10.9	20.7	22.8	24.8	15.9	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSUMPTIVE USE	0.0	0.0	10.1	21.1	24.8	24.6	43.5	45.4	41.6	28.2	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	JUL. (19)	(20)	(21)	(22)	AUG. (23)	(24)	(25)	SEP. (26)	(27)	(28)	OCT. (29)	(30)	(31)	NOV. (32)	(33)	(34)	DEC. (35)	(36)
1ST AREA	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
2ND AREA	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
CONSUMPTIVE USE	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

TABLE F1-16 MONTHLY RAINFALL DURING RICE PLANTING PERIODS (PHASE II AREA)

(Unit: mm)

Month	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970
1st Crop														
Oct.	20.6	0	22.5	16.2	74.2	99.1	41.2	33.6	62.1	18.0	61.5	15.4	16.4	77.8
Nov.	148.0	85.1	175.9	88.7	183.7	134.8	248.5	106.4	382.2	75.9	107.2	141.8	232.2	118.3
Dec.	257.4	94.1	132.7	102.3	129.6	126.6	119.6	80.2	148.5	142.6	141.7	143.5	198.4	159.3
Jan.	145.3	121.6	182.7	156.3	139.6	118.5	218.9	97.6	213.6	101.7	248.3	114.7	76.0	95.2
Feb.	141.9	110.2	100.3	93.5	96.5	208.1	111.9	213.3	166.4	86.5	173.1	84.0	65.8	122.6
Mar.	105.3	96.9	141.2	63.0	76.9	145.9	151.1	48.3	120.3	74.3	170.8	97.3	96.7	76.3
Apr.	108.4	0.5	27.8	15.5	56.3	0	55.1	37.8	5.5	0.8	23.4	0	0	19.0
Sub-total	926.9	508.4	783.1	535.5	756.8	833.0	946.3	617.2	1,098.6	499.8	926.0	596.7	685.5	668.5
2nd Crop														
May	5.7	82.9	42.2	58.9	13.6	90.6	27.5	90.5	26.0	13.6	108.0	15.3	87.5	17.8
June	194.1	129.8	88.4	143.9	92.3	195.7	90.3	112.4	193.9	87.9	117.0	126.9	126.4	211.0
July	236.6	169.3	285.9	173.4	232.9	196.7	202.2	182.1	131.1	220.8	124.5	111.4	168.1	174.3
Aug.	137.4	86.9	167.6	91.8	117.0	222.1	240.1	69.2	105.8	155.5	109.8	109.4	115.6	121.6
Sep.	119.5	155.6	158.1	160.1	164.4	216.8	170.7	187.5	145.5	107.5	142.6	151.4	132.1	127.5
Oct.	43.4	163.8	122.4	167.6	248.0	140.0	243.6	152.6	130.2	212.2	124.1	173.8	114.4	227.3
Nov.	46.0	64.6	32.8	59.1	24.6	84.3	86.7	108.3	16.6	41.5	88.3	17.9	68.6	14.8
Sub-total	882.7	852.9	897.4	854.8	892.8	1,146.2	1,061.1	902.6	749.1	839.0	814.3	706.1	812.7	894.3
Total	1,809.6	1,361.3	1,680.5	1,390.3	1,649.6	1,979.2	2,007.4	1,519.8	1,847.7	1,338.0	1,740.3	1,302.8	1,498.2	1,562.8

Month	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	Average
1st Crop															
Oct.	152.2	7.3	79.8	12.6	28.6	75.2	52.4	20.9	13.1	69.6	134.6	41.6	10.6	48.5	46.6
Nov.	151.1	202.5	130.5	302.5	191.9	103.9	115.3	135.7	120.8	100.2	114.3	124.9	78.5	173.9	152.7
Dec.	115.3	101.2	124.9	173.5	169.8	155.0	198.4	78.2	169.5	109.5	224.3	209.2	96.9	248.1	148.2
Jan.	175.7	228.0	76.3	84.9	216.9	189.6	200.4	169.0	87.2	242.6	240.6	78.3	58.7	152.8	151.1
Feb.	82.9	76.4	76.8	180.5	116.4	86.4	174.0	113.0	62.6	208.8	82.0	129.7	29.6	175.5	120.3
Mar.	112.0	103.2	73.9	114.7	102.3	66.3	101.9	60.7	56.6	35.5	94.1	196.9	28.4	91.5	96.5
Apr.	2.2	55.3	27.2	75.8	7.4	5.0	27.3	10.1	16.8	22.1	9.3	27.2	0	11.6	23.1
Sub-total	791.4	773.9	589.4	944.5	833.0	681.4	869.7	587.6	526.6	788.3	899.2	807.8	302.7	901.9	738.5
2nd Crop															
May	17.9	138.2	0	56.8	49.0	22.9	66.2	41.5	63.8	24.7	37.8	66.3	12.4	13.5	46.1
June	206.4	150.5	151.1	175.9	158.9	155.3	110.1	167.4	208.5	206.1	101.5	136.2	99.1	102.9	144.3
July	164.0	119.6	145.3	110.8	148.9	106.8	179.0	118.3	146.0	179.1	196.1	228.8	193.6	156.2	171.1
Aug.	138.5	171.1	190.9	106.9	102.2	183.1	176.1	105.3	102.2	252.2	53.1	234.5	208.1	85.3	141.4
Sep.	148.6	183.3	165.7	98.4	180.5	123.0	101.6	201.8	159.8	212.4	103.6	95.1	137.5	181.6	151.2
Oct.	153.4	133.8	129.4	112.6	186.6	83.8	144.5	132.4	128.0	308.8	161.7	186.9	150.1	162.3	162.1
Nov.	113.6	52.3	47.5	91.5	38.8	38.0	82.7	57.9	15.2	28.4	78.3	37.1	82.6	66.9	56.6
Sub-total	942.4	948.8	829.1	752.9	864.9	712.9	860.2	824.6	823.5	1,211.7	732.1	984.9	883.4	758.7	872.8
Total	1,733.8	1,722.7	1,418.5	1,697.4	1,697.9	1,394.3	1,729.9	1,412.2	1,350.1	2,000.0	1,631.3	1,792.7	1,186.1	1,660.6	1,611.3

TABLE F1-17 MONTHLY RAINFALL DURING UPLAND CROP PLANTING PERIOD (PHASE II AREA)

(Unit: mm)

Month	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970
Dec.	137.0	9.6	7.1	64.3	42.7	49.9	58.9	23.5	52.4	22.7	35.7	2.5	65.4	20.4
Jan.	146.3	121.6	182.7	156.3	139.6	118.5	218.9	97.6	213.6	101.7	248.3	114.7	76.0	95.2
Feb.	141.9	110.2	100.3	93.5	96.5	208.1	111.9	213.3	166.4	86.5	173.1	84.0	65.8	122.6
Mar.	105.3	96.9	141.2	63.0	76.9	145.9	151.1	48.3	120.3	74.3	170.8	97.3	96.7	76.3
Apr.	123.1	74.7	45.0	133.8	98.9	50.7	60.8	83.4	63.2	89.8	83.0	63.8	69.7	70.7
Total	652.6	413.0	476.3	510.9	454.6	573.1	601.1	466.1	615.9	375.0	710.9	362.3	373.6	385.2

Month	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	Average
Dec.	17.3	42.2	8.1	105.3	105.3	35.8	43.7	9.6	26.3	30.1	120.4	19.8	13.4	101.7	45.4
Jan.	175.7	228.0	76.3	84.9	216.9	189.6	200.4	169.0	87.2	242.6	240.6	78.3	58.7	152.8	151.1
Feb.	82.9	76.4	76.8	180.5	116.1	86.4	174.0	113.0	62.6	208.8	82.0	129.7	29.6	175.5	120.3
Mar.	112.0	103.2	73.9	114.7	102.3	66.3	101.9	60.7	56.6	35.5	94.1	196.9	28.4	91.5	96.5
Apr.	111.2	76.0	64.3	160.7	125.3	55.1	48.1	79.4	74.1	51.8	39.5	34.3	4.2	73.6	75.3
Total	499.1	525.8	299.4	646.1	665.9	433.2	568.1	431.7	306.8	568.8	576.6	459.0	134.3	595.1	488.6

TABLE F1-18 MONTHLY EFFECTIVE RAINFALL DURING RICE PLANTING PERIOD (PHASE II AREA)

(Unit: mm)

Month	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970
1st Crop														
Oct.	20.6	0	22.5	16.2	74.2	86.6	41.2	33.6	62.1	18.0	61.5	15.4	16.4	74.3
Nov.	124.2	85.1	152.8	88.7	158.3	92.4	107.8	98.7	135.5	75.9	107.2	141.8	128.9	117.5
Dec.	200.4	94.1	130.1	102.3	129.6	126.6	119.6	80.2	148.5	142.6	141.7	132.4	156.7	159.3
Jan.	99.6	121.6	126.6	156.3	139.6	118.5	165.2	97.6	130.4	101.7	198.5	114.7	76.0	95.2
Feb.	113.9	110.2	100.3	93.5	96.5	180.8	111.9	171.0	166.4	86.5	145.5	84.0	65.8	122.6
Mar.	105.3	96.9	141.2	63.0	76.9	109.1	151.1	44.7	104.3	74.3	83.7	97.3	92.8	76.3
Apr.	66.4	0.5	27.8	15.5	56.3	0	55.1	37.8	5.5	0.8	23.4	0	0	19.0
Sub-total	730.4	508.4	701.3	535.5	731.4	714.0	751.9	563.6	752.7	499.8	761.5	585.6	536.6	664.2
2nd Crop														
May	5.7	82.9	42.2	58.9	13.6	90.6	27.5	90.5	26.0	13.6	90.1	15.3	87.4	17.8
June	157.1	129.8	48.4	143.9	92.3	171.3	90.3	112.4	160.0	87.9	117.0	126.9	126.4	200.5
July	161.5	160.2	222.7	173.4	233.0	184.2	202.2	182.1	131.1	187.3	103.8	111.4	149.5	119.8
Aug.	137.4	86.9	160.7	91.8	117.0	190.4	212.2	69.2	105.8	142.5	109.8	109.4	102.1	121.6
Sep.	111.8	155.6	158.1	160.1	164.4	175.9	148.5	154.6	145.5	107.5	142.6	131.4	132.1	127.5
Oct.	92.6	154.2	122.4	166.8	182.8	140.0	134.5	152.6	120.4	177.9	113.9	161.4	114.4	202.8
Nov.	46.0	64.6	32.8	59.1	24.6	84.3	86.7	91.7	16.6	41.5	88.3	17.9	68.6	14.8
Sub-total	712.1	834.2	787.3	854.0	827.7	1,036.7	901.9	853.1	705.4	758.2	765.5	673.7	780.5	804.8
Total	1,442.5	1,342.6	1,488.6	1,389.4	1,559.1	1,750.7	1,653.8	1,416.7	1,458.1	1,258.0	1,527.0	1,259.3	1,317.1	1,469.0

Month	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	Average
1st Crop															
Oct.	103.5	7.3	79.8	12.6	28.6	75.2	52.4	20.9	13.1	69.6	96.7	41.6	10.6	48.5	45.6
Nov.	132.1	163.2	130.5	157.1	171.4	103.9	115.3	134.9	120.8	100.2	114.3	124.9	78.5	173.9	131.6
Dec.	98.3	101.2	62.9	162.0	154.7	155.0	173.0	78.2	163.2	109.5	201.3	113.7	96.9	169.5	141.2
Jan.	160.0	187.7	76.3	84.9	193.3	163.6	162.9	167.1	86.9	209.2	172.8	78.3	58.7	152.8	143.8
Feb.	82.9	76.4	76.8	126.7	100.1	86.4	136.9	113.0	62.6	98.4	82.0	129.7	29.6	175.5	117.0
Mar.	112.0	92.6	73.9	114.7	74.5	66.3	99.3	51.8	56.6	35.5	94.1	164.5	28.4	91.5	93.7
Apr.	2.2	55.3	27.2	75.8	8.4	5.0	27.3	10.1	16.8	22.1	9.3	27.2	0	11.7	23.0
Sub-total	691.0	683.7	527.4	733.8	731.0	655.4	767.1	576.0	520.0	644.5	770.5	679.9	302.7	823.4	695.9
2nd Crop															
May	17.9	123.6	0	56.8	49.0	22.9	66.2	41.5	63.8	24.7	37.8	62.8	12.4	13.5	48.7
June	209.5	141.4	151.1	166.9	154.1	155.3	110.1	166.7	162.3	161.5	101.5	136.2	99.1	102.9	146.1
July	164.0	67.2	145.3	110.8	142.7	106.8	179.0	118.3	109.6	179.1	169.8	171.2	186.4	156.2	165.1
Aug.	138.5	171.1	190.9	106.9	94.1	181.4	176.1	105.3	102.2	210.9	53.1	215.8	208.1	85.3	145.6
Sep.	147.9	183.3	165.7	98.4	174.1	112.7	101.6	191.0	141.1	163.1	103.6	95.1	137.5	124.4	151.7
Oct.	125.9	133.8	52.6	112.6	186.6	83.8	144.5	132.4	128.0	172.7	143.0	151.2	118.4	148.6	148.1
Nov.	113.6	52.3	47.5	87.3	38.8	38.0	82.7	57.9	15.2	28.4	78.2	37.1	77.9	66.9	60.7
Sub-total	917.3	872.7	753.1	739.7	839.4	700.9	860.2	813.1	722.2	940.4	687.0	869.4	839.8	697.8	866.0
Total	1,608.3	1,556.4	1,280.5	1,473.5	1,570.4	1,356.3	1,627.3	1,389.1	1,242.2	1,584.9	1,457.5	1,549.3	1,142.5	1,521.2	1,561.9

TABLE F1-19 MONTHLY EFFECTIVE RAINFALL DURING UPLAND CROP PLANTING PERIOD (PHASE II AREA)

(Unit: mm)

Month	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970
Dec.	0	9.6	7.1	64.3	42.7	49.9	58.9	23.5	52.4	22.7	35.7	2.5	65.4	20.4
Jan.	145.3	121.6	147.7	132.0	130.3	118.5	168.1	97.6	135.2	101.7	161.3	114.7	76.0	95.2
Feb.	96.3	110.2	100.3	93.5	96.5	147.1	90.1	155.7	150.6	86.5	149.3	84.0	65.8	122.6
Mar.	105.3	96.9	141.2	63.0	76.9	136.5	141.2	48.3	101.2	74.3	104.7	97.3	68.5	76.3
Apr.	95.7	74.7	45.0	118.9	98.9	50.7	53.4	83.4	63.2	89.8	83.0	63.8	69.7	70.7
May														
Total	442.6	413.0	441.3	471.7	445.3	502.7	511.7	408.5	502.6	375.0	534.0	362.3	345.4	385.2

Month	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	Average
Dec.	17.3	35.5	8.1	66.9	78.3	35.8	43.7	9.6	26.3	30.1	86.2	19.8	13.4	77.3	37.1
Jan.	154.5	133.2	65.4	84.9	152.5	147.7	144.3	158.7	87.2	149.4	149.4	78.3	58.7	152.8	134.5
Feb.	82.9	76.4	76.8	122.8	111.4	78.3	146.0	90.7	62.6	94.2	82.0	129.7	29.6	148.8	111.3
Mar.	112.0	99.2	73.9	114.7	102.3	66.3	101.9	60.7	56.6	35.5	94.1	150.8	28.4	91.5	95.8
Apr.	103.4	76.0	64.3	160.7	125.3	55.1	48.1	79.4	74.1	51.8	39.5	34.3	4.2	74.4	77.8
May															
Total	470.1	420.3	288.5	550.0	569.8	383.2	484.0	399.1	306.8	361.0	451.2	412.9	134.3	544.8	456.5

TABLE FI-20 10-DAYS RAINFALL AND ITS EFFECTIVE RAINFALL FOR PADDY IN SELECTED DRY YEAR (PHASE II AREA)

(Unit: mm)

Cropping Period	1957 - 1958		1959 - 1960		1965 - 1966		1972 - 1973		1978 - 1979		1982 - 1983		Average	
	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall
1st Crop														
Oct. III	0	0	16.2	16.2	18.0	18.0	79.8	79.8	13.1	13.1	10.6	10.6	23.0	23.0
Nov. I	46.0	46.0	32.8	32.8	16.6	16.6	52.3	52.3	57.9	57.9	37.1	37.1	40.5	40.5
II	29.8	29.8	17.8	17.8	25.9	25.9	20.3	20.3	56.3	56.3	26.1	26.1	29.4	29.4
III	9.3	9.3	38.1	38.1	33.4	33.4	57.9	57.9	6.6	6.6	15.3	15.3	26.8	26.8
Dec. I	21.0	21.0	29.7	29.7	39.4	39.4	102.7	40.7	104.1	100.7	42.2	42.2	56.5	45.6
II	63.5	63.5	8.3	8.3	80.5	80.5	14.1	14.1	39.1	36.2	41.3	41.3	41.1	40.7
III	9.6	9.6	64.3	64.3	22.7	22.7	8.1	8.1	26.3	26.3	13.4	13.4	24.1	24.1
Jan. I	47.6	47.6	4.0	4.0	24.5	24.5	76.3	76.3	32.4	32.4	39.2	39.2	37.5	37.3
II	34.2	34.2	41.7	41.7	41.1	41.1	0	0	3.9	3.9	17.2	17.2	23.0	23.0
III	39.8	39.8	110.6	110.6	36.1	36.1	0	0	50.9	50.6	2.3	2.3	40.0	39.9
Feb. I	23.7	23.7	43.6	43.6	7.5	7.5	22.2	22.2	43.1	43.1	19.3	19.3	26.6	26.6
II	67.4	67.4	12.1	12.1	21.3	21.3	54.6	54.6	12.8	12.8	0.5	0.5	28.1	28.1
III	19.1	19.1	37.8	37.8	57.7	57.7	0	0	6.7	6.7	9.8	9.8	21.9	21.9
Mar. I	71.9	71.9	2.6	2.6	17.4	17.4	9.3	9.3	39.6	39.6	26.6	26.6	27.9	27.9
II	1.5	1.5	42.2	42.2	56.9	56.9	1.8	1.8	0.4	0.4	0.8	0.8	17.3	17.3
III	23.5	23.5	18.2	18.2	0	0	62.8	62.8	16.6	16.6	1.0	1.0	20.4	20.4
Apr. I	0.5	0.5	15.5	15.5	0.8	0.8	27.2	27.2	16.8	16.8	0	0	10.1	10.1
Total	508.4	508.4	535.5	535.5	499.8	499.8	589.4	527.4	526.6	520.0	302.7	302.7	493.7	482.3

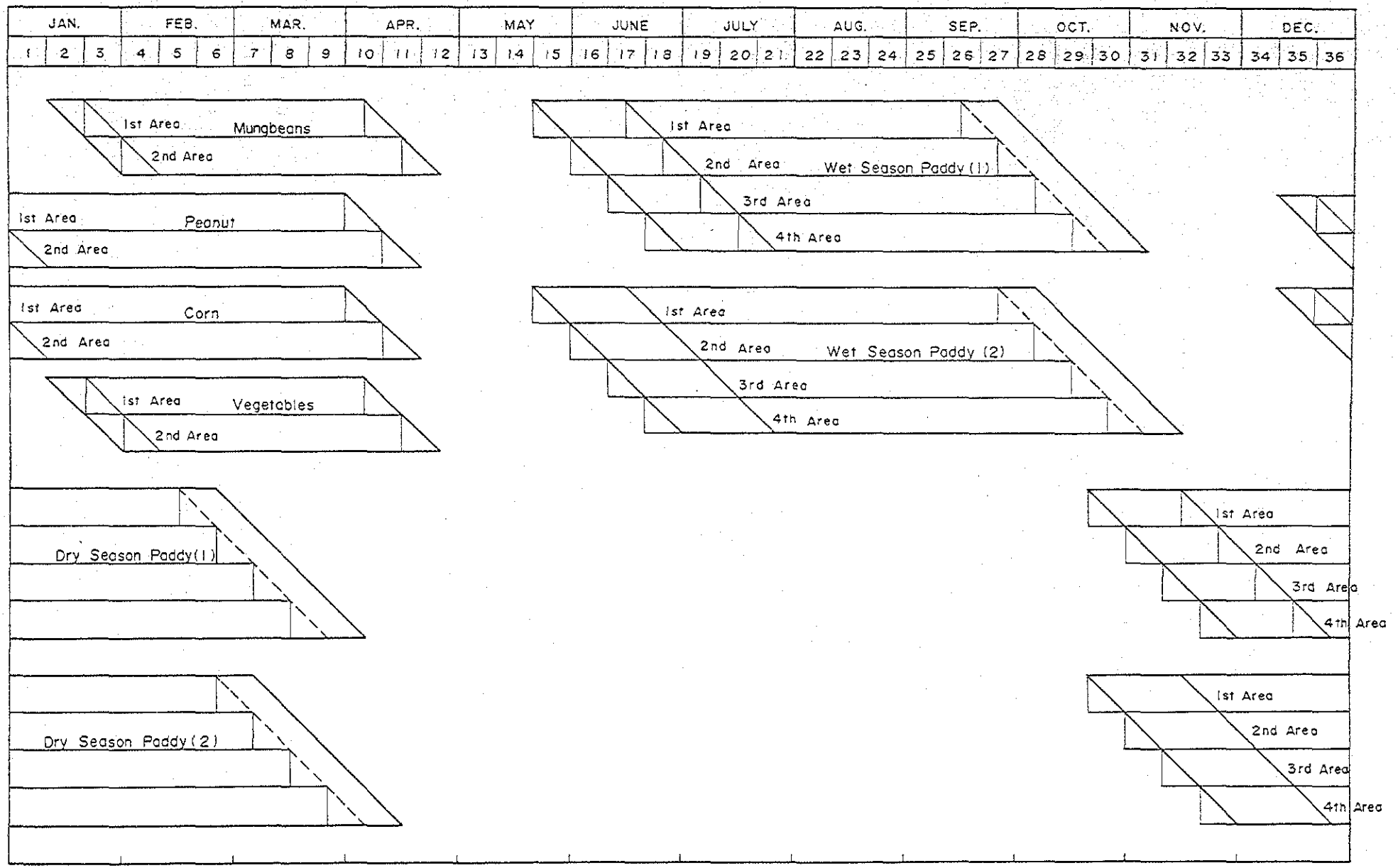
Cropping Period	1956 - 1957		1964 - 1965		1967 - 1968		1975 - 1976		1980 - 1981		1983 - 1984		Average	
	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall
2nd Crop														
May III	5.7	5.7	26.0	26.0	15.3	15.3	22.9	22.9	37.8	37.8	13.5	13.5	20.2	20.2
June I	106.9	70.1	88.7	88.7	43.5	43.5	25.0	25.0	33.2	33.2	57.5	57.5	59.1	53.0
II	72.3	72.1	86.8	52.9	6.0	6.0	91.3	91.3	12.2	12.2	26.9	26.9	49.3	43.6
III	14.9	14.9	18.4	18.4	77.4	77.4	39.0	39.0	56.1	56.1	18.5	18.5	37.4	37.4
July I	149.0	99.2	61.7	61.7	78.1	78.1	34.2	34.2	100.5	89.7	23.2	23.2	74.5	64.4
II	70.7	45.4	34.3	34.3	24.7	24.7	30.8	30.8	43.2	27.7	33.1	33.1	39.5	32.7
III	16.9	16.9	35.1	35.1	8.6	8.6	41.8	41.8	52.4	52.4	99.9	99.9	42.5	42.5
Aug. I	67.2	67.2	10.1	10.1	98.2	98.2	53.4	53.4	4.1	4.1	46.5	46.5	46.6	46.6
II	32.2	32.2	63.2	63.2	5.9	5.9	121.2	119.5	9.0	9.0	11.8	11.8	40.6	40.3
III	38.0	38.0	32.5	32.5	5.3	5.3	8.5	8.5	40.0	40.0	27.0	27.0	25.2	25.2
Sep. I	7.2	7.2	7.1	7.1	3.1	3.1	91.3	81.0	0	0	132.8	75.6	40.3	29.0
II	40.6	40.6	56.3	56.3	138.2	118.2	21.8	21.8	25.7	25.7	9.3	9.3	48.7	45.3
III	71.7	64.0	82.1	82.1	10.1	10.1	9.9	9.9	77.9	77.9	39.5	39.5	48.5	47.3
Oct. I	96.5	45.7	39.0	29.2	68.6	68.6	2.9	2.9	65.3	65.3	68.1	54.4	56.7	44.4
II	46.9	46.9	73.2	73.2	88.8	76.4	28.5	28.5	54.8	36.1	66.6	66.6	59.8	54.6
III	0	0	18.0	18.0	16.4	16.4	52.4	52.4	41.6	41.6	27.6	27.6	26.0	28.0
Nov. I	46.0	46.0	16.6	16.6	17.9	17.9	38.0	38.0	78.3	78.2	66.9	66.9	44.0	43.9
Total	882.7	712.1	749.1	705.4	706.1	673.7	712.9	700.9	732.1	687.0	768.7	697.8	758.6	696.2

TABLE F1-21 10-DAYS RAINFALL AND ITS EFFECTIVE RAINFALL FOR UPLAND CROPS IN SELECTED DRY YEAR (PHASE II AREA)

(Unit: mm)

Cropping Period		1957 - 1968		1968 - 1969		1972 - 1973		1978 - 1979		1979 - 1980		1982 - 1983		Average	
		Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall	Rain-fall	Effective Rainfall
Dec.	III	2.5	2.5	65.4	65.4	8.1	8.1	26.3	26.3	30.1	30.1	13.4	13.4	24.3	24.3
Jan.	I	25.1	25.1	30.6	30.6	76.3	65.4	32.4	32.4	52.2	47.0	39.2	39.2	42.6	40.0
	II	28.7	28.7	41.9	41.9	0.0	0.0	3.9	3.9	49.5	44.6	17.2	17.2	23.5	22.7
	III	60.9	60.9	3.5	3.5	0.0	0.0	50.9	50.9	140.9	57.8	2.3	2.3	43.1	29.2
Feb.	I	43.3	43.3	50.4	50.4	22.2	22.2	43.1	43.1	32.0	32.0	19.3	19.3	35.1	35.1
	II	7.2	7.2	1.4	1.4	54.6	54.6	12.8	12.8	176.8	62.2	0.5	0.5	42.2	23.1
	III	33.5	33.5	14.0	14.0	0.0	0.0	6.7	6.7	0.0	0.0	9.8	9.8	10.7	10.7
Mar.	I	67.5	67.5	85.3	57.1	9.3	9.3	39.6	39.6	0.0	0.0	26.6	26.6	38.1	33.4
	II	24.7	24.7	9.3	9.3	1.8	1.8	0.4	0.4	16.6	16.6	0.8	0.8	8.9	8.9
	III	5.1	5.1	2.1	2.1	62.8	62.8	16.6	16.6	18.9	18.9	1.0	1.0	17.8	17.8
Apr.	I	0.0	0.0	0.0	0.0	27.2	27.2	16.8	16.8	22.1	22.1	0.0	0.0	11.0	11.0
	II	63.8	63.8	0.0	0.0	22.9	22.9	57.3	57.3	3.2	3.2	4.2	4.2	25.2	25.2
	III	0.0	0.0	69.7	69.7	14.2	14.2	0.0	0.0	26.5	26.5	0.0	0.0	18.4	18.4
Total		362.3	362.3	373.6	345.4	299.4	288.5	306.8	306.8	568.8	361.0	134.3	134.3	340.9	299.7

FIGURE F1-4 SCHEMATIC CROPPING PATTERN FOR ESTIMATION OF CROP WATER REQUIREMENTS



b) Irrigation Efficiency

Overall project irrigation efficiency (1-loss) is usually divided into two parts: the efficiency of water use below the farm turnout and the efficiency of water use in the conveyance systems between the source of water supply and the farm turnout. Furthermore, from the aspects of water losses encountered in the operation of irrigation systems, the water losses are subdivided into following three stages:

i) Farm waste,
ii) Lateral and tertiary losses, and
iii) Main canal losses

i) Farm Waste - quantity of water lost in the farm due to seepage and leakages in the paddy dikes, uneven leveling of paddy leading to excess ponding in low spots and demanding over application of irrigation water to cover sufficiently the high spots, unscheduled drainage and spillage.

This waste expressed as field application efficiency, or the efficiency on the farm, varies during the crop cycle. At the commencement of cultivation, efficiencies are generally lower because the tillage operation loosens and aerates the soil leaving voids through which the irrigation water can rapidly percolate. Subsequent irrigation tends to consolidate the soil and reduces infiltration rates and water holding capacity of this layer. In paddy cultivation, this consolidation operation is deliberately undertaken during the land preparation stage to reduce deep percolation and to enable the paddy to be flooded. Towards the end of the season, farmers often pay less attention to the amount of water supplied to their crop and outflows from the ends of rows or from paddies can become excessive. Also, during the latter stages of upland crop cultivation when the roots are deeper, there is a tendency for the farmers to irrigate less frequently. The surface soil tends to crack and irrigation water then penetrates more deeply.

The application efficiency in the project is estimated at 73 percent in dry season paddy field, 70 percent in wet season paddy field and 55 percent in upland field respectively, based upon the prevailing local conditions as well as standard criteria such as FAO Irrigation and Drainage Paper.

ii) Lateral and Tertiary Losses - quantity of water lost due to seepages and leakages in the lateral and tertiary and through illegal turnouts and water take-offs by farmers. These losses can be expressed as field canal conveyance efficiency.

The field canal conveyance efficiency factor takes into account evapotranspiration from the canal surface and vegetation, seepage from the canal, and operation losses. Canal evapotranspiration losses can be fairly accurately determined. Seepage losses are more difficult to determine. Operation losses can be readily determined by measuring outflows from the system. The manner in which the system is operated can affect both evapotranspiration and seepage losses from the canals. For example, rotational irrigation, in which the canal banks are periodically dried out and then have to be recharged until steady state seepage conditions are obtained, tends to increase losses. Lack of water control structures, measuring devices and effective water management organizations contribute significantly to field canal conveyance losses.

In the project, conveyance efficiency is estimated at 80 percent with unlined canals.

iii) Main Canals - quantity of water lost through breaks in lining, illegal diversions and leakages through the gates. In the project, main canal is to be lined by concrete. Under the conditions, operation efficiency of main canal is estimated at 90 percent for both crops, paddy and upland crops.

As the results, overall irrigation efficiency for the project is decided at 55.8 percent for dry season paddy and 53.6 percent for wet season paddy respectively, and 42.1 percent for upland crops, as shown below:

Efficiency	Paddy		Upland Crop
	Dry Season (%)	Wet Season (%)	(%)
Application Efficiency	73	70	55
Conveyance Efficiency	85	85	85
Operation Efficiency	90	90	90
Overall	55.8	53.6	42.1

c) Estimation of Irrigation Water Requirements

Irrigation water requirements in case of five cropping intensities, 160, 170, 180, 190 and 200 percent, have been calculated in both irrigation systems, Boyongan and Capayas systems, in adding to an effective rainfall and irrigation efficiency to the estimated crop water requirements.

The results of estimation for irrigation water requirements are shown in TABLE F1-22 to TABLE F1-36.

TABLE F1-22. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Boyongan System, Cropping Intensity: 160%)

UNIT ; MCM

CROP-YEAR	<---- WET SEASON ----> TRANS-PLANTED (HA) 3310	DIRECT SEEDED (HA) 830	SUB-TOTAL (HA) 4140	<---------- DRY SEASON ----------> TRANS-PLANTED (HA) 1180	DIRECT SEEDED (HA) 510	SUB-TOTAL (HA) 1690	DIVERSIFIED CROPS (HA) 800	TOTAL DEMAND
1956-1957	17.788	4.694	22.482	4.404	2.086	6.490	1.576	30.547
1957-1958	18.109	4.662	22.771	6.510	3.086	9.596	1.958	34.325
1958-1959	15.431	3.982	19.413	5.432	2.687	8.119	1.419	28.950
1959-1960	14.140	3.657	17.797	6.304	3.005	9.308	2.092	29.197
1960-1961	15.845	4.260	20.105	3.985	2.062	6.047	1.767	27.919
1961-1962	7.643	2.113	9.756	3.415	1.717	5.132	2.009	16.897
1962-1963	13.449	3.484	16.933	4.154	1.918	6.071	1.720	24.724
1963-1964	15.044	3.951	18.995	6.734	3.156	9.891	2.000	30.885
1964-1965	17.622	4.555	22.177	3.591	1.552	5.143	1.207	28.527
1965-1966	18.116	4.720	22.836	6.777	3.241	10.018	2.386	35.239
1966-1967	17.917	4.787	22.704	3.656	1.724	5.380	1.819	29.902
1967-1968	23.954	6.231	30.185	6.497	3.021	9.518	2.136	41.840
1968-1969	16.312	4.651	20.963	6.852	3.362	10.215	3.202	34.379
1969-1970	14.686	3.835	18.522	5.421	2.568	7.989	1.680	28.191
1970-1971	13.167	3.414	16.581	4.796	2.384	7.180	1.787	25.548
1971-1972	15.133	4.138	19.272	4.896	2.456	7.352	1.739	28.362
1972-1973	14.902	4.069	18.970	7.382	3.670	11.052	2.775	32.797
1973-1974	16.497	4.627	21.124	5.207	2.397	7.604	1.652	30.381
1974-1975	15.027	3.962	18.989	2.820	1.418	4.238	1.760	24.987
1975-1976	18.950	5.311	24.261	5.299	2.631	7.930	2.248	34.439
1976-1977	11.661	3.147	14.808	3.263	1.676	4.939	1.747	21.494
1977-1978	12.992	3.482	16.474	5.028	2.430	7.458	2.043	25.974
1978-1979	16.944	4.311	21.255	6.652	3.248	9.900	2.592	33.747
1979-1980	10.562	2.760	13.322	4.746	2.408	7.154	2.617	23.093
1980-1981	22.875	5.848	28.724	3.508	1.895	5.403	1.663	35.790
1981-1982	14.743	4.032	18.775	6.733	3.139	9.872	1.115	29.761
1982-1983	14.220	3.608	17.828	8.685	4.322	13.007	4.013	34.848
1983-1984	20.568	5.445	26.013	2.361	1.247	3.608	1.123	30.744
AVERAGE	15.868	4.205	20.072	5.182	2.518	7.700	1.994	29.767

TABLE F1-23. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Capayas System, Cropping Intensity: 160%)

UNIT : MCM

CROP-YEAR	<---- WET SEASON ----> TRANS-PLANTED (HA) 930	DIRECT SEEDED (HA) 230	SUB-TOTAL (HA) 1160	<---------- DRY SEASON ----------> TRANS-PLANTED (HA) 320	DIRECT SEEDED (HA) 140	SUB-TOTAL (HA) 460	DIVERSIFIED CROPS (HA) 240	TOTAL DEMAND
1956-1957	4.998	1.301	6.298	1.194	0.573	1.767	0.473	8.538
1957-1958	5.088	1.292	6.380	1.765	0.847	2.613	0.587	9.580
1958-1959	4.336	1.103	5.439	1.473	0.738	2.211	0.426	8.075
1959-1960	3.973	1.013	4.986	1.709	0.825	2.534	0.628	8.148
1960-1961	4.452	1.180	5.632	1.081	0.566	1.647	0.530	7.809
1961-1962	2.147	0.586	2.733	0.926	0.471	1.397	0.603	4.733
1962-1963	3.779	0.966	4.744	1.126	0.526	1.653	0.516	6.913
1963-1964	4.227	1.095	5.322	1.826	0.866	2.693	0.600	8.614
1964-1965	4.951	1.262	6.214	0.974	0.426	1.400	0.362	7.975
1965-1966	5.090	1.308	6.398	1.838	0.890	2.727	0.716	9.841
1966-1967	5.034	1.326	6.360	0.991	0.473	1.465	0.546	8.371
1967-1968	6.730	1.727	8.457	1.762	0.829	2.591	0.641	11.689
1968-1969	4.583	1.289	5.872	1.858	0.923	2.781	0.960	9.614
1969-1970	4.126	1.063	5.189	1.470	0.705	2.175	0.504	7.868
1970-1971	3.700	0.946	4.646	1.300	0.654	1.955	0.536	7.137
1971-1972	4.252	1.147	5.399	1.328	0.674	2.002	0.522	7.922
1972-1973	4.187	1.127	5.314	2.002	1.007	3.009	0.832	9.156
1973-1974	4.635	1.282	5.917	1.412	0.658	2.070	0.496	8.483
1974-1975	4.222	1.098	5.320	0.765	0.389	1.154	0.528	7.002
1975-1976	5.324	1.472	6.796	1.437	0.722	2.159	0.674	9.630
1976-1977	3.276	0.872	4.148	0.885	0.460	1.345	0.524	6.017
1977-1978	3.650	0.965	4.615	1.364	0.667	2.030	0.613	7.258
1978-1979	4.761	1.195	5.955	1.804	0.892	2.695	0.778	9.428
1979-1980	2.968	0.765	3.732	1.287	0.661	1.948	0.785	6.465
1980-1981	6.427	1.621	8.048	0.951	0.520	1.472	0.499	10.018
1981-1982	4.142	1.117	5.260	1.826	0.862	2.687	0.334	8.282
1982-1983	3.995	1.000	4.995	2.355	1.186	3.542	1.204	9.741
1983-1984	5.779	1.509	7.288	0.640	0.342	0.983	0.337	8.607
AVERAGE	4.458	1.165	5.623	1.405	0.691	2.097	0.598	8.318

TABLE F1-24. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Total Area, Cropping Intensity: 160%)

UNIT ; MCM

CROP-YEAR	WET SEASON TRANS-PLANTED (HA) 4240	WET SEASON DIRECT SEEDED (HA) 1060	WET SEASON SUB-TOTAL (HA) 5300	DRY SEASON TRANS-PLANTED (HA) 1500	DRY SEASON DIRECT SEEDED (HA) 650	DRY SEASON SUB-TOTAL (HA) 2150	DIVERSIFIED CROPS (HA) 1040	TOTAL DEMAND
1956-1957	22.786	5.994	28.780	5.598	2.658	8.256	2.048	39.085
1957-1958	23.197	5.954	29.151	8.275	3.933	12.209	2.545	43.905
1958-1959	19.767	5.085	24.852	6.904	3.425	10.329	1.845	37.026
1959-1960	18.113	4.670	22.784	8.013	3.830	11.843	2.719	37.346
1960-1961	20.297	5.440	25.737	5.065	2.629	7.694	2.297	35.728
1961-1962	9.790	2.699	12.489	4.341	2.189	6.530	2.611	21.630
1962-1963	17.227	4.450	21.677	5.280	2.444	7.724	2.236	31.637
1963-1964	19.271	5.046	24.316	8.560	4.023	12.583	2.600	39.500
1964-1965	22.574	5.817	28.391	4.564	1.978	6.542	1.569	36.503
1965-1966	23.205	6.028	29.234	8.614	4.131	12.745	3.102	45.080
1966-1967	22.951	6.113	29.064	4.647	2.198	6.845	2.364	38.273
1967-1968	30.685	7.957	38.642	8.259	3.851	12.110	2.777	53.529
1968-1969	20.895	5.940	26.835	8.710	4.285	12.996	4.162	43.993
1969-1970	18.813	4.898	23.711	6.891	3.273	10.164	2.185	36.060
1970-1971	16.867	4.360	21.226	6.096	3.039	9.135	2.323	32.685
1971-1972	19.385	5.285	24.670	6.223	3.130	9.354	2.260	36.284
1972-1973	19.088	5.196	24.285	9.384	4.677	14.061	3.607	41.953
1973-1974	21.132	5.909	27.042	6.619	3.055	9.674	2.148	38.864
1974-1975	19.250	5.059	24.309	3.585	1.807	5.392	2.289	31.989
1975-1976	24.274	6.783	31.057	6.736	3.353	10.090	2.922	44.069
1976-1977	14.938	4.018	18.956	4.147	2.137	6.284	2.272	27.512
1977-1978	16.642	4.447	21.089	6.391	3.097	9.488	2.656	33.232
1978-1979	21.705	5.506	27.210	8.455	4.140	12.595	3.370	43.175
1979-1980	13.530	3.524	17.054	6.033	3.069	9.102	3.402	29.558
1980-1981	29.303	7.469	36.771	4.459	2.415	6.875	2.162	45.808
1981-1982	18.885	5.149	24.034	8.559	4.000	12.559	1.449	38.043
1982-1983	18.215	4.608	22.823	11.040	5.509	16.549	5.217	44.588
1983-1984	26.347	6.954	33.301	3.001	1.589	4.591	1.459	39.351
AVERAGE	20.326	5.370	25.696	6.588	3.209	9.797	2.593	38.086

TABLE F1-25. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Boyongan System, Cropping Intensity: 170%)

UNIT ; MCM

CROP-YEAR	WET SEASON TRANS-PLANTED (HA) 3310	WET SEASON DIRECT SEEDED (HA) 830	WET SEASON SUB-TOTAL (HA) 4140	DRY SEASON TRANS-PLANTED (HA) 1360	DRY SEASON DIRECT SEEDED (HA) 580	DRY SEASON SUB-TOTAL (HA) 1940	DIVERSIFIED CROPS (HA) 960	TOTAL DEMAND
1956-1957	17.788	4.694	22.482	5.076	2.372	7.448	1.891	31.820
1957-1958	18.109	4.662	22.771	7.503	3.510	11.013	2.349	36.133
1958-1959	15.431	3.982	19.413	6.260	3.056	9.316	1.703	30.431
1959-1960	14.140	3.657	17.797	7.265	3.417	10.682	2.510	30.990
1960-1961	15.845	4.260	20.105	4.593	2.346	6.938	2.120	29.163
1961-1962	7.643	2.113	9.756	3.936	1.953	5.889	2.411	18.055
1962-1963	13.449	3.484	16.933	4.787	2.181	6.968	2.064	25.965
1963-1964	15.044	3.951	18.995	7.762	3.590	11.351	2.400	32.746
1964-1965	17.622	4.555	22.177	4.138	1.765	5.903	1.448	29.529
1965-1966	18.116	4.720	22.836	7.810	3.686	11.496	2.863	37.195
1966-1967	17.917	4.787	22.704	4.213	1.961	6.174	2.183	31.060
1967-1968	23.954	6.231	30.185	7.488	3.436	10.924	2.563	43.673
1968-1969	16.312	4.651	20.963	7.898	3.824	11.721	3.842	36.526
1969-1970	14.686	3.835	18.522	6.248	2.921	9.169	2.016	29.707
1970-1971	13.167	3.414	16.581	5.527	2.711	8.239	2.145	26.964
1971-1972	15.133	4.138	19.272	5.643	2.793	8.436	2.086	29.794
1972-1973	14.902	4.069	18.970	8.508	4.174	12.682	3.330	34.982
1973-1974	16.497	4.627	21.124	6.002	2.726	8.728	1.983	31.834
1974-1975	15.027	3.962	18.989	3.250	1.612	4.863	2.112	25.964
1975-1976	18.950	5.311	24.261	6.108	2.992	9.100	2.698	36.058
1976-1977	11.661	3.147	14.808	3.760	1.906	5.667	2.097	22.571
1977-1978	12.992	3.482	16.474	5.795	2.763	8.558	2.451	27.483
1978-1979	16.944	4.311	21.255	7.666	3.694	11.360	3.110	35.725
1979-1980	10.562	2.760	13.322	5.470	2.738	8.208	3.140	24.670
1980-1981	22.875	5.848	28.724	4.043	2.155	6.199	1.996	36.918
1981-1982	14.743	4.032	18.775	7.760	3.569	11.329	1.338	31.442
1982-1983	14.220	3.608	17.828	10.010	4.915	14.925	4.816	37.568
1983-1984	20.568	5.445	26.013	2.721	1.418	4.139	1.347	31.500
AVERAGE	15.868	4.205	20.072	5.973	2.864	8.837	2.393	31.302

TABLE F1-26. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Capayas System, Cropping Intensity: 170%)

UNIT ; MCM

CROP-YEAR	WET SEASON TRANS-PLANTED (HA) 930	WET SEASON DIRECT SEEDED (HA) 230	WET SEASON SUB-TOTAL (HA) 1160	DRY SEASON TRANS-PLANTED (HA) 370	DRY SEASON DIRECT SEEDED (HA) 160	DRY SEASON SUB-TOTAL (HA) 530	DIVERSIFIED CROPS (HA) 280	TOTAL DEMAND
1956-1957	4.998	1.301	6.298	1.381	0.654	2.035	0.551	8.885
1957-1958	5.088	1.292	6.380	2.041	0.968	3.009	0.685	10.075
1958-1959	4.336	1.103	5.439	1.703	0.843	2.546	0.497	8.482
1959-1960	3.973	1.013	4.986	1.977	0.943	2.919	0.732	8.638
1960-1961	4.452	1.180	5.632	1.249	0.647	1.897	0.618	8.147
1961-1962	2.147	0.586	2.733	1.071	0.539	1.609	0.703	5.046
1962-1963	3.779	0.966	4.744	1.302	0.602	1.904	0.602	7.250
1963-1964	4.227	1.095	5.322	2.112	0.990	3.102	0.700	9.123
1964-1965	4.951	1.262	6.214	1.126	0.487	1.613	0.422	8.249
1965-1966	5.090	1.308	6.398	2.125	1.017	3.142	0.835	10.375
1966-1967	5.034	1.326	6.360	1.146	0.541	1.687	0.637	8.684
1967-1968	6.730	1.727	8.457	2.037	0.948	2.985	0.748	12.190
1968-1969	4.583	1.289	5.872	2.149	1.055	3.203	1.121	10.196
1969-1970	4.126	1.063	5.189	1.700	0.806	2.506	0.588	8.283
1970-1971	3.700	0.946	4.646	1.504	0.748	2.252	0.626	7.523
1971-1972	4.252	1.147	5.399	1.535	0.771	2.306	0.609	8.313
1972-1973	4.187	1.127	5.314	2.315	1.151	3.466	0.971	9.752
1973-1974	4.635	1.282	5.917	1.633	0.752	2.385	0.578	8.880
1974-1975	4.222	1.098	5.320	0.884	0.445	1.329	0.616	7.265
1975-1976	5.324	1.472	6.796	1.662	0.825	2.487	0.787	10.070
1976-1977	3.276	0.872	4.148	1.023	0.526	1.549	0.612	6.309
1977-1978	3.650	0.965	4.615	1.577	0.762	2.339	0.715	7.669
1978-1979	4.761	1.195	5.955	2.086	1.019	3.105	0.907	9.967
1979-1980	2.968	0.765	3.732	1.488	0.755	2.243	0.916	6.892
1980-1981	6.427	1.621	8.048	1.100	0.595	1.695	0.582	10.324
1981-1982	4.142	1.117	5.260	2.111	0.985	3.096	0.390	8.746
1982-1983	3.995	1.000	4.995	2.723	1.356	4.079	1.405	10.479
1983-1984	5.779	1.509	7.288	0.740	0.391	1.132	0.393	8.812
AVERAGE	4.458	1.165	5.623	1.625	0.790	2.415	0.698	8.737

TABLE F1-27. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Total Area, Cropping Intensity: 170%)

UNIT ; MCM

CROP-YEAR	WET SEASON TRANS-PLANTED (HA) 4240	WET SEASON DIRECT SEEDED (HA) 1060	WET SEASON SUB-TOTAL (HA) 5300	DRY SEASON TRANS-PLANTED (HA) 1730	DRY SEASON DIRECT SEEDED (HA) 740	DRY SEASON SUB-TOTAL (HA) 2470	DIVERSIFIED CROPS (HA) 1240	TOTAL DEMAND
1956-1957	22.786	5.994	28.780	6.456	3.027	9.483	2.442	40.705
1957-1958	23.197	5.954	29.151	9.544	4.478	14.022	3.035	46.208
1958-1959	19.767	5.085	24.852	7.963	3.899	11.862	2.199	38.913
1959-1960	18.113	4.670	22.784	9.242	4.360	13.602	3.242	39.628
1960-1961	20.297	5.440	25.737	5.842	2.993	8.835	2.739	37.310
1961-1962	9.790	2.699	12.489	5.007	2.492	7.498	3.114	23.101
1962-1963	17.227	4.450	21.677	6.090	2.782	8.872	2.666	33.215
1963-1964	19.271	5.046	24.316	9.873	4.580	14.453	3.100	41.869
1964-1965	22.574	5.817	28.391	5.264	2.252	7.516	1.871	37.778
1965-1966	23.205	6.028	29.234	9.935	4.703	14.638	3.698	47.570
1966-1967	22.951	6.113	29.064	5.360	2.502	7.861	2.819	39.745
1967-1968	30.685	7.957	38.642	9.525	4.384	13.909	3.311	55.862
1968-1969	20.895	5.940	26.835	10.046	4.879	14.925	4.962	46.722
1969-1970	18.813	4.898	23.711	7.948	3.727	11.674	2.605	37.990
1970-1971	16.867	4.360	21.226	7.031	3.459	10.490	2.770	34.487
1971-1972	19.385	5.285	24.670	7.178	3.564	10.742	2.695	38.107
1972-1973	19.088	5.196	24.285	10.823	5.325	16.148	4.301	44.734
1973-1974	21.132	5.909	27.042	7.634	3.478	11.112	2.561	40.715
1974-1975	19.250	5.059	24.309	4.135	2.057	6.192	2.729	33.229
1975-1976	24.274	6.783	31.057	7.769	3.818	11.587	3.484	46.128
1976-1977	14.938	4.018	18.956	4.783	2.432	7.216	2.708	28.880
1977-1978	16.642	4.447	21.089	7.372	3.525	10.897	3.166	35.152
1978-1979	21.705	5.506	27.210	9.752	4.713	14.465	4.018	45.693
1979-1980	13.530	3.524	17.054	6.958	3.494	10.452	4.056	31.562
1980-1981	29.303	7.469	36.771	5.143	2.750	7.893	2.578	47.242
1981-1982	18.885	5.149	24.034	9.871	4.554	14.425	1.728	40.188
1982-1983	18.215	4.608	22.823	12.733	6.271	19.004	6.220	48.047
1983-1984	26.347	6.954	33.301	3.462	1.809	5.271	1.740	40.312
AVERAGE	20.326	5.370	25.696	7.598	3.654	11.252	3.091	40.039

TABLE F1-28. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Boyongan System, Cropping Intensity: 180%)

UNIT ; MCM

CROP-YEAR	<---- WET SEASON ----> TRANS-PLANTED (HA) 3310	DIRECT SEEDED (HA) 830	SUB-TOTAL (HA) 4140	<---------- DRY SEASON ----------> TRANS-PLANTED (HA) 1560	DIRECT SEEDED (HA) 670	SUB-TOTAL (HA) 2230	DIVERSIFIED CROPS (HA) 1080	TOTAL DEMAND
1956-1957	17.788	4.694	22.482	5.822	2.740	8.562	2.127	33.171
1957-1958	18.109	4.662	22.771	8.607	4.054	12.661	2.643	38.075
1958-1959	15.431	3.982	19.413	7.181	3.530	10.711	1.916	32.039
1959-1960	14.140	3.657	17.797	8.334	3.948	12.281	2.824	32.902
1960-1961	15.845	4.260	20.105	5.268	2.709	7.978	2.385	30.467
1961-1962	7.643	2.113	9.756	4.515	2.256	6.771	2.712	19.238
1962-1963	13.449	3.484	16.933	5.491	2.519	8.010	2.322	27.265
1963-1964	15.044	3.951	18.995	8.903	4.147	13.050	2.700	34.744
1964-1965	17.622	4.555	22.177	4.747	2.039	6.786	1.629	30.593
1965-1966	18.116	4.720	22.836	8.959	4.258	13.217	3.221	39.273
1966-1967	17.917	4.787	22.704	4.833	2.265	7.098	2.455	32.257
1967-1968	23.954	6.231	30.185	8.589	3.969	12.558	2.884	45.627
1968-1969	16.312	4.651	20.963	9.059	4.417	13.476	4.322	38.761
1969-1970	14.686	3.835	18.522	7.167	3.374	10.541	2.269	31.331
1970-1971	13.167	3.414	16.581	6.340	3.132	9.472	2.413	28.466
1971-1972	15.133	4.138	19.272	6.472	3.227	9.699	2.347	31.318
1972-1973	14.902	4.069	18.970	9.759	4.821	14.581	3.746	37.297
1973-1974	16.497	4.627	21.124	6.884	3.149	10.033	2.230	33.388
1974-1975	15.027	3.962	18.989	3.728	1.863	5.591	2.377	26.956
1975-1976	18.950	5.311	24.261	7.006	3.457	10.462	3.035	37.758
1976-1977	11.661	3.147	14.808	4.313	2.202	6.516	2.359	23.682
1977-1978	12.992	3.482	16.474	6.647	3.192	9.839	2.758	29.070
1978-1979	16.944	4.311	21.255	8.794	4.267	13.061	3.499	37.815
1979-1980	10.562	2.760	13.322	6.274	3.163	9.437	3.533	26.292
1980-1981	22.875	5.848	28.724	4.638	2.490	7.128	2.245	38.096
1981-1982	14.743	4.032	18.775	8.901	4.123	13.025	1.505	33.305
1982-1983	14.220	3.608	17.828	11.482	5.678	17.160	5.418	40.405
1983-1984	20.568	5.445	26.013	3.122	1.638	4.760	1.516	32.288
AVERAGE	15.868	4.205	20.072	6.851	3.308	10.159	2.692	32.924

TABLE F1-29. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Capayas System, Cropping Intensity: 180%)

UNIT : MCM

CROP-YEAR	WET SEASON TRANS-PLANTED (HA) 930	WET SEASON DIRECT SEEDED (HA) 230	WET SEASON SUB-TOTAL (HA) 1160	DRY SEASON TRANS-PLANTED (HA) 430	DRY SEASON DIRECT SEEDED (HA) 180	DRY SEASON SUB-TOTAL (HA) 610	DIVERSIFIED CROPS (HA) 320	TOTAL DEMAND
1956-1957	4.998	1.301	6.298	1.605	0.736	2.341	0.630	9.270
1957-1958	5.088	1.292	6.380	2.372	1.089	3.461	0.783	10.625
1958-1959	4.336	1.103	5.439	1.979	0.948	2.928	0.568	8.934
1959-1960	3.973	1.013	4.986	2.297	1.061	3.358	0.837	9.181
1960-1961	4.452	1.180	5.632	1.452	0.728	2.180	0.707	8.519
1961-1962	2.147	0.586	2.733	1.244	0.606	1.850	0.804	5.387
1962-1963	3.779	0.966	4.744	1.514	0.677	2.190	0.688	7.623
1963-1964	4.227	1.095	5.322	2.454	1.114	3.568	0.800	9.690
1964-1965	4.951	1.262	6.214	1.308	0.548	1.856	0.483	8.553
1965-1966	5.090	1.308	6.398	2.469	1.144	3.613	0.954	10.966
1966-1967	5.034	1.326	6.360	1.332	0.609	1.941	0.728	9.029
1967-1968	6.730	1.727	8.457	2.368	1.066	3.434	0.854	12.745
1968-1969	4.583	1.289	5.872	2.497	1.187	3.684	1.281	10.836
1969-1970	4.126	1.063	5.189	1.975	0.906	2.882	0.672	8.743
1970-1971	3.700	0.946	4.646	1.748	0.841	2.589	0.715	7.949
1971-1972	4.252	1.147	5.399	1.784	0.867	2.651	0.695	8.745
1972-1973	4.187	1.127	5.314	2.690	1.295	3.985	1.110	10.410
1973-1974	4.635	1.282	5.917	1.898	0.846	2.744	0.661	9.322
1974-1975	4.222	1.098	5.320	1.028	0.500	1.528	0.704	7.552
1975-1976	5.324	1.472	6.796	1.931	0.929	2.860	0.899	10.555
1976-1977	3.276	0.872	4.148	1.189	0.592	1.781	0.699	6.628
1977-1978	3.650	0.965	4.615	1.832	0.858	2.690	0.817	8.122
1978-1979	4.761	1.195	5.955	2.424	1.146	3.570	1.037	10.562
1979-1980	2.968	0.765	3.732	1.729	0.850	2.579	1.047	7.358
1980-1981	6.427	1.621	8.048	1.278	0.669	1.947	0.665	10.660
1981-1982	4.142	1.117	5.260	2.454	1.108	3.561	0.446	9.267
1982-1983	3.995	1.000	4.995	3.165	1.525	4.690	1.605	11.291
1983-1984	5.779	1.509	7.288	0.860	0.440	1.301	0.449	9.037
AVERAGE	4.458	1.165	5.623	1.888	0.889	2.777	0.798	9.198

TABLE F1-30. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Total Area, Cropping Intensity: 180%)

UNIT ; MCM

CROP-YEAR	WET SEASON TRANS-PLANTED (HA) 4240	WET SEASON DIRECT SEEDED (HA) 1060	WET SEASON SUB-TOTAL (HA) 5300	DRY SEASON TRANS-PLANTED (HA) 1990	DRY SEASON DIRECT SEEDED (HA) 850	DRY SEASON SUB-TOTAL (HA) 2840	DIVERSIFIED CROPS (HA) 1400	TOTAL DEMAND
1956-1957	22.786	5.994	28.780	7.427	3.476	10.903	2.757	42.440
1957-1958	23.197	5.954	29.151	10.979	5.143	16.122	3.426	48.699
1958-1959	19.767	5.085	24.852	9.160	4.479	13.639	2.483	40.974
1959-1960	18.113	4.670	22.784	10.631	5.008	15.639	3.661	42.083
1960-1961	20.297	5.440	25.737	6.720	3.437	10.158	3.092	38.986
1961-1962	9.790	2.699	12.489	5.759	2.862	8.621	3.515	24.625
1962-1963	17.227	4.450	21.677	7.005	3.196	10.201	3.010	34.888
1963-1964	19.271	5.046	24.316	11.357	5.261	16.618	3.500	44.434
1964-1965	22.574	5.817	28.391	6.056	2.587	8.642	2.112	39.145
1965-1966	23.205	6.028	29.234	11.429	5.402	16.830	4.175	50.239
1966-1967	22.951	6.113	29.064	6.165	2.874	9.039	3.183	41.286
1967-1968	30.685	7.957	38.642	10.957	5.035	15.992	3.738	58.373
1968-1969	20.895	5.940	26.835	11.556	5.604	17.160	5.603	49.598
1969-1970	18.813	4.898	23.711	9.142	4.281	13.423	2.941	40.074
1970-1971	16.867	4.360	21.226	8.087	3.974	12.061	3.128	36.415
1971-1972	19.385	5.285	24.670	8.257	4.094	12.350	3.043	40.063
1972-1973	19.088	5.196	24.285	12.449	6.117	18.566	4.856	47.707
1973-1974	21.132	5.909	27.042	8.782	3.995	12.777	2.891	42.710
1974-1975	19.250	5.059	24.309	4.756	2.363	7.119	3.081	34.509
1975-1976	24.274	6.783	31.057	8.937	4.385	13.322	3.934	48.313
1976-1977	14.938	4.018	18.956	5.502	2.794	8.296	3.058	30.310
1977-1978	16.642	4.447	21.089	8.479	4.049	12.529	3.575	37.192
1978-1979	21.705	5.506	27.210	11.218	5.414	16.631	4.536	48.377
1979-1980	13.530	3.524	17.054	8.004	4.013	12.017	4.580	33.651
1980-1981	29.303	7.469	36.771	5.916	3.159	9.075	2.911	48.757
1981-1982	18.885	5.149	24.034	11.355	5.231	16.586	1.951	42.571
1982-1983	18.215	4.608	22.823	14.646	7.204	21.850	7.023	51.696
1983-1984	26.347	6.954	33.301	3.982	2.078	6.060	1.965	41.326
AVERAGE	20.326	5.370	25.696	8.740	4.197	12.937	3.490	42.123

TABLE F1-31. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Boyongan System, Cropping Intensity: 190%)

UNIT : MCM

CROP-YEAR	<---- WET SEASON ----> TRANS-PLANTED (HA) 3310	DIRECT SEEDED (HA) 830	SUB-TOTAL (HA) 4140	<---------- DRY SEASON ----------> TRANS-PLANTED (HA) 1770	DIRECT SEEDED (HA) 760	SUB-TOTAL (HA) 2530	DIVERSIFIED CROPS (HA) 1240	TOTAL DEMAND
1956-1957	17.788	4.694	22.482	6.606	3.108	9.714	2.442	34.638
1957-1958	18.109	4.662	22.771	9.765	4.599	14.364	3.035	40.169
1958-1959	15.431	3.982	19.413	8.147	4.004	12.152	2.199	33.764
1959-1960	14.140	3.657	17.797	9.455	4.478	13.933	3.242	34.973
1960-1961	15.845	4.260	20.105	5.977	3.073	9.051	2.739	31.894
1961-1962	7.643	2.113	9.756	5.122	2.559	7.681	3.114	20.551
1962-1963	13.449	3.484	16.933	6.230	2.858	9.088	2.666	28.687
1963-1964	15.044	3.951	18.995	10.101	4.704	14.805	3.100	36.900
1964-1965	17.622	4.555	22.177	5.386	2.313	7.699	1.871	31.747
1965-1966	18.116	4.720	22.836	10.165	4.830	14.995	3.698	41.528
1966-1967	17.917	4.787	22.704	5.483	2.570	8.053	2.819	33.576
1967-1968	23.954	6.231	30.185	9.746	4.502	14.248	3.311	47.744
1968-1969	16.312	4.651	20.963	10.278	5.011	15.289	4.962	41.214
1969-1970	14.686	3.835	18.522	8.131	3.827	11.959	2.605	33.085
1970-1971	13.167	3.414	16.581	7.193	3.553	10.746	2.770	30.097
1971-1972	15.133	4.138	19.272	7.344	3.660	11.004	2.695	32.970
1972-1973	14.902	4.069	18.970	11.073	5.469	16.542	4.301	39.813
1973-1974	16.497	4.627	21.124	7.811	3.572	11.383	2.561	35.068
1974-1975	15.027	3.962	18.989	4.230	2.113	6.343	2.729	28.061
1975-1976	18.950	5.311	24.261	7.949	3.921	11.870	3.484	39.615
1976-1977	11.661	3.147	14.808	4.894	2.498	7.392	2.708	24.908
1977-1978	12.992	3.482	16.474	7.542	3.621	11.163	3.166	30.802
1978-1979	16.944	4.311	21.255	9.977	4.840	14.818	4.018	40.090
1979-1980	10.562	2.760	13.322	7.119	3.588	10.707	4.056	28.085
1980-1981	22.875	5.848	28.724	5.262	2.824	8.086	2.578	39.388
1981-1982	14.743	4.032	18.775	10.100	4.677	14.777	1.728	35.280
1982-1983	14.220	3.608	17.828	13.027	6.441	19.468	6.220	43.516
1983-1984	20.568	5.445	26.013	3.542	1.858	5.400	1.740	33.153
AVERAGE	15.868	4.205	20.072	7.774	3.753	11.526	3.091	34.690

TABLE F1-32. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Capayas System, Cropping Intensity: 190%)

UNIT ; MCM

CROP-YEAR	WET SEASON TRANS-PLANTED (HA) 930	WET SEASON DIRECT SEEDED (HA) 230	WET SEASON SUB-TOTAL (HA) 1160	DRY SEASON TRANS-PLANTED (HA) 480	DRY SEASON DIRECT SEEDED (HA) 200	DRY SEASON SUB-TOTAL (HA) 680	DIVERSIFIED CROPS (HA) 360	TOTAL DEMAND
1956-1957	4.998	1.301	6.298	1.791	0.818	2.609	0.709	9.617
1957-1958	5.088	1.292	6.380	2.648	1.210	3.858	0.881	11.119
1958-1959	4.336	1.103	5.439	2.209	1.054	3.263	0.639	9.341
1959-1960	3.973	1.013	4.986	2.564	1.178	3.743	0.941	9.670
1960-1961	4.452	1.180	5.632	1.621	0.809	2.430	0.795	8.857
1961-1962	2.147	0.586	2.733	1.389	0.673	2.063	0.904	5.699
1962-1963	3.779	0.966	4.744	1.690	0.752	2.442	0.774	7.960
1963-1964	4.227	1.095	5.322	2.739	1.238	3.977	0.900	10.199
1964-1965	4.951	1.262	6.214	1.461	0.609	2.069	0.543	8.826
1965-1966	5.090	1.308	6.398	2.757	1.271	4.028	1.074	11.499
1966-1967	5.034	1.326	6.360	1.487	0.676	2.163	0.818	9.342
1967-1968	6.730	1.727	8.457	2.643	1.185	3.828	0.961	13.246
1968-1969	4.583	1.289	5.872	2.787	1.319	4.106	1.441	11.419
1969-1970	4.126	1.063	5.189	2.205	1.007	3.212	0.756	9.158
1970-1971	3.700	0.946	4.646	1.951	0.935	2.886	0.804	8.335
1971-1972	4.252	1.147	5.399	1.992	0.963	2.955	0.782	9.136
1972-1973	4.187	1.127	5.314	3.003	1.439	4.442	1.249	11.005
1973-1974	4.635	1.282	5.917	2.118	0.940	3.058	0.743	9.719
1974-1975	4.222	1.098	5.320	1.147	0.556	1.703	0.792	7.815
1975-1976	5.324	1.472	6.796	2.156	1.032	3.187	1.012	10.995
1976-1977	3.276	0.872	4.148	1.327	0.657	1.985	0.786	6.919
1977-1978	3.650	0.965	4.615	2.045	0.953	2.998	0.919	8.532
1978-1979	4.761	1.195	5.955	2.706	1.274	3.980	1.166	11.101
1979-1980	2.968	0.765	3.732	1.931	0.944	2.875	1.178	7.785
1980-1981	6.427	1.621	8.048	1.427	0.743	2.170	0.748	10.966
1981-1982	4.142	1.117	5.260	2.739	1.231	3.970	0.502	9.731
1982-1983	3.995	1.000	4.995	3.533	1.695	5.228	1.806	12.029
1983-1984	5.779	1.509	7.288	0.960	0.489	1.449	0.505	9.242
AVERAGE	4.458	1.165	5.623	2.108	0.988	3.096	0.897	9.617

TABLE F1-33. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Total Area, Cropping Intensity: 190%)

UNIT : MCM

CROP-YEAR	WET SEASON TRANS-PLANTED (HA) 4240	WET SEASON DIRECT SEEDED (HA) 1060	WET SEASON SUB-TOTAL (HA) 5300	DRY SEASON TRANS-PLANTED (HA) 2250	DRY SEASON DIRECT SEEDED (HA) 960	DRY SEASON SUB-TOTAL (HA) 3210	DIVERSIFIED CROPS (HA) 1600	TOTAL DEMAND
1956-1957	22.786	5.994	28.780	8.397	3.926	12.323	3.151	44.255
1957-1958	23.197	5.954	29.151	12.413	5.809	18.222	3.916	51.289
1958-1959	19.767	5.085	24.852	10.357	5.058	15.415	2.838	43.105
1959-1960	18.113	4.670	22.784	12.019	5.656	17.676	4.184	44.643
1960-1961	20.297	5.440	25.737	7.598	3.882	11.480	3.534	40.751
1961-1962	9.790	2.699	12.489	6.511	3.232	9.744	4.018	26.250
1962-1963	17.227	4.450	21.677	7.920	3.610	11.530	3.440	36.647
1963-1964	19.271	5.046	24.316	12.841	5.941	18.782	4.000	47.099
1964-1965	22.574	5.817	28.391	6.847	2.921	9.768	2.414	40.573
1965-1966	23.205	6.028	29.234	12.922	6.101	19.023	4.772	53.028
1966-1967	22.951	6.113	29.064	6.970	3.246	10.216	3.638	42.918
1967-1968	30.685	7.957	38.642	12.388	5.687	18.076	4.272	60.990
1968-1969	20.895	5.940	26.835	13.066	6.329	19.395	6.403	52.633
1969-1970	18.813	4.898	23.711	10.336	4.835	15.171	3.361	42.243
1970-1971	16.867	4.360	21.226	9.144	4.488	13.632	3.574	38.433
1971-1972	19.385	5.285	24.670	9.335	4.623	13.959	3.477	42.106
1972-1973	19.088	5.196	24.285	14.076	6.908	20.984	5.550	50.819
1973-1974	21.132	5.909	27.042	9.929	4.512	14.441	3.304	44.787
1974-1975	19.250	5.059	24.309	5.377	2.669	8.046	3.521	35.876
1975-1976	24.274	6.783	31.057	10.105	4.953	15.057	4.496	50.610
1976-1977	14.938	4.018	18.956	6.221	3.156	9.377	3.495	31.827
1977-1978	16.642	4.447	21.089	9.587	4.573	14.161	4.086	39.335
1978-1979	21.705	5.506	27.210	12.683	6.114	18.797	5.184	51.192
1979-1980	13.530	3.524	17.054	9.049	4.532	13.582	5.234	35.870
1980-1981	29.303	7.469	36.771	6.689	3.567	10.257	3.326	50.354
1981-1982	18.885	5.149	24.034	12.838	5.908	18.746	2.230	45.011
1982-1983	18.215	4.608	22.823	16.560	8.136	24.696	8.026	55.545
1983-1984	26.347	6.954	33.301	4.502	2.347	6.849	2.245	42.396
AVERAGE	20.326	5.370	25.696	9.882	4.740	14.622	3.989	44.306

TABLE F1-34 ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Boyongan System, Cropping Intensity: 200%)

UNIT ; MCM

CROP-YEAR	WET SEASON TRANS-PLANTED (HA) 3310	WET SEASON DIRECT SEEDED (HA) 830	WET SEASON SUB-TOTAL (HA) 4140	DRY SEASON TRANS-PLANTED (HA) 1950	DRY SEASON DIRECT SEEDED (HA) 830	DRY SEASON SUB-TOTAL (HA) 2780	DIVERSIFIED CROPS (HA) 1360	TOTAL DEMAND
1956-1957	17.788	4.694	*22.482	7.277	3.395	10.672	2.679	35.832
1957-1958	18.109	4.662	22.771	10.758	5.022	*15.780	3.328	41.880
1958-1959	15.431	3.982	19.413	8.976	4.373	13.349	2.412	35.174
1959-1960	14.140	3.657	17.797	10.417	4.890	*15.307	3.556	36.660
1960-1961	15.845	4.260	20.105	6.585	3.357	9.942	3.004	33.050
1961-1962	7.643	2.113	9.756	5.643	2.795	8.438	3.415	21.609
1962-1963	13.449	3.484	16.933	6.864	3.121	9.985	2.924	29.842
1963-1964	15.044	3.951	18.995	11.129	5.137	16.266	3.400	38.660
1964-1965	17.622	4.555	*22.177	5.934	2.526	8.460	2.052	32.689
1965-1966	18.116	4.720	22.836	11.199	5.275	*16.473	4.056	43.365
1966-1967	17.917	4.787	22.704	6.041	2.806	8.847	3.092	34.643
1967-1968	23.954	6.231	*30.185	10.737	4.917	15.654	*3.632	49.470
1968-1969	16.312	4.651	20.963	11.324	5.472	16.796	*5.443	43.201
1969-1970	14.686	3.835	18.522	8.958	4.180	13.138	2.857	34.517
1970-1971	13.167	3.414	16.581	7.925	3.880	11.805	3.038	31.424
1971-1972	15.133	4.138	19.272	8.091	3.997	12.088	2.956	34.315
1972-1973	14.902	4.069	18.970	12.199	5.973	*18.172	*4.717	41.859
1973-1974	16.497	4.627	21.124	8.605	3.901	12.506	2.809	36.439
1974-1975	15.027	3.962	18.989	4.660	2.307	6.968	2.993	28.949
1975-1976	18.950	5.311	*24.261	8.757	4.282	13.039	3.822	41.122
1976-1977	11.661	3.147	14.808	5.392	2.728	8.120	2.971	25.898
1977-1978	12.992	3.482	16.474	8.309	3.954	12.263	3.473	32.209
1978-1979	16.944	4.311	21.255	10.992	5.286	*16.278	*4.406	41.939
1979-1980	10.562	2.760	13.322	7.843	3.918	11.761	*4.449	29.532
1980-1981	22.875	5.848	*28.724	5.797	3.084	8.882	2.827	40.432
1981-1982	14.743	4.032	18.775	11.127	5.108	16.234	1.895	36.905
1982-1983	14.220	3.608	17.828	14.352	7.034	*21.386	*6.822	46.036
1983-1984	20.568	5.445	*26.013	3.902	2.029	5.931	1.908	33.853
AVERAGE	15.868	4.205	20.072	8.564	4.098	12.662	3.391	36.125

Note: Figures with an asterisk show the water requirements in dry year.

TABLE F1-35. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Capayas System, Cropping Intensity: 200%)

UNIT : MCM

CROP-YEAR	WET SEASON TRANS-PLANTED (HA) 930	WET SEASON DIRECT SEEDED (HA) 230	WET SEASON SUB-TOTAL (HA) 1160	DRY SEASON TRANS-PLANTED (HA) 540	DRY SEASON DIRECT SEEDED (HA) 220	DRY SEASON SUB-TOTAL (HA) 760	DIVERSIFIED CROPS (HA) 400	TOTAL DEMAND
1956-1957	4.998	1.301	*6.298	2.015	0.900	2.915	0.788	10.001
1957-1958	5.088	1.292	6.380	2.979	1.331	*4.310	0.979	11.669
1958-1959	4.336	1.103	5.439	2.486	1.159	3.645	0.709	9.793
1959-1960	3.973	1.013	4.986	2.885	1.296	*4.181	1.046	10.213
1960-1961	4.452	1.180	5.632	1.824	0.890	2.713	0.883	9.229
1961-1962	2.147	0.586	2.733	1.563	0.741	2.303	1.004	6.041
1962-1963	3.779	0.966	4.744	1.901	0.827	2.728	0.860	8.332
1963-1964	4.227	1.095	5.322	3.082	1.362	4.443	1.000	10.765
1964-1965	4.951	1.262	*6.214	1.643	0.669	2.313	0.603	9.130
1965-1966	5.090	1.308	6.398	3.101	1.398	*4.499	1.193	12.090
1966-1967	5.034	1.326	6.360	1.673	0.744	2.417	0.909	9.687
1967-1968	6.730	1.727	*8.457	2.973	1.303	4.277	*1.068	13.802
1968-1969	4.583	1.289	5.872	3.136	1.450	4.586	*1.601	12.059
1969-1970	4.126	1.063	5.189	2.481	1.108	3.589	0.840	9.618
1970-1971	3.700	0.946	4.646	2.195	1.028	3.223	0.894	8.762
1971-1972	4.252	1.147	5.399	2.240	1.060	3.300	0.869	9.568
1972-1973	4.187	1.127	5.314	3.378	1.583	*4.961	*1.387	11.663
1973-1974	4.635	1.282	5.917	2.383	1.034	3.417	0.826	10.160
1974-1975	4.222	1.098	5.320	1.291	0.612	1.902	0.880	8.102
1975-1976	5.324	1.472	*6.796	2.425	1.135	3.560	1.124	11.480
1976-1977	3.276	0.872	4.148	1.493	0.723	2.216	0.874	7.238
1977-1978	3.650	0.965	4.615	2.301	1.048	3.349	1.021	8.985
1978-1979	4.761	1.195	5.955	3.044	1.401	*4.445	*1.296	11.696
1979-1980	2.968	0.765	3.732	2.172	1.039	3.210	*1.308	8.251
1980-1981	6.427	1.621	*8.048	1.605	0.818	2.423	0.832	11.302
1981-1982	4.142	1.117	5.260	3.081	1.354	4.435	0.557	10.252
1982-1983	3.995	1.000	4.995	3.974	1.864	*5.839	*2.006	12.840
1983-1984	5.779	1.509	*7.288	1.081	0.538	1.618	0.561	9.468
AVERAGE	4.458	1.165	5.623	2.372	1.086	3.458	0.997	10.079

Note: Figures with an asterisk show the water requirements in dry year.

TABLE F1-36. ESTIMATION OF IRRIGATION WATER REQUIREMENTS
(Total Area, Cropping Intensity: 200%)

UNIT ; MCM

CROP-YEAR	WET SEASON TRANS-PLANTED (HA) 4240	WET SEASON DIRECT SEEDED (HA) 1060	WET SEASON SUB-TOTAL (HA) 5300	DRY SEASON TRANS-PLANTED (HA) 2490	DRY SEASON DIRECT SEEDED (HA) 1050	DRY SEASON SUB-TOTAL (HA) 3540	DIVERSIFIED CROPS (HA) 1760	TOTAL DEMAND
1956-1957	22.786	5.994	*28.780	9.293	4.294	13.587	3.466	45.833
1957-1958	23.197	5.954	29.151	13.737	6.354	*20.091	4.307	53.549
1958-1959	19.767	5.085	24.852	11.461	5.532	16.994	3.122	44.967
1959-1960	18.113	4.670	22.784	13.302	6.187	*19.488	4.602	46.874
1960-1961	20.297	5.440	25.737	8.409	4.246	12.655	3.887	42.279
1961-1962	9.790	2.699	12.489	7.206	3.535	10.741	4.419	27.650
1962-1963	17.227	4.450	21.677	8.765	3.948	12.713	3.784	38.174
1963-1964	19.271	5.046	24.316	14.210	6.498	20.709	4.400	49.425
1964-1965	22.574	5.817	*28.391	7.577	3.195	10.772	2.655	41.819
1965-1966	23.205	6.028	29.234	14.300	6.673	*20.973	5.249	55.455
1966-1967	22.951	6.113	29.064	7.714	3.550	11.264	4.001	44.329
1967-1968	30.685	7.957	*38.642	13.710	6.220	19.930	*4.700	63.272
1968-1969	20.895	5.940	26.835	14.459	6.923	21.382	*7.044	55.260
1969-1970	18.813	4.898	23.711	11.439	5.288	16.727	3.697	44.135
1970-1971	16.867	4.360	21.226	10.119	4.909	15.028	3.932	40.186
1971-1972	19.385	5.285	24.670	10.331	5.057	15.388	3.825	43.883
1972-1973	19.088	5.196	24.285	15.577	7.556	*23.133	*6.105	53.523
1973-1974	21.132	5.909	27.042	10.988	4.935	15.923	3.635	46.600
1974-1975	19.250	5.059	24.309	5.951	2.919	8.870	3.873	37.052
1975-1976	24.274	6.783	*31.057	11.183	5.417	16.600	4.946	52.602
1976-1977	14.938	4.018	18.956	6.885	3.451	10.336	3.844	33.136
1977-1978	16.642	4.447	21.089	10.610	5.002	15.612	4.494	41.195
1978-1979	21.705	5.506	27.210	14.036	6.687	*20.724	*5.702	53.636
1979-1980	13.530	3.524	17.054	10.015	4.957	14.972	*5.757	37.784
1980-1981	29.303	7.469	*36.771	7.403	3.902	11.305	3.659	51.735
1981-1982	18.885	5.149	24.034	14.208	6.462	20.670	2.453	47.157
1982-1983	18.215	4.608	22.823	18.326	8.899	*27.225	*8.829	58.877
1983-1984	26.347	6.954	33.301	4.982	2.567	7.550	2.470	43.320
AVERAGE	20.326	5.370	25.696	10.936	5.184	16.120	4.388	46.204

Note: Figures with an asterisk show the water requirements in dry year.

TABLE F1-37 IRRIGATION WATER REQUIREMENT FOR 100 HA (PHASE II AREA)
(DRY SEASON PADDY)

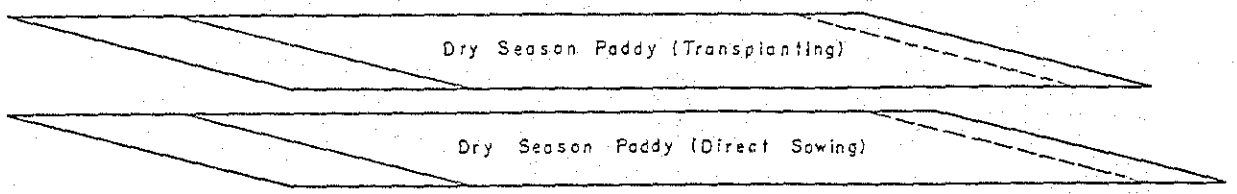
Item	Oct.			Nov.			Dec.			Jan.			Feb.			Mar.			Apr.			
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
Proposed Cropping Pattern																						
A. Transplanting Paddy (70%)																						
1. Cropping Area (ha)																						
Land Preparation			4.0	10.0	16.0	18.0	14.0	7.0	1.0	—	—	—	—	—	—	—	—					
Transplanting / Growing			—	—	2.0	18.0	35.0	53.0	66.0	70.0	70.0	70.0	70.0	61.0	44.0	26.0	9.0					
2. Water Requirement (mm)																						
Land Preparation Stage			170	170	170	170	170	170	170	—	—	—	—	—	—	—	—					
Transplanting / Growing Stage			—	—	59	59	54	54	59	63	63	69	60	60	48	69	69					
3 Effective Rainfall (mm)			23	41	29	27	46	41	24	37	23	40	27	28	22	28	17					Total = 453.0 mm.
4. Irrigation Efficiency (%)			55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8					
5. Diversion Water Demand (10^3 m^3)			10.5	23.1	41.5	56.5	36.1	28.5	44.0	32.6	50.2	36.4	41.4	35.0	20.5	19.1	8.4					Total = 483.8 x 10^3 m^3
B. Direct Sowing Paddy (30%)																						
1. Cropping Area (ha)																						
Land Preparation			1.0	4.0	7.0	8.0	6.0	3.0	1.0	—	—	—	—	—	—	—	—	—				
Growing Stage			—	—	1.0	8.0	15.0	23.0	28.0	30.0	30.0	30.0	30.0	30.0	26.0	19.0	11.0	4.0				
2. Water Requirement (mm)																						
Land Preparation			170	170	170	170	170	170	170	—	—	—	—	—	—	—	—	—				
Transplanting / Growing			—	—	59	59	54	54	59	63	63	69	60	60	48	69	69	76				
3 Effective Rainfall (mm)			23	41	29	27	46	41	24	37	23	40	27	28	22	28	17	20				Total = 473 mm
4. Irrigation Efficiency (%)			55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8				
5. Diversion Water Demand (10^3 m^3)			2.6	9.2	18.2	25.1	15.5	12.3	20.2	14.0	21.5	15.6	17.7	17.2	12.1	14.0	10.3	4.0				Total = 229.5 x 10^3 m^3
C. Total Diversion Demand (10^3 m^3)			13.1	32.3	59.7	81.6	51.6	40.8	64.2	46.6	71.7	52.0	59.1	52.2	32.6	33.1	18.7	4.0				Total = 713.3 x 10^3 m^3

TABLE FI-38

IRRIGATION WATER REQUIREMENT FOR 100 HA (PHASE II AREA)
(WET SEASON PADDY)

Item	May			June			July			Aug.			Sep.			Oct.			Nov.		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Proposed Cropping Pattern	Wet Season paddy (Transplanting)																				
	Wet Season Paddy (Direct Sowing)																				
A. Transplanting Paddy (80%)																					
1. Cropping Area (ha)																					
Land Preparation			4.0	12.0	18.0	20.0	16.0	8.0	2.0	—	—	—	—	—	—	—	—				
Transplanting / Growing			—	—	2.0	20.0	40.0	60.0	75.0	80.0	80.0	80.0	80.0	70.0	50.0	30.0	10.0				
2. Water Requiement (mm)																					
Land Preparation Stage			210	210	210	210	210	210	210	—	—	—	—	—	—	—	—				
Transplanting / Growing Stage			—	—	67	67	65	65	72	66	66	73	58	58	58	58	58				
3. Effective Rainfall (mm)			20	53	44	37	64	33	43	47	40	25	29	45	47	44	55		Total = 626 mm		
4. Irrigation Efficiency (%)			53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6				
5. Diversion Water Demand (10^3 m^3)			14.2	35.1	56.6	75.7	44.3	62.2	46.8	28.4	38.8	71.6	43.3	17.0	10.3	7.8	0.6		Total = 5527 x 10^3 m^3		
B. Direct Sowing Paddy. (20%)																					
1. Cropping Area (ha)																					
Land Preparation			1.0	3.0	4.0	5.0	4.0	2.0	1.0	—	—	—	—	—	—	—	—	—			
Transplanting / Growing			—	—	1.0	5.0	10.0	15.0	19.0	20.0	20.0	20.0	20.0	20.0	18.0	13.0	8.0	2.0			
2. Water Requirement (mm)																					
Land Preparation Stage			210	210	210	210	210	210	210	—	—	—	—	—	—	—	—	—			
Growing Stage			—	—	67	67	65	65	72	66	66	73	58	58	58	58	58	58			
3. Effective Rainfall (mm)			20	53	44	37	64	33	43	47	40	25	29	45	47	44	55	28	Total = 654. mm		
4. Irrigation Efficiency (%)			53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6			
5. Diversion Water Demand (10^3 m^3)			3.5	8.8	12.8	18.8	11.1	15.6	13.4	7.1	9.7	17.9	10.8	4.9	3.7	3.4	0.4	1.1	Total = 143.0 x 10^3 m^3		
C. Total Diversion Demand (10^3 m^3)			17.7	43.9	69.4	94.5	55.4	77.8	60.2	35.5	48.5	89.5	54.1	21.9	14.0	11.2	1.0	1.1	Total = 695.7 x 10^3 m^3		

TABLE FI-39 IRRIGATION WATER REQUIREMENT FOR 100HA (PHASE II AREA)
(UPLAND CROPS)

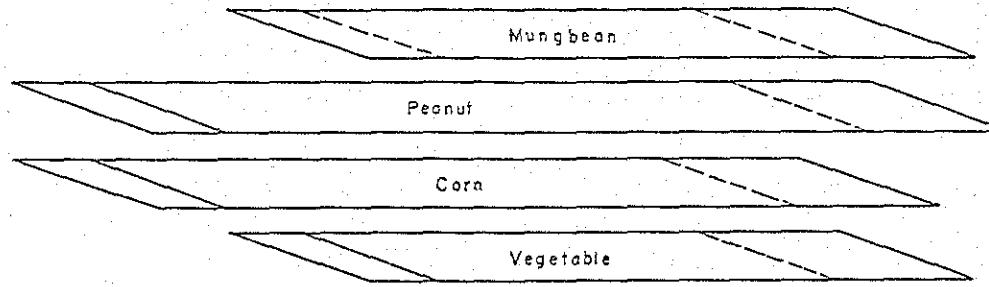
Item	Dec.			Jan.			Feb.			Mar.			Apr.			May			June		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Proposed Cropping Pattern																					
1 Cropping Area (ha)																					
Mungbean			—	—	—	6.3	18.8	25.0	25.0	25.0	23.5	12.5	1.6								
Peanut			6.3	18.8	25.0	25.0	25.0	25.0	25.0	25.0	25.0	18.8	6.3								
Corn			6.3	18.8	25.0	25.0	25.0	25.0	25.0	25.0	18.8	6.3	—								
Vegetable			—	—	—	6.3	18.8	25.0	25.0	25.0	23.5	12.5	1.6								
2. Water Requirement (mm)																					
Mungbean			—	—	—	20.6	21.3	24.9	24.8	42.6	45.0	48.2	21.0								
Peanut			19.3	20.0	21.6	27.3	31.5	35.9	30.2	44.8	42.7	36.6	27.2								
Corn			19.3	20.0	22.0	28.7	34.5	39.4	33.6	50.0	49.2	46.4	—								
Vegetable			—	—	—	19.8	21.1	25.1	24.9	43.1	45.0	49.2	18.0								
3. Effective Raintall (mm)			24.3	40.0	22.7	29.2	35.1	23.1	10.7	33.4	8.9	17.8	5.5						Total = 250.7 mm		
4. Irrigation Efficiency (%)			42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1								
5. Diversion Water Requirement (10^3 m^3)			0	0	0	0	0	19.5	42.0	27.9	78.4	31.0	4.3						Total = 203.1×10^3 m^3		

TABLE F1-40 MAXIMUM 10-DAY IRRIGATION WATER REQUIREMENTS DURING LAND PREPARATION AND CROP GROWING PERIODS

Year	Land Soaking and Preparation Period				Crop Growing Period			
	Bayongan System (MCM)	Capayas System (MCM)	Total MCM	Total ℓ/sec/ha	Bayongan System (MCM)	Capayas System (MCM)	Total MCM	Total ℓ/sec/ha
1956-1957	4.84	1.36	6.20	1.354	4.84	1.36	6.20	1.354
1957-1958	1.51	0.43	1.94	0.424	4.69	1.31	6.00	1.310
1958-1959	2.68	0.75	3.43	0.749	4.50	1.26	5.76	1.258
1959-1960	1.70	0.48	2.18	0.476	4.51	1.26	5.77	1.260
1960-1961	5.84	1.64	7.48	1.634	5.84	1.66	7.50	1.489
1961-1962	2.21	0.62	2.83	0.618	2.77	0.78	3.55	0.705
1962-1963	0.19	0.05	0.24	0.052	4.17	1.17	5.34	1.166
1963-1964	3.33	0.93	4.26	0.930	5.08	1.42	6.50	1.420
1964-1965	4.57	1.28	5.85	1.278	4.57	1.28	5.85	1.161
1965-1966	3.04	0.85	3.89	0.850	3.99	1.12	5.11	1.116
1966-1967	0	0	0	0	4.39	1.23	5.62	1.116
1967-1968	0.02	0.01	0.03	0.007	5.12	1.44	6.56	1.302
1968-1969	2.49	0.70	3.19	0.697	5.44	1.53	6.97	1.384
1969-1970	0	0	0	0	4.42	1.24	5.66	1.124
1970-1971	1.54	0.43	1.97	0.430	2.90	0.81	3.71	0.736
1971-1972	0	0	0	0	5.38	1.51	6.89	1.368
1972-1973	2.82	0.79	3.61	0.788	4.14	1.16	5.30	1.157
1973-1974	0	0	0	0	5.10	1.43	6.53	1.426
1974-1975	0.23	0.07	0.30	0.066	5.05	1.42	6.47	1.413
1975-1976	2.98	0.84	3.82	0.834	4.87	1.37	6.24	1.239
1976-1977	2.48	0.67	3.15	0.688	3.49	0.98	4.47	0.976
1977-1978	0	0	0	0	4.31	1.21	5.52	1.096
1978-1979	0	0	0	0	4.54	1.27	5.81	1.269
1979-1980	0	0	0	0	3.93	1.10	5.03	1.098
1980-1981	1.66	0.47	2.13	0.465	4.78	1.34	6.12	1.336
1981-1982	5.11	1.43	6.54	1.428	5.11	1.43	6.54	1.428
1982-1983	0	0	0	0	3.88	1.09	4.97	1.085
1983-1984	4.57	1.28	5.85	1.278	4.57	1.28	5.85	1.278

Note; 1) Above figures show the maximum irrigation requirements in case of cropping intensity of 200 percent
2) Underlined figures show the maximum irrigation water requirements exceeding design unit discharge of 1.422 ℓ/sec/ha

1.2 Irrigation for Upland Crop

1.2.1 Measurements of Intake Rate

Intake rates at upland fields have been measured at six sites in the project area, in order to plan an adequate irrigation method and amounts to be supplied to the crop.

Following table gives the obtained basic intake rate, based on the observation of the rate.

Obtained Basic Intake Rate (Ib)

Location	Ib (mm/hr)	Remarks
1. Cambangay Norte, San Miguel	-	-
2. La Union, Trinidad	70.0	Wet Conditions
3. Mahagbo, Ubay	18.3	- do -
4. Bayang, Ubay	1.7	- do -
5. Hambabauran, Ubay	106.8	Dry Conditions
6. Corazon, San Miguel	160.2	- do -
7. Gabi, Ubay	35.7	Wet Conditions

Location of measuring sites and detailed calculation of basic intake rates are shown in FIGURE F1-5 to FIGURE F1-11.

1.2.2 Depth and Interval of Irrigation Application

In parallel with the above mentioned intake rate measurements, soil samples in the depth of 50 cm with an interval of 10 cm depth were taken at seven sites to analyze the physical properties of the soil in the field, such as specific gravity, property, field capacity and wilting point. TABLE F1-41 shows the results of soil tests.

Based upon the obtained soil analysis data, i) available moisture of each soil layer within effective root zone, ii) Total Readily Available Moisture (TRAM) and iii) depth and interval of irrigation application have been calculated as shown in TABLE F1-42 to TABLE F1-45 in each crop.

TABLE F1-41 PHYSICAL FEATURES OF SOIL FOR UPLAND IRRIGATION

Location	Condition	Soil Depth (cm)	Real Specific Gravity(Sr) (g/cm^3)	Aparent Specific Gravity(Sa) (g/cm^3)	Porosity(P) 1/ (%)	Field Capacity(Fc) (%)	Wilting Point(Wp) (%)
1. Cambangay Norte	Wet Condition	10	2.64	1.39	47.35	15.67	7.43
		20	2.67	1.34	49.81	19.97	9.03
		30	2.66	1.19	55.26	25.22	13.59
		40	2.68	1.06	60.45	23.14	11.25
		50	2.60	1.69	35.00	25.30	13.51
2. La Union	Wet Condition	10	2.70	1.65	38.89	10.57	4.98
		20	2.70	1.60	40.74	10.81	5.02
		30	2.67	1.37	48.69	16.12	7.73
		40	2.63	1.24	52.85	19.63	9.45
		50	2.68	1.18	55.97	21.41	10.32
3. Mahagbo	Wet Condition	10	2.64	1.36	48.48	15.36	8.05
		20	2.70	1.49	44.81	15.20	7.81
		30	2.70	1.42	47.41	16.75	8.38
		40	2.70	1.43	47.04	18.62	7.92
		50	2.70	1.30	51.85	20.47	9.32
4. Bayang	Wet Condition	10	2.64	1.57	40.53	13.01	5.12
		20	2.70	1.57	41.85	12.82	5.30
		30	2.69	1.44	46.47	15.32	6.75
		40	2.70	1.37	49.26	20.90	10.40
		50	2.65	1.16	56.23	26.50	11.35
5. Hambabauran	Dry Condition	10	2.60	1.39	46.54	12.80	6.59
		20	2.61	1.39	46.74	12.51	5.05
		30	2.62	1.57	40.08	14.05	6.41
		40	2.60	1.59	38.85	14.52	5.72
		50	2.70	1.69	37.41	13.59	6.98
6. Corazon	Wet Conditions	10	2.59	1.59	38.61	11.19	5.28
		20	2.70	1.29	52.22	12.21	5.82
		30	2.71	1.22	54.98	11.52	6.35
		40	2.59	1.17	54.83	13.05	5.15
		50	2.59	1.08	58.30	16.26	8.27
7. Gabi	Dry Conditions	10	2.61	1.39	46.74	9.78	4.38
		20	2.68	1.53	42.91	8.21	5.03
		30	2.64	1.58	40.15	9.52	4.35
		40	2.68	1.71	36.19	9.61	5.38
		50	2.61	1.51	42.15	11.51	6.28
Average		10	2.63	1.48	43.73	12.63	5.98
		20	2.68	1.46	45.52	13.10	6.15
		30	2.67	1.40	47.56	15.50	7.65
		40	2.65	1.37	48.30	17.07	7.90
		50	2.65	1.37	48.30	19.29	9.43

Note: 1/: $P = (Sr-Sa) / Sr \times 100$

TABLE F1-42 NET AMOUNT OF WATER TO BE REPLACED FOR CROPS (MUNGBEAN)

Design Moisture-Extraction Depth : 80 cm

(1) Depth (cm)	(2) Available Moisture (AM) [1/] (mm)	(3) Ratio of Moisture Extraction	(4) (2)/(3) (mm)	(5) Restricting Layer of Moisture	(6) TRAM [2/] (mm)	(7) Net Amount of Water to be Replaced (mm)
0-20	23.0	0.4	57.6	*	57.6	57.6
20-40	23.0	0.3	76.6			
40-60	23.0	0.2	115.0			
60-80	23.0	0.1	230.0			

Note: 1/: $AM = \frac{1}{100} (Fc - Wp).Sa.D$

Fc: Field Capacity (%)

Wp: Wilting Point (%)

Sa: Aparent Specific Gravity (g/cm^3)

D: Depth (mm)

$$AM = \frac{1}{100} (15.5-7.4) \times 1.42 \times 200 = 23.0 \text{ mm}$$

2/: TRAM: Total Readily Available Moisture

TABLE F1-43 NET AMOUNT OF WATER TO BE REPLACED FOR CROPS (PEANUT)

Design Moisture-Extraction Depth : 60 cm

(1) Depth (cm)	(2) Available Moisture (AM)[1/] (mm)	(3) Ratio of Moisture Extraction	(4) (2)/(3) (mm)	(5) Restricting Layer of Moisture	(6) TRAM[2/] (mm)	(7) Net Amount of Water to be Replaced (mm)
0-15	17.3	0.4	43.3	*	43.3	47.3
15-30	17.3	0.3	57.7			
30-45	17.3	0.2	85.0			
45-60	17.3	0.1	173.0			

Note: 1/: $AM = \frac{1}{100} (Fc - Wp).Sa.D$

Fc: Field Capacity (%)

Wp: Wilting Point (%)

Sa: Aparent Specific Gravity (g/cm^3)

D: Depth (mm)

$$AM = \frac{1}{100} (15.5-7.4) \times 1.42 \times 150 = 17.3 \text{ mm}$$

2/: TRAM: Total Readily Available Moisture

TABLE F1-44 NET AMOUNT OF WATER TO BE REPLACED FOR CROPS (CORN)

Design Moisture-Extraction Depth : 120 cm

(1) Depth (cm)	(2) Available Moisture (AM) (mm) [1/]	(3) Ratio of Moisture Extraction	(4) (2)/(3) (mm)	(5) Restricting Layer of Moisture	(6) TRAM [2/] (mm)	(7) Net Amount of Water to be Replaced (mm)
0-30	34.5	0.4	86.3	*	86.3	86.3
30-60	34.5	0.3	115.0			
60-90	34.5	0.2	172.5			
90-120	34.5	0.1	345.0			

Note: 1/: $AM = \frac{1}{100} (Fc - Wp).Sa.D$

Fc: Field Capacity (%)

Wp: Wilting Point (%)

Sa: Aparent Specific Gravity (g/cm^3)

D: Depth (mm)

$AM = \frac{1}{100} (15.5-7.4) \times 1.42 \times 300 = 43.5$ mm

2/: TRAM: Total Readily Available Moisture

TABLE F1-45 NET AMOUNT OF WATER TO BE REPLACED FOR CROPS (VEGETABLE)

Design Moisture-Extraction Depth : 40 cm

(1) Depth (cm)	(2) Available[1/] Moisture (AM) (mm)	(3) Ratio of Moisture Extraction	(4) (2)/(3) (mm)	(5) Restricting Layer of Moisture	(6) TRAM[2/] (mm)	(7) Net Amount of Water to be Replaced (mm)
0-10	11.5	0.4	28.8	*	28.8	28.8
10-20	11.5	0.3	38.3			
20-30	11.5	0.2	57.5			
30-40	11.5	0.1	115.0			

Note: 1/: $AM = \frac{1}{100} (Fc - Wp).Sa.D$

Fc: Field Capacity (%)

Wp: Wilting Point (%)

Sa: Aparent Specific Gravity (g/cm^3)

D: Depth (mm)

$$AM = \frac{1}{100} (15.5-7.4) \times 1.42 \times 100 = 11.5 \text{ mm}$$

2/: TRAM: Total Readily Available Moisture

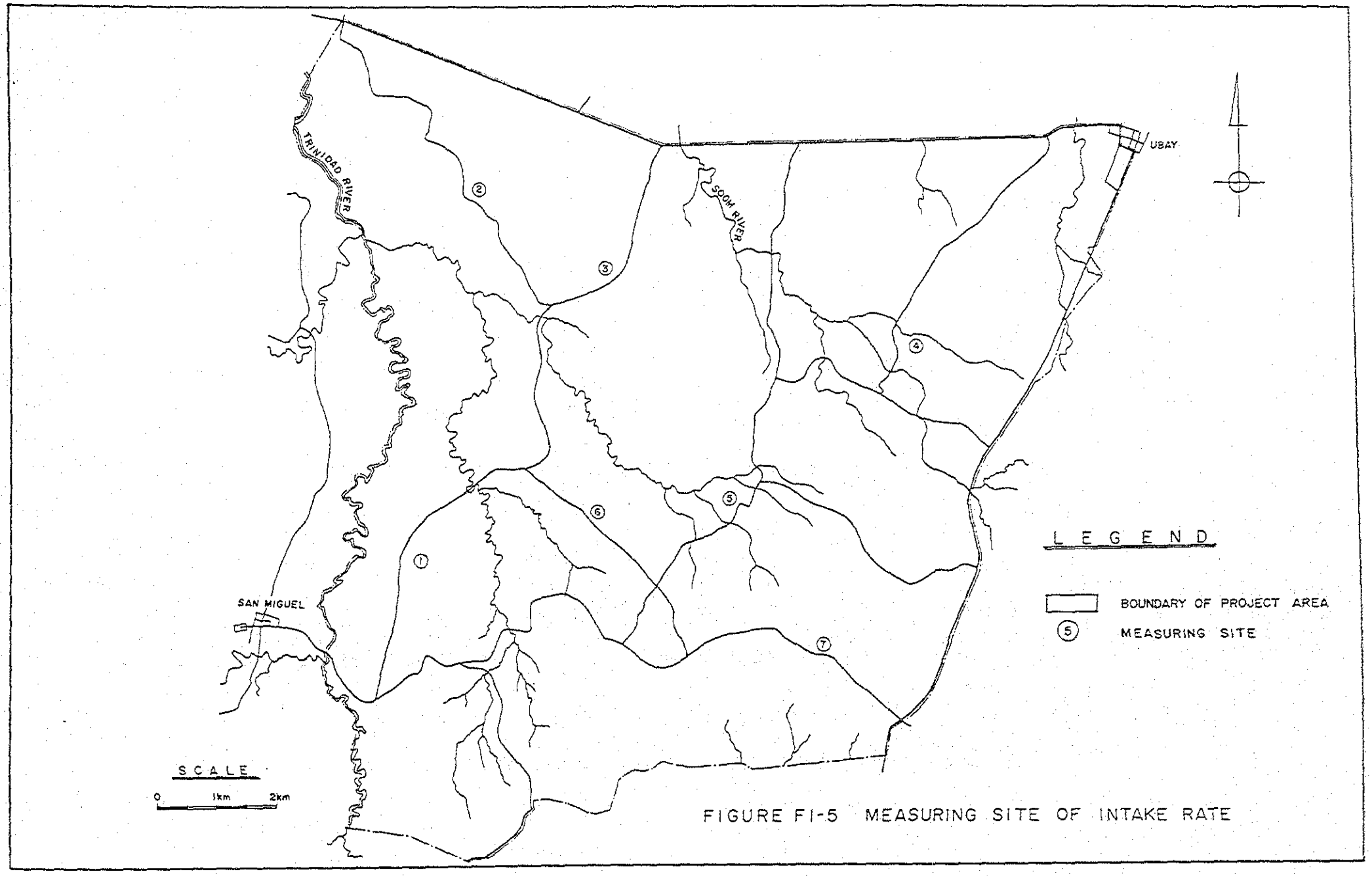


FIGURE FI-5 MEASURING SITE OF INTAKE RATE

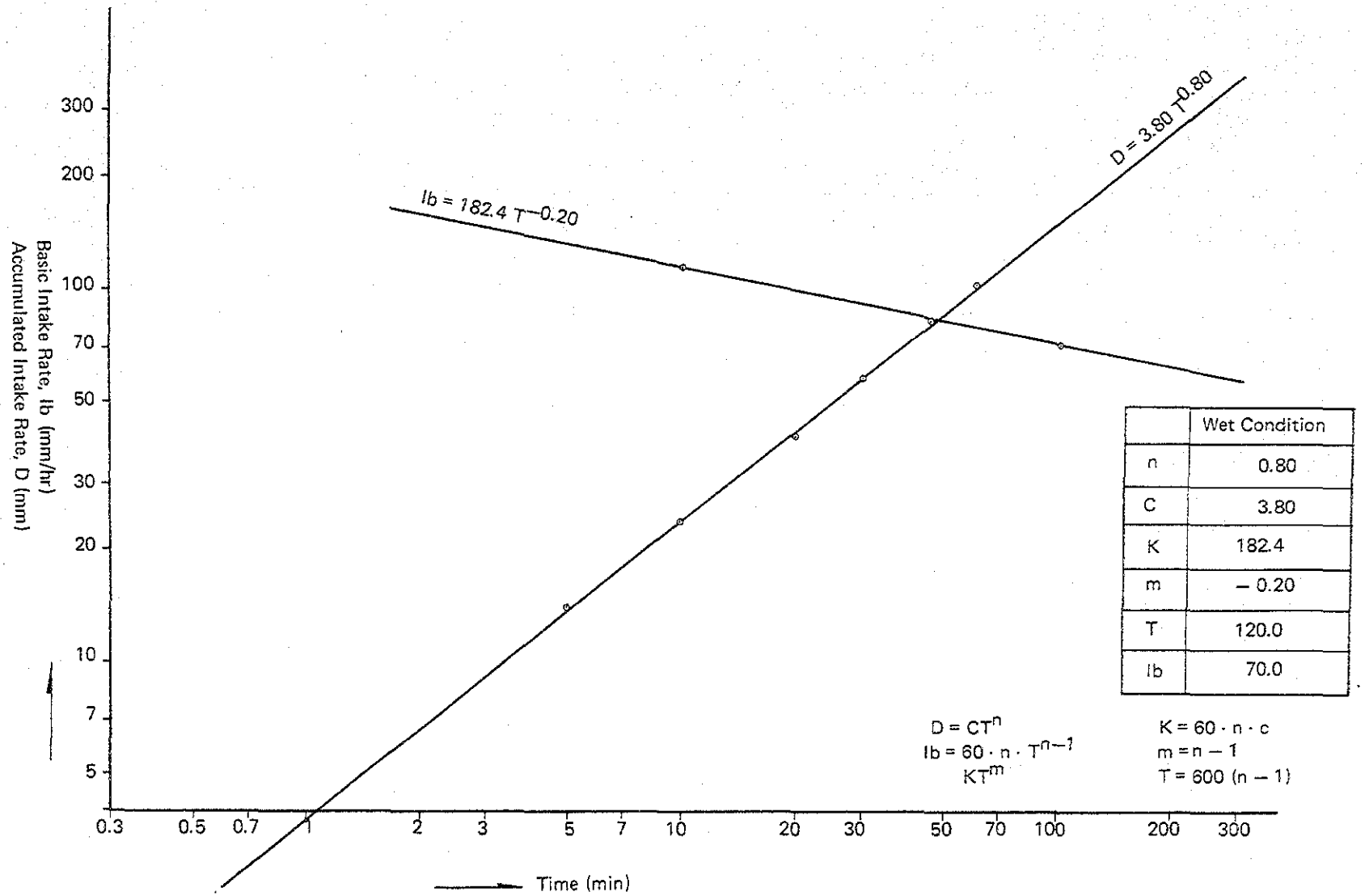
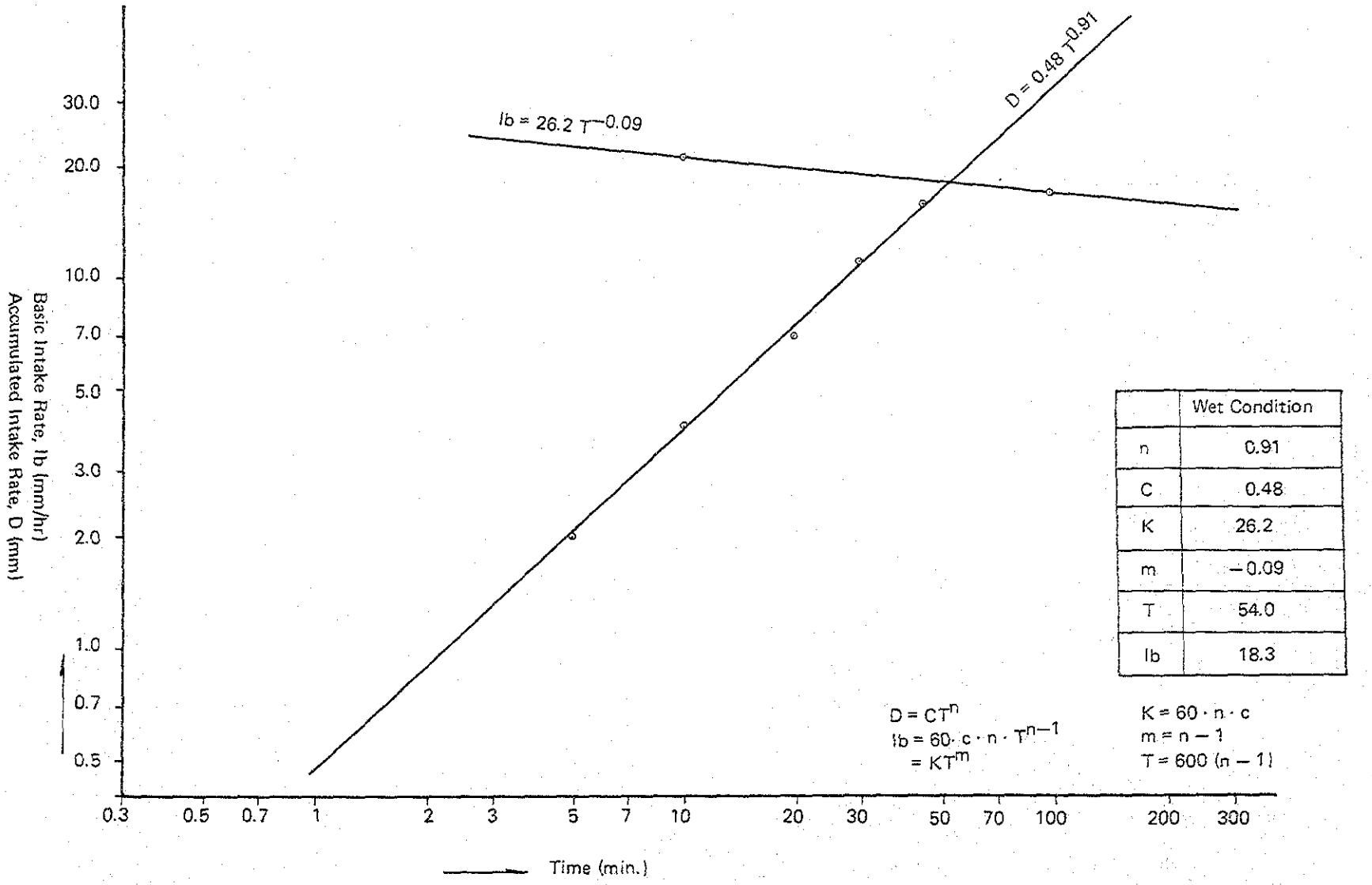
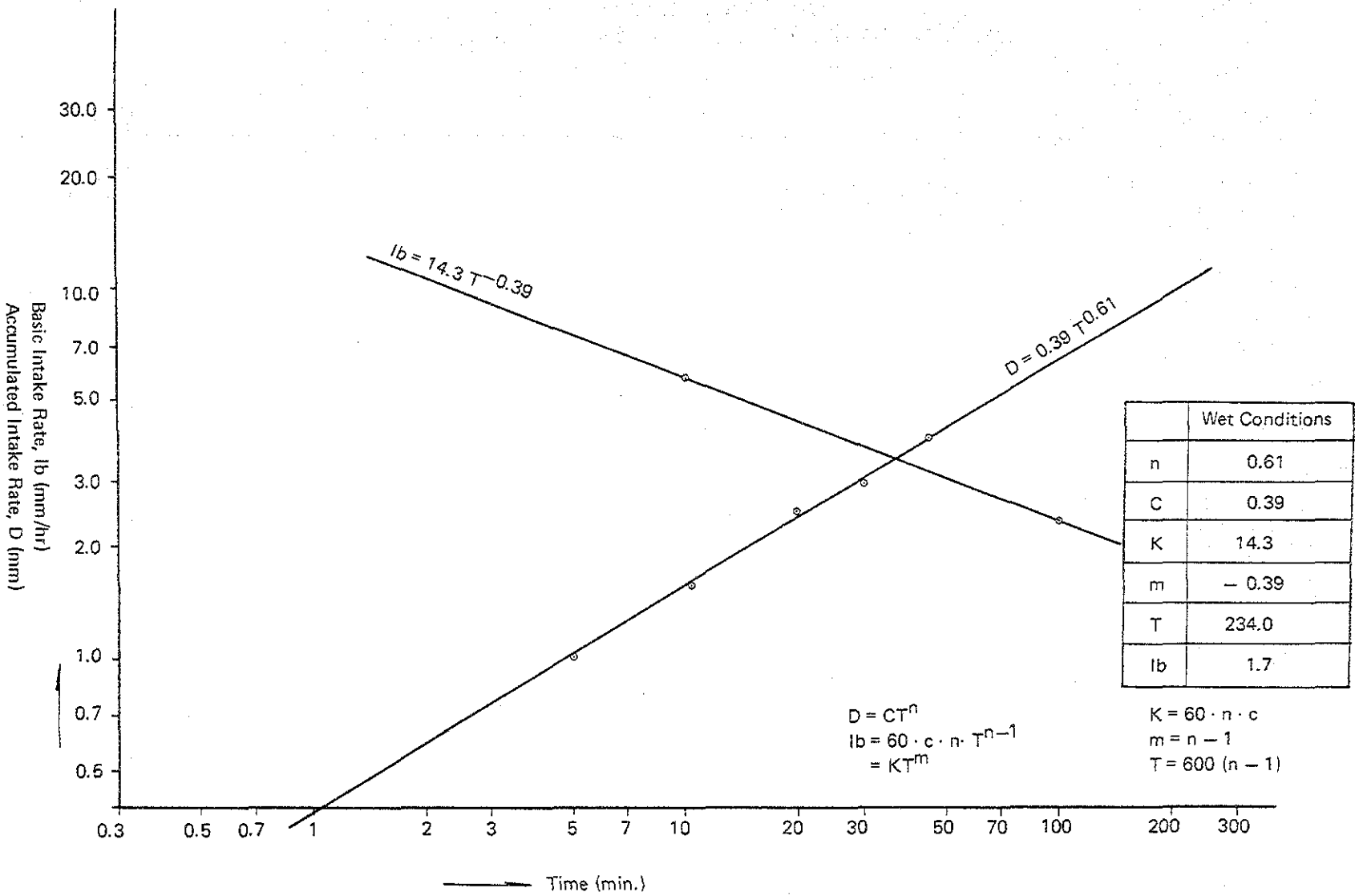


FIGURE F1–6 RESULT OF CYLINDER INTAKE RATE TEST (LA UNION, TRINIDAD)



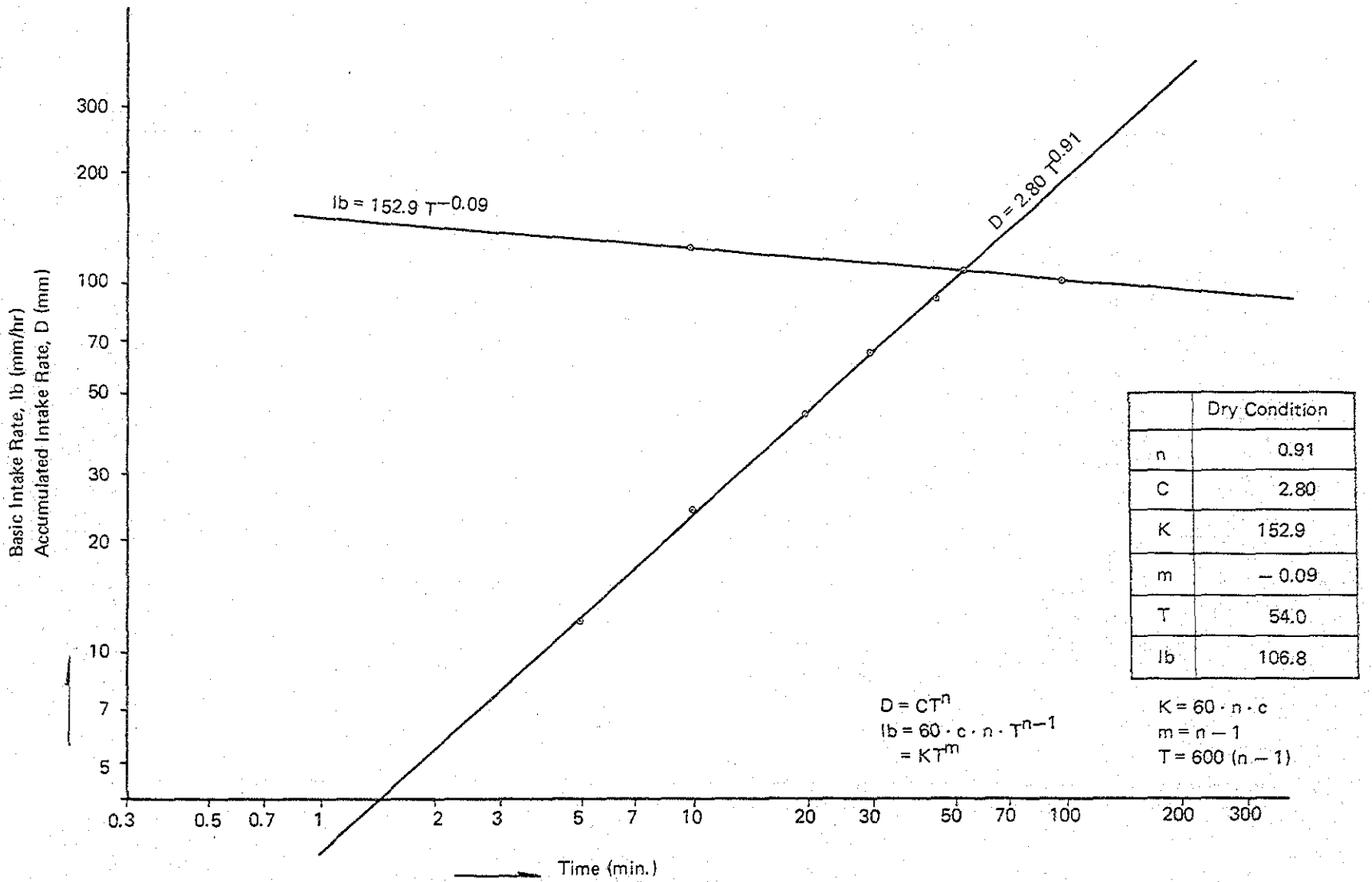
	Wet Condition
n	0.91
C	0.48
K	26.2
m	−0.09
T	54.0
Ib	18.3

FIGURE F1–7 RESULT OF CYLINDER INTAKE RATE TEST (MAHAGBO, UBAY)



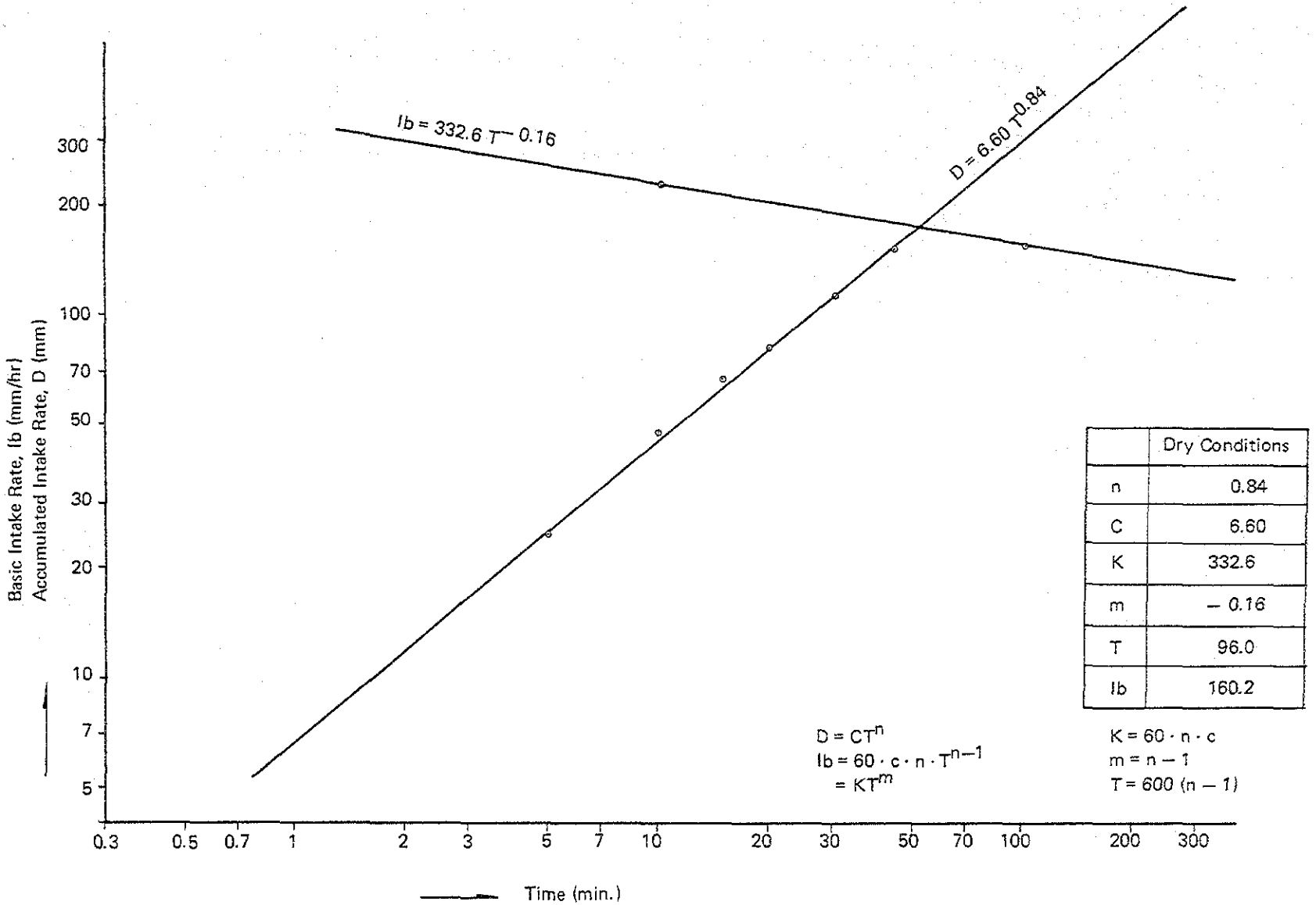
	Wet Conditions
n	0.61
C	0.39
K	14.3
m	− 0.39
T	234.0
Ib	1.7

FIGURE F1–8 RESULT OF CYLINDER INTAKE RATE TEST (BAYANG, UBAY)



	Dry Condition
n	0.91
C	2.80
K	152.9
m	− 0.09
T	54.0
Ib	106.8

FIGURE F1–9 RESULT OF CYLINDER INTAKE RATE TEST (HAMBABAURAN, UBAY)



	Dry Conditions
n	0.84
C	6.60
K	332.6
m	– 0.16
T	96.0
Ib	160.2

FIGURE F1–10 RESULT OF CYLINDER INTAKE RATE TEST (CORAZON, SAN MIGUEL)

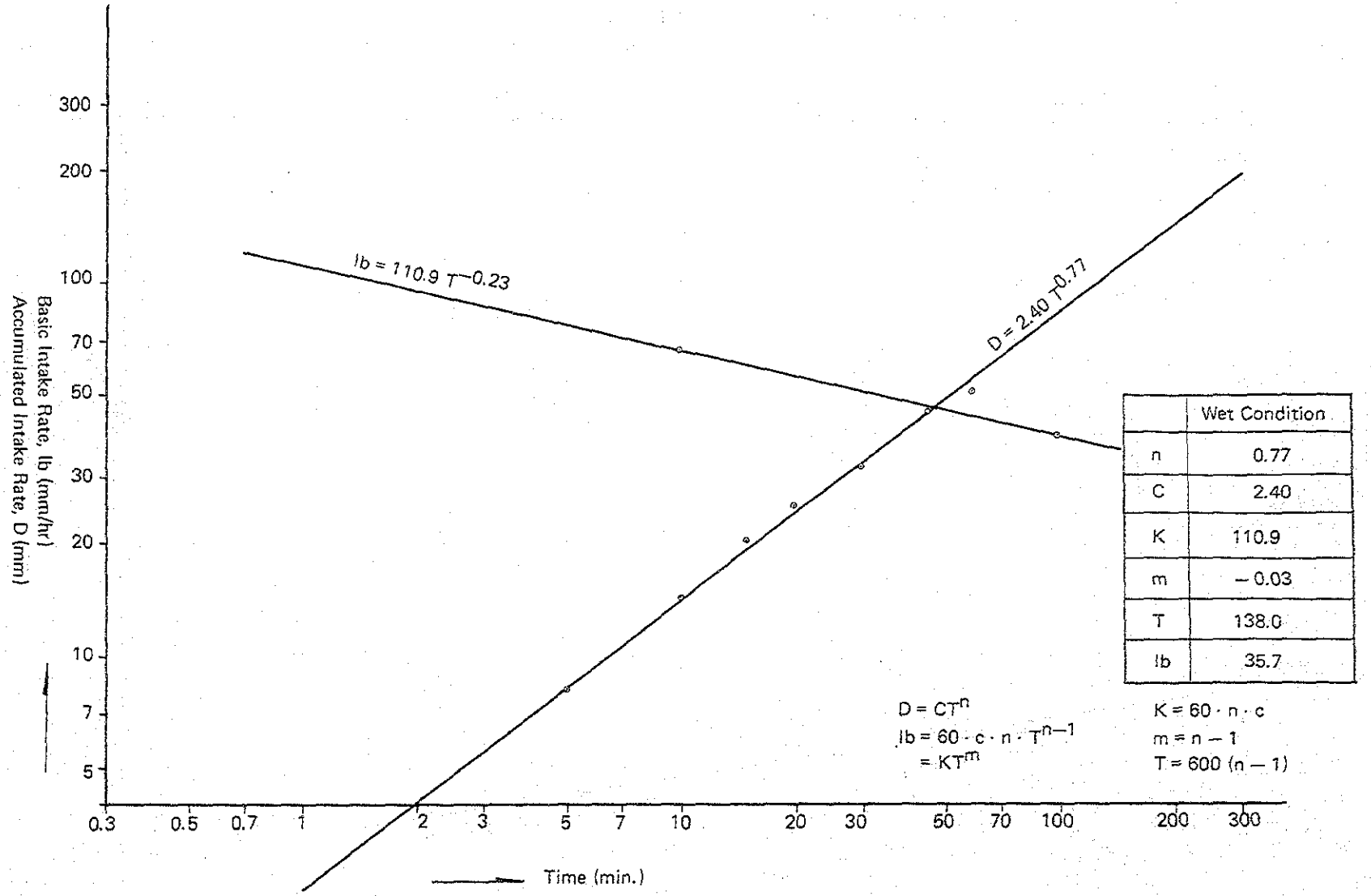


FIGURE F1–11 RESULT OF CYLINDER INTAKE RATE TEST (GABI, UBAY)

CHAPTER II DRAINAGE PLAN

2.1 Runoff Capacity of Present Drainage Rivers

In order to check the present runoff capacity of drainage creeks and rivers in the project area, typical cross sections of these creeks and rivers were measured at ten sites as shown in FIGURE F2-1 and their runoff capacities were calculated in TABLE F2-1.

As is seen in TABLE F2-1, runoff capacity of the rivers is about 80 mm/hr to 6.0 mm/hr in range, which is deemed to be enough large against the required runoff discharge of 3.0 mm/hr to 5.0 mm/hr in the paddy field. Therefore, existing creeks and rivers are basically planned to be no improvement in the project. However, some connecting drainage canals, which will function to convey the drainage discharge from paddy fields reclaimed to the existing drainage creeks and rivers, will be provided in the project.

2.2 Drainage Modulus

a) Rainfall Date for Drainage Study

There are two observation stations of hourly rainfall in the catchment area of the Malinao diversion dam, however, these data are not sufficient to use the analysis of drainage study, because of short observation periods, altough those stations have been installed during the Feasibility Study of Phase I Project. Therefore, design modulus for drainage was made based on the daily rainfall.1/

1/: For the reference, hourly rainfall data observed at Cebu are indicated in FIGURE F2-2 to FIGURE F2-4.

Regarding the daily observation data, three observation stations are provided in the project area, that is, Ubay (Central), Ubay (Bayang) and Ubay (Gabi). TABLE F2-2 to TABLE F2-4 show the maximum 1-day, 2-day and 3-day consecutive rainfall for these stations, and TABLE F2-5 presents the probable rainfalls for these data in cases of 1/2, 1/5 and 1/10 of return periods.

b) Design Drainage Modulus

All of the service area of 5,300 ha will be utilized for paddy cultivation during the wet season, and the maximum inundation period in the field can be considered to be two days from the viewpoint of paddy growing immediately after the transplanting. On this basis, the storm rainfall is planned to be drained during the two days in the field.

1-day maximum rainfalls with the return period of 1/5 observed at the both stations of Ubay (Bayang) and Ubay (Gabi) are selected as the design rainfall for planning drainage modulus. Out of three rainfall stations mentioned above, since the station of Ubay (Central) is located on the coastal area, this station can not be considered to be a representative one with relatively low amounts of rainfall among three stations.

Consequently, design modulus for drainage can be calculated at 5.61 l/sec/ha as shown belows;

$$\frac{(93.0\ \text{mm} + 101.1\ \text{mm}) \times 10^{-3} \times 1.0\ \text{ha} \times 10^{4} \times 10^{3}}{2 \times 24\ \text{hr} \times 2\ \text{days} \times 3{,}600\ \text{sec}} = 5.61\ \text{l/sec/ha}$$

TABLE F2-1 RUNOFF CAPACITY OF PRESENT DRAINAGE RIVERS

No.[1/]	Name of River	Drainage Area(1)(ha)	Run-off Capacity A(sq.m) (2)	R(m) (3)	I (4)	V(m/s) (5)	Q(cu.m/sec) (6)=(2)x(5)	q(mm/hr) (7)=(6)/(1)
1	Trinidad							
2	Cambaygay Creek	486.4	37.6	26.0	1/330	2.01	75.6	55.9
3	Mahagbo Creek	158.1	25.0	24.0	1/450	1.38	34.5	78.5
4	Mahagbo Creek	284.1	35.8	35.0	1/600	1.19	42.6	54.0
5	Bayang Creek	343.5	6.7	7.0	1/350	1.48	9.9	10.4
6	Bayang River	1,677.0	40.2	23.0	1/570	1.74	69.8	15.0
7	Bayang River	2,913.0	30.0	16.0	1/640	1.72	51.5	6.4
8	Mahagbo Creek	2,125.1	33.3	19.0	1/340	2.25	74.9	12.7
9	Mahagbo Creek	1,329.8	20.7	16.0	1/570	1.42	29.4	7.9
10	Cambangay Creek	2,213.7	25.8	16.5	1/720	1.43	36.9	6.0
	Average	970.1	28.3	20.3	1/508	1.62	47.2	35.2

A: Cross sectional area (sq·m)
P: Wetted perimeter (m)
R: Hydraulic radius
I: Hydraulic gradient
V: Water velocity (m/sec) = $1/n \cdot R^{2/3} \cdot I^{1/2}$ (n=0.035)
Q: River discharge (cu·m/sec) = V·A
q: Runoff capacity (l/sec/ha) = Q/A
1/: Location is shown in FIGURE F2-1

TABLE F2-2 MAXIMUM 1-DAY, 2-DAY AND 3-DAY CONSECUTIVE RAINFALL

Station: Ubay (Central)

Year	1-Day Rainfall		2-Day Rainfall		3-Day Rainfall	
	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date
1956	47.9	Dec.27	68.9	Jan.12-13	97.1	Jan.11-13
1957	79.9	Feb. 1	88.7	Apr. 2- 3	90.8	Apr. 2- 4
1958	59.9	Apr.25	64.3	Jul. 8- 9	73.1	Jul. 8-10
1959	53.7	Jan. 8	88.8	Jan. 7- 8	88.9	Jan. 7- 9
1960	59.8	Apr.21	60.6	Jan.26-27	67.2	Jan.25-27
1961	41.2	Aug.12	61.3	Aug.12-13	61.3	Aug.12-14
1962	73.9	Nov.27	84.6	Nov.26-27	86.9	Nov.25-27
1963	65.2	Apr. 7	65.2	Apr. 7- 8	67.0	Apr. 7- 9
1964	211.3	Nov.19	252.4	Nov.18-19	258.6	Nov.17-19
1965	53.5	Jul. 1	70.1	Oct.18-19	79.4	Oct.18-20
1966	35.6	Oct.10	48.1	Jul.25-26	61.0	Jul.25-27
1967	46.3	Dec.17	64.5	Jan.18-19	79.7	Jan.18-20
1968	83.3	Dec. 2	88.5	Dec. 1- 2	91.5	Dec. 1- 3
1969	60.4	Mar. 8	73.0	Mar. 8- 9	73.0	Mar. 8-10
1970	42.7	May.10	42.8	Jul. 4- 5	55.0	Jul. 4- 6
1971	57.7	Oct.20	58.5	Oct.19-20	59.1	Oct.18-20
1972	74.3	Dec. 3	82.2	Dec. 2- 3	82.2	Dec. 2- 4
1973	85.2	Oct. 1	107.3	Nov.18-19	112.4	Nov.18-20
1974	81.3	Feb.12	83.9	Feb.11-12	89.5	Feb.11-13
1975	53.6	Oct.28	68.1	Dec.12-13	83.4	Dec.11-13
1976	54.1	Jan.23	98.8	Jan.22-23	118.9	Jan.21-23
1977	38.6	Oct.15	48.3	Oct.18-19	63.8	Oct.18-20
1978	35.6	Feb.21	43.9	Feb.21-22	51.8	Feb.20-22
1979	53.3	May 11	75.5	Oct. 8- 9	75.5	Oct. 8-10
1980	99.2	Jun.29	163.7	Feb.11-12	222.7	Feb.11-13
1981	79.3	Dec. 4	129.4	Dec. 3- 4	155.6	Dec. 2- 4
1982	77.0	Aug.19	87.4	Jul. 9-10	117.4	Jul. 8-10
1983	70.0	Dec.25	113.0	Dec.25-26	140.0	Dec.25-27
1984	69.7	Sep. 2	95.3	Sep. 1- 2	95.3	Sep. 1- 3
Average	67.01		85.41		96.47	

TABLE F2-3 MAXIMUM 1-DAY, 2-DAY AND 3-DAY CONSECUTIVE RAINFALL

Station: Ubay (Bayang)

Year	1-Day Rainfall		2-Day Rainfall		3-Day Rainfall	
	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date
1956	54.6	Dec.27	82.3	Jan.12-13	115.9	Jan.11-18
1957	95.2	Feb. 1	107.4	Apr. 2- 3	109.6	Apr. 2- 4
1958	83.8	Nov.19	99.1	Sep.21-22	139.7	Sep.20-22
1959	73.7	Jan. 7	114.3	Jul.22-23	129.5	Jul.21-23
1960	71.7	Apr.21	80.1	Nov.21-22	106.5	Nov.20-22
1961	61.0	Mar.27	59.7	Oct.16-17	78.7	Oct.15-17
1962	148.6	Nov.27	170.2	Nov.26-27	179.1	Nov.25-27
1963	63.5	Oct.13	63.5	Oct. 3- 4	111.8	Oct. 2- 4
1964	94.0	Feb.15	133.4	Feb.14-15	144.8	Oct.13-14
1965	88.9	Sep.19	116.8	Sep.18-19	119.3	Sep.18-20
1966	42.8	Sep.10	55.3	Jul.25-26	70.2	Jul.25-27
1967	55.1	Dec.17	73.6	Jan.18-19	90.9	Jan.17-19
1968	96.5	Dec. 2	136.1	Nov.18-19	137.6	Nov.17-19
1969	75.2	Mar. 8	90.9	Mar. 8- 9	90.9	Mar. 8-10
1970	54.7	May 10	62.9	Nov.23-24	65.1	Nov.23-25
1971	68.2	Oct.20	69.1	Oct.19-20	69.8	Oct.18-20
1972	89.8	Dec. 3	99.4	Dec. 2- 3	99.4	Dec. 2- 4
1973	102.5	Oct. 1	121.3	Nov.18-19	127.1	Nov.18-20
1974	94.9	Feb.12	129.4	Feb.11-12	135.9	Feb.11-13
1975	79.9	Aug.21	81.2	Aug.21-22	102.8	Aug.21-23
1976	62.6	Jan.23	79.5	Dec. 9-10	85.5	Dec. 9-11
1977	71.9	Dec. 1	90.2	Jan.26-27	90.7	Jan.26-28
1978	71.6	Jan. 2	88.1	Jun.25-26	109.3	Jun.25-27
1979	63.8	May 11	54.3	Apr.14-15	75.3	Apr.13-15
1980	58.9	May 14	82.4	Feb.13-14	108.0	Feb.13-15
1981	68.1	May 30	106.6	Dec. 1- 2	150.4	Dec. 1- 3
1982	74.2	Aug.17	82.2	Aug.17-18	98.1	Aug.17-19
1983	72.5	Mar. 7	56.3	Jun.24-25	86.3	Jun.24-26
1984	89.8	May 1	111.2	Sep. 1- 2	111.2	Sep. 1- 3
Average	76.81		92.99		108.25	

TABLE F2-4 MAXIMUM 1-DAY, 2-DAY AND 3-DAY CONSECUTIVE RAINFALL

Station: Ubay (Gabi)

Year	1-Day Rainfall		2-Day Rainfall		3-Day Rainfall	
	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date
1956	69.0	Dec.27	91.3	Jan.12-13	131.1	Jan.11-13
1957	108.2	Feb. 1	117.7	Apr. 2- 3	120.1	Apr. 2- 4
1958	78.7	Jul. 8	89.1	Jul. 8- 9	101.3	Jul. 8-10
1959	74.6	Jan. 8	127.4	Jan. 7- 8	127.4	Jan. 7- 9
1960	80.4	Apr.21	84.2	Jan.26-27	93.8	Jan.25-27
1961	55.5	Sep. 5	71.6	Jul. 3- 4	84.4	Jul. 3- 5
1962	105.5	Nov.27	120.8	Nov.26-27	124.0	Nov.25-27
1963	80.1	Apr. 7	67.7	Jan. 6- 7	85.8	Jan. 5- 7
1964	88.9	Feb.14	375.4	Nov.18-19	384.6	Nov.17-19
1965	71.4	Jul. 1	100.6	Jan.15-16	108.7	Jan.14-16
1966	50.5	Oct.10	68.5	Jul.25-26	86.9	Jul.25-27
1967	62.8	Dec.17	92.7	Jan.18-19	114.5	Jul.17-19
1968	117.4	Dec. 2	169.6	Nov.18-19	171.4	Nov.17-19
1969	76.6	Mar. 8	92.5	Mar. 8- 9	92.5	Mar. 8-10
1970	51.7	May 10	57.2	Oct.26-27	76.7	Oct.25-27
1971	79.0	Oct.20	80.1	Oct.19-20	80.9	Oct.18-20
1972	98.8	Dec. 3	109.3	Dec. 2- 3	109.3	Dec. 2- 4
1973	114.0	Nov.18	156.4	Nov.18-19	163.9	Nov.18-20
1974	113.5	Feb.12	154.8	Feb.11-12	162.6	Feb.11-13
1975	88.4	Aug.21	89.8	Aug.21-22	113.7	Aug.21-23
1976	75.5	Jan.23	97.6	Dec. 9-10	105.0	Dec. 9-11
1977	74.2	Jan.26	110.8	Jan.26-27	111.4	Jan.26-28
1978	88.9	Dec. 3	156.3	Dec. 2- 3	163.9	Dec. 1- 3
1979	79.8	Nov.28	96.3	Nov.27-28	96.3	Nov.26-28
1980	117.4	Oct.28	193.8	Oct.27-28	194.6	Oct.26-28
1981	114.8	Sep.28	163.2	Dec. 3- 4	184.5	Dec. 2- 4
1982	89.4	Mar.26	159.5	Mar.25-26	160.5	Mar.24-26
1983	85.8	Jul.13	116.3	Jul.12-13	116.3	Jul.11-13
1984	113.3	Oct. 3	133.1	Sep. 1- 2	133.1	Sep. 1- 3
Average	86.34		122.19		130.98	

TABLE F2-5 PROBABLE RAINFALL FOR 1-DAY, 2-DAY AND 3-DAY CONSECUTIVE RAINFALL[1/]

(Unit: mm)

Stations	1-Day Rainfall			2-Day Rainfall			3-Day Rainfall		
	1/2	1/5	1/10	1/2	1/5	1/10	1/2	1/5	1/10
Ubay (Central)	60.0	79.0	92.0	77.3	107.6	129.2	84.3	118.7	146.3
Ubay (Bayang)	75.8	93.0	102.3	89.5	114.7	130.2	106.3	130.1	143.7
Ubay (Gabi)	84.0	101.1	111.0	108.8	151.1	179.7	120.1	160.4	188.7

1/: Rainfall records of 29 years, 1956-1984

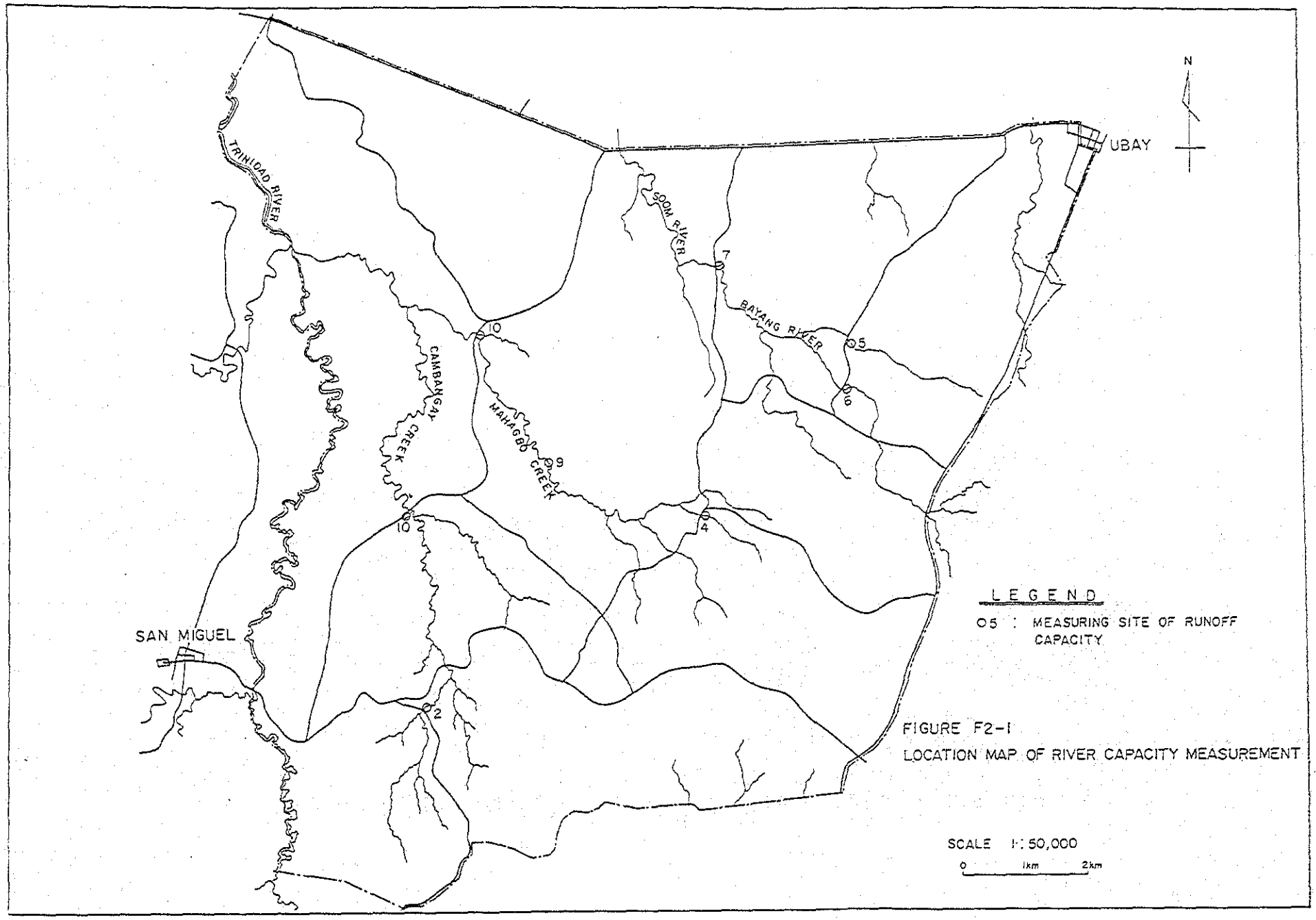
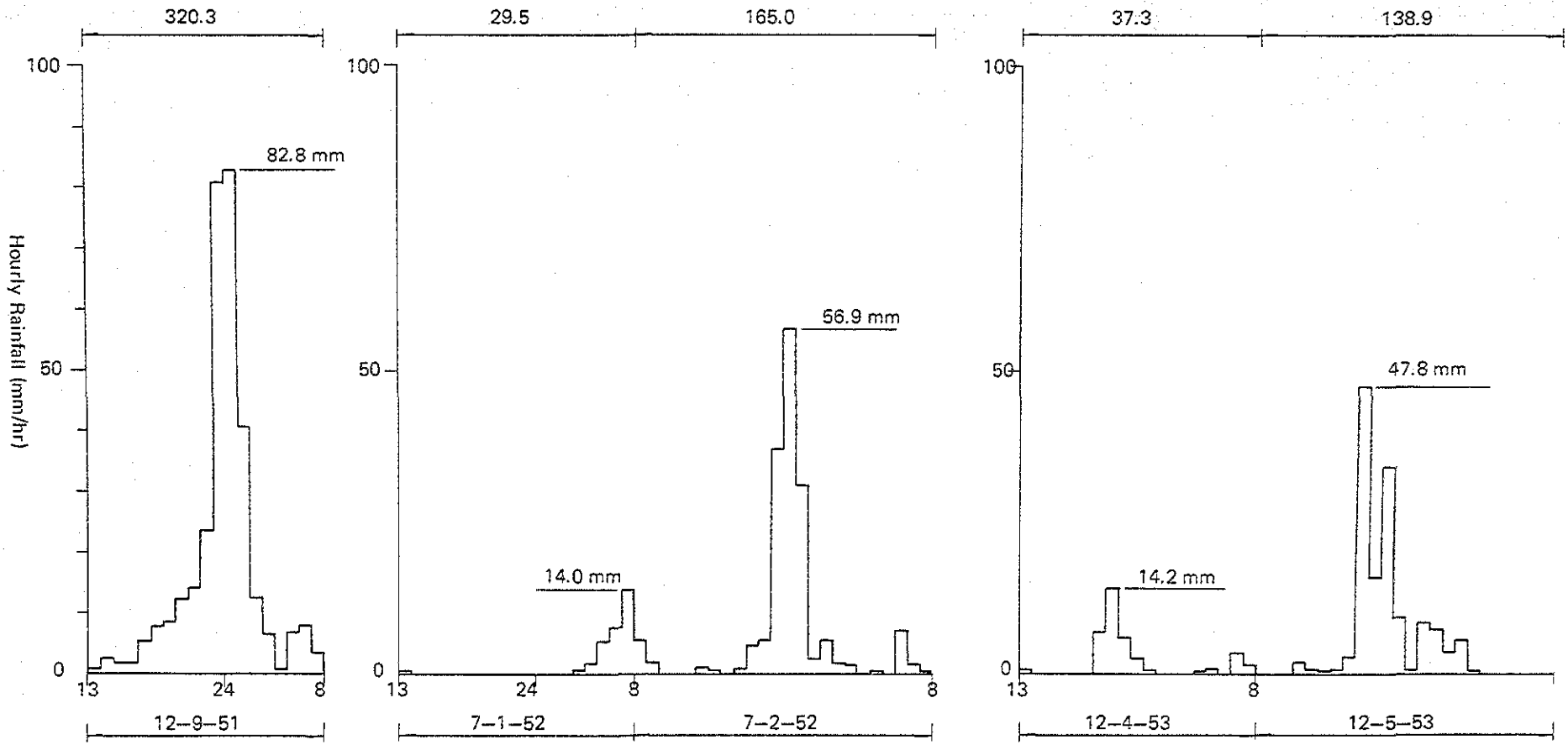


FIGURE F2-1
LOCATION MAP OF RIVER CAPACITY MEASUREMENT

FIGURE F2–2 HOURLY RAINFALL PATTERN (CEBU STATION) (1)



Source: Appendix I, Hydrology, Bohol Irrigation Project–Stage I.

FIGURE F2-3 HOURLY RAINFALL PATTERN (CEBU STATION) (2)

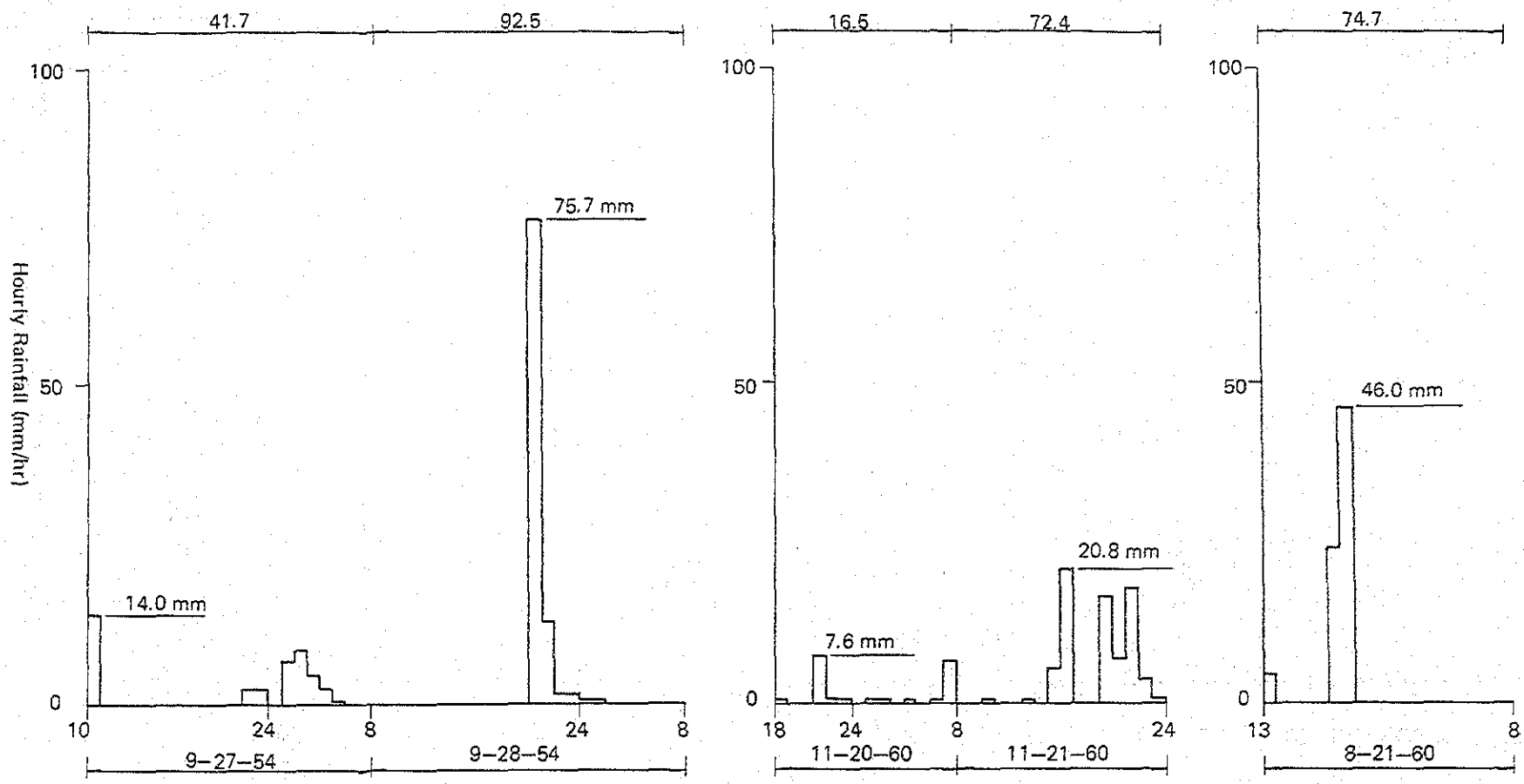
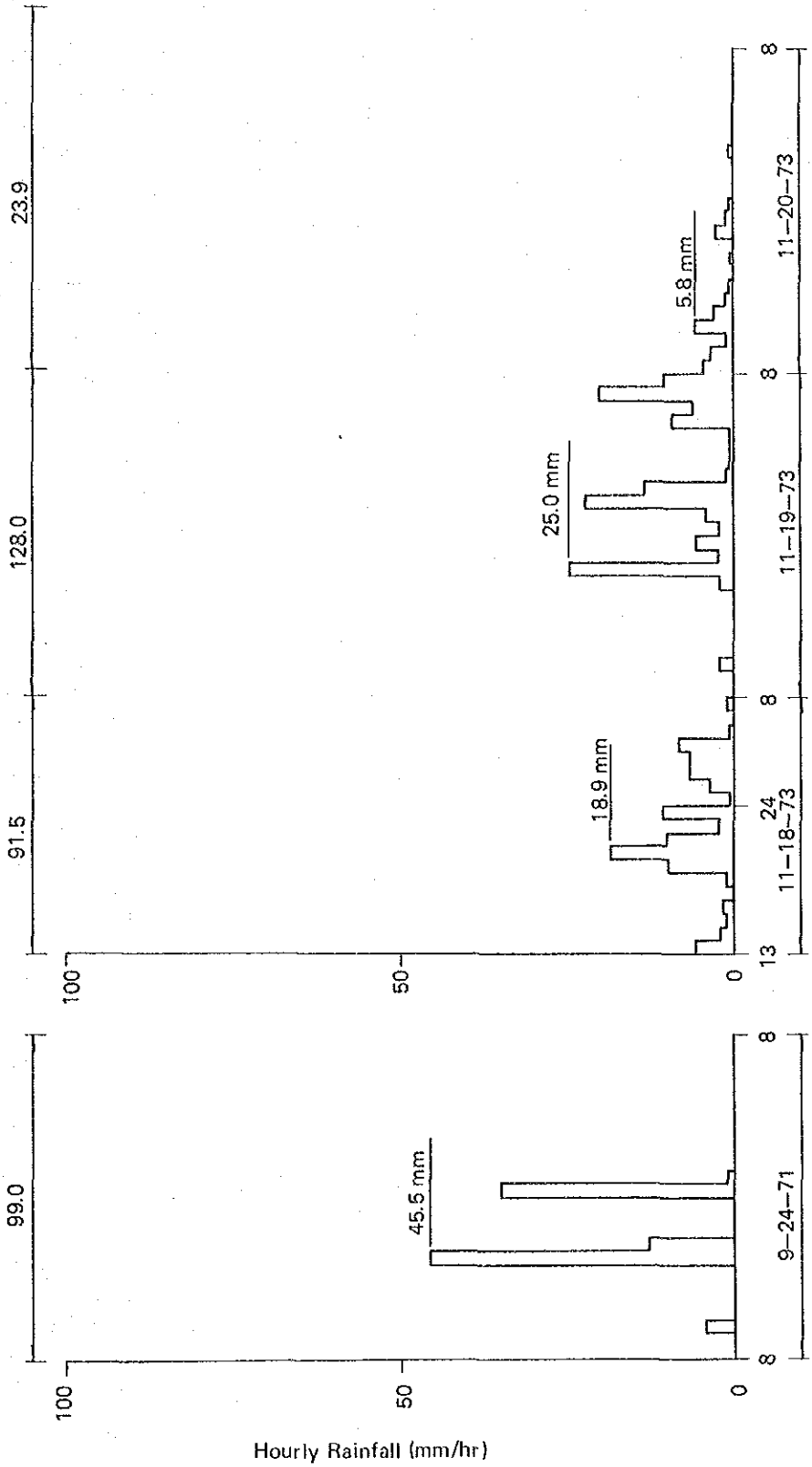


FIGURE F2-4 HOURLY RAINFALL PATTERN (CEBU STATION) (3)



ANNEX G. AGRICULTURE AND SUPPORTING SERVICES

ANNEX G AGRICULTURE AND SUPPORTING SERVICES

LIST OF TABLES

LIST OF FIGURES