DISCUSSIONS

Irrigation water and rainfall supplied to the paddy field is lost through (1) evaporation from soil surface,(2) transpiration from the rice plant (and weeds), (3) vertical percolation, and (4) lateral seepage. Amount of water necessary for rice cultivation is usually divided into 2 periods such as for land preparation and for growth duration (after direct sowing or transplanting).

Preparation Water

Amount of water for ploughing and puddling work mostly depend on the practice of land preparation. In the experimental area or Mae Klong area, ploughing work is usually done after the paddy field becomes flooded. Because of its heavy soil type, it is difficult to plough the field by power tiller or small tractors in dry conditions. In this practice, more amount of preparation water is necessary than ploughing paddy field in dry conditions.

Preparation water obtained in the intensive area was 270.3 mm (174.6 mm for ploughing and 95.7 mm for puddling). It was 281.7mm (180.8 mm for ploughing and 100.9 mm for puddling in estimation) in the semi-intensive area.

Nakajima and Misawa (1983) obtained the amount of preparation water in different field conditions at the agricultural demonstration center. In 1983 dry season, 137.6 mm of preparation water (only for puddling) was required to the field (7,850 m^2) where rotavated twice after harvesting 1982 wet season rice, and 165.1 mm of preparation water (137.6 mm for ploughing and 27.5 mm for puddling) was necessary to another field (7,850 m^2) where rice straw was spread on the field after harvesting.

Murao (1984) derived 103 mm of soaking water from 3 phase distribution of the soil (Appendix 21). Based on the amount of water supplied (174.6 mm), water depth at ploughing (55.5 mm) and the amount of water necessary for soaking soil (103 mm), field efficiency (Ef) of preparation water for ploughing of the intensive area was obtained as follows:

$$\text{Ef for ploughing} = \frac{\text{Water required}}{\text{Water supplied}}$$

$$= \frac{(55.5 \text{ mm} + 103 \text{ mm})}{174.6 \text{ mm}}$$

$$= 0.91$$

Evaporation was not taken into account in this calculation. Due to its irrigation schedule, Ef for ploughing was not obtained from the semi-intensive area.

In similar procedure, Ef of preparation water (ploughing and puddling) became 0.69 and 0.67 for intensive and semi-intensive area, respectively. Amount of water supplied for adjustment was not included in this calculation. The lesser Ef in preparation water was mostly due to water loss through evaporation.

Although amount of preparation water supplied to the common area was not measured, it was estimated as 304.4 mm based on water depth at 2 days after puddling (104 mm), soaking water (103 mm) and the coefficient obtained from the experimental area (0.68 as mean). However, actual amount of water supplied was probably more than this value. Because puddling work was finished 3 days later than experimental area, and apparently more water was drained from the irrigation unit during the land preparation period.

Longer land preparation period in farmer fields was probably the main reason of more preparation water. Longer field preparation period requires more water for evaporation, percolation and seepage. Preparation water was saved if the field was ploughed after harvesting.

Because of its proper water management during land preparation period, preparation water obtained from the intensive area (270.3 mm in 23 days) is probably the minimum value in farmer fields in Mae Klong area in dry season. Preparation water of 300 to 330 mm in 30 days would be the resonable amount for farmer fields in the area. It becomes 1.16 to 1.27 liter per second per ha of water duty (0.19-0.20 L/sec/rai) or 22.2 to 24.4 liter per second of water discharge at the head of farm ditch (terminal irrigation canal) of standard irrigation unit (19.2 ha) in the pilot project No. 1.

Based on the water requirement in depth of 7.72 mm per day (JICA, 1977) and estimated field efficiency of 0.70, Hisamoto (1984) proposed the peak water requirement of 11.03 mm per day at the head of farm ditch. It becomes 330.9 mm in 30 days. It is quite a reasonable amount of preparation water for farmer fields. The value obtained in the experiment (270-280 mm of preparation water) would be the target in the future.

Land Preparation Period

Land preparation period is mostly influenced by availability of water, ability of farm machine (or draft animal) and management practices. In Mae Klong area, power tillers are mostly used for land preparation. Germinated seed direct sowing method of rice cultivation becomes popular recently, especially for dry season rice. About 90 percent of paddy planted area in the pilot project No. 1 was direct seeded in 1984 dry season.

Period of preparation water supply was 23 days in the experimental area and 27 days in the common area. Period from starting irrigation to finishing puddling was 27 days in the experimental area and 29 days in the common area. Period from starting irrigation to finishing sowing was 27 days in the semi-intensive area, 30 days in the intensive area (including transplanting field), and 31 days in the common area. More than 90 percent of paddy field in the pilot project area finished land preparation when the common irrigation unit finished land preparation. It means that about 30 days of preparation period is enough for farmers to finish land preparation in dry season, if they apply direct sowing and there is enough water. Due to more labor necessary for uprooting and transplanting work, the period would be prolonged if they apply transplanting method.

In the Mae Klong area, irrigation water supply usually stop for 2 months (December and January) for maintenance work of irrigation system. The rice plant faces the risk of cold weather damage, if it flowers later than November 20. Under these circumstances, farmers can start land preparation for dry season rice in February, and they should harvest wet season rice at last within the year.

Because of sunny weather in dry season and harvesting work of sugarcane (December to April), farmers prefer direct sowing method for dry season rice. Improved varieties (mostly RD-23 at present) are planted in dry season, and their growth duration is about 120 days. If farmers can finish land preparation for dry season rice within February or by early March, they can harvest in June or early July.

Farmers should sow rice seeds (either directly to the main field or to the nursery) by August 20 for the safety of wet season rice. After the above practices for dry season rice, farmers have 1 to 2 months of land preparation period for wet season rice depending on the sowing date of respective field in dry season. Longer land preparation period is necessary for wet season rice, because rice farming in more diversified in wet season. Farmers plant more number of varieties including photo sensitive traditional ones which have different harvesting dates. Since direct sowing fields face the risk of poor seedling establishment if heavy rain falls within 10 days after sowing, transplanting method is still popular for wet season rice (about 45 % of the paddy fields in pilot project No. 1 in 1984).

Field Efficiency of Water

Roughly estimated drainage water discharge was about 465 m^3 per day at the end of the drainage ditch (D 2-4). However, it became 487 m^3 per day if the data from April 3 to July 6 were used. The drainage ditch was constructed just between the intensive and semi-intensive area, and approximately one half of water drained from the respective area went to the drainage ditch. Based on the assumptions that irrigation water was equally distributed within the intensive or semi-intensive area and evapotranspiration and percolation rates were same over the experimental area, 487 m^3 per day became 2.68 mm per day, then water requirement in depth excluding seepage was 6.96 mm per day [(9.03 + 10.24) / 2 - 2.68]. It means that seepage water was 2.07 mm per day and 3.28 mm per day for intensive and semi-intensive area, respectively. In other words, about 77 percent and 68 percent of supplied water (including rainfall) was used for evapotranspiration and percolation in the intensive area and semi-intensive area, respectively.

The daily amount of seepage water obtained in the experiment area was less than that estimated for the wide irrigation area (4.91 mm per day). Under field to field irrigation practice and earth made levees along the drainage ditch, the field efficiency of water obtained from the intensive area was quite high, and that obtained from the semi-intensive area was satisfactory. The data indicate that the field efficiency of 70 percent can be obtained if farmers are properly oriented and water is properly supplied. Development of mutual understandings among farmers about the importance of water and its effective utilization is necessary to improve the field efficiency of water.

Water Requirement in Depth

Water requirement in depth is influenced by evaporation, transpiration, vertical percolation and lateral seepage. In farmer fields, seepage is usually the biggest factor which affects the water requirement in depth, because other factors are not easily controlled.

Amount of irrigation water supplied for 104.625 days after puddling was 800.5 mm for intensive and 926.4 mm for semi-intensive area. There was 144.5 mm of rainfall in the period. As the result, average daily water supply was 9.03 mm for intensive and 10.24 mm for semi-intensive area including rainfall (Table 8). Approximate water requirement in depth obtained at the different points was 9.26 mm per day and 11.31 mm per day in average for intensive and semi-intensive area, respectively. The difference of the values obtained from the amount of water supplied and from field observation was quite small. However, the approximate water requirement in depth ranged quite widely (Table 13) due to field to field irrigation practice and different field water conditions. Fig. 26 shows the fractuation of water depth at different fields in the intensive area. It indicates that water depth decreased more than 40 mm in one day in some fields (Appendix 15).

Water requirement in depth excluding seepage obtained in the controlled field was 6.45 mm per day as an average of 20 days from May 22 to June 11 (Table 17). It was 8.43 mm per day as an average of sunny days and 6.13 mm per day as an average of slight rainy days (including rainfall). Although percolation rate was not obtained in the experiment, it was reported as about 1 mm per day (JICA, 1977).

Fig. 27 shows water requirement in depth obtained in experimental area, controlled field, and some water requirement research stations in 1980 dry season. It was 7.39 mm per day at Mae Taeng (March to June), 7.55 mm per day at Sam Chuk (February to May), and 8.02 mm per day at Petchaburi (January to May). Although it is difficult to compare the values obtained at different places at different years, rather late measuring time of the controlled field (late May to early June) is probably the main reason of lower water requirement in depth. Because rainfall greatly affect evapotranspiration. Higher water requirement in depth in farmer fields was due to seepage.

Rotational Irrigation

Two kind of rotational irrigation schedules were introduced in the experimental area. The intensive area had different rotational irrigations for land preparation and rice growth duration. The semi-intensive area had weekly rotational irrigation throughout the experimental period. However,

Fig. 26 Fractuation of water depth at different fields in intensive area.

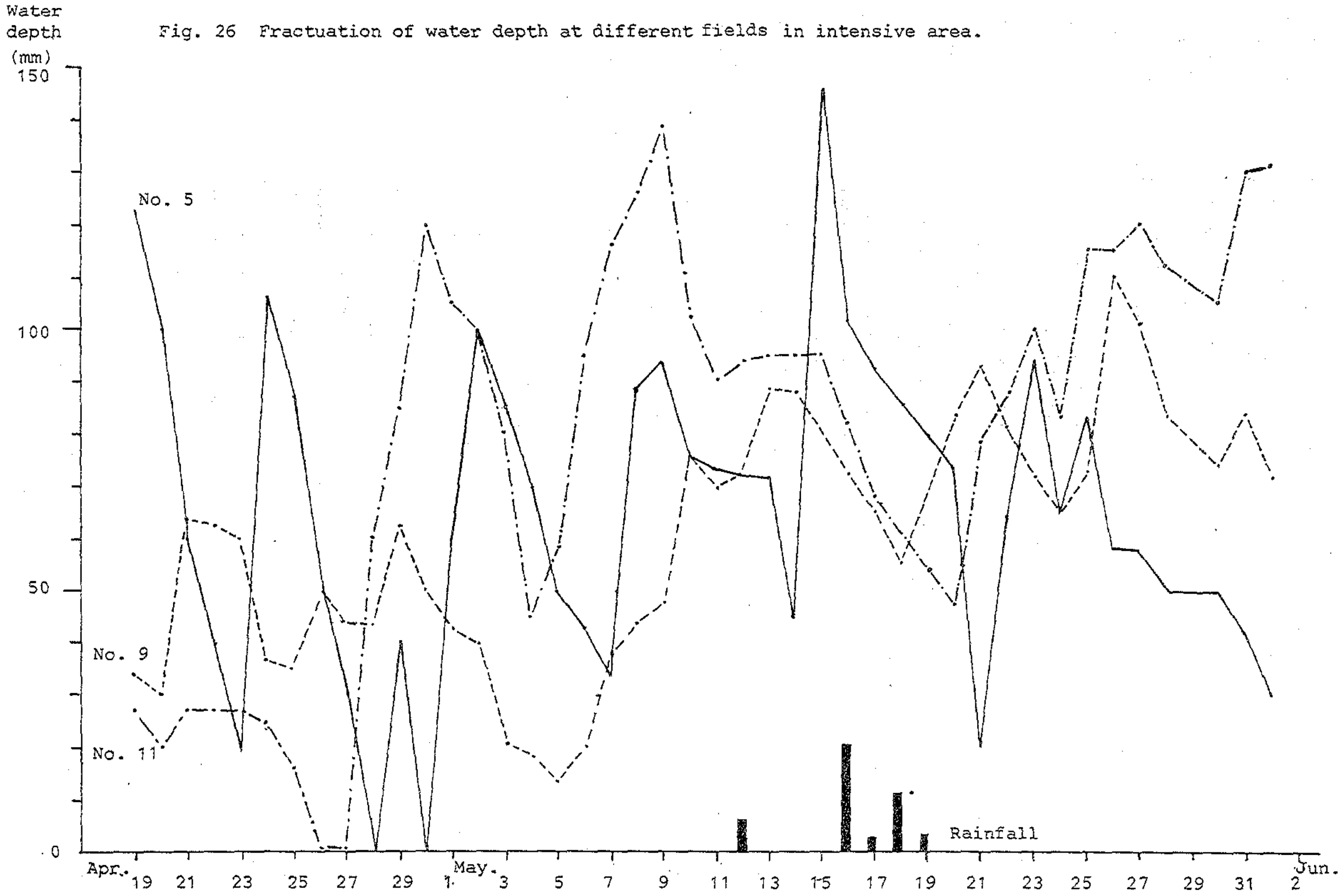
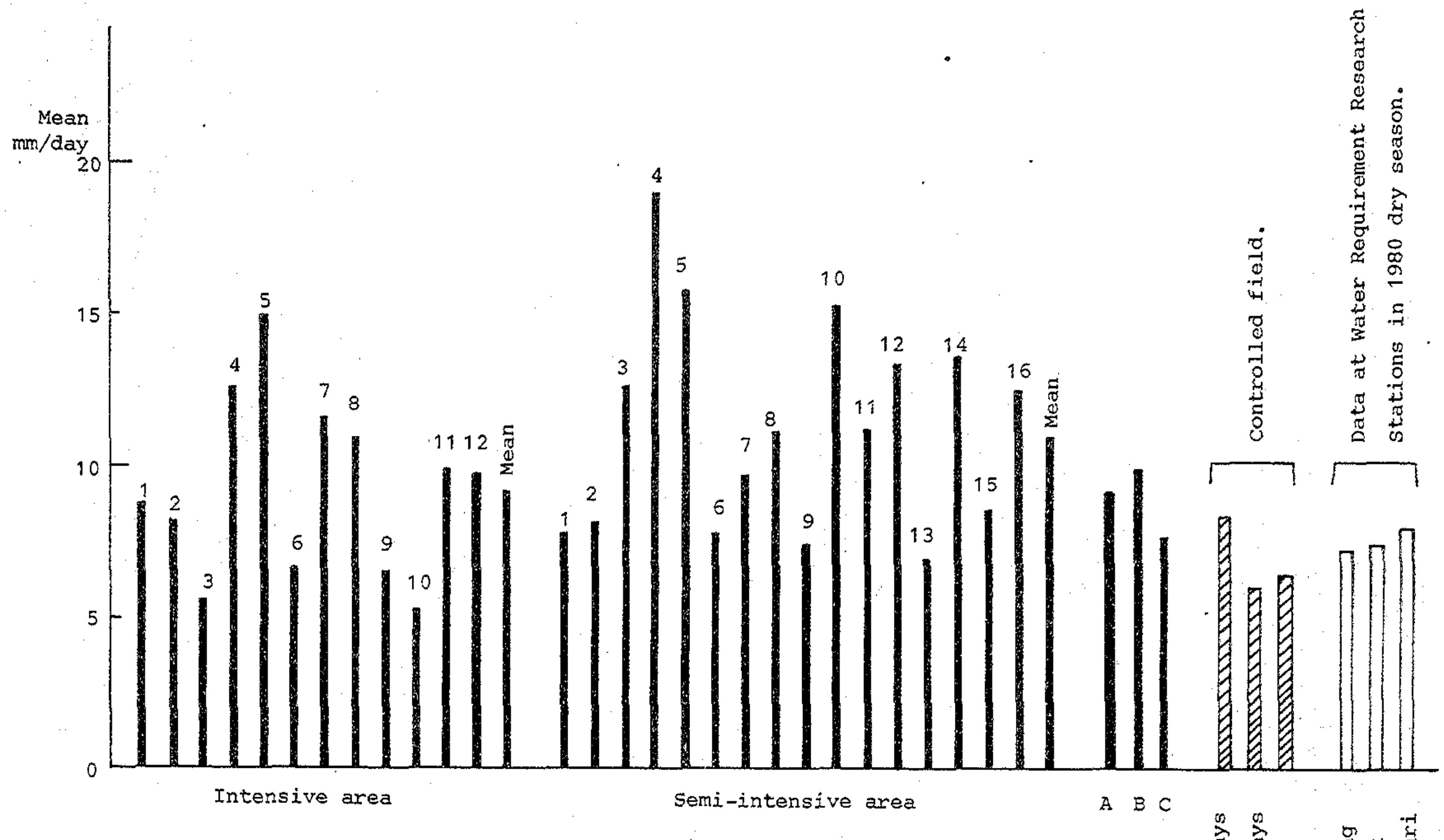


Fig. 27 Water requirement in depth in different paddy fields.



A : Water supplied to intensive area.

B : Water supplied to semi-intensive area.

C : Water used for evapotranspiration and percolation in the experimental area.

except the one for land preparation of the intensive area, they did not strongly compel the farmers to follow. Diversified field conditions in water balance in the experimental area made difficult to persist the scheduled rotational irrigations. But, at least, farmers had benefits from the irrigation schedules, because they could take water on assigned days, if their fields were lack of water. Field water conditions after seedling establishment (Table 12) shows that the water distribution was satisfactory.

Table 18 shows number of paddy fields seeded (or transplanted) at different days after flooding. It was 17.6 days in average for intensive area (ranged 9-24 days), 12.0 days for semi-intensive area (ranged 2-24 days), and 9.5 days for common area (ranged 2-23 days). It means that in 30 days of total land preparation period in the intensive area, every field finished sowing (or transplanting) in 17.6 days in average. The longer land preparation period of respective field in the intensive area was the result of separating preparation water for ploughing and puddling. This practice has an advantage in weed control, because weed seeds germinate after flooding (or ploughing) and weed seedlings are later puddled into the soil.

However, it is difficult to introduce this kind of rotational irrigation to wider area at present. There are at least 2 pre-requisites for rotational irrigation, such as (1) provision of terminal irrigation facilities and (2) mutual cooperation among farmers. Even pilot project No. 1, which received an intensive method of land consolidation, field to field irrigation is still a common practice because of lesser number of inlets and more number of paddy fields. In Mae Klong area, Operation and Maintenance Office of RID has responsibility for primary and secondary canal maintenance and water distribution to tertiary canals. Then farmers have responsibility for tertiary canals or farm ditches. Water user groups are being organized in the area where land consolidation work is completed. Farmers are oriented about water management, and water fee for repair and maintenance of respective canal is collected

Table 18 Number of paddy fields seeded (or transplanted) at different days after first flooding.

Days	Intensive area[a]	Semi-intensive area	Common area
2	0	4	2
3	0	2	6
4	0	3	7
5	0	2	5
6	0	3	9
7	0	8	7
8	0	1	11
9	1	9	1
10	6	3	0
11	5	6	6
12	0	2	1
13	0	9	5
14	3	0	3
15	8	0	8
16	5	8	0
17	4	5	2
18	4	7	2
19	9	6	1
20	18	2	4
21	4	1	0
22	5	1	0
23	4	0	1
24	2	1	0
Mean	17.6	12.0	9.5
S.D.	4.0	5.6	5.2

[a]Excluding a small portion later added to the experimental area.

from 1 year after the completion of land consolidation. It is 40 baht per rai per year for extensive land consolidation area, and 70 baht per rai per year for intensive land consolidation area.

It will take some more years for farmers to understand the importance of water management. It is the common practice at present that farmers who have paddy fields at the head of farm ditch take more water and drain out excess water, then farmers who have paddy fields at the end of farm ditch have less water and they sometimes pump up water from drainage canal. This situation makes difficult to collect water fee for maintenance.

To cope with this problem, Hisamoto (1984) proposed a practical rotational irrigation schedule for each farm ditch (20 in total) in the pilot project No. 1. Based on the existing inlets and boundaries of land owners in each irrigation unit, he divided the area into 3 rotational blocks as standard. Example of the proposed rotational schedule is in Appendix 22. In the schedule, changing irrigation block is either 6:00, 12:00 or 18:00 hours, and the rotational block of the middle and the end receives 1.2 and 1.4 times of water of the head of the farm ditch, respectively. The schedule ensures the farmers that they can get water on assigned days if their fields are lack of water.

The rotational irrigation schedule of 3 blocks in standard is a quite a practical method at present. It will improve water distribution within the farm ditch. More precise irrigation schedule, such as that of intensive area, can be introduced after the farmers become familiar with rotational irrigation and installing additional inlets at appropriate points.

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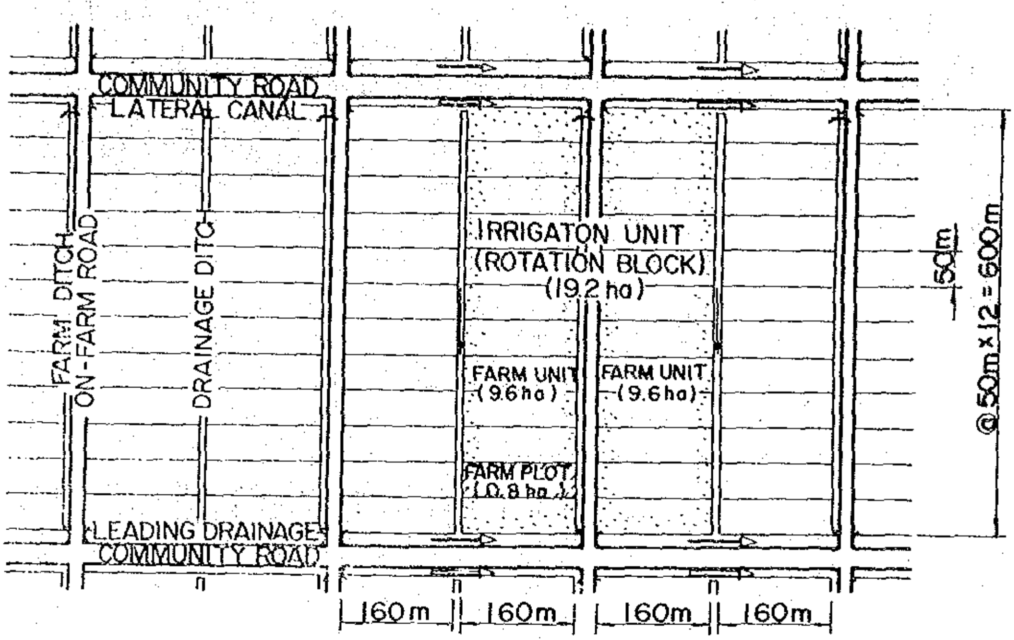
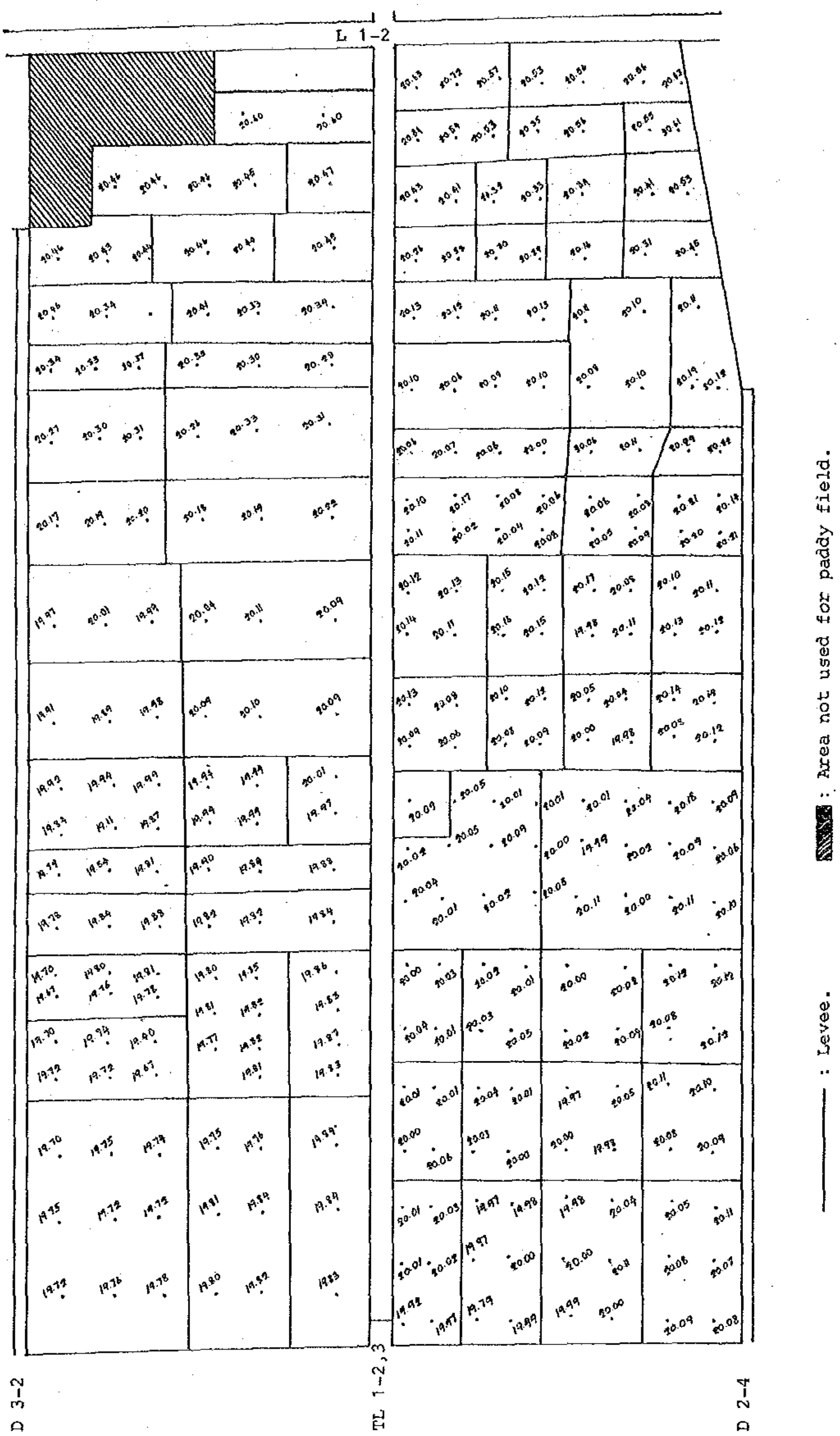
Appendix 1 Standard size of terminal irrigation unit[a].

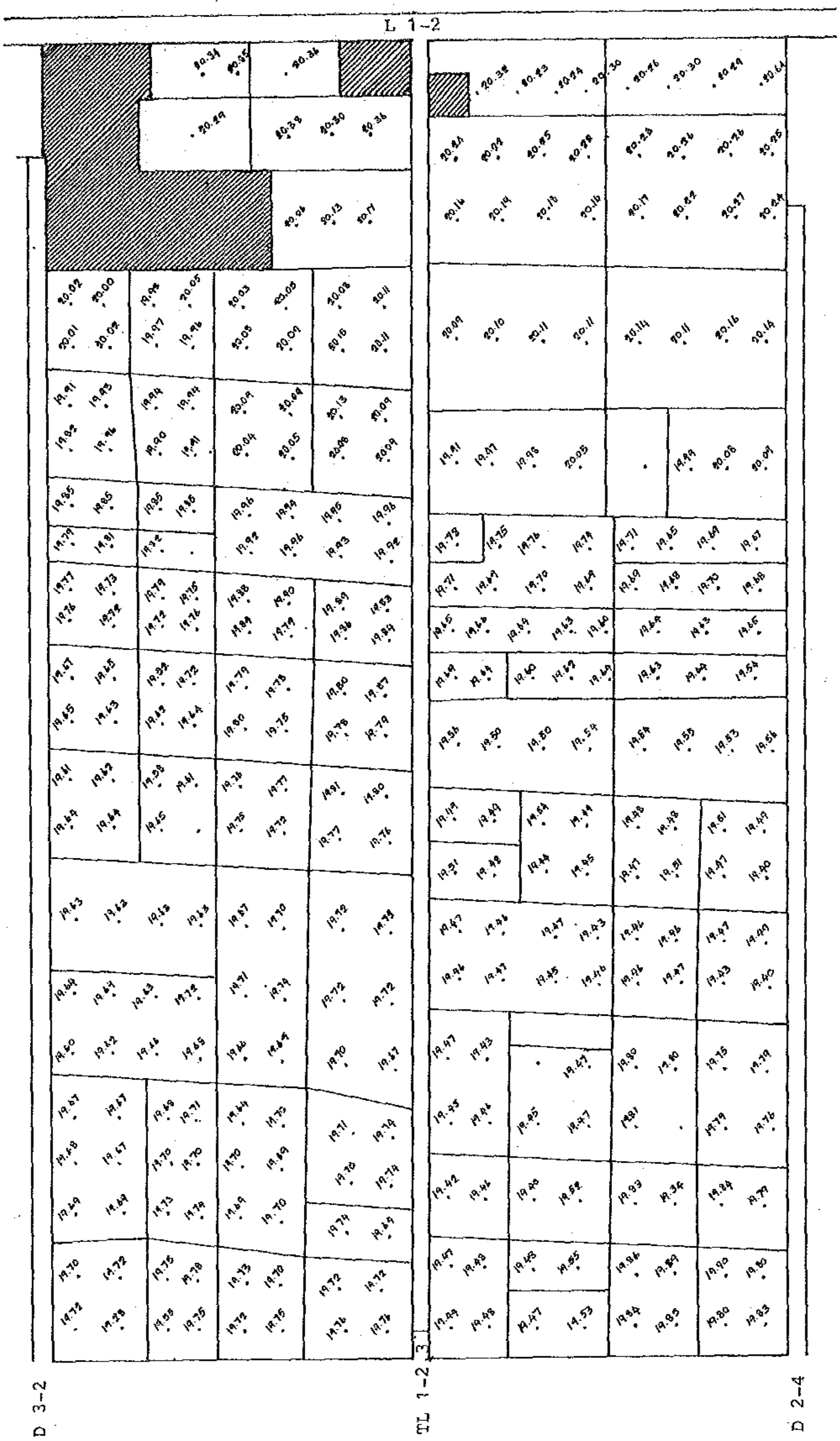


[a]From " Design report, Mae Klong pilot project in the technical cooperation on the irrigated agriculture development in Thailand ", p. 3 - 22, JICA, 1977.

Appendix 2 Elevation of the spots in intensive area (m above MSL)



Appendix 3 Elevation of the spots in semi-intensive area (m above MSL).



: Area not used for paddy field.

: Levee.

Appendix 4-1 Irrigation and farming schdule for intensive area.

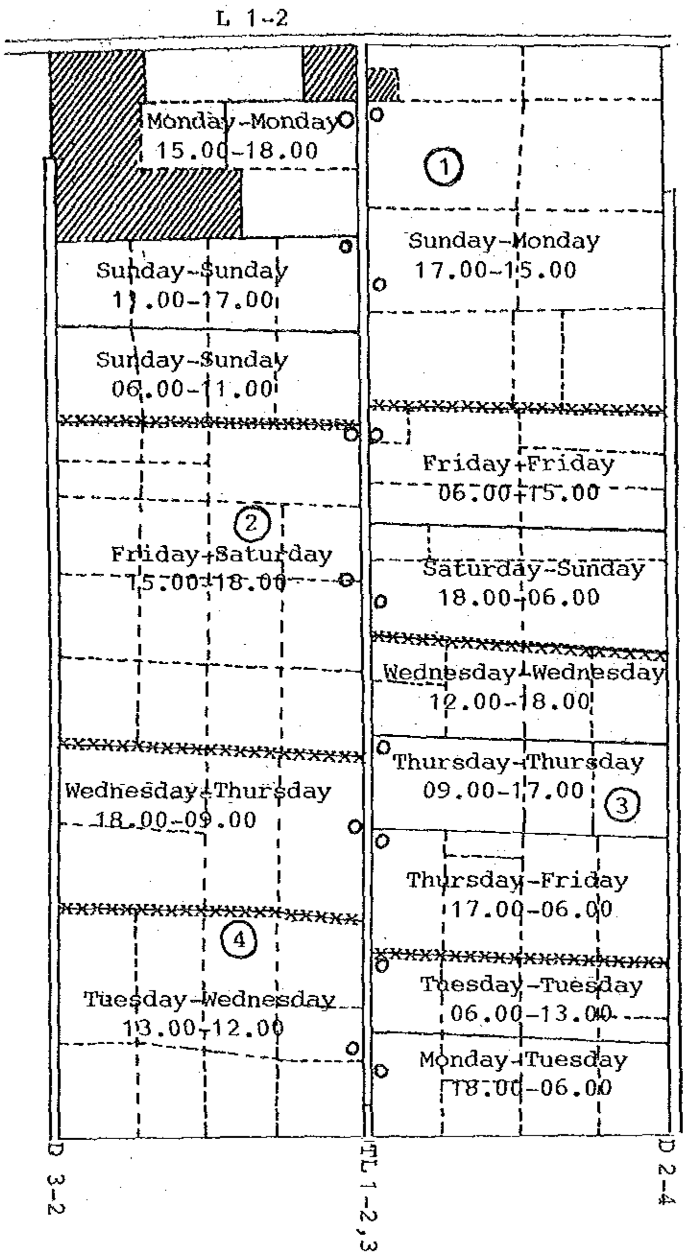
(March 1 – April 19; Reserved days for adjustment: about March 19–22)

Block & area	Preparation water for ploughing		Preparation water for puddling			
1 3.4 ha	222 mm 3.494 days	Ploughing	159 mm	Puddling Planking	Sowing	127 mm
2 3.4 ha	222 mm 3.494 days	Ploughing	159 mm	Puddling Planking	Sowing	127 mm
3 2.9 ha	223 mm 2.99 days	Ploughing	186 mm	Puddling Planking	Sowing	149 mm
4 3.0 ha	216 mm 3.0 days	Ploughing	180 mm	Puddling Planking	Sowing	144 mm
5 2.9 ha	223 mm 2.99 days	Ploughing	186 mm	Puddling Planking	Sowing	149 mm
6 2.8 ha	231 mm 2.99 days	Ploughing	193 mm	Puddling Planking	Sowing	154 mm

4-2 ตารางการส่งน้ำ และ การเพาะปลูก (intensive area).

บล๊อค หมายเลข	มีนาคม (1–31)	เมษายน (1–18)
1 3.4 (เฮคแตร์)	222 มม 3.494 วัน; ไถ; (วันสำรองน้ำ); 159 มม; เทือก คราด; หว่าน	127 มม
2 3.4 (เฮกแตร์)	222 มม 3.494 วัน; ไถ; วันสำรองน้ำ; 159 มม; เทือก คราด; หว่าน	127 มม
3 2.9 (เฮกแตร์)	223 มม 2.99 วัน; ไถ; (วันสำรองน้ำ); 186 มม; เทือก คราด	หว่าน; 149 มม
4 3.0 (เฮกแตร์)	สิ้นสุดการเก็บเกี่ยวข้าว; 216 มม 3.0 วัน; ไถ; สิ้นสุดการเก็บเกี่ยว[illegible]; 180 มม	เทือก คราด; หว่าน; 144 มม
5 2.9 (เฮกแตร์)	สิ้นสุดการเก็บเกี่ยวข้าว; 223 มม 2.99 วัน; ไถ; สิ้นสุดการเก็บเกี่ยว[illegible]	186 มม; เทือก คราด; หว่าน; 149 มม
6 2.8 (เฮกแตร์)	231 มม 2.99 วัน; ไถ	193 มม; เทือก คราด; หว่าน; 154 มม

Appendix 5 Irrigation schdule for semi-intensive area.



①
06.00 น. วันอาทิตย์
ถึง
18.00 น. วันจันทร์

06.00 Sunday
to
18.00 Monday

②
06.00 น. วันศุกร์
ถึง
06.00 น. วันอาทิตย์

06.00 Friday
to
06.00 Sunday

③
12.00 น. วันพุธ
ถึง
06.00 น. วันศุกร์

12.00 Wednesday
to
06.00 Friday

④
18.00 น. วันจันทร์
ถึง
12.00 น. วันพุธ

18.00 Monday
to
12.00 Wednesday

o : Inlet

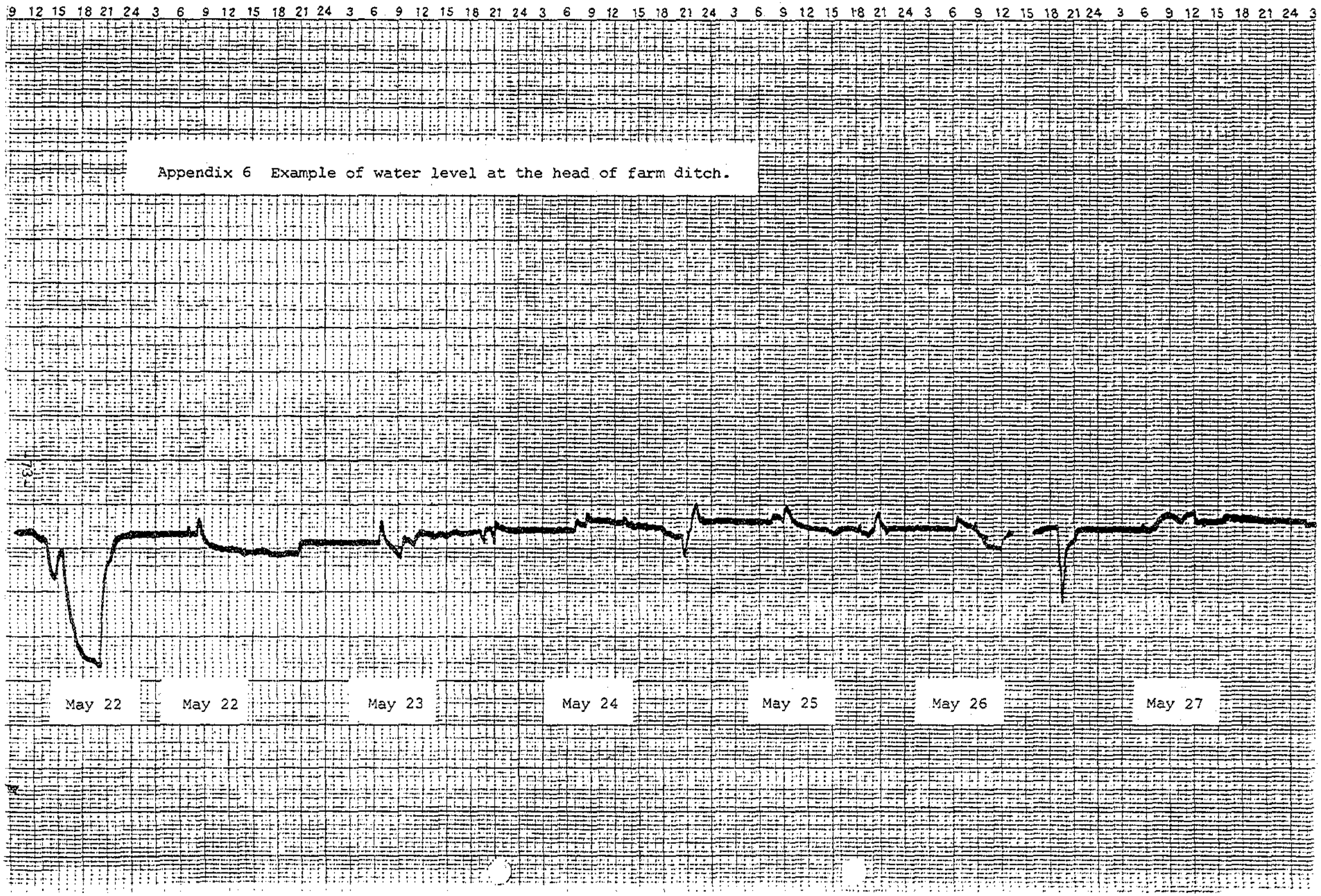
—— : Boundary of cultivater.

xxx : Boundary of irrigation block.

▨ : Not paddy field.

◯ : Irrigation block.

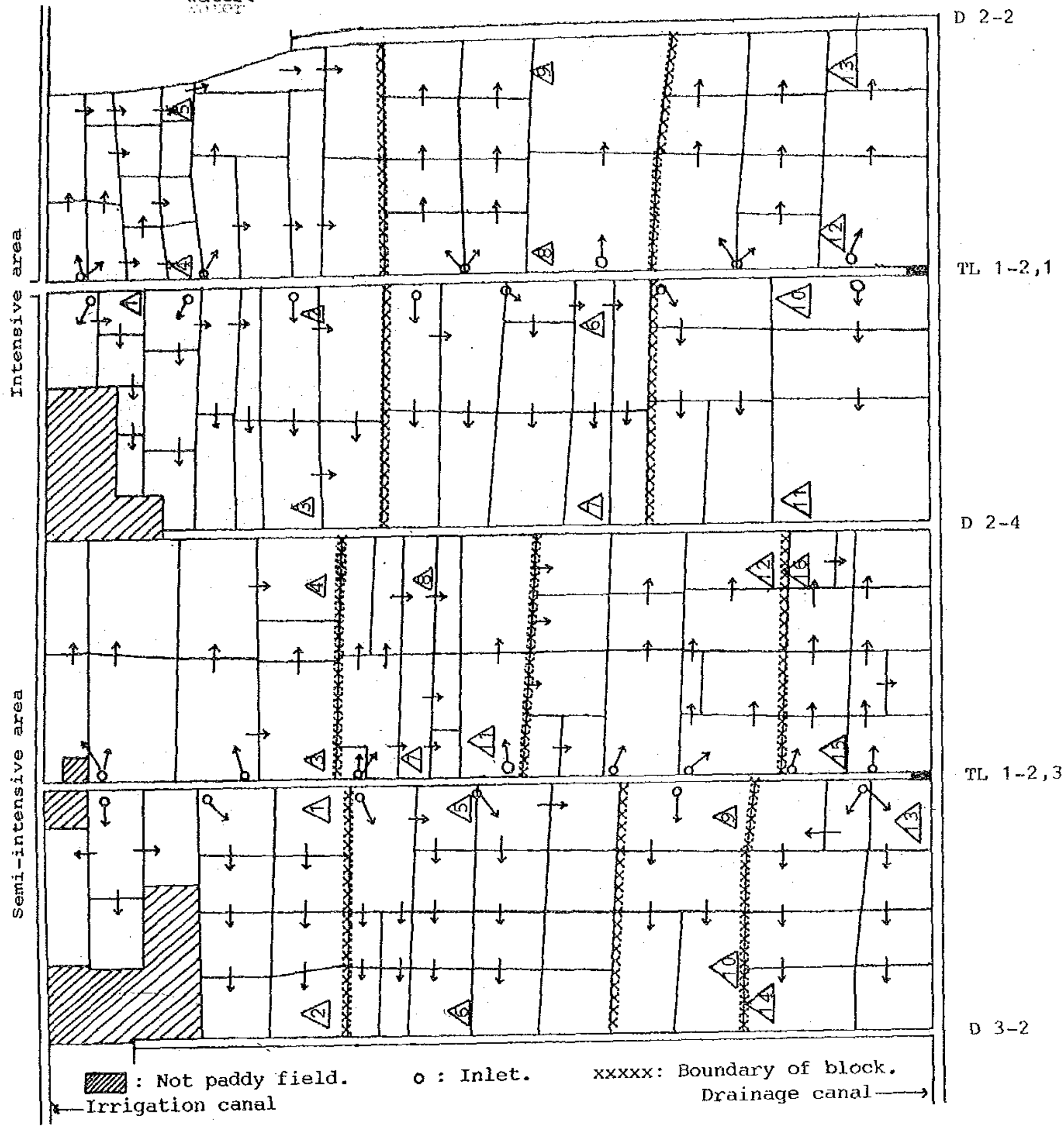
Appendix 6 Example of water level at the head of farm ditch.



Appendix 7 Example of calculating water discharge at the head of farm ditch.

Date	Time	Ha (cm)	Q (L/sec)	v (m^3)	V (m^3/day)
May 22	0.00	16.50			
	8.00	16.75	22.38	644.69	
	8.25	18.00	24.00	36.00	
	9.40	15.30	22.44	100.97	
	13.15	14.70	19.03	245.45	
	14.00	14.50	18.23	49.23	
	16.15	14.60	18.13	146.88	
	18.00	14.20	17.84	112.38	
	20.50	14.40	17.64	179.96	
	21.00	15.60	19.03	11.42	
	24.00	15.60	20.24	218.63	
					1746
May 23	0.00	15.60			
	6.40	15.70	20.35	488.31	
	7.00	17.70	22.54	27.05	
	7.35	15.90	22.76	47.79	
	9.10	14.00	18.93	107.88	
	10.00	16.00	19.03	57.08	
	11.00	15.60	20.66	74.36	
	12.00	16.80	21.49	77.36	
	15.00	16.50	22.44	242.33	
	16.00	16.90	22.54	81.16	
	17.00	16.70	22.76	81.93	
	19.10	16.80	22.65	176.68	
	19.40	16.00	21.91	39.43	
	20.00	17.20	22.33	26.80	
	20.40	17.30	23.73	56.95	
	20.57	16.00	22.44	22.89	
	21.05	17.70	22.87	10.98	
	23.00	17.10	24.06	165.99	
	24.00	17.10	23.40	84.25	
					1869
May 24	0.00	17.10			
	7.00	17.10	23.40	589.78	
	7.05	18.00	24.38	7.32	
	8.15	17.70	25.05	105.19	
	8.30	18.50	25.60	23.04	
	13.20	18.10	26.05	453.29	
	18.00	17.30	24.71	415.20	
	20.15	16.80	23.30	188.70	
	20.50	14.20	20.04	42.08	
	21.30	17.20	20.45	49.08	
	22.03	19.80	26.50	52.47	
	22.40	18.20	27.64	61.37	
	24.00	18.30	25.94	124.51	
					2112

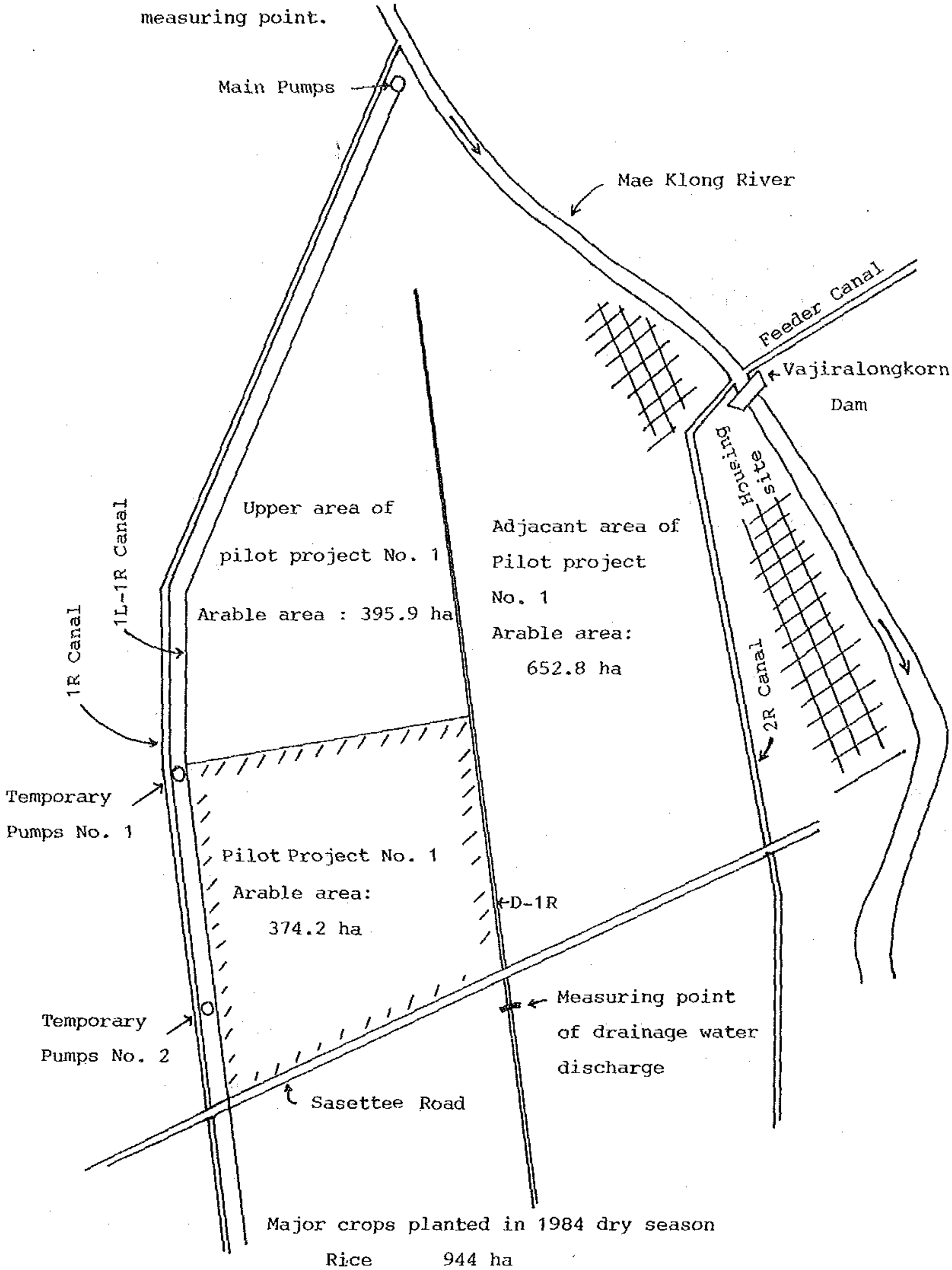
Appendix 8 Measuring points of water depth and flowing way of irrigation water.



△ Measuring point of water depth.

→ Flowing way of water after inlet.

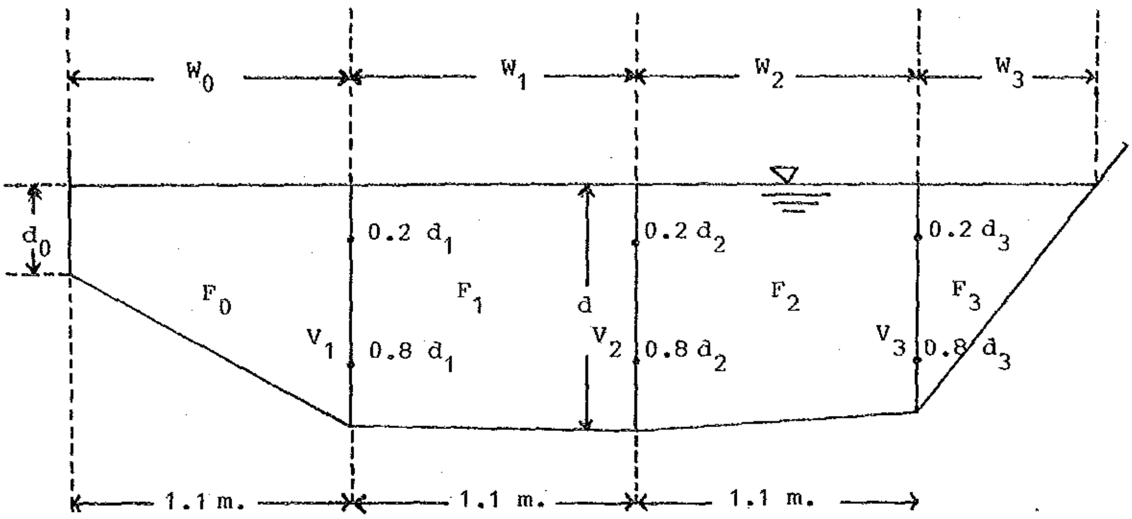
Appendix 9 Profile of land use in the upper stream of draining water measuring point.



Major crops planted in 1984 dry season

Rice	944 ha
Sugarcane	370 ha

Appendix 10 Section of drainage canal at the point of measuring water discharge and procedure of obtaining water discharge.



1. Calculation F:

$$F_0 = \frac{(d_0 + d_1) \times W_0}{2}$$

$$F_1 = \frac{(d_1 + d_2) \times W_1}{2}$$

$$F_2 = \frac{(d_2 + d_3) \times W_2}{2}$$

$$F_3 = \frac{d_3 \times W_3}{2}$$

2. Calibrated velocity:

$$V_c = 0.118\ V + 0.014$$

$$V_{c\ 0} = \frac{2\ V_0}{3}$$

$$V_{c\ 1} = \frac{V_1 + V_2}{2}$$

$$V_{c\ 2} = \frac{V_2 + V_3}{2}$$

$$V_{c\ 3} = \frac{2\ V_3}{3}$$

3. $q = F \times Vc$

4. $Q = q_0 + q_1 + q_2 + q_3$

Appendix 11 Climatological data for the period 1951-1980[a].

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (°C)													
Mean	25.6	28.1	30.3	31.4	29.9	28.9	28.3	28.2	27.8	27.2	26.1	25.0	28.1
Mean maximum	32.3	34.9	37.2	37.9	35.4	33.7	33.1	32.9	32.6	31.5	30.7	30.8	33.6
Mean minimum	17.7	20.6	23.0	24.9	25.0	24.6	24.2	24.0	23.8	23.0	20.8	18.2	22.5
Extreme maximum	38.1	40.3	41.9	43.5	41.6	38.4	37.8	37.8	37.6	37.3	37.5	37.2	43.5
Extreme minimum	5.5	12.1	11.2	17.2	21.5	22.0	20.8	21.5	20.8	16.2	11.6	6.8	5.5
Rainfall (mm)													
Mean	5.5	17.2	36.2	71.3	158.9	92.5	106.3	107.9	232.2	222.9	56.3	7.8	1115.0
Mean rainy days	1.1	2.0	3.4	6.4	14.2	13.5	16.1	17.2	18.7	15.1	5.4	1.6	114.7
Greatest in 24 hrs	54.4	82.0	133.9	75.8	95.4	74.1	65.8	99.5	165.5	162.8	117.6	45.6	165.5
Pan evaporation (mm)	141.0	153.1	211.2	235.9	207.3	158.9	164.7	148.9	127.6	127.7	129.5	140.1	1945.9
Relative humidity (%)													
Mean	62.0	60.0	57.0	59.0	69.0	72.0	73.0	74.0	76.0	79.0	73.0	67.0	68.0
Mean maximum	87.1	85.0	81.9	81.6	86.6	87.8	88.4	88.9	91.5	93.0	90.9	88.5	87.6
Mean minimum	41.3	39.0	35.8	38.8	52.1	57.3	58.0	58.5	61.3	64.2	57.4	48.4	51.0
Extreme minimum	11.0	15.0	14.0	15.0	22.0	32.0	34.0	35.0	36.0	31.0	27.0	21.0	11.0

[a]From "Climatological data of Thailand 30-year period (1951-1980)", p. 30, Meteorological Department, Ministry of Communications, 1982.

Appendix 12 Amount of irrigation water supplied.

Date	Intensive area	Semi-intensive area
Mar. 3	561	475
4	1,056	710
5	1,064	1,044
6	1,394	1,456
7	1,907	1,900
8	2,109	2,266
9	2,235	2,172
10	2,536	2,693
11	2,356	2,635
12	2,194	2,504
13	2,419	2,607
14	2,141	2,295
15	1,920	1,785
16	2,512	2,386
17	2,228	2,523
18	2,289	2,598
19	705	963
sub-total (Ploughing)	31,626 m^3 174.6 mm 10.96 mm/day 23.0 L/sec	33,012 m^3 180.8 mm 11.34 mm/day 24.0 L/sec
Mar 19	1,781	1,533
20	1,886	2,114
21	1,780	2,036
22	1,803	2,563
23	2,971	2,392
24	3,017	3,202
25	2,952	3,090
26	1,131	1,490
Sub-total (Puddling)	17,327 m^3 95.7 mm 13.75 mm/day 28.8 L/sec	18,420 m^3 100.9 mm 14.50 mm/day 30.6 L/sec
Mar. 26	543	1,490
27	1,121	2,265
28	2,015	1,392
29	659	396
30	26	27
31	19	628
Apr. 1	0	123
2	75	1,125
3	116	1,429
4	11	47
5	29	496
Sub-total (Adjustment)	4,614 m^3 25.5 mm 2.40 mm/day 5.0 L/sec	9,418 m^3 51.6 mm 4.86 mm/day 10.3 L/sec
Apr. 6	210	1,850
7	1,722	2,249
8	2,221	2,299
9	1,564	1,477
10	2,009	2,527
11	1,830	2,221
12	1,254	1,934
13	1,067	1,532
14	2,446	2,552
15	2,467	2,546
Sub-total (Pre-rotation)	16,790 m^3 92.7 mm 9.27 mm/day 19.4 L/sec	21,189 m^3 119.5 mm 11.95 mm/day 24.5 L/sec
Apr. 16	1,120	2,007
17	1,014	1,983
18	1,772	2,265
19	1,816	2,234
20	1,765	2,337
21	1,517	2,088
22	1,253	1,989
Sub-total (Rotation1)	10,257 m^3 56.6 mm 8.09 mm/day 17.0 L/sec	14,893 m^3 81.5 mm 11.64 mm/day 24.6 L/sec
Apr. 23	907	1,668
24	1,164	1,984
25	1,144	1,845
26	1,061	1,774
27	1,467	1,988
28	788	1,411
29	925	1,323
Sub-total (Rotation2)	7,456 m^3 41.2 mm 5.89 mm/day 12.3 L/sec	11,863 m^3 65.0 mm 9.29 mm/day 19.6 L/sec

Date	Intensive area	Simi-intensive area
Apr. 30	918	1,307
May 1	802	1,315
2	1,867	1,734
3	1,980	1,843
4	2,803	2,358
5	2,564	2,581
6	2,443	2,363
Sub-total	13,377 m^3	13,500 m^3
(Rotation3)	73.9 mm	73.9 mm
	10.54 mm/day	10.56 mm/day
	22.1 L/sec	22.3 L/sec
May 7	2,288	2,253
8	2,916	2,209
9	2,872	2,204
10	2,866	2,264
11	3,006	2,215
12	3,086	2,106
13	3,060	2,089
Sub-total	20,094 m^3	15,340 m^3
(Rotation4)	111.0 mm	84.0 mm
	15.86 mm/day	12.0 mm/day
	33.2 L/sec	25.4 L/sec
May 14	2,556	2,373
15	2,140	2,253
16	2,065	2,200
17	1,912	2,104
18	2,075	2,180
19	1,881	2,136
20	2,183	2,358
Sub-total	14,812 m^3	15,604 m^3
(Rotation5)	81.8 mm	85.4 mm
	11.69 mm/day	12.20 mm/day
	24.5 L/sec	25.8 L/sec
May 21	1,671	2,328
22	1,746	2,088
23	1,869	2,049
24	2,112	2,084
25	2,154	2,100
26	1,946	2,051
27	2,205	2,165
Sub-total	13,703 m^3	14,865 m^3

Date	Intensive area	Semi-intensive area
(Rotation6)	75.7 mm	81.4 mm
	10.81 mm/day	11.63 mm/day
	22.7 L/sec	24.6 L/sec
May 28	1,922	1,891
29	1,859	1,708
30	1,619	1,723
31	1,689	1,912
June 1	637	587
2	0	7
3	0	0
Sub-total	7,726 m^3	7,830 m^3
(Rotation7)	42.7 mm	42.9 mm
	6.10 mm/day	6.13 mm/day
	12.8 L/sec	12.9 L/sec
June 4	0	0
5	0	0
6	949	716
7	1,841	1,750
8	1,753	2,004
9	1,466	1,985
10	162	896
Sub-total	6,171 m^3	7,351 m^3
(Rotation8)	34.1 mm	40.3 mm
	4.87 mm/day	5.76 mm/day
	10.2 L/sec	12.2 L/sec
June 11	1,117	1,393
12	1,528	1,595
13	1,106	1,557
14	1,360	1,862
15	1,808	1,962
16	1,836	1,898
17	1,750	1,779
Sub-total	10,509 m^3	12,046 m^3
(Rotation9)	58.0 mm	66.0 mm
	8.29 mm/day	9.43 mm/day
	17.4 L/sec	19.9 L/sec

Date	Intensive area	Semi-intensive area
June 18	1,215	1,347
19	897	996
20	978	1,085
21	1,403	1,560
22	1,524	1,642
23	1,525	1,654
24	1,469	1,685
Sub-total (Rotation10)	9,011 m^3 49.8 mm 7.11 mm/day 14.9 L/sec	9,969 m^3 54.6 mm 7.80 mm/day 16.5 L/sec
June 25	1,556	1,722
26	1,267	1,583
27	971	1,376
28	1,181	1,639
29	797	1,125
30	378	593
Jul. 1	1,241	1,888
Sub-total (Rotation11)	7,391 m^3 40.8 mm 5.83 mm/day 12.2 L/sec	9,930 m^3 54.4 mm 7.77 mm/day 16.4 L/sec
Jul. 2	1,219	1,371
3	1,129	1,289
4	991	1,348
5	899	1,337
6	0	13
7	37	22
8	0	7
Sub-total (Rotation12)	4,279 m^3 23.6 mm 3.37 mm/day 7.1 L/sec	5,387 m^3 29.5 mm 4.21 mm/day 8.9 L/sec

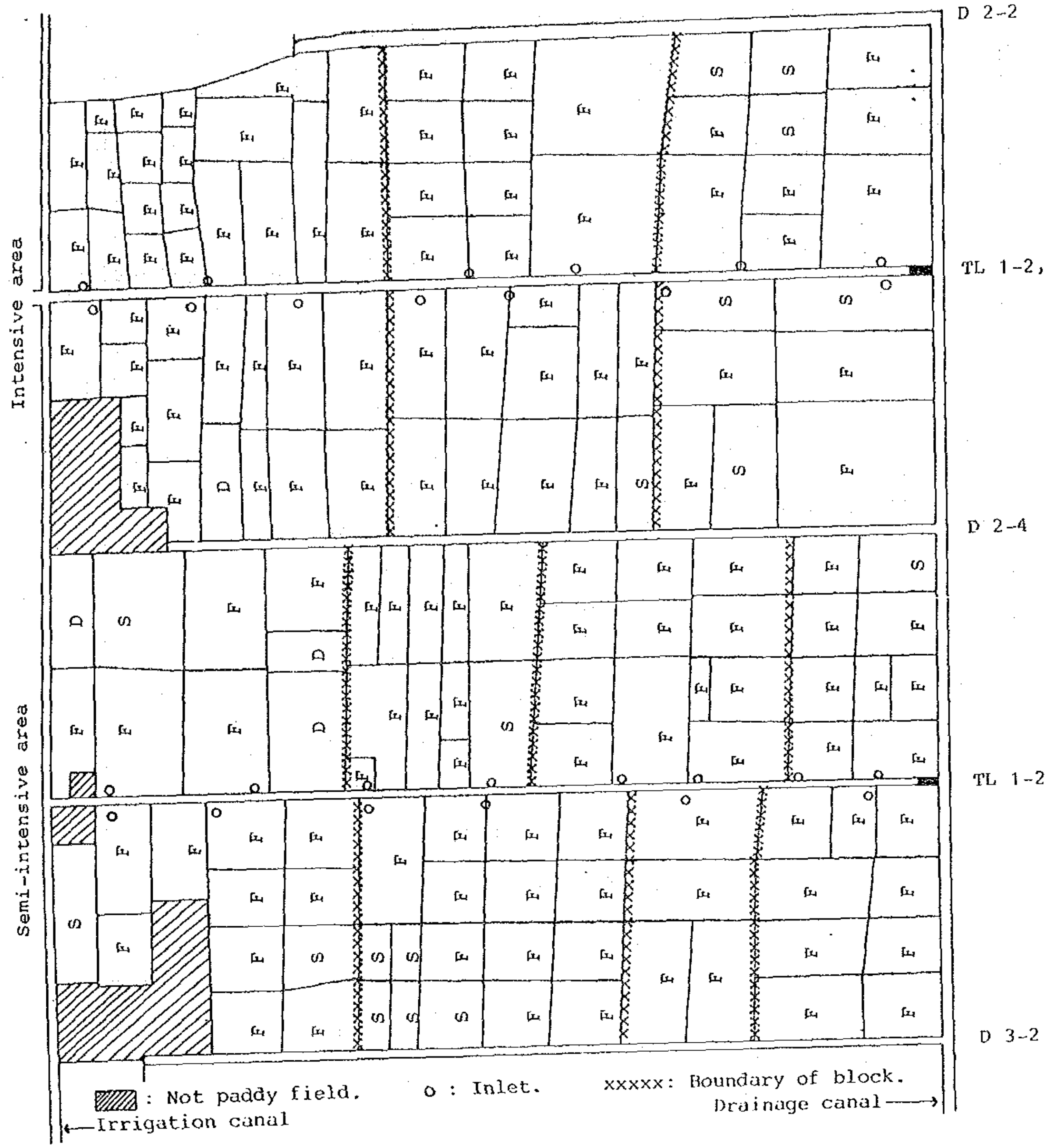
Appendix 13 Amount of water drained.

Date	Water discharge	
	m^3/day	L/sec
Mar. 12	40	
13	40	
14	33	
15	22	
16	61	
17	636	
18	1,069	
19	598	
20	170	
21	522	
22	531	
S.total	3,722	(11 days)
Mean (1)	338	3.92
Mar. 23 - Apr. 2 Missing		
Apr. 3	131	
4	184	
5	44	
6	17	
7	22	
8	138	
9	169	
10	456	
11	595	
12	937	
13	1,111	
14	541	
15	498	
16	565	
17	524	
18	381	
19	522	
20	308	

Date	Water discharge	
	m^3/day	L/sec
Apr. 21	224	
22	208	
S.total	7,575	(20 days)
Mean (2)	379	4.38
Apr. 23		
24	375	
25	251	
26	214	
S.total	840	(3 days)
Mean (3)	280	3.24
Apr. 27 - May 8 Missing		
May 9	1,129	
Mean (4)	1,129	13.07
May 10 - 20 Missing		
May 21	806	
22	1,830	
23	2,050	
24	1,676	
25	1,543	
S.total	7,905	(5 days)
Mean (5)	1,581	18.30
May 26 - Jun. 24 Missing		
Jun. 25	653	
26	760	
27	492	
28	348	
29	303	
30	166	
Jul. 1	107	
S.total	2,829	(7 days)
Mean (6)	404	4.68

Date	Water discharge	
	m^3/day	L/sec
Jul. 2	87	
3	59	
4	25	
5	14	
6	10	
S.total	195	(5 days)
Mean (7)	39	0.45
G. total	24,195	(53 days)
Mean	457	5.28

Appendix 14-1 Water condition of paddy field (April 20).

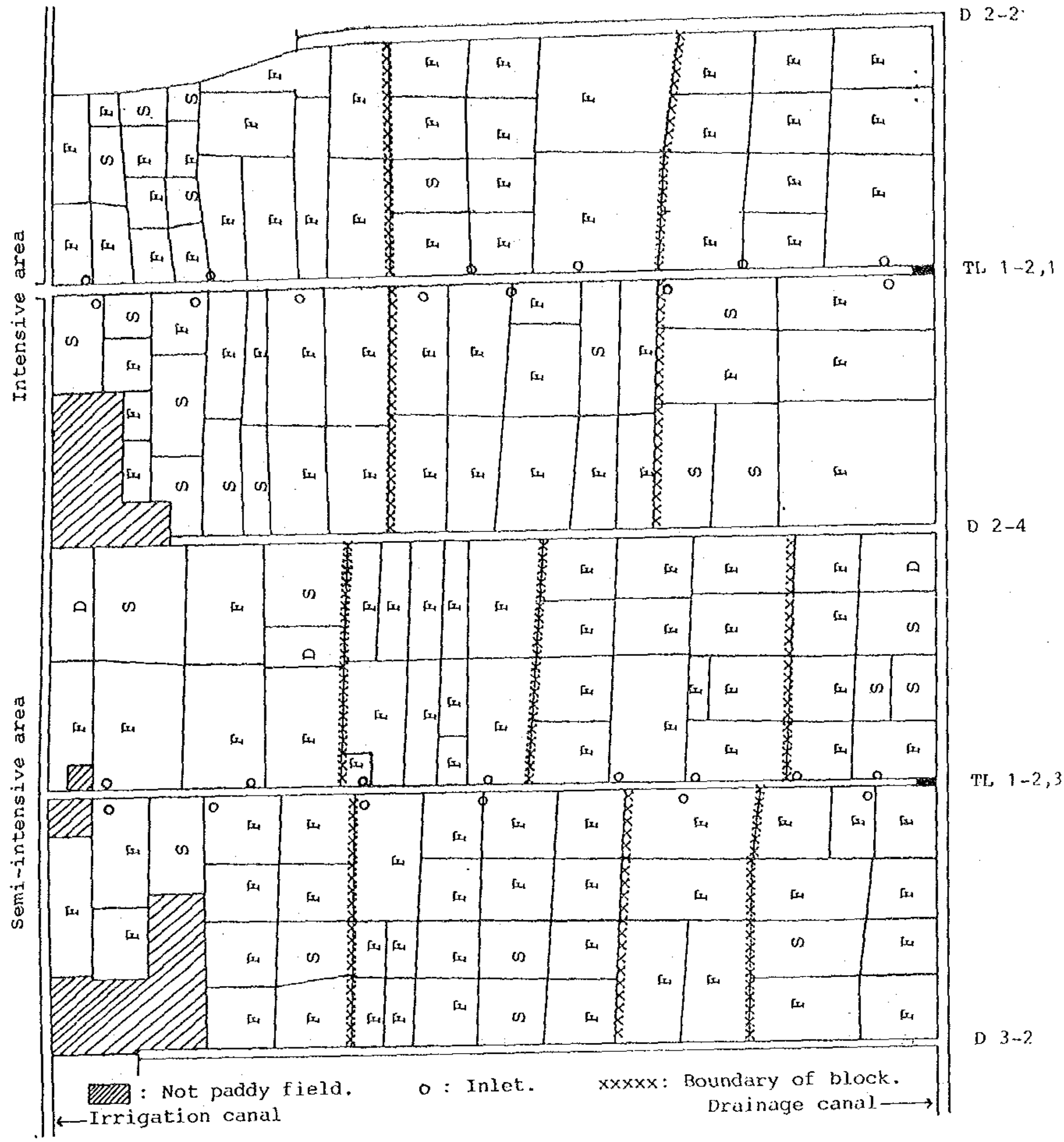


F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 14-2 Water condition of paddy field (April 27).

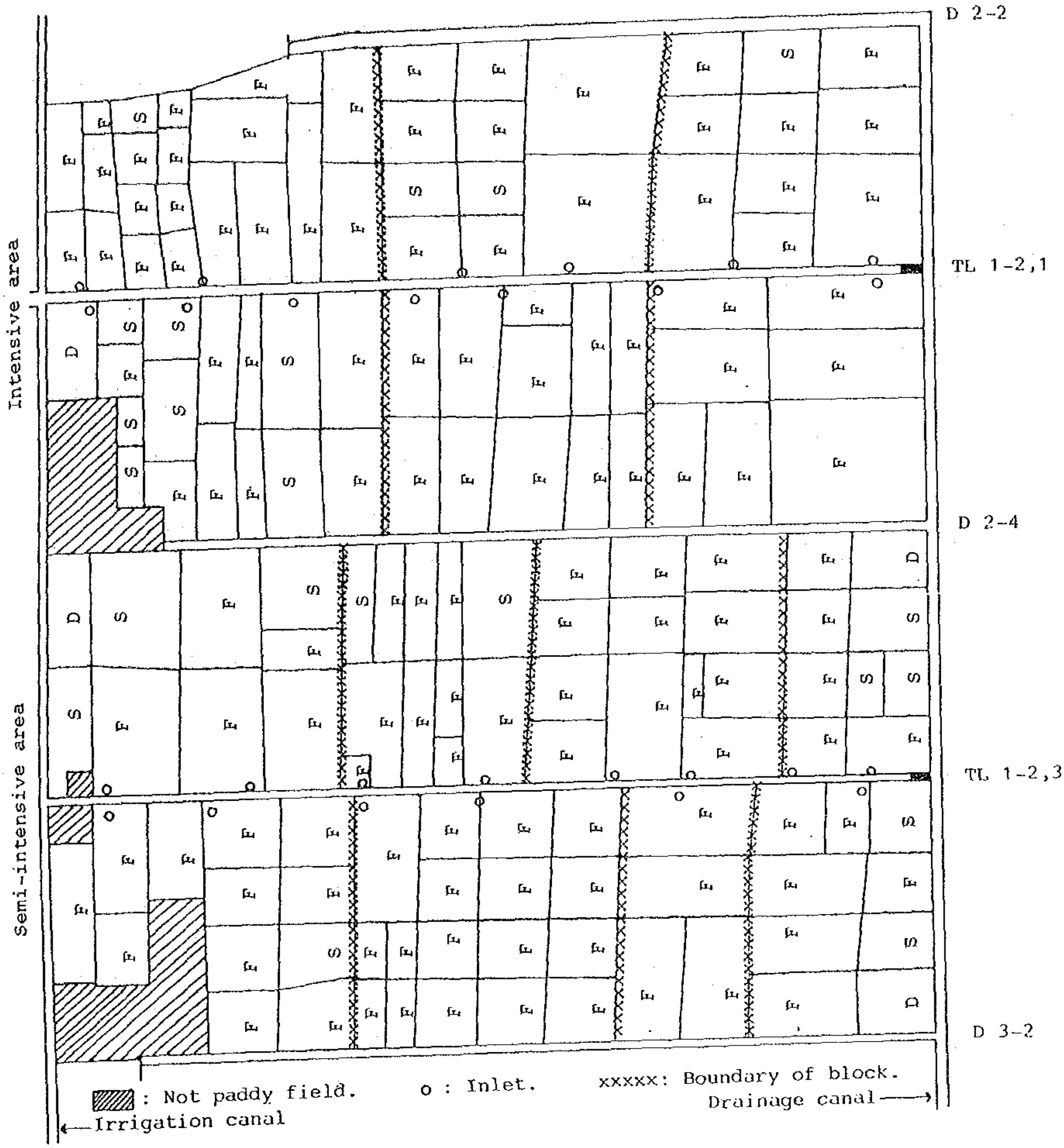


F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 14-3 Water condition of paddy field (May 6).

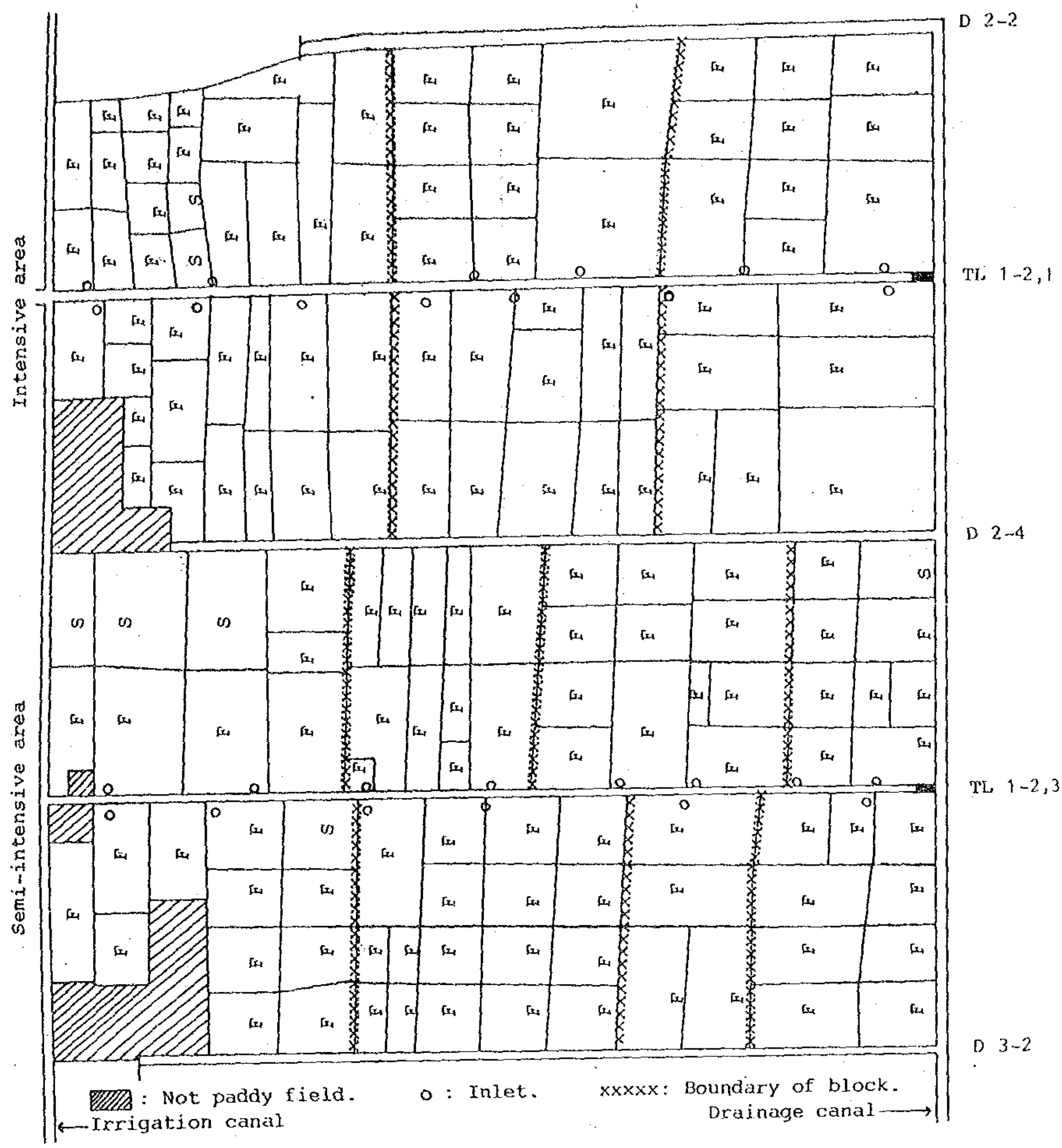


F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 14-4 Water condition of paddy field (May 11).

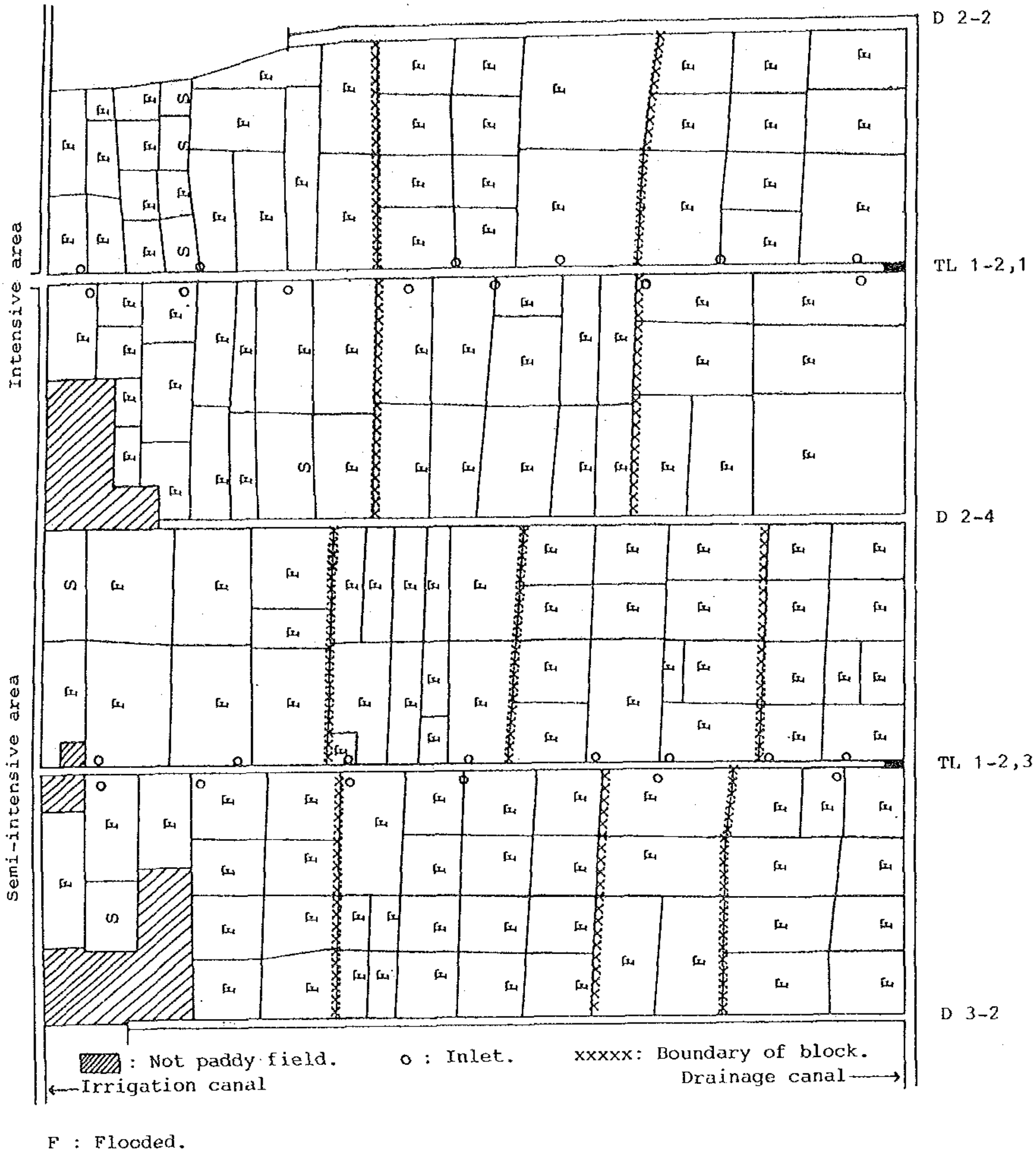


F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 14-5 Water condition of paddy field (May 19).

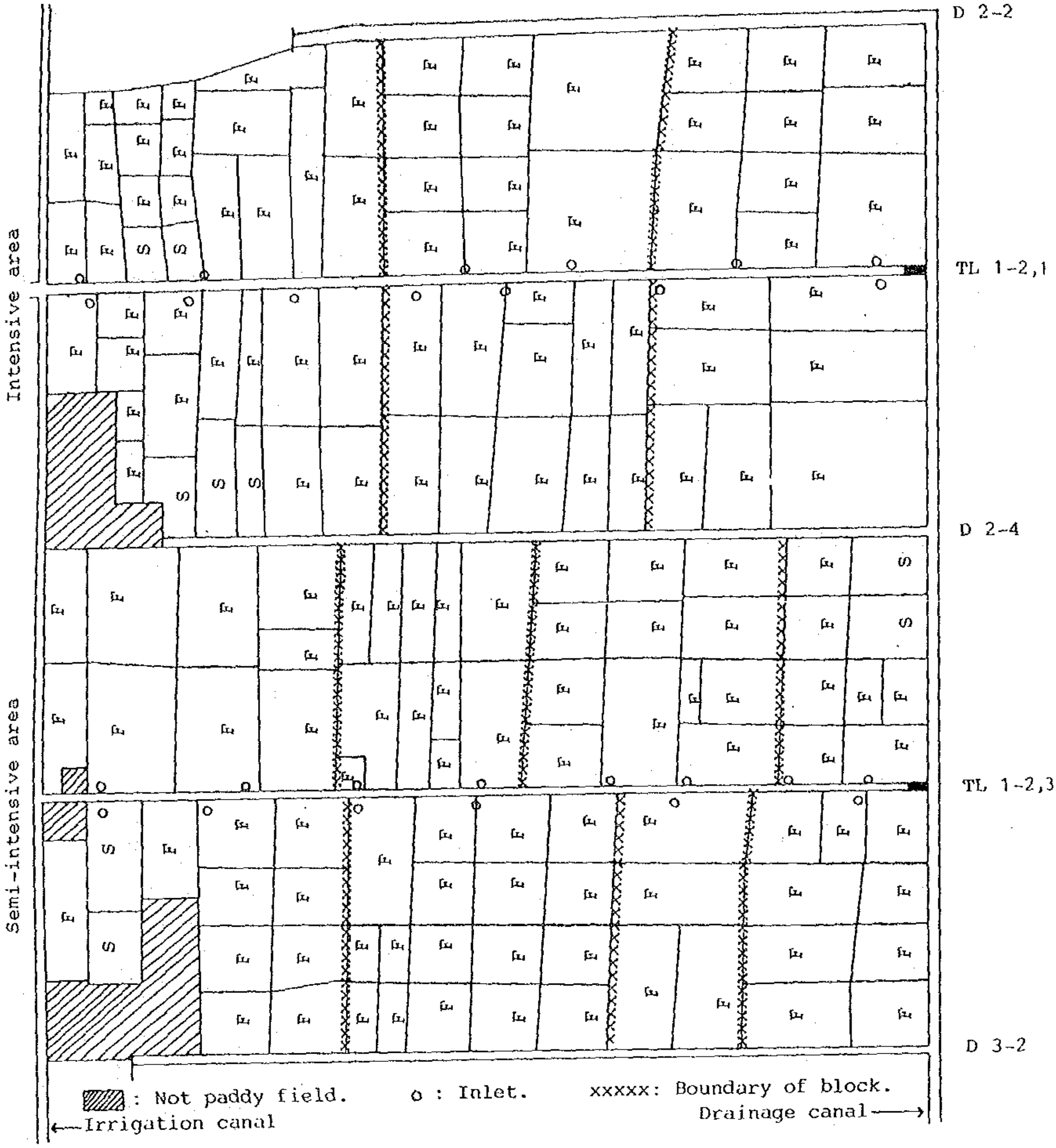


F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 14-6 Water condition of paddy field (May 25).

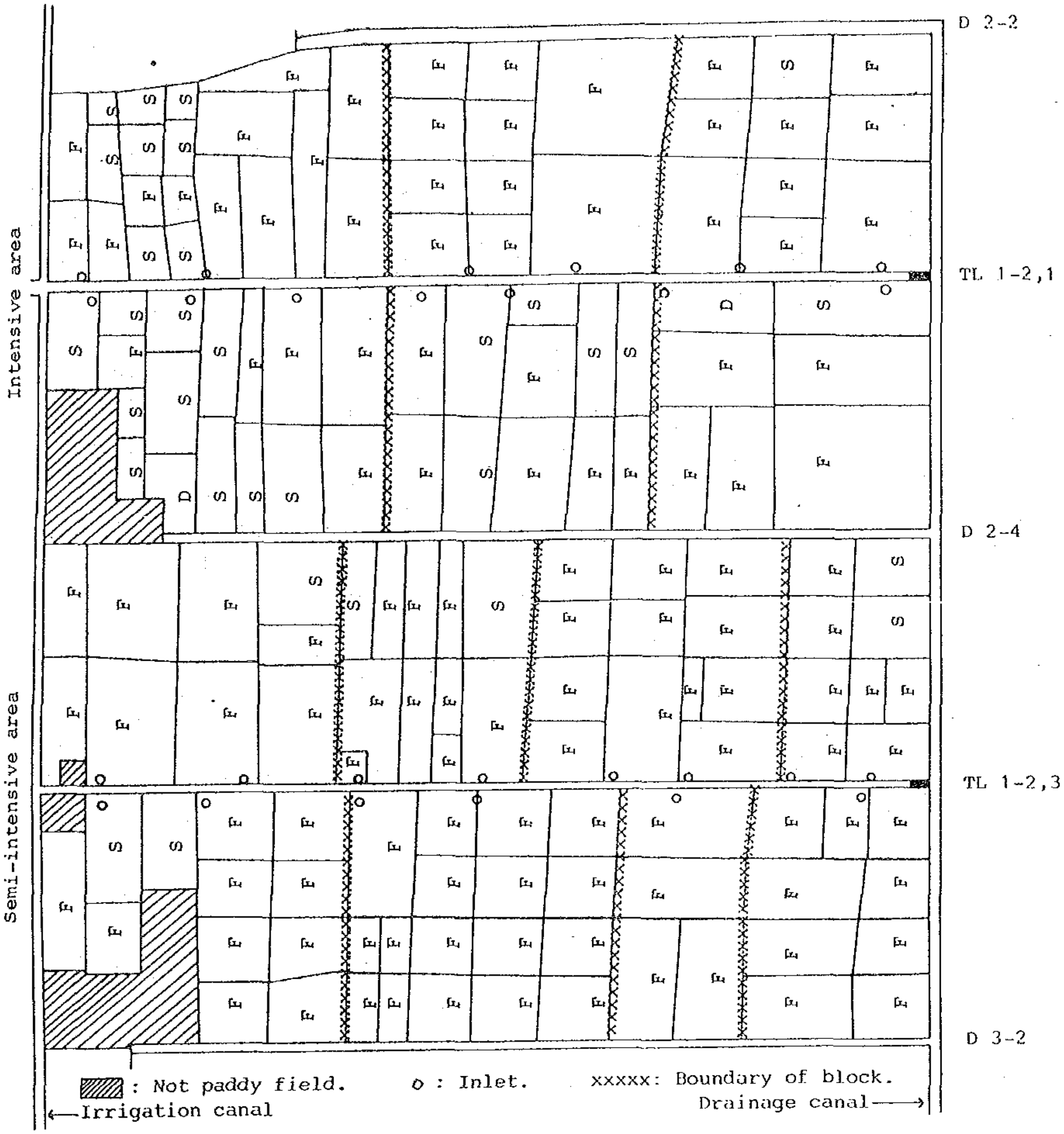


F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 14-7 Water condition of paddy field (June 2).

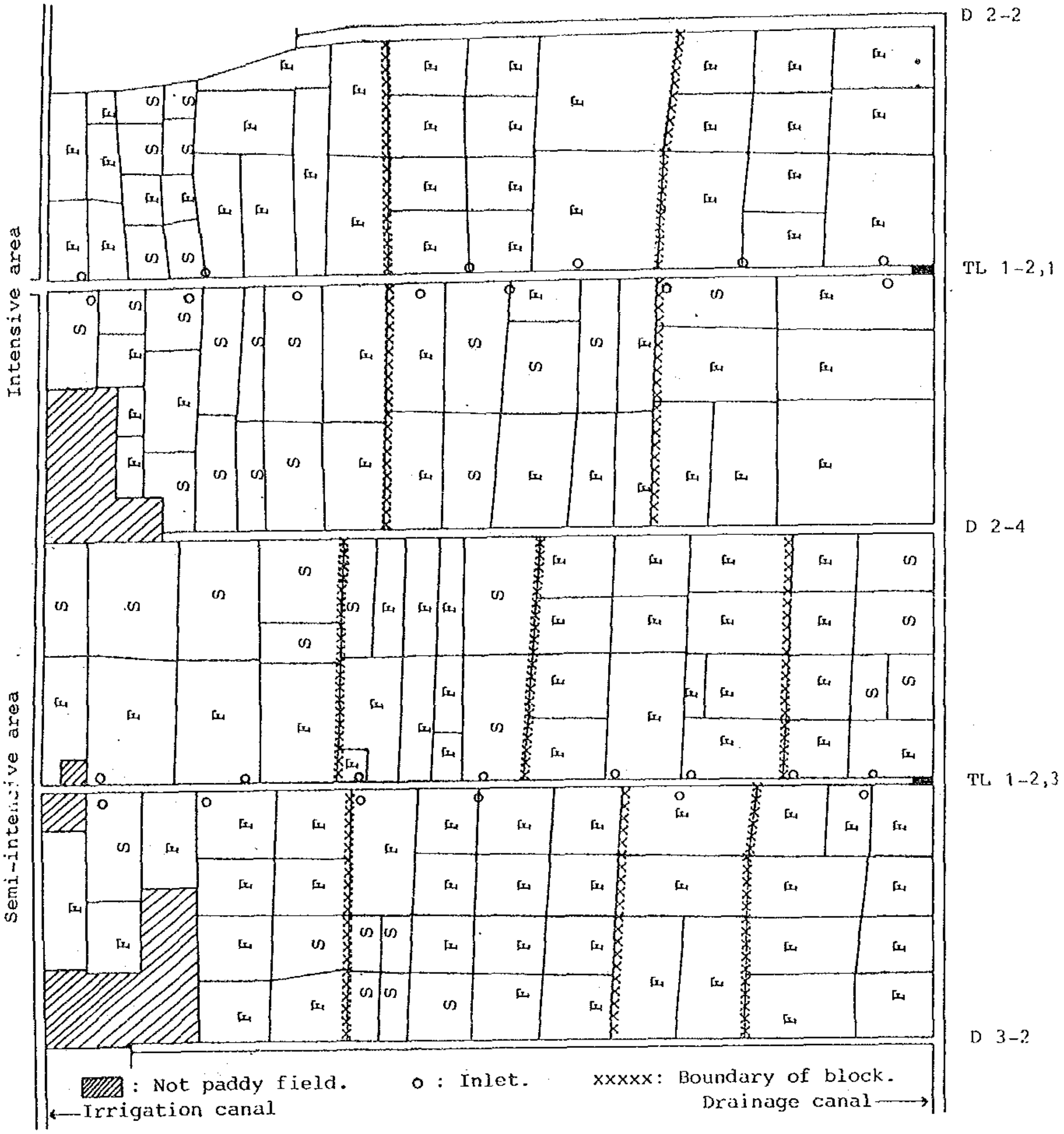


F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 14-8 Water condition of paddy field (June 10).

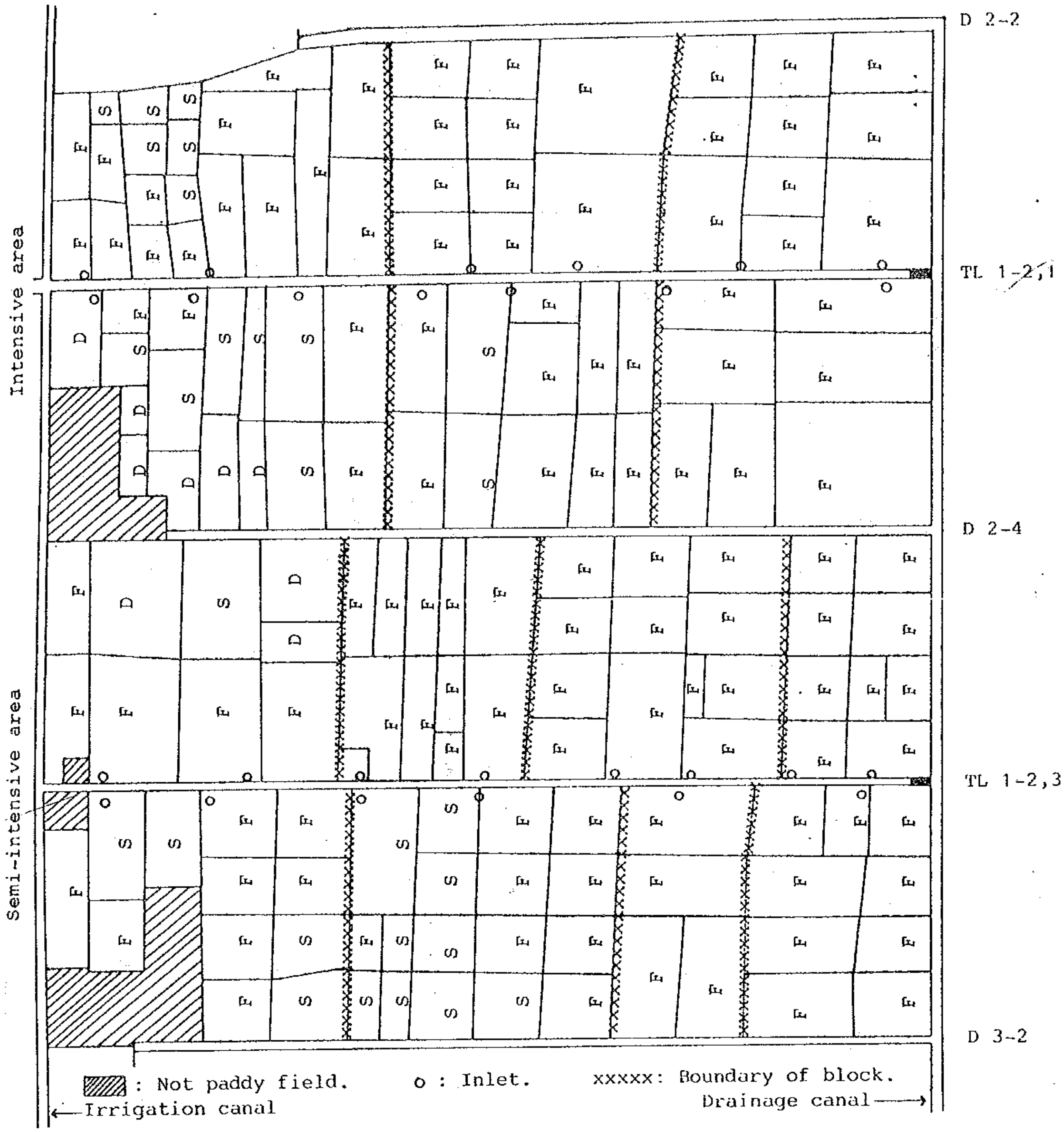


F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 14-9 Water condition of paddy field (June 15).

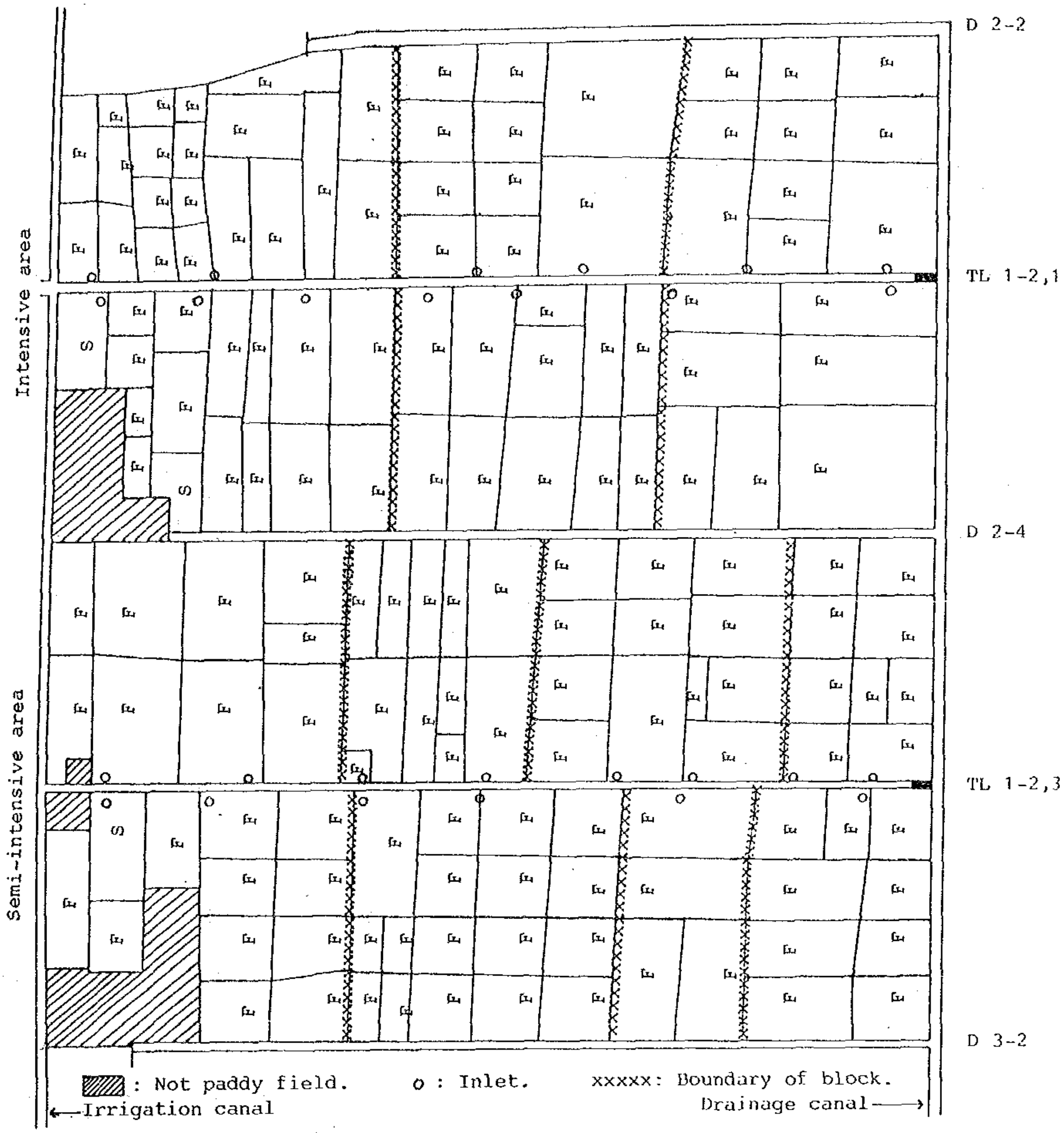


F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 14-10 Water condition of paddy field (June 24).

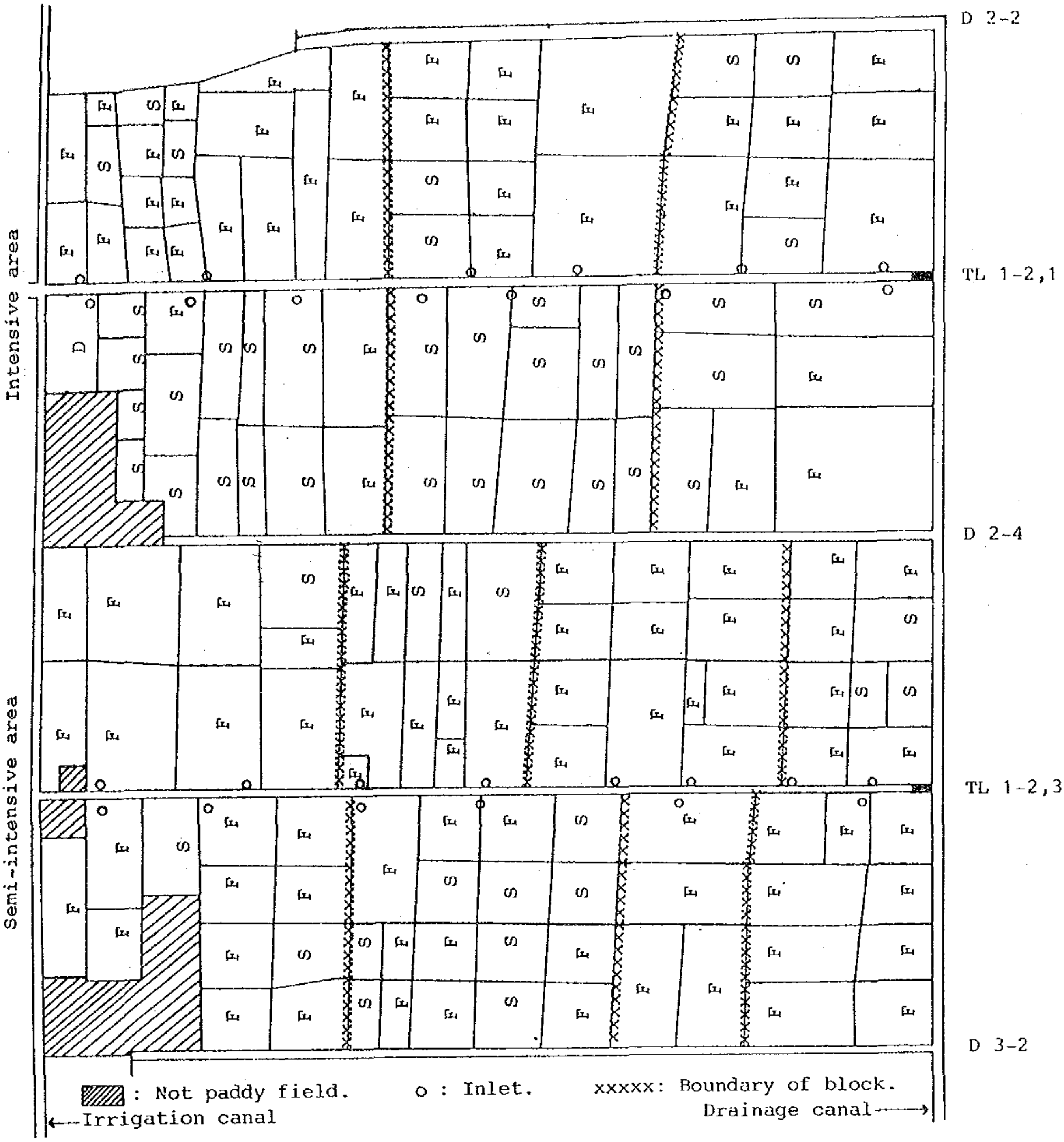


F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 14-11 Water condition of paddy field (June 30).

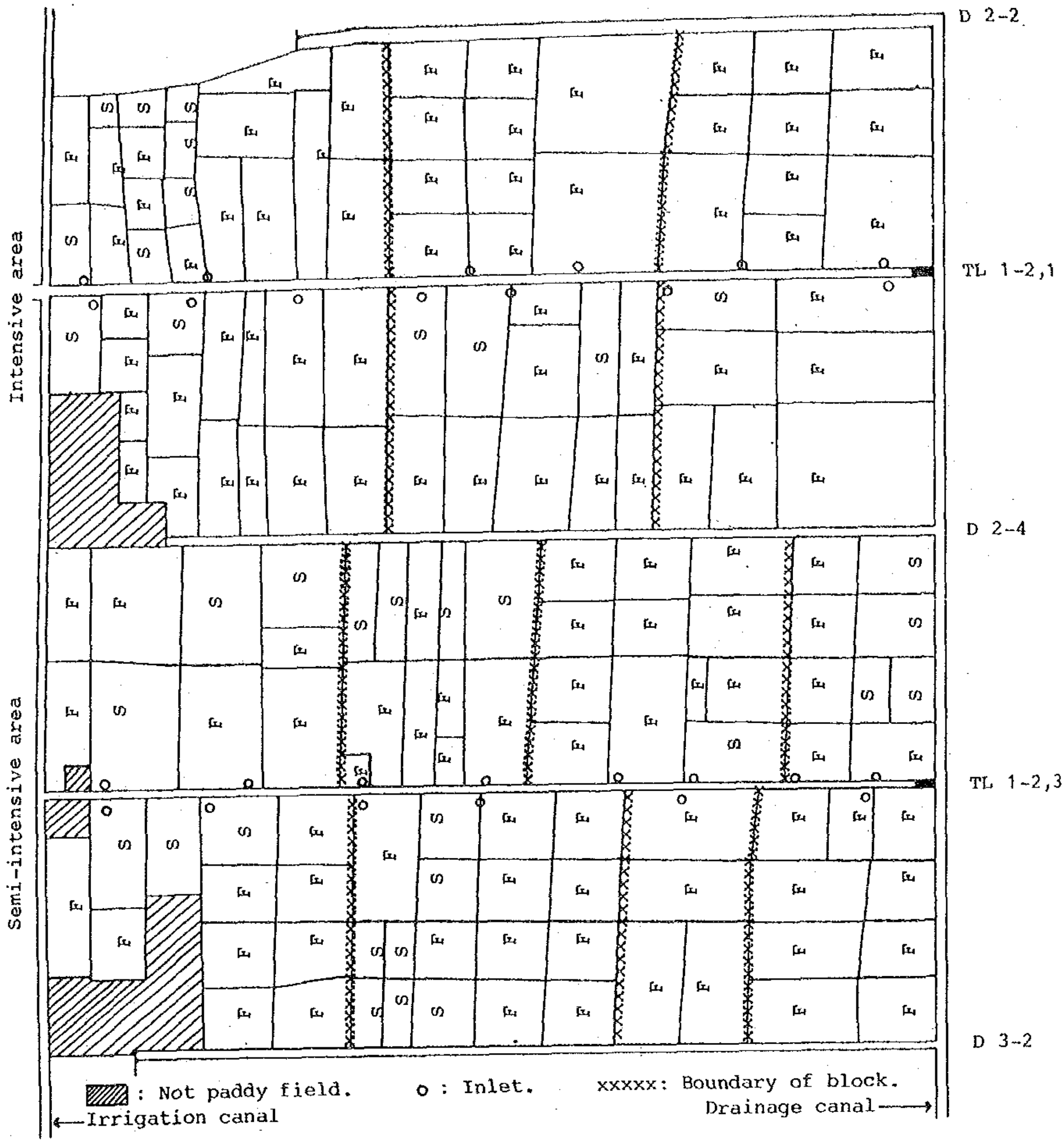


F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 14-12 Water condition of paddy field (July 7).



F : Flooded.

S : Saturated - More than 20 % of the surface soil has no standing water, but the most surface soil is visually water saturated.

D : Dried - More than 20 % of the surface soil is visually not water saturated.

Appendix 15-1 Daily water depth at different points in intensive area (mm).

Date	B 1, P1		B 1, P 2		B 1, P 3		B 2, P 4		B 2, P 5		B 3, P 6		B 3, P 7		B 4, P 8		B 4, P 9		B 5, P 10		B 5, P 11		B 6, P 12	
	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.
Apr. 19	0		24		43		59		122		25		88		0		34		0		27		24	
20	22	-22	34	-10	32	11	59	0	100	22	44	-19	100	-22	40	-40	30	4	0	0	20	7	12	12
21	0	22	29	5	43	-11	58	1	60	40	44	0	68	32	50	-10	64	-34	0	0	27	- 7	0	12
22	0	0	28	1	29	14	67	- 9	40	20	35	9	55	13	31	19	63	1	0	0	27	0	0	0
23	0	0	20	8	23	6	65	2	20	20	25	10	42	13	24	7	60	3	0	0	27	0	0	0
24	38	-38	20	0	20	3	50	15	106	-86	4	21	0	42	2	22	37	23	0	0	25	2	0	0
25	20	18	29	- 9	18	2	62	-12	87	19	0	4	0	0	1	1	35	2	0	0	16	9	40	-40
26	2	18	20	9	16	2	36	26	52	35	0	0	0	0	60	-59	50	-15	0	0	0	16	55	-15
27	1	1	20	0	1	15	20	16	30	22	0	0	63	-63	75	-15	44	6	20	-20	0	0	60	- 5
28	0	1	43	-23	0	1	10	10	0	30	0	0	62	1	50	25	44	0	10	10	60	-60	65	- 5
29	0	0	22	21	32	-32	30	-20	40	-40	23	-23	85	-23	60	-10	63	-19	0	10	85	-25	85	-20
30	68	-68	10	12	5	27	20	10	0	40	0	23	74	11	40	20	50	13	0	0	120	-35	57	28
May 1	20	48	0	10	0	5	0	20	60	-60	0	0	11	63	27	13	43	7	0	0	105	15	60	- 3
2	0	20	2	- 2	0	0	89	-89	100	-40	0	0	0	11	0	27	40	3	0	0	100	5	60	0
3	0	0	20	-18	0	0	62	27	85	15	0	0	0	0	40	-40	21	19	0	0	80	20	50	10
4	0	0	22	- 2	23	-23	41	21	70	15	61	-61	118	-118	23	17	19	2	0	0	45	45	52	- 2
5	0	0	20	2	21	2	37	4	50	20	60	1	125	- 7	17	6	13	6	0	0	59	-14	47	5
6	0	0	14	6	15	16	42	- 5	43	7	52	8	134	- 9	52	-35	20	- 7	0	0	95	-36	45	2
7	61	-61	38	-24	29	-14	31	11	34	9	45	7	124	10	32	20	38	-18	0	0	117	-22	45	0
8	34	27	25	13	55	-26	56	-25	89	-55	19	26	107	17	30	2	43	- 5	0	0	126	- 9	67	-22
9	3	31	25	0	31	24	120	-64	94	- 5	30	-11	68	39	53	-23	48	- 5	0	0	129	- 3	52	15
10	0	3	28	- 3	28	3	93	27	76	18	56	-26	97	-29	84	-31	72	-24	0	0	102	7	64	-12
11	0	0	28	0	43	-15	52	41	74	2	52	4	96	1	70	14	70	2	37	-37	90	12	62	2
12	0	0	26	2	42	1	39	-37	73	1	51	1	95	1	63	7	73	- 3	25	12	94	- 4	54	8

Note. B : Block No., P : Measuring point No., W.L. : Water level, R.D. : Water requirement in depth.

Date	B 1, P 1		B 1, P 2		B 1, P 3		B 2, P 4		B 2, P 5,		B 3, P 6		B 3, P 7		B 4, P 8		B 4, P 9		B 5, P 10		B 5, P 11		B 6, P 12	
	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.
May 13	0	0	25	1	54	-12	30	9	72	1	49	2	130	-35	59	4	89	- 4	23	2	95	- 1	115	-61
14	0	0	20	5	50	4	20	10	45	27	63	-14	130	0	50	9	88	1	45	-22	95	0	110	5
15	30	-30	30	-10	34	16	60	-40	145	-100	20	43	130	0	40	10	80	8	40	5	95	0	107	3
16	35	- 5	30	0	35	- 1	80	-20	102	43	50	-30	100	30	32	8	72	8	50	-10	82	13	140	-33
17	32	3	29	1	35	0	78	2	92	10	49	1	96	4	95	-63	65	7	47	3	68	14	123	17
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	48	-	97	-	33	-	0	-	74	-	82	-	20	-	65	-	75	-	130	-	47	-	20	-
21	32	16	41	56	50	-17	17	-17	20	54	50	32	63	-43	78	-13	93	-18	12	118	78	-31	89	-69
22	20	12	30	11	25	25	25	- 8	64	-44	44	6	57	6	53	25	81	12	0	12	88	-10	72	17
23	9	11	28	2	30	- 5	0	25	94	-30	60	-16	30	27	40	13	72	9	0	0	100	-12	57	15
24	0	9	28	0	43	-13	82	-82	65	29	40	20	77	-47	79	-39	65	7	10	-10	83	17	78	-21
25	0	0	26	2	26	17	40	42	83	-18	30	10	44	33	78	1	73	- 8	36	-26	115	-32	100	-22
26	0	0	30	- 4	10	16	12	28	58	25	39	- 9	74	-30	93	-15	110	-47	31	5	115	0	119	-19
27	62	-62	10	-20	22	-12	5	7	58	0	30	9	36	38	82	11	101	9	28	3	120	- 5	80	39
28	52	10	32	-22	44	-22	49	-44	50	8	25	5	29	7	76	6	83	18	25	3	112	8	69	11
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	0	-	25	-	32	-	13	-	50	-	29	-	59	-	87	-	74	-	20	-	105	-	54	-
31	0	0	20	5	26	6	10	3	42	8	27	2	58	1	92	- 5	84	-10	13	7	130	-25	54	0
June 1	0	0	17	3	20	6	3	7	30	12	22	5	48	10	81	11	72	12	40	-27	131	- 1	47	7
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	21	-	110	-	12	-	19	-	7	-	5	-	36	-	87	-	65	-	10	-	79	-	92	-
10	85	-64	103	7	0	12	0	19	0	7	0	5	8	28	75	12	53	12	0	10	110	-31	110	-18
11	0	85	20	83	0	0	0	0	0	0	0	0	0	8	50	25	45	8	0	0	107	3	80	30
12	0	0	30	-10	0	0	10	-10	0	0	0	0	0	0	45	5	40	5	0	0	98	9	70	10

Date	B 1, P 1		B 1, P 2		B 1, P 3		B 2, P 4		B 2, P 5		B 3, P 6		B 3, P 7		B 4, P 8		B 4, P 9		B 5, P 10		B 5, P 11		B 6, P 12	
	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.
June 13	0	0	28	2	0	0	32	-22	0	0	0	0	0	0	37	8	13	10	0	0	89	9	62	8
14	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	0	0	20	-	0	-	27	-	0	-	20	-	65	-	70	-	28	-	20	-	87	-	115	-
16	0	0	20	0	0	0	20	7	0	0	20	0	61	4	68	2	21	7	32	-12	86	1	117	- 2
17	10	-10	23	- 3	0	0	15	5	0	0	15	5	60	1	63	5	20	1	30	2	86	0	116	1
18	0	10	37	-14	0	0	51	-36	13	-13	0	15	56	4	60	3	17	3	30	0	90	- 4	76	40
19	0	0	45	- 8	0	0	60	- 9	18	- 5	0	0	53	3	52	8	10	7	34	- 4	123	-33	71	5
20	0	0	32	13	0	0	62	- 2	40	-22	0	0	48	5	61	- 9	10	0	41	- 7	138	-15	70	1
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	0	-	30	-	0	-	58	-	37	-	0	-	42	-	60	-	9	-	41	-	132	-	68	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	0	-	12	-	0	-	44	-	25	-	0	-	35	-	51	-	0	-	29	-	121	-	69	-
25	0	0	24	-12	0	0	51	-47	12	13	0	0	60	-25	35	16	19	-19	13	16	113	8	43	26
26	0	0	37	-13	15	-15	54	- 3	7	5	0	0	54	6	30	5	18	1	0	13	104	9	37	6
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	5	-	18	-	2	-	31	-	3	-	1	-	46	-	19	-	3	-	0	-	80	-	15	-
30	5	0	14	4	0	2	11	20	0	0	0	1	38	8	10	9	5	- 2	0	0	75	5	5	10
July 1	75	-70	20	- 6	0	0	46	-35	0	0	0	0	22	16	0	10	2	3	0	0	68	7	2	3
2	52	23	20	0	0	0	41	5	17	-17	23	-23	16	6	0	0	0	2	0	0	51	17	0	2
3	31	21	16	4	0	0	40	1	20	- 3	28	- 5	10	6	0	0	11	-11	0	0	23	28	9	- 9
4	0	31	24	- 8	0	0	39	1	34	-14	26	2	0	10	40	-40	29	-18	0	0	0	23	17	- 8
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	0	-	18	-	0	-	37	-	24	-	22	-	0	-	37	-	18	-	0	-	0	-	38	-
7	0	0	13	5	0	0	36	1	0	24	0	22	0	0	35	2	12	6	20	-20	0	0	60	-22
8	0	0	10	3	0	0	25	11	0	0	0	0	0	0	22	13	7	5	12	8	0	0	56	4

Table 15-2 Daily water depth at different points in semi-intensive area (mm).

Date	B 1,P 1		B 1,P 2		B 1, P 3		B 1, P 4		B 2, P 5		B 2,P 6		B 2,P 7		B 2,P 8	
	W.L.	R.D	W.L	R.D.	W.L	R.D	W.L.	R.D.	W.L	R.D	W.L.	R.D.	W.L	R.D	W.L.	R.D.
Apr. 19	21		68		103		0		25		44		21		98	
20	20	1	66	2	82	21	15	-15	25	0	24	20	40	-19	85	13
21	21	1	57	9	90	- 8	62	-47	90	-65	64	-40	52	-12	92	- 7
22	28	- 7	70	-13	92	- 2	39	23	66	24	63	1	52	0	96	- 4
23	52	-24	81	- 9	92	0	0	39	50	16	58	5	55	- 3	92	4
24	32	20	78	3	79	13	59	-59	30	20	46	12	48	7	101	- 9
25	20	12	65	13	79	0	50	9	13	17	40	6	38	10	78	23
26	14	6	65	0	67	12	29	21	10	3	35	5	60	-22	64	14
27	3	11	61	4	36	31	0	29	50	-40	28	7	21	39	58	6
28	3	0	50	11	30	6	29	-29	100	-50	50	-22	27	- 6	63	- 5
29	45	-42	60	-10	45	-15	45	-16	62	38	65	-15	72	-45	109	-46
30	29	16	55	5	43	2	0	45	30	32	49	16	60	12	95	14
May 1	2	27	45	10	38	5	0	0	20	10	22	27	30	30	66	29
2	0	2	41	4	22	16	45	-45	0	20	0	22	29	1	58	8
3	0	0	44	- 3	30	- 8	85	-40	0	0	27	-27	21	8	32	26
4	35	-35	41	3	41	-11	87	- 2	87	-87	21	6	19	2	15	17
5	28	7	53	-12	32	9	62	25	69	18	15	6	15	4	0	15
6	25	3	47	- 6	45	13	50	12	50	19	14	1	0	15	58	-58
7	69	-44	80	-33	2	43	155	-105	25	25	18	- 4	0	0	53	5
8	34	35	83	- 3	10	- 8	98	57	24	1	14	4	97	-97	109	-56
9	20	14	66	17	50	-40	43	55	10	14	14	0	73	24	123	-14
10	20	0	65	1	38	12	38	5	8	8	11	3	56	17	89	34
11	20	0	64	1	21	17	30	8	45	-37	26	-15	40	16	77	12
12	25	- 5	70	- 6	12	9	18	12	42	3	45	-19	23	17	46	31
13	48	-23	84	-14	10	2	0	18	39	3	42	3	0	23	20	26

Date	B 3,P 9		B 3,P 10		B 3,P 11		B 3,P 12		B 4, P13		B 4, P 14		B 4, P 15		B 4, P 16	
	W.L	R.D	W.L	R.D.	W.L.	R.D	W.L.	R.D.	W.L.	R.D	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.
Apr. 19	60		112		42		40		45		80		39		26	
20	72	-12	110	2	39	3	30	10	48	- 3	83	- 3	30	9	10	16
21	64	8	100	10	30	9	17	13	38	10	72	10	15	15	0	10
22	45	19	94	6	25	5	15	2	30	8	67	5	10	5	0	0
23	40	5	72	22	20	5	15	0	20	10	44	23	1	9	2	- 2
24	40	0	40	32	32	-12	10	5	20	0	34	10	28	-27	15	-13
25	33	7	24	16	50	-18	53	-43	20	0	0	34	27	1	38	-23
26	65	-32	55	-31	65	-15	41	12	20	0	8	- 8	26	1	22	16
27	64	1	80	-35	53	12	55	-14	20	0	27	-15	18	8	28	- 6
28	54	10	80	0	41	12	54	1	15	5	48	-21	16	2	21	7
29	64	-10	115	-35	63	22	75	-21	31	-16	82	-34	27	-11	45	-24
30	60	4	130	-15	69	- 6	109	-34	46	-15	100	-18	27	0	77	-32
May 1	64	- 4	127	3	69	0	87	22	50	- 4	100	0	46	-19	59	18
2	60	4	74	53	76	- 7	95	- 8	49	1	80	20	60	-14	65	- 6
3	45	15	51	23	57	19	86	9	37	12	68	12	41	19	58	7
4	32	13	24	27	52	5	72	14	29	8	41	27	20	21	37	21
5	39	- 7	3	21	20	32	53	19	20	9	0	41	2	18	24	13
6	37	2	78	-75	61	-41	85	-32	20	0	46	-46	0	2	66	-42
7	77	-40	85	- 7	-	-	109	-24	-	-	56	-10	13	-	81	-
8	36	41	91	- 6	-	-	130	-21	75	-	62	-14	36	-23	10	71
9	77	-41	100	- 9	-	-	120	10	70	5	70	- 8	80	-44	85	-75
10	76	1	103	- 3	-	-	87	33	68	2	90	-20	47	33	36	49
11	75	1	116	-13	-	-	62	25	64	4	92	- 2	43	4	30	6
12	70	5	113	3	-	-	50	12	59	5	93	- 1	38	5	23	7
13	69	1	120	- 7	-	-	50	0	57	2	100	- 7	35	3	20	3

Note. B : Block No., P : Measuring point No., W.L. : Water level, R.D. : Water requirement in depth.

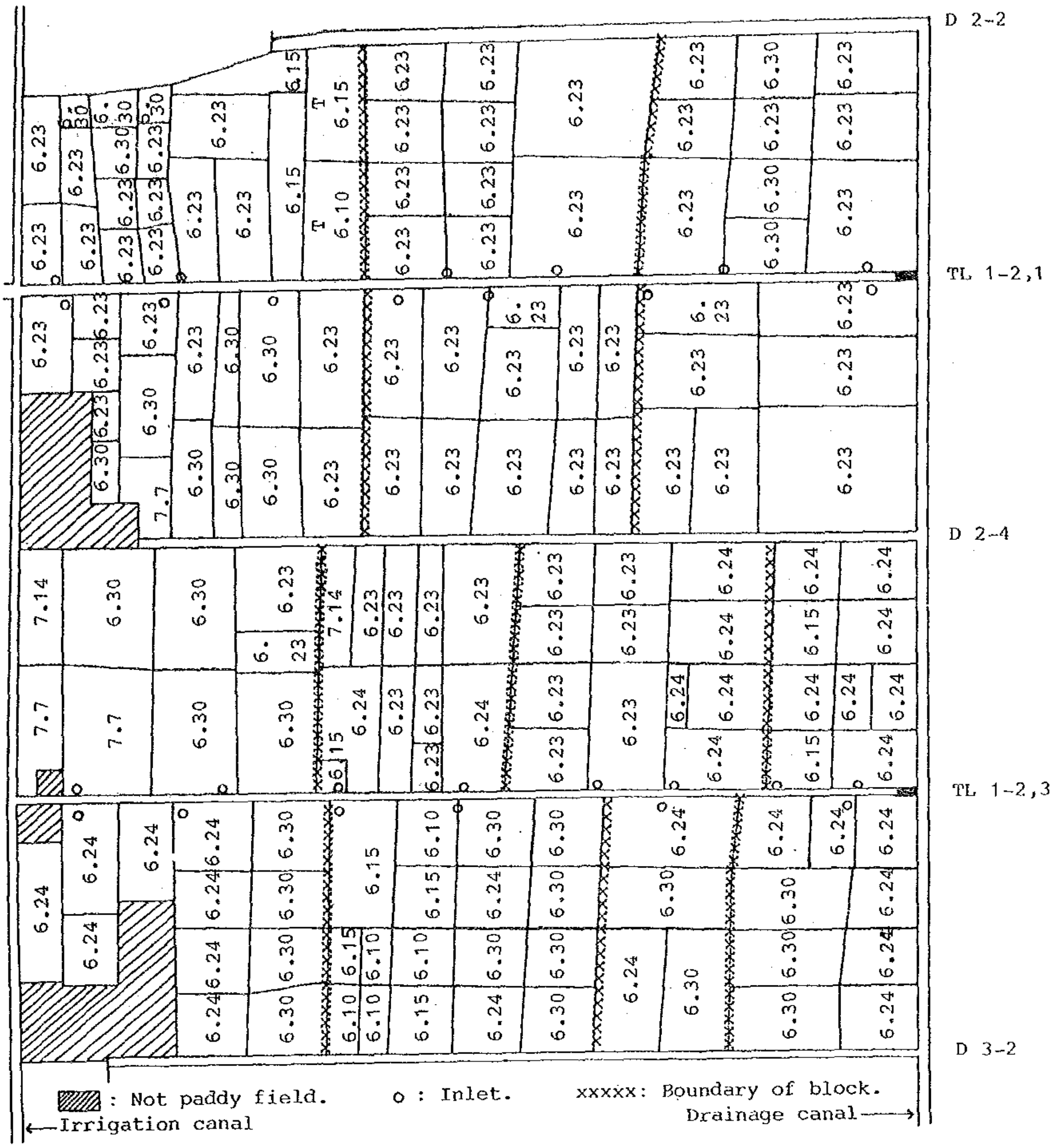
Date		B 1,P 1 W.L.	B 1,P 1 R.D.	B 1,P 2 W.L.	B 1,P 2 R.D.	B 1,P 3 W.L.	B 1,P 3 R.D.	B 1,P 4 W.L.	B 1,P 4 R.D.	B 2,P 5 W.L.	B 2,P 5 R.D.	B2, P 6 W.L.	B2, P 6 R.D.	B 2,P 7 W.L.	B 2,P 7 R.D.	B 2,P 8 W.L.	B 2,P 8 R.D.
May	14	59	-11	106	-22	28	-18	0	0	31	8	48	- 6	30	-30	49	-29
	15	50	9	96	10	17	11	137	-137	35	- 4	52	- 4	27	3	42	7
	16	56	- 6	104	- 8	60	-43	102	35	50	-15	43	9	27	0	40	2
	17	52	4	93	11	54	6	97	5	45	5	37	6	20	7	32	8
	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	48	-	97	-	33	-	0	-	74	-	82	-	20	-	65	-
	21	52	- 4	95	2	93	-60	150	-150	70	4	56	26	0	20	64	1
	22	45	7	92	3	63	30	78	72	60	10	55	1	47	-47	70	- 6
	23	36	9	74	18	62	1	61	17	45	15	30	25	69	-22	62	8
	24	35	1	70	4	37	25	48	13	28	17	24	6	40	29	83	-21
	25	42	- 7	70	0	50	-13	82	-34	10	18	16	8	25	15	76	7
	26	34	8	61	9	74	-24	68	14	70	-60	76	-60	72	-47	89	-13
	27	57	-23	75	-14	100	-26	73	- 5	39	31	47	29	44	28	72	17
	28	57	0	90	-15	107	- 7	150	-77	37	2	43	4	26	18	63	9
	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	30	90	-	130	-	93	-	91	-	36	-	60	-	6	-	54	-
	31	102	-12	147	-17	96	- 3	60	31	32	4	47	13	2	4	50	4
June	1	94	8	128	19	84	12	51	9	48	-16	50	- 3	57	-55	50	0
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	42	-	51	-	39	-	18	-	67	-	17	-	23	-	67	-
	10	55	-13	84	-33	51	-12	0	18	44	23	0	17	0	23	55	12
	11	65	-10	95	-11	44	7	0	0	40	4	0	0	0	0	60	- 5
	12	58	7	89	6	37	7	0	0	38	2	0	0	13	-13	60	0
	13	51	7	85	4	32	5	0	0	35	3	0	0	32	-19	65	- 5

Date		B 3, P 9 W.L.	B 3, P 9 R.D.	B 3,P 10 W.L.	B 3,P 10 R.D.	B 3,P 11 W.L.	B 3,P 11 R.D.	B 3,P 12 W.L.	B 3,P 12 R.D.	B 4,P 13 W.L.	B 4,P 13 R.D.	B 4,P 14 W.L.	B 4,P 14 R.D.	B 4,P 15 W.L.	B 4,P 15 R.D.	B 4,P 16 W.L.	B 4,P 16 R.D.
May	14	56	13	75	45	-	-	36	14	45	12	60	40	20	15	10	10
	15	55	1	80	- 5	-	-	25	11	89	-44	47	13	47	-27	10	0
	16	70	-15	80	0	-	-	23	2	85	4	47	0	56	- 9	11	- 1
	17	69	1	77	3	-	-	42	-19	73	12	42	5	48	8	7	4
	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	75	-	130	-	-	-	20	-	3	-	92	-	46	-	20	-
	21	62	13	78	52	-	-	52	-32	1	2	53	39	37	9	12	8
	22	50	12	50	28	-	-	87	-35	50	-49	38	15	52	-15	65	-53
	23	45	5	49	1	-	-	90	- 3	66	-16	28	10	52	0	62	3
	24	89	-44	97	-48	-	-	65	25	49	17	62	-34	41	11	41	21
	25	66	23	116	-19	-	-	62	3	45	4	85	-23	23	18	11	30
	26	58	8	120	- 4	-	-	98	-36	44	1	90	- 5	16	7	88	-77
	27	63	- 5	130	-10	-	-	135	37	50	- 6	100	-10	68	-52	110	-22
	28	72	- 9	118	12	-	-	150	15	45	5	105	- 5	80	-12	125	-15
	29	78	- 6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	30	73	5	104	-	-	-	135	-	70	-	104	-	80	-	110	-
	31	68	5	94	10	-	-	120	15	65	5	98	6	72	8	130	-20
June	1	61	7	84	10	-	-	103	17	47	18	93	5	61	11	112	18
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	68	-	117	-	-	-	95	-	51	-	65	-	14	-	60	-
	10	60	8	109	8	-	-	110	-15	57	- 6	77	-12	43	-29	78	-18
	11	48	12	80	29	-	-	105	5	46	11	52	25	40	3	75	3
	12	50	- 2	90	-10	-	-	100	5	54	- 8	73	-21	69	29	100	-25
	13	52	- 2	100	-10	-	-	130	-30	52	2	72	1	65	4	100	0

Date	B 1,P 1		B 1,P 2		B 1,P 3		B 1,P 4		B 2,P 5		B 2,P 6		B 2,P 7		B 2,P 8	
	W.L.	R.D	W.L.	R.D.	W.L.	R.D	W.L	R.D.	W.L.	R.D	W.L.	R.D.	W.L.	R.D	W.L	R.D.
June 14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	51	-	88	-	30	-	0	-	26	-	0	-	31	-	70	-
16	46	5	81	7	32	-2	0	0	90	-64	29	-29	5	26	57	13
17	62	-16	87	-6	40	-8	10	-10	87	3	26	3	3	2	49	8
18	50	12	78	9	67	-27	97	-87	60	27	0	26	28	-25	71	-22
19	65	15	106	-28	46	21	90	7	60	0	0	0	20	8	65	6
20	71	-6	105	1	33	13	80	10	65	-5	0	0	19	1	62	3
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	70	-	102	-	30	-	73	-	62	-	0	-	17	-	60	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	57	-	89	-	15	-	50	-	48	-	0	-	12	-	37	-
25	53	4	78	11	0	15	41	9	32	16	7	-7	10	2	60	-23
26	68	-15	85	-7	128	-128	35	6	47	-15	-	7	18	-8	55	5
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	44	-	63	-	127	-	75	-	140	-	1	-	0	-	42	-
30	40	4	61	2	113	14	63	12	168	-28	0	1	0	0	38	4
July 1	62	-22	91	-30	131	-18	57	6	187	-19	0	0	0	0	24	14
2	32	30	47	44	123	8	50	7	180	7	0	0	0	0	18	6
3	21	11	29	18	110	13	41	9	173	7	0	0	0	0	9	9
4	19	2	18	11	104	6	91	-50	165	8	0	0	0	0	58	-49
5	20	-1	24	-6	87	17	66	25	92	73	10	-10	0	0	47	11
6	19	1	36	-12	78	9	47	19	33	59	20	-10	0	0	32	15
7	19	0	36	0	50	28	37	10	10	23	22	-2	0	0	32	0
8	17	2	22	14	40	10	22	15	2	8	15	7	0	0	21	11

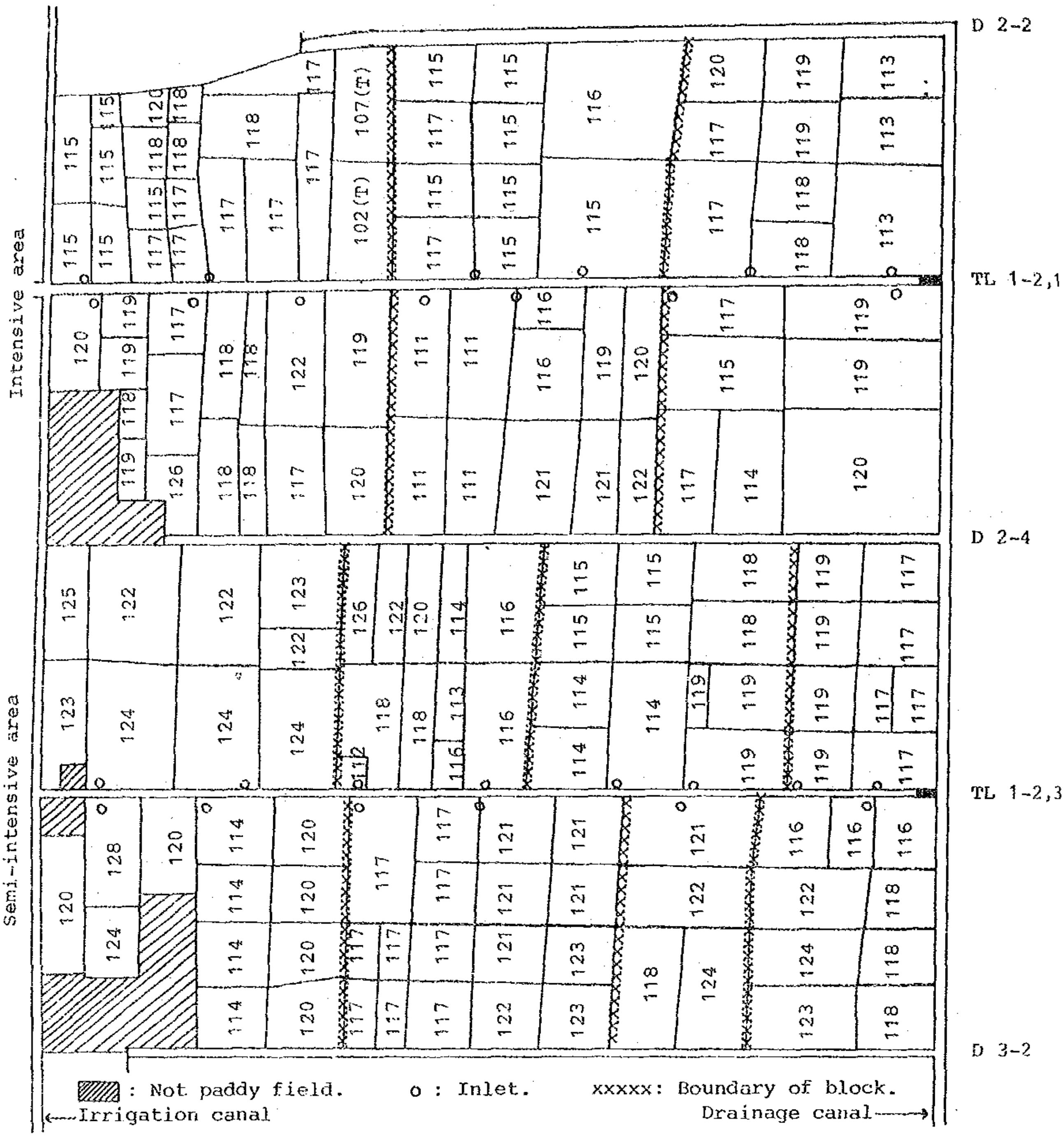
Date	B 3,P 9		B 3,P 10		B 3,P 11		B 3,P 12		B 4,P 13		B 4,P 14		B 4,P 15		B 4,P 16	
	W.L.	R.D	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D.	W.L.	R.D	W.L.	R.D.
June 14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	67	-	98	-	-	-	120	-	65	-	68	-	61	-	92	-
16	75	-8	114	-16	-	-	155	-35	65	0	81	-13	87	-26	120	-28
17	67	8	100	14	-	-	150	5	63	2	80	1	80	7	118	2
18	67	0	110	-10	-	-	142	8	72	-9	85	-5	94	-14	120	-2
19	95	-28	115	-5	-	-	165	-23	70	2	82	3	95	1	135	-15
20	82	13	100	15	-	-	157	8	80	-10	106	-24	93	2	130	5
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	78	-	102	-	-	-	155	-	78	-	106	-	92	-	131	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	71	-	80	-	-	-	163	-	72	-	126	-	110	-	122	-
25	69	2	101	-21	-	-	151	12	70	2	108	18	105	5	118	4
26	66	3	100	1	-	-	144	7	77	-7	80	28	92	13	108	10
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	57	-	80	-	-	-	138	-	46	-	51	-	61	-	94	-
30	51	6	61	19	-	-	120	18	51	-5	60	-9	35	26	77	17
July 1	44	7	52	9	-	-	112	8	43	8	61	-1	0	35	50	27
2	41	3	47	5	-	-	71	41	19	24	50	11	0	0	41	9
3	43	-2	53	-6	-	-	37	34	0	19	47	3	0	0	0	41
4	44	-1	65	-12	-	-	2	35	0	0	35	12	0	0	0	0
5	42	2	47	18	-	-	10	-8	22	-22	36	-1	0	0	0	0
6	41	1	33	14	-	-	22	-12	30	-8	36	0	0	0	0	0
7	40	1	32	1	-	-	21	1	30	0	36	0	0	0	0	0
8	22	18	18	14	-	-	3	18	21	9	18	18	0	0	0	0

Appendix 16 Date of flowering.



T : Transplanted field

Appendix 17 Growth duration (from sowing to harvesting) at different fields.



Note: T-transplanted field (from transplanting to harvesting).

Appendix 18 Distribution of growth duration.

Growth duration	Experimental area				Comparative area		
	Area (m^2)	%[a]	%	% Accum.	Area (m^2)	%	% Accum.
102	3,339	1.8 T	-	-	-	-	-
107	3,080	1.7 T	-	-	-	-	-
111	12,531	6.9	7.2	7.2	-	-	-
112	-	-	-	-	463	0.3	0.3
113	10,125	5.6	5.8	13.0	1,891	1.0	1.3
114	3,250	1.8	1.9	14.9	17,523	9.6	10.9
115	30,170	16.7	17.3	32.3	7,531	4.1	15.0
116	11,455	6.3	6.6	38.8	13,239	7.2	22.2
117	36,266	20.0	20.8	59.6	21,714	11.9	34.1
118	16,570	9.1	9.5	69.1	20,752	11.4	45.5
119	22,090	12.2	12.6	81.7	12,189	6.7	52.2
120	18,357	10.1	10.5	92.2	14,598	8.0	60.2
121	5,788	3.2	3.3	95.5	13,047	7.1	67.3
122	5,307	2.9	3.0	98.5	18,613	10.2	77.5
123	-	-	-	-	13,485	7.4	84.9
124	-	-	-	-	21,042	11.5	96.4
125	-	-	-	-	2,293	1.3	97.7
126	2,779	1.5	1.6	100.0	1,716	0.9	98.6
127	-	-	-	-	-	-	-
128	-	-	-	-	2,530	1.4	100.0
Total	181,107				182,626		

a : Including transplanted area.

Appendix 19 Water discharge in a main drainage canal.

Date		Quantity (m^3/sec)	Period mean (m^3/sec)	Quantity (m^3/day)	Period (days)	Total amount (m^3)
March	2	0.040	–	–	–	–
	6	0.080	0.060	5184	4	20736
	12	0.180	0.130	11232	6	67392
	16	0.250	0.215	18576	4	74304
	19	0.345	0.298	25747	3	77241
	20	0.445	0.395	34128	1	34128
	21	0.621	0.533	46051	1	46051
	23	0.737	0.679	58666	2	117332
	26	0.819	0.778	67219	3	201657
	27	0.837	0.828	71539	1	71539
	30	0.839	0.838	72403	3	217209
April	4	0.820	0.830	71712	5	358560
	9	0.568	0.693	59875	5	299375
	11	0.454	0.511	44150	2	88300
	15	0.475	0.465	40176	4	160704
	19	0.491	0.483	41731	4	166924
	22	0.411	0.451	38966	3	116898
	24	0.333	0.372	32141	2	64282
	27	0.464	0.399	34474	3	103422
May	2	0.574	0.519	44842	5	224210
	8	0.347	0.461	39830	6	238980
	15	0.636	0.492	42509	7	297563
	17	0.752	0.694	59962	2	119924
	18	1.517	1.135	98064	1	98064
	21	1.403	1.460	126144	3	378432
	28	0.351	0.877	75773	7	530411
	31	0.505	0.428	36979	3	110937
June	4	0.550	0.528	45619	4	182476
	5	0.958	0.754	65146	1	65146
	11	0.689	0.824	71194	6	427164
	15	0.185	0.437	37757	4	151028
	19	0.313	0.249	21514	4	86056
	22	0.345	0.329	28426	3	85278
	26	0.412	0.379	32746	4	130984
	29	0.330	0.371	32054	3	96162
Total or Mean			0.536	46293	119	5508869

Appendix 20 Amount of water supplied to 1L-1R canal in 1984 dry season.

Month		Permanent Pump Ø 24 inch		Temporary Pump						Total Quantity (M^3)
				Ø 12 inch		Ø 10 inch		Ø 8 inch		
		hr	Wq	hr	Wq	hr	Wq	hr	Wq	
Feb.	1	–	–	–	–	–	–	–	–	–
	2	199	360986	11	9900	–	–	–	–	370886
	3	317	575038	419	377100	–	–	–	–	952138
Mar.	1	414	750996	729	656100	–	–	–	–	1407096
	2	466	845324	678	610200	15	8640	–	–	1464164
	3	486	881604	741	666900	204	117504	–	–	1666008
Apr.	1	444	805416	653	587700	162	93312	–	–	1486428
	2	383	694762	492	442800	197	113472	14	5544	1256578
	3	242	438988	454	408600	409	235584	220	87120	1170292
May	1	230	417220	982	883800	402	231552	38	15048	1547620
	2	260	471640	1046	941400	333	191808	–	–	1604848
	3	286	518804	1113	1001700	423	243648	–	–	1764152
June	1	74	134236	1046	941400	410	236160	–	–	1311796
	2	72	130608	731	657900	213	122688	–	–	911196
	3	225	408150	788	709200	145	83520	–	–	1200870
Jul.	1	139	252146	–	–	–	–	–	–	252146
	2	–	–	–	–	–	–	–	–	–
	3	–	–	–	–	–	–	–	–	–
Total		4237	7685918	9883	8894700	2913	1677888	272	107712	18366218

Note : Formular of the Calculation

Permanent Pump : Ø 24 ( ) hr x 0.504 m^3/s x 3600 s/hr = ( ) hr x 1814 m^3/hr

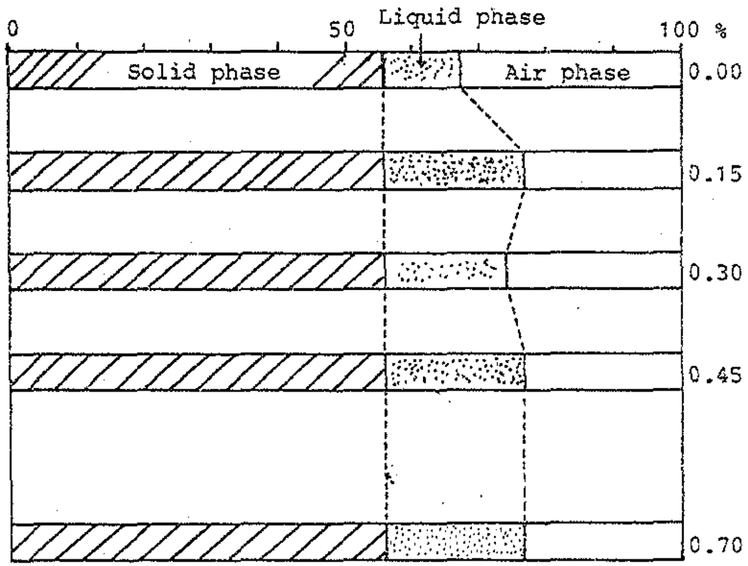
Temporary Pump : Ø 12 ( ) hr x 0.250 m^3/s x 3600 s/hr = ( ) hr x 900 m^3/hr

: Ø 10 ( ) hr x 0.160 m^3/s x 3600 x hr = ( ) hr x 576 m^3/hr

: Ø 8 ( ) hr x 0.110 m^3/s x 3600 x hr = ( ) hr x 396 m^3/hr

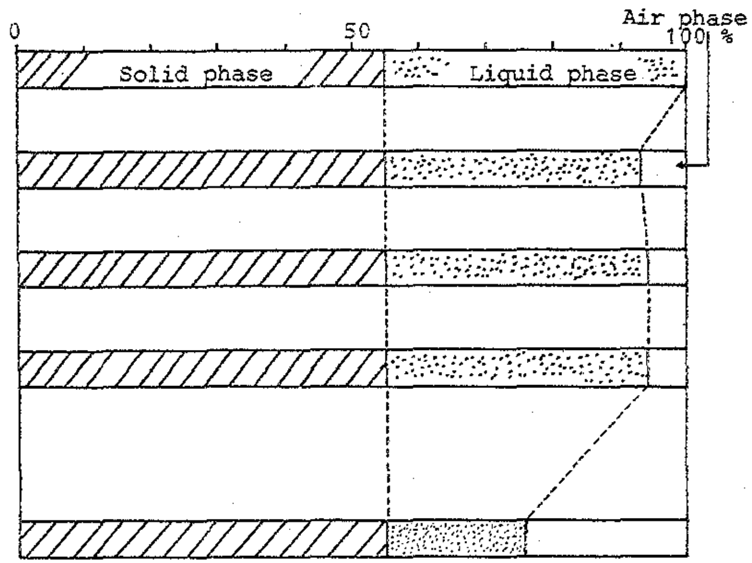
Appendix 21 Three phases of the soil and amount of soaking water[a].

1. Volume percentage before irrigation.



Soil depth (m).

2. Volume percentage after 3 days irrigation.



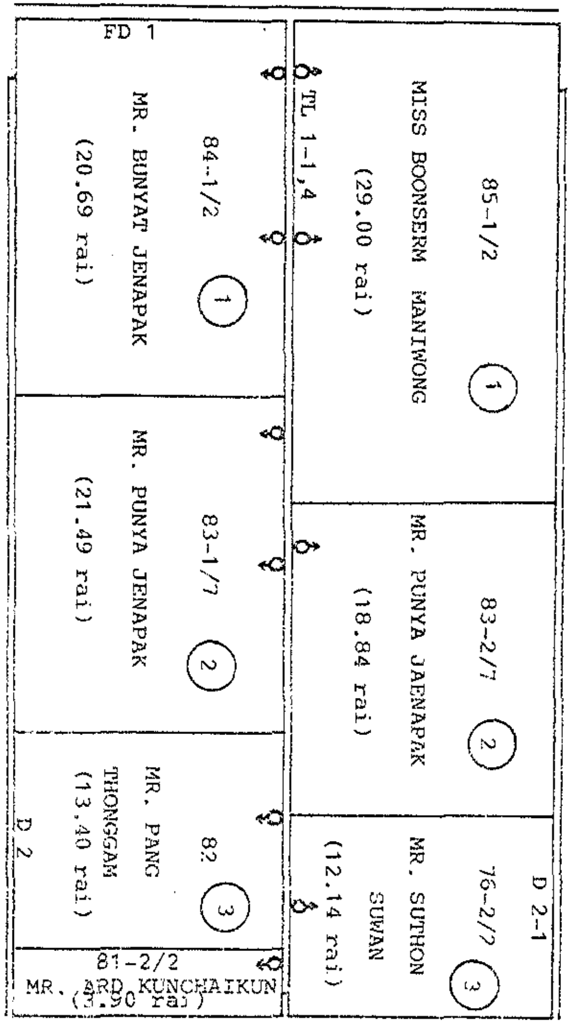
Water depth = Soil depth x Average Liquid phase

Soil depth (m)	Liquid phase (%)				Water depth (mm)
	Before	After	Water increased	Average	
Surface	11.9	44.7	32.8	-	-
0.02	22.1	38.6	16.5	24.7	5.0
0.15	22.1	38.6	16.5	16.5	21.0
0.30	19.3	38.9	19.6	18.1	27.0
0.45	22.0	39.3	17.3	18.5	28.0
0.70	22.0	22.0	0	8.7	22.0
Total					103.0

[a]From " Progress report on water management study ", p. 6, Murao, S., IADP, 1984.

Basic data were from " Fundamental survey for water management ", Nakajima, J. and K. Misawa, IADP, 1983.

Appendix 22 Example of proposed rotational irrigation schedule in pilot project No. 1[a].



Rotation unit	Plot No.	No. of Inlet	Name	a (rai)	a' (rai)	E.I.T. (hr)	Irrigation Time (hr)
1	84-1/2	2	Mr. Bunyat	20.69	a x 1.0	a'/A' x 156	Mon 6.00
	85-1/2	2	Miss Boon-serm	29.00			Wed 18.00
Total		4		49.69	49.69	56	60
2	83-1/7	1	Mr. Punya	21.49	a x 1.2	a'/A' x 156	Wed 18.00
	83-2/7	2	Mr. Punya	18.84			Sat 6.00
Total		3		40.33	48.40	55	60
3	82	1	Mr. Pang	13.40	a x 1.4	a'/A' x 156	Sat 6.00
	81-2/2	1	Mr. Ard	3.90			
	76-2/2	1	Mr. Suthon	12.14			Mon 6.00
Total		3		29.44	41.22	46	48
Grand Total		10		A = 119.46	A' = 139.31	156	168

Irrigation time : 7 days x 24 hr = 168 hr.

E.I.T. (Effective Irrigation Time) : 168 hr - (3 unit - 1) x 6 hr = 156 hr.

[a]From " Rotational irrigation schedule in Mae Klong pilot project No. 1 ", Hisamoto, K., IADP, 1984.