付 属 資 料

NATIONAL WATER MANAGEMENT TRAINING CENTRE

KOTA BHARU, KELANTAN

WATER MANAGEMENT TRIALS IN PILOT FARMS FOR THE OFF-SEASON RICE CULTIVATION IN 1985

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BY ENGINEERING SECTION

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PREFACE

In recent years, it has been recognized that on-farm water management is essential for the successful implementation of irrigation projects. The *National Water Management Training Centre Project has been formulated* by the Government of Malaysia under the technical assistance of Japan through JICA. The Project envisages a long term plan to increase the rice production by fully utilizing the agricultural development potential in Malaysia. The components of the Project are summarized as follows.

1) Construction of four Pilot Farms and a Training Centre with facilities comprising an office building, a hostel and a demonstration farm.

2) Introduction of basic water management techniques at farm level.

3) Provision of training for engineers and other staff engaged in water management in irrigation schemes, in order to increase their capability and efficiency.

Problems and difficulties which prevent proper on-farm water management can be identified and will be solved through the water management trials to be carried out in four Pilot Farms attached to the Centre. The first water management trials were conducted for the off-season rice cultivation in 1985. This report summarizes the results of the trials in three Pilot Farms, No.1, 2 and 3. The trial in P/F No.4 could not be carried out because of the delay in the construction work.

Through the trials, many findings, both structural and operational have been found in achieving proper water management. These findings will be usefull in designing and operating on-farm facilities in future. However, the findings arrived at through the trials in 1985 may have been rather limited, because they were carried out under comparatively favorable conditions, i.e., frequent rainfall. By means of continuing the water management trials in the consecutive cropping seasons, many other findings could be found and these would be very important for the future of on-farm development and proper water management in Malaysia.

It is our hope that this report will be useful for the future of on-farm development and water management and also for the utilization of consecutive water management trials.

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1. OBJECTIVES

It is recognized that on-farm water management is substantial for saving irrigation water as well as for introducing improved paddy cultivation. For a proper on-farm water management, however, it will be necessary to solve many problems and difficulties which hinder its successful implementation. These problems or difficulties should be made clear and should be solved through water management trials to be carried out in Pilot Farms attached to the Centre. The water management trials were carried out, for the first time, in three Pilot Farms; No.1, 2 and 3 for the off-season rice cultivation in 1985. The trial in P/F No.4 has not been conducted because it is still under construction. The aims of proper water management are summarized as follows.

1) to supply enough water for rice cultivation,
2) to minimize irrigation water losses,
3) to evenly distribute irrigation water to each lot,
4) to keep the water in a lot at a suitable depth for rice cultivation,
5) to increase the cropped area in Pilot Farms, and finally
6) to contribute to the increase of rice production.

In order to achieve the above aims, the water management trials have been put into practice with the following objectives.

1) to identify problems and difficulties in executing proper on-farm water management,
2) to analyse causes of the problems and difficulties,
3) to find out solutions for the above,
4) to provide recommendations on layout planning, design and construction of on-farm facilities for future use,
5) to establish proper operation and maintenance procedures of Pilot Farms and finally,
6) to establish on-farm water management techniques.

For the execution of water management trials, four criteria on the water management have been established and routine procedures for the trial have been developed. These will also be utilized as useful teaching materials at the Centre.

2. METHOD OF WATER MANAGEMENT TRIALS

2.1 Preparatory Work

Prior to the commencement of the water management trials, the following preparatory work was carried out both in the office and at the field.

(1) The criteria for water management trials

For a proper water management and for making an appropriate judgement of the results of the water management trials, the following four criteria have been established. (More information on the criteria is mentioned in Part III of the Technical Notes on On-farm Water Management).

1. Irrigation efficiency ; IE

IE = (qin-qout)/qin x 100 (%)

qin : Inflow to a drainage unit (l/sec)
qout: Outflow from the drainage unit (l/sec)

2. Even distribution of water ; ED

ED = qn/(Qin x R) x 100 (%)

Qin : Inflow to a Pilot Farm (l/sec)
qn : Inflow to a lot or an irrigation block (l/sec)
R : Distribution rate, R=a/A
a : Irrigated area of a lot or an irrigation block (ha)
A : Total irrigated area of a Pilot Farm (ha)

3. Control of water depth in lot ; R

R = Sn/Tn x 100 (%)

Sn : Number of lots where water is kept at a suitable depth
Tn : Total number of lots measured

4. Presaturation ; P

$$P = Pa/Pp \times 100\ (\%)$$

Pa : Actual days spent for presaturation (day)
Pp : Planned period for presaturation (day)

For the above four criteria, the following standard figures have been tentatively determined as a target of the water management trials.

- -Irrigation efficiency ; IE is more than 80.
- -Even distribution of water ; ED is between 90 and 110.
- -Control of water depth in lot ; R is more than 80.
- -Presaturation ; P is between 50 and 120.

(2) Delineation of drainage unit and irrigation block

The above irrigation efficiency is based on the water balance in drainage units. The coefficient of even distribution is to be calculated for each irrigation block which is covered by one field off-take. Thus, it becomes necessary to delineate both drainage units and irrigation blocks within a Pilot Farm area. Taking the existing topographic, irrigation and drainage conditions into account, both drainage unit and irrigation block were delineated for each Pilot Farm as shown in Fig.2.1 to 2.3.

(3) Preparation of forms and relevant maps

For the easy recording and filling of data measured during the trials, various forms were prepared for each Pilot Farm. These consist of the following;

- -Form-1 Measurement of discharge
- -Form-2 Calculation of IE and ED
- -Form-3 Water depth survey in lot
- -Form-4 Gate operation
- -Form-5 Record of water management trials
- -Form-6 Summary of water management trials
- -Form-7 Summary of water depth survey

Maps showing the locations of points where the measurement of discharge is to be made and the selected lots for measurement of water depth were also prepared.

(4) Calibration of H-Q tables

For an easy observation of discharges, the H-Q tables have been calibrated at the following measuring points of discharge;

-Field canals at downstream of turnouts and field off-take
-Parshall flumes
-Triangular weirs
-Field outlets

For the calibration of H-Q tables, water discharge was measured at various sites by using current meters. At the same time, the gradient of field canals in all Pilot Farms were surveyed to find out the discrepancies between the design and the construction. After knowing the actual gradients, the H-Q tables were calibrated by using the micro computer, Macintosh. The list of programs developed for the calculation of discharge is attached in the Annex and the programs are neatly arranged in a disk for the use in future. The field canals in P/F No.2 and 3 are effected by backwater, thus the water discharge was measured directly by using a current meter.

Many discrepancies were found between the designed and the actual gradients of canals. The result of survey is shown in Table 2.1.

(5) Repairing of leakage and clearing of field canals

During the course of discharge measurements in the field canals in P/F No.1, many leakages were found. The leakages were concentrated in joints of flumes and in an inlet and outlet box of the siphon installed under the access to the field. It is obvious that proper distribution of irrigation water cannot be achieved and much water loss will take place when the amount of leakage is considerable. Thus all the leakage was repaired by filling it with clayey soil or mortar. Silt and debris deposited in field canals were cleared as far as possible before the commencement of the water management trials.

In P/F No.2, the embankment of the drainage canal had collapsed because of the heavy rainfall. The damaged portion was repaired and an additional field outlet was installed. These were carried out by a contractor.

(6) Installation of equipment for the water management trials

In evaluating the control of water depth in lots, it may be necessary to measure the depth of water in every lot in Pilot Farms. However, this work is monotonous and time consuming. Thus twelve representative lots have been selected from each Pilot Farm. Out of the twelve lots, four lots were selected from the elevated lots, four from the medium elevated and the remaining four from the low lying lots. In each selected lot, a peg with nails was fixed. Each lot has small undulations. It is difficult to appraise the average elevation of a lot. Therefore, the peg was placed just after transplanting, because a lot is filled with water and the average elevation of the lot can be easily estimated . Beside the pegs, the following were also used in Pilot Farm areas for the trials.

-One N-type lysimeter in each Pilot Farm
-One rainfall gauge in each Pilot Farm
-Four triangular weirs in P/F No.3
-One concrete rectangular weir in P/F No.1

(7) Replacement of stoplogs by sluice gate

In P/F No.1, stoplogs in four field off-takes, No.1-1, 2-1, 3-1 and 4-1 were replaced by a sluice gate made of steel, for easy adjustment of the distribution of water. In P/F No.2, two sluice gates were provided at the downstream of the turnout No.2 and 4.

(8) Adjustment of stoplogs in field off-takes and field canals

There are two methods in adjusting stoplogs depending on the difference in hight between the canal bottom and the surface of the lot.

In case the elevation of canal bottom is 5 to 10 cm higher than the elevation of lot as seen in P/F No.1, the water can be supplied easily to a lot without being influenced by the water level in the lot.

The stoplogs in the field off-take are to be adjusted so as that excessive water should not be allowed to the lot.

As seen in P/F No.2 and 3, no remarkable differences can be found between elevation of the bottom of field canal and of the lot: the water is distributed to the lot by mean of raising the water level in the field canal. In this case, both stoplogs in the field canal and the field off-take are to be adjusted so as to keep the water in the lot at a suitable depth. The methods of adjustment are mentioned in more detail in Chapter 4. These adjustments were carried out before the commencement of the trials.

(9) Adjustment of stoplogs in field outlet

The water depth in a lot is directly affected by the height of stoplogs in a field outlet. Considering the important function of stoplogs in field outlet, the height of all the stoplogs in Pilot Farm areas were adjusted by the staff at the Centre. The suitable height of each stoplog is summarized in Table 2.2 to 2.4 The figure in the table is a fixed figure and will also be useful for the water depth control in lots in consecutive cropping seasons.

Table 2.1 Comparison of the Designed and Actual Canal Gradients

PILOT FARM	NAME OF CANAL	DESIGNED GRADIENT	ACTUAL GRADIENT
No.1	FC1 TO1 to TO2	1/2000	1/960
	FC1 TO2 to TO3	1/2000	1/1300
	FC1 TO3 to TO4	1/2000	1/2500
	FC5	1/2000	1/1100
NO.2	FC1 TO1 to TO2	1/2270	1/2850
	FC1 TO2 to TO3	1/2270	1/1400
	FC1 TO3 to END	1/2270	1/14300
	FC2 TO1 to TO4	1/880	1/1000
	FC2 TO4 to TO5	1/880	1/1550
	FC2 TO5 to TO6	1/880	1/1800
	FC2 TO6 to END	1/880	1/400
No.3	FC1 TO1 to TO2	1/2700	1/3200
	FC1 TO2 to TO3	1/4400	1/4900
	FC2 upstream	1/4400	1/3800

Remarks ; FC and TO are the abbreviations of Field Canal and Turnout respectively. The locations of field canals and turnouts are shown in Fig.2.1, 2.2 and 2.3.

Table 2.2 Suitable Height of Steplogs in Outlets in F/F No.1

Name of Outlet	Suitable Height(cm)
d2	(not functioning)
d3	14.0
d4	(not functioning)
d5	25.0
d6	(not functioning)
d7	7.0
d8	(not functioning)
d9	14.0
d10	18.0
d11	(not functioning)
d12	10.0
d13	(not functioning)
d14	(not functioning)
d15	(not functioning)
d16	(not functioning)

Table 2.3 Suitable Height of Steplogs in Outlets in F/F No.2

Name of Outlet	Suitable Height(cm)
d1	35.0
d2	36.0
d3-1	26.0
d3-2	32.0
d4	31.0
d5	35.0
d6	31.0
d7	28.0
d8	20.0
d9	21.0

Table 2.4 Suitable Height of Stoplogs in Outlets in P/F No.3

Name of Outlet	Suitable Height(cm)	Name of Outlet	Suitable Height(cm)
1	16.0	26	28.0
2	6.0	27	34.0
3	24.0	28	25.5
4	22.0	29	16.5
5	8.0	30	31.0
6	17.0	31	13.0
7	26.0	32	0.0
8-1	20.0	33	20.0
8-2	36.0	34	14.0
9	26.0	35	24.0
10	12.0	36	27.5
11	38.5	37	25.0
12	24.5	38	4.0
13	25.0	39	1.0
14	17.0	40	22.0
15	19.0	41	21.0
16	28.0	42	17.0
17	18.0	43	8.0
18	25.0	44	18.0
19	24.0	45	12.5
20	23.0	46	0.0
21	17.0	47	9.0
22	29.5	48	8.5
23	24.5	49	18.5
24	29.0	50	8.0
25	19.0		

2.2 Field Work

Field work was carried out on a fixed date each week for three Pilot Farms, No.1, 2 and 3, respectively. The main field work of the water management trials is summarized below.

(1) Measurement of water discharge

Both inflow and outflow discharges were measured. Where the H-Q table had been calibrated, the water depth was measured by a steel scale. When no rating curve was available, the discharge was measured by one of the following three methods.

a. By a current meter

Because of backwater, the rating curve cannot be calibrated for the measuring points in field canals in P/F No.2 and 3. In such cases, a current meter was used for the measurement of discharges. The measurement was done at the point in the centre of the canal and at a point two-thirds of the way down from the surface.

b. By a triangular weir

For the measurment of outflow in field drains in P/F No.3, four triangular weirs with a 90 degrees notch were temporarily installed for the trials. The dimensions of a triangular weir are shown in Fig.2.4. The discharge from the weir can be calculated by the following formula.

$$Q = C\, h\text{\^{}}(5/2)$$

$$C = 1.353 + 0.004 + (0.014 + 0.2/ D)\,(h/B - 0.09)\text{\^{}}2$$

where, Q : discharge (m3/sec)
h : water depth (m)
C : coefficient of discharge
D : height of notch from the canal bottom (m)
B : canal width (m)

The above formula is applicable under the following conditions with an error of not more than 1.4 percent or less than -1.4 percent.

$0.5\ m < B < 1.2\ m$
$0.1\ m < D < 0.75\ m$
$0.07m < h < 0.26\ m$ and, $h < B/3$

The H-Q table showing the discharges under various conditions of water depth has been calibrated for the use at the site.

c. By a bucket or a measuring cylinder

At the measuring points where the above methods cannot be applied, a bucket with ruler or a measuring cylinder was used. In case the discharge was less than about 1.0 l/sec, the cylinder was used for measuring. The accuracy of the measurement was checked by a current meter and it was found that the measurement by a bucket or a measuring cylinder was reliable enough.

(2) Measurement of water depth in the selected lots

The water depth was measured in twelve selected lots in each Pilot Farm area, by means of a fixed peg and a steel scale. During the survey, water depth in other lots was also observed as far as possible. The result of the survey and observations was recorded in Forms and utilized for the operation of gates in Pilot Farms.

(3) Measurement of net water requirement

Net water requirement, which is the sum of evapotranspiration and percolation was measured daily at a fixed time by a N-type lysimeter installed in each Pilot Farm. At the same time, the rainfall was also recorded and the net water requirement was calculated.

(4) Patrol of on-farm facilities

During the course of the above measurements and observations, all the on-farm facilities were inspected paying attentions to the following points;

-No seepage is found from any part of the embankment,
-Gates and taps are properly operated,
-No damage is found as a result of rainfall or because of other factors.

(4) Operation of gates

Prior to operating any gates in a Pilot Farm, the IE and ED values were calculated at the site by using the result of the measurement of discharges. The IE value was used for operating the gate in the main off-take and the ED value for the gates in turnouts and field off-takes.

For saving irrigation water, the inflow discharge (Qin) at the main off-take was controlled so as to minimize the outflow discharge (Qout). The required inflow (Qre) was decided prior to the operation of the main off-take gate by using the following criteria. The gate was so operated that the inflow discharge became equal to the Qre.

In case Qout is observed and,

$IE > 80\%$ then, $Qre = Qin$
$IE < 80\%$ then, $Qre = Qin - 0.8\ Qout$

In case Qout is not observed,

$Qre = 1.1\ Qin$ and if $Qp > 1.1\ Qin$ then,
$Qre = Qp$

where, Qp is the net water requirement measured by a N-type lysimeter and calculated by the following formula.

$Qp = H \times A / 8.64$ (l/sec)

H : reading of N-type lysimeter (mm/day)
A : irrigated area (ha)

(5) Other observations

Beside the above surveys and measurements, the following were observed.

-Water level in KADA canal,
-Inflow discharge from the outside area,
-Seepage to drainage canal or to outside area,
-Illegal intake of irrigation water by farmers,
-Siltation in field canals,
-Damages of rice plant by rats, birds and so on.

And on the whole, it was confirmed that there was no shortage or excess of water in Pilot Farm areas.

2.3 Office Work

The data and information collected during the field work were noted down in Forms and the Forms were neatly arranged in files prepared for the respective Pilot Farms.

After the field work, a meeting was held between the senior staff of the Centre and Japanese experts on the same day that the field work was conducted. The personnel from MARDI who had participated in the water management trials, also attended the meeting occasionally. Every problem and difficulty encountered during the field work was discussed and countermeasures and actions to be taken to overcome the problems were discussed. The detailed schedule for the next field work was also determined.

2.4 Countermeasures Taken during the Trials

Based on conclusions of the meeting, necessary countermeasures were taken to diminish the cause of problems or difficulties on on-farm management. The work was mainly carried out by the staff at the Centre. Some heavy work such as repairing of canal breaches was made by a contractor. The main countermeasures taken during the trials are summarized below.

(1) Pilot Farm No.1

a. Repairing leakage in field canals,
b. Adjustment of batas in F/B No.4-2, where the water cannot be evenly distributed because of slight local undulations.
c. Installation of a concrete weir in the field canal to raise the water level in the canal.
d. Provision of a field ditch in order to convey water to the highly elevated lot, where water cannot be obtained by lot to lot practice.

(2) Pilot Farm No.2

a. Repairing a collapse in the drainage canal and provision of an additional field outlet to prevent further collapse.
b. The possibility of including the irrigable elevated irrigable land into Pilot Farm area,
c. Installation of a sluice gate in the turnout No.2 and 4.

(3) Pilot Farm No.3

a. Repairing drainage canals, from which considarable seepage was found,
b. Adjustment of stoplogs in field canals in order to ascertain the distribution of water to each lot,
c. Introduction of rotational irrigation during the normal growth stage of rice plant.

3. RESULTS OF WATER MANAGEMENT TRIALS

3.1 Pilot Farm No.1

The water management trial in P/F No.1 was conducted from May 7 to July 10, 1985. Field work was carried out regularly on Sundays. The regular visit to the site was made nine times during the period. Additional observations were made occasionally. The results of the water management trial for the off-season rice cultivation in 1985 are summarized in Table 3.1 to 3.3.

(1) Outflow discharge

During the initial stage of the trial, the outflow discharge (Qout) showed a large figure of about 28 l/sec. Consequently, the Qout was gradually decreased by means of reducing the inflow discharge (Qin). The gate of the main off-take was operated by the staff of the Centre. But, it was once operated by a watchman of KADA. This was against the practice suggested by the Centre. The Qout couldn't be reduced as expected. After Hari Raya, the supply of irrigation water was completely stopped for about a week. This time, the Qout was decreased by 2.6 l/sec. Throughout the period of the trial, the average Qout was 13.1 l/sec.

The record of outflow discharge is chronologically shown in Fig.3.1.a. When comparing the results of the water depth control shown in Fig.3.1.b, the following facts will be clear, though these facts should be confirmed more strictly during consecutive trials.

- The Qout is generally proportional to the Qin.
- When the Qin is more than 35 l/sec, the water in lots is kept at the suitable depth.
- In case the Qin becomes less than about 30 l/sec, water deficit will occur in about a half of lots in the pilot farm.
- It will be necessary to allow some amount of Qout to convey the water to all the lots in the farm.
- Data obtained in the sixth observation show fairly good results in the water depth control, irrigation efficiency and even distribution.
- The Qout in the sixth observation, 9.0 l/sec will be the minumum discharge required for conveying the water to all the lots in the farm satisfactorily.

As will be mentioned in Chapter 4, the water management loss in P/F No.1 will be equivalent to this Qout, namely 9.0 l/sec.

(2) Inflow discharge

When the water management trial was started, an inflow discharge (Qin) was as much as 50 l/sec which is equivalent to about 2.5 times that of the estimated field water requirement. It had been necessary to reduce the Qin. However, the main off-take gate had not been operated until all the repair work in the field canal was completed. The first operation was carried out after the fourth field observation carried out on June 3. Since then, the Qin was gradually decreased. Efforts were continued to reduce the Qin. After Hari Raya, water deficit was found in many lots. Thus the Qin was increased to the maximum. The average Qin during the period was 34.2 l/sec. The chronological record of inflow discharge is shown in Fig.3.1.a.

(3) Field water requirement

The field water requirement is defined as the actual amount of water consumed in the fields and is found through the water balance study in the fields, namely the difference between the inflow and outflow discharges. Both the inflow and outflow discharges change time to time. There will be a tendency that a difference of inflow and outflow discharges becomes small when the amount of water stored in the lot increases. And the difference of the discharges becomes large when the amount of water stored in the lot decreases. Thus the average amount of the differences of the inflow and outflow discharges for a long period of time will show the approximate amount of the field water requirement. The difference of the discharges was calculated for each drainage unit as well as for the whole pilot farm area. For the purpose of comparison, it was converted into mm/day. The result of calculation is shown in the following table.

Water Balance Study in P/F No.1 in mm/day

NO	DATE	Qin (l/sec)	Qout (l/sec)	Qnet (l/sec)	Qnet (mm/day)
1	May 7*	-	-	-	-
2	May 19	33.4	4.8	28.6	14.4
3	May 26	43.5	27.9	15.6	7.9
4	June 3	50.5	24.1	26.4	13.3
5	June 9	28.2	11.2	17.0	8.6
6	June16	35.1	9.0	26.1	13.2
7	June23	4.3	2.6	1.7	0.9
8	July 1	44.2	12.0	32.2	16.2
9	July 7*	0.0	3.0	-3.0	-1.5
	AVERAGE	**34.2**	**13.1**	**21.1**	**10.6**

*Note : The results of observation with an asterisk is not included in the calculation showing the averages.

As seen in the table, the field water requirement of P/F No.1 is estimated to be 21.1 l/sec or 10.6 mm/day, though the figures should be confirmed during the consecutive trials.

(4) Irrigation efficiency; IE

The irritation efficiency (IE) fluctuated from 36 % to 86 %. The average IE was 60 % throughout the period of the trial. The result was far behind the target of 80 %. The following are considered for this reason.

- At the initial stage of the trial, the Qin was not controlled.
- Some amount of Qout is required to supply with water to each lot satisfactorily.
- As mentioned above, this amount is estimated to be about 9.0 l/sec, which is equivalent to about 43 % of the field water requirement.
- After Hari Raya, water supply was interrupted because of the long holiday.

(5) Even distribution; ED

The percentage of even distribution fluctuated considerably. The result shows that the upstream irrigation blocks got much water during the initial stage of the trial. However, the supply of water to the upstream blocks was controlled and gradually decreased. As a result, the distribution was well-balanced at the final stage of the trial. The amount of water distributed to each irrigation block was calculated and it was converted in mm/day. The results of the analysis are tabulated as follows and shown in Fig.3.1.c.

Actual Water Distributed to Each Irrigation Block in mm/day

NO	DATE	IB NO.1	IB NO.2	IB NO.3	IB NO.4
1	May 7*	-	-	-	-
2	May 19	42.4	12.2	6.7	12.4
3	May 26	36.6	20.6	14.2	19.9
4	June 3	53.3	18.3	16.3	21.4
5	June 9	7.3	19.1	14.0	15.0
6	June16	12.9	18.3	16.9	22.0
7	June23	5.1	2.1	1.9	0.0
8	July 1	20.9	12.6	31.4	26.0
9	July 7*	0.0	0.0	0.0	0.0
	AVERAGE	**25.5**	**14.7**	**14.5**	**16.7**

Data obtained during the observation with an asterisk are excluded in finding the averages.

It becomes clear from the above table and Fig.3.1.c that the distribution to the irrigation block No.1 was well controlled through the water management trial and the distribution was equalized with the progress of the trial. It is noted that some zeros in Block No.3-2 and 4-2 were recorded as shown in Table 3.1. This fact shows that the even distribution of water between field off-takes is quite difficult, in case the water is controlled by the farmers. The even distribution can be achieved only if the gate is kept locked.

(6) Water depth control in lots

Water was kept suitably in more than half of lots in the pilot farm throughout the period of the trial. The water deficit occured occasionally in the remaining lots. It is judged that water depth control was successfully made, though the coefficient of water depth control shows about 73 % throughout the period of the trial. The result of the water depth control is chronologically shown in Fig.3.1.b.

(7) Measurement by a N-type lysimeter

The measurement was conducted every day except official holiday from May 20 to July 10. Data obtained on a rainy day showed abnormal figures. Thus such figure was excluded from the analysis. The result of analysis is summarized in Table 3.3. From the table, it is found that the net water requirement is to be 7.9 mm/day. It is converted in l/sec as shown below.

$Q = 7.9 \times 17.13 / 8.64 \approx 15.7$ l/sec

Table 3.1 SUMMARY OF WATER MANAGEMENT TRIAL IN P/F NO.1

NO	DATE	Qin (l/sec)	Qout (l/sec)	ED (%) 1-1	1-2	2-1	2-2	3-1	3-2	4-1	4-2
1	May 7*	0.0	0.0	-	-	-	-	-	-	-	-
2	May19	33.4	4.8	148	404	15	161	35	43	29	13
3	May26	43.5	27.9	203	111	94	94	151	0	23	177
4	June 3	50.5	24.1	277	110	97	35	121	21	81	87
5	June 9	28.2	11.2	29	82	192	21	216	17	62	161
6	June16	35.1	9.0	46	107	162	12	23	149	217	0
7	June23	4.3	2.6	200	333	163	0	200	0	0	0
8	July 1	44.2	12.0	75	123	63	45	224	82	207	0
9	July 7*	0.0	3.0	-	-	-	-	-	-	-	-
AVERAGE		**34.2**	**13.1**	**140**	**181**	**112**	**53**	**139**	**45**	**88**	**63**

NO	IE (%)	R (%) Rn	Re	Rs	Qre (l/sec)	Q (l/sec)	Qact (l/sec)	Qp (l/sec)
1*	-	17	0	83	-	-	-	-
2	86	33	0	67	33.4	33.4	28.6	15.7
3	36	50	8	42	21.2	43.5	15.6	15.7
4	52	75	25	0	31.2	24.9	26.4	15.7
5	60	59	33	8	19.2	18.7	17.0	15.7
6	74	58	42	0	27.9	28.2	26.1	15.7
7	40	33	0	67	26.4	4.3	1.7	15.7
8	73	75	17	8	34.6	23.3	32.2	15.7
9*	-	33	8	59	17.4	-	-3.0	15.7
AVERAGE	**60**	**55**	**18**	**27**	**27.7**	**25.2**	**21.1**	**15.7**

Data obtained in the field surveys with an asterisk are excluded in finding the averages.

Qin : inflow discharge
Qout: outflow discharge
Qre : required inflow discharge
Qp : net water requirement
Qact : actual water consumed
Q : discharge after adjusted

IE : irrigation efficiency
ED : coefficient of even distribution
R : coefficient of water depth control
Rn : suitable water depth
Re : excessive water depth
Rs : Shortage of water depth

Table 3.2 SUMMARY OF WATER DEPTH SURVEY IN P/F NO.1

		PEG NO.											
NO	**DATE**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	May 7	3.0	0.0	4.5	3.0	6.5	4.0	0.0	0.5	1.0	0.0	2.0	5.0
2	May19	2.5	5.0	9.0	0.0	5.0	3.0	2.0	1.0	1.0	9.0	2.5	4.0
3	May26	10.0	4.0	7.5	3.0	8.0	5.5	3.0	3.0	3.0	10.5	9.5	7.5
4	June 3	11.5	5.0	5.0	5.0	9.0	5.0	5.0	5.0	6.0	15.0	11.0	10.0
5	June 9	11.0	8.0	11.0	5.0	8.0	12.0	4.0	8.0	6.5	11.0	9.5	5.0
6	June16	11.0	9.5	11.0	5.0	13.0	14.0	5.0	8.0	5.0	10.0	8.0	13.0
7	June23	0.0	0.0	10.0	0.0	8.0	6.0	0.0	1.0	4.0	3.0	9.0	1.0
8	July 1	10.0	6.0	5.0	5.0	10.0	9.0	4.0	7.0	7.0	12.0	6.0	12.0
9	July 7	0.0	0.0	3.0	1.0	4.5	7.0	0.0	0.0	12.0	9.0	8.0	7.0
AVERAGE		**6.6**	**4.2**	**7.3**	**3.0**	**8.0**	**7.3**	**2.6**	**3.7**	**5.1**	**8.8**	**7.3**	**7.2**

Table 3.3 Analysis on the Net Water Requirement by Lysimeter in P/F No.1 (mm)

MONTH	DAY	RAINFALL	WATER DEPTH	DIFFERENCE OF DEPTH	WATER REQUIREMENT
May	30	0.0	221		
	31	0.0	-		8.0
June	1	0.0	205	16	8.0
	3	0.0	221		
	4	0.0	213	8	8.0
	9	0.0	212		
	10	0.0	203	9	9.0
	18	0.0	236		
	19	0.0	229	7	7.0
July	1	0.0	215		
	2	0.0	-		5.5
	3	0.0	204	11	5.5
	4	0.0	193.(192)	11	11.0
	5	0.0	-		10.5
	6	0.0	171	21	10.5
	7	0.0	0.(163)		
	8	0.0	158	5	5.0
	9	0.0	151	7	7.0
	10	0.0	143	8	8.0

Total of available figures (mm)	103.0
Number of days (day)	13
Averaged net water requirement (mm/day)	**7.9**

Remarks : The measurement was not made on holiday. Data obtained on rainy days were omitted in finding the average net water requirement.

3.2 Pilot Farm No.2

The water management trial in P/F No.2 was carried out from May 8 to July 10, 1985. The shaded area in Fig.2.2 is supplied with water from the outside upstream area. Thus the area was excluded from the water management trial. The field survey was practiced regularly on Mondays and it was conducted nine times in total. When it becames necessay, additional field work was also made. The results of the water management trial for the off-season rice cultivation in 1985 are summarized in Table 3.4 to 3.6.

(1) Outflow discharge

Outflow discharge (Qout) was measured at seven places. The locations of the measurement are shown in Fig.2.2. Though the number of times of the measurement is limited, it is deemed that the outflow discharge from P/F No.2 has the following tendencies.

- In P/F No.2, the water supplied from the outside area is predominant over the water taken from the main off-take. Thus the Qout is also influenced greatly by the water from the outside.

- The Qout is concentrated in the downstream extream lots. Especially, the drained water from the outlets, d5, d8 and d9 is remarkable.

- Water drained from other outlets is negligible small.

The Qout flactuated and there were many zeros in the latter half of the period. The average was 4.8 l/sec throghout the priod.

(2) Inflow discharge

Inflow discharge was measured at six places as shown in Fig.2.2. The inflow from the main off-take was directly influenced by the water level in the secondary canal of KADA. The gate was always opened during the trial. The change of the intake of water was fully depend on the water level in the secondary canal. The average Qin was 11.1 l/sec throughout the period.

(3) Irrigation efficiency; IE

The irritation efficiency (IE) of individual irrigation block was not correctly found because the blocks influenced each other and inflow and outflow discharges couldn't observed. The IE of the whole pilot farm area was 45 percent as shown in Table 3.4. Such low irrigation efficiency was resulted in the inflow from the outside area.

(4) Even distribution; ED

Throughout the period of the trial, the ED couldn't controlled, because the intake of water was too small to achieve the proper distribution.

(5) Water depth control in lots

Though the intake of water was limited during the latter half of the period, the water in the lots was kept suitably in the downstream lots. The water deficit occured only several lots in the upstream. Throughout the period, the water was kept at a suitable depth in about 60 percents of lots. This was because of the following reasons.

- The water supply from the outside had a good effect on the water control in the lot.
- Batas in the pilot farm were high and could keep a large amount of water.
- The slope in the pilot farm is gentle and lot to lot irrigation can be practiced without difficulties. Once the water is supplied in the upstream lots, the water can be conveyed to the downstream.

It is considered that an effect of on-farm development is few in an area with a gentle and constant slope such as P/F No.2.

(6) Measurement by a N-type lysimeter

The measurement was carried out every day except official holiday from May 20 to July 10. Data obtained on a rainy day showed abnormal figure and such a figure was excluded from the analysis. The result of analysis is summarized in Table 3.6. It is preliminarily estimated that the net water requirement is to be 6.0 mm/day.

Table 5.4 SUMMARY OF WATER MANAGEMENT TRIAL IN P/F NO.2

NO	DATE	Qin (l/sec)	Qout (l/sec)	IE (%) IB1	IB2	IB3	IB4	IB5	Total
1	May 8	-	-	-	-	-	-	-	-
2	May20	23.7	-	-	-	-	-	-	-
3	May27	11.4	11.2	100	100	-21	4	**	30
4	June 4	14.4	12.9	100	100	70	**	4	10
5	June11	24.4	1.0	100	100	100	10	**	96
6	June17	0.0	0.0	-	-	-	-	-	-
7	June27	14.9	8.6	100	100	100	100	-86	42
8	July 1	0.0	0.0	-	-	-	-	-	-
9	July 8	0.0	0.0	-	-	-	-	-	-
	AVERAGE	11.1	4.8	100	100	62	**	**	45

Remarks : "**" shows a infinite figure because of the qin is equal to zero.

NO	ED (%) IB1	IB2	IB3	IB4	IB5	R (%) Rn	Re	Rs	Qre (l/sec)	Qp (l/sec)	Qact (l/sec)
1	-	-	-	-	-	25	17	58	-	-	-
2	76	221	271	47	48	33	25	42	-	6.0	-
3	157	175	82	118	5	50	33	17	2.4	6.0	0.2
4	188	305	34	0	79	58	25	17	4.1	6.0	1.5
5	49	289	43	6	0	42	33	25	24.4	6.0	23.4
6	-	-	-	-	-	33	17	50	-	-	-
7	32	200	190	77	35	25	25	50	8.0	6.0	6.3
8	-	-	-	-	-	-	-	-	6.0	6.0	0.0
9	-	-	-	-	-	25	17	58	6.0	6.0	0.0
AVERAGE	107	242	87	50	50	36	24	40	8.5	6.0	5.2

Qin : inflow discharge
Qout: outflow discharge
Qre : required inflow discharge
Qp : net water requirement
Qact : actual water consumed

IE : irrigation efficiency
ED : coefficient of even distribution
R : coefficient of water depth control
Rn : suitable water depth
Re : exdessive water depth
Rs : shortage of water depth

Table 3.5 SUMMARY OF WATER DEPTH SURVEY IN P/F NO.2

		PEG NO.											
NO	**DATE**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	May 8	2.0	5.5	11.0	7.0	4.5	11.5	10.0	1.0	2.5	2.0	3.0	4.5
2	May20	0.0	4.0	5.0	2.0	14.5	7.0	7.0	1.5	0.0	6.0	15.5	11.0
3	May27	7.0	5.0	10.0	10.0	14.5	7.0	14.0	3.0	1.0	6.5	15.0	11.0
4	June 4	8.0	8.5	9.0	13.0	5.5	2.5	5.0	5.0	0.0	7.0	15.0	12.0
5	June11	4.0	8.0	10.0	12.0	10.0	7.0	14.0	0.0	0.0	10.0	11.0	12.0
6	June17	2.0	2.0	0.0	8.0	10.0	8.0	13.0	0.0	0.0	2.0	12.0	8.0
7	June27	1.5	8.5	0.0	0.0	13.5	7.0	0.0	0.0	0.0	9.5	19.0	13.5
8	July 1	-	-	-	-	-	-	-	-	-	-	-	-
9	July 8	3.0	3.0	1.0	8.0	0.0	12.0	12.0	3.0	0.0	1.0	8.0	9.0
	AVERAGE	**3.1**	**4.9**	**5.1**	**6.7**	**8.1**	**6.9**	**8.3**	**1.5**	**0.4**	**4.9**	**10.9**	**9.0**

Table 3.6 Analysis on the Net Water Requirement by Lysimeter in P/F No.2 (mm)

MONTH	DAY	RAINFALL	WATER DEPTH	DIFFERENCE OF DEPTH	WATER REQUIREMENT
June	1	0.0	279		
	2	0.0	-		5.5
	3	0.0	268	11	5.5
	8	0.0	168		
	9	0.0	162	6	6.0
	11	0.0	165		
	12	0.0	155	10	10.0
	16	0.0	159		
	17	0.0	151	8	8.0
	18	0.0	89		
	19	0.0	82	7	7.0
	29	0.0	129		
	30	0.0	125	4	4.0
July	6	0.0	145		
	7	0.0	139.(192)	6	6.0
	8	0.0	189	3	3.0
	9	0.0	184.(198)	5	5.0
	10	0.0	181	-	

Total of available figures (mm)	60.0
Number of days (day)	10
Average net water requirement (mm/day)	**6.0**

Remarks : The measurement has not been done on holidays.
Data obtained on rainy days were excluded in finding the average net water requirement.

3.3 Pilot Farm No.3

The water management trial in P/F No.3 was conducted from May 7 to July 10, 1985. Field work was carried out regularly on Tuesdays and the regular visit to the site was made nine times during the period. During the course of the trial, it became difficult to distribute the water evenly to each lot when the intake of water reached about 25 l/sec. Consequently, the rotational irrigation was introduced at the beginning of July. After the introduction, more frequent visits were made. The results of the water management trial for the off-season rice cultivation in 1985 are summarized in Table 3.7 to 3.9.

(1) Outflow discharge

During the period of the trial, the outflow discharge (Qout) from the pilot farm area fluctuated within a range of about 10 to 20 l/sec, except after Hari Raya when the water supply was completely stopped. An effort was continued to reduce the Qout by means of decreasing the inflow discharge (Qin). However, the gate of the main off-take couldn't be closed tightly and much leakage occured through the gate. When the water in KADA canal was at the normal level, the amount of leakage was about 25 l/sec. Throughout the period, the average Qout was 9.7 l/sec as shown in Table 3.7. In order to carry out strict water management and to save irrigation water, it will be necessary to repair or replace the main off-take gate.

(2) Inflow discharge

When the water management trial was started, an inflow discharge (Qin) was as much as 50 l/sec which is equivalent to two to three times that of the estimated field water requirement. It was necessary to reduce the Qin. However, the main off-take gate had not been operated until after the observation carried out on June 4, because the key of the gate was held by the watchman of KADA. The key was duplicated and the operation of the gate became easier after that. The Qin was gradually decreased. As mentioned above, the Qin could not be decreased less than 25 l/sec due to the leakage from the gate. The gate was closed after June 18. The discharge of intake water changed only because of the variation of the water level in KADA canal. The average Qin during the period was 29.2 l/sec.

The record of outflow and inflow discharges are chronologically shown in Fig.3.2 together with the results of other observations. A special attention should be paid to the fifth observation carried out on June 10. From the result of the fifth observation, it becomes clear the following features.

- During the period before the fifth observation, the Qin was much and the water was fully supplied to the lots. However, the water was not evenly distributed. As a result, the Qout showed large figures.

- The Qin was gradually reduced and it reached 28.2 l/sec at the time of the fifth observation. Data obtained in the observation still showed fairly good results in the water depth control (67 %), irrigation efficiency (70%) and even distribution.

- After the fifth observation, the water supply to the pilot farm was abnormally decreased because of Hari Raya holiday and consecutive troubles of KADA's main facilities. Data obtained after the fifth observation showed poor results in the water management.

From the features above, it can be drawn that the Qin, 28.2 l/sec, measured at the fifth observation would be the approximate minimum amount to irrigate the pilot farm area satisfactorily. The Qout was 8.5 l/sec at this time. This amount would be correspond to the water management loss as will be described in Chapter 4.

(3) Field water requirement

The difference of the inflow and outflow discharges was calculated for each irrigation block as well as for the whole pilot farm area. For the purpose of comparison, it was converted into mm/day. The results of calculation are shown in the following table.

Water Balance Study in P/F No.3 in mm/day

NO	DATE	IB NO.1	IB NO.2 & 3	IB NO.4	Total
1	May 16	-	-	-	-
2	May 22	26.0	0.2	0.7	8.3
3	May 29	60.1	11.9	18.7	28.5
4	June 4	53.4	28.3	5.3	30.1
5	June10	3.5	22.7	26.1	17.7
6	June18	1.1	16.8	14.1	11.3
7	June25	4.7	15.4	25.7	14.7
8	July 3	4.1	4.9	31.7	11.5
9	July 9	3.5	38.1	0.0	17.8
	Average	19.6	17.3	15.3	17.5

As mentioned in Section 3.1, the average amount of difference of the inflow and outflow discharges for a long period of time will show the approximate amount of the field water requirement. Though the number of observations is not enough because of the limited period of time, it is estimated that the field water requirement is 17.5 mm/day in P/F No.3 as shown in the above table, or 19.5 l/sec as calculated below.

$$Q = 17.5 \times 9.63\ (\text{ha}) / 8.64 = 19.5\ \text{l/sec}$$

(4) Irrigation efficiency; IE

The irrigation efficiency increased with the progress of the trial. During the period of the water managemenent trial, the average IE was 70 %. The IE could not be raised more because the inflow discharge could not be decreased below 25 l/sec at the normal level in KADA canal. The water deficit occured in many lots when the IE came near to 70 %. Durig the observations after Hari Raya, the IE reached 96 %, but there was water deficit in about half of the lots located in the downstream area. Experience has shown that it would be rather easy to raise the IE value up to 70 %, but the coefficient of even distribution becomes worse if the IE becomes more.

In the sixth observation carried out on June 18, the outflow discharge of 3.5 l/sec was recorded from the lot in IB No.1. This amount of discharge is equivalent to about one-fifth of the water required to irrigate the whole area of P/F No.3. This fact shows that the poor operation of only one tap makes it difficult for the even distribution of water. Based upon this fact, the decision was made to introduce the rotational irrigation into P/F No.3.

(5) Even distribution; ED

In the initial stage of the trial, the coefficient of even distribution was large in the irrigation block (IB) No.1 and No.3 and less in IB NO.2 and 4. Thus the water to IB No.3 was reduced and the taps in IB No.1 were carefully controlled so that the outflow became nearly to zero. As a result, the average ED value was between 89 % and 121 % as shown in Table 3.7.

It was found that it would be very difficult to distribute the water evenly to each lot when the number of off-takes becomes large. Operation of one off-take or one tap will influence other off-takes. And once water is excessively taken from one tap, shortage of water will definitely occur in the downstream lots. It will be too ideal if all the taps and off-takes function properly in P/F No.3.

(6) Water depth control in lots

Water in lot was kept at the suitable level in 10 lots out of 12 lots selected for the study, except after Hari Raya when the water supply from the KADA canal was completely stopped. In the remaining two lots, the water was sometimes below the suitable depth. This was because the two lots are highly elevated and the water is taken only when the water in the field canal is at full supply level. On the whole, however, the water depth was controlled fairly well during the period of the trial. This was due to the following two reasons.

a. Adjustment of stoplogs in field ontlets

Prior to the commencement of the trial, all the stoplogs in the field outlets were adjusted by the staff at the Centre. Some stoplogs were cut by a saw and additional stoplogs were installed in the other ontlets. The work was carried out just after the transplanting so that suitable water level in each lot could be determined easily. As a result, there was no excessive storage of water during the whole period of the trial. The water was always kept under the allowable maximum depth of about 10 cm.

b. Ample supply of irrigation water

As mentioned above, the intake of water cannot be decreased when it becomes about 25 l/sec. As a result, the area received ample water during the period. It should be examined in the consecutive trials whether the water in a lot can be continuously kept at the suitable depth when the intake of water becomes near to the field water requirement of about 20 l/sec.

(7) Measurement by a N-type lysimeter

The water depth in a lot was measured by using the N-type lysimeter every day except on public holiday from May 22 to July 10. The obvservation was greatly influenced by rainfall. Data obtained on a rainy day showed abnormal figure. These figure was excluded from the calculation of the net water requirement. Results of the measurement are summarized in Table 3.9.

Though the available data are limited, it is appraised that the avarage amount of water consumed in a lot is 7.2 mm/day as shown in Table 3.9. The net water requirement of P/F No.3 is estimated to be 8.0 l/sec as shown in the following calculation.

$Qn = 7.2 \times 9.63 / 8.64 = 8.0$ l/sec

Table 3.7 SUMMARY OF WATER MANAGEMENT TRIAL IN F/F NO.3

NO	DATE	Qin (l/sec)	Qout (l/sec)	IE (%) IB1	IB2,3	IB4	Total	ED (%) IB1	IB2	IB3	IB4
1	May 16	-	-	-	-	-	-	-	-	-	-
2	May 22	26.8	17.6	89	1	3	34	121	40	136	91
3	May 29	50.8	19.1	81	29	96	62	165	39	136	42
4	June 4	48.2	14.6	76	65	50	70	163	100	100	24
5	June10	28.2	8.5	22	80	83	70	63	97	127	127
6	June18	25.4	12.8	4	86	62	50	119	85	86	102
7	June 25	17.1	0.7	71	100	100	96	43	111	90	170
8	July 3	16.7	3.9	50	62	90	77	54	63	45	238
9	July 9	20.5	0.7	92	97	0	97	20	176	251	0
AVERAGE		29.2	9.7	61	65	61	78	94	89	121	99

NO	R (%) Rn	Re	Rs	Q (l/sec)	Qre (l/sec)	Qp (l/sec)	Qact (l/sec)
1	50	8	42			8.0	-
2	42	8	50	12.7	12.7	8.0	9.2
3	67	8	25	35.5	35.5	8.0	31.7
4	67	0	33	-	36.5	8.0	33.6
5	67	0	33	24.0	21.4	8.0	19.7
6	42	8	50	25.4	15.2	8.0	12.6
7	25	0	75	17.1	17.1	8.0	16.4
8	58	0	42	16.7	13.6	8.0	12.8
9	8	0	92	20.5	20.5	8.0	19.8
Average	47	4	49	23.1	21.6	8.0	19.5

Qin : inflow discharge
Qout: outflow discharge
Qre : required inflow discharge
Qp : net water requirement
Qact : actual water consumed

IE : irrigation efficiency
ED : coefficient of even distribution
R : coefficient of water depth control
Rn : suitable water depth
Re : excessive water depth
Rs : shortage of water depth

Table 3.8 SUMMARY OF WATER DEPTH SURVEY IN P/F NO.3

		PEG NO.											
NO	**DATE**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	May16	6.0	7.0	4.0	7.0	3.5	3.0	10.0	3.0	11.0	7.0	4.0	8.0
2	May22	0.0	4.5	5.0	6.0	3.0	2.0	5.0	0.0	10.5	7.0	5.5	3.0
3	May29	9.0	4.5	6.5	8.0	3.0	6.5	6.0	5.0	12.0	4.5	5.0	7.5
4	June 4	9.0	5.0	8.0	7.5	3.5	5.0	5.0	3.0	9.0	4.5	2.0	7.0
5	June10	8.5	4.4	6.3	7.5	3.9	3.5	6.5	0.0	6.5	6.0	0.0	7.3
6	June18	10.8	3.6	3.3	7.8	4.0	2.1	5.2	3.5	6.4	4.9	1.8	7.3
7	June25	6.5	3.9	2.2	4.1	10.0	0.0	0.0	0.0	0.0	10.0	2.2	0.0
8	July 3	8.5	4.0	5.0	6.0	5.0	2.0	5.5	0.0	0.0	6.0	0.5	6.5
9	July 9	5.0	2.5	0.0	2.0	2.0	0.0	2.0	0.0	0.0	1.5	0.0	2.5
	AVERAGE	**7.0**	**4.4**	**4.5**	**6.2**	**4.2**	**2.7**	**5.0**	**1.6**	**6.2**	**5.7**	**2.3**	**5.5**

Table 3.9 Analysis on the Net Water Requirement by Lysimeter in P/F No.3 (mm)

MONTH	DAY	RAINFALL	WATER DEPTH	DIFFERENCE OF DEPTH	WATER REQUIREMENT
June	1	0.0	149		
	2	0.0	143	6	6.0
	9	0.0	181		
	10	0.0	172	9	9.0
	11	0.0	162	10	10.0
	12	0.0	155	7	7.0
	18	0.0	145		
	19	0.0	140	5	5.0
July	1	0.0	141		
	2	0.0	132	9	9.0
	3	0.0	123	9	9.0
	6	0.0	156		
	7	0.0	153	3	3.0
	8	0.0	145	8	8.0
	9	0.0	135	10	10.0
	10	0.0	132	3	3.0

Total of available figures (mm)	79.0
Number of days (day)	11
Average of net water requirement (mm/day)	**7.2**

Remarks : The measurement was not made on holiday.
Data obtained on a rainy days were excluded in finding the average of the net water requrement.

4. FINDINGS

4.1 Water Requirements

The result of observations by a N-type lysimeter in each pilot farm has shown slightly different figure each other. The figure obtained by observations is termed as **the net water requirement** which is the sum of evapotranspiration and percolation losses. The average net water requirement in each Pilot Farm area is summarized below.

Name of Pilot Farm	Average Net Water Requirement	
	Depth	Unit Discharge
Pilot Farm No.1	7.9 mm/day	0.91 l/sec/ha
Pilot Farm No.2	6.0 mm/day	0.69 l/sec/ha
Pilot Farm No.3	7.2 mm/day	0.83 l/sec/ha

In case all other losses in Pilot Farms are disregarded, the water discharge required for each Pilot Farm would be very small and can be calculated as shown below:

Pilot Farm	Area (ha)	Unit Water Re. (l/sec/ha)	Re. Discharge (l/sec)
No.1	17.13	0.91	15.7
No.2	8.58	0.69	6.0
No.3	9.63	0.83	8.0

It is obvious from the water management trials that the irrigation water in Pilot Farms is quite insufficient with such a small amount of water. Some unavoidable loss in irrigation should be included in the amount of water to be supplied to Pilot Farms. Such losses as evaporation in field canals, invisible seepage from embankment and leakage from the on-farm facilities cannot be avoided with normal operation and maintenance. Thus the water required in irrigating a Pilot Farm area is the sum of the net water requirement and the unavoidable loss. This is defined as **the field water requirement**. The field water requirement can be found through the water balance study in Pilot Farm area. The result of the water balance study in each Pilot Farm is summarized in the following table.

Pilot Farm	Area (ha)	Field Water Re. (l/sec)	Unit F. Water Re. (l/sec/ha)
No.1	17.53	21.1	1.20
No.2	8.58	-	-
No.3	9.63	19.5	2.02

From the above table, it becomes clear that the field water requirement changes considerably in accordance with the conditions of pilot farms. It is seemed that much water is required in P/F No.3 compared with P/F No.1. This will be because that the P/F No.3 area was newly developed and much unavoidable loss would be included. Comparing the field requirement with the net water requirement, it is understood that at the least 30 % of the net water requirement should be regarded as an unavoidable water loss. In case a newly developed area, this unavoidable loss will become to equivalent to the net water requirement or more. The field water requirement should be the basis of the water management in Pilot Farm area. Irrigation efficiency and other factors are to be calculated on the basis of this field water requirement.

In order to convey the amount of field water requirement through field canals to each irrigation block or lot, there is still need for a certain amount of water at the turnout or field off-take to keep the water in the field canal at a certain level for distribution. It is known that the potential energy of irrigation water play an important role in distributing the water. The additional water used for the distribution is to be called **the water management loss**. One of the main objectives of on-farm water management is to minimize this water management loss.

A sum of the field water requirement and the water management loss is an amount of water required at the head of the Pilot Farm. This amount is named as **the gross water requirement**. The gross water requirement should be equivalent to the minimum inflow discharge to achieve sufficient and most effective irrigation. It will be variable with the existing conditions of Pilot Farms. The inflow discharge at the final stage of the water management trials would show the approximate figure of the gross water requirement. The gross water requirement of each Pilot Farm is estimated as shown below.

Name of Pilot Farm	Gross Water Re.	Unit Water Re.
Pilot Farm No.1	34.2 l/sec	1.95 l/sec/ha
Pilot Farm No.2	-	-
Pilot Farm No.3	28.2 l/sec	2.93 l/sec/ha

It is noted that the above gross water requirement is based on the on-farm level and the unit gross water requirement shows large figure compared with KADA's standard figure of 0.80 l/sec/ha. If a study is carried out for a large scale area, an unit gross water requirement will show comparatively small figure. It could be near to the net water requirement. In order to find the water amount required for a large area, other studies should be made by other organizations than the Centre.

The relation of various water requirements mentioned in this section is illustrated in Fig.4.1. And the result of observations of water requirements is summarized in the following figure.

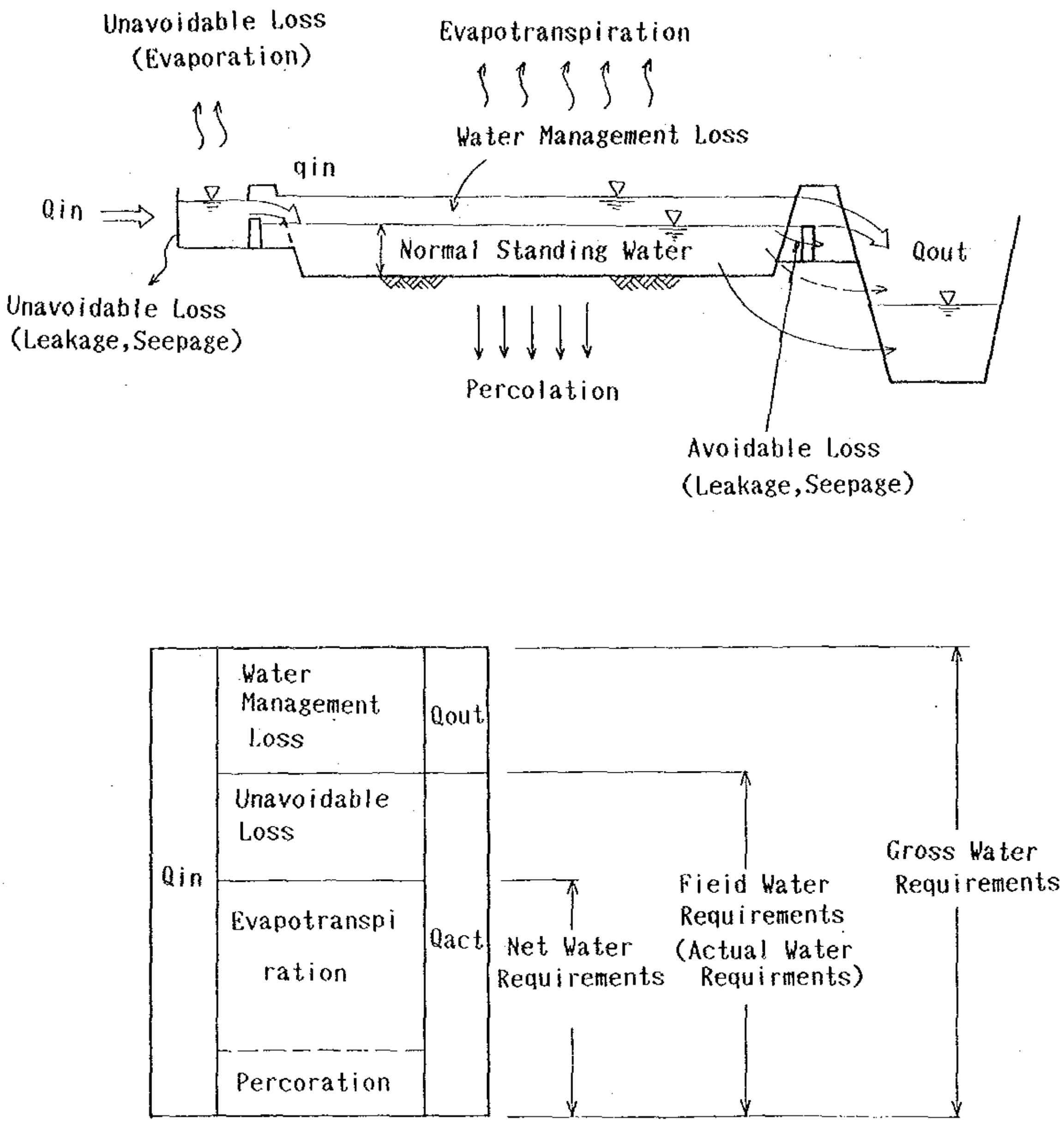


Fig.4.1 Definition of Water Requirements

4.2 Factors Hindering Proper Water Management

Under proper water management, the gross water requirement should be approximate to the field water requirement. In the water management trials, however, it was experienced that it would be very difficult to evenly distribute small amount of water to each lot, and much water would be required to irrigate all the lots in pilot farm areas. There are many factors hindering proper water management. These factors are summarized below from both structural and operational view points.

4.2.1 Structural Aspect

(1) Main off-take

The proper adjustment of discharge at the main off-take is the most important factor in saving irrigation water in Pilot Farms. In P/F No. 1 and 3, a sluice gate is equipped in the main off take. The sluice gate has several holes in its spindle for the operation. The discharge control at the off-take is carried out by changing the position of hole. The interval of the holes is 4.5 cm in P/F No.1 and 5 cm in P/F No.3, respectively. The delicate control of discharge cannot be made with this control method. In case the position of hole is moved by one interval upward under the normal water level in KADA canal, the discharge is increased by 9 l/sec and 5 l/sec in P/F No.1 and 3, respectively.

Even when the gate is entirely closed, considerable amount of water is allowed through the gate in the main off-take of P/F No.1 and 3. The minimum amount of controlled water is estimated to be about 5 l/sec and 25 l/sec in P/F No.1 and 3, respectively.

The gate installed in the main off-take of P/F No.2 is a sluice gate with a screw spindle. A slight control of the gate opening is possible. However, the hydraulic head at the entrance of the gate is not enough to get the designed water discharge. When the gate is fully opened, the intake of water discharge becomes about 24 l/sec under the highest water level of KADA canal. When the water level becomes lower than normal, almost no water can be taken from the main off-take.

(2) *Field canals*

In case the irrigation water cannot be supplied to the lots along the field canal, the farmer will try to get water by means of either installing a pipe at the bottom of the canal or by destroying a part of the canal. These were done in P/F No.1 area and badly affected proper water management. The lot along the field canal is normally highly elevated, thus such practices by farmers as mentioned above are often practiced in many irrigation projects. Therefore, it is recommended that special attention be paid to the planning of canal alignment so that every lot along the field canal can get irrigation water easily.

It is noted that the water level in the field canal should be kept high enough to distribute the water into an irrigation block or a lot. During the normal growth period, the discharge in the field canal is very small, when strict water management is practiced. If the canal is wide, it takes a long time to adjust the water in the canal to a suitable level, and water management loss will be increased. It is not necessary to select the hydraulically most effective canal section for the design of field canals. The narrower canal is more convenient for operating field canals.

As shown in Table 2.1, there seems to be great discrepancies in canal gradients between the designed and the constructed ones. Therefore, stricter construction supervision would be necessary. However, it is rather common to find so many discrepancies between the design and the construction of minor structures such as these of on-farm facilities, as a result of neglect by contractors. Thus some allowance should be given in the design of on-farm facilities especially in elevations to ensure that there is a proper supply of water to each lot.

In order to protect the canal from damages caused by rats and crabs, the field canal should be lined. As a result of the water management trials, it was concluded that the cast in-situ concrete canal is most advantageous when compared with other canal materials. In case the precast concrete products are used for field canals, proper care should be taken at the joints. There was a lot of leakage from the joints in the U-shaped canal in P/F No.1 and it is therfore not recommended for use for field canals in the future.

(3) Turnout

The turnout is the most important facility in controlling the discharge in field canals. All the turnouts in Pilot Farms are equipped with two sluice gates. However, the control of discharge is carried out by using only one gate during the normal growth period. The other gate is always fully opened. In case the rotational irrigation is not applied during the normal growth period, one gate will be enough for a turnout.

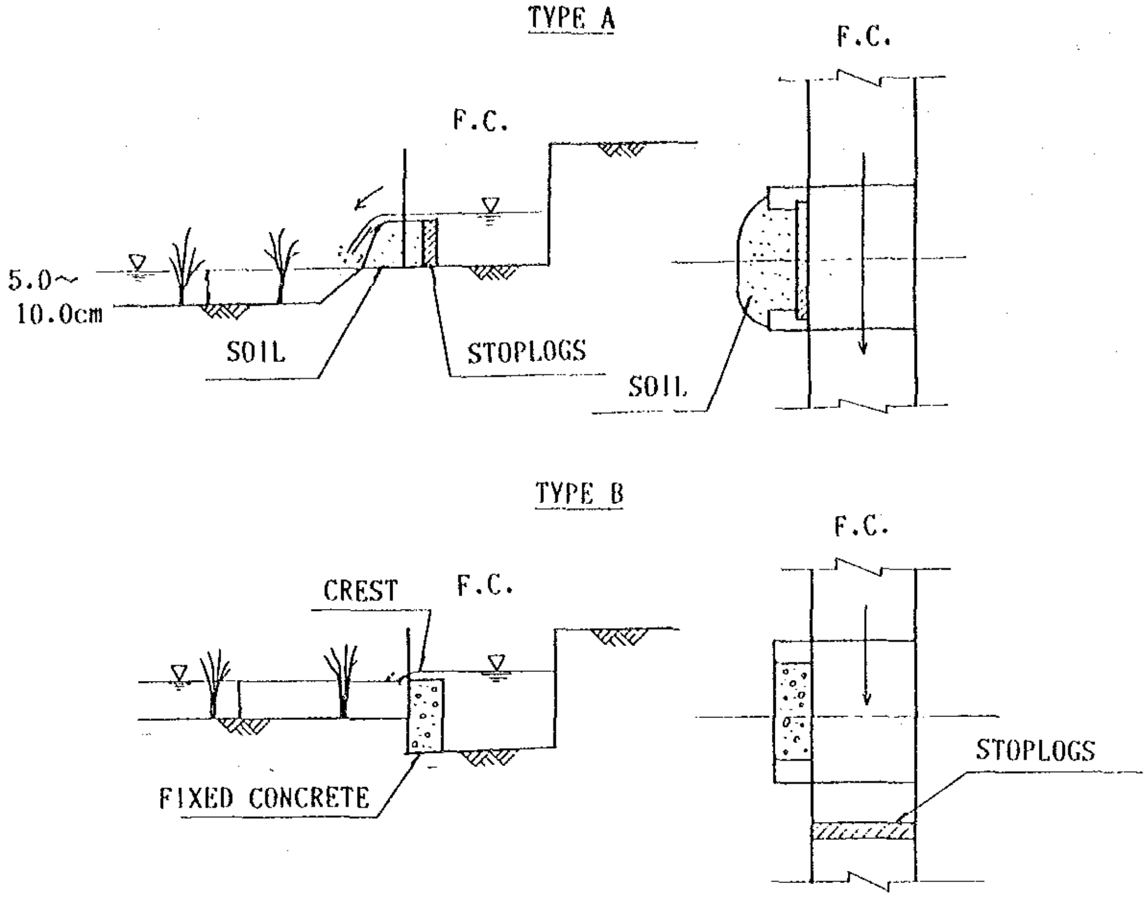
In case the operation of the gate is conducted by using holes in its spindle, a delicate control of discharge cannot be achieved. A screw gate is recommended.

(4) Field off-take

The location of the field off-take should be at the highest lot in an irrigation block. All the field off-takes in the Pilot Farms are suitably located and can supply water to each lot. The main factor which affects the proper water management is the crest elevation of the field off-take. As seen in the following figure, two types of field off-takes, with and without crest, should be provided depending on the water level in the field canal and the one in the lot. In case of type-b in the figure, the stoplogs should also be provided in a field canal to raise the water level in the canal.

A subtle control of water discharge becomes impossible if the height of stoplog is typically fixed. Thus stoplogs with various heights should be provided.

Leakage between stoplogs causes a considerable loss of water. It would be necessary to put soil behind the stoplogs to stop the leakage completely. Thus the inflow to a lot can be observed and controlled by noting the depth of the overflow oveter the stoplogs.



(5) Field outlet

The field outlet plays an essential role in keeping the water in a lot at a suitable depth, if it is properly located at the lowest point in the lot and the stoplog is correctly adjusted. Field outlets in P/F No.2 and 3 are working well, however many of the field outlets in P/F No.1 are not functioning.

In order to know the correct location of the field outlet, a detailed survey should be made when a field is filled with water. Thus the route of water flow in a field can be found and the proper location of field outlet can be pinpointed.

The height of the stoplogs in a field outlet should be adjusted when the rice plant is still young. Prior to the adjustment, it will be necessary to prepare various stoplogs of different heights. Once this adjustment is made, it will also be effective for the consecutive cropping seasons.

In order to prevent the leakage between stoplogs, it is necessary to put soil in front of the stoplogs. Some grooves in field outlets have not been properly constructed and the stoplogs cannot be fixed. These grooves should be reconstructed.

(6) Field drains

Seepage and leakage through the embankment of field drains cause much water loss in Pilot Farm. Thus the proper maintenance of the embankment is required. However, no attention is normally paid to field drains. There are many holes made by rats and crabs in the embankments. The maintenance work would be beyond the capacity of farmers. Accordingly, the construction of concrete walls or the provision of farm roads along the field drains should be considered in future to diminish the leakage from the embankment.

The leakage was also found between the ground and the embankment. Stripping of top soil should be made before the construction of the embankement to stop the leakage.

(7) Batas

Even if water is supplied fully to a lot, the water cannot be used effectively if batas are not properly maintained. The maintenance of batas should be responsibility of the farmers. Farmers should be instructed on the proper maintenance of batas. The batas of the control lot play an important role in suppling water to the adjacent lot. Maintenance of such batas should be under the direct guidance by the Centre.

(8) Irrigation block

The size of an irrigation block plays a very important part in on-farm development. The size cannot be predetermined. It is subject to exsisting topographic conditions, especially land undulation. The size of an irrigation block should be so determined that the slope in the block becomes gentle and there is no remarkable undulation within a block. In case the land has a lot of undulations, levelling will be necessary for proper on-farm development though it is rather costly.

4.2.2 Operational Aspect

(1) Lack of maintenance work

Almost no maintenance work has been done on the on-farm facilities in Pilot Farms. Only when there have been serious problems, have measures been taken solely by the Centre. Consequently, some parts of field canals are heavily silted and the designed discharge cannot pass through. Some gates especially in the drainage canals cannot be opened or closed due to the lack of oiling and repair work. Maintenance work should be carried out regularly and the responsibility of clearing canals and minor repairs should be gradually transferred to the farmers.

(2) The importance of the role of the farmers

Farmers play a vital role in performing the on-farm water management. Water in a lot can be kept at the suitable depth by farmers protecting the batas. Considarable amount of losses due to seepage and leakage from the embankment of drainage canals can be prevented by a small amount of work by farmers. The training of farmers in this respect should be continued at the Centre.

(3) Control lot

Under the lot to lot irrigation practice, water in a lot is directly affected by the adjacent upstream lot. In case the upstream lot is lower than the downstream one, water cannot be conveyed to the downstream lot without keeping the water in the upstream lot deep. Thus, this upstream lot becomes the key to the irrigation in an irrigation block. Such a lot should be called **the control lot.** Frequently, the lot where the field off-take has been installed becomes the control lot. Two control lots have been found in P/F No.1 and 2.

The batas of the control lot should be well protected and maintained by the farmer. However, the batas of control lots in Pilot Farms have not been well maintained and the irrigation water could not be distributed evenly within the irrigation block which includes the control lot. Special instructions should be given to the farmer who holds the control lot.

(4) Operation of gates

Even with a slight change in the opening of a gate, the change in discharge is remarkable. Thus the gate should be operated by a person with experience. It is noted that the gate need not be operated frequently. Once the opening of the gate is properly set at the initial stage of each cropping season, it could be effective during the whole season. In case the rotational irrigation is applied during the normal growth stage, the gate should be always fully opened or entirely closed.

(5) Suitable water depth in lot

As a result of the water management trials, it was found that it would be practically difficult to change the depth of water to suit the growth stage of rice plant, if the lot to lot irrigation is practiced. It is also found that the water in a lot should be kept rather deep: as much as 10 cm during the whole growth period so that the damage by rats could be minimized.

(6) Operation of tap

Taps equipped in P/F No.3 have both advantages and dis-advantages. Discharge can be easily controlled by a tap and a very fine control is also possible. However, the flow from a tap is quite large of about 10 l/sec. Even if only one tap is not properly operated, the amount of water wasted can be equivalent to about a half of the net water requirement of P/F No.3.

(7) Introduction of rotational irrigation

It has been found through the water management trial in P/F No.3 that the water cannot reach the downstream lots when the intake of water becomes about 25 l/sec, which is equivalent to about 1.3 times that of the field water requirement. This is because many taps and field off-takes have been installed and water is used excessively in the upstream lot. The water management loss is thus considered to be great. In order to diminish such uneven use of water, the rotational irrigation should be applied during the normal growth stage, too.

5. RECOMMENDATIONS

5.1 Continuous Water Management Trials

Every problem and difficulty which hinders proper on-farm water management can be identified and to diminish causes of the problems, solutions should be found through the water management trials carried out in the four Pilot Farms attached to the Centre. Due to the delay of construction work in P/F No.4, the water management trial has not been conducted in P/F No.4. The trials should be carried out in all four Pilot Farms.

The water management trials for the off-season rice cultivation in 1985 ware carried out under favorable conditions i.e., frequent rainfall. There was more rainfall this year than in normal year. It is, therfore assumed that the problems encountered during the trials would be less. Thus, it is recommended that the water management trials be continued in the consecutive cropping seasons.

In the coming trials, special attentions should be paid to the following.

(1) Presaturation

Rotational irrigation during the presaturation period has not been studied this year. It should be examined in the coming season.

(2) Target of the water management trials

The target settled for the trials in 1985 is considered to be too high. The target should be reset for the consecutive trials. For the four criteria, the following standard figures are recommended.

-Irrigation efficiency ; IE is more than 70.
-Even distribution of water ; ED is between 80 and 120.
-Control of water depth in lots ; R is more than 70.
-Presaturation ; P is between 50 and 120.

(3) Inflow discharge

In order to save irrigation water and to achieve high efficiency in irrigation in the trials, the inflow discharge in each Pilot Farm should be controlled from the beginning of the trials. The following discharges are recommended at the main off-take.

Pilot Farm No.1	34.0 l/sec
Pilot Farm No.2	11.0 l/sec
Pilot Farm No.3	28.0 l/sec

5.2 Farmers' Participation in the Trials

In the on-farm water management, farmers play a vital role. In particular, the maintenance of batas depends chiefly on the individual performance by farmers. In the water management trials for the off-season rice cultivation in 1985, the farmers were not asked to paticipate in the trials. Responsibilities for the operation and maintenance of on-farm facilities should be gradually transferred to the farmers. Thus, the farmers should be encouraged to participate as much as possible in the consecutive trials. Participation by farmers should be expected in the following;

- Maintenance of batas,
- Cleaning of field canals,
- Repairing of minor collapses of on-farm facilities,
- Adjustment of stoplogs in field off-take and outlet under the guidance of the staff at the Centre,
- Direct participation in the trials by representatives of the farmers.

In order to execute the above work as well as to let farmers know the importance of on-farm water management, a meeting should be held among farmers with an initiative coming from the Centre.

5.3 Study on Rotational Irrigation

It has been preliminarily concluded that a relatively high irrigation efficiency can be achieved in Pilot Farm areas with the proper on-farm water management. However, it has been also found that the even distribution of water becomes very difficult if the inflow discharge comes near to the field water requirement. This is obvious especially in P/F No.3, where an individual lot is equipped with a tap or a field off-take. By the poor operation of only one tap, the amount of loss comes to about a half of the water required to irrigate the whole area in P/F No.3. Thus the water shortage occurs in the downstream lots.

It has been found as a result of the trials that the introduction of rotational irrigation during the normal growth period would be very effective in such an area as P/F No.3. It is therefore recommended that a more detailed study on the rotational irrigation be made in the consecutive trials. The main items to be studied will be as follows.

- Interval of rotation in relation to the inflow discharge,
- Order and method of rotation,
- Irrigation efficiency after introducing the rotational irrigation,
- Daily change of standing water depth in a lot after practicing the rotational irrigation.

5.4 Replacement of Main Off-take Gate

The main off-take gates in P/F No.1 and 3 have a lot of leakage even if the gates are entirely closed. At the same time, a delicate control of discharge cannot be achieved because the opening of gate is adjusted by selecting a hole provided in its spindle. The interval of holes is too distant to make the delicate control possible.

The main off-take gate is very important to contribute to proper on-farm water management. For the purpose of study, the gates in Pilot Farms should enable the precise control of water, in order to make a detailed study of on-farm water management. The main off-take gates in P/F No.1 and 3 should be replaced.

ANNEX : PROGRAMS FOR CALCULATION OF DISCHARGES

The following programs were developed using a microsoft basic. The programs are kept in a disk named "MICROSOFT BASIC DATA DISK" for a future use.

1. Discharge for a rectangular weir under perfect flow

2. Discharge for a rectangular weir under submerged flow

3. Discharge for field canals in P/F No.1

4. Discharge for a rectangular concrete canal

5. Discharge for a Parshall flume of 6 inches

6. Discharge for a triangular weir with a notch of 90 degrees

7. Maximum water requirement during the presaturation period

8. Length of presaturation period under the fixed intake discharge

Ⅱ　芳住喜介専門家
（農業機械）

任期　60. 8. 22 ～ 60. 9. 21

1. 概　　要

マレイシア水管理訓練計画は１９８６年3月末をもって終了するにあたって、同計画によって日本から供与された農業機械等の点検を行い、計画協力終了後に同事業を継続遂行するために必要な農業機械等の予備部品を整備し、さらに将来の農業機械等の運用と更新についての提言をするようマレイシア側より要請があった。これにもとづき、昭和６０年8月２２日より9月２１日までの１ケ月間短期専門家として、前記の業務を実施するべく赴任し、その業務を終了し帰国したので、ここに報告する次第である。

現地着任後、水管理訓練計画の所長、職員及び現地派遣専門家と討議を重ねた結果、同水管理訓練センターでの農業機械は次の様に位置づけられていると理解された。

1) 予灌水方式（Presaturation　Irrigation　System）の導入による、耕うん、整地、代かき、田植作業の一貫体系を機械化する。
2) 水稲栽培の機械化導入と収穫後調製の一連の作業を体系的に展示、訓練する。
3) 地域内パイロット、ファームにおいて同様の展示、演示を実施する。

これらの取り組みは技術協力期間中に実施促進されている。そして、さらに技術協力終了後もマレイシア側により継続して実施される計画で１０月１日に予定されている日本、マレイシア合同委員会に於いて確認されることになっている。

2. 業務内容

2．1　農業機械等の現況と予備部品についての考察

概要で述べた事柄を前提として、マレイシア水管理訓練センター（プロジェクト）に於いて、農業機械等の現況を把握することから始めた。

部品供与を必要とされる農業機械等はあらかじめプロジェクトより提示されていたので、その提示された表を基礎に農業機械等を点検し、部品の供与が必要と考慮される農業機械等を検討した結果を表にし、現地に提出したレポートに添付したTable 1に示すとおりである。また、水稲栽培の機械化導入及び収穫後調製の一貫作業の訓練に必要な農業機械等の現況および利用状況は表１に示すようになっていた。さらに、部品供与を必要とする農業機械等の選択には、現況および利用状況を検討するとともに派遣専門家および現地職員と合議し、次に示す事柄を基本に考慮した。

1) 耕うん、代かき、田植作業は水管理上の予備灌水行程を導入することにより機械による一貫作業を実証、展示する。

即ち、乾季の水稲作付けには、耕うんのための灌水は不可欠であり、この予備灌水を有効に活用するために短期間に集中的に作業し、耕うん、代かき、田植作業を完結する必要がある。とくに田植作業は労働力の不足とそれにともなう安易な散播の結果減収をまねく要因となり、また畜力の所有も激減している、故々に機械による田植の導入もやむを得ない現状である。一般には賃耕業者による耕うん、代かき作業が普及している。

2) 防除作業は農薬が容易に入手可能にもかかわらず適切な防除機が不足しているため、いったん病虫害が発生すると広範囲に影響することになる。この事は小職の短期在任中にも新聞で報道された程である。

農薬は水溶液が主体であり、動力散布を主に実施するとともに緊急時非常用に背負式動力散布機も導入することが賢明であるとの結論に達した。

3) 収穫作業は耕うん、代かき作業同様、賃貸業者による機械収穫が一般的である。同時にこの時点での労働力の不足も大きな要因であり、収穫機械を導入することもやむを得ない。

4) 収穫後調製は現有の供与機械を利用出来ない要因がいくつかある。それは、電源の供給が昨年になって実施され、各機械を据付けた。その間、乾燥機の電気制御系統がねずみにより食害され使用不能になった。穀物貯蔵機に揚穀装置が付帯してなく、使用困難である等、種々の事柄があげられる。

そこで今回、配電、配線、原動機などの交換、乾燥機の電気制御系統の修理再配線などを行い、稼動可能な状態に修復した。

これにより、二国間合議にある水稲栽培から精白米生産までの一連の行程を訓練、実習するとの条項を充たすよう整備する一助とし、今後の訓練計画にも含められることになった。

従って前述の揚穀機の供与は不可欠であると考える。

5) 施工された水路、土堤などの維持管理、保全作業も水管理上、欠かせない作業で、現有の利用可能な管理機械を稼動可能な状態に維持する必要がある。

以上の事柄を基本に選択された農業機械等の予備部品を、冷却水、潤滑油、燃料、その他種々の現地特有の条件などとともに考慮し、作成した必要予備部品を添付の一覧表に示すものである。部品の数量については同機種の保有台数と耐用年数を想定し、さらに既供与の部品の種類数量等も考慮して計上した。

2．2　予備部品の保管、管理

つぎに現有の部品の保管、管理状況を点検したところ、車輌関係の部品は車種別に区分されロッカーに収納されていた。農業機械の部品では、主要機械については、小梱包のまま機種別を記入して棚上に区分けされ、さらに、その他の機種、とくに大型部品、長尺部品については棚や倉庫の片隅に積み重ねてあった。

部品台帳、分類、出収納表も全く整備されてなかったが、保管状態は概して良好であった。

そこで部品の区分け、分類、収納の方法、部品台帳の記載、整理、管理カード等を整備するよう助言と指導を行った。カードは準備が必要なため当座は部品にラベルを付けて整理することから始め、部品台帳に記載する作業が開始された。

現有の予備部品の整備でもかなりの数量になり、数ケ月間を費やすことになると推定される。それ故、現地派遣専門家による適時の促進を希待するものである。

2．3　現地側に対する提言

さらに、いくつかの提言をプロジェクト所長や関係職員に対して行った。そのうち現地での報告書中に文書として残したものはつぎのようなものである。

1) 前述した部品管理について、部品棚を整理し、管理カードと部品台帳を整備し、適切な管理を行う。
2) 空席となっている農業機械担当の職員を早急に採用、任命し農業機械等の利用計画を調整し、運用を実施する必要がある。同時に予備部品の管理も責任下におくことが望ましい。
3) 収穫後調製を当初の事業計画に従って、訓練の一項に加え、水稲の作付から精米までの一貫した作業工程を展示、訓練することが望ましい。なお農業機械担当職員に収穫後調製機械の操作と運用を修得させる必要があると考えられる。

以上のような提言を行い、同時に農業機械等の予備部品表を会議において検討、承認された。現地報告書と予備部品表は、現地所長、職員および派遣専門家に提出し、任務を終了した。さらにプロジェクト所長のC. C. CHAN 氏より、予備部品表と携行機材の受領書を交付されたので添付する。

最後に現地において多大な支援と協力をして下さった島田輝男、松沢清士両専門家、C. C. CHAN 所長はじめ関係職員の方々に深くお礼を申し上げる次第です。

以　上

業務日程行動表

	月　日		
1	8月 22日	木	ＪＬ７２１にて成田発クアラランプール、ＭＨ３２２にてコタバル着
2	23	金	（休日）島田、松沢専門家より一般事情説明、業務日程、（案）作成
3	24	土	プロジェクト着任挨拶、業務内容検討、事務室整備、資料集収
4	25	日	機械、部品収納及び現況調査、専門家、現地側個別に意見聴取
5	26	月	（祝日）農業機械、個別調査、MODEL、型式、製造年度番号等確認
6	27	火	（祝日）農業機械現況リスト作成、トラクター等部品検討
7	28	水	パーツリスト収集、トラクタ及びアタッチメント等の部品リスト作成
8	29	木	耕うん機等部品リスト作成、トラクタ、耕うん機稼動状況観察
9	30	金	（休日）田植機類試運転、部品リスト作成
10	31	土	（祝日）コンバイン、脱穀機、部品リスト作成
11	9月　1日	日	コンバイン稼動観察、脱穀機部品リスト英訳
12	2	月	田植機部品リスト作成、英訳、コンバイン稼動検討
13	3	火	田植機部品リスト作成、乾燥機、貯蔵機、モミ摺精米機の利用検討
14	4	水	防除機、管理作業機部品リスト作成
15	5	木	防除機、乾燥機、穀物貯蔵機等部品リスト作成
16	6	金	（休日）既供与部品、機種数量検討、既存部品リスト収集
17	7	土	既供与部品をリストと照合、部品の分類、整理を提言指導
18	8	日	パイロットファーム№1.2.3及びKADA農場視察
19	9	月	既存部品と作成部品リストを照合、修正部品リスト作成
20	10	火	乾燥機点検、必要部品手配、動力電源給配電を点検
21	11	水	乾燥機駆動部総点検、モーター交換、制御盤結線交換、貯蔵機点検
22	12	木	乾燥機、温度、燃焼制御関係点検、再結線、試運転、運転指導

	月　日		
2 3	9月 1 3日	金	(休日) 現地提出レポート原稿作成
2 4	1 4	土	部品リスト、プリントアウト完了後編成、レポート原稿両専門家と点検
2 5	1 5	日	Copy 機整備、部品リストコーピー
2 6	1 6	月	(祝日) レポート、タイプ
2 7	1 7	火	JOINT MEETINGにて、レポート、部品リスト、説明検討
2 8	1 8	水	Pilot Farm No.4 松沢専門家に同行視察、業務引き継整理
2 9	1 9	木	事務室整理、帰任挨拶、MH３２１にてクアラランプール、ＪＩＣＡ　Ｋ．Ｌ事務所岩佐氏に業務報告
3 0	2 0	金	業務整理、ＪＬ７２２にてクアラランプール発
3 1	2 1	土	ＪＬ７２２にて成田着、ＪＩＣＡ本部にて業務報告

（表１） 主要農業機械現況・利用状況表

機械名	機種	仕様			台数
トラクター	TS3100F−DU	4輪駆動	稼動時間130hrs、主に展示農場の代かき作業	A	1
	TS2510	4輪乗用	稼動時間約200hrs、2台、センター内耕うん、代かき作業農場整備、訓練実習 同約400hrs 4台、KADA、パイロット・ファームにて、耕うん、代かき作業	A	5
耕うん機	K120	ディゼルエンジン	プロジェクト・サイト内の運搬作業、試験圃場の耕うん、代かき作業、3台程度は遊休状態 耕うん部の部品は不要	B	5
田植機	YP400		展示農場内の田植作業、訓練実習	A	2
	YP430		同上（Parts List が入手出来なかった、YP400と同様の部品が必要）	A	
	PF450		旧型なためあまり利用されていない、パイロット・ファームに貸与予定 予備部品もかなりあり、耐用限度も近い。	D	
	PF451		未使用、予備部品かなりある。	B	2
	PL600		未使用	B	1
防除機	MS353	安置型	展示農場内の防除作業、パイロット・ファーム貸与予定、訓練実習	B	3
	MS075	背負型	未使用、試験圃場の緊急防除作業予定	B	1
	MD150	同上	1台未使用、他4台は耐用時間をすぎ、修理は不適、訓練実習予定	C	5
	MD35DX	同上	未使用 訓練実習予定	B	2
収穫機	TC3500MW	コンバイン・ハーベスタ	マレーシア仕様のため展示農場全ての収穫作業に稼動	A	1
	HL1300	同上	ほとんど利用されていない、パイロット・ファーム乾季収穫に貸与予定	B	1
	HD3100	同上	車高が低く、地耐力が小さいため、水田乾燥時のみ利用、貸与予定 予備部品、種類、数量とも充分にある	D	2
脱穀機	HMD700	自走式	試験圃場、その他小区画非常時の脱穀作業、予備部品かなりある	B	1
	HM711	同上	同上、予備部品はかなりある。	B	1
乾燥機	SH235SR	循還式	電気制御回路の鼠害により、未使用	A	1
穀物貯蔵機	RFT260B	通風式	揚穀装置が付帯しておらず未使用	A	1
籾摺精米機	KANEKO500	ゴムロール・ワンパス	乾燥機が使用出来ず、従って未使用、揚穀機を付帯する要あり	A	1

機械名	機　種	仕　様			台数
トラクター アタッチメント	SR1610CD	ローターベーター	2機未使用同様	A	6
	HY242	ドライブハロー	3機未使用	A	4
	HY201S	同　上	展示農場に主として利用、訓練実習	D	2
	HD202B	同　上	TS3110に装着、展示農場内にて利用 （専用）		1
	SR−240	同　上	爪車がねじ曲って砕損　利用しない	C	1
	DTS251	ドッキング・ローダー	トラクター1台にリアグレイダーと共に装着未使用	D	1
トレンチャー	CT40	乗用型	展示農場施工後使用されていない、ブレイド予備6セット保有	D	1
ファーム ポーター	X60	クローラー型	利用されていない	D	1
管理用機械	EHM63Z	ハンマーナイフ	プロジェクト・サイト場内整備、ナイフ駆動部故障	D	1
	SHM650	モアー	未使用、プロジェクト・サイト場内整備、予備部品多少有り	B	1
	RC161A	ロータリー・カッター	未使用　展示農場農道整備、予備部品多少有り	B	1
	KT−17	草刈機	土堤、水路整備作業、長時間使用1、修理不可		3
	S340−XF	同　上	KT17と更新され同上作業に利用	A	2
	（その他、3機種5台が現地にて調達、利用されている。これ等の部品、更新は現地調達可能である）				
グラスボート	U18F	船外機付	利用されていない		1

PUSAT LATIHAN PENGURUSAN AIR KEBANGSAAN

JABATAN PARIT DAN TALI AIR
PETI SURAT 246,
KOTA BHARU, KELANTAN.

Telefon: 09-922600

Bil. (59) dlm: JPT. KN. PLPAK. 9
Jld.1
Tarikh 17hb. Sept, 1985.

Mr. Yoshisuke Yoshizumi,
Japanese Short-Term Expert,
National Water Management Training Centre,
Kota Bharu, Kelantan.

Dear Mr. Yoshizumi,

I acknowledge receipt of the following items from you.

i) Recommended spare-parts list for the operation of farm machinery of the Centre.

ii) Following instruments:-

a) 1 No. 600 mm steel rule
b) 1 No. 150 mm steel rule
c) 1 No. Screw Gauge No.156
d) 1 No. Screw Gauge No.137.

With this, we would also like to express our appreciation and gratitude for the works you have completed for the Centre during your short assignment with us.

Thank you and with best regards.

Yours sincerely,

(Ir. C. C. Chan)
Director,
National Water Management Training Centre,
Drainage and Irrigation Department,
Malaysia.

A Report on Agricultural Machinery at National Water Management Training Center, Malaysia.

According to the application as Form A 1 under the Colombo Plan, the expert on Agricultural Machinery has been assigned by JICA from 22nd. August to 20th. September 1985 to check all the agricultural machinery and to draw up a list of spare parts for machine maintenance and repair as well as to make recomendation for future operation and replacements.

The list on agricultural machinery which has been submitted requires list of their spare parts as mentioned in the application.

The agricultural machinery based on the given application have been listed as following to the project plan in future which were discussed and informed as briefing by the officials concerned and Japanese experts.

A selection on the kind of agricultural machinery has been reached based on the following consideration and discussions:

1. Paddy field is prepared by machinery following introduction of presaturation irrigation system.

2. Pest control will be needed to introduce effective method to be carried out in wide area at short time. So, a power sprayer is recommendable to fill the condition above. A knapsack type power mist duster is also recommended to assist pest control in emergency cases.

3. Harvesting of a paddy necessitate to use of machinery due to lock of labour during peak labour damand in Malaysia.

4. Post harvest machinery will be utilized as part of a serial mechanization training which has been initially planned in the training scheme.

5. Water canals should be maintained and cleaned properly and several equipments are required to assist in executing the works.

The present condition of agricultural machinery have been observed and checked carefully in the machinery pool or in their operating condition. Soil has been confirmed on its effect for machinery usage as well as water, oil, fuel and grease on the machinery. And central workshop of DID and

KADA have also been visited for further consideration on repair and maintenance of machinery.

The list of agricultural machinery has been summarized according to the above mentioned and is shown in Table 1..

The list of spare parts for agricultural machinery which have been inspected and checked was prepared as shown in Annex.

The required quantity of spare parts is estimated considering the number of machinery units and their life for about five to seven years.

The quantity of machinery spare parts which are available in the store room has also been considered as estimation of requesting spare parts.

Besides, several matters are recommended on proper operation and maintenance of machinery and also to improve storing system for spare parts.

1. To install spare parts properly in individual racks with attached cards and to enter into store book properly.

2. At least one personnel should be assigned for maintainning operational procedure on spare parts and annual machinery performance schedule to coordinate field cultivation planning.

3. As discussion with officials, Paddy dryer, Paddy storage and Rice miller are recommended to be included as part of training scheme which has been initially planned. In the meantime, repairs on paddy dryer has been completed and in operational condition. One personnel will be suggested to be assigned for these operations even as an additional post for above 2 paragraph.

Finally, I would express my appreciation for kind cooperation and warmful hospitalities of the Director, National Water Management Training Center, Malaysia and his officers.

Japan International Cooperation Agency
17/9/85
Yoshisuke Yoshizumi,
Expert on Agricultural machinery.

Table 1

A observed condition on farm machinery at present (Sept. 1985)

No.	Machinery	Model	Maker	Discription	Remarks	No. Unit
1	Tractor	TS3100F-DU	Iseki	4 Wheel drive	Paddling	1
2	Tractor	TS3510	Iseki	4 Wheel	Soil preparation	5
3	Rotervator	SR1610CD	Iseki			6
4	Drive Harrow	HT242	Niplo		3 set not use yet	4
5	Powertiller	K120	Kubota	2 Wheel	For trial plot. Transportation	5
6	Transplanter	YP400	Yanmar			2
7	Transplanter	PF451	Iseki		Not use yet	2
8	Transplanter	PL600	Yanmar	Riding type	Not use yet	1
9	Transplanter	PF450	Iseki		Life will be over soon	4
10	Power sprayer	MS359	Maruyama			3
11	Power sprayer	MS075	Maruyama	Knapsack type	Not use yet	1
12	Power mist duster	MD150	maruyama	Knapsack type	1 Set not use yet, others overlife	5
13	Power mist duster	MD35DX	Arimitsu	Knapsack type	Not use yet	2
14	Combine harvester	TC3500	Yanmar			1
15	Combine harvester	HL1300	Iseki		For dry field	1
16	Field thresher	HMD700	Iseki			1
17	Field thresher	HM711	Iseki			1
18	Paddy dryer	SH235SR	Kaneko	Rea'rculation type	Not use yet	1
19	Paddy storage	RFT260B	Kaneko		Not use yet	2
20	Bush cutter	S340XF	IKS			2
21	Floil mower	SHM650	Sato		Not use yet	1
22	Rotary cutter	RC161A	Sasaki		Not use yet	1
23	Drive harrow	HD202B	Niplo			1
24	Transplanter	YP430	Yanmar		Minor truble	1

JICA