DETAILED DESIGN REPORT
THE TECHNICAL COOPERATION PROJECT
ON
WATER MANAGEMENT TRAINING
IN
MALAYSIA

OCTOBER 1977

JAPAN INTERNATIONAL COOPERATION AGENCY

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FOREWARD

The Government of Malaysia with its Third Malaysia Plan, which has been started from the year 1976, is actively driving forward a policy by which to contemplate an increase in food production, particularly a stable supply of rice by realization of double cropping. In conformity with this line, major irrigation facilities have been completed for irrigating the planned double cropping areas in Malay peninsula, and readjustment and expansion of the minor irrigation and drainage facilities are to be grappled with from now on.

With such situation for a background, the Government of Malaysia has schemed out a project for training and education of technical officials to be engaged in water management and, in October 1975, has made a request to the Government of Japan for technical cooperation with regard to the implementation of such project.

In compliance with such request, the Government of Japan despatched to Malaysia a preliminary survey team in March 1976 and the second survey team in January 1977 and exchanged views and opinions with the Government of Malaysia with regard to the scope and method of technical cooperation for this project.

Further, two (2) experts were despatched to Malaysia from April to August 1977 to carry out the necessary surveys and preparatory works for the implementation of this project, and a detailed design team was despatched from June to September 1977 in order to make and prepare detailed design for Demonstration Farm and related facilities attached to the Water Management Training Centre, the main point of training programme for technical officials to be engaged in water management and the Record of Discussions on the necessary measures to be taken by both Governments to successfully implement the said project.

This report is a compilation of the results of these surveys and investigations together with the Record of Discussions between the Japanese survey team and the representatives of the Government of Malaysia.

Our profound gratitude is hereby expressed to the people of concerned Government authorities and agencies of Malaysia, the Japanese Embassy in Malaysia, Japanese Colombo Plan Experts and Japan Overseas Cooperation Volunteers who have given every possible conveniences and cooperation in carrying out these surveys. Our gratitude is also extended to the Ministry of Foreign Affairs and the Ministry of Agriculture and Forestry of the Government of Japan for their active assistance and cooperation toward the materialization of this project.

Tokyo, October 1977

SHINSAKU HOGEN

President
Japan International Cooperation Agency

PREFACE

On this project, a series of surveys and studies has been made, namely a preliminary survey in March 1976 and an agricultural survey in January 1977, for surveying and studying the feasibility of the project, the direction in which the project should be proceeded and so forth. Subsequently, on the basis of the results of these surveys, Dr. Katsumi Deguchi, who was the head of these two survey teams, and Dr. Katsuo Sugimoto, who has a profound knowledge of rice cropping in Malaysia, were despatched from April to August 1977 to Malaysia as "Project Preparatory Experts" to carry out various surveys and preparatory works required for the implementation of the project.

Further, a detailed design team, headed by the undersigned, was despatched to Malaysia for the periods from June 21 to July 26, 1977 and from August 24 to September 6, 1977. This team, in cooperation with the above mentioned "Project Preparatory Experts", has prepared a training programme for the irrigation engineers agricultural officers and technicians, carried out necessary surveys for detailed design of Demonstration Farm and related facilities attached to the Training Centre and compiled the Record of Discussions on the necessary measures with regard to the implementation of the project.

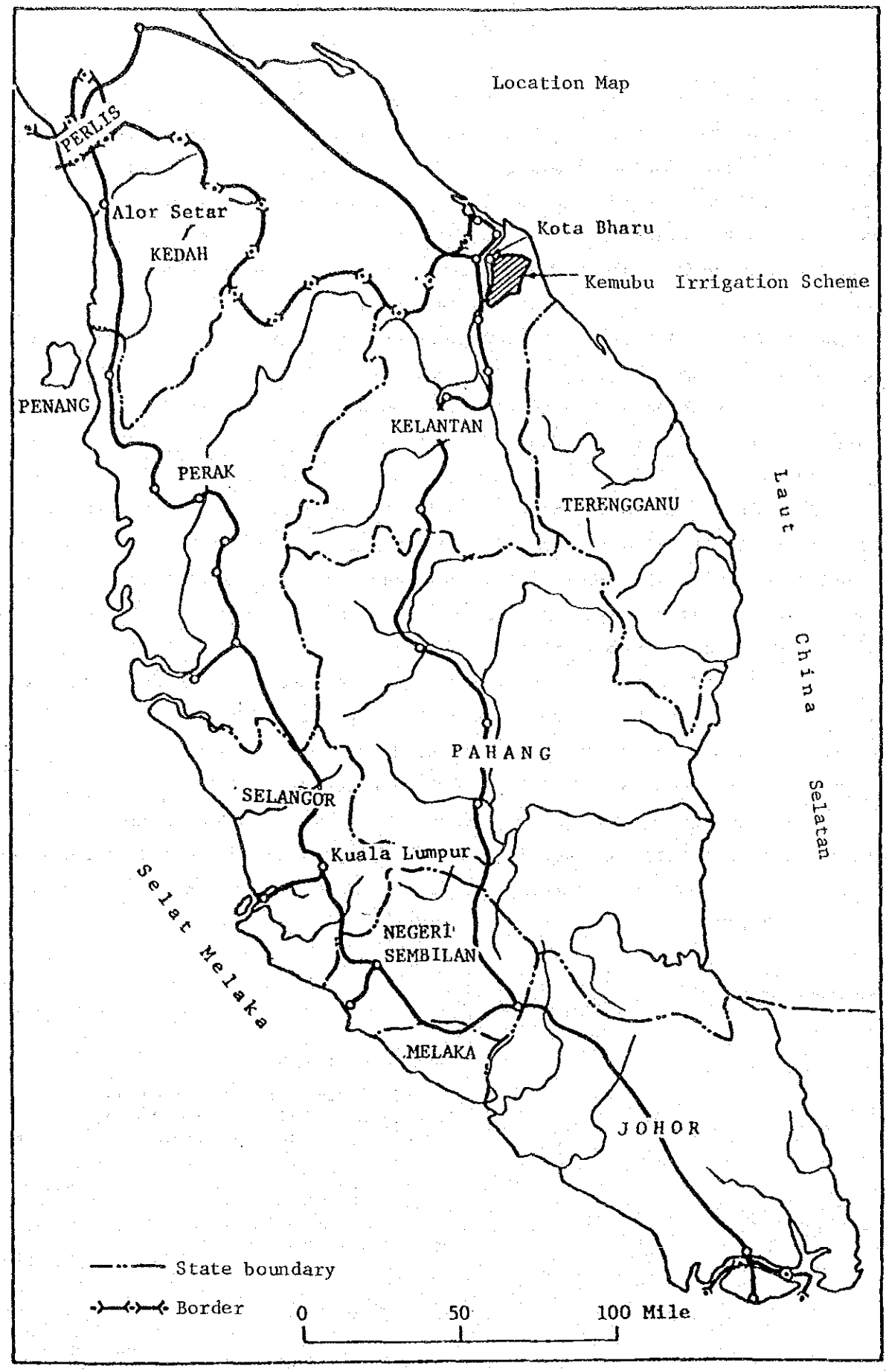
I am pleased indeed to submit herewith this report of the detailed design team and am hoping that this report will be of great use hereafter in the operational aspect and/or technical aspect of the project which will be implemented under the cooperation of both Governments of Malaysia and Japan.

My sincere thanks are hereby expressed to the people of concerned Government authorities and agencies of both Malaysia and Japan and to the other people concerned who have given great conveniences and cooperation in carrying out these surveys.

Tokyo, October 1977

MICHIO NAKAHARA

Head of the Japanese Detailed
Design Team for Water Management
Training Project in Malaysia


Location Map
PERLIS
Alor Setar
KEDAH
Kota Bharu
Kemubu Irrigation Scheme
PENANG
KELANTAN
PERAK
TERENGGANU
Laut China Selatan
PAHANG
SELANGOR
Kuala Lumpur
Selat Melaka
NEGERI SEMBILAN
MELAKA
JOHOR
State boundary
Border
0
50
100 Mile

Abbreviations and Explanation of Terms

Abbreviations	Official Designation (Words in parentheses are of Malaysian language)
DOA	Department of Agriculture (Jabatan Pertanian)
DID (J.P.T.)	Drainage and Irrigation Department (Jabatan Parit dan Taliair)
KADA	Kemubu Agricultural Development Authority
MADA	Muda Agricultural Development Authority
MARDI	Malaysia Agricultural Research and Development Institute
FMTC	Farm Mechanization Training Centre
FAMA	Federal Agricultural Marketing Authority
EPU	Economic Planning Unit
PWD (J.K.R.)	Public Works Department (Jabatan Kerja Raya)
FELDA	Federal Land Development Authority
ENEX	A New Zealand consultants
JICA	Japan International Cooperation Agency
SOGREAH	A French Consultants
D.I.E.	Drainage and Irrigation Engineer
T.A.	Technical Assistant
A.O.	Agricultural Officer
A.A.	Agricultural Assistant
A.T.	Agricultural Technician
C.I.I.	Chief Irrigation Inspector
I.I.	Irrigation Inspector
I.O.	Irrigation Overseer
E.W.	Extension Worker
L.C.E.	Lower Certificate of Education (in English)
S.R.P.	(An equivalent to L.C.E. in Malay)
M.C.E.	Malaysia Certificate of Education (in English)
S.P.M.	(An equivalent to M.C.E. in Malay)
M.C.V.E.	Malaysia Certificate of Vocational Education
H.S.C.	High School Certificate (in English)
S.T.P.	(An equivalent to H.S.C. in Malay)

Measurement Unit

(a) Area

One acre =0.4047 hectare (Ha) = 10 square chains

One hectare=2.4711 acre

One Relong =0.71 acre = 0.287 ha

(b) Length

One inch = 2.54 cm

One foot = 12 inches = 30.48 cm = One Kaki

One yard = 3 feet = 91.44 cm

One chain = 66 feet = 20.12 m

One mile = 80 chains = 1.6093 km = One batu

(c) Weight

One ounce (Oz.) = 28.3495 grammes

One pound (lbs.) = 16 oz. = 453.6 grammes

One kilogramme = 2.205 lbs.

One long ton (Lg.t) = 2.240 lbs = 1.016 tons

One pikul = 133.33 lbs = 60.48 kg

(d) Capacity

One gantang = 1 gallon (Br.) = 4.546 litres

One cubic feet = 6.23 gallons = 28.3 litres

One cubic yard = 0.76455 m^3

(e) Others

One ft^3/acre = 69.84 (Lit./ha)

One cusec = 1 ft^3/sec = 28.3 Lit/sec

One cusec/acre = 69.84 Lit/ha/sec.

(f) Conversion of agricultural products

Paddy: One gantang = 5.6 lbs = 2.54 kg

400 gantang = 1.0 long ton = 1.016 metric ton

400 gantang/acre = 2,240 lbs/acre = 2,511 kg/ha

Monetary Unit

One Ringgit = One Malaysian Dollar = US$0.40 =¥110.00

Fiscal Year: From last January to 31st December of each year

Specific Words:

Padi = Paddy

Sawa = Paddy field

Kampung (Kg.) = village

Sungai (Sg.) = River

Karabao - buffalo

Gantang = A unit indicating cubage equal to one gallon (Br.) = 4.546 litres

Pikul = A weight indicating unit and is equal to 60.48 Kg

Daerah = District

Mukim = Sub-district

TABLE OF CONTENTS

I. OUTLINE OF THE SURVEY

Chapter I. Outline of the Survey

1 - 1 Background of the Project

One of the important agricultural policies in Malaysia is an increase in food production, particularly of an increase in the production of rice which is the staple food of Malaysian people. Hitherto, the supply of rice in this country, the greater part of it, has been dependent on the imports from Thailand, Burma and other countries.

The Government of Malaysia, therefore, has been undertaking to implement the projects for the expansion of paddy area by reclamation and for the expansion of double cropping areas by providing more irrigation facilities in order to bring up the nation's food production to self-sufficiency level and thereby to stabilize the national economy as well as to increase the farmers' income and thereby to stabilize their standard of living. In recent years, the emphasis has been placed particularly on the latter projects for the expansion of double cropping areas and, consequently, the main canal facilities have been almost completed in those double cropping areas. However, speaking from the farm level, the plot-to-plot irrigation, which is substantially the rain-fed irrigation, has been still practiced in most of the areas making it not well achieved the effective utilization of water. Accordingly, the expected yield has not been cropped in those areas.

Under such circumstances, the Government of Malaysia has been concerned with the problems with respect to the water management in paddy field. It has actively attended the international seminars on water management and has held a water management seminar jointly with FAO in 1973 at Alor Star. Taking this opportunity, the necessity of training of the engineers and technicians has been recognized in this field that the Government of Malaysia has schemed out the project to establish the Water Management Training Centre and that it has made a request to the Government of Japan in October 1975 for necessary cooperation in order to materialize such project.

In compliance with such request, the Government of Japan has carried out a survey with regard to the possibility of agricultural technical cooperation by despatching a preliminary survey mission in March 1976, and has carried out another survey with regard to the direction in which such project should be proceeded by despatching the second survey mission in February 1977. Subsequently to these survey missions, Dr. Katsumi Deguchi, who was the head of these two survey missions, and Dr. Katsuo Sugimoto, who has a profound knowledge on rice cropping in Malaysia, were despatched to Malaysia as "project preparatory experts" to carry out various surveys and preparatory works required for the implementation of this project.

Finally, this detailed design team was despatched to prepare, in cooperation with the "Project Preparatory Experts", the main point of training programme for engineers agriculture officers and technicians and detail design of Demonstration Farm and related facilities attached to the Training Centre. The team has also compiled the Record of Discussions on the necessary measures to be taken by both Governments for the implementation of this project. With the completion of this record, this project will be proceeded from the state of planning and entered into the stage of implementation.

1 - 2 Purpose of Survey

The location for the training centre and the pilot farm has been decided through the preliminary survey and implementation survey that were conducted up to the previous survey. Outline of the lay-out of the farm attached to the training centre and of the pilot farms was also decided. As the trainees were almost decided, outline of the training programme has been completed. In order to concrete the conception in accordance with all these results, the followings were carried out in the survey of this time through exercising partial correction to the results obtained through the previous surveys:

1) The detailed design of the farm attached to the training centre and related facilities thereto. (Refer to Chapter III.)

2) Temporary designing of pilot farms emphasing on an irrigation system (Refer to Chapter III.)

3) Preparation of the essential part of the training programme (Tentative plan) (Refer to Chapter II. 2 - 5)

4) Listing up of equipment and materials necessary for management of the project (Refer to Chapter II. 2 - 6)

5) Arrangement of Record of Discussions to be exchanged (Refer to Chapter IV.)

1 - 3 Formation of Survey Team

The members of the implementation survey team and two project preparatory experts who have completed this report, are as follows:

Mr. Michio Nakahara; Team leader; Director of Agricultural Development Cooperation Department of Japan International Cooperation Agency.

Mr. Katsuhiro Sawai; Water management; Assistant Chief of the Readjustment and Consolidation Section, Construction Division, Tokai Agricultural Administration Bureau, Ministry of Agriculture and Forestry.

Mr. Shigemi Suzuki; Agricultural machinery; Training Instructor of Agri-

cultural Technique Training Institute, Agricultural, Sericultural and Horticultural Bureau, Ministry of Agriculture and Forestry.

Mr. Michiaki Saito; Irrigation; Design Group Chief, Agricultural Land Section, Agricultural, Forestry and Fisheries Division, Fukui Prefecture.

Mr. Junji Inoue; Land Consolidation; Technical adviser to Japan Irrigation and Reclamation Consultants.

Mr. Noboru Machida; Land Consolidation; Assistant Chief of First Designing Section Engineering Division, Japan Irrigation and Reclamation Consultants.

Mr. Isaburo Takemoto; Irrigation and Drainage; Engineer of Fourth Designing Section, Engineering Division, Japan Irrigation and Reclamation Consultants.

Mr. Tsuneo Tsukada; Coordinator; Assistant Chief of Agricultural Technical Cooperation Section, Agricultural Development Cooperation Department, Japan International Cooperation Agency.

Project Preparatory Experts:

Dr. Katsumi Deguchi; Ex-Director-General of National Research Institute of Agricultural Engineering, Ministry of Agriculture and Forestry.

Dr. Katsuo Sugimoto, Chief Research Officer, Tropical Agriculture Research Center, Ministry of Agriculture and Forestry.

1 - 4 Survey Schedule

21st June, Tuesday:	Air trip from Tokyo, Japan, to Kuala Lumpur, Malaysia (Except team leader and Mr. Sawai) Arrangement on working schedule was made with both Dr., Deguchi, Project Proparatory Expert and office manager Mr. Kasai.
22nd June, Wednesday:	Courtesy call at Embassy of Japan, and explained on working schedule, received survey report from Dr. Deguchi and arranged schedule on detailed design and its course.
23rd June, Thursday:	Courtesy call at DID and arranged on outline of design with Mr. Thavaraj, (Assistant-Director General, DID). Visit to Oversea Office of the Agency, Arranged schedule with Dr. Deguchi, Project Preparatory Expert,on detailed design.
24th June, Friday:	Made preparation for detailed design. Arrangement on detailed design schedule with Dr. Deguchi.
25th June, Saturday:	Air trip from Kuala Lumpur to Kota Bharu. Received survey report from Mr. Sugimoto, Project Preparatory Expert and Mr. Kubota, a member of JOCV,and made arrangements on detailed design and working schedule.
26th June, Sunday:	Arrangement on detailed design in the workshop of DID, Kelantan State. Courtesy call at DID, Kelantan State,

	Mr. Aminuddin B Zainuddin (Acting Director of State DID: District Engineer, DID Pasir Mas). Courtesy call at Government of Kelantan State,Mr. Mustapha Mohd Zair (Director, State Economic Planning Unit), Mr. Wan Yahua Wan Salleh (Assistant Director, State Economic Planning Unit)
27th June, Monday:	Visited State DID Kelantan, Mr. Mohd. Noh B. Abu Samah (Acting Director: Technical Assistant State DID). Inspection of the site of Pilot Farms (P3T1S6K, P4S3L, P2M),the site for Training Centre and Pump Station of Kemubu Irrigation Scheme.
28th June, Tuesday:	Inspected the site of Pilot Farm at Padang Lindong and Pasir Mas Pump Station. Worked on the detailed design.
29th June, Wednesday:	Land surveying of the Pilot Farm site P3T1S6K. Worked on detailed design.
30th June, Thursday:	Land surveying of the Pilot Farm site P3T1S6K. Worked on detailed design.
1st July, Friday:	Worked on detailed design.
2nd July, Saturday:	Worked on detailed design.
3rd July, Sunday:	Worked on detailed design. Courtesy call at KADA, Mr. Abdul Wahid B. Hg. Azahard (Director of Agriculture, Kelantan, General Manager KADA) Mr. Mohd. Ismail (Chief Extension Officer, Department of Agriculture, Kelantan)
4th July, Monday:	Worked on detailed design.
5th July, Tuesday:	Worked on detailed design. Dr. Deguchi, a Project Preparatory Expert,arrived at Kota Bharu from Kuala Lumpur and studied together detailed design of the Training Centre.
6th July, Wednesday:	Worked on detailed design. Study on Training Programme.
7th July, Thursday:	Worked on detailed design.
8th July, Friday:	Worked on detailed design.
9th July, Saturday:	Made study on detailed design of Training Centre. Air trip from Kota Bharu to Penang. Received explanation on rice crops in Western Malaysia from Mr. Yoshihiro Akama, an overseas research officer, Tropical Agricultural Research Centre.
10th July, Sunday:	Trip from Penang to Alor Star. Inspected Farm Mechanization Training Centre at Bumbong Lima en route to Alor Star. Inspected Farm Mechanization Training Centre and Crop Production Centre at Telok Chengai, MUDA Irrigation Scheme

followed by Mr. Tsuneo Yamashita, an overseas research officer for Tropical Agricultural Research Centre.

11th July, Monday: Visited MADA Engineering Division, Mr. Teoh Tiaw Seang (Head of Engineering Division, MADA) who explained the outline of irrigation conditions in MADA. Air trip from Ator Star to Kota Bharu. Mr. Sawai, an expert, reached Kuala Lumpur from Tokyo.

12th July, Tuesday: Mr. Sawai, an expert, left for Kota Bharu from Kuala Lumpur and inspected the Pilot Farm site (P3T1S6K, P4S3L). Some team members visited Farm Mechanization Training Centre in Lundang. Worked on detailed design.

13th July, Wednesday: Mr. Sawai, expert, and some others visited State DID, Kelantan and the Training Centre site. Worked on detailed design. Interim compilation of the detailed design. Meeting on taking over the duty of Mr. Saito and Mr. Suzuki, both the experts, who were leaving for Tokyo.

14th July, Thursday: Mr. Saito and Mr. Suzuki, experts, left Kota Bharu for Kuala Lumpur. Worked on detailed design.

15th July, Friday: Study on the Record of Discussion in draft. Mr. Saito and Mr. Suzuki, experts, left Kuala Lumpur for Tokyo.

16th July, Saturday: Inspection of Besut Irrigation Project and Besut Agricultural Institute.

17th July, Sunday: Dr. Deguchi left Kota Bharu for Kuala Lumpur. Worked on detailed design.

18th July, Monday: Worked on compiling Interim Report.

19th July, Tuesday: Mr. Kasai, Office manager, arrived in Kota Bharu from Kuala Lumpur, and visited State DID Kelantan, and inspected the proposed sites for the Pilot Farm (P3T1S6K) and for the Training Centre. Worked on compiling Interim Report.

20th July, Wednesday: Mr. Kasai left Kota Bharu for Kuala Lumpur. Worked on compiling Interim Report.

21th July, Thursday: Presented Interim Report to Mr. Tay Lang Seng (Assistant Director General, DID) and Mr. A. Kulasingam (Director of the State DID) at DID office in Kelantan. Received explanation from the member of the U.S. Peace Corps on the scholarship in scientific lessons of Malaysian middle and high school students.

22nd July, Friday: Air trip from Kota Bharu to Kuala Lumpur together with Dr. Sugimoto. Reported to Embassy of Japan on the results of detailed design.

23rd July, Saturday: Worked on arrangement and adjustment of the detailed design.

24th July, Sunday: Discussion on the presentation of Interim Report to DID with Dr. Deguchi and Dr. Sugimoto.

25th July, Monday: Presented Interim Report to Mr. Cheong Chap Lim (Deputy Director General, DID), Mr. Tay Lang Seng and Mr. A. Lyander at DID office.

26th July, Tuesday: Air trip from Kuala Lumpur to Tokyo.

- -

24th August, Wednesday: Air trip from Tokyo to Kuala Lumpur of Team Leader and Mr. Tsukada, Coordinator, and arrangements on working schedule with Dr. Deguchi and Dr. Sugimoto.

25th August, Thursday: Courtesy call at the Embassy of Japan. Had first round talks on "Record of Discussions" with the personnel in charge of Ministry of Agriculture, DID, Department of Agriculture, and EPU.

26th August, Friday: Had second round talks on "Record of Discussions" with the personnel in charge of Ministry of Agriculture, DID, Department of Agriculture, and EPU.

27th August, Saturday: Air trip from Kuala Lumpur to Kota Bharu with Dr. Deguchi and visited State DID Kelantan, also inspected the proposed sites for the Training Centre and Pilot Farms, and Kemubu Pump Station.

28th August, Sunday: Inspected one proposed site for the Pilot Farm Padong Lindong. Air trip to Kuala Lumpur from Kota Bharu together with Dr. Deguchi and Dr. Sugimoto

29th August, Monday: Had third round talks on "Record of Discussions" with the concerned personnel of the Malaysian Government.

30th August, Tuesday: The survey team and the Malaysian side waited for the instructions from their Governments respectively.

31th August, Wednesday: 20th Independence Anniversary of Malaysia. Worked to settle various matters on the "Record of Discussions". Dr. Deguchi and Dr. Sugimoto left Kuala Lumpur for Tokyo.

1st September, Thursday: Had fourth round talks on "Record of Discussions" with the concerned personnel of the Malaysian Government.

2nd September, Friday: Had fifth round talks on "Record of Discussions" with the concerned personnel of the Malaysian Government.

3rd September, Saturday: Mr. Nakahara, Team Leader, and Mr. Pang Leong Hoon (Director General, DID) signed the "Record of Discussions" in the Director General's room in DID office. Air trip from Kuala Lumpur to Bangkok, Thailand.

1 - 5 List of Personnel Concerned in Malaysia

A. ECONOMIC PLANNING UNIT (E.P.U)

Mr. Phang Ping Suan	- Director, Foreign Assistance Programme
Mr. Zulkefli A. Hassen	- Foreign Assistance Programme

B. MINISTRY OF AGRICULTURE

Secretariat

Mohammed Esa Shariff	- Secretary

Planning & Development Branch

Miss Lin Mui Kiang	- Assistant Secretary

Drainage & Irrigation Division (D I D)

Mr. Pang Leong Hoon	- Director General
Mr. Cheong Chap Lim	- Deputy Director General
Mr. Tay Lang Seng (Project)	- Assistant Director General
Mr. H. Thavaraj (Planning)	- Ditto
Mr. Lim Hun Soon (Northern States)	- Ditto
Mr. Khoo Soo Hock	- Senior Engineer (Planning)
Mr. Martin M. Dorai	- Engineer (Planning)
Mr. Ryan	- Storekeeper
Mr. A. Lyander	- Senior Engineer, Water Management Training Centre, Kota Bharu

North Kelantan Rural Development Project

Mr. Zahanuddin b. Jaafar	- Project Manager
Mr. Chan Gak Kok	- Project Engineer
Mr. Mohammed b. Ismail	- Chief Extension Officer

Crop Production Centre, Lundang, Agricultural Division (DOA)

Mr. Goh Klek Boon	- Senior Agricultural Officer

Besut Irrigation Project (DOA & DID)

Mr. Zulkefli b. Ayob	- Project Manager

Besut Agricultural Institute (DOA)

Mr. Zainol Kashid b. Mohd Daud	- Principal
Mr. N. Munusang Mohd. Daud	- Assistant Principal

Mr. Zainal Abidin - Instructor

C. MALAYSIAN AGRICULTURAL RESEARCH & DEVELOPMENT INSTITUTE (MARDI)

Branch Station, Kelantan

Mr. Joy Varughese - Head

D. STATE KELANTAN

State Government

Dato' Nik Sulaiman - State Secretary

Dato' Nordin - Chief Asst. State Secretary

Mr. Mustapha - Director, State Planning Unit

Mr. Mohd. Tajol Aros - Director, Land & Mines

Mr. Ismail b. Hj. Kadir - State Development Officer

State DID Kelantan

Mr. A. Kulasingam - State Director

Mr. Muthlah - Mechanical Engineer

Mr. C. Kubota (JOCV) - Engineer (Water Management)

Mr. H. Yamaguchi (PCV) - Engineer (Irrigation)

Mr. Mohd. Noh b. Abu Samah - Assistant Engineer

Mr. Aminuddin b. Zainuddin - District Engineer

Mr. Song Teng Hock - Senior Technical Assistant

Mr. Muhamed b. Salleh - Storekeeper

E. KEMUBU AGRICULTURAL DEVELOPMENT AUTHORITY (KADA)

Mr. Abd. Wahid b. Hj. Azahari-General Manager

Mr. Abd. Aziz b. Yusof - Head, Agricultural Division

Mr. Lim Thye Lian - Head, Engineering Division

Mr. Wan Aziz - Mechanical Engineer

Mr. Zakaria (Kemubu) - Chief Irrigation Inspector

Mr. Ismail b. Hassan (Lemal)- Ditto

Miss Rohaini bt. Zakaria - Economist

F. Japanese Officals

Embassy of Japan

Mr. Tomoya Kawamura - Councillor

Mr. Kazuya Sadachi - First Secretary

(Successor: Mr. Koji Kadoya)

Mr. Ichiro Ozawa - Second Secretary

JICA Office

Mr. Tooru Kasai - Representative

Tropical Agricultural Research Centre

Mr. Keihiko Sasaki	-	Overseas researcher	(Forestry)
Mr. Yasuo Oosumi	-	"	(Forestry)
Mr. Tsuneo Yamashita	-	"	(Irrigation)
Mr. Yoshihiro Akama	-	"	(Agronomy)

II. TRAINING PROGRAMME ON WATER MANAGEMENT

Chapter II Training Programme on Water Management

2 - 1 Purposes and Scale of the Programme

This programme, though named by the Japanese side as "Training Programme on Water Management," should correctly be called "technical Assistance Project on setting up of National Water Management Training Centre." The character of this project is somewhat different in its conception from that of the other agricultural technical cooperation projects. Therefore, it is quite important to proceed on to carry out this project after having clarified the characteristics --purposes, background, planning, management, etc., -- of the project and having full understanding of these characteristics. The origin of the project is found in the request for cooperation "Project Proposal for the setting up of A Water Management Training Centre at Kemubu Irrigation Project, Malaysia" directed to the Japanese Government by the Malaysian Government. In answer to the request, the Japanese side took up the project by conducting a preliminary survey (in March and April, 1976), the second survey (in January and February, 1977), a survey by project preparatory experts (from April to September, 1977), and finally a detailed design survey (from June to September, 1977), from which repeated discussions ensued between the Japanese and Malaysian sides to what it is.

The original request made by the Malaysian Government contained a number of targets extensively for the training programme as follows:

(1) The target in the long run was to promote diversified agriculture and increased rice yield through introduction of proper water management activities combined with improved farming practices which will be facilitated by concentrating the efforts towards training firstly of Government officials, field workers, rural leaders and ultimately farmers.

(2) The target in the immediate future was to have Japan cooperate with DID in their effort to newly establish as well as to carry out the management of the water management training centre in Kemubu District in Kelantan State. The principal purpose of the Training Centre comprises: 1) to render necessary training on water management technique to DID engineers, technitians and agricultural extension workers; 2) to construct training facilities complete with attached farms and other related facilities; and 3) to carry out the following applied studies in order to support the suitable training programme;

(i) Water management for both rice and other crops.

(ii) Water management technique, including operation of irrigation system and farming practices, including agricultural mechanization.

(iii) Implementation plan for improvement of various existing irrigation and drainage systems in the region.

(iv) Land consolidation programme

Against this request, the Japanese side made a suggestion as a result of the Preliminary Survey in April 1976 and the second Survey in February 1977 that the scope of works and services to be handled by the Training Centre should be limited only to the water management related to the paddy for the time being (tentatively for the period of five years for which time the cooperation from Japan is expected), postponing all other works and services until sometime in future. This suggestion was accepted by the headquarters of DID. The reason why the Japanese side wanted to limit the scope of works and services of the Training Centre only to the paddy was because it was conceived by them that it would be almost impossible to achieve so many targets as aforementioned at the initial stage of the Training Centre because of its scale and the period of time for which the cooperation from Japan is to be extended. The scale of the Training Centre to suffice the works and services, as originally requested by DID to include those crops other than rice, shall necessitate at least 100 officials which is equivalent of the man-power service in one agricultural experimental station with one attached training facility in Japan. What is being planned by DID in all is a centre manned with between 10 and 20 staff for a compact centre building with an area of 1,100 m^2. Accordingly, it must be said that even only to carry out the water management for paddy alone may sometimes be of overburden to the Training Centre of this size.

Test and research, and training and extension service are, in essence, independent functions and services for themselves. Therefore, it is usual in advanced countries that the official organizations and agencies for these functions and services are also divided functionally. Generally, a new technique which is a fruit of any test and research is supplied to organization or agency for training and extension to be used as teaching material. Should all these functions and services be carried out at an elevated level by a single organization or agency, such organization or agency would no doubt necessitate a large organization, a good number of personnel and a large facility.

This project, however, intends to create the experimental farms on which water management technique to be established, to theorize such technique and to implement the training by using thus developed theory as teaching material for the on-the-job training. It is clear in view of these intensions that the future development of the functions of the training centre may be a long and no easy course filled with trial and error and repeated amendments.

At the same time, it is an entirely new attempt in the world to carry out the training on water management in field. However, in fact, the farmers in Japan or Taiwan are conversant of the water management technique and are

proficient in its application, therefore, there is not a need of any training to be given to them now. There should be a full understanding of what has been a cause for this difference in the capability of the farmers of Japan/Taiwan and this country, and based on such understanding the operation of this project should be contemplated. The switchover of occupational custom from time-honoured rain-water supply to artificial irrigation is something that cannot be realized so rapidly, and this is where the difficulty is existing in any of the extension works with farmers.

All the above mentioned points are required to be thoroughly studied as basic factor of the project and are required to be clarified in the policies for the project and these ought to be the prerequisite to the detailed design.

However, a meeting between the experts and the staff of DID on the basic plicy of the project was held on 2nd and 3rd of August at the DID headquarters, after the Japanese detailed design team left to Japan. The papers compiled by the experts and handed over in advance to DID was used to proceed the meeting, and by this meeting, the agreement was reached in general. Main points agreed upon were as follows:

1) At the beginning, the scope of the subjects of training shall be limited to the establishment and acquirement of water management technique only for paddy field. However, applied studies on irrigation and drainage projects, etc., shall be taken into the special course as the occasion may demand.

2) In operating the attached farm, the training centre shall depend on the function of the existing special organizations such as MARDI, etc., for any works concerning agricultural pursuit itself such as culture test, selection of seeds or the like, and the training centre shall not make disposition of these matters by itself.

3) The subjects of training as well as the facilities required therefore shall not be overlapped with those being already adopted by the Research Station which is existing under the direct control of DID (Located in K.L. Ampang and fully equipped with testing facilities for hydraulics, soil mechanics, materials and structures).

These points are suggesting that the purpose and scope of the intended training and facilities therefore should be condensed to the minimum required. This is based on the thinking that the initial target of this Training Centre should be set at the training of water management in paddy field only so that the scale of the Centre will be comparatively small and the function of the Centre will be concentrated on those which are directly necessary for the water management in paddy field.

2 - 2 Background of the Programme

There was almost nothing worthy of notice in the crop agricultural products in Malaysia before the World War II, therefore, up to 60 per cent of rice, their staple food, had been imported from Thailand and Burma. The Government of Malaysia laid emphasis of her policy on self-support of food-stuff and improving farmers' living standard, while rapid increase in her population was remarkable after the War. As a result of the Government's intensified effort in pushing forward agricultural development as a part of her national plan through a series of First Malaya Plan (1956 - 1960), First Malaysia Plan (1966 - 1970), and Second Malaysia Plan (1971 - 1975), paddy yield amounted to four times as that of 1930 to attain 1.7 million tons (for approximately 11 million population) and about 90 per cent self-support in rice. For this purpose, they improved vast areas of coastal jungle into arable land and irrigated farmland as well as accomplished drainage work on a large scale in order to achieve double-cropping of rice through World Bank financing, etc. Some typical examples are; Tanjong Karang (Selangor State, reclamation of paddy field in 20,000ha, headwork, pump station, and canal, 1948 - 1966), and Muda (Kedah Plain, Irrigation, of 98,000ha., dam, headwork, and canal, 19 5 - 1969), both on the West coast, and Kemubu (Irrigation of 20,000ha, pump station, watergate, and canal, 1967 - 1971) on the East coast.

These construction works were accomplished under direct supervision and control of DID, and maintenance and operation of them were later taken care of by the Government agencies such as MADA, KADA and some others. In these project areas, the construction works are completed down to secondary and tertiary canals, and turnouts. However, the paddy fields within the project area remain intact as they were as rain-fed paddy field, still resorting to plot-to-plot irrigation. There was not even a plan to implement the construction of these terminal irrigation systems. This particular condition may be compared with such a Japanese version as that the canals of national and prefectural government classes have been completed, but branch or terminal canals of farmers' organization classes which are to be connected to those secondary and tertiary canals are not yet in existence. Under such circumstances, it takes 30 to 40 days of time for puddling water to be distributed to the paddy fields of the sizes ranging from 20 ha to 1,000 ha. Any satisfactory agricultural work such as water management, fertilization, harvesting, and the like could hardly be expected under the circumstances. Therefore, the yeild of rice crop from these paddy field is only 2 to 3 tons/ha (in paddy). One of the worst rice crop is seen in Kemubu district and its neighbouring areas where irrigation by large scale pumps is in operation, realizing the irrigation in the dry season

also, thus realized a double-cropping of rice to some extent. However, there is not any legislation by which to stipulate the burdening of irrigation cost by the farmers in these areas that redemption of construction cost by the farmers are not yet implemented.

Various measures have been taken by the Government in order to foster the fruits of these agricultural development projects. It was judged necessary that the technical staffs of the Government to be given a practical training on water management technique in order to truly produce results of the agricultural promotion activities. In conformity with this line, the Government has schemed out a project to establish a national water management training centre within the framework of the Third Malaysia Plan (1976-1980), and took up Kemubu district as its site.

2 - 3 Cooperation with Japan

The cooperation originally expected by Malaysia comprised necessary technical assistance to cover from planning up to implementation of the training centre and training programme, and supply of required equipment and materials described as follows: Despatch to Malaysia of; a) 3 experts (of irrigation, water management, and rice cropping) for 4 years, b) several consultants (of soil and fertilizers, tropical farm products, agricultural machineries and equipment, farming, irrigation facilities, and other) for 1 year. Supply to Malaysia of; Vehicles, tractors, experimental and testing equipment, training equipment, agricultural machineries, equipment and tools, fertilizers, agricultural chemicals, etc. Construction of: A pilot farm with area of 200 ha. And to undertake to render study and training in Japan for 5 Malaysian technical officials.

In this connection, conferences were held repeatedly between the both sides to reach a conclusion as described in the "Record of Discussions", so that the number of experts was finally increased by five men including a team leader and a coordinator, and the period of cooperation was tentatively set at five years (subject to either extension or termination with mutual agreement).

With respect to the method of cooperation con erning establishment of training centre and implementation of the training, DID requested the Japanese side to give suggestions on the conceptual plan for training centre in view of the fact that the project under consultation is being an exceptional case. Therefore,the Japanese side complied with the request though there was a principle that the Japanese side is to assist DID in their planning and operation. Upon implementation of the training programme, the Japanese experts should admonish themselves not to teach a class by themselves and should adhere to the principle that they shall be in a position to back up the Malaysian teachers.

2 - 4 Planning on Training Facilities

DID is totally responsible for the planning and construction of the buildings of the training centre out of the entire training facilities. The Japanese team shall be involved with the planning and construction of the demonstration farm and pilot farms. Progress and proceedings of the survey of the selected proposed sites for these farms, preparation of the layout and the detailed design of each stage are considered to be useful for understanding the basic concept of this project and, therefore, the main points of them are described hereunder:

1) The prime object of the water management training is to have the trainees understood the importance of terminal irrigation canal systems in the farm and to recognize the necessity of the same. Secondly to have such utility and necessity of the systems be well accepted by and extended among the farmers and to have the projects of land readjustment and consolidation be induced. For this purpose, one ideal example of such ditch systems, which cannot be seen in this country, must be shown to the farmers.

2) The pilot farm should not be just an example farm. It must be a possible one which can be imitated by the farmers for the application easily and economically in their own farms and the one from which can expect a considerable effect, i.e., increase in production and efficiency.

3) Type of the pilot farm, in order to meet the above requirements, may be classified into several types according to the conditions prevailing in the site and it must be improved to have a higher productivity year by year.

4) The pilot farm, in order to meet the above requirements, shall be located and established in 4 farm areas which are owned privately and are now in use for actual farming. When results of the pilot farm are realized to some extent, the pilot farm shall be transferred to another area in the vicinity. On this stage, the pilot farm shall be provided with higher level of irrigation and draimage facilities. It is intended with this kind of a step-by-step advancement of the pilot farm in the long-run that this pilot farm to be a guidepost for ultimately introducing a full scale land readjustment project together with farm road networks and exchange of farm plot.

5) One of the future and ideal types of these pilot farms is that of the demonstration farm. With this demonstration farm, a high standard of agricultural productivity is planned to be demonstrated by providing as most appropriate farm condition as possible at present as to its irrigation, drainage, soil layers and farm plotting, by having it adapted with the natural conditions of the site and by applying fully an adequate water management technique and cultivation technique on it.

A few demonstration farms have so far been constructed in Thailand, Indonesia and some other countries, and each of them is demonstrating the latest level of technique. However, in reality, there are no following of these techniques by the farmers in the district where the demonstration farm is located. In other words, the demonstration farms are only demonstrating "a flower on the inaccessible heights" to the farmers. For this reason, it has been planned for this project that a demonstration farm (named as pilot farm in this project) which will be capable of demonstrating actual and practical demonstration effect to the farmers. The pilot farm shall be with such scale and standard -- as to right of site, cost of construction, period of construction, benefit, etc. -- which can be readily accepted by the farmers. Technically, the pilot farm may be started with a primitive level but it should be with the possibility that its technical level can be heightened to the latest level which can be seen in the demonstration farm. Detailed design for the pilot farms was proceeded along with the line of these concepts.

2 - 5 Training Programme

In due consideration of the existing education system in Malaysia and of quality of Malaysian technicians, it was agreed between both parties of Japan and Malaysia (Refer to 5-6-12) that more time should be spent for compilation of training programme and not jump onto a conclusion that the transfer of curriculum and education facilities for irrigation and drainage course of Japanese agricultural high schools would solve the problem as some of the concerned Japanese officials actually held such opinion and judgement. According to the above mentioned agreement, the outline of training has been established as follows:

(1) The training of backbone engineers shall be started while the construction of the demonstration farm and pilot farms are underway. During this training, the training programme for lower grade technicians (normal course) shall be studied.

(2) The programme and the policy for operation of the training shall be determined by the joint committee (as described in the "Record of Discussions").

(3) The normal training course shall be started when all the facilities for training have been completed as well as the water management and cultivating techniques have sufficiently been stabilized.
Nevertheless, the tentative training programme which was already studied by the survey team is described as follows as for a basic reference for a full study to be conducted by the Japanese experts and Malaysian Authorities in near future.

2 - 5 - 1 Engineers, Agronomists and Technicians to participate in the Training Programme

The persons related with water management in this country comprise the following classes of people:

(1) The specialists who plan and design construction of water management facilities (so-called "Engineers").

(2) The technicians (I.I. and I.O.) who take actual care of both maintenance and operation of the facilities.

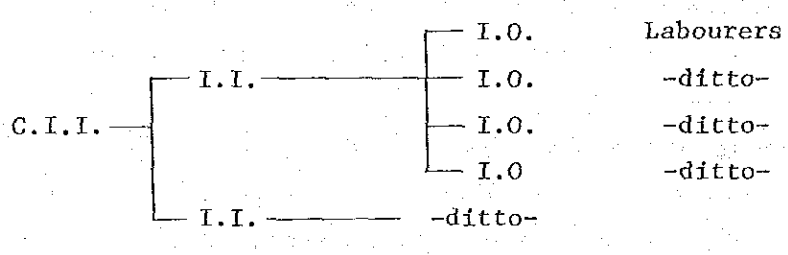
(3) The officials related with agricultural techniques (mainly A.T.) who perform cultivation under various irrigation conditions.

In this Programme, the major persons to participate in the training programme shall be I.I. and I.O. The water management officials as will be mentioned later signify the technicians referred to in the second Item in the above classification. Besides all the above-mentioned persons, some A.T. who are inseparably related with water management techniques through their pursuit in promotion and extension of this Programme, Engineers who plan as well as integrate all the irrigation projects in this country, and agricultural officials (A.O. and A.A.) who are related with water management shall participate in the training programme as sub-members.

2 - 5 - 2 Duties of Water Management Officials

The duties of water management officials consist of maintenance and operation (maintemance of the functions, operation of turn-outs, design, construction and repairing of terminal facilities) of irrigation facilities.

An I.I. is assuming command of about 4 I.O. to take charge of the maintenance and operation of the canals (of a commanding area of between 8,000 and 10,000 acres). An I.O. is utilizing a group of labourers between 10 and 15 persons to onduct operation of the pump stations and off-takes, and maintenance work of the canals.



2 - 5 - 3 Formation of DID Engineers and Technicians

Table 2-1 shows the formation of technical officials belonging to DID as of June, 1977. There are total of about 100 I.I. and about 400 I.O. among which 100 persons are expected to be qualified. Therefore, a total of 200 persons

will be the members to participate in the training programme.

Table 2-1 Table showing number of emplyees of DID by grade and by age

Organization	Fedetal				State					Engineering Div. MADA					Eng. Div. KADA			Total
Age	20	21 30	31 40	41 50	20	21 30	31 40	41 50	51	20	21 30	31 40	41 50	51	30	31 40	51	(persons)
1. Drainage & Irrigation Engineer (Bachelor)	1	53	14	4		16	7	1	1		5	3	1			1		107
2. Technical Assistant (Diploma)		25	5	8	1	50	38	12	9			1				2	1	152
3. Irrigation Inspector (I.I.) (MCE/MOVE/SPM)					2	31	23	4	3		12	4	3	2		6	3	93
4. Various Technician (MCE/MOVE/SPM)		92	30	13	2	35	104	25	7	1	37	11				5	1	363
5. Irrigation Overseer (I.O.) (LCE/SRP)					13	170	93	34	18		56	10	5	4	23	3	1	430

Note: 1. All the engineers ranking in State Director, or Project Director or higher, and Mechanical Engineers are not included in item 1.

2. As for MCE, MCVC, SPM, LCE, SRP,refer to abbreviation table.

3. The data are in accordance with DID tabulation as of June, 1977.

2 - 5 - 4 Training Programme (Primary draft)

The Programme hereby described is one of the primary draft presented to the Malaysian side as an interim report of the survey team to which any official comment by the Malaysian side has not been indicated yet. Therefore, the Programme is anticipated to be studied and improved from now on by the educational staff of the training centre and the Japan-Malaysia Joint Committee.

(1) Classification of the training course.

The training course is classified into the following 3 courses:

A) Normal A course

I.I. and I.O. (one who holds the same knowledge as an I.I.) shall perticipate for ten months.

B) Normal B course

A. T. Who are engaged in extension services shall perticipate for two months.

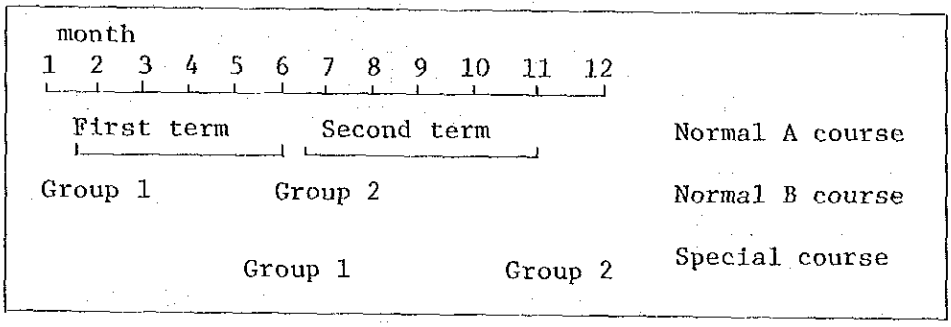
C) Special course

Engineer, T.A., A.O. and A.A. shall perticipate for ten days.

(2) Annual Programme

Time schedule for each training course is shown in the following Fig. 2-2.

Fig. 2-2



(3) Table showing each course

Curriculum for each course is shown in the following Table

Table 2-2

Course	Participants	Term	Fixed Number	Curriculum
Normal A	I.I., I.O. with five-year or longer experience, I.O. shall hold the same schalarship as an I.I.	40 weeks	20 persons	Mathematics, Outline of agriculture, Water management, Rice cultivation Practice, Experiment, Observation-study
Normal B	A.T. with five years or longer experience	8 weeks	10 persons	Outline of agriculture, Water management, Rice cultivation, Experiment, Practice Observation-study
Special	DID Engineer, T.A. DOA A.O. A.A.	From 7 to 10 days	10 persons 5 persons	Water management, Rice cultivation, Seminar, Observation-study

(4) Curriculum

Normal A course

Table 2-3 Kind of Subject

Name of Subject		Time table (week)
Mathematics		2.0
Surveying		3.0
Outline of Agriculture		1.0
Water management		10.0
Breakdown	Hydraulics	2.0
	Irrigation facilities	3.0
	Water management	5.0
Rice cultivation		3.5
Practice, Experiment, Observation on Water Management, Rice cultivation and Surveying		20.0
Orientation		0.5
Total		40.0

Breakdown of practice, experiment and observation-study in Table 2-3

Table 2-4

	Practice (week)	Experiment (Week)	Observation-study (week)
Hydraulics		1	
Irrigation design		1	
Water management	7.5		
Rice cultivation	8		
Land improvement project			0.5
Surveying	2		
Total	17.5	2.0	0.5

Normal B course

Table 2-5

Name of Subject	Time table (week)
Outline of agriculture	0.5
Water management	2.0
Rice cultivation, General and Improvement Techniques	2.0
Practice, Experiment, and Observation-Study	3.0
Orientation	0.5
Total	8.0

Special course

Table 2-6

Name of Subject	Time (day)
Water management techniques and construction of terminal infrastructures	2 ∿ 3
Cultivation techniques, physiology, and water management techniques for paddy	1 ∿ 2
Rice crop and latest techniques in advanced countries	1 ∿ 2
Seminar and discussions	1 ∿ 1.5
Techniques and measures thereof relative to Increased yield	
Problems on construction techniques and countermeasures thereof	
Proposal on introduction of techniques	
Observation-study	1.5
Total	7 ∿ 10

2 - 6 Required Equipment, Materials, and Machineries

The following list gives the names of equipment, materials, and machineries which are considered by the survey team to be furnished from Japan as the items required for operation and maintenance of the training center, attached demonstration farm and pilot farms. It is necessary to furnish the Malaysian side with the items which are difficult to acquire in the country and are really required for the transfer of the techniques after sufficient investigation on training programme and schedule of the project.

1. Machineries related with soil testing and investigation
   (1) Limit liquidity measurement equipment

(2) Limit plasticity measurement equipment
(3) Compaction test device
(4) Direct shear test device
(5) Variable water level permeability tester
(6) Constant water level permeability tester
(7) Hand auger and replacement auger bits
(8) Auger lifter
(9) Cone penetrometer
(10) Hydrograph
(11) Water meter
(12) Parshall flume
(13) Current meter
(14) N type Pan
(15) Hook gauge
(16) Quick leakage measurement device

2. Drafting instrument
3. Surveying instrument Measuring apparatus, and their parts
4. Machineries and instruments for agriculture
(1) Grain corpuscular meter
(2) Rice and barley mositure meter
(3) Ball mill for testing
(4) Tension meter
(5) Ripening ratio measuring device
(6) Automatic leaf planimeter
(7) Soil test stick
(8) Soil auger
(9) Soil resistance meter
(10) Soil hardness meter
(11) Soil collector
(12) Soil sieve
(13) Winnower for crop estimation test
(14) Seeder thrasher
(15) Thermostatic germinator
(16) Measuring cylinder for water-holding capacity of soil
(17) Measuring pan for maximum water-holding capacity of soil
(18) Wagner pot
(19) Grain counting board
(20) Nitrogen decomposing apparatus
(21) Nitrogen distillatory apparatus

(22) Nitrogen titration apparatus

5. Scientific Instruments and spare parts

(1) pH meter

(2) Conductivity meter

(3) Screen

(4) Anemometer

(5) Maximum and minimum thermometer

(6) Self-registering thermometer

(7) Self-registering hygrometer

(8) Psychrometer

(9) Rain gauge

(10) Rain measure

(11) Vaporimeter

(12) Jordan pyrheliometer

(13) ROBITCHI self-registering pyrheliometer

(14) Bent pipe underground thermometer

(15) Direct reading balance

(16) Even beam balance

(17) Even spring balance

(18) Platform scale

(19) Slide caliper

(20) External micrometer

(21) Hand counter

(22) Hustler tachometer

(23) Dissection microscope

(24) Microscope

(25) Magnifying glass

(26) Microspic specimen-making outfit

(27) Pure-water making device

(28) Water distiller

(29) Circulatory blower type constant temperature drier

(30) Natural convection constant temperature dryer

(31) Constant temperature keeper

(32) Refrigerator

(33) Shelved cabinet for chemicals and medical appliances

(34) Table for balance

(35) Central testing bench

(36) Shelves for reagents

(37) Side testing bench

(38) Willey grinder

(39) Bottle vibrator
(40) Chemical balance
(41) Physical balance
(42) Even balance
(43) Drying machine
(44) Data sheet

6. Glasswares
(1) Petri dish
(2) Weighing bottle
(3) Reagent bottle
(4) Beaker
(5) Frlenmeyer flask
(6) Test tube
(7) Burette
(8) Pipette
(9) Measuring cylinder
(10) Nitrogen discomposition bottle
(11) Funnel stand
(12) Dessicator
(13) Crucible, Crucible tongs
(14) Paper filter
(15) Pycnometer
(16) Vaporimeter
(17) Thermometer

7. Chemicals
(1) Silicagel
(2) Granulated soda lime
(3) Potassium iodide
(4) Potassium sulfate
(5) Potassium chrolide
(6) Magensium carbonate
(7) Magnesium oxide
(8) Magnesium boric acid
(9) Normal sulfuric acid standard solution
(10) Normal sodium hydroxide standard solution
(11) Methyl Red
(12) Methylene Blue

8. Audio Visual Equipment and Office equipment
(1) 10mm projector

(2) 8mm projector
(3) Slide projector
(4) Movie camera
(5) Camera
(6) Life-size projector
(7) Over-head projector
(8) Cassette tape recorder
(9) Video tape recorder
(10) Video camera
(11) Photographic materials, chemicals, sensitized materials, and equipment necessary for developing, printing and enlarging (enlarger)
(12) Duplicating machine
(13) Typewriter
(14) Scanner
(15) Paper cutter
(16) Electronic calculator, table type
(17) Stopwatch
(18) Calculating scale
(19) Calculator
(20) White black board

9. Farm machines and implements
(1) Tractor
(2) Rotary tiller
(3) Puddling harrow
(4) Disc harrow
(5) Cultivator
(6) Puddling machine
(7) Grain scattering machine
(8) Rice transplantation machine
(9) Complete set of equipment and materials for raising seedlings
(10) Back-packing type power sprayer
(11) Sprayer
(12) Intertillage grass eliminating machine for paddy field
(13) Grass mower
(14) Self-disengaging combine
(15) Bridge
(16) Power thrasher
(17) Treadle thrasher
(18) Winnower
(19) Land clearing machine

(20) Scoop
(21) Hoe
(22) Sickle
(23) Trailer vehicle
(24) Trencher
(25) Drying machine
(26) Storage tank
(27) Classifier
(28) Small ditcher

10. Fertilizer and Chemicals
(1) Chemical fertilizer
(2) Urea
(3) Bitter earth lime silicate
(4) Ammophos
(5) Ammonium sulphate
(6) Soluble phosphorus fertilizer
(7) Potassium chrolide
(8) Granulated
(9) 2-4D soda salt
(10) etc.

11. Vehicles
(1) Four wheel drive car (Jeep type)
(2) Car for both passengers and luggages (Wagon type)
(3) Micro bus
(4) Small size truck
(5) Motorcycle
(6) Passenger car

Ⅲ. DETAILED DESIGN OF FACILITIES

(REFER TO SUB-TABLE OF CONTENTS)

Chapter III Detailed Design of Facilities

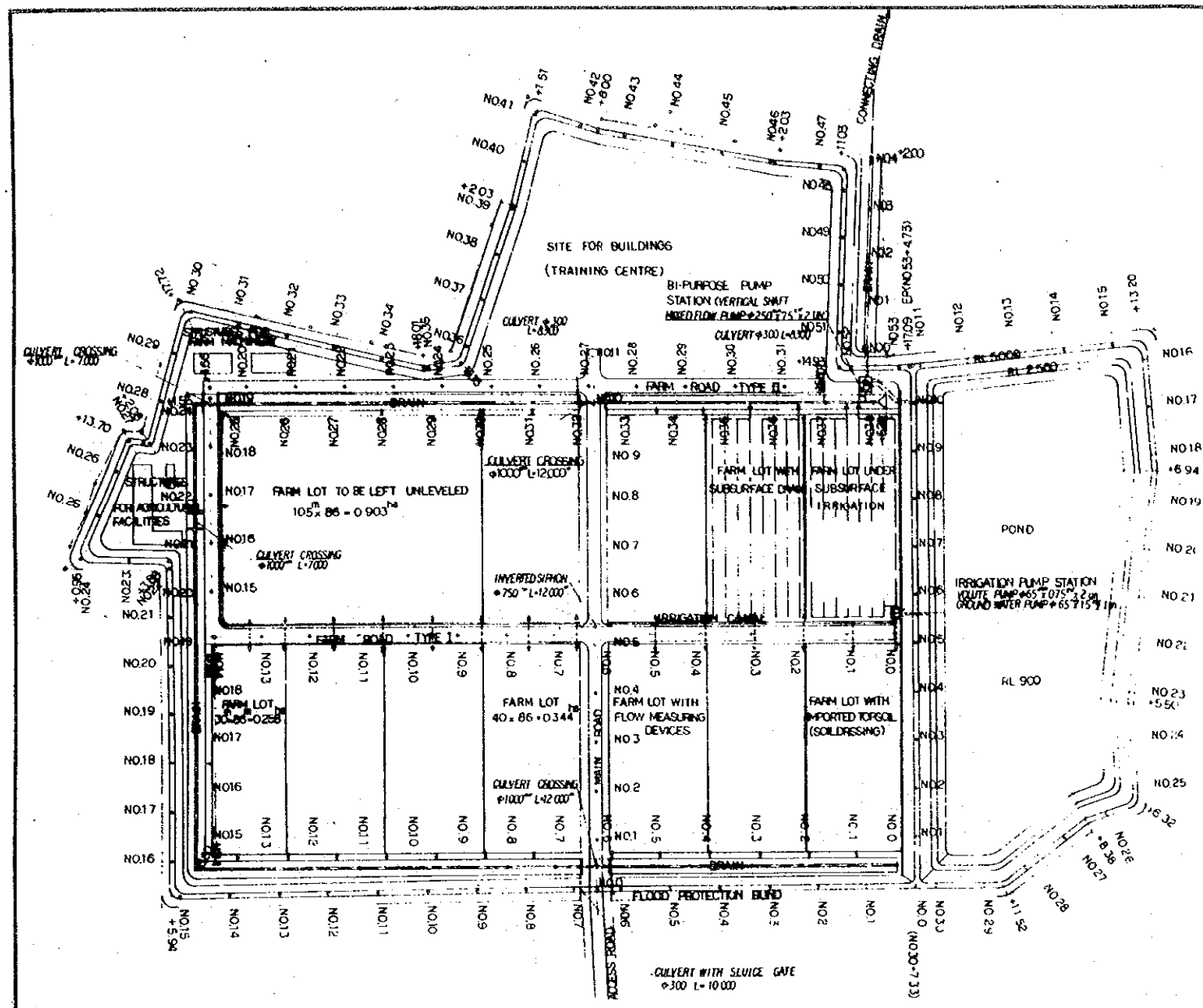
Subtable of CONTENTS

WATER MANAGEMENT TRAINING CENTRE PROJECT

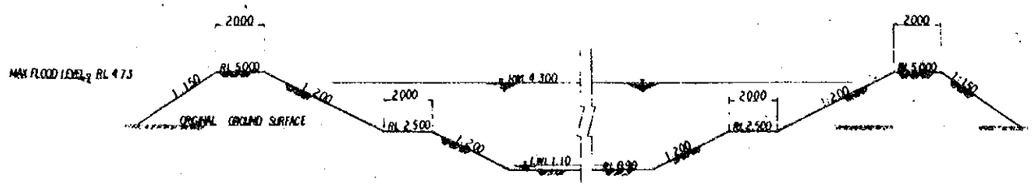
List of Drawings

Table 3-1

No.	TITLE	SCALE	NO.
A- 1	Location Map	1 : 63,360	1
B- 1	Contour Map of Demonstration Farm and Training Centre	1 : 1,000	1
B- 2	General plan of demonstration Farm and Training Centre	1 : 1,000	1
B- 3	Longitudinal Section of Bund	1 : 1,000	1
B- 4	Longitudinal Section of Roads	1 : 1,000	1
B- 5	Longitudinal Section of Drain	1 : 1,000	1
B- 6	General Plan of Bi-purpose pump station	1 : 100	1
B- 7	General Plan of Irrigation pump station	1 : 100	1
B- 8	Details of Demonstration Farm and related structures 1 ∿ 2	1 : 500	2
B- 9	Reinforcement plan of Bi-purpose pump station 1 ∿ 6	1 : 50	6
B-10	Details of Metal-works for Bi-purpose pump station and related structures	1 : 20	1
B-11	Reinforcement plan of Irrigation pump station 1 ∿ 2	1 : 40	2
B-12	Plan of Piling and earth works for pump stations	1 : 100	1
C- 1	Spot leveling Map of Pilot Farms 1 ∿ 2	1 : 200	2
C- 2	Plan of Pilot Farm, Padang Lindong Area 1 ∿ 2	1 : 1,584	2
C- 3	Plan of Pilot Farm, P_2M 1 ∿ 2	1 : 1,584	2
C- 4	Plan of Pilot Farm, $P_3T_1S_6K$ 1 ∿ 2	1 : 1,584	2
C- 5	Plan of Pilot Farm, P_4S_3L 1 ∿ 2	1 : 1,584	2
C- 6	Details of Offtakes	1 : 20	1
	TOTAL		31

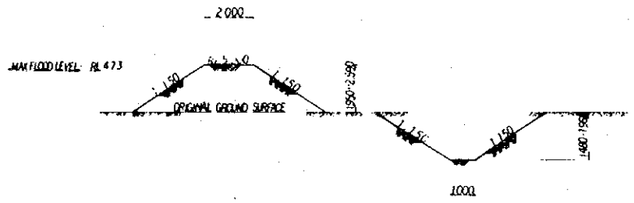


PLAN



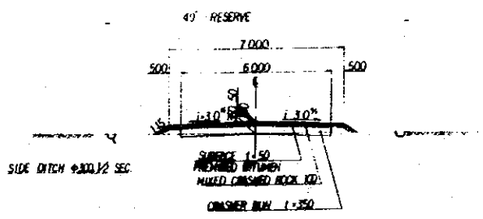
CROSS SECTION OF POND

S = 1 100



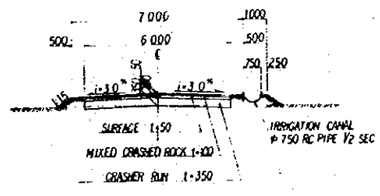
CROSS SECTION OF FLOOD PROTECTION BUND and DRAIN

S = 1 100



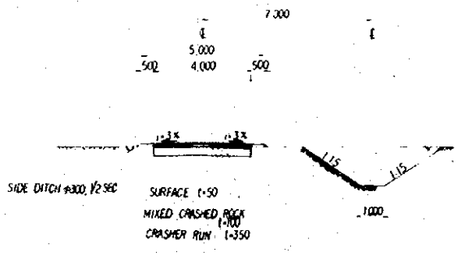
MAIN ROAD

S = 1:100



FARM ROAD TYPE I

S = 1 100



FARM ROAD TYPE II

WATER MANAGEMENT TRAINING PROJECT	
GENERAL PLAN OF DEMONSTRATION FARM AND TRAINING CENTRE	
Japan International Cooperation Agency	
DRAWN	NO. B – 2
TRACED	
CHECKED	SCALE 1 : 1000
APPROVED	

I. Project Components

1. Water management Training Centre

(1) Total area: About 11 ha

(2) Flood Protection Bund

Top level: RL 5.00 m, High water level; RL 4.73 m

Spillway level: RL 4.75 m

Top width: 2.0 m

Side slope: 1:1.5

Banking height: 1.95 m - 2.59 m

Length (excluding the part of pond) : 1,064.73 m

Embankment volume (excluding the part of pond) : 13,574.45 m^3

(3) Access road with 40' reserve

To be designed and constructed by the Malaysian Authorities

(4) Buildings

To be deisgned and constructed by the Malaysian Authorities

(5) Drainage channels (connecting drains) outside the area

To be designed and constructed by the Malaysian Authorities

(6) Main roads (See Demonstration Farm under 2 below)

2. Demonstration Farm

(1) Farm Total area: 4.60 ha

* 1 lot under sub-irrigation 40 m x 86 m = 0.344 ha
* 1 lot with subsurface drain 40 m x 86 m = 0.344 ha
* 1 lot with soil dressing (imported topsoil) = 0.344 ha
* 1 lot with flow measuring devices 40 m x 86 m = 0.344 ha
* 6 ordinarly lots 6 x 40 m x 86 m = 2.064 ha
* 1 ordinary lot 30 m x 86 m = 0.258 ha
* 1 lot to be left unleveled 103 m x 86 m = 0.90 ha

(2) Roads

* Main road with 40' reserve

  Effective width 6.0 m Total width 7.0 m Length 220 m

  (except access road) Premixed bitumen surface

* Farm road

  Type I Effective width 6.00 m Total width 7.0 m

  Length 384.66 m Premixed bitumen surface

  Type II Effective width 4.00 m Total width 5.00 m

  Length 231.34 m Premixed bitumen surface

* Culvert crossing

  ϕ1,000 mm L = 12.00 m 2 places

  ϕ1,000 mm L = 7.00 m 2 places

(3) Land Leveling

Topsoil thickness 0.20 m

Volume of soil to be handled 9,200 m^3

Volume of soil to be transported 500 m^3

(4) Irrigation facilities

* Irrigation pond

Top level RL 5.00 m, Berm level RL 2.50 m,

H.W.L. R.L. 4.30 m, L.W.L. RL 1.10 m

Bottom level R.L. 0.50 m.

Top width 2.0 m Berm width 2.0 m

Side slope: Outside 1 : 1.5, inside 1 : 2.0

Pond area 1.82 ha Catchment area 1.90 ha

Effective storage 49,800 m^3. Dead storage 2,500 m^3

Embankment volume 8,808 m^3, Excavation volume 23,594.26 m^3

* Bi-purpose pump

(See the paragraph on Drainage Facilities)

* Irrigation pump

Rated discharge 0.32 m^3/min/unit No. of unit: 2 units

Total head 4.00 m

Bore 65 mm Type Single suction volute pump

Motor Output 0.75 KW/unit 50 HZ 4P/1,500 RPM

Type of motor Totally enclosed outdoor type

Pump house (to be shared by underground water pump)

(Outdoor type)

* Underground water pump

Rated discharge 0.241 m^3/min/unit No. of unit: 1 unit

Total head 10.50 m

Bore 65 mm Type Submerged motor pump

Output 1.5 KW 50HZ 2P 3,000 RPM

Pump Station (To be shared by irrigation pump. Manipulating board will
(Outdoor type) be provided on the embankment of the irrigation pond.)

* Irrigation ditch

To be laid along one side of Type I farm road.

Max. discharge 0.0106 m^3/sec.

Section of ditch Semi circle RC pipe ϕ750 mm

Gradient 1/20,000 Water depth 20cm

Freeboard 17.5 cm

Length 360.00 m

Siphon ϕ150 mm L = 7.00 m PVC pipe 14 places

Siphon ϕ750 mm L = 12.00 m R.C. pipe 1 place

Check plank 15 places

* Intake pipe

PVC pipe ϕ300 mm L = 10.00 m

Reinforced concrete pipe ϕ1,000 mm L = 28.20 m

(5) Drainage facilities

* Bi-purpose pump (irrigation and drainage)

Max. discharge 6.29 m^3/min/unit No. of unit: 2 units

Total head 4.40 m Bore: 250 mm

Type of pump: Vertical shaft centrifugal propeller pump, double-layer type.

Motor output 7.5 KW 8P 50 HZ 750 RPM

Type of motor Totally enclosed outdoor type

Pump house : Two-layer reinforced concrete building with motor and manipulating board provided on the roof.

* Drainage canal

Botom width 1.00 m

Gradient of face of slope 1:1.5

Bottom gradient 1/5,000

Design water depth 1.54 m ~ 1.90 m

Volume of excavation 5,174.07 m^3

* Pipe for drainage canal outside embankment

Reinforced concrete pipe ϕ300 mm L = 10.00 m 2 places

* Drainage pipe

R.C. pipe ϕ1,000 mm L = 13.70 m 1 place

(also for use as intake pipe)

* Drainage facilities for sewage

(To be designed and constructed by the Malaysian Authorities.)

Bill of Quantities for Construction Works for Demonstration Farm

Table 3-2

Work	Item	Unit	Quantity of Construction								Total
			Road	Drainage Facilities	Irrigation Facilities	Farms	Irrigation Pump house	Bi-purpose Pump house	Irrigation Pond	Embankment	
1. Earth work	Excavation	m^3	626.58	5,320.94	578.24	1,783.66		433.79	23,594.26		32,337.47
	Banking	m^3	997.69	-	399.28	444.34			8,808.00	13,574.45	24,223.76
	Back filling	m^3	-	312.74				303.86			616.60
	Sodding	m^2	1,135.23	-					7,030.40	10,977.21	19,142.82
	Surface Soil removing	m^2				9,200.00					9,200.00
2. Concrete work	Lean concrete	m^3		1.014	6.27	13.86	6.229	11.972			39.345
	Reinforced concrete	m^3		21.134	35.45	222.02	18.759	87.127			384.49
	Reinforcing bar	Kg		1,855.98	2,650.81	28,287.85	1,741.875	7,118.271			41,654.786
	Forms	m^2		226.40	365.57	2,616.55	114.01	474.785			3,797.315
	Plain concrete	m^3		-				1.180			1.180
3. Foundation work	Foundation cobble	m^3				173.80	11.742	23.945			209.487
	Sand	m^3				655.84		24.66			680.50
	ϕ5'L=5.00m	pes					36.	66			102
4. Revetment	Foundation pile Riprap	m^3					15.033	56.762			71.795
5. Piping	R.C.Pipe ϕ1,000	m		38.00				41.90			79.90
	Steel Pipe ϕ400	m						46.10			46.10
	R.C.Pipe ϕ300	m		59.40							59.40
	R.C.Pipe Semi-circular ϕ300	m		412.40							412.40
	R.C.Pipe ϕ750	m			12.00						12.00
	R.C.Pipe Semi-circular ϕ750	m			286.20						286.20
6. Pavement	Area to be paved	m2	4,573.32								4,573.32

Construction Cost of Demonstration Farm

Table 3-3

		Unit		
I.	Cost of construction works	1	¥51,611,077	M$ 469,191.61-
II.	Portion provided by Japan	1	¥25,840,638	M$ 234,914.89-
	Total		¥77,451,715	M$ 704,106.50-

Note: Cost of field installation of parts is not included.

Cost of Construction Works for Demonstration Farm

Table 3-4

(Excluding cost of parts provided by Japan)

1. Direct construction cost: Road	1 unit	105,476.27
2. Drainage facilities	1 unit	2,518.28
3. Irrigation facilities	1 unit	22,707.72
4. Farms	1 unit	95,859.67
5. Irrigation pump station	1 unit	4,997.41
6. Bi-purpose pump station	1 unit	24,866.53
7. Irrigation pond	1 unit	45,278.67
8. Flood protection Bund	1 unit	25,948.08
Sub-total		327,652.63

Cost of general temperary works

Object cost x rate for cost of general temperary works

Object Cost = Net construction cosit - cost of major manufactured material x $\frac{1}{2}$

= 327,652.63 - $\frac{1}{2}$ x 110,336.11=272,484.57

* Rate for cost of general temporary works 17.5%

Cost of general temporary works

272,484.57 x 0.175 47,684.79

Cost at site

Object cost x rate for cost at site

Object cost = Net construction cost + cost of general temporary works - Cost of major manufactured material x 1/2

= 327,652.63 + 47,684.79 - $\frac{1}{2}$ x 110,336.11

= 320.169.36

Rate for cost at site 12.8%

Cost at site 320,169.36 x 0.128 = 40,981.67

Over Head Charges

Primary cost x Rate for overhead charges

Primary cost = 327,652.63+47,684.79+ 40,981.67=416,319.09

	Rate for Overhead charges 12.7%	
	Overhead charges	
	416,319.09x0.127 = 52,872.52	
Total		M$ 469,191.61

Cost of Portion provided by Japan

Table 3-5

1. Drainage Facilities	1 unit	337,520
2. Irrigation Facilities	1 unit	791.210
3. Farm Facilities	1 unit	5,172,989
4. Irrigation pump station	1 unit	3,598,888
5. Bi-purpose Pump Station	1 unit	15,940,031
Total		¥25,840,638

3. Pilot Farms

Facilities Table 3-6

	Unit	Padang Lindong	P_2M	$P_3T_1S_6K$	P_4S_3L	Total
Size of area	ha	18.2	15.2	18.1	11.1	62.6
Total length of ditch	m	1,405.5	1,598.0	1,884.0	936.0	5,823.5
Earth ditch b=360	m	1,405.5	-	-	-	1,405.5
C.U.G ditch b=300	m	-	1,197.5	-	-	1,197.5
C.U.G ditch b=600	m	-	400.5	-	-	400.5
Corrugated iron flume ditch 750 x 400	m	-	-	1,884.0	-	1,884.5
Concrete canal	m	-	-	-	936.0	936.0
Canal density	m/ha	77.2	105.1	104.1	84.3	-
Off-takes	place	16	26	30	8	80
Form road	m	-	-	1,721.0	-	1,721.0
Drains	m	928.5	-	380.0	-	1,308.5
Design intake discharge	m^3/sec	0.061	0.040	0.047	0.087	-

Quantities

Note: Borrow material is in its natural state.

Table 3-7

	Unit	Padang Lindong	P_2M	P_3 T_1 S_6 K	P_4 S_3 L
Earth work					
Excavation	m^3	133.4	63.2	38.0	171.8
Banking	m^3	514.5	472.8	2,533.5	389.8
Sand bed	m^3	-	0.14	2.09	56.89
Slope grading	m^2	2,965.7	1,452.8	2,592.5	1,153.9
Borrow material	m^3	381.1	409.6	2,495.5	218.0
Concrete etc.					
Reinforced concrete	m^3	-	6.840	12.781	6.901
Plain concrete	m^3	0.8	-	-	228.852
Forms	m^2	11.5	81.6	138.2	1,848.1
Reinforcing bar	Kg	-	260.6	472.6	281.8
Hume pipe ϕ100	m	-	7.5	119.85	-
Hume pipe ϕ150	m	32.0	-	-	-
Hume pipe ϕ300	m	-	-	19.0	-
Hume pipe ϕ500	m	-	-	-	6.25
Stop log	m^3	0.238	0.437	0.609	0.187
Gangway ladder	pes.	-	4	4	12
C.U.G. 360	pes.	-	1,996.0	-	-
C.U.G. 300	pes.	-	668.0	-	-
Corrugated iron flume 600 x 300	m	-	-	1,884.0	-
Gate	unit	-	-	-	2

Table of Construction Cost for Pilot Farms Table 3-8

Area	Acreage of area (ha)	Total Construction cost (M$)	Direct const. cost (M$)	Cost of Major manufactural material (M$)	Construction cost per ha	Direct const. cost per ha	Cost of Major manufactured material per ha.	Remarks
Padang Lindong	18.2	15,700	10,209	349.7	863	561	19	Earth ditch
P_2 M	15.2	29,210	20,294	10,029.7	1,922	1,335	660	U-shaped concrete flume ditch
$P_3T_1S_6K$	18.1	105.840	77,657	57,448.4	5,848	4,290	3,174	Corrugated pipe ditch
P_4 S_3 L	11.1	49,230	33,693	10,305.5	4,435	3,035	928	Concrete ditch

II. Demonstration Farm

1. Irrigation

1 - 1 Investigation on irrigation water

1) Irrigation area

The irrigation area is the area where paddy is being cultivated on rainfed paddy fields. This area is submerged almost annually due to floods. Topographi cally, the area is located in the flood plain of the Kelantan River. It forms a gentle slope running from the natural levee on the Pengkalan Datu River, a tributary of the Kelantan River, toward the inland. The soil in this area is as described below according to the results of the auger boring. The topsoil is 2.0 - 2.5 m thick consisting of yellow or reddish yellow heavy clay soil which gets darker in color as it gets near the surface layer. The layer below the surface layer is black consisting of peaty silt and sand. Decomposition of peat has progressed considerably. The layer below this is the sand layer.

The area which will be used as the paddy field hereafter under the project is about 4.6 ha.

2) Investigation on water sources

As this area at present is depending solely on natural rainfall, it is necessary to resort to a means to secure the sources of irrigation water. In the plan formulated by the Second Survey Team, it has been planned to draw water from the Pengkalan Datu River in the neighborhood. Later, the water quality of the river was checked. Among the results of the test, the electric conductiveity, pH value, suspended solids, and chlorine ion contents are as shown below. (Table 3-8)

On the other hand, relationship between salinity and paddy growth has been observed by various research organs, and one example is seen in Table 3-9.

WATER MANAGEMENT TRAINING PROJECT		
CONTOUR MAP OF DEMONSTRATION FARM AND TRAINING CENTRE		
Japan International Cooperation Agency		
DRAWN		NO. B-1
TRACED		
CHECKED		SCALE 1:1000 1:10000
APPROVED		

Analysis: Jabatan Kimia, Trengganu

Table 3-8

1977 Date of Sampling	Time	Tide	No.of Sample	Place of Sample (depth in m)	P H	Electric conduct-vity (μΩ/cm)	Suspended Solids (PPM)	Chlorine ion (PPM)
2 5	15.30	Ebb	91	Water surface	6.8	26	75	5
"	15.40	"	92	1.25m	7.1	1,730	365	980
"	16.30	"	93	River bed	7.2	2,790	785	1,180
3 21	13.47	High	104	Water surface	6.8	9,135	785	4,050
"	14.00	"	105	1.20m	7.5	11,540	270	5,400
"	14.10	"	106	River bed (2.25)	7.5	14,420	1,485	7,650
4 12	16.53	"	111	Water surface	7.0	6,250	45	1,920
"	17.13	"	112	Intermidiate	6.9	9,615	490	3,300
"	17.07	"	113	River bed	6.8	17,308	1,765	5,500
5 8	8.05	Ebb	116	Water surface (30m from left)	7.2	2,115	130	555
"	8.14	"	117	Intermidiate(")	6.9	2,165	40	566
"	8.20	"	118	River bed (")	7.3	2,210	30	592
"	8.30	"	119	Water surface (Centre)	7.0	2,070	100	760
"	8.35	"	120	Intermidiate (")	6.8	2,356	80	790
"	8.45	"	121	River bed (")	7.0	8,170	510	2,380
"	8.53	"	122	Water surface (30m from right)	7.1	2,310	1,095	620
"	9.03	"	123	Intermidiate (")	6.9	2,350	134	630
"	9.15	"	124	River bed (")	6.8	23,070	3,400	7,410
"	12.12	Medium	125	Intermidiate (")	6.8	5,675	1,255	1,590
"	12.20	"	126	Intermidiate (Centre)	6.9	7,690	760	2,170
"	12.30	"	127	Intermidiate (30m from right)	6.9	17,310	9,485	4,880
"	15.45	High	128	Water surface (30m from left)	6.9	13,461	315	4,010
"	15.55	"	129	Intermidiate (")	7.0	22,115	470	6,580
"	16.00	"	130	River bed (")	7.5	21,155	1,015	2,860
"	16.07	"	131	Water surface (Centre)	7.6	10,580	135	1,440
"	16.10	"	132	Intermidiate (")	7.3	21,635	440	3,220
"	16.17	"	133	River bed (")	7.0	22,115	6,080	6,810
"	16.24	"	134	Water surface (30m from right)	7.1	11,925	380	1,580
"	16.27	"	135	Intermidiate (")	7.2	21,155	580	2,920
"	16.30	"	136	River bed (")	7.1	23,075	17,585	7,320
6 11	10.05	Ebb	141	Water surface (Centre)	6.6	575	50	155
"	10.18	"	142	Intermidiate (")	6.6	905	95	290
"	10.25	"	143	River bed (")	6.5	1,875	170	504

Relationship between salinity and growing of paddy

Table 3-9

Chlorine ion (ppm)	Height of paddy (cm)	Tillering (stalk)	Weight of paddy (g)	Weight of stalks (g)	Ratios of grain weights (%)
5,000	Withered	-	-	-	-
3,000	Withered	-	-	-	-
2,000	77.5	22.0	36.0	49.0	67
1,000	79.9	20.5	46.5	56.0	86
500	78.1	21.5	47.5	55.0	88
300	81.4	19.5	47.0	59.0	87
100	82.6	19.5	52.0	59.0	97
0	80.9	21.0	53.5	59.3	100

(Note: Water Resources Handbook (Yamaguchi Prefecture Agricultural Experiment Station,Japan).

And, the Hokkaido Development Bureau has given the following values for each growth period as referential values.

pH 6~7 and electric conductivity of 500μΩ/cm are the standards set by the Ministry of Agriculture and Forestry of the Japanese Government for water for agricultural use.

After studying the data mentioned above, it seems that the water of the Pengkalan Datu River is not suitable for irrigation purpose since its salinity exceeds the tolerance limits most of the time of the year at the supposed point of the river. Therefore, the alternative water sources have been studied among which the major ones are the following.

a) Groundwater

b) Pond (Utilization of flood water and streams)

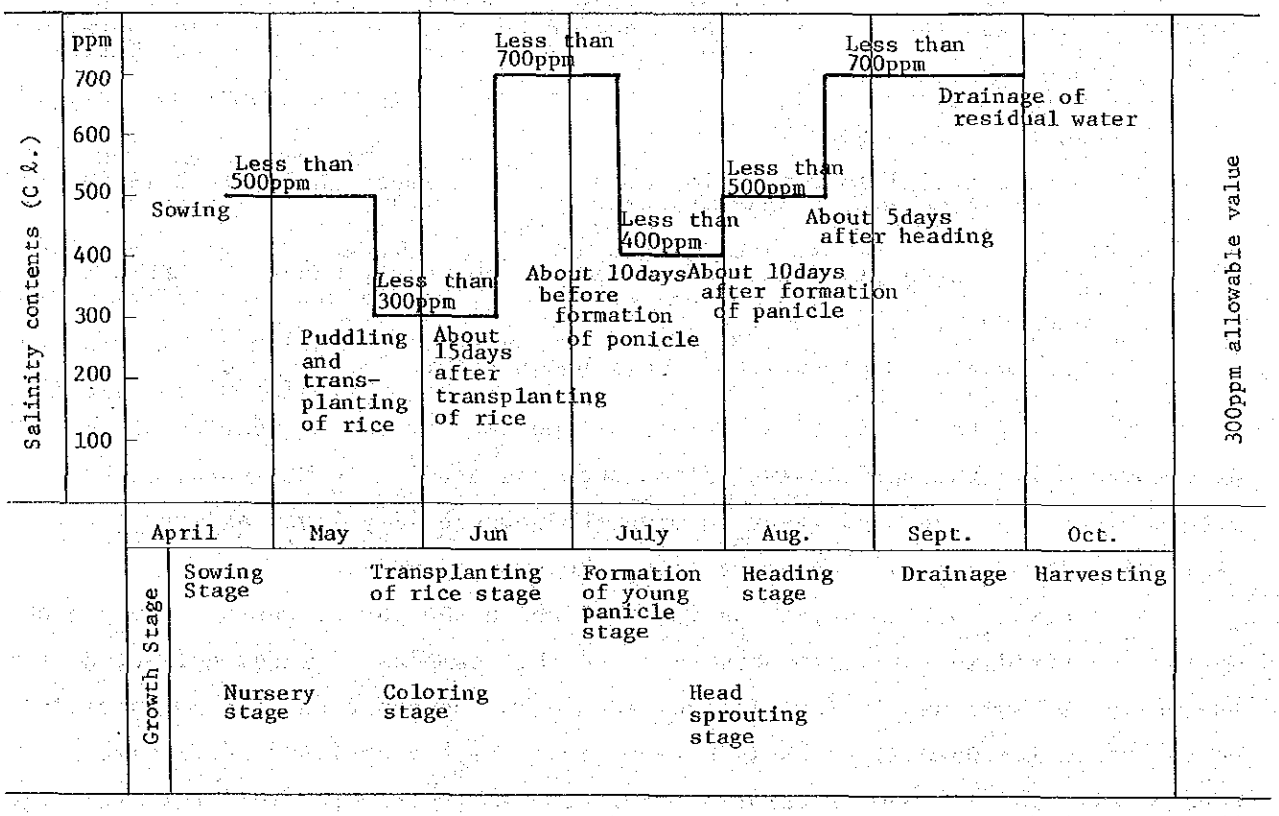
c) Drawing water from the canals in the Kemubu Area

d) Utilization of service water

Values of Salinity Content on the Growth Stages of Paddy

by Hokkaido Dev. Bureau, Japan Table 3-10

	Stage	Solinity tolerance limit
1st stage	Nursery stage	Less than 500 ppm
2nd stage	Transplanting of rice to coloring stage	Less than 300 ppm
3rd stage	Tillering stage	Less than 700 ppm
4th stage	Before and after formation of young panicle	Less than 400 ppm
5th stage	Head sprouting stage to immediately after heading	Less than 500 ppm
6th stage	After 5th stage till drainage of residual water (ripening stage)	Less than 700 ppm
Remarks	Tolerance limits of Salinity are shown as $C\ell^-$ content of irrigation water.	



a) Groundwater

The investigation of the groundwater was carried out in 1974 by a West German consulting firm using the geoelectrical sounding method. According to the results of the investigation, the proposed sites for the Water Management Training Centre and the Demonstration Farm are located between Station 14 and Station 17 on L-L' Survey Line. They have No. 1 permeable layer and No. 2 permeable layer, and both are free from salt water intrusion.

ENEX, another consulting firm of New Zealand, is carrying out a survey on the possiblity of utilization of the groundwater in the basin of the Kelantan River. This survey includes the observation of water level at 334 existing wells and the investigation of water pressure at 33 wells at a depth of 60 meters. It is still not able to arrive at the final conclusion, but the maximum amount of water that can be pumped up is estimated at 25 $l/sec/km^2$.

Again, the Public Works Department, with the cooperation given by a West German investigation team, is carrying out an investigation on groundwater for waterworks. According to the results of the investigation wells now in use are shallow wells, and the amount of water pumped up from each well ranges between 0.76 lit./sec and 8.84 lit./sec.

Books for reference:

1. Geoelectrical Investigation Kota Bharu, Kelantan/Malaysia 1974 by Prof. Dr. H. FLATHE
2. The Kelantan River Basin Study Eighth Quarterly Report by ENEX. September, 1976.
3. Groundwater Exploration in Kota Bharu Report No. 1 PWD

According to the data on boring carried out for the foundation of the structures while the said investigation team was staying in Malaysia, it has become clear that the sand layer forming the permeability layer exists at 2.7 - 14 m, 21 - 24 m, and 25 m and more below the ground surface.

The result of the water quality test which the investigation team requested during the field investigation has revealed that samples of water collected from the wells for home use in the villages located along the road running parallel to the Pengkalan Datu River shows high salinity recording 1,490 μΩ/cm electric conductivity and 148 ppm of chlorine ion. The water from the well for irrigation use on the southwestern edge of the Training Centre recorded 74μΩ/cm and 13 ppm respectively. The water from the well located at the crossing of the access road and Jl. Hospital recorded 84μΩ/cm and 17 ppm. It is concluded that the water from these wells is of low salinity within the tolerance limits of the irrigation water. Judging from the fact that the water of shallow wells located along the river has high salinity content, it is quite possible that saline water may go up if a large quantity of groundwater is pumped up.

b) Irrigation pond

The proposed sites for the Water Management Training Centre and the Demonstration Farm are located in the area submerged several times every year by the floods. The plan is to pump up flood water during the high water season into the irrigation pond by using the drainage pump and thereby secure necessary quantity of water for raising two crops of rice a year.

c) Drawing water from the Kemubu Area

On the other side of the Pengkalan Datu River opposite to the proposed site for the Centre and the Demonstration Farm are installed the tertiary canals of the Kemubu Irrigation Scheme. The idea is to draw water from these tertiary canals to the proposed site.

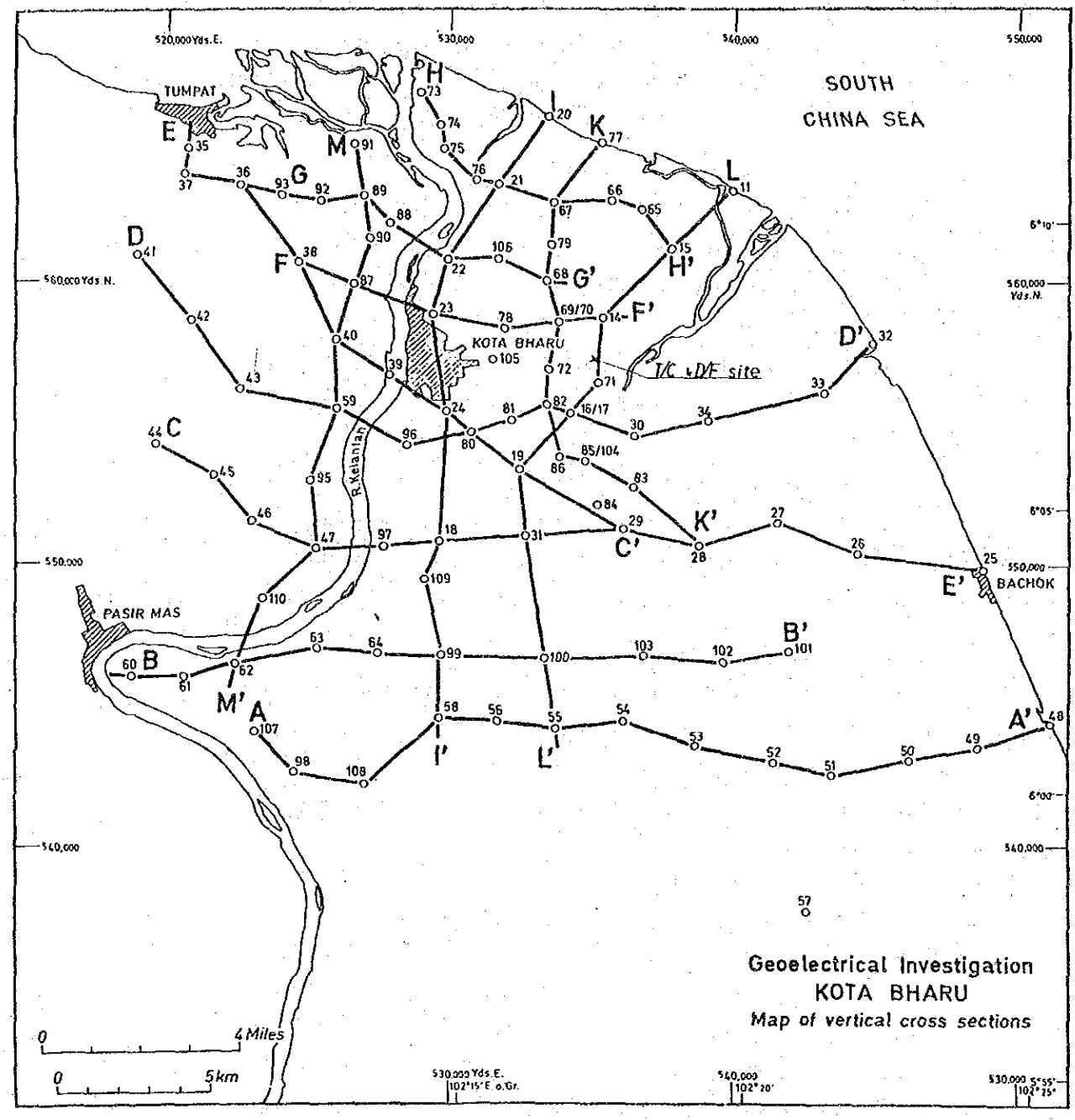
The length of the driving channel required is 3.5km as shown in the following figure, and it is necessary to provide facilities to cross the Pengkalan Datu River.

Again, the Kemubu Scheme is carrying out the pumping irrigation, and the supply of water is stopped during the non-irrigation season. Therefore, it is conceivable that it may be impossible to draw water in case the paddy cultivation period of the Kemubu Scheme is different from that of the Demonstration Farm.

d) Utilization of City Water

Waterworks in Kota Bharu is depending on pumped-up groundwater. This water is available along J1. Hospital near the proposed site for the Training Centre, and is only about 1.5 km away from the entrance of the access road. Along the road running along the Pengkalan Datu River, such city water is available more readily.

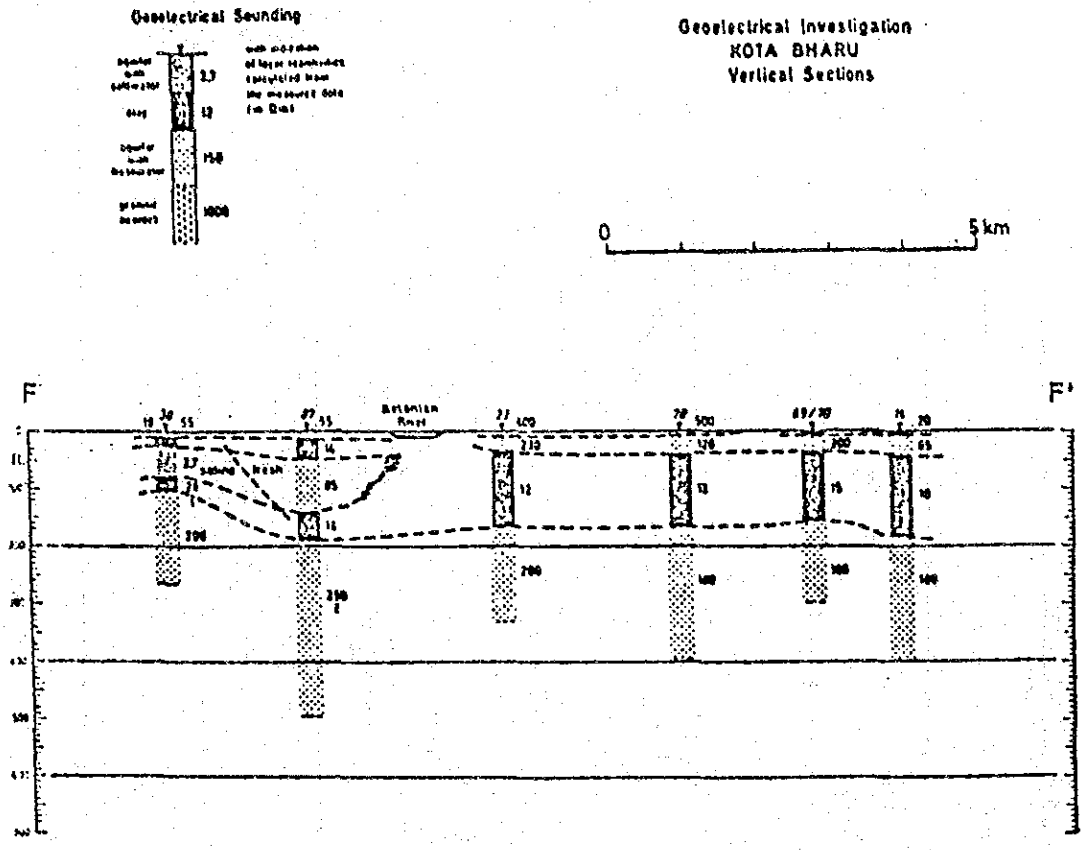
fig - 5



Geoelectrical Investigations Kata Bharu

Kelantan/Malaysia

Fig. -6


Geoelectrical Sounding
Geoelectrical Investigation
KOTA BHARU
Vertical Sections
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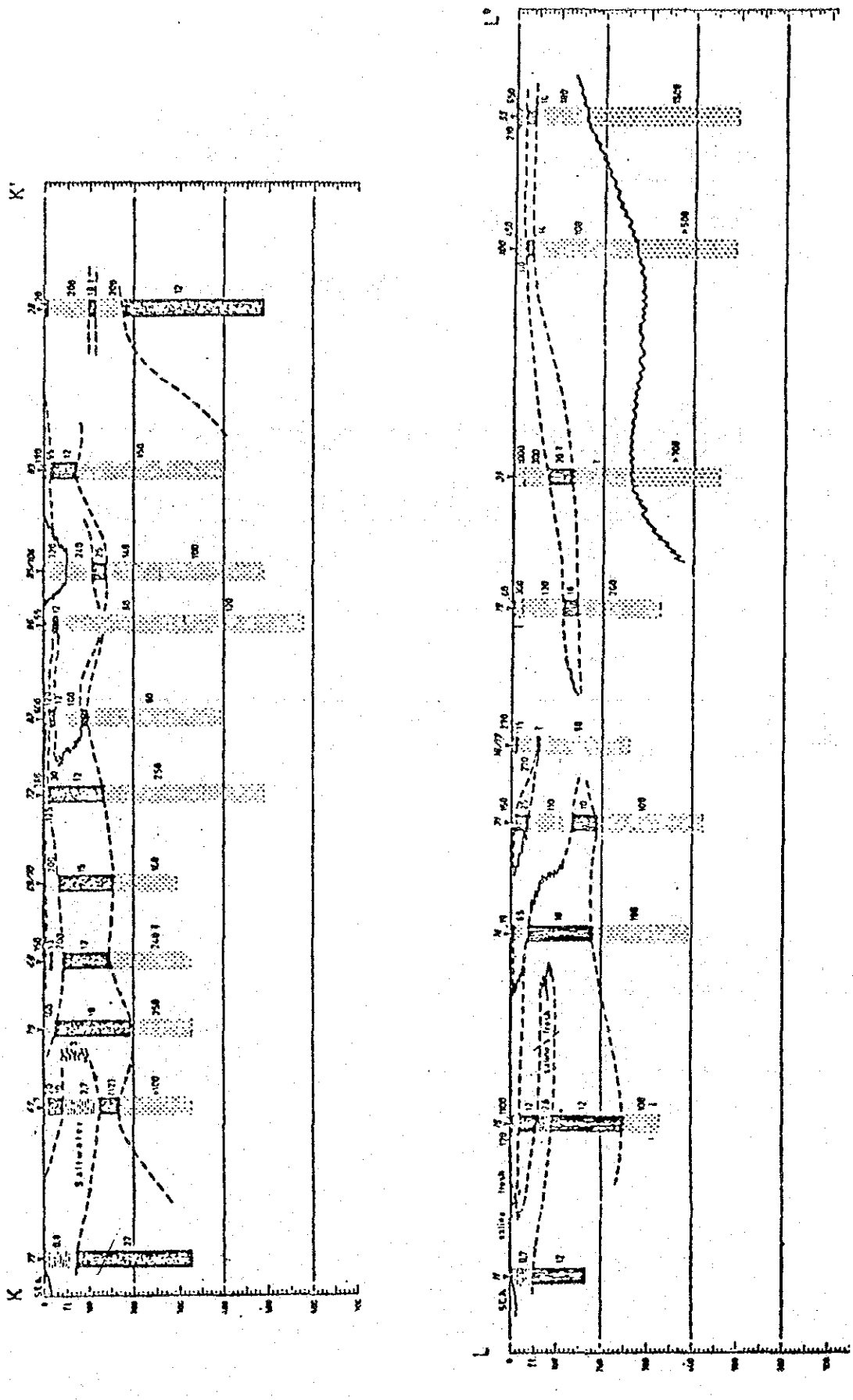
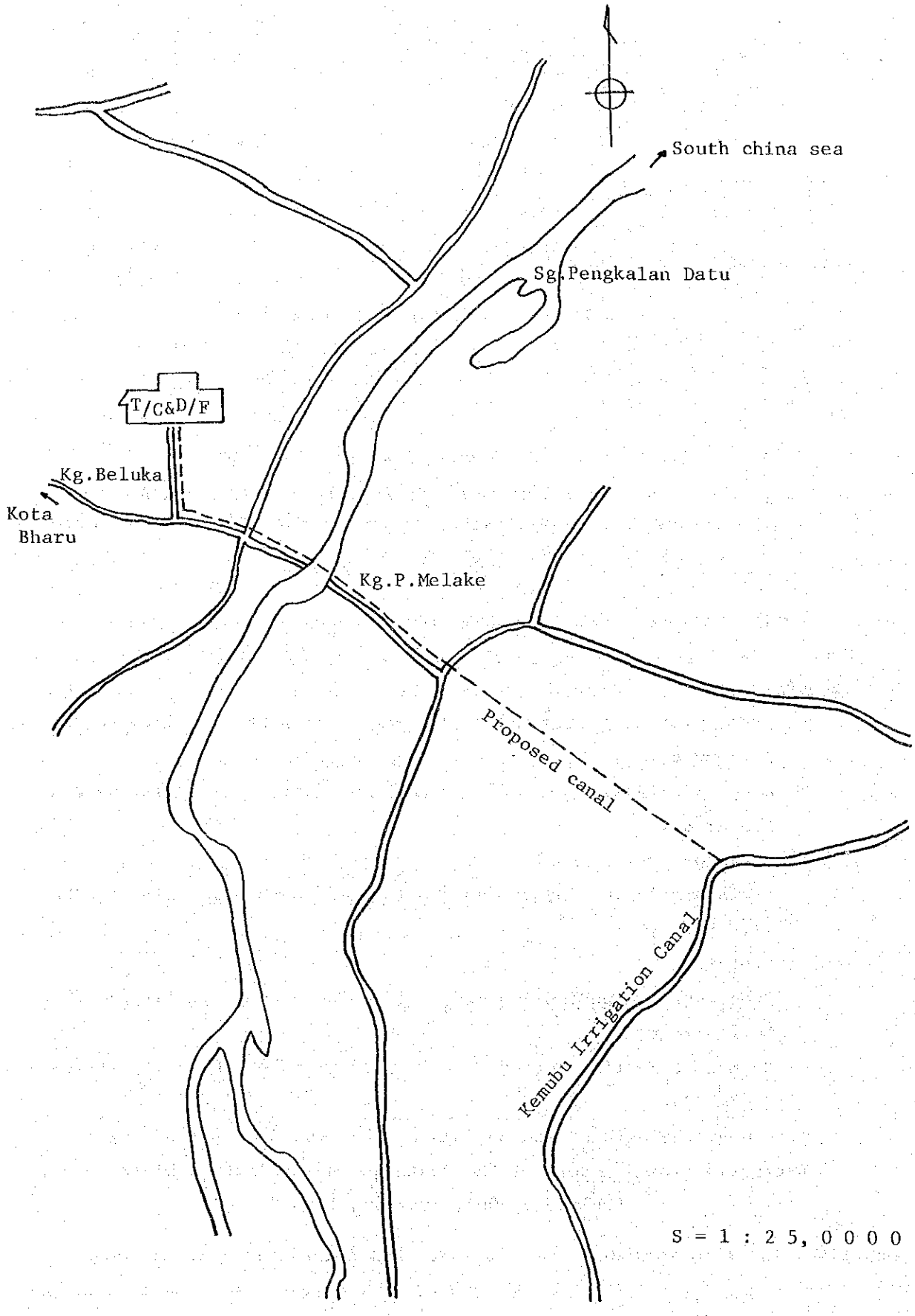


Fig. -7

Fig. -8 PLAN OF DRAWING WATER FROM KEMUBU SCHEME



3) Irrigation requirement for lowland rice

According to FAO's publication titled "No. 14 Irrigation Requirement for Double Cropping of Lowland Rice in Malaysia," the following results have been obtained at Dewan Salor Irrigation Scheme in the suburbs of Kota Bharu.

Off season (dry season)

May	4.8 mm/day
June	4.8 mm/day
July	5.8 mm/day
August	5.1 mm/day

Main season (wet season)

October	4.3 mm/day
November	4.6 mm/day
December	3.6 mm/day
January	4.1 mm/day

4) Irrigation requirement and water required for puddling

In 1961, specialists were dispatched from Holland as the aid provided by FAO, and the specialists gave the following advice as the result of the study which extended over a period of $1\frac{1}{2}$ years.

* Irrigation requirement for lowland rice in Malaysia

Double cropping

(1) Off season (dry season)

a) Presaturation period (40 days) 15 inch/month 1.5 lit./sec/ha
12.7 mm/day

b) Normal irrigation period 10 inch/month 1.0 lit./sec/ha
8.5 mm/day

(2) Main season (wet season)

a) Presaturation period (40 days) 13 inch/month 1.3 lit./sec/ha
11.0 mm/day

Single cropping

a) Presaturation period (40 days) 12 inch/month 1.2 lit./sec/ha
10.2 mm/day

b) Normal irrigation period 9 inch/month 0.9 lit./sec/ha
7.6 mm/day

(Based on the data of Tanjung Karang Scheme, State of Selangor)

Extracted from: "Report of the Drainage and Irrigation Division for the years 1961, 1962 and 1963."

1 - 2 Irrigation Plan

1) Irrigation water source plan

As regards drawing water from the nearby Pengkalan Datu River planned by the Second Investigation Team, the investigation carried out later has revealed that the river water is not suitable for paddy cultivation due to high salinity content. (See the results of the water quality test)

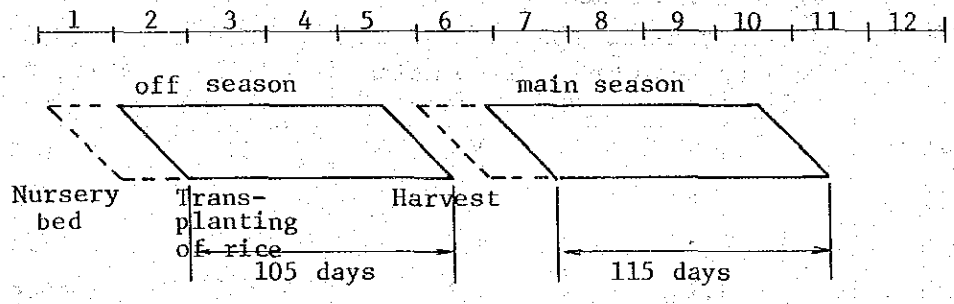
Judging from the present condition of utilization of the groundwater, it is clear that it is impossible to pump up a large quantity of water. Again, pumping up groundwater excessively in the dry season may exert the influence circle of groundwater over the saline water zone and may cause salt intrusion. Consequently, it seems necessary to minimize the use of groundwater.

In case of the plan of construction of an irrigation pond, the pump necessary for the drainage inside the embankment can also be used for pumping up water to be stored in the irrigation pond. More than a half of the filled-up portion of the irrigation pond can be used as embankment, and the excavated earth of the irrigation pond can be used as banking material. When filling up with earth transported from other sites is considered, such excavation will not be a disadvantage from the viewpoint of the construction cost.

Upon consideration of various plans mentioned above, it is planned to use the irrigation pond as the main water source and the groundwater as the subsidiary water source for the Demonstration Farm. In other words, the flood water available during the period of November to January is introduced by gravity or pumped up and stored in the irrigation pond to secure sufficient quantity of water for raising two crops of rice a year. It is planned to use the groundwater only when the irrigation water is particularly necessary or in case of a drought year.

2) Cropping plan

Cropping plan is as shown below. The flood season from the middle of November to the middle of January is avoided.



Upon planning irrigation and water balance, the most critical condition when the cropping has delayed will be assumed.

A period of 10 days is planned for presaturation before puddling and for puddling. The irrigation requirement during this period is planned as 200 mm. This quantity includes losses.

3) Water distribution plan

Water is distributed to the fields with water flowing down naturally or pumped up water through the irrigation ditch made of U-shaped reinforced concrete flume. As the distance over which the water is to be conveyed is short under this project, it is considered that most of the loss is the loss due to operation. Again, as this operation loss is planned to be reused as rotating water, water distribution loss of 10% is considered when making the plan of water balance.

In the future, the increase in water requirement due to improved water management and sub-surface drainage will be covered by reuse of water and using the subsidiary water source, the groundwater, and therefore they are not considered under this plan.

4) Design irrigation requirement

i) Irrigation requirement during presaturation period and puddling

75 mm as the quantity of irrigation water during presaturation period and 75 mm as the quantity of irrigation water for puddling are to be conveyed in 10 days. Evaporation of about 5 mm/day (a total of about 50 mm) during that period is considered. In short, it is planned to supply 200 mm in 10 days. This quantity includes the conveyance loss.

ii) Normal irrigation period

As the irrigation requirement during normal irrigation per od, the value of consumptive use for the dry season crop actually observed in the Salor Irrigation Area in the suburbs of Kota Bharu is used.

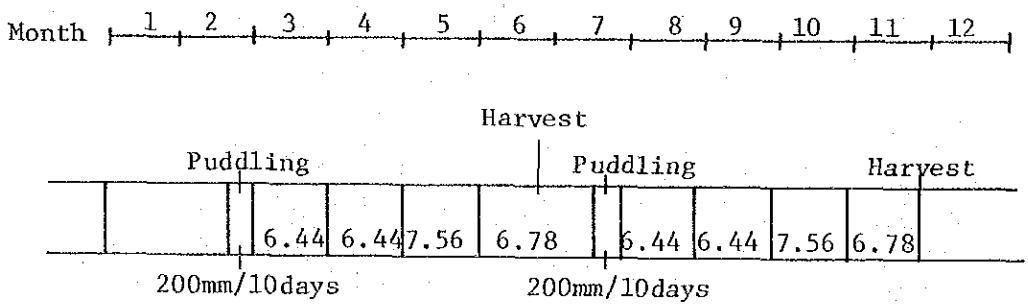
Percolation from the ground in most cases is generally less than 10 mm/day as the soil is the heavy clay containing 50% of clay. Percolation value used here is 10 mm/day. Therefore, the irrigation requirement in normal irrigation season including 10% loss for each month is as follows.

	Consumptive Use (mm/day)	Percolation (mm/day)	Total	Irri. Requirement (mm/day)
1st month	4.8	1.0	5.8	6.4
2nd month	4.8	1.0	5.8	6.4
3rd month	5.8	1.0	6.8	7.6
4th month	5.1	1.0	6.1	6.8

(Note: Irrigation requirements generally used in Malaysia are much larger than the values shown above because the conveyance and the operation losses are large.)

Irrigation plan for water balance

(The worst cropping case is assumed)



5) Design Basic Year

The annual rainfall for the periods of July to October and January to June less the rainfall in non-cropping months of November and December is calculated from the data recorded for the past 12 years (1965/66-1976/77). The probability is calculated, and 1971/72 water year which corresponds to the year of 10-year probability is used as the design basic year.

6) Calculation of water balance

A) Evaporation from the Pond

The relation between the Class A Pan and the evaporation from water surface of the reservoir is 0.7 according to the study made by US Weather Bureau. However, the pan used by DID for measuring evaporation is painted black, and so the value must be corrected to 0.66.

The evaporation has been measured continuously for over 5 years using the pan at Pasir Mas Pump Station on the opposite bank of the Kelantan River, and so the data available at this point are used.

The results of the measurement show that the evaporation immediately after a heavy rainfall is abnormally large. As such could be considered as errors in the measurement, the monthly evaporation exceeding 200 mm is excluded, and the mean monthly evaporation of the period after 1972 is used in the plan.

Monthly Rainfall

Table 3-11

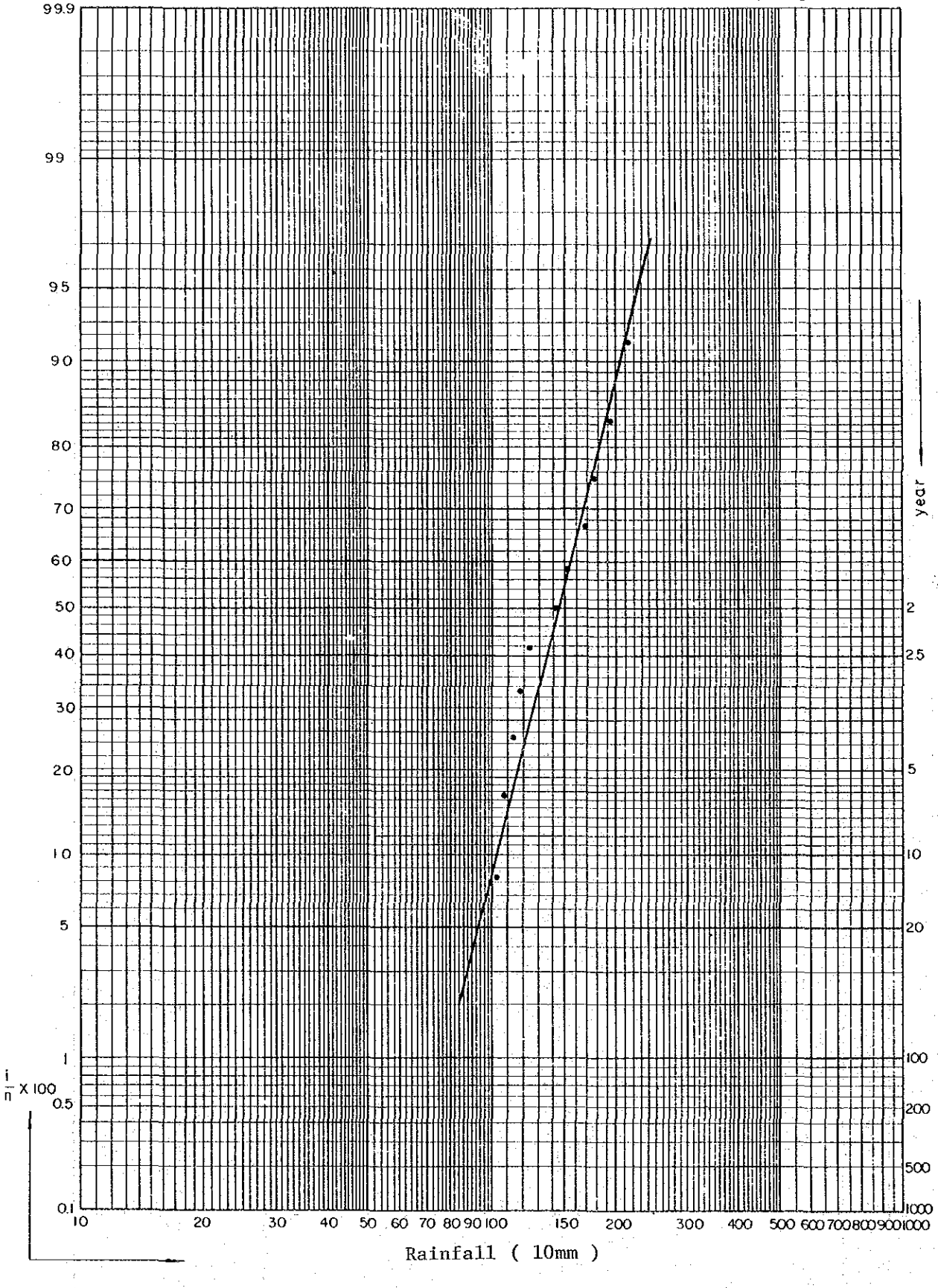
(Unit: mm)

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	Annual	Except. Nov.Dec.	Order
1965/66	108.2	204.5	205.2	413.0	902.5	1,033.5	517.4	86.1	65.3	69.1	252.2	211.1	4,0581.1	2,132.1	11
1966/67	138.9	133.9	324.9	354.3	465.8	866.9	1,488.4	181.4	31.2	111.0	117.6	178.8	4,393.1	3,060.4	12
1967/68	158.5	180.6	202.4	200.4	649.0	200.7	20.8	8.1	3.3	8.9	180.6	119.1	1,932.4	1,082.7	2
1968/69	118.1	222.8	226.8	470.7	213.6	916.2	157.7	35.8	19.8	55.4	19.8	198.4	2,655.1	1,525.3	7
1969/70	121.9	104.9	91.4	208.0	1,249.2	278.1	169.2	30.5	49.3	299.5	67.1	49.4	2,708.4	1,181.1	4
1970/71	173.0	118.9	290.6	267.5	513.8	562.1	99.1	78.5	228.1	0	121.9	32.3	2,485.8	1,409.9	6
1971/72	128.5	166.4	90.4	313.7	806.5	601.0	29.5	4.3	1.8	167.6	60.2	58.7	2,428.6	1,021.1	1
1972/73	182.9	314.7	210.6	278.1	307.8	464.6	60.2	56.1	477.3	103.4	35.3	215.9	2,706.9	1,934.5	10
1973/74	220.5	204.5	142.7	444.0	544.3	1,195.8	22.4	77.0	161.0	88.6	81.8	248.2	3,430.8	1,690.7	8
1974/75	85.3	89.4	183.4	344.4	483.9	640.8	461.5	93.2	108.5	29.2	147.6	200.7	2,867.9	1,765.6	9
1975/76	100.0	196.5	191.0	296.5	592.0	696.0	37.5	3.5	41.6	54.5	218.1	101.5	2,528.7	1,240.7	5
1976/77	173.4	106.7	163.2	225.9	1,523.0	250.8	63.5	52.0	31.7	19.5	117.2	181.5	2,908.4	1,134.6	3
Mean													2,926.2		

Note: DID store, Kota Bharu.

Probability Graph

(Fig -I0)



Rainfall in 1971/72 Water Year

Table 3-12 (Unit: mm)

day	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	Annual
1	-	-	-	-	6.1	112.8	-	-	-	-	-	-	
2	-	2.5	-	-	-	7.6	-	-	-	-	-	-	
3	-	2.8	-	-	6.4	31.0	-	-	-	-	-	-	
4	-	-	-	1.8	21.8	54.6	-	-	-	-	-	-	
5	-	-	-	31.0	7.1	53.3	-	0.3	-	8.4	-	1.3	
6	-	1.3	-	-	4.6	1.3	1.3	1.3	-	43.4	-	-	
7	-	7.6	-	-	3.6	3.3	0.8	-	-	-	-	17.0	
8	0.1	-	-	3.8	3.3	0.8	-	-	-	14.7	-	6.9	
9	-	-	5.1	-	-	3.8	-	-	-	54.6	-	1.5	
10	-	6.9	-	-	2.3	3.3	-	-	-	3.8	0.5	-	
11	-	1.8	13.2	14.7	-	0.8	-	-	-	12.7	34.5	2.5	
12	2.8	21.1				17.8	-	-	-	4.8	-	-	
13	-	-	-	-	21.6	-	-	-	-	3.8	16.5	-	
14	3.3	-	1.3	4.1	26.2	39.4	-	-	0.3	-	2.0	-	
15	-	-	1.3	72.4	92.7	100.6	1.5	-	-	-	-	-	
16	23.4	6.1	9.4	14.2	-	2.5	-	-	-	-	-	-	
17	1.0	-	-	-	-	6.6	6.4	-	-	-	-	9.9	
18	16.0	4.6	0.8	27.7	3.3	15.2	6.6	-	-	-	-	-	
19	23.0	8.1	6.9	1.3	75.4	6.9	1.3	-	-	-	-	-	
20	24.6	14.7	29.2	36.8	64.5	2.8	-	-	-	-	-	5.1	
21	1.6	14.2	20.8	7.9	72.4	16.8	-	0.3	-	-	-	-	
22	-	-	2.5	36.8	32.8	82.8	-	-	-	-	-	4.8	
23	-	29.2	-	1.8	4.1	7.6	-	-	-	-	-	2.5	
24	1.6	7.4	-	45.7	21.1	26.4	-	-	-	1.3	-	-	
25	-	-	-	-	48.0	3.0	9.4	-	-	14.0	-	-	
26	-	15.7	-	3.0	84.8	-	2.3	1.8	1.5	3.3	0.8	-	
27	-	-	-	-	3.8	-	-	0.8	-	1.0	5.8	-	
28	-	-	-	-	-	-	-	-	-	1.8	-	7.1	
29	40.1	22.4	-	8.1	13.0	-	-	-	-	-	-	-	
30	-	-	-	2.5	187.7	-	-	x	-	-	-	-	
31	-	-	x	-	x	-	-	x	-	x	-	x	
	128.5	166.4	90.5	313.6	806.6	601.0	29.6	4.5	1.8	167.6	60.1	58.6	2,428.8

Note: DID Store Kota Bharu

Pan Evaporation

At Pasir Mas Pump Station

Table 3-13 Unit: mm

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Remarks
1972	128.8	161.0	188.0	165.1	(297.4)	154.4	158.5	144.8	152.7	129.8	117.1	( )		
1973	129.8	139.7	159.5	(297.7)	157.7	149.1	149.6	131.6	190.5	136.7	(275.8)	(541.5)		
1974	125.7	129.8	166.1	153.9	149.1	149.6	161.8	185.9	214.9	137.4	135.1	(328.7)		
1975	(300.0)	139.5	167.5	174.0	146.5	187.0	172.5	191.5	149.0	153.0	168.0	(239.0)		
1976	134.5	163.5	203.5	185.0	173.0	156.5	176.1	185.0	159.5	143.5	(805.5)	156.8		
1977	159.0	130.0	184.5	174.0										
Mean	135.6	143.9	178.2	170.4	156.6	159.3	163.7	167.8	173.3	140.1	140.1	156.8	1,885.8	
Mean Per day	4.37	5.08	5.75	5.68	5.05	5.31	5.28	5.41	5.78	4.52	4.67	5.06	(5.16)	
Eva.from Pond (mm/day)	2.88	3.35	3.80	3.75	3.33	3.50	3.48	3.57	3.81	2.98	3.08	3.34		Epx0.66

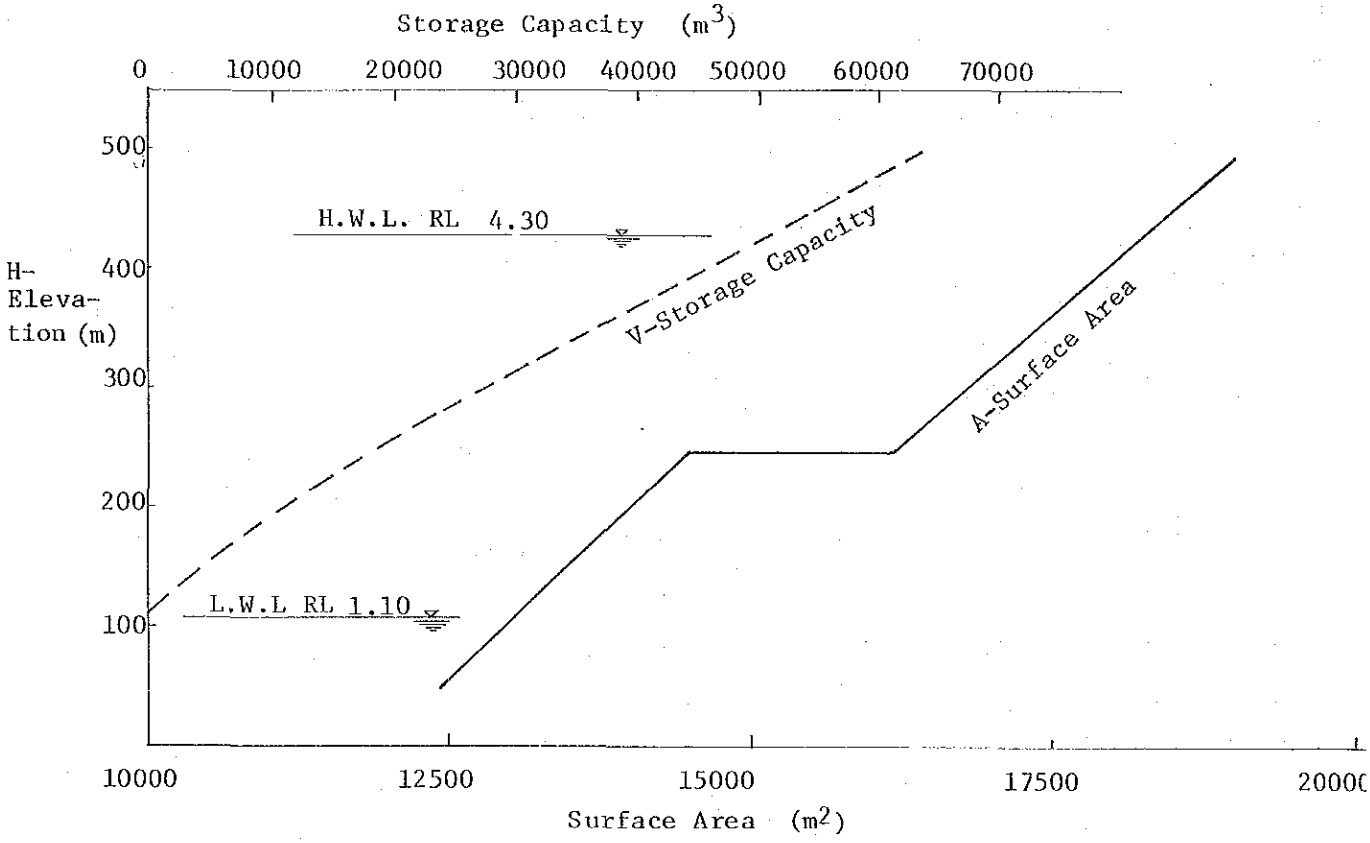
Calculation of Water Balance Table 3-14

Month	Irri. requirement (4.6ha)				Effective Rainfall (6.5ha)		Reservoir Water Surface Evaporation				Water balance (m^3)	Total required Capacity (m^3)	Total Capacity (m^3)	
	5 days	mm/ day	mm/5 days	(x46) m^3/5 days	mm/5 days	(x65) mm/5 days	mm/ day	mm/5 days	Reservoir area	m^3/5 days				
12	6												49,800	RL 4.30
1	1						2.88	14.40	18,100	261	- 261	261	49,539	
	2						"	"	18,100	261	- 261	522	49,278	
	3				(1.9ha)		"	"	18,060	260	- 260	781	49,018	
	4				(1.9ha) 13.0	247	"	"	18,050	260	- 13	795	49,005	
	5				(1.9ha) 9.4	179	"	"	18,050	260	- 81	876	48,924	
	6						"	17.29	18,050	312	- 312	1,188	48,612	
2	1						3.35	16.75	18,050	302	- 302	1,490	48,310	
	2						"	"	18,030	302	- 302	1,792	48,008	
	3						"	"	18,030	302	- 302	2,094	47,706	
	4						"	"	18,030	302	- 302	2,396	47,404	
	5		100 mm	4,600			"	"	18,000	302	- 4,902	7,298	42,502	
	6		100 mm	4,600			"	"	17,650	296	- 4,896	12,194	37,606	
3	1	6.4	32.20	1,481			3.80	19.00	17,350	330	- 1,811	14,005	35,795	
	2	"	"	"			"	"	17,240	328	-1,809	15,814	33,986	
	3	"	"	"			"	"	17,120	325	-1,806	17,620	32,180	
	4	"	"	"			"	"	17,000	323	-1,804	19,424	30,376	
	5	"	"	"			"	"	16,860	320	-1,801	21,225	28,575	
	6	"	38.64	1,777			"	22.80	16,740	382	-2,159	23,384	26,416	
4	1.	6.4	32.20	1,481	8.4	546	3.75	18.75	16,600	311	-1,246	24,630	25,170	
	2	"	"	"	112.7	7,326	"	"	16,500	309	+5,536	19,094	30,706	
	3	"	"	"	12.7	826	"	"	16,900	317	- 976	20,066	29,734	
	4	"	"	"			"	"	16,820	315	-1,796	21,862	27,938	
	5	"	"	"	14.0	910	"	"	16,700	313	- 884	22,746	27,054	
	6	"	"	"			"	"	16,660	312	-1,793	24,539	25,261	
5	1	7.6	37.80	1,739			3.33	16.65	16,500	275	-2,014	26,553	23,247	
	2	"	"	"			"	"	16,380	273	-2,012	28,565	21,235	
	3	"	"	"	51.0	3,315	"	"	16,300	271	+1,305	27,260	22,540	
	4	"	"	"			"	"	16,330	272	-2,011	29,271	20,529	
	5.	"	"	"			"	"	16,250	271	-2,010	31,281	18,519	
	6	"	45.36	2,087	5.8	377	"	19.98	14,420	288	-1,998	33,279	16,521	

(Continued)

6	1	6.8	33.90	1,559			3.50	17.50	14,260	250	-1,809	35,088	14,712
	2	"	"	"	17.69	1,150	"	"	14,150	247	- 656	35,744	14,056
	3	"	"	"			"	"	14,130	247	-1,806	37,550	12,250
	4				(ha) 15.0	285	"	"	13,950	244	+ 41	37,509	12,291
	5				(ha)		"	"	13,970	244	- 244	37,753	12,047
	6				7.1	135	"	"	13,950	244	- 109	37,862	11,938
7	1						3.48	17.40	13,950	243	- 243	38,105	11,695
	2						"	"	13,920	242	- 242	38,347	11,453
	3						"	"	13,900	242	- 242	38,589	11,211
	4		100 mm	4,600	87.0	5,655	"	"	13,770	240	+ 815	37,774	12,026
	5		100 mm	4,600			"	"	13,920	242	-4,842	42,616	7,184
	6	6.4	32.20	1,777	40.1	2,607	"	20.88	13,560	283	+ 547	42,069	7,731
8	1	"	32.20	1,481			3.57	17.85	13,600	243	-1,724	43,793	6,007
	2	"	"	"	14.5	943	"	"	13,500	241	- 779	44,572	5,228
	3	"	"	"	21.1	1,372	"	"	13,420	240	- 349	44,921	4,879
	4	"	"	"	28.9	1,879	"	"	13,400	239	+ 159	44,762	5,038
	5	"	"	"	50.8	3,302	"	"	13,420	240	+1,581	43,181	6,619
	6	6.4	32.20	1,777	38.1	2,477	"	21.42	13,540	290	+ 410	42,771	7,029
9	1	"	32.20	1,481			3.81	19.05	13,560	258	-1,739	44,510	5,290
	2	"	"	"	5.1	332	"	"	13,420	256	-1,405	45,915	3,885
	3	"	"	"	13.2	858	"	"	13,320	254	- 877	46,792	3,008
	4	"	"	"	45.5	2,958	"	"	13,250	252	+1,225	45,567	4,233
	5	"	"	"	20.8	1,352	"	"	13,560	255	- 384	45,951	3,849
	6	7.6	37.80	1,739			"	"	13,320	254	-1,993	47,944	1,856
10	1	"	"	"	31.0	2,015	2.98	14.90	13,150	196	+ 80	47,864	1,936
	2	"	"	"			"	"	13,150	196	-1,935	49,799	1
	3	"	"	"	87.1	5,662	"	"	13,000	194	+3,729	46,070	3,730
	4	"	"	"	78.7	5,116	"	"	13,320	198	+3,179	42,891	6,909
	5	"	"	"	90.4	5,876	"	"	13,560	202	+3,935	38,956	10,844
	6	6.8	40.68	1,871	8.1	527	"	17.88	13,770	246	-1,590	40,546	9,254
11	1	"	33.90	1,559	41.4	2,691	3.08	15.40	13,750	212	+ 920	39,626	10,174
	2	"	"	"			"	"	13,810	213	-1,772	41,398	8,402
	3	"	"	"	140.5	9,133	"	"	13,670	211	+7,363	34,035	15,765
	4	"	"	"			"	"	14,220	219	-1,778	35,813	13,987
	5												
	6												

Fig. -10 H - A -V CURVES



B) Effective rainfall

The effective rainfall is calculated from the daily rainfall data of 1971/72 basic year on the assumption that all rainfall exceeding 5 mm/day is utilized effectively. This is based on the way of thinking that even when the water is drained from the surface of the paddy field, the same amount of water is reused as return flow.

C) Calculation of Water Balance

The irrigation pond is filled with water to its full capacity by the end of December. The water thus stored is used for raising two crops of rice a year. Water balance is to calculate the required capacity of the pond. Therefore, evaporation from water surface of the pond will be taken into consideration from January 1.

In the calculation of water balance, all rainfall exceeding 5 mm/day on paddy fields and reservoir inside of the embankment is considered to have been used effectively. Again, the total capacity of the pond is calculated on the assumption that H.W.L. is R.L. 4.30 and L.W.L. is R.L. 1.10. The pond area is the value that corresponds to each capacity within the aforementioned range of water level.

D) Results of Calculation

In case the water level is R.L. 4.30 when the pond is full, the required capacity is 49,700 ≒ 50,000 m^3. L.W.L. is R.L. 1.10.

7) Irrigation method

The irrigation method adopted for the Demonstration Farm can be explained as follows.

(1) Water storage method

a) Natural inflow

When the water level of the pond at the time of a flood is lower than the flood level outside of the embankment, water is stored by natural inflow using pipes. In an ordinary year it is possible to store water up to R.L. 3.00.

b) Pumping storage

* In order that the pond may be fully stored with water (R.L. 4.30) by the end of December, water in drainage ditches inside and outside and the flood water are pumped up.

* In the irrigation season, rainwater inside of the embankment and the flood water (return flow) are pumped up from the drainage ditches to be stored.

(2) Irrigation method

a) Natural irrigation

In case the water level of the pond is high (R.L. 2.80 and above), the distribution of water by natural irrigation is possible.

b) Pumping irrigation

In case the pond water level is below R.L. 2.80, pumping irrigation is carried out.

c) Groundwater irrigation

When the pond water level is remarkably low or when there is a fear of shortage of irrigation water, groundwater is pumped up to directly irrigate the fields. As the water in the pond is wasted as evaporation, it is planned to use the water stored in the pond with priority.

2. Drainage plan

2 - 1 Drainage plan inside the area

(1) Size and present condition of the drainage area

The planned drainage area is the rainfall paddy field of 10.15 ha in total to be surrounded by the embankment. The area to be provided as pond is 1.9 ha and that of the paddy field is about 4.6 ha. The rest is occupied by roads, drainage ditches, building sites, playground, etc.

(2) Drainage method

The method of drainage in the area is to collect drainage water in the lowest portion in the area through earth canals to be constructed on the outer circumference of the farm lots in three directions, and to drain water to the outside of the area or into the irrigation pond. Drainage to the outside of the area will be done naturally as much as possible. Pumping drainage is carried out in case the outside of the area is flooded or the outside water level is higher than the inside.

For the calculation of the volume of pumping drainage, it is assumed that the flooding of the fields in the area is within three days, and the allowable flooding depth is not considered since the Training Centre conducts the experimental raising of crops also.

(1) Natural drainage

a) Non-irrigation season

When the outside water level is lower than the inside water level, the natural drainage is possible. Flooding of the fields in non-irrigation season is not allowed. Therefore, the highest water level is set at R.L. 2.40.

(2) Pumping drainage

a) Irrigation season

In the irrigation season, rainwater inside of the embankment and the drainage water of the fields are stored temporarily in the drainage ditches inside of the embankment, and then pumped up and conveyed to the pond.

b) Non-irrigation season

When the outside water level is higher than the inside water level and the inside water level exceeds the allowable stage of R.L. 2.40, pumping drainage is necessary.

(3) Basic rainfall

Rainfall of 5-year probability generally used in Malaysia is used as the basic rainfall. Max. 24-hour, 48-hour, and 72-hour rainfalls of the period of 7 years from 1970/71 to 1976/77 are as shown in the following table.

The distribution is checked on the basis of the data by using the probability sheet, but no favourable results are obtained. Therefore, the max. 72-hour rainfall of 1976/1977 corresponding to the rainfall of 5-year probability of 535.00 mm/day is used as the basic rainfall when planning the volume of pumping drainage, and 351.00 mm/day as the basic rainfall in planning the drainage ditches.

Maximum Rainfall (1970 - 1977) Table 3-15

(DID store, Kota Bharu) (Unit: mm)

	1970.71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77
Max.24hr.	228.6	187.7	282.2	302.3	235.5	194.0	351.0
Max.48hr.	268.7	300.5	292.1	431.5	287.5	269.5	470.0
Max.72hr.	279.9	313.4	297.2	522.2	332.5	329.5	535.0

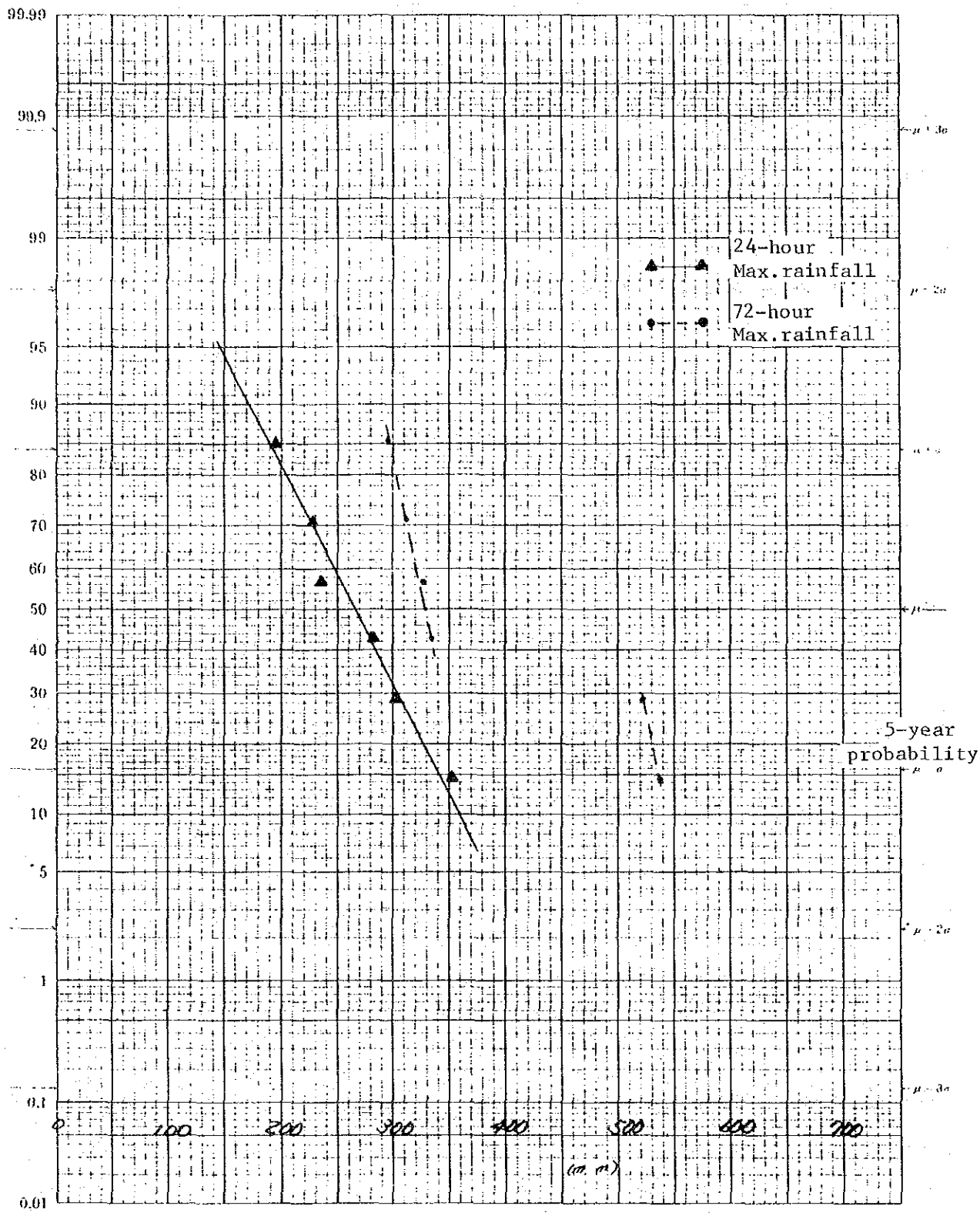
Maximum Rainfall (1965 - 1970) (DID store, Kota Bharu)

Max 24 hr. 585.0 (mm)

Max 48 hr. 984.3 "

Max 72 hr. 1,238.5 "

Maximum Rainfall Probility Graph (Fig-12)



4) Volume of pumping drainage

When planning the volume of pumping drainage, it is assumed that the amount of 72-hour basic rainfall is drained in three days. In other words, it is considered that flooding for a period of three days is unavoidable.

$$Q = \frac{1}{3 \times 24 \times 60 \times 60} \times t_3 \times 10^{-3} \times A \times 10^4$$

where Q = Design drainage (m^3/sec)

t_3 = 72-hour basic rainfall 535.5 (mm/3 days)

A = Drainage area 10.15 (ha)

$$Q = \frac{1}{259,200} \times 535 \times 10^{-3} \times 10.15 \times 10^4 = 0.2095 \ (m^3/sec)$$

$$= 12.57 \ (m^3/min)$$

5) Drainage capacity of drainage ditch

For the capacity of drainage canals, it is planned to drain 24-hour basic rainfall in one day because there are more cases in which the natural drainage is possible.

$$Q = \frac{1}{24 \times 60 \times 60} \times t_1 \times 10^{-3} \times A \times 10^4$$

where Q = Design drainage capacity (m^3/sec)

t_1 = 24-hour basic rainfall 351 (mm/day)

A = Drainage area 10.15 (ha)

$$Q = \frac{1}{24 \times 60 \times 60} \times 351 \times 10^{-3} \times 10.15 \times 10^4 = 0.412 \ (m^3/sec)$$

2 - 2 Drainage plan outside the area

1) Drainage method

The proposed sites for the Water Management Training Centre and the Demonstration Farm are located in a depression gently sloping from south to north, and stretched across about 450 meters from east to west. The highest elevation on the western end is R.L. 3.11 and R.L. 3.20 on the eastern end. The elevation at the low central part is R.L. 2.50. Therefore, in case an embanlment with top level in R.L. 5.00 is constructed, the protion out of the embankment is flooded to a maximum depth of 60 cm due to the outflow from the hinterland.

The area where the flooding can be anticipated at present is the rainfed paddy field. As the border between paddy fields are high and the storage capacity of the fields is large, the runoff from this portion is expected to be delayed compared with the runoff from the Demonstration Farm area. As, the drainage of this area may be influenced by the structures of the centre, a due consideration is necessary against any possible problem.

3. Farmland development

3 - 1 Layout and scale of facilities

1) Drainage ditch

The drainage ditches are distributed as to face directly each farm lot and located along the ring bund, in order to make drainage possible from each farm lot. Again, as underground drainage and sub-irrigation are considered for some farm lost , it is planned that the drainage ditches will have a range of water depth up to 1.5 meters.

2) Farm roads

A farm road running from east to west is constructed in the centre of the farm and so the farm is divided into four sections by this road and the main road.

These roads will have a total width of 7.0 m and effective width of 6.0 m so that the vehicles can pass each other easily. Besides these, a farm road 5.0 m in total width and 4 m in effective width is constructed along the drainage ditch on the north and south side.

3) Irrigation ditch

Irrigation ditch of U-shaped flume constructed along the northern side of the farm road running east to west. The irrigation water is distributed to each lot by the ditch.

4) Farm lot

A farm lot will be 40 m wide and 86 m long due to the restriction of the shape and size of the site. The standard size of a farm lot is 0.344 ha.

3 - 2 Land leveling plan

Land leveling is to be carried out on the farm, but as it is possible that the border between paddy fields may be changed in the future, the farm lots surrounded by roads and drainage ditches shall be of the same height. However, the north-western portion of about 0.9 ha will be kept as it is, for comparison with other new lots.

The farm at present is a rainfed paddy field without much variation in the soil layer, and not much cultivated soil has been formed. It is judged that no remarkable effect can be expected from the surface soil removing, but temporary surface soil removing to a depth of 20 cm will be carried out to prevent uneven growth of paddy immediately after the land leveling.

4. Embankment plan

The site for the Water Management Training Centre is flooded almost annually. Therefore, the Training Centre and the Demonstration Farm will be protected by the ring bund to secure activities of the Centre and also to guarantee paddy cultivation.

4 - 1 Determination of the height of bund

No observation of flood level has been carried out in this area, and observation of water level of the nearby Pengkalan Datu River has just been commenced at the beginning of 1978. Therefore, farmers' testimonies and the traces of floods are the only data to rely on. According to these, flood level in a normal year is about R.L. 3.00 m, and it is said that the flood level in 1967 recorded at R.L. 4.73 m.

The height of the bund is set at R.L. 5.00 m including extra banking in anticipation of the future sinking by consolidation. However, as the construction of an bund on the Kelantan River is under planning, it is possible that the height of the bund may be changed as the result of the future observation of water level, etc.

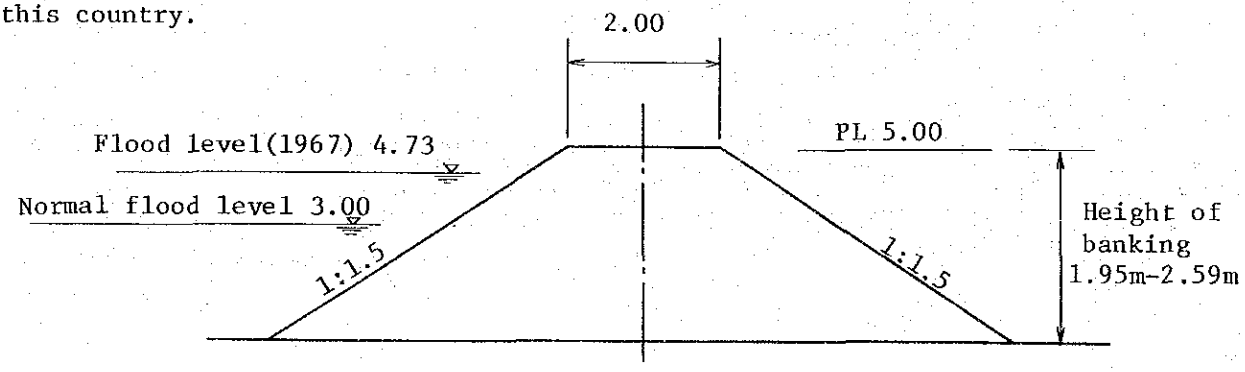
4 - 2 Determination of the cross section of the bund

(1) Top width

Top width is 2.0 m so that one can ride a bicycle on it for inspection.

(2) Side slope

Excavated earth of the drainage ditch and the irrigation pond is utilized as the banking material. Judging from the data on boring carried out in the neighbourhood and the core, the layer down to 2.0 m below the ground surface consists of yellow or reddish yellow hard heavy clay. Excavation both for the drainage ditch and the pond is within the depth of 2.0 m, and hard clay only can be used as the banking material. In due consideration of the facts that the height of banking is only 2.5 m and floods occur only once a year, that the load of automobiles does not exert on the bund and that here is no earthquake, the slope is decided at 1:1.5 using as reference the past examples of the works in this country.



4 - 3 Spillway

In case the recorded maximum flood level exceeds R.L. 4.73 m, a spillway is provided to prevent the collapse of the bund. The cross of the bund and the access road will function as spillway with the sill height R.L. 4.75 m.

5. Irrigation facilities

A pond is planned for storing the flood water and also to store surplus irrigation water for repeated use and the pumped-up rainwater in the irrigation season.

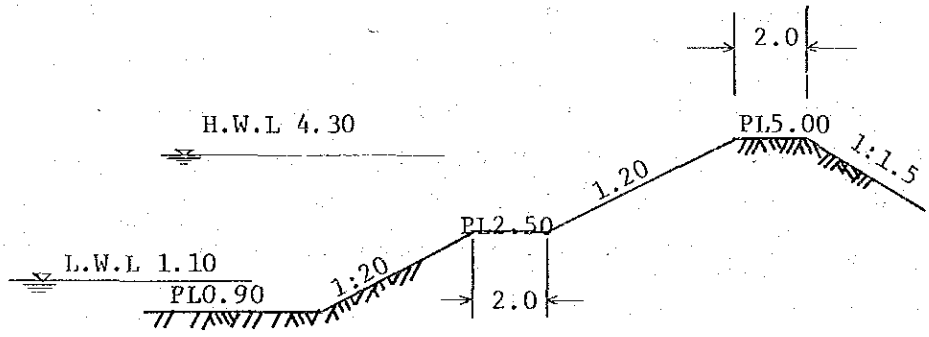
(1) Capacity of pond

The capacity of the pond based on the water balance calculation is planned at approximately 50,000 m^3.

(2) Cross section of pond

Crest width is 2.0 m which is the same as that of the flood protection bund. similarly, the outside side slope is 1:1.5. However,the inside side slope is set at 1:2.0 because the submerged period is long. At the elevation of R.L. 2.50 m, a berm 2.0 m wide is planned.

Crest height	R.L. 5.00 m	
Berm height	R.L. 2.50	
Elevation of bottom	R.L. 0.90	
High Water Level	R.L. 4.30	
Low Water Level	R.L. 1.10	(sedimentation layer of 0.20 m is considered)
Pond area at full supply	1.81 ha	
Catchment area	1.90 ha	



(3) Spillway

The capacity of the spillway is calculated on the assumption that it could drain out 24-hour basic rainfall of 351.0 mm/day in one day.

$$Q = t_1 \times 10^{-3} \times A \times 10^4 \times \frac{1}{24 \times 60 \times 60} \quad (m^3/sec)$$

where t_1 : 24-hour basic rainfall of 351 mm/day

A : Drainage area 1.9 ha

$$Q = 351 \times 10^{-3} \times 1.9 \times 10^4 \times \frac{1}{24 \times 60 \times 60} = 0.077 \quad (m^3/sec)$$

The spillway shall be the pipeline, and its bore is obtained as follows.

Water level at full supply R.L. 4.30

Drainage water level R.L. 2.40

Difference in water level H=4.30 - 2.40 = 1.90 m

Assuming that bore is ϕ 200 mm

$$V = \sqrt{\frac{2gH}{fi \frac{tfo + \Sigma fb + fl}{d}}} \qquad Q = \frac{2d^2}{4} V$$

where V: Velocity of flow (m/sec)

g: acceleration of gravity 9.8 (m/sec^2)

H: Difference in water level 1.90 m

fi: Coefficient of loss due to inflow bell mouth 0.1

fo: Coefficient of loss due to outflow 1.0

Σfb: Coefficient of loss due to curve 90° 0.1

l: About 40 m

$$f: \frac{124.5\ m^2}{D^{1/3}} = \frac{124.5 \times 0.015^2}{1.2^{1/3}} = 0.016 \qquad \text{Concrete n: } 0.015$$

$$V = \sqrt{\frac{2 \times 9.8 \times 1.9}{0.1 + 1.0 + 0.1 + 0.016} \frac{40}{0.2}} = 2.91 \text{ m/sec}$$

$$Q = \frac{2 \times 0.2^2}{4} \times 2.91 = 0.0914\ m^3/sec > 0.077\ m^3/sec$$

Therefore, the spillway is a pipeline with ϕ 200 mm.

5 - 2 Bi-purpose pump

In order to have the pond filled at the end of the rainy season, it is necessary to use the drainage pump in the rainy season to pump up water from the drainage ditches inside and outside of the area to store water in the pond. And, in the irrigation season, it is planned to pump up runoff and surplus rainwater inside the area to the pond without draining the water to the outside of the area, and use repeatedly the irrigation water. In all cases, when water stage of the pond is comparatively low, storage of water by natural inflow is considered as much as possible.

(1) Specifications of pump (See 6, 6-1)

Rated discharge/unit		6.29 (m^3/min)
Total head		4.40 m
Bore of pump		250 mm Vertical shaft mixed flow pump
Output	7.5 kW	8 P, 50 Hz, 750 RPM
Number of units		2

5 - 3 Irrigation pump

As the gravity irrigation becomes impossible when the water level of the pond gets low, irrigation water is pumped up from the pond into the irrigation ditch.

1) Design discharge

The design discharge of the pump is planned according to the puddling stage when water requirement reaches the maximum.

Irrigation water required for puddling 200 mm/10 days = 20 mm/day

$$Q = qp \times 10^{-3} \times A \times 10^{4} \times \frac{1}{24 \times 60}$$

Where Q: Rated discharge (intake) (m^3/min)

qp: Irri. water required for puddling 20 mm/day

A: Area of paddy field 4.60 ha

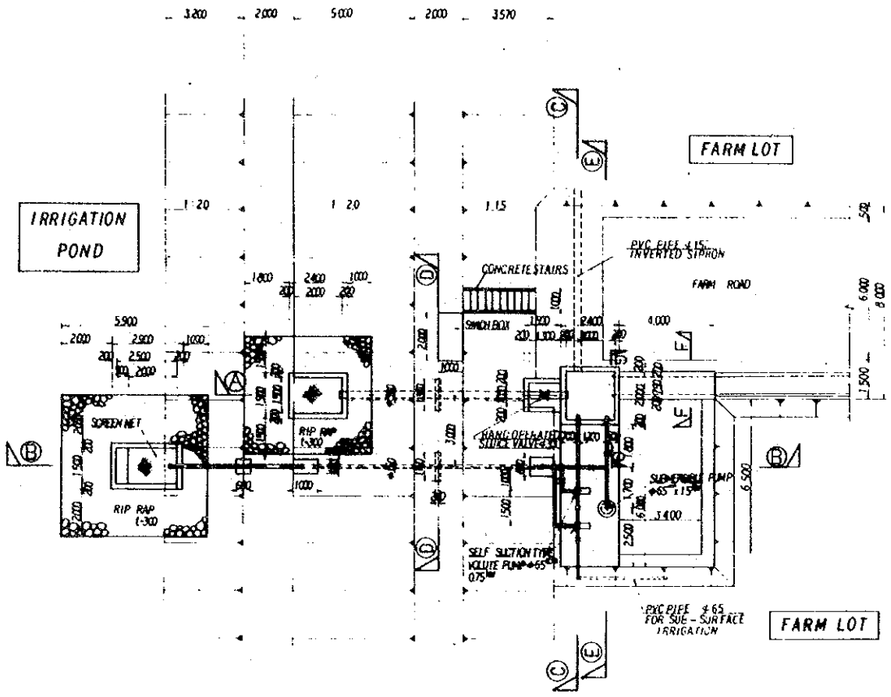
$$Q = 20 \times 10^{-3} \times 4.6 \times 10^{4} \times \frac{1}{24 \times 60} = 0.639 \ (m^3/min)$$

2) Design total head

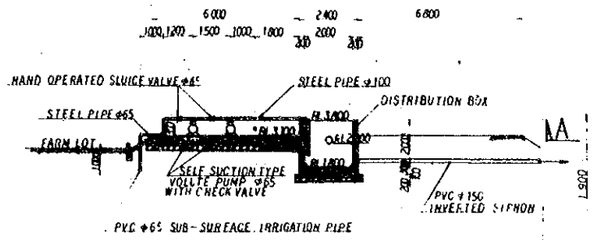
Design water level at out-let	R.L. 3.50
Design water level at inlet	R.L. + 1.10
Design effective head	2.40 m
Friction loss in pipeline	1.50 m
Design total head	3.90 ≒ 4.0 m

3) Specifications of pump

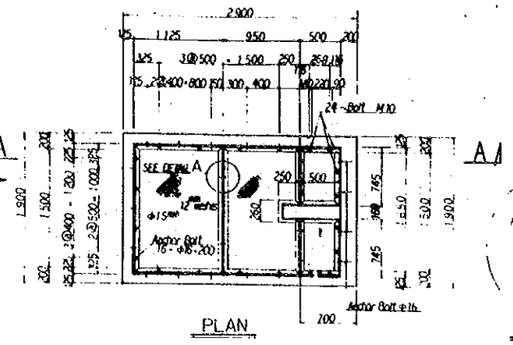
The type of pump is the single suction centrifugal pump because of the small discharge. And the pump is of the self-feeding type for easy operation because the pump is operated at frequent intervals.



PLAN

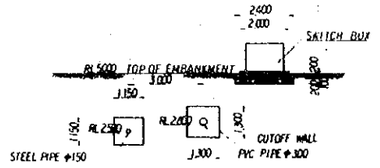


SECTION C–C

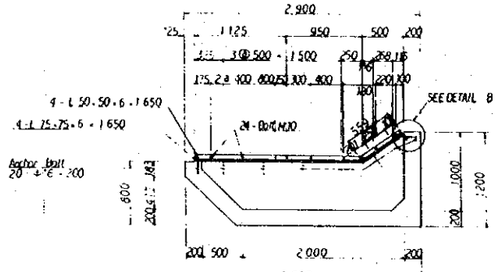


PLAN

DETAIL A



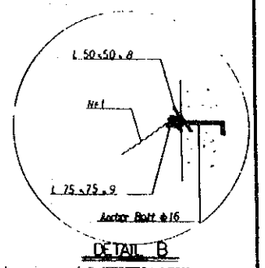
SECTION D–D



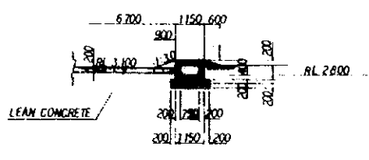
SECTION A–A

DETAIL OF SCREEN NET

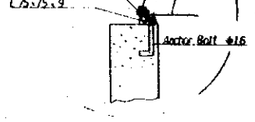
S=1:30



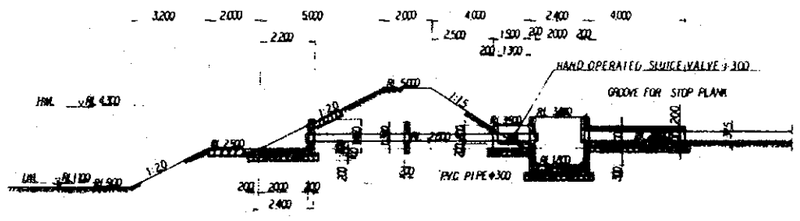
DETAIL B



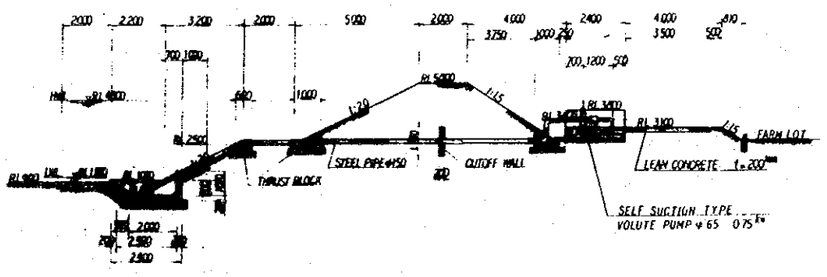
SECTION F–F



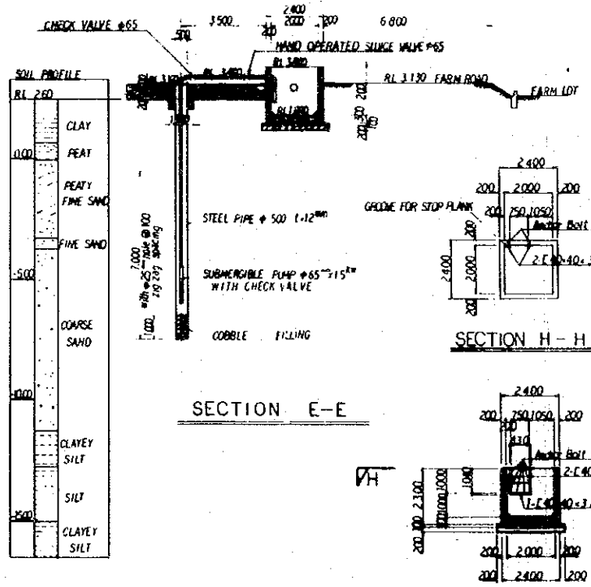
DETAIL C



SECTION A – A



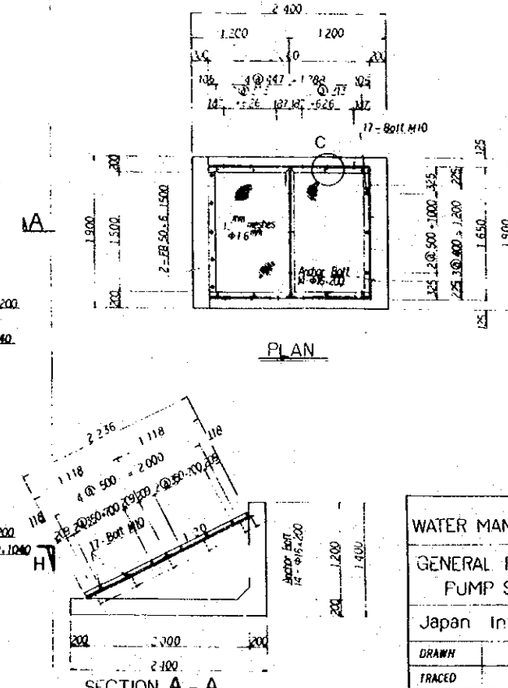
SECTION B – B



SECTION E–E

SECTION H – H

SECTION G – G



PLAN

SECTION A – A

DETAIL OF SCREEN NET

S=1:20

WATER MANAGEMENT TRAINING PROJECT	
GENERAL PLAN OF IRRIGATION PUMP STATION	
Japan International Cooperation Agency	
DRAWN	NO
TRACED	B-
CHECKED	SCALE
APPROVED	1:100 1:20

Plural number of pumps are installed in due consideration of diversification of risks because the pumps are operated at frequent intervals. As the irrigation requirement in the normal irrigation period is less than a half of that required during puddling, one pump is sufficient if two pumps are installed. Therefore, two pumps are planned to be installed.

Discharge/unit	0.32 (m^3/min)
Total head	4.00 m
Bore	65 mm ϕ
Output	0.75 KW 50 Hz 1,500 RPM
Number of units	2
Type of pump	Self-feeding single suction pump

In case the water level at the out-let exceeds R.L. 3.50, the pump stops automatically by means of the electrode rod switch.

4) Pump station

The groundwater pump is installed in the same pump station. Electric installation such as switchboard, etc. are installed at above R.L. 5.00 on the assumption of the case in which the flood water level has exceeded the recorded maximum flood water level and the area inside the embankment is flooded. And, the motor is of the type which can be removed and kept in a shed easily. Pumps, motors, etc. are the outdoor types. Switchboard too is of the outdoor type.

5 - 4 Groundwater pump

1) Design quantity of water intaken

As groundwater is a supplementary water source, it is used only to supply irrigation water in the normal irrigation season. In case it is necessary to depend on groundwater for irrigation water required for puddling, groundwater is pumped up and stored in the irrigation pond in advance, and the water is distributed therafter. Therefore, the design discharge is to be the irrigation requirement of the normal irrigation season.

$$Q = \frac{1}{Ei} (Etp + I) \times 10^{-3} \times A \times 10^{4} \times \frac{1}{24 \times 60}$$

Where Q: Design quantity of water intaken (m^3/min)

Ei: Irrigation efficiency 0.9

Etp: Quantity of water consumed 5.8 mm/day

Maximum consumptive use of dry season crop of Salor Irrigation Area