Japan International
Cooperation Agency
(JICA)

Department of Irrigation
and Drainage (DID)
Malaysia

THE STUDY ON MODERNIZATION OF IRRIGATION WATER MANAGEMENT SYSTEM IN THE GRANARY AREAS OF PENINSULAR MALAYSIA

Volume-I

MAIN REPORT

July 1998

Nippon Koei Co., Ltd.

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THE GRANARY AREAS
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CURRENCY EQUIVALENT

US$ 1.0 = RM 4.4 = Yen 129.5
(as of January, 1998)

PREFACE

In response to a request from the Government of Malaysia, the Government of Japan decided to conduct a Study on Modernization of Irrigation Water Management System in the Granary Areas of Peninsular Malaysia and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to the Malaysia a study team headed by Mr. Takeshi KAWAGUCHI, Nippon Koei Co., Ltd., three times from February 1997 to July 1998.

The team held discussions with the officials concerned of the Government of Malaysia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Malaysia for their close cooperation extended to the team.

July, 1998

Kimio FUJITA
President
Japan International Cooperation Agency

July, 1998

Mr. KIMIO FUJITA
The President of
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

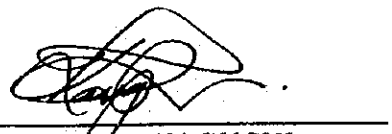
We have the pleasure of submitting herewith the Study Report on Modernization of Irrigation Water Management System in the Granary Areas of Peninsular Malaysia, in accordance with the terms of reference issued by your Agency.

The Study was carried out for a total period of 18 months from February 1997 to July 1998 dividing into two phases, Phase I and Phase II. The Phase I Study was set to formulate a master plan for modernizing irrigation water management systems in the five schemes located in Peninsular Malaysia to achieve higher paddy production. The Phase II Study dealt with the feasibility study on three priority schemes selected in the Phase I Study. The final goal of the Project is to raise paddy production in accordance with nation's policy of attaining self-sufficiency of 65 % in 2010 through ; (i) ensuring irrigation water supply by rehabilitation and improvement of the existing irrigation and drainage facilities; (ii) modernization of current irrigation water management system from both hardware and software points of view; (iii) establishment of a proper operation and maintenance system; (iv) farm land consolidation to introduce advanced agricultural practices using large machinery to overcome the shortage of farm labor; and (v) reinforcement of farmers' organizations by promoting the water user group development.

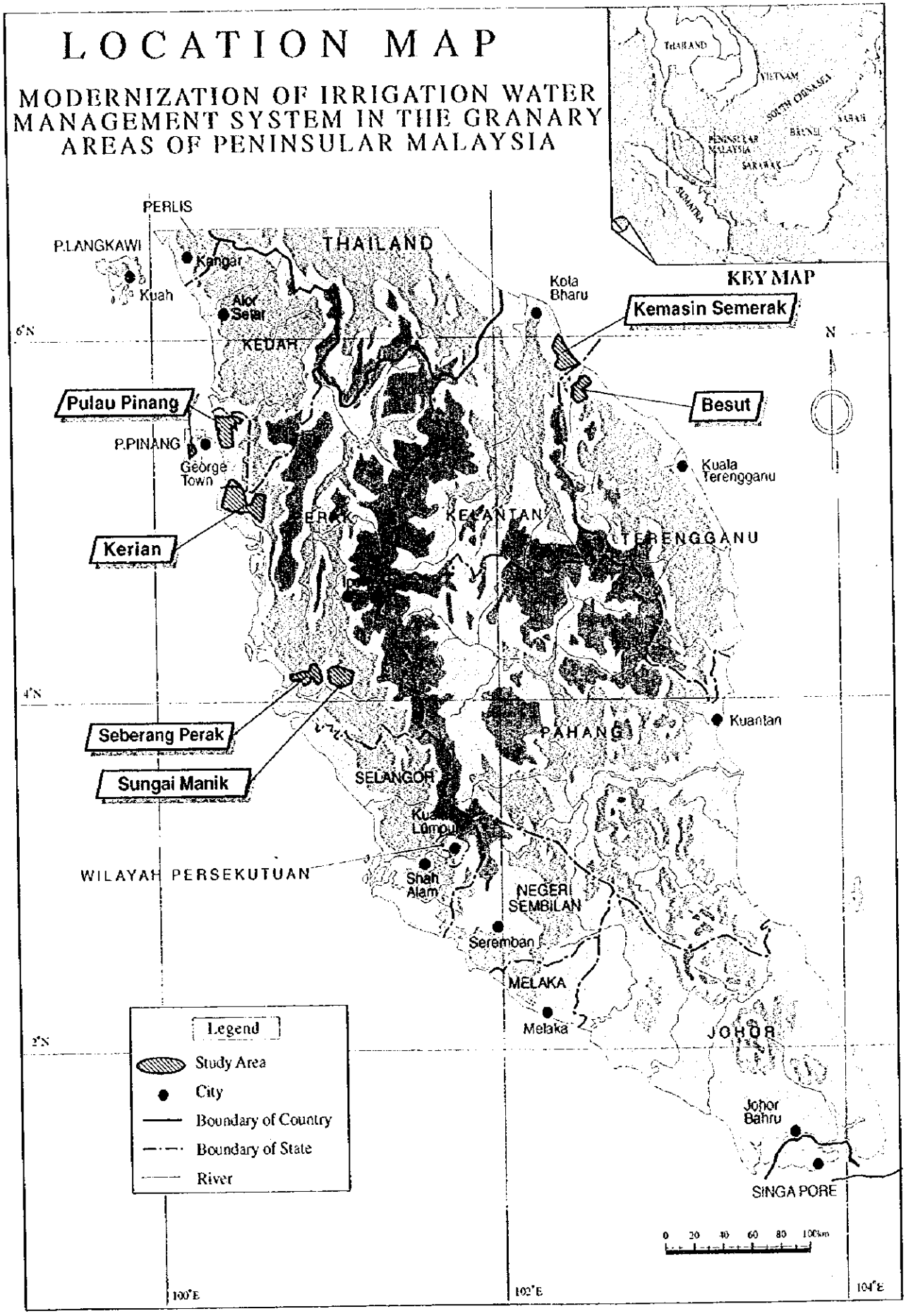
The Project has been judged to be technically sound, economically feasible and financially viable. The Project will increase rice production and contribute to secure stable source of food, so it is concluded that this is a realistic and appropriate plan for reaching the target of the national agricultural policy. Therefore, we would like to recommend that the Project soon be implemented in line with the conclusion presented in the Report.

We wish to express our deep appreciation and gratitude to the personnel concerned of your Agency, the Embassy of Japan in Malaysia, and the Authorities concerned of the Government of Malaysia for the courtesies and cooperation extend to us during our field survey and study.

Very truly yours,

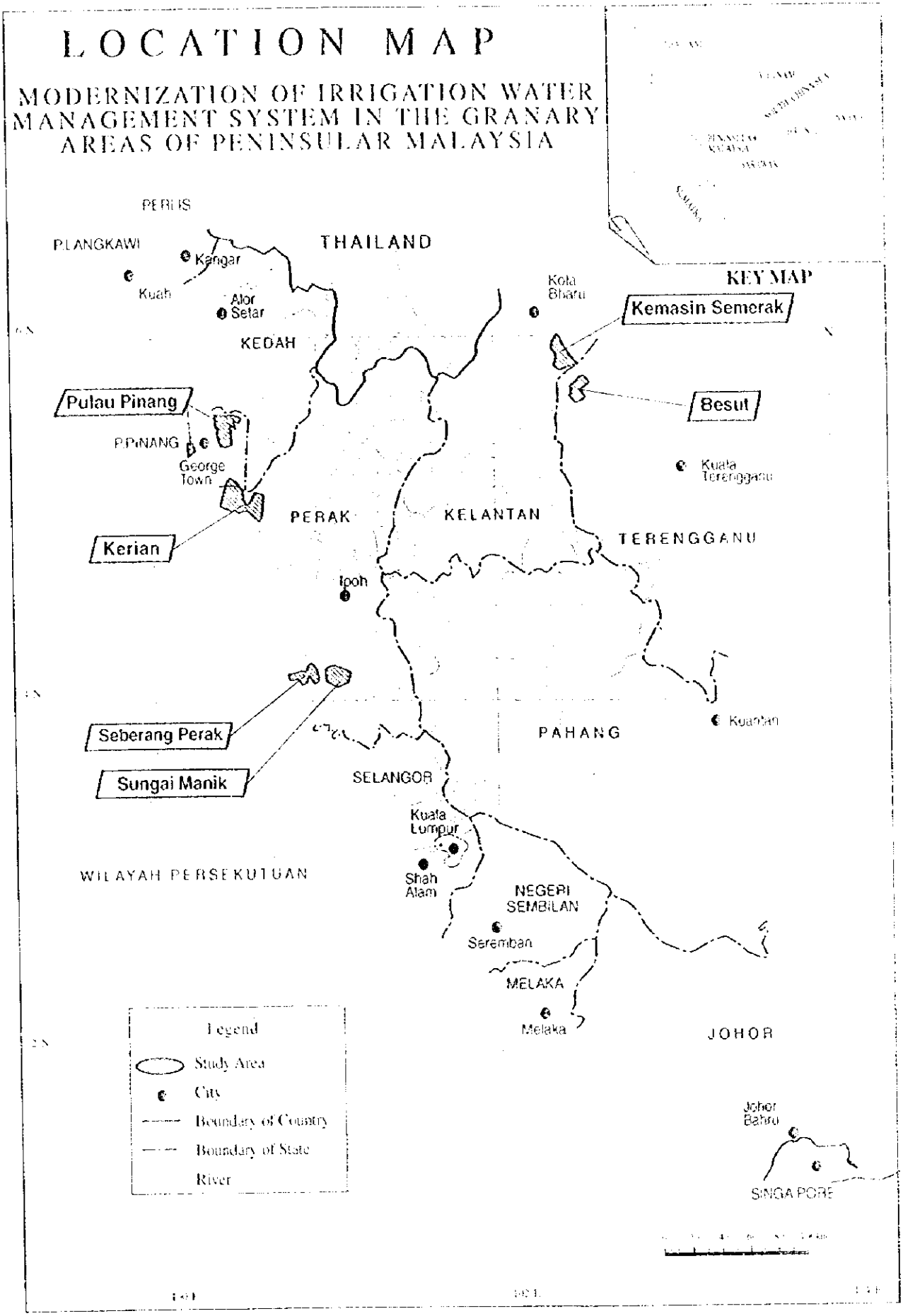


Takeshi KAWAGUCHI
Leader of Study Team on Modernization
of Irrigation Water Management System in
the Granary Areas of Peninsula Malaysia

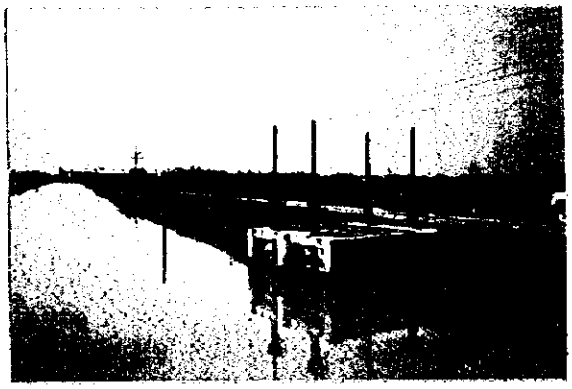

LOCATION MAP
MODERNIZATION OF IRRIGATION WATER MANAGEMENT SYSTEM IN THE GRANARY AREAS OF PENINSULAR MALAYSIA
KEY MAP
THAILAND
VIETNAM
SOUTH CHINA SEA
BRUNEI
SUMATRA
PERLIS
P.LANGKAWI
Kangar
Kuah
Alor Setar
KEDAH
Kota Bharu
Kemasin Semerak
Besut
Pulau Pinang
P.PINANG
George Town
Kuala Terengganu
PERAK
KELANTAN
TERENGGANU
Kerian
Seberang Perak
Sungai Manik
Kuantan
PAHANG
SELANGOR
Kuala Lumpur
WILAYAH PERSEKUTUAN
Shah Alam
NEGERI SEMBILAN
Seremban
MELAKA
Melaka
JOHOR
Johor Bahru
SINGAPORE
Legend
Study Area
City
Boundary of Country
Boundary of State
River
N
6°N
4°N
2°N
100°E
102°E
104°E
0 20 40 60 80 100km

LOCATION MAP

MODERNIZATION OF IRRIGATION WATER MANAGEMENT SYSTEM IN THE GRANARY AREAS OF PENINSULAR MALAYSIA

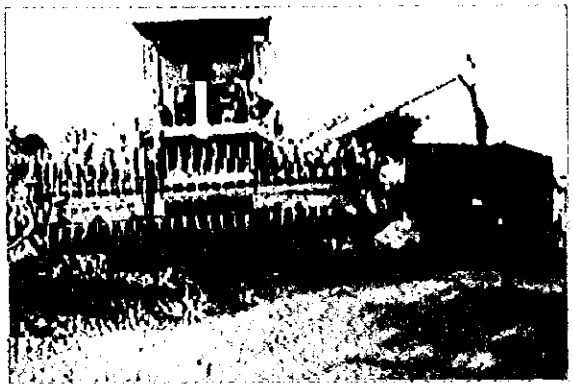


⋘ The Present Condition of the Study Areas (1/2) ⋙



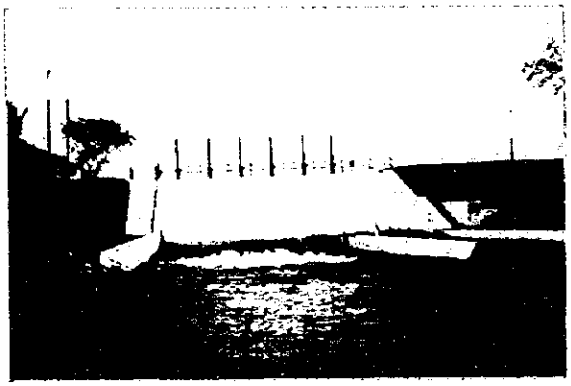
Pulan Pinang Scheme

Main Canal in Sungai Muda Sub-Scheme
Constant Head Orifice Offtake



Pulan Pinang Scheme

Large-size combine harvester and bulk handling system

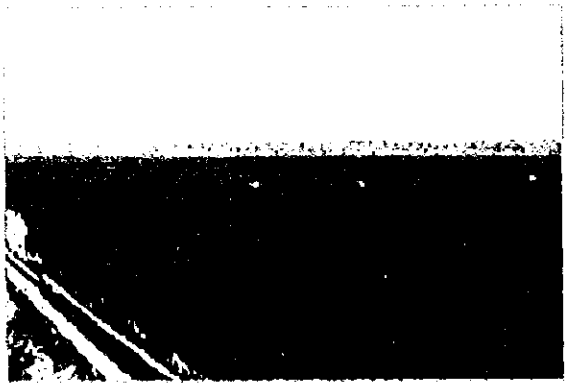


Kerian Scheme

Intake Structure at Bukit Merah Reservoir

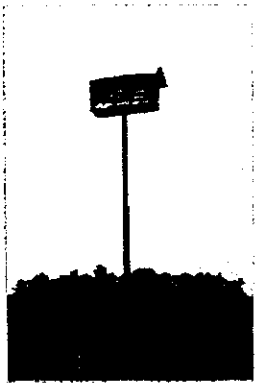
Kerian Scheme

Members of Water User's Group Joined in the Project Meeting



Sungai Manik Scheme

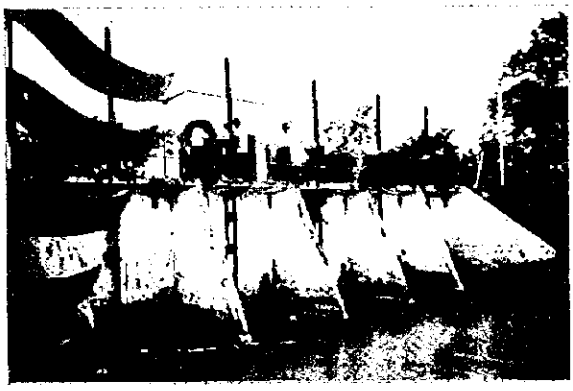
Paddy Field in Sungai Manik Sub-Scheme
Paddy field in the distance has a lot of weeds (seen in yellow color) compare with the front field, because of poor management.



Sungai Manik Scheme

Nest box of owl for controlling mouse pests in the Integrated Pest Management

⋘ The Present Condition of the Study Areas (2/2) ⋙



Seberang Perak Scheme

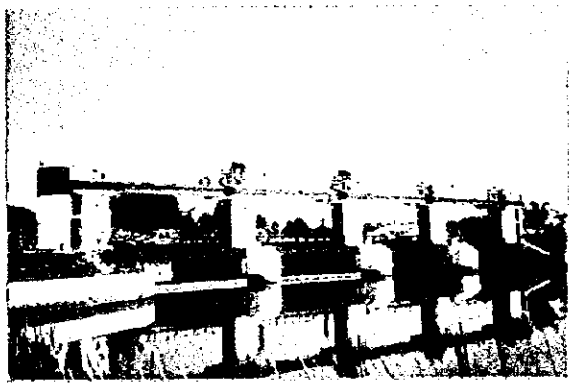
Telok Sena Gravity Free Intake

Seberang Perak Scheme

Direct Seeding Using Motor Blower
Water will be drained after seeding.

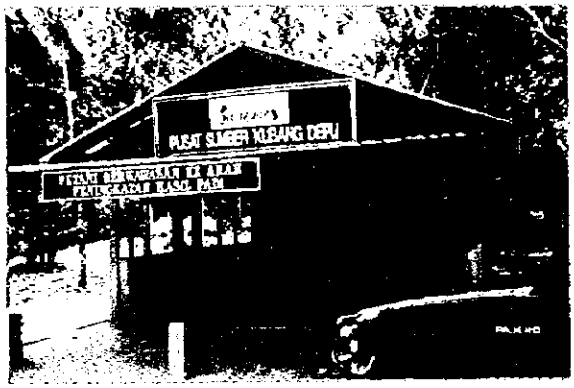
Kemasin/Semerak Scheme

Main Canal and Paddy Field in the Kemasin Hilir Sub-Scheme



Ketara (Besut) Scheme

Besut Headworks (Upstream)



Ketara (Besut) Scheme

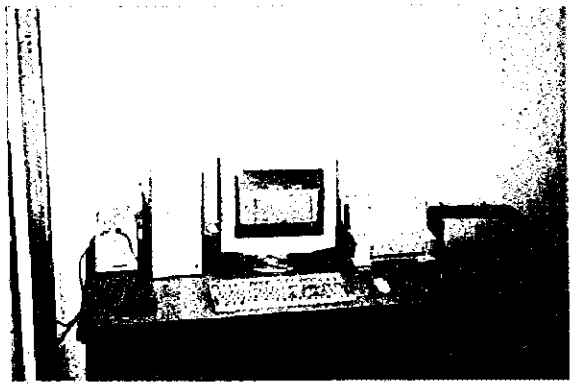
Farmer's Development Center in Kubang Depu

Ketara (Besut) Scheme

Recycling Pump Station

Pilot Project < Ketara (Besut) Scheme >

Central Control Station
Master Controller



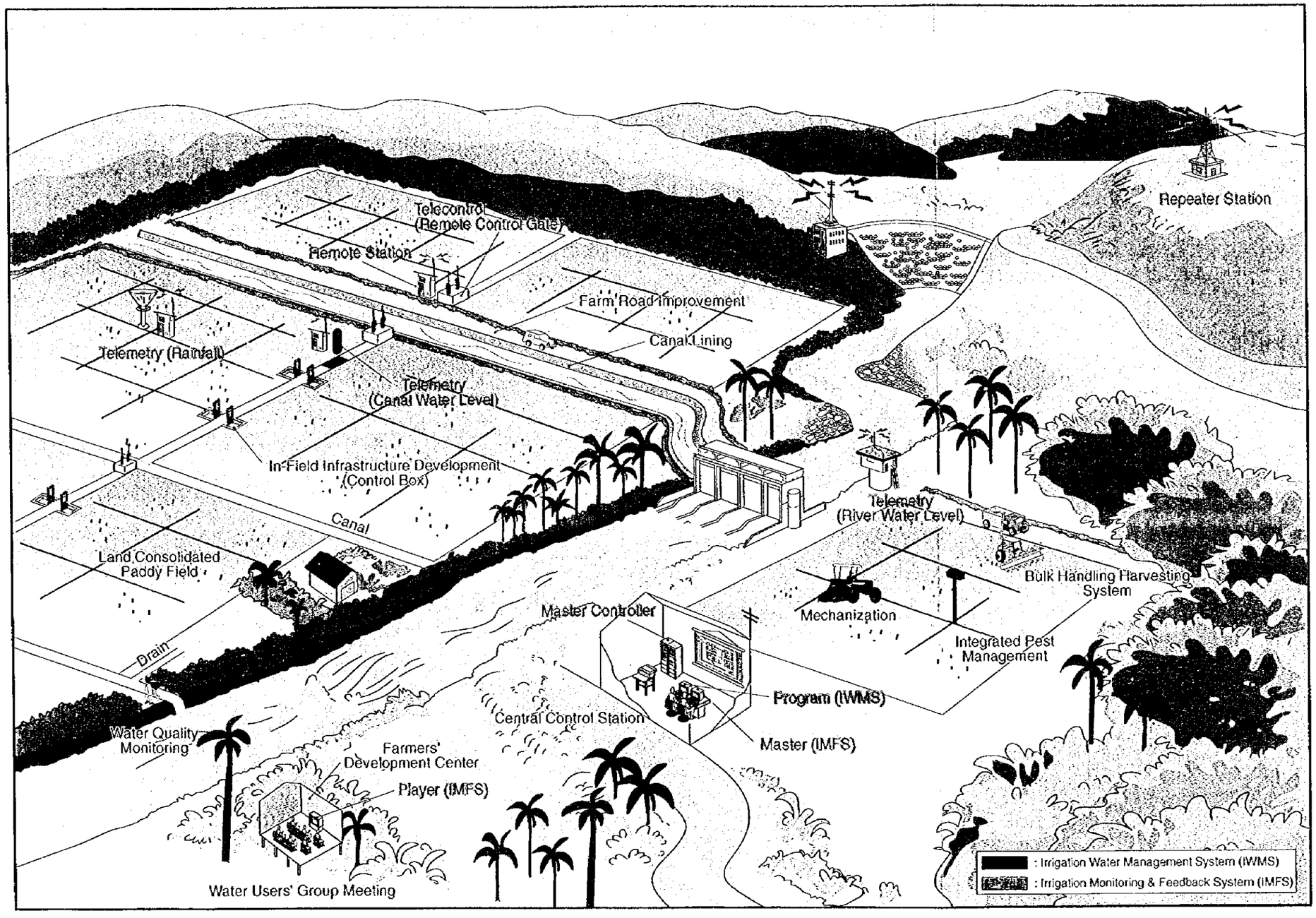
Central Control Station
Computer for Irrigation Water Management System

Rainfall Gauge at Besut Headworks

Water Level Gauge at Point O
in the Secondary Canal

Remote Control Gate at Point G
in the Main Canal

Actuator for Remote Control Gate at Point G
in the Main Canal



Layout View of the Irrigation Water Management System Modernization

SUMMARY

1. Introduction

This final report is prepared in accordance with the Clause VI-2 of the Scope of Work (S/W) for "The Study on Modernization of Irrigation Water Management System in the Granary Areas of Peninsular Malaysia," which was agreed upon between the Malaysian Government and the Japan International Cooperation Agency (JICA) on 20 November, 1996. This report presents a master plan for development on the five(5) granary schemes in Phase I and a feasibility study on the three(3) prioritized schemes in Phase II.

2. Background of the Project

Based on the National Agricultural Policy (NAP, 1992-2010), Malaysian Government is aiming to have a capacity of producing 1.20 million tons of rice by 2010 with a self-sufficiency level of 65 %. To achieve this, the Government designated eight(8) strategic granary areas, namely (i) MADA, (ii) KADA, (iii) IADP North-Western Selangor, (iv) IADP Pulau Pinang, (v) IADP Kerian/Sungai Manik, (vi) IADP Seberang Perak, (vii) IADP Kemasin/Semerak and (viii) IADP Ketara(Besut). Among these eight(8) granary areas, MADA, KADA and IADP North-Western Selangor are likely to reaching the goal in both crop yield per unit of area and annual plantation rate with improvement of irrigation facilities, development of infrastructure in rice fields for the use of machinery, intensification of direct seeding and modernization of water management system. However, rice production of the other five(5) granary areas is only 3.3 tons/ha in crop yield and 158% in cropping intensity according to the paddy statistic in 1995. It is, therefore, required to develop these five(5) areas in order to reach the goal of NAP.

Under such circumstances, the Government of Malaysia requested in October 1995 that the Government of Japan provide technical support of improving rice productivity in the five(5) granary areas. In response to this request, the Government of Japan dispatched a preliminary survey mission in November 1996 and had a discussion with the Government of Malaysia. Then, on 20 November 1996 an agreement (S/W) was made between the two governments for an establishment of the project entitled "The Study on Modernization of Irrigation Water Management System in the Granary Areas of the Peninsular Malaysia" to make a Master Plan (M/P) for five(5) granary schemes and a Feasibility Study (F/S) for three(3) granary schemes prioritized through the Master Plan.

3. Present Conditions of the Five Granary Areas

3.1 Location and Administration

Local administration bodies concerned with the five(5) granary areas are summarized below. Total net irrigation area of the five(5) granaries is 60,477 ha.

Granary Area	Net Irrigation Area (ha)	State	District	Mukim (no.)
Pulau Pinang	9,832	Pulau Pinang	Seberang Perai Utara, Seberang Perai Tengah, Barat Daya	26
Kerian / Sungai Manik	29,878			
- Kerian	23,560	Perak, P.Pinang	Seberang Perai Selatan, Kerian,	10
- Sungai Manik	6,318	Perak	Hilir Perak	2
Seberang Perak	8,708	Perak	Perak Tengah	3
Kemasin / Semerak	6,895	Kelantan	Kota Bharu, Bachok, Pasir Putch	19
Ketara (Besut)	5,164	Terengganu	Besut	7

3.2 Agriculture

Total area of the paddy fields annually cultivated in five(5) granary areas is estimated at 102,950 ha, of which 55,370 ha is cultivated in the main season and 47,580 ha in the off season. Cropping intensity of each granary is shown below. Cropping intensity of Kemasin /Semerak is rather low because some parts can not be cultivated due to an ongoing flood mitigation project.

(Unit: %)

Granary Area	Annual	Main Season	Off Season
Pulau Pinang	189	95	94
Kerian	164	89	75
Sungai Manik	191	95	96
Seberang Perak	191	94	98
Kemasin / Semerak	57	50	6
Ketara (Besut)	164	87	77

Source : Paddy statistics of Malaysia 1995 and IADP Kerian/Sg. Manik

The average yield and annual production of paddy from 1991 to 1995 in the five(5) granary areas are summarized in the following table. Yields have not reached sufficient levels because of : (i) inadequate input of nitrogenous fertilizer, (ii) farmers' non-compliance to set irrigation schedules, (iii) insufficient facilities in paddy fields for mechanization, (iv) a shortage of machinery for farming activities, and (v) a shortage of labor force.

Granary Area	Production (ton)	Average Yield (ton/ha)
Pulau Pinang	58,674	2.80
Kerian	112,668	2.94
Sungai Manik	36,808	3.05
Seberang Perak	58,853	3.53
Kemasin / Semerak	19,098	2.82
Ketara (Besut)	27,787	3.18

Source : paddy statistics of Malaysia 1995 and IADP Kerian

3.3 System Infrastructure

The irrigation and drainage facilities in the granary areas are relatively well provided and maintained except for Kemasin/Semerak. The Kemasin/Semerak scheme consists of eight(8) sub-schemes, of which six(6) have no irrigation facilities because flood mitigation works are under construction. The problems facing the system infrastructure in the granary areas are : (i) sedimentation in canals, (ii) seepage from canals, (iii) insufficient numbers of regulating structures, (iv) damage to gate structures such as barrage, intake, offtake and check structure,

(v) less land consolidation, and (vi) existence of bumpy road surface and insufficient road width.

3.4 Water Management and O&M

The Kerian scheme is the only granary that is currently using a telemetry system for acquiring of data on rainfall and water level. However, the present data acquisition performance is poor due to deterioration of equipment and radio links as well as inadequate maintenance, and there is no computer system for processing data collected. The present problems facing the water management and O&M of the irrigation and drainage facilities are (i) lack of records of gazetted areas, irrigation rates and amount collected, (ii) poor database maintenance and retrieved system, (iii) lack of updated version of O&M manuals, (iv) inadequate records of monitored O&M parameters, (v) apparent over reliance on experience and judgment for decision-making, and (vi) inadequate field channels and land leveling.

3.5 Farmers' Organization

There has been no tradition of a strong water-based agriculture in Malaysia. Farmers have taken for granted that they receive irrigation development and financial support from the Government, and thus have not been involved heavily in agricultural development. Present village-based organizations have been established mainly on cultural and social basis with the exception of registered FOs which have been established with socio-economic objectives. However, all these organizations are not geared for irrigation water management. Recently, the Besut area has reorganized farmers' groups based on the irrigation command area with formation of water users' group(WUG).

4. Basic Concept for Modernization of Irrigation Water Management System

Agricultural policy of Malaysia is described in the National Agricultural Policy (NAP). NAP 3 is currently being revised, but its main targets are to attain (i) a self-sufficiency rate of rice for 65% and (ii) paddy yield of 5.5 t/ha by the year 2010. Basic strategic plans to achieve the goals of the NAP3 are : (i) rehabilitation/improvement of current system and in-field infrastructures for effective use of available water, (ii) introduction of telemetry/telecontrol and computerized systems to modernize water management system, (iii) land consolidation for rearranging farm plots for efficient mechanization and improved productivity, (iv) acceleration of mechanized farming with the aim of overcoming labor shortage, and (v) strengthening of farmers' organization.

5. Master Plan

5.1 Water Balance Study

The water balance study was made in order to confirm whether five(5) granary areas have enough irrigation water or not by estimating the available irrigation water, irrigation water requirements and future demands of non-farm water use in 2010. Sungai Manik, Seberang Perak and Kemasin/Semerak areas have enough water to achieve 200% cropping intensity. The Kerian area can also get 200% cropping intensity with improvement of irrigation efficiency and

modification of cropping pattern. In Besut area, the maximum potential cropping intensity is about 175% considering the recycling of drainage water which is estimated at about 10% of peak diversion irrigation water requirement. The Pulau Pinang area will be able to achieve 200% cropping intensity with construction of new dams proposed in the "Comprehensive Management Plan in Muda River Basin(JICA 1995)".

5.2 Improvement Plan for System Infrastructure

(1) Pulau Pinang Scheme

Since industrialization is being remarkably developed around this scheme, shortage of labor for farming is one of the major constraints for agricultural activity in this scheme. Therefore, allocation of water for agriculture, industry and domestic use is a crucial issue, so that it is required to establish a sufficient water distribution system for irrigation. The following improvement plans for system infrastructure are formulated:

- Concrete lining for main and secondary canals including removal of sediment in the canals
- Provision of regulating structures and rehabilitation of damaged structures
- Desilting of tertiary drains
- Pavement and widening of farm roads
- Provision of water management facilities connecting with telemetry and telecontrol system

(2) Kerian Scheme

Drainage problems, particularly in Compartments A, B and C, prevent mechanized farming and direct seeding from being introduced into this scheme. Also, because of its large size, better water distribution is required. Main improvement plans are as follows:

- Construction of new drains and desilting of existing drains
- Construction of bunds
- Provision and rehabilitation of drainage gates
- Concrete lining for main and secondary canals including removal of sediment in the canals
- Provision of regulating structures and rehabilitation of damaged structures
- Pavement and widening of farm roads
- Provision of water management facilities connecting with telemetry and telecontrol system

(3) Sungai Manik Scheme

There is sufficient water available for irrigation in the area, however, operation and maintenance of the irrigation facilities is not adequately performed. Especially in Sungai Manik sub-scheme, tertiary canals are earthen and land consolidation is not sufficiently executed. In this scheme, upgrading of the existing facilities will be given high priority. Main improvement plans are:

- Construction of settling basin downstream of intake structure
- Concrete lining of secondary and tertiary canals

- Provision of regulating structures and road crossing structures, and rehabilitation of damaged structures
- Desilting of main drains
- Pavement and widening of farm roads
- Provision of water management facilities connecting with telemetry and telecontrol system

(4) Seberang Perak Scheme

There is plenty of water available in this scheme, but gates for intaking water are not sufficiently controlled. Silting and erosion in main canals represent problems as well. Rehabilitation and improvement plans to overcome those problems are :

- Removal of sediment and reshaping of main canals
- Concrete lining for secondary and tertiary canals
- Provision of regulating structures and spillway, and rehabilitation of damaged structures
- Desilting of main drains
- Construction of new farm roads and widening of existing farm roads along tertiary canals
- Provision of water management facilities connecting with telemetry and telecontrol system

(5) Kemasin / Semerak Scheme

A flood mitigation project is under progress in the Semerak area and the irrigation facilities of six(6) sub-schemes in this area are scheduled to be implemented after the project is completed. Consequently, the following rehabilitation and improvement plans for system infrastructure are formulated as regards two(2) on-going projects, namely Kemasin Hilir and Jelawat Rusa in the Kemasin area:

- Rehabilitation of structures
- Desilting of main drains
- Provision of farm roads along tertiary canals
- Provision of water management facilities connecting with telemetry and telecontrol system

(6) Ketara (Besut) Schemes

According to the results of the water balance study, this area faces a serious water shortage. Therefore, effective water use is the most important issue for this scheme. Main improvement plans are :

- Replacement of Angga Barrage
- Repair of Besut Barrage gates
- Concrete lining for main, secondary and tertiary canals
- Heightening of lining
- Provision of regulating structures and rehabilitation of damaged structures
- Desilting of main drains and provision of drainage controls
- Pavement of farm roads along main canals and widening of existing farm roads along tertiary canals

- Provision of water management facilities connecting with telemetry and telecontrol system

5.3 Improvement Plan of Water Management and O&M

(1) Reorganize O&M responsibility

Tertiary systems operations will be gradually handed over to the Water Users Groups with the DID acting on a supervisory and advisory role. The DID will continue to be fully responsible for the main and secondary systems management. In the process, the DID field staff size (staff whose scope of works is 100 % irrigation O&M) will be reduced. The Senior Irrigation Inspectors, Irrigation Inspectors, Irrigation Technicians and pump operators operating primary and secondary pumps should be maintained for overall scheme management. The handover would directly affect the gatekeepers/linesmen and general workers. The average O&M staff cost reduction is RM 70/ha/yr with the assumption that about 64% of the total field staff is involved in tertiary systems O&M.

(2) Water management facilities

For all granary areas, a central control station should be established and set up a coherent water management system. Data can be collected and managed with the least number of staff that is required, and decisions that are made are implemented effectively with the introduction of such a system. The water management system is planned and operated with a computerized system, and data on water level of main and secondary canals together with rainfall data are collected with a telemetric system. All the data are to be entered into water balance/hydrological model to determine the amount of water available, required and being distributed. Facilities required for the water management system are listed below.

- Communication network system
- Telemetry system for data collection on rainfall and water level
- Gated structures/pumps monitoring system
- Computer system with displays consisting of irrigation water management system(IWMS) and irrigation monitoring and feedback system(IMFS)
- Telemetric control system for gates and pumps

(3) In-field infrastructure improvement

Physical improvements refer to in-field infrastructure development comprising land leveling, in-field channels and control boxes installation. The land leveling will be based on the DOA's specification of zero grading at +/- 5 cm accuracy covering 100 % of 10m x 10m grid points. The assumption is that the DOA will implement 40 % of the land leveling and the private sector will do the remainder. The PPK will be encouraged to undertake these works. In-field channels density target is 150 m/ha and two(2) control boxes are provided for one consolidated lot .

(4) Land consolidation

The land consolidation approach aims at integrating adjacent lots to form one large operating plot 3 to 5 ha each through removal of field bunds(batas) wherever the need arise or

if it is suitable to do so. The proposed consolidated plot sizes is 5 ha in granary areas located on the west coast and 3 ha in areas on east coast of the Peninsular Malaysia considering the present farm sizes. The proposed land consolidation requires intensive promotion to get the consensus of lot owners. Ideally it should be performed concurrent with the in-field infrastructure works described above.

5.4 Improvement of Agriculture

(1) Cropping intensity

Based on the result of the water balance study, future cropping intensity of each granary area is determined as below.

(Unit: %)

Name of Scheme	Main Season	Off Season	Annual
Pulau Pinang	100	100	200
Kerian	100	100	200
Sungai Manik	100	100	200
Seberang Perak	100	100	200
Ketara (Besut)	100	75	175
Kemasin/Semerak	100	100	200

(2) Farming practices

The proposed agriculture improvement plan is summarized below:

I. Land preparation	Wet	Land preparation 2 times	Tractor + Rotavator
		Puddling 1 time	Tractor + Paddy harrow
	Dry	Land preparation 2 times	Tractor + Rotavator
		Pressing 1 time	Tractor+Roter bucket/Land roller
II. Seeding	Seed rate	(60-80 kg/ha)	
	Wet	Power blower/Granule applicator/Broadcaster	
	Dry	Power blower/Granule applicator/Broadcaster	
III. Fertilizer application		$N:P_2O_5:K_2O$=100-120:30-50:30-40	
		Subsidized: Mixture 200kg/ha and Urea 100kg/ha	
		Additional: Mixture 100kg/ha and Urea 40kg/ha	
IV. Harvesting		Combine harvester	

(3) Anticipated yield

It is expected that unit yield of paddy would increase considerably on account of adequate irrigation water supply and improved farming practices through the modernization of irrigation water management. The anticipated yield of paddy in the study area is set at 5.5 ton per ha based on the available yield data such as yield records in paddy fields of Besut area where DRIS was practiced(5.5 - 6 ton per ha), and in the advanced areas of Changkat Jong and Skinchang(6 - 7 ton per ha).

5.5 Strengthening of Farmers' Organization

Present farmers' groups are based on a social/cultural background and will not operate the irrigation water management system efficiently. It is, therefore, required that the groups be reorganized according to irrigation system boundary. The main purpose of the reorganized farmers' groups (water users group) is to implement proper water management, but the groups will also have other farming functions such as farm mechanization, fertilizer management,

pest/disease and weed control, marketing which are to be linked or coordinated with the registered farmers organization. Farmers' understanding and cooperation are required to carry out this reorganization process, and this plan should be implemented with seminars and training programs by the National Water Management Training Center together with DID and DOA.

5.6 Initial Environmental Examination (IEE)

Environmental impact assessment is required as described in the guidelines (A Handbook of Environmental Impact Assessment) issued by the DOE of Malaysia. According to EIA Order 1987, environmental impact assessment is necessary when development has taken place after 1 April 1988. However, all of the irrigation schemes proposed in this project had started well before the EIA Order came in effect. Therefore, environmental impact assessment in this study was conducted according to JICA's environmental guidelines. Construction of additional facilities and land clearing are not the main portion of this project so it is unlikely to cause significant impacts on the physical environment. However, use of chemicals (e.g. fertilizer, herbicide and pesticide) is already a common agricultural practice, so it will be difficult to significantly reduce the amount of chemicals being used. Therefore, excessive use of chemical compounds is the key factor to be considered as a main source of environmental impacts in the study. Environmental monitoring program is planned in the second phase (Feasibility Study) as a mitigation measure, which will monitor water quality around the study areas.

5.7 Cost Estimate

Initial investment cost for each granary area is shown in the following table:

Name of Granary	Initial Investment Cost (10^3 RM)			
	System Infrastructure	Field Infrastructure	Water Management	Total
Pulau Pinang	32,060	4,316	10,307	46,683
Kerian	78,379	21,881	15,499	115,759
Sungai Manik	28,198	2,911	6,385	37,494
Seberang Perak	20,288	1,814	8,985	31,087
Kemasin/Semerak	1,700	861	1,651	4,212
Ketara (Besut)	26,796	2,435	4,447	33,678

* Estimate of Kemasin/Semerak Scheme includes only Jelawat Rusa and Kemasin Hilir sub-schemes

5.8 Project Evaluation

The project benefit is defined as the difference between the net production value of the "with-project case" and "without-project case" conditions. The project benefit will start to be realized after the completion of the construction of facilities and will reach the target yield 5 years after completion. The economic internal rate of return (EIRR) is calculated based on the project cost and benefit for each scheme, and the results are summarized below. Evaluation for the Kemasin/Semerak scheme is not done because Flood Mitigation Project is still under the process and irrigation facilities are not provided yet.

	Pulau Pinang	Kerian	Sungai Manik	Seberang Perak	Besut
EIRR (%)	20.4	25.3	19.0	18.1	11.0

5.9 Project Implementation Schedule

The works for modernization of water management system in the granary areas are formulated from the hardware and software viewpoints. The former consists of rehabilitation / improvement of system infrastructures and in-field infrastructures and establishment of water management / monitoring facilities, and the latter comprises of formation and training of water users' group. In order to achieve the target yield of 5.5 ton/ha in 2010 in the National Agricultural Policy, it is scheduled that the works for modernization of water management in all granary schemes commence in 1999 and be completed in 2006. In Kemasin / Semerak scheme, it is essential to complete the on-going Flood Mitigation Project as early as possible so the modernization works can be started.

5.10 Selection of Priority Schemes for Feasibility Study

The following nine items formed the criteria to select three(3) priority schemes for the feasibility study : (i) location, (ii) scale of scheme, (iii) water availability for irrigation, (iv) irrigation and drainage facilities, (v) water management system, (vi) cropping intensity and unit yield of paddy, (vii) farm income, (viii) farmers' organization and (ix) competition with industrialization. As a result, Kerian, Ketara (Besut) and Pulau Pinang(Seberang Perai only) schemes were selected.

6. Feasibility Study

6.1 Kerian Scheme

(1) Reorganizing O&M responsibility

The review of field staff positions and proposed reduction is based on assuming 80% reduction for gatekeepers and general workers. For the overall staff reduction, including non-field staff, the impact on O&M staff figures are summarized below:

IADP	Scheme	Present			After Staff Reduction		
		Total Staff	No/1000ha	RM/ha '97	Total Staff	No/1000ha	RM/ha '97
Kerian/ Sg.Manik	Kerian	239	11	100	103	5	39

(2) Telemetry and telecontrol system

A Central Control Station is established at Bagang Serai Office. However, the existing telemetry system for rainfall/water level is not functioning sufficiently due to deterioration of equipment and radio links as well as inadequate maintenance. The proposed new system is as follows:

(a) Establishment of an observation network : 4 rainfall remote stations and 44 water level remote stations
(b) Establishment of a communication system : 150 MHz radio link.
(c) Establishment of two computer systems

(i) Irrigation water management system (IWMS)

IWMS will assist the irrigation system operator in proper decision making. Basically, the system has two functions, one is for daily operations and the other is for project monitoring. For daily operations, the following information is provided to the operator :

- Water demand at major diversion points
- Actual water supply at major diversion points
- Proper distribution simulation
- Required gate opening level

For project monitoring, such information as rainfall trends and water levels is provided. Visual Basic(VB) Version 5 is recommended for developing IWMS as it is the latest and the most popular programming language for Window 95.

(ii) Irrigation monitoring and feedback system (IMFS)

The proposed monitoring and feedback system uses telephone line communication. This system allows the systems manager to produce, author and schedule and distribute multimedia information for TV output. IMFS network for the Kerian scheme is proposed as follows:

IADP/Office	Master (Nos.)	Player (Nos.)	Additional TV (Nos.)
PMU	-	-	1
DID Component	-	-	1
DOAComponent (Spg. Tiga)	-	1	-
DID O&M Central Control	1	1	1
FDC	-	6	-
PPK	-	2	-
Total	1	10	3

(d) Establishment of a gate/pump telecontrol system

(3) System infrastructure

The improvement plans for irrigation and drainage facilities and farm roads are shown below.

(a) Irrigation facilities

(i) Concrete lining : 62 km of main canals and 40 km of secondary canals including removal of sediment in the canals

(ii) Provision of regulating structures : 7 nos. on main canals and 8 nos. on secondary canals

(iii) Rehabilitation of damaged structures : replacement of 16 diversion gates and replacement of 2 gate spindles

(b) Drainage facilities

(i) Rehabilitation and construction of drainage gates : 2 tidal gates and 120 drainage control structures

(ii) Desilting of drains : 580 km

(iii) Construction of bunds : 153 km

(iv) Construction of additional drains : 17 km

(v) Provision of drainage pumps : 10 nos.

(vi) Others : Drainage pipes, etc.

(c) Farm roads

(i) Pavement : asphalt pavement along main canals 40 km

(ii) Widening : 100 km along tertiary canals

(4) In-field infrastructure/land consolidation

Land leveling and construction of canals and control boxes in paddy fields are planned for the improvement of in-field infrastructure as shown below. Each consolidation aims for 5 ha farm plot and the number of target consolidated lots will be 4,712.

Compart-ment	No. of paddy fields	Area for land leveling (ha)	Canals in paddy fields (km)	No. of control boxes	No. of conso-lidated farms
A	1,955	2,402	360	961	480
B	2,803	3,822	573	1,529	800
C	2,039	3,575	536	1,430	792
D	1,665	2,103	315	841	672
E	1,082	1,700	255	680	469
F	1,246	2,050	308	820	540
G	411	675	101	270	366
H	1,450	2,062	309	825	593
Total	12,651	18,389	2,757	7,356	4,712

(5) Agriculture

(a) Cropping schedule

Considering the result of water balance study in the Kerian scheme, dry direct seeding methods will be introduced for the all area in off-season and wet direct seeding methods will be introduced in main-season except for organic soil areas, which occupy about 17% of the total area. The annual cropping intensity will be 200%. The areas demarcated for the three cropping schedules are summarized in the following table:

Schedule	Compartment	Area (ha)
1	A, B, C	10,364
2	D, E, F	8,403
3	G, H	4,793

(b) Mechanization

The estimated number of the agriculture machines is summarized in the following table :

Machinery / Equipment	Necessary Nos.	Available Nos.	Purchase Nos.
I. 4W tractor			
- 60 hp class	263	189*	74
- Management tractor (10-20hp class)	145	---	145
II. Implements			
- Lime spreader	42	---	42
- Rotavator	161	87	74
- Paddy harrow	60	---	60
- Rear bucket or Land roller	41	---	41
- Granule applicator / Broadcaster	96	---	96
- Boom sprayer	44	---	44
- Carpet duster	28	---	28
III. Combine harvester (6t class)	45	45	---
- Chopper spreader	45	---	45

Low bearing capacity area			
I. 4W tractor			
- 30 hp class	95	32	63
- Management tractor (10-20hp class)	41	---	41
II. Implements			
- Lime spreader	18	---	18
- Rotavator	68	5	63
- Paddy harrow	---	---	---
- Rear bucket or Land roller	17	---	17
- Granule applicator / Broadcaster	29	---	29
- Boom sprayer	9	---	9
- Carpet duster	9	---	9
III. Combine harvester (3t class)	19	6	13
- Chopper spreader	19	6	13

* : 20 by FMC Kerian, 169 by contractors including farmers, Source - FMC Kerian and IADP Kerian

(c) Fertilizer application

The amount of fertilizer and timing of application are proposed as follows:

- Amount and rate of fertilizer : N:P (P_2O_5):K (K_2O)= 100:40:30 (kg/ha)
  - N : 1st; 1/4, 2nd; 1/4 and 3rd; 1/2 on 15 - 21 day after sowing (HST), 45 - 50 HST and panicle initiation stage respectively
  - P : 15 - 21 HST together with N
  - K : 15 - 21 HST together with N

The additional elements application is recommended for the organic soil areas as follows :

Calcium fertilizer (GML) : 2.5 ton/ha before first land preparation

(6) Water Users' Group

IADP Kerian-Sungai Manik initiated a WUG pilot project at the end of 1997 at Tebok Pancor in the Kerian scheme. There are no firm implementation program yet but the ISAs will form the basis of WUG boundaries. The proposed targets are shown below.

Compartment	Total Target WUG	Area/WUG (ha/WUG)
A&B	20	320
C	4	990
D	17	198
E&F	22	229
G&H	21	228
Total	84	280

The average size per WUG of 280 ha/WUG appears to be rather large compared to IADP Pulau Pinang at 76 ha/WUG and Besut at 172 ha/WUG. It is recommended that the area and farmers membership size for Kerian be reduced to at most about 175 ha/WUG at 100 farmers/WUG. Two one-day training sessions on-site are proposed for all WUG members and one three-day training sessions off-site at the National Water Management Training Center is proposed for 2 leaders of each WUG. These training sessions should include promoting the in-field infrastructure development program and land consolidation. The one-day on-site training program will be held once during the off-season and once during the main season during the initial crop growth stage when farm activities are relatively low.

(7) Cost estimate

Initial investment cost for the Kerian scheme is shown in the following table:

(Unit : RM)

Items	Direct Cost	Contingency, etc.	Total
System Infrastructure	64,422,000	19,326,600	83,748,600
In-field Infrastructure	19,249,100	5,774,800	25,023,900
Water management	11,924,100	3,577,500	15,501,600
Total	95,595,200	28,678,900	124,274,100

(8) Project implementation plan

To achieve the target of the National Agricultural Policy in 2010, the works for modernization of the water management system will commence in 1999 and will be completed in 2006. Training of water users' group will be executed in parallel with the above works.

(9) Project evaluation

Based on the project cost and benefit, EIRR, B/C and NPV of the project are calculated as below.

EIRR (%)	24.1
B/C	2.59
NPV (1,000RM)	277,028

The sensitivity analysis is made in terms of EIRR for (i) 10% and 20% increase of construction cost and (ii) 10% and 20% of decrease of benefit. The results are shown in the following table.

(Unit : %)

	Construction Cost		
Benefit	0% Increase	10% Increase	20% Increase
0% decrease	24.1	22.9	21.8
10% decrease	22.3	21.1	20.1
20% decrease	20.3	19.2	18.3

After the implementation of the project, both gross farm income and net farm income are expected to increase to a great extent. The farm budget for present conditions and "with-project case" are shown in the following table:

(Unit : RM)

Items	Present	With-project
1. Gross Farm Income	5,930	12,170
2. Production Cost	3,020	4,360
3. Net Farm Income (1-2)	2,910	7,810
4. Non-farm Income	5,900	5,900
5. Total Income (3+4)	8,810	13,710
6. Living Expense	8,300	8,300
7. Net Reserve (5-6)	510	5,410

6.2 Ketara (Besut) Scheme

(1) Reorganizing O&M responsibility

The review of field staff positions and proposed reduction is based on assuming 80% reduction for gatekeepers and general workers. The impact on the overall O&M staff strength and cost is summarized below.

IADP	Scheme	Present			After Staff Reduction		
		Total Staff	No/1000ha	RM/ha '97	Total Staff	No/1000ha	RM/ha '97
Ketara (Besut)	Besut	56	11	72	18	3	32

(2) Telemetry and telemetric control system

A Central Control Station should be established at IADP Ketara Office and managed by the O&M unit of the DID Besut. This will improve irrigation management decisions which are primarily based on the water level and supply situations at the Besut and Angga Barrage. The following telemetry and telecontrol system is proposed for modernization of water management in the Besut scheme :

(a) Establishment of an observation network : 3 rainfall remote stations and 38 water level remote stations
(b) Establishment of a communication system : 150 MHz radio link.
(c) Establishment of two computer systems
  (i) Irrigation water management system (IWMS)
  IWMS will assist the irrigation system operator in proper decision making. Basically, the system has two functions, one is for daily operations and the other is for project monitoring. For daily operations, the following information is provided to the operator.
    - Water demand at major diversion points
    - Actual water supply at major diversion points
    - Proper distribution simulation
    - Required gate opening level

  For project monitoring, such information as rainfall trends and water levels is provided. Visual Basic(VB) Version 5 is recommended for developing IWMS as it is the latest and the most popular programming language for Window 95.
  (ii) Irrigation monitoring and feedback system (IMFS)
  The proposed monitoring and feedback system uses telephone line communication. This system allows the systems manager to produce, author and schedule and distribute multimedia information for TV output. IMFS network for the Ketara(Besut) scheme is proposed as follows:

IADP/Office	Master (Nos.)	Player (Nos.)	Additional TV (Nos.)
PMU	-	-	1
DID Component	-	-	1
DOA Component	-	-	1
DID Central Control Station	1	1	1
DID District Office	-	1	-
Besut Barrage Office	-	1	-
DID Compartment Stations	-	4	-
FDC	-	4	-
Total	1	11	4

(d) Establishment of a gate/pump telecontrol system

(3) System infrastructure

The improvement plans for system infrastructures in the Besut scheme are summarized below.

(a) Irrigation facilities
  (i) Replacement of Angga barrage
  (ii) Rehabilitation of Besut barrage gates
  (iii) Concrete lining : 4.4 km of main canals, 16.9 km of secondary canals and 3.0 km of tertiary canals
  (iv) Heightening of lining : 8.8 km of main canals and 2.8 km of secondary canals
  (v) Provision of regulating structures : 5 nos. on main canals and 1 no. on secondary canal
  (vi) Rehabilitation of damaged structures : 74 nos.

(b) Drainage facilities
  (i) Desilting of main drains : 16 km
  (ii) Construction of drainage control : 15 nos.

(c) Farm roads
  (i) Pavement along main canal : asphalt pavement 8 km
  (ii) Widening and laterite pavement along tertiary canals : 27 km

(4) In-field infrastructure/land consolidation

Land leveling and construction of canals and control boxes in paddy fields are planned for the improvement of in-field infrastructure as shown below. Each consolidation aims for 3 ha farm plot and the number of target consolidated lots will be 1,721.

Compart-ment	No. of paddy fields	Area for land leveling (ha)	Canals in paddy fields (km)	No. of control boxes	No. of consoli-dated farms
1	1,172	1,111	167	741	411
2	962	1,017	153	678	383
3	1,544	1,175	176	783	435
4	1,534	1,353	203	903	492
Total	5,211	4,656	699	3,105	1,721

(5) Agricultural

(a) Cropping schedule

The proposed cropping schedule is determined considering the water availability, flood effected period and harvesting period. The wet direct seeding method is presently common in the Besut area, and this method would be applied principally, however the partial introduction of the dry direct seeding (for approximately 20% of the planted area in off-season) will also be recommended in order to avoid high peak water demand during pre-saturation period in off season. A 175% cropping intensity will be obtained by the improved cropping pattern. The phase-wise planted areas are summarized as follows:

Schedule	Compartment	Area (ha)
1	1,4 and part of 2	3,439.9
2	3 and part of 2	1,723.4

(b) Mechanization

The necessary numbers of machinery and implements are estimated and summarized as below.

Machinery / Equipment	Necessary Nos.	Available Nos.	Purchase Nos.
I. 4W tractor			
- 60 hp class	129	74*	55
- Management tractor (10-20hp class)	42	---	42
II. Implements			
- Lime spreader	16	---	16
- Rotavator	82	27	55
- Paddy harrow	31	---	31
- Rear bucket or Land roller	3	---	3
- Granule applicator / Broadcaster	35	---	35
- Boom sprayer	14	---	14
- Carpet duster	14	---	14
III. Combine harvester (6t class)	23	23	---
- Chopper spreader	23	---	23

* : 20 by FMC Besut, 14 by IADP Ketara, 10 by contractors including farmers and 30 by FMC Kelantan, Source - FMC Besut and IADP Ketara

(c) Fertilizer application

The proposed amount of fertilizer and timing of application are as follows:

- Amount and rate of fertilizer : N:P (P_2O_5):K (K_2O)= 100:40:30 (kg/ha)

(i) N : 1st; 1/4, 2nd; 1/4 and 3rd; 1/2 on 15 - 21 day after sowing (HST), 45 - 50 HST and panicle initiation stage respectively

(ii) P : 15 - 21 HST together with N

(iii) K : 15 - 21 HST together with N

The additional elements application is recommended for the low pH area as follows :

Calcium fertilizer (GML) : 2.5 ton/ha before first land preparation

Magnesium fertilizer : 130 kg/ha before first land preparation

(6) Water Users' Group

The Besut scheme has reorganized its Farmers' Groups to conform to the ISA units. This is also referred to as the WUG boundaries. There are now 30 WUGs. Although Besut has implemented the WUGs, training is still necessary as up to now, only those members in Kubang Depu pilot project are given exposure. For on-site training, two separate one-day sessions are proposed. For the WUG leaders, one 3-day training session is proposed at the National Water Management Training Center. The WUG characteristics are summarized below.

Compartment	Farmers (Nos.)	WUG (Nos.)	Area/WUG (ha)	Farmer/WUG (Nos.)
1	659	8	154	82
2	509	5	226	102
3	858	8	163	107
4	1,028	9	167	114
Total/Average	3,054	30	172	102

(7) Cost estimate

Initial investment cost for the Ketara scheme is presented in the following table:

(Unit : RM)

Items	Direct Cost	Contingency, etc.	Total
System Infrastructure	21,460,600	6,438,200	27,898,800
In-field Infrastructure	1,874,300	562,200	2,436,500
Water management	3,421,000	1,026,500	4,447,500
Total	26,755,900	8,026,900	34,782,800

(8) Project implementation plan

The works for modernization of water management system will commence in 1999 and will be completed in 2006 taking into consideration the target of the National Agricultural Policy in 2010. Training of water users' group will be carried out in parallel with the above works.

(9) Project evaluation

Based on the project cost and benefit, EIRR, B/C and NPV of the project are estimated as shown below.

EIRR (%)	11.2
B/C	1.14
NPV (1,000RM)	6,178

The sensitivity analysis is made in terms of EIRR for (i) 10% and 20% increase of construction cost and (ii) 10% and 20% of decrease of benefit. The results are shown in the following table:

(Unit : %)

	Construction Cost		
Benefit	0% Increase	10% Increase	20% Increase
0% decrease	11.2	10.6	10.1
10% decrease	10.2	9.6	9.1
20% decrease	9.1	8.6	8.1

After the implementation of the project, both gross farm income and net farm income are expected to increase to a great extent. The farm budget for present conditions and "with-project case" are shown in the following table:

(Unit : RM)

Items	Present	With-project
1. Gross Farm Income	5,370	9,910
2. Production Cost	2,010	3,900
3. Net Farm Income (1-2)	3,360	6,010
4. Non-farm Income	3,300	3,300
5. Total Income (3+4)	6,660	9,310
6. Living Expense	6,260	6,260
7. Net Reserve (5-6)	400	3,050

6.3 Pulau Pinang Scheme

(1) Reorganizing O&M responsibility

The review of field staff positions and proposed reduction is based on assuming 80% reduction for gatekeepers and general workers. The impact on the overall O&M staff strength for IADP Pulau Pinang cannot be estimated directly due to incomplete data. Instead, adopting the average reduction rate of the Kerian and Besut schemes, the impact on the O&M overall staff is summarized below.

IADP	Scheme	Present			After Staff Reduction		
		Total Staff	No/1000ha	RM/ha '97	Total Staff	No/1000ha	RM/ha '97
Pulau Pinang	Pulau Pinang	204	21	186	75	8	78

(2) Telemetry and telemetric control system

A central control station is proposed to be located at the DID Seberang Jaya Office. This will coordinate water management system that involves coordinating irrigation for the 4 sub-schemes (Sg. Muda, Pinang Tunggal, Sg. Jarak and Sg. Kulim) and the inter-basin transfer via the Jarak Transfer Canal. The following telemetry and telecontrol system is proposed for modernization of water management in the Pulau Pinang scheme :

(a) Establishment of an observation network : 4 rainfall remote stations and 53 water level remote stations
(b) Establishment of a communication system : 150 MHz radio link.
(c) Establishment of two computer systems
  (i) Irrigation water management system (IWMS)
    IWMS is developed to assist the irrigation system operator in proper decision making. Basically, the system has two functions, one is for daily operations and the other is for project monitoring. For daily operations, the following information is proposed to the operator :
    - Water demand at major diversion points
    - Actual water supply at major diversion points
    - Proper distribution simulation
    - Required gate opening level

For project monitoring, such information as rainfall trends and water levels is provided. Visual Basic(VB) Version 5 is recommended for developing IWMS as it is the latest and the most popular programming language for Window 95.

(ii) Irrigation monitoring and feedback system (IMFS)

The proposed monitoring and feedback system uses telephone line communication. This system allows the systems manager to produce, author and schedule and distribute multimedia messages and information for TV output. IMFS network for the Pulau Pinang scheme is proposed as follows:

IADP/Office	Master (Nos.)	Player (Nos.)	Additional TV (Nos.)
PMU	-	-	1
DID Component	-	-	1
DOA Component	-	1	-
DID Central Control Station	1	1	1
DID Field Office	-	2	-
FDC	-	4	-
PPK	-	3	-
Total	1	11	3

(d) Establishment of a gate/pump telecontrol system

(3) System infrastructure

The improvement plans for irrigation and drainage facilities and farm roads in the Pulau Pinang scheme are shown below.

(a) Irrigation facilities
  (i) Concrete lining : 35 km of main canals and 79 km of secondary canals including removal of sediment in the canals
  (ii) Provision of regulating structures : 6 nos. on main canals and 12 nos. on secondary canals
  (iii) Rehabilitation of damaged structures : replacement of 2 diversion gates

(b) Drainage facilities
  (i) Desilting of tertiary drains : 40 km

(c) Farm roads
  (i) Pavement along main canal : asphalt pavement 11 km
  (ii) Widening along tertiary canals : 100 km

(4) In-field infrastructure/land consolidation

Land leveling and construction of canals and control boxes in paddy fields are planned for the improvement of in-field infrastructure as shown below. Each consolidation aims for 5 ha farm plot and the number of target consolidated lots will be 1,920.

Sub-scheme	No. of paddy fields	Area for land leveling (ha)	Canals in paddy fields (km)	No. of control boxes	No. of consoli-dated farms
Sungai Muda	10,129	6,564	985	2,626	1,377
Pinang Tunggal	1,123	697	105	279	277
Sungai Jarak	384	283	42	113	188
Sungai Kulim	1,284	1,053	158	421	78
Total	12,920	8,597	1,290	3,439	1,920

(5) Agriculture

(a) Cropping schedule

The present cropping schedule in the Pulau Pinang area is divided into 4 schedules. However, the area under schedule 4 is being distributed among the other 3 schedules. This revised cropping pattern is acceptable judging from the water balance study result and rainfall conditions during the harvesting time. The wet direct seeding method is recommended in the Pulau Pinang area for both seasons. The areas for the revised schedule are summarized below.

Schedule	Area (ha)
1	3,312
2	3,223
3	3,066

(b) Mechanization

The proposed mechanization farming system is shown below.

Machinery / Equipment	Necessary Nos.	Available Nos.	Purchase Nos.
I. 4W tractor			
- 60 hp class	214	123*	91
- Management tractor (10-20hp class)	91	---	91
II. Implements			
- Lime spreader	4	---	4
- Rotavator	153	62	91
- Paddy harrow	57	---	57
- Rear bucket or Land roller	---	---	---
- Granule applicator / Broadcaster	78	---	78
- Boom sprayer	26	---	26
- Carpet duster	26	---	26
III. Combine harvester (6t class)	43	43	---
- Chopper spreader	43	---	43

* : 33 by FMC Pulau Pinang, 10 by DOA, 80 by contractors including farmers
Source - Farm machinery services for farmers

(c) Fertilizer application

The fertilizer application method recommended by MARDI will be adopted. The proposed fertilizer amount and application timing are as follows:

- Amount and rate of fertilizer : N:P (P_2O_5):K (K_2O)= 100:40:30 (kg/ha)

(i) N : 1st; 1/4, 2nd; 1/4 and 3rd; 1/2 on 15 - 21 day after sowing (HST), 45 - 50 HST and panicle initiation stage respectively

(ii) P : 15 - 21 HST together with N

(iii) K : 15 - 21 HST together with N

Soil conditions of the Pulau Pinang area have the potential to support good plant growth with good. However, some cases of copper deficiency have been reported. Therefore, the application of minor elements dressing should also be considered. The area-wise optimum rate and amount of fertilizer will be obtained through the practice of DRIS.

(6) Water Users' Group

The basic characteristics of the proposed WUGs in IADP Pulau Pinang is summarized below based on the program by IADP Pulau Pinang.

Scheme	Farmers (Nos.)	WUG (Nos.)	Area/WUG (ha)	Farmer/WUG (Nos.)
Sg. Muda	-	105	68	-
Sg. Kulim	-	10	117	-
P. Tunggal	-	7	117	-
Sg. Jarak	-	3	123	-
Total/Average	7,301	125	76	58

Formation of WUG requires intensive promotion by field officers. A special training program for WUG leaders should be developed. For on-site training, two separate one-day sessions are proposed. For the WUG leaders, one 3-day training sessions is proposed at the National Water Management Training Centre. These training sessions should include promoting in-field infrastructure development program and land consolidation. The one-day on-site training program will be held once during the off-season and once during the main season during the initial crop growth stage when farm activities are relatively low.

(7) Cost estimate

Initial investment cost for the Pulau Pinang scheme is estimated as follows:

(Unit : RM)

Items	Direct Cost	Contingency, etc.	Total
System Infrastructure	26,034,700	7,810,400	33,845,100
In-field Infrastructure	3,320,800	996,200	4,317,000
Water management	7,929,900	2,379,300	10,309,200
Total	37,285,400	11,185,900	48,471,300

(8) Project implementation plan

The works for modernization of water management system in the Pulau Pinang scheme will commence in 1999 and will be completed in 2006 taking into consideration the target of the National Agricultural Policy. Training of water users' group will be carried out in parallel with the above works.

(9) Project evaluation

Based on the project cost and benefit, EIRR, B/C and NPV of the project are shown in the following table:

EIRR (%)	19.5
B/C	2.08
NPV (1,000RM)	80,131

The sensitivity analysis is made in terms of EIRR for (i) 10% and 20% increase of construction cost and (ii) 10% and 20% of decrease of benefit. The results are shown in the following table:

(Unit : %)

Benefit	Construction Cost		
	0% Increase	10% Increase	20% Increase
0% decrease	19.5	18.6	17.8
10% decrease	18.0	17.1	16.4
20% decrease	16.4	15.6	14.9

After the implementation of the project, both gross farm income and net farm income are expected to increase to a great extent. The farm budget for present conditions and "with-project case" are shown below.

(Unit : RM)

Items	Present	With-project
1. Gross Farm Income	5,580	11,590
2. Production Cost	2,360	4,030
3. Net Farm Income (1-2)	3,220	7,560
4. Non-farm Income	9,200	9,200
5. Total Income (3+4)	12,420	16,760
6. Living Expense	9,950	9,950
7. Net Reserve (5-6)	2,470	6,810

7. Environmental Management Plan

The Environmental Management Plan (EMP) is to achieve the following items:

- Identify key potential impact areas
- Establish a program for monitoring the potential impacts
- Establish reporting and mitigating (including emergency) response procedures

Adverse effect on water quality in adjacent waterways is the most important environmental issue to the granary development. Therefore, a water quality monitoring system will be constructed to check the quality of drainage water from the paddy fields. Basic parameters for the water monitoring system include ammoniacal nitrogen (NH_3N), biochemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solid (SS), pH, phosphorus and nitrate. Water sampling will be established in main drainage canals in each paddy field, and at pumping stations which recycle water for irrigation. When any excessive use of agro-chemicals is detected, appropriate management actions must be taken place immediately, and the DID and DOA should play a key role in such a process.

For the smooth operation of the EMP, an institutional framework which allocates qualified staff to appropriate positions is required. It is proposed that the following four positions be established in the DID. These positions can be filled by new employees or incumbents.

- Environmental Manager/Coordinator : Headquarters of the DID (Planning and Evaluation Section)
- Environmental Control Officer : Each State Office of the DID
- Senior Field Staff : Each field office (IADP Office/Granary Area)
- Field Technician : Each field office (IADP Office/Granary Area)

Staff training program is an important part of the EMP. The training program should focus on data collection (water sampling / analysis), computer applications, data quality control / assurance and communication skills. It is proposed to organize three levels of training, and the training program should be planed in cooperation with various departments.

CONCLUSION AND RECOMMENDATION

1. Conclusion

The Economic Internal Rate of Return (EIRR) of four(4) granary schemes except for Kemasin/Semerak scheme where a flood mitigation project is currently under progress, ranges from 11.2% to 24.1%. The Project is technically feasible and economically viable from a viewpoint of the national economy. Through the study, the Project is justified summarized as below:

(a) For farm economy, it is expected that the current gross farm income will be nearly doubled after the implementation of the project. This will improve farmers' living standard and to motivate farmers' positive attitude toward paddy production.

(b) It is expected that the introduction of the latest technologies such as a telemetry/telecontrol system and a computer system and a coherent mechanized agricultural operation together with the organization of water users group can modernize and activate the rural areas.

(c) Reduction of the DID staff by transferring responsibility of the operation and maintenance of the tertiary canal system to farmers' organizations will improve and streamline management systems.

(d) Introduction of a telemetry/telecontrol system with a computer system in addition to the improvement and rehabilitation of irrigation facilities and farm roads, will rationalize management systems and promote effective use of water resources. This will contribute to achieve the target of the NAP.

(e) Acceleration of the large scale mechanization system for farming activities will improve work efficiency and save farming cost. Furthermore, proper water management with telemetry/telecontrol system and fertilizer/chemical application management introducing DRIS and IPM will increase cropping intensity and crop yield.

(f) Establishment of units for production by rearranging of present farmers' group to water users groups based on irrigation facilities will effectively urge operation and management of the tertiary canal system, and mechanization of farming activities.

(g) Particular remarks for the three prioritized schemes are summarized below :
   (i) Kerian scheme
   Rehabilitation of drainage systems and improvement of farm roads will allow direct seeding with machinery, which can save labor and largely increase crop

production. It is expected to modernize the water management system by replacing the existing telemetry system with a new telemetry/ telecontrol system and computer system.

(ii) Ketara (Besut) scheme
This scheme is selected as the pilot project area, and in prior to other granaries, farmers' group have been established based on the irrigation system. With this background, this scheme is expected to lead other granaries and act as a model for modernization of the granaries.

(iii) Pulau Pinang scheme
Introduction of modern water management system and group farming are expected to increase rice production and to sustain the agricultural activities in the scheme which is adjacent to industrial areas.

2. Recommendation

The Project will increase rice production and secure a stable source of food, and will allow the target of the NAP to be reached. It is, therefore, recommended that this project be implemented as soon as possible. Strategic plans to increase production and improve maintenance of granary areas are summarized below :

(a) Reorganization of granary areas
Sungai Burung sub-scheme on Pinang Island in Pulau Pinang scheme shall be excluded from the granary areas because it will be difficult to remain an active component of the granary area. IADP Kerian and IADP Sungai Manik schemes are independent schemes, and are geographically largely separated, which results in various administrative constraints in terms of scheme management. Therefore, it is recommended that Seberang Perak, Sungai Manik and Changkat Jong schemes be combined under the same scheme, because all of these granaries belong to the same Perak river basin, then integrated management system can be developed over the united scheme.

(b) Expedition of the flood mitigation project in Kemasin/Semerak scheme
The on-going flood mitigation project in Kemasin/Semerak scheme must be completed and appropriate irrigation facilities should be established by the time the proposed modernization program is implemented in order to reach the target of the NAP by the year 2010.

(c) Establishment of meteo-hydrological stations in the Besut river basin and check of function of the Peringat hydrological station in the Kerian river
No discharge records are available for the both upstream of Besut and Angga rivers that are main water sources of the Besut scheme. There is presently water shortage in this scheme, and it is predicted that more water will be required for other sectors than for agriculture in the future. Therefore, it is recommended that meteo-hydrological stations be established upstream of the existing Besut and Angga barrages as soon as possible to monitor the actual discharges of the rivers. There is a Peringat hydrological station for Kemasin river that is a main waterway in Kemasin/Semerak scheme, but no

record has been taken since 1990. Additional irrigation is supposed to be provided by KADA, and it is necessary to check the function of the station to confirm this.

(d) Securing additional water resources in Ketara (Besut) scheme
Water shortage is a major problem and since there are large fluctuations in water discharge in Ketara (Besut) scheme, cropping intensity is unstable in this area. From 1994 to 1995, DID conducted a feasibility study on a multi-purpose water resources project (Paya Peda Dam), which is located upstream of Angga River to secure irrigation and drinking water and to control flood. This project would include Ketara (Besut) granary area together with other small irrigation schemes, and its construction primarily for irrigation purposes may enable Besut scheme to achieve cropping intensity of 200 %. No decisive implementation schedule has been planned yet, but it is recommended that the implementation of this project be seriously considered in the light of future water demand.

(e) Establishment of water users group
Farmers' groups in the granary areas are not firmly structured yet, and it appears that this grouping process is still in the initial stage. It is important that these farmers' groups be rearranged to water users groups to make farming practice more efficient. Therefore, it is necessary that organizations such as IADP PMU, DID, DOA, PPK, FELCRA and National Water Management Training Center must realize the importance of formulating water users groups and quickly implement this reform.

(f) Consensus of farmers toward land consolidation
Land consolidation which requires rearrangement of farming plots is essential to introduce mechanized farming practice. Farmers and land owners must reach an agreement on such a plan if it is to be implemented. It is, therefore, recommended that IADP PMU play a primary role in such a plan, and PPK and DOA must cooperate to form a task force to support the implementation.

(g) Durability of the Project
It is inevitable to form an organization that leads and operates centralized management on farmers on behalf of present IADP PMU, which has been organized for development and for implementation of the Project. Farmers' Organization Authority (FOA) is probably the most appropriate institution for this task, and it is recommended that FOA will act as a center of management and operation of granary areas with technical supports from DID and DOA in future.

(h) Implementation of environmental management plan
The project is not heavily involved in construction of large buildings or land clearing, so the impact to the surrounding environment is predicted to be minimal. However, no study has been conducted to monitor effects of using agro-chemicals. It is, therefore, recommended that a water quality monitoring system be introduced for the purpose of checking drainage water discharged from paddy fields and also for monitoring utilization of agro-chemicals by farmers.

Summary Table (1/2)

1. Present Condition of Projects

Item \ Schemes	Unit	Pulau Pinang	Kerian	Sungai Manik	Seberang Perak	Kemasin/Semerak	Ketara(Besut)
(1) Location		West Coast	West Coast	West Coast	West Coast	East Coast	East Coast
(2) Administration (State)		Pulau Pinang State	Perak State	Perak State	Perak State	Kelantan State	Terengganu State
(3) Project area (Net irrigation area)	ha	9,832	23,560	6,318	8,708	6,895	5,164
(4) Climate							
a) Rainfall region		North West Peninsular Malaysia	West Peninsular Malaysia	West Penaisular Malaysia	West Peninsular Malaysia	East Peninsular Malaysia	East Peninsular Malaysia
b) Average annual rainfall	mm	2,120	2,227	2,333	2,182	2,589	2,904
(5) Soil		coastal alluvial soils	coastal alluvial soils, alluvial soils of riverine origin and organic soils	alluvial soils	alluvial soils of riverine origin	alluvial soils	alluvial soils and organic soils
(6) Population & labor force							
a) Number of house of house-hold	nos	7,301	13,485	4,030	2,333	11,889	3,054
b) Average family size	nos	5.0	4.9	4.7	5.1	5.2	5.2
c) Estimated population		36,500	66,100	18,900	11,900	61,800	15,900
d) Literacy rate	%	91.4	91.5	91.5	81.2	78.8	81.2
e) Ethnic group							
i) Malay	%	75.0	62.5	50.1	98.7	97.6	96.5
ii) Chinese	%	19.4	22.3	23.2	0.1	1.3	1.8
iii) Indian	%	4.9	9.9	8.2	0.0	0.0	0.1
iv) Others	%	0.6	5.3	18.5	1.2	1.1	1.6
(7) Agriculture							
a) Average holding size	ha	1.32	1.54	1.73	1.82	1.04	1.29
b) Cropping schedule							
i) Main season		September-February	August-February	January-July	September-February	October-March	November-April
ii) Off season		March-September	February-August	July-January	March-August	April-October	May-October
c) Yield							
i) Main season	t/ha	2.90	2.86	3.16	6.57	2.91	3.34
ii) Off season	t/ha	2.71	3.05	2.94	3.50	2.22	3.00
iii) Total	t/ha	2.80	2.94	3.05	3.53	2.82	3.18
d) Cropping intensity							
i) Main season	%	95	89	95	94	50	87
ii) Off season	%	94	75	96	98	6	77
iii) Total	%	189	164	191	191	57	164
e) Labor input	man-day	13.0	DS10.9, TP58.0	10.3	18.8	25.4	12.9
f) Farming practice							
i) Planting method		Wet Direct Seeding	Wet and Dry Direct Seeding and Trans Planting	Wet and Dry Direct Seeding	Wet Direct Seeding	Wet Direct Seeding	Wet Direct Seeding
ii) Fertilizer application	N kg/ha	78	88	88	92	77	80
iii) Mechanization							
Land Preparation (4W & 2W tractor)	%	100	65	100	100	100	100
Harvesting (Combine harvester)	%	100	62	100	100	100	100
iv) Variety							
MR84	%	98.3	21.6	100.0	100.0	85.0	100.0
Semerak	%	-	29.7	-	-	-	-
MR10	%	-	12.6	-	-	-	-
Others	%	1.7	36.1	-	-	15.0	-
(8) Marketing and processing							
a) No. of mills	nos	14	10	1	1	1	3
b) Annual capacity	mt/year	294,000	220,000	20,000	40,000	20,000	29,000
c) Paddy production in scheme	mt	58,674	112,668	36,808	58,853	19,098	27,787
(9) Irrigation and drainage							
a) Water source		Muda, Kulim, Jarak rivers	Bukit Merah reservoir, Kerian river	Batang Padang river	Perak river	Kemasin, Jelawat rivers	Besut, Angga rivers
b) Irrigation method		Pump+Gravity	Gravity+Pump	Gravity+Pump	Gravity	Pump	Gravity
c) Irrigation area	ha	9,832	23,560	6,318	8,708	6,895	5,164
d) Irrigation system							
i) Canal length							
Main&branch canal	km	34.2	62.7	13.4	60.3	17.9	47.0
Secondary canal	km	78.6	343.0	51.2	65.9	-	86.0
Tertiary canal	km	264.0	320.1	186.5	188.6	36.1	116.5
Related structures	nos	567	2,524	422	3,075	334	242
ii) Canal density	m/ha	39	31	40	36	33	48
iii) Canal type		earth + concrete lining	earth + concrete lining	earth + concrete lining	earth + concrete lining	earth + concrete lining	earth + concrete lining
e) Drainage system							
i) Drain length							
Main&secondary drain	km	95	570	61	63	47	177
Tertiary drain	km	207	473	181	314	11	64
ii) Drain density	m/ha	36	44	38	43	35	35
f) Farm road system							
Road length	km	340.0	700.0	245.3	432.0	89.0	241.0
						Above features indicate for Jelawat Rusa and Kemasin Hilir	
(10) Water management system							
a) O&M activities		follow O&M manual but incomplete	follow O&M manual	no O&M manual	no latest O&M manual	follow O&M manual	follow O&M manual but incomplete
b) O&M cost (Staff Cost Only)	RM/ha	186	100	157	87	-	72
c) Irrigation rates	RM/ha	9.88-34.59	7.41-12.36 (Perak) 9.88-34.59 (Pinang)	7.41-12.36	7.41-12.36	12.36	9.88
d) Telemetry and telecontrol system		Telemetry for flood warning	Available telemetry but incomplete	not available	not available	not available	not available
(11) Rural credit							
a) Number of branches of BPM	nos	4	3	1	1	3	1
(12) Farmers' organization							
a) under PPK	nos	35	31	11	1	13	-
b) under DOA	nos	108	50	11	6	6	30
c) under FELCRA	nos	-			1	-	-
(13) Farm economy							
a) Crop budget							
i) Return/Cost ratio	-	1.79	1.66	1.59	1.68	1.42	1.50
b) Farm income	RM	6,407	1,693	3,479	3,713	1,409	2,784
c) Non-farm income	RM	9,169	5,923	4,337	4,086	4,027	3,336
d) Total income	RM	15,576	7,616	7,816	7,799	5,436	6,120
e) Poverty rate	%	0.8	3.4	3.9	5.9	15.4	13.0
(14) Environment							
a) Significant forests and habitats (in 30 km radius)	nos	2 on Pinang Is.	3	3	3	1	1
b) Water quality (level of pollution)	-	slightly polluted	slightly polluted	slightly polluted	clean	clean	clean

Summary Table (2/2)

	Item \ Schemes	Unit	Pulau Pinang	Kerian	Sungai Manik	Seberang Perak	Kemasin/Semerak	Ketara(Besut)
2. Modernization Plan	(1) System infrastructure improvement							
	a) Irrigation system							
	i) Concrete lining							
	Main canal	km	35.0	62.0	-	-	-	4.4
	Secondary canal	km	79.0	40.0	51.0	12.0	-	16.9
	Tertiary canal	km	-	-	135.0	69.0	-	3.0
	ii) Removal of sediment	km	-	-	-	46.0	-	
	iii) Lining heightning	km	-	-	-	-	-	11.6
	iv) Regulating structure provision	nos	18	15	2	5	-	6
	v) Headworks replacement	nos	-	-	-	-	-	1
	vi) Headworks gate replacement	nos	-	-	-	-	-	3
	vii) Damaged structure rehabilitation	nos	2	18	54	53	9	74
	viii) Other additional canal structures	nos	-	-	7	1	-	-
	b) Drainage system							
	i) Drain desilting	km	40	580	12	13	20	16
	ii) Drainage gate rehabilitation and constructio	nos	-	122	-	-	-	15
	iii) Bund construction	km	-	153	-	-	-	-
	iv) Additional drains	km	-	17	-	-	-	-
	v) Drainage pump provision	nos	-	10	-	-	-	-
	c) Farm roads							
	i) Additional farm road	km	-	-	-	6	-	-
	ii) Asphalt pavement	km	11	40	13	-	-	8
	iii) Widning along tertiary canals	km	100	100	42	35	36	27
	(2) Water management facilities provision							
	a) Central station	nos	1	1	1	1	1	1
	b) Master equipment	nos	1	1	1	1	1	1
	c) Radio repeater	nos	-	1	-	-	-	-
	d) RTU	nos	41	38	17	34	11	37
	e) Rainfall gauge	nos	4	4	2	2	2	3
	f) Water level gauge	nos	53	44	21	42	13	38
	g) Control point							
	i) Key control point	nos	7	5	5	4	-	3
	ii) Second control point	nos	4	3	-	3	-	2
	h) Monitoring point							
	i) Key monitoring point	nos	8	7	2	4	3	4
	ii) Second monitoring point	nos	8	8	2	5	7	5
	iii) Third monitoring point	nos	13	13	6	18	-	19
	i) Irrigation water management system	set	1	1	1	1	1	1
	j) Irrigation monitoring and feedback system							
	i) Master	nos	1	1	1	1	1	1
	ii) Player	nos	11	10	5	10	9	11
	iii) Additional TV	nos	3	3	1	1	4	4
	(3) Water users' group formation							
	a) Farmers	nos	7,301	13,485	4,030	2,333	11,889	3,054
	b) WUGs	nos	125	84	36	20	39	30
	c) Area/WUG	ha/WUG	77	282	176	183	177	172
	d) Farmers/WUG	nos/WUG	58	161	112	117	305	102
	(4) Water users' group formation training							
	a) No. of on-site training		500	676	184	102	199	153
	b) No. of off-site training (NWMTC)		7	4	2	1	2	2
	(5) In-field infrastructure improvement							
	a) Lots for improvement	nos	12,920	12,651	3,149	2,348	15,998	5,212
	b) Area for land leveling	ha	8,597	18,389	5,783	3,605	6,025	4,656
	c) In-field channel	km	1,290	2,757	876	541	930	699
	d) In-field control boxes	nos	3,439	7,356	2,313	1,442	4,137	3,105
	(6) Land consolidation							
	a) No. of farmers	nos	7,301	13,485	4,030	2,333	11,889	3,054
	b) No. of lots	nos	14,231	16,641	3,499	2,609	17,775	5,790
	c) Area	ha	9,601	23,560	6,318	4,005	6,895	5,164
	d) Estimated no. of consolidation farms	nos	1,920	4,712	1,264	801	2,298	1,721
	(7) Agriculture improvement plan							
	a) Cropping pattern							
	i) Main season		September-January	July-February	January-July	September-February	October-March	October-February
	ii) Off season		March-August	January-August	July-January	March-August	April-October	March-August
	b) Cropping intensity							
	i) Main season	%	100	100	100	100	100	100
	ii) Off season	%	100	100	100	100	75	100
	iii) Annual	%	200	200	200	200	175	200
	c) Mechanization (Necessary/purchase)							
	i) 4W tractor (30-60 PS class)	nos	214/91	358/137	-	-	-	129/55
	ii) Management tractor (20 PS class)	nos	91/91	171/171	-	-	-	42/42
	iii) Combine harvester	nos	43/0	6: 45/0, 3: 19/13	-	-	-	23/0
	(8) Environment							
	a) Water quality monitoring points	nos	13	8	-	-	-	8
3. Cost Estimate	(1) Initial investment cost							
	a) System infrastructure	1,000RM	33,845	83,749	28,198	20,288	1,700	27,899
	b) In-field infrastructure	1,000RM	4,317	25,024	2,911	1,814	861	2,436
	c) Water management	1,000RM	10,309	15,501	6,385	8,985	1,651	4,448
	d) Total	1,000RM	48,471	124,274	37,494	31,087	4,212	34,783
	(2) Replacement cost and O&M cost							
	a) Replacement cost							
	i) Infrastructure	1,000RM	7,632	21,754	6,222	4,420	512	6,068
	ii) Water manageme / Monitring and Feedbac	1,000RM	7,930	11,924	5,053	7,111	1,270	3,421
	b) O&M cost		3,584	7,943	2,171	2,897	750	1,577
	(3) Water users' group training cost							
	a) Number of group	nos	125	84	36	20	39	30
	b) Off-site	1,000RM	300	202	86	48	94	72
	c) On-site	1,000RM	73	135	40	23	119	31
	d) Total	1,000RM	373	337	127	71	213	103
4. Project Benefit	(1) Production value							
	a) Without project	1,000RM	19,957	37,880	13,210	24,890	-	11,031
	b) With project	1,000RM	49,663	119,630	32,680	45,040	-	21,565
	(2) Incremental value	1,000RM	29,706	81,750	19,470	20,150	-	10,534
5. Project Evaluation	(1) Economic evaluation							
	a) EIRR	%	19.5	24.1	19.0	18.1	-	11.2
	(2) Financial analysis in F/S							
	a) Total Income	RM	16,760	13,710	-	-	-	9,310
	b) Living Expense	RM	9,950	8,300	-	-	-	6,260
	c) Net Reserve	RM	6,810	5,410	-	-	-	3,050

Note : The above values in the modernization plan indicate those for feasibility level in Pulau Pinang, Kerian and Besut schemes, and for master plan level in the remaining schemes.

THE STUDY
ON
MODERNIZATION OF IRRIGATION
WATER MANAGEMENT SYSTEM
IN
THE GRANARY AREAS
OF
PENINSULAR MALAYSIA

- FINAL REPORT -
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ABBREVIATIONS

Plans

NDP	:	New Development Policy
NEP	:	New Economic Policy
NAP	:	National Agricultural Policy
IMP	:	Industrial Master Plan
7MP	:	Seventh Malaysia Plan, 1996 - 2000

Organizations

BPM	:	Agricultural Bank of Malaysia (Bank Pertanian Malaysia)
DID	:	Department of Irrigation and Drainage
DOA	:	Department of Agriculture
DOE	:	Department of Environment
DRIS	:	Diagnosis Recommendation Integrated System
DSM	:	Department of Survey and Mapping
EPU	:	Economic Planning Unit
FAMA	:	Federal Agricultural Marketing Authority
FELCRA	:	Federal Land Consolidation and Rehabilitation Authority
FOA	:	Farmers' Organization Authority
IPM	:	Integrated Pest Management
JICA	:	Japan International Cooperation Agency
KADA	:	Kemubu Agricultural Development Authority
LPN	:	National Paddy and Rice Board
LPP	:	Farmers' Organization Authority
MADA	:	Muda Agricultural Development Authority
MARDI	:	Malaysian Agricultural Research and Development Institute
MMS	:	Malaysia Meteorological Services
MOA	:	Ministry of Agriculture
MOF	:	Ministry of Finance
PPK	:	Area Farmers' Organization
PPN	:	State Farmers' Organization

Others

EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
FIRR	:	Financial Internal Rate of Return
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
IADP	:	Integrated Agricultural Development Project
O&M	:	Operation and Maintenance
Sg.	:	Sungai (River)

CONVERSION FACTORS

	Metric to Imperial			Imperial to Metric		
Length	1 cm	=	0.394 inch	1 inch	=	2.54 cm
	1 m	=	3.28 feet	1 feet	=	30.48 cm
	1 km	=	0.621 mile	1 mile	=	1.609 km
Area	1 m^2	=	10.76 sq.ft	1 sq.ft	=	0.0929 m^2
	1 ha	=	2.471 acre	1 acre	=	0.4047 ha
	1 km^2	=	0.386 sq.mile	1 sq.mile	=	2.59 km^2
Volume	1 lit	=	0.22 gal (imp)	1 gal(imp)	=	4.55 lit
	1 m^3	=	35.3 cu.ft	1 cu.ft	=	28.33 lit
	1 MCM	=	811 acre-ft	1 acre-ft	=	1,233.5 m^3
Weight	1 kg	=	2.20 lb	1 lb	=	0.4536 kg
	1 ton	=	0.984 long ton	1 long ton	=	1.016 ton
Derived	1 m^3/sec	=	35.3 cusec	1 cusec	=	0.0283 m^3/sec
Measures	1 ton/ha	=	891 lb/acre	1 lb/acre	=	1.12 kg/ha
	1 m^3/sec	=	19.0 mgd	1 mgd	=	0.0529 m^3/sec
Temperature	°C	=	(°F-32) x 5 / 9	°F	=	1.8 x °C + 32
Local Measures	1 lit	=	0.22 gantang	1 gantang	=	4.55 lit
	1 kg	=	1.65 kati	1 kati	=	0.606 kg
	1 ton	=	16.5 pikul	1 pikul	=	60.6 kg

CURRENCY EQUIVALENT

(as of Jan. 1998)

US$ 1.0 = RM 4.4 = Yen 129.5

PART - I

GENERAL BACKGROUND OF THE PROJECT

1.1 Introduction

1.1.1 Authorities

The Final Report is prepared in accordance with the Clause VI-2 of the Scope of Work (S/W) for the Study on Modernization of Irrigation Water Management System in the Granary Areas of Peninsular Malaysia agreed upon between the Malaysian Government and the Japan International Cooperation Agency (JICA) on 20 November, 1996. The S/W and the Minutes of Meeting on the S/W are attached to this report as Attachment 1 and 2.

The Final Report consists of two(2) volumes ; Volume - I "Main Report" and Volume - II "Annexes". This Report compiles the results of survey and study conducted by the JICA Study Team in both Phase - I and II Study periods. The Main Report is composed of six(6) parts, Part-I : General Background of the Project, Part-II : Present Conditions of the Five(5) Granary Areas, Part-III : Basic Concept for Modernization of Granaries, Part-IV : Master Plan for Five(5) Granary Schemes, which was established based on the data and information collected in the Phase -I Study period, Part-V : Feasibility Study for the Selected Three(3) Granary Schemes, which was conducted on the basis of the additional data and information gathered in the Phase-II Study period, and Part-VI : Pilot Project which has been implemented by the Malaysian Government with technical advice and guidance of the JICA Study Team during the Phase-II Study period. Volume - II "Annexes" shows detailed explanations with calculation/analysis sheets in each field.

1.1.2 Background of the Project

Industrialization in Malaysia has rapidly progressed by the policy of economical modernization (public leading development) in the 1970s, New Economic Policy (to counteract poverty and economical unbalance) and open policy to promote foreign investment. As a result, after 1987, industrial output has grown to be higher than agricultural product in the share of gross domestic product (GDP), and it was certain that the country was essentially being transformed to an industrialized nation. During the Sixth Malaysia Plan period (1991-1995), the thrust of agricultural production programmes was to improve the competitiveness of agricultural industrial commodities, expand the production of food commodities and promote the cultivation of agricultural produce. The expansion of food commodities contributed significantly to the development of the agriculture sector.

Based on the National Agricultural Policy (NAP, 1992-2010), Malaysian Government is aiming to have a capacity of producing 1.20 million tons of rice by 2010 with a self-sufficiency level of 65 percent (this NAP is currently being reviewed, and proposed production targets and strategies of the new NAP3 are yet to be finalized). Consequently, some important areas for rice production were selected by the Government, which include 8 major granary

areas, namely (i) MADA, (ii) KADA, (iii) IADP North-Western Selangor, (iv) IADP Pulau Pinang, (v) IADP Kerian/Sungai Manik, (vi) IADP Seberang Perak, (vii) IADP Kemasin Semerak and (viii) IADP Ketara (Besut). Among these 8 granary areas, MADA, KADA and IADP North-Western Selangor are reaching the goal in both crop yield per unit of area and annual plantation rate with an improvement of irrigation facilities, development of infrastructure in rice fields for use of machinery, intensification of direct seeding and modernization of water management system. However, rice production in other 5 granary areas are left with a low level such as only 3.3 tons/ha in crop yield and 158 per cent in cropping intensity according to the paddy statistic in 1995. It is, therefore, required to develop these 5 areas in order to reach the goal.

For the above 5 granary areas, it is generally required to improve agricultural techniques on irrigation water supply in the dry season, water management systems, farming practices of rice cultivation. Because of a rapid growth of industry and municipal water use, it is getting difficult to develop new water sources for a use of agriculture. Furthermore, from the aspect of natural environment, it is also limited to develop new water resources for sake of irrigation purposes. On the other hand, due to the decreasing agricultural population, existing irrigation systems as well as water management systems and farming practices have been left in a poor maintenance, which resulted in a deterioration of the systems and non-intensive farming practices. Therefore, an effective use of water resources by rationalizing irrigation systems and impartial water allocation with a suitable water management practice are the key factors for an improvement of rice production. In terms of farmers' organization in Malaysia, it is not structured for an operation and maintenance of irrigation and drainage system. Instead, local offices of Department of Irrigation and Drainage(DID) bear the burden of high cost and large manpower input. In order to overcome such unsuitable conditions, DID expected that local farmers participate voluntarily in an operation and maintenance of on-farm facilities.

Under such circumstances, the Government of Malaysia requested in October 1995 that the Government of Japan provide a technical support of improving rice productivity with a modernization of water management facilities, and an introduction of modern farming practices and an effective water management systems for the 5 granary areas out of the 8 granary areas in the country. In response to this request, the Government of Japan dispatched a preliminary survey mission in November 1996 and had a discussion with the Government of Malaysia. Then, an agreement (S/W) was made between the two governments on 20 November 1996 for an establishment of the project entitled "Study on Modernization of Irrigation Water Management System in the Granary Areas of the Peninsular Malaysia".

1.1.3 Objective of the Study

The objectives of the Study are:

(i) to formulate a Master Plan for modernizing irrigation water management systems in the five schemes located in peninsular Malaysia to achieve higher paddy production,

(ii) to conduct a Feasibility Study to formulate development plans in the three selected schemes prioritized in the Master Plan, and

(iii) to carry out technology transfer to the Malaysian counterpart personnel through on-the-job training in the course of the Study.

1.1.4 Study Area

The study area shall cover 5 existing granary schemes consisting of (1) IADP Pulau Pinang Scheme, (2) IADP Kerian/Sungai Manik Scheme, (3) IADP Seberang Perak Scheme, (4) IADP Kemasin Semerak Scheme and (5) IADP Ketara (Besut) Scheme in Peninsular Malaysia.

1.1.5 Activities of the Study Team

The Study consists of two phases. The Phase-I Study was conducted from February to August 1997 for formulation of a master plan for the five(5) granary areas. The Phase-II Study was carried out from September 1997 to March 1998 for making a feasibility study for the three(3) priority schemes selected through the Phase-I Study. During the Phase-II Field Work in Malaysia (September to December 1997), the JICA Study Team supported DID for implementation of the pilot project in Besut Scheme. During these study periods, the Study Team prepared and submitted Inception Report in February 1997, Progress Report (I) in May 1997, Interim Report in August 1997, Progress Report (II) in December 1997 and Draft Final Report in March 1998. The Minutes of Meetings on these reports held with the Malaysian Government are attached hereto as Attachment 3 to 7. At the end of May 1998, a seminar was conducted by JICA as the technology transfer program to the Malaysian counterpart personnel. The seminar consisted of 2-day lectures and 1-day study tour to the Besut pilot project.

1.2 General Economic and Agricultural Background

1.2.1 Land and Population

Malaysia lies between latitudes 1 degrees and 7 degrees north and longitudes 100 degrees and 120 degrees east, comprising Peninsula Malaysia and the two(2) states of Sabah and Sarawak on the island of Borneo. The country covers a total land area of 329,758 km^2, with Peninsular Malaysia covering about 131,598 km^2 and Sabah and Sarawak totaling around 198,160 km^2. The land boundaries total 2,669 km with border countries of Thailand(506 km), Indonesia(1,782 km) and Brunei(381 km). The lands are occupied mainly by forest and woodland(63 %) followed by permanent crops(10 %), arable land(3 %) and others.

Malaysia lies entirely in the equatorial zone. The climate is governed by the regime of the north-east and south-west monsoons which blow alternately during the course of the year. The north-east monsoons blows from approximately October till March, and the south-west monsoon between May and September, the periods of change between the two monsoons being marked by heavy rainfall. The north-east monsoon coming from across the open South China Sea is responsible for the heavy rains which hit the east coast of the Peninsula and frequently cause widespread floods, particularly between December and February, and likewise cause the wettest season in Sabah and Sarawak. Only Kedah and Peris, lying too far north to be properly affected, go through a dry spell during this period. On the other hand, the period of

the south-west monsoon is a drier period for the whole country, particularly for the other states of the west coast of the Peninsula. The average annual rainfall is between 2,000 mm to 2,500 mm, and the average temperature throughout the year is constantly high, about 26 °C.

The population of the country was estimated at approximately 20 million in 1996, and nearly 80 % of the total population lives in the 11 states of the Peninsula. Malaysia is a multi-racial country made up of a mixture of ethnic groups which are dominated by Malay(58 %) followed by Chinese(26 %), Indian(8 %) and others.

1.2.2 National Economy

During the two and half decades since 1970, Malaysia has achieved significant progress in economic growth as well as in meeting its social objectives. The nation was able to sustain its pace of development, with Gross Domestic Product (GDP) growing at an average rate of 6.7 per cent per annum during the New Economic Policy (NEP) period, 1971-1990 and 8.7 per cent during the Sixth Plan period (1991-1995). During the last eight years since 1988, the economy's performance has been even more impressive with a sustained high growth of 8.9 per cent per annum.

Following a period of rapid expansion in the last eight years, the Malaysian economy is estimated to expand at a more sustainable pace in 1996. Real Gross Domestic Product (GDP) is envisaged to register a slower growth of 8.2 % in 1996 (1995 : 9.5 %), with the rates of growth in all sectors expected to moderate from the high levels achieved in 1995. The main impetus to growth continues to come from the manufacturing sector, which is envisaged to record a double-digit growth, while the services and construction sectors are also envisaged to perform better than the national average growth. However, output growth of the primary sector is expected to be lacklustre, with the growth of the mining sector expected to decelerate. In line with the GDP growth, nominal Gross National Product (GNP) continues to increase by 13.1 % to RM 235.3 billion. Concomitant with the increase in GNP, the per capita income of the population is envisaged to rise by 10.5 % to reach RM 11,118. In terms of purchasing power parity, the per capita income is equivalent to US$ 12,508, an increase of 10.4 % from the 1995 level.

The economy is envisaged to continue to record a more sustainable level of growth in 1997. The nation's resource position is envisaged to improve, with the level of domestic demand being more compatible with the level of national output. At the same time, the rate of national savings is envisaged to increase further. This will enable a significantly larger portion of domestic investment to be financed from national savings and thereby, reduce the need for the nation to resort to external funds for financing economic growth. The nation's balance of payments position is also expected to improve further in 1997, with the current account recording a smaller deficit. Inflation is expected to remain low as expansion of domestic demand for consumption goods and services is expected to be moderate. Thus, the fundamentals of the Malaysian economy are expected to strengthen further in 1997, with the economy maintaining a high level of sustainable growth against a background of low inflation and improved balance of payments position.

1.2.3 National Agricultural Policy (NAP)

Malaysian agriculture is now facing acute labor shortages, limited availability of suitable land and increasing cost of production arising from intersectoral competition for resources as well as intense competition in the global market resulting from the trade liberalization. However, the role of agriculture will remain strategically important as a provider of food and raw materials for the agro- and resource-based industrial development.

The agricultural sector's share to GDP declined from 18.7 per cent in 1990 to 13.5 per cent in 1995. Nevertheless, in absolute terms, the total value added of the sector continued to increase significantly from RM 14,827 million in 1990 to RM 16,406 million in 1995. At the same time, the sector's contribution to total export earnings and employment declined from 22.2 per cent and 26 per cent to 13.1 per cent and 18 per cent, respectively. The share of agricultural industrial commodities to total agricultural value-added, declined from 73.5 per cent in 1990 to 68.5 per cent in 1995. On the other hand, the better performance of food commodities, mainly fisheries and livestock, resulted in an increase in their contribution to total agricultural value-added from 18.4 per cent to 21.4 per cent during the same period. The palm oil subsector remained the major contributor to the sector's growth, accounting for 41.5 per cent of the overall agricultural value added in 1995. Although the shares of the livestock and fisheries subsectors to total agricultural value added were only 5.1 per cent and 12.2 per cent, respectively, these subsectors contributed substantially to the overall growth of the sector. Regarding the paddy subsector, its contribution to the sector was only 4.1% in 1995.

The total physical paddy area in Malaysia is estimated to be 598,483 ha of which 379,469 ha are located in Peninsular Malaysia with the remaining in Sabah and Sarawak. Wet paddy constituted 85 per cent of the total paddy area in the country and the remaining 15 per cent were made up of hill paddy. In Peninsular Malaysia, 76 per cent of the area is provided with extensive irrigation and drainage facilities while only 15 per cent of the area in East Malaysia is irrigated. Of the irrigated areas, approximately 217,000 ha are designated as granary areas and another 28,000 ha are classified as mini-granary areas.

Over the 1991 - 1995 period, the country recorded an increase in total paddy production and average yield and a marginal decline in total planted area. Total paddy production increased from 1.9 million metric tons in 1991 to 2.1 million metric tons in 1995 while national yield recorded an increase from 2.8 mt/ha to 3.2 mt/ha during the period. The eight(8) main granary areas which accounted for more than 70 per cent of paddy production recorded an increase in yield from 3.7 mt/ha in 1991 to 4.0 mt/ha. Over the same period, domestic production accounted for about 77 per cent of the total domestic consumption. In 1995, importation of rice amounted to 427,570 metric tons valued at RM 356.1 million. Per capita consumption of rice declined marginally from 90.3 kg in 1991 to 86.9 kg in 1995.

The New Development Policy (NDP) and Vision 2020, together, is a significant departure from the development emphasis and thrusts of the last twenty years. An economy that is built on the philosophy of vision 2020 must have component sectors which are equally vigorous and dynamic. The first National Agricultural Policy (NAP, 1984) was promulgated for the gradual liberalization of the agricultural sector. The emphasis then was to continue on new land development and consolidation of uneconomic farm size through in-situ development.

Stressing productivity driven growth, the policy recognizing the need for the sector to be efficient in order to sustain agricultural growth in the long run.

The period of 1984 -1990 marks an important threshold in the transformation and development of the Malaysian economy. This era saw the rapid expansion of the manufacturing sector and altered the relative importance of the agricultural sector. The overall development of the agricultural sector was beset with problems including labor shortages and increasing wages, and increasing competition for land for other uses. Favorable policies towards industrialization also created biasness against agriculture and consequently led to the flow of investment resources out of agriculture. Subsequently, the first NAP was reviewed and a second NAP (1992 - 2010) was introduced. Greater emphasis was given to address productivity, efficiency and competitiveness issues in the context of sustainable development and linkages with other sector of the economy.

During the period of 1990 - 1995, structural changes in the economy and development at the international level posed new challenges to agriculture. This calls for the formulation of new policies and strategies, and at present NAP3 (1997 - 2010) is being prepared, which will outline policies and strategic directions for the continuance of the production of rice as a strategic crop for food security. Support measures will be repackaged with the view of restructuring the industry towards enhancing its economic viability consistent with government's efforts to liberalize the industry in the long term.

The objectives of the rice industry are ; (i) to ensure a minimum self-sufficiency level (SSL) of 65 per cent, (ii) to increase production of higher quality, specialty and fragrant rice, and (iii) to maintain strategic quantity of rice stockpile. The strategic directions are as follows :

(1) Rationalizing resource use
   - Designating paddy producing areas
   - Utilization of unproductive paddy areas
(2) Increasing efficiency and productivity
   - Increasing farm yield and cropping intensity
   - Improving production structure
   - Greater participation of private sector
(3) Strengthening competitiveness/liberalizing industry
   - Reforming the rice industry
   - Repackaging price and fertilizer support program
(4) Strengthening economic foundation
   - Strengthening the institutions and support services
   - Encouraging off-shore investment
(5) Promoting sustainable development
   - Ensuring sustainable development