ANNEX-III

WATER MANAGEMENT AND OPERATION & MAINTENANCE

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III. WATER MANAGEMENT AND OPERATION & MAINTENANCE

1. INTRODUCTION

1.1 General

Into the 21st century, higher production levels of the Granary areas will not be achieved through spatial expansion nor major intensification and investment in irrigation infrastructure (as in the 60s, 70s and early 80s). The present strategies will center on modernization of irrigation systems management for improved performance and increased productivity. Consequently, the aim will be to provide a system that is operated by a compact team that is highly skilled and complemented by modern technology applications. The system will serve fewer farmers but operating larger farm sizes, fully mechanized and with higher farmers' participation in systems O&M than now. The modernization process will seek to strengthen coordination between system operators and the farmers. This will ensure that the modern granaries will be effectively managed as "paddy factories." To achieve this, the water management system and facilities must be to ensure data accuracy and timeliness of operations within a season and in between seasons. This forms the basic objective of granary irrigation systems management that is to "ensure adequate and timely supply and removal of water for paddy production, twice a year every year."

2. PRESENT CONDITION

2.1 Organization Structure

The Granary management is presently led by the IADP Project Management Unit (PMU) which reports directly to the Ministry of Agriculture (MOA) (Fig. III-1). Under the PMU are the respective implementation agencies. The two major components are the Department of Agriculture (DOA) and the Department of Irrigation and Drainage (DID). These three set-ups i.e. the PMU, DOA and DID are staffed and financed by the Federal Government. The other members of the PMU co-opted from the local offices are the Farmers' Organization Authority (FOA), the Agriculture Bank and Padi Beras Nasional Bhd. (BERNAS) (established upon the corporatization of the National Padi and Rice Board (LPN)).

The design and construction of the irrigation and drainage system in the Granaries is by the DID component of the IADP PMU. Upon completion, the system is handed over to the respective State DID through a commissioning process. The subsequent operations and maintenance (O&M) is the responsibility of the local District DID office. The DID headquarters continue to provide technical support, advise, coordination through the existing Federal and State DID linkages.

The District DID office is not just specifically for the O&M of the Granary Schemes but cover all functions of the DID namely irrigation, drainage, river engineering, coastal engineering and hydrology. For irrigation, the O&M scope also cover non-granary schemes

within the boundary of the District. However, in all the Granary area, irrigation O&M is a major function compared to other functions and the higher proportion of staff and financial allocation for irrigation within the office structure reflect this.

The O&M of irrigation schemes is headed by the District Engineer assisted by a Technical Assistant. The field staffs (those putting in 100% of their work time on irrigation function) are the Irrigation Inspectors (IIs), Irrigation Technicians, pumphouse operators and the linesmen or gatekeepers.

For irrigation administration, each scheme is divided into smaller areas defined by physical boundaries such as roads, rivers, canals and drains and that each area are with independent intake for water supply and drainage outlet. The terms applied to sub-divide a granary area for irrigation administration are Scheme, Block, Compartment, Irrigation Service Area (ISA) and Irrigation Service Unit (ISU) (Table III-1 to III-2). Usually, the ISU is the smallest irrigation administrative unit in a particular scheme.

On farm water management is the purview of the Agriculture Component and coordinated with the State Agriculture Office. It is one aspect of introducing good farm practices for improved yields and this is promoted through Farmers' Groups formed and managed by the DOA. DID field staffs provide supporting role in farmers training and water supply coordination aspects.

2.2 Water Management System

(1) Telemetric system, central control station and automation

With the exception of Kerian scheme, none of the granaries have installed telemetric system for irrigation and drainage system management. The rainfall data collected are not for immediate consumption for irrigation operations but for compilation by the Hydrology Division.

Daily operational activities appear not to be coordinated from a single control center (except for Kerian scheme). In some instances, field staff contact structure operators direct for their supply and water level requirements. The mode of communication is usually by telephone. Where available, VHF radio sets are used.

Automation plans are still conceptual. The Mechanical Services Division of the DID has plans to test some automation parts particularly for gated structures (such as tidal gates) and pump stations.

(2) Water User Groups

In 1997 the DID initiated a program for the formation of Water User Groups (WUGs) in irrigation schemes. Guidelines for the formation of the WUGs is already prepared. The Besut Scheme in fact began a pilot project on WUG at Kubang Depu earlier in 1996. IADP Pulau Pinang and the Kerian Scheme has just implemented a WUG pilot project each at the end of 1997 (Table III-1).

(3) On-farm water management

Good on-farm water management infrastructure and practices is well recognized as very important factor for yield improvement. With the adoption of direct seeding, farmers have, to a limited extent, undertook some form of land leveling for improve water depth control in their field. They are however not prepared to invest in proper land leveling works. Instead their effort is mainly to move soil to cover serious depressions detected during the previous season and this is carried out during land preparation for the next planting. The level accuracy is low. To accelerate this process, the DOA initiated a land leveling and field channel construction programs. The land leveling specification is for zero grade with +/-5 cm accuracy. The field channels (45cm x 30 cm x 60 cm depth) is for faster water application and removal as well as better depth control. These programs are presently implemented on a demonstration basis only using Departmental machinery. However there are plans to extend this program by encouraging the Area Farmers' Association (PPK) to participate and for farmers to pay for part of the cost.

(4) National Water Management Training Center (NWMTC)

The NWMTC trains farmers and systems operators on water management. In 1991 it introduced an Irrigation System Management Course which emphasize on human resource development and management skills for managers and farmers. NWMTC also conducts in-situ collective training programs for IADP Besut and IADP Kerian/Sg. Manik.

2.3 Operations and Maintenance

(1) Operations and Maintenance Procedures

In 1989, the DID produced "A Guide for Operation and Maintenance of Irrigation and Drainage Projects". The existing O&M procedures are mostly based on systems planned for transplanting culture. Now all the areas are nearly 100% direct seeded except for Kerian Laut part of the Kerian scheme where transplanting is still the method of planting paddy. Actual systems operations procedures were adjusted to suit the direct seeding culture. This change however was not systematically monitored and documented. As a result the present systems management rely considerably on staff experience and judgement. Over time too, the original database and monitored O&M parameters have become outdated or disorganized.

The level of database, operations procedures and monitoring system varies greatly between the offices. There is also a lack of documented operating procedure for the overall system of a granary. There are designer's O&M manual but these are mostly for specific tertiary level projects only. Commissioning reports are not all available.

The key monitoring parameters are Full Supply Level (FSL) values and a subjective evaluation of depth of water in the field. Flow rates and volume are poorly recorded. Gate settings are based on tabulated figures in the operation manual.

Most schemes do not have well documented drainage O&M procedure.

(2) Operation

The operations framework is defined by a the start time and ending time of a season. The water supply date for presaturation is still the pivot for determining start times of all preceding and succeeding farming activities. Generally, irrigation period over a season is between 100 to 145 days. Water is drained about two weeks before harvest.

The cropping schedule is planned in concurrence with the local rainfall pattern such that harvesting is during the dry period and planting and growth stages in the wet months. Within a season, water is supplied over a specific area in schedules and, within a schedule, the supply is staggered (i.e. for a smaller area, over a shorter duration and in sequence).

Farmers' non-compliance to schedules is a major issue in all areas.

(3) Maintenance

The reference "A Guide for Operation and Maintenance of Irrigation and Drainage Projects" provides a comprehensive guide to maintenance approach for the various structures and system components. In addition, the Mechanical Services Division services plants such as pumps and gated structures.

Maintenance work is mostly through contracts (works costing over RM 50,000), quotations (works above RM 20,000 but less than RM 50,000) and indents (works below RM 20,000). The remaining works are by the DID staff. Only registered (with the Government) contractors qualify to participate in the contracts and quotation works. The local PPK usually has preference over other contractors. Channel clearing is through indents. The local Village Security and Development Committee (*JKKK*) and the Farmers' Groups are given preference to undertake these works. Usually, channel clearing is performed in 3 to 5 cycles a year. The number of sites and indents administered by the DID is quite large. It is estimated to be over 500 in IADP Pulau Pinang to well over 1000 sites in Kerian Scheme every year. Apart from being necessary for channel efficiency maintenance, the concept for this approach is to provide income opportunity for the locals and to inculcate a sense of participation in the system O&M works.

Major problems pertaining to farmroads are surface damages by heavy machinery.

The Federal government bears all maintenance and repair cost of the system until it is commissioned and handed over to the State government. Subsequently, the State finances the maintenance works. For these expenditure, the State government may seek 50% reimbursement from the Federal government but not exceeding the approved budget.

Landowners in gazetted irrigation areas are charged irrigation rates annually. The rates vary between States (Table III-3) and collected by the Collector of Land Revenue of the District Office. Records of gazetted areas, actual rates charged and amount collected annually are not kept by the DID.

Data and information on maintenance are often kept for financial reporting and office budget monitoring. Thus detailed expenditure records for specific system components are not

readily available.

(4) O&M Cost and staffing

In 1996, the Irrigation Division began an O&M survey for all irrigation schemes in Peninsular Malaysia. Based on this, the range of O&M cost (1994 and 1995 data) estimated for the granaries is between RM 100/ha. to RM 230/ha. (Table III-4 to III-5). The staff cost is estimated to be between RM 70/ha. to RM 180/ha. (Table III-6). The overall O&M staff density is estimated at between 10 staff/1,000 ha. to 20 staff/1,000 ha. (Table III-7).

2.4 IADP Pulau Pinang

The Granary Areas system O&M is by the Seberang Jaya DID District Office. This office comprise the Seberang Perai Utara (SPU) sub-District which covers the Sg. Muda, Pinang Tunggal and Sg. Jarak Schemes and the Seberang Perai Tengah (SPT) sub-District which manages the Sg. Kulim schemes. Each scheme is further sub-divided into blocks (Table III-8 to III-9). Not all the irrigation blocks are designated as Granary areas.

All the paddy areas in this granary is said to be gazetted. The irrigation rates ranges between RM 9.88 to RM 34.59 per ha. (RM 4.00 to RM 14.00 per acre). These records are not available in the DID Office.

The system design module is 2.60 l/s/ha for a 15 day presaturation period at farm level. The module for normal irrigation is 1.30 l/s/ha. For actual irrigation supply estimate, distribution efficiency is assumed to be 95% and field application at 75%.

For drainage, the module adopted is 8.5 l/s/ha (78 cusec/sq. mile) for 1 in five year and 72 hours storm duration.

Farm offtakes installed serve about 3 ha. farm lots. The pipe sizes used are 80 mm, 100 mm and 150 mm with capacities of 15 l/s, 18 l/s and 22 l/s at command of 230 mm respectively. For drainage, 300 mm pipe diameter drainage outlets are provided.

Up to December 1996 nearly 90% of the tertiary development of this granary was completed. The Commissioning Section of the DID Component leads the commissioning process together with the O&M staff of DID Seberang Perai District. Designer's operation manual are available but the documented overall scheme operations and maintenance procedure are not available.

The irrigation supply is divided into four schedules I, II, III and IV beginning with schedule I for areas at the most downstream portion of the system and progresses sequentially upstream with the other schedules. The interval between each schedule is 10 days and the presaturation period within a schedule is 10 days. The total supply period from presaturation start to stop supply is about 95 days for the main season and 105 days for the off-season. The design water depth in the field is 100 mm.

To simplify administration, these schedules are fixed to begin as follows:

Planting Schedule Start Dates

Schedule	Main Season	Off-season
I	1 September	15 March
II	10 September	25 March
III	20 September	5 April
IV	30 September	15 April

These dates as well as dates for other activities namely broadcasting completion, water supply cut-off, drainage and end of harvesting are gazetted by the State Authority under the Rice Cultivation Ordinance (S.S. Chapter 145).

There is no central control section for O&M. Designers' Operations Manual for the system are available but these are for reference only. Field staff rely totally on experience and judgement for operations and guided by gate openings reference book. Coordination with farmers is through the Farmers' Groups managed by the DOA.

The average O&M cost (1994 and 1995) for these schemes (excluding Sungai Burung) is between RM 100 to RM 230/ha. (Table III-4). In 1997 a major decision was made to award a single contract the State Farmers' Organization Authority for channel clearing works. Prior to this, the DID Office had to administer over 500 indent works annually. Breakdown of O&M cost are shown in Table III-10 to III-17.

Currently a performance assessment program is being implemented but is still at its early stages. The indicators selected for this granary are Relative Water Supply (RWS), Cropping Intensity (C.I), Maintenance Cost (RM/ha), and Water Productivity Index (WPI).

There are no telemetry system for irrigation system management the project area. However there is one pilot flood warning telemetry system for the State of Pulau Pinang. Another is planned for water resource. Telecommunication between central office and main gate stations/pump stations is by telephone lines.

A program for the formation of Water Users' Groups (WUGs) began at the end of 1997. The total WUGs targeted is 128 with 7 planned for 1997 and 73 in 1998 (Table III-18). This exercise is seen as a strategic move to organize all the farmers in the IADP area since about 20% of the farmers have abstained from joining the Farmers' Groups. These abstention are mostly by advance farmers operating large farms and more on a commercial basis. However, since water is a common issue and an important input, all these farmers have no option but to participate in the activities of the WUGs. Since the committee members of the WUGs will be from the Farmers' Groups, the non-members would indirectly be involved in the planning decisions of the Farmers' Groups. Whilst ideally the WUG boundary should be concurrent with the boundary of Farmers' Groups, initial indications are that reorganizing the Farmers' Groups in this manner may not be entirely possible. This is mainly due to the strong member coherence and financial status of some of the groups. Under this circumstance, some WUG boundaries will overlap with respect to Farmers' Group boundaries. This will be overcome through representation of the committee member in charge of water management from the overlapping Farmers' Group into the WUG.

The status of land leveling program is shown in Table III-19 to III-22. There are over 13,500 paddy lots in IADP Pulau Pinang. Assuming that all these lots need to be leveled to the DOA specifications, the present progress can be considered as very low since only 858 ha. or

just 10% has been leveled. The remainder 90% (8,594 ha. out of 9452 ha.) still need leveling. There are no records of in-field channel construction but feedback form PMU IADP Pulau Pinang indicated that the progress is also very low.

2.5 IADP Kerian-Sungai Manik

(1) The Kerian Scheme

The O&M of this sub-project is the responsibility of DID Kerian District. The density of staff on irrigation for this scheme is 11 staff/1000 ha. and costing about RM 100/ha. (Table III-23). Field staff (those spending 100% of their time on irrigation O&M) strength is 198 (Table III-24) and led by a Senior Irrigation Inspector.

The Kerian irrigation administration is divided into two regions, Kerian Laut and Kerian Darat. These are sub-divided into compartments, 4 in Kerian Laut and 4 in Kerian Darat (Table III-1). Each Compartment is further divided into blocks. These are primarily service blocks defined for extension services. Further subdivision are ISAs (84 nos.) and ISUs (471 nos.).

The Kerian Scheme is gazetted as an irrigation area. The irrigation rates charged to landowners here ranges between RM 7.41 to RM 12.36 per ha. (RM 3.00 to RM 5.00 per acre) in the Perak State and RM 9.88 to RM 34.59 per ha. (RM 4.00 to RM 14.00 per acre) in the Pulau Pinang State (Block A (PP). These records are not available at the DID Office. The average O&M cost (1994 and 1995 data) for this scheme is about RM 200 to 213 per ha. (Table III-4).

The "managed-as-planned" procedure was adopted in 1986. Field staff observes water conditions in the field, record planting activities and report once a week to the Control Unit formed in 1991 in Bagan Serai. Estimation of water requirement is based on a presaturation module of 2.40 l/s/ha. (30 ac/cusec) and supplementary module of 1.20 l/s/ha. (60 ac/cusec). Water requirement is forwarded to the control unit three days in advance.

The operations system is supported by a telemetry system. Telecommunication and the telemetry system use the 150 MHz band radio links.

Farmers non-compliance to schedule appears to be an inherent problem particularly in the Kerian Laut area. This is due to its topographical nature as low lying thus suffer from drainage problem. Transplanting is still practiced in this area and therefore complicate water supply and management. The DID has started a pilot project for polder drainage in this area and will implement this project later for about 4,000 ha.

Maintenance of the irrigation and drainage channels is performed on a fixed cycle of 4 to 5 times a year. Almost 80% of the clearing works is undertaken by farmers and the remaining 20% by DID staff. The rate is at RM 0.01776/m^2 (RM 0.00165/ft^2). Typically the DID office administer over 1,000 indent works annually totalling RM 1.4 million. The overall O&M cost (1994 and 1995) is about RM 200/ha. (Table III-5). Breakdown of O&M cost are shown in Table III-25 to III-26.

Performance assessment program is already implemented here. The indicators selected

for this scheme are Relative Water Supply (RWS), Cropping Intensity (C.I), and Water Productivity Index (WPI).

In December 1997 a Pilot Project on Water Users' Groups (WUGs) was launched in Telok Pancor. The overall implementation program is still being formulated. The total number of WUGs to be formed is 84 (Table III-18).

For on-farm water management improvement, land leveling and on-farm ditches program have been implemented over the last 10 years particularly to improve drainage in the Kerian Laut areas. Overall progress is still relatively low. Out of a total 16,641 lots (23,560 ha.) just over 20% (3,990 lots, 5,171 ha.) have been leveled (Table III-27). For in-field channels, 213 km is already constructed and another 1,400 km is planned by the year 2000.

(2) Sungai Manik Scheme

The operation and maintenance of Sungai Manik Scheme is the responsibility of DID Hilir Perak. The field staff density is estimated at about 20/1,000 ha. and costing RM 150/ha. (Table III-7). This scheme comprise two sub-schemes namely Sungai Manik sub-scheme and Labu Kubong sub-scheme. Each scheme is further sub-divided into blocks, 3 in Sg Manik and 2 in Labu Kubong (Table III-1).

This scheme is said to be gazetted. The irrigation rates are between RM 7.62 and RM 12.70/ha. (RM 3.00 to RM 5.00 per acre). Records pertaining to these are not kept by the DID.

Irrigation start dates are fixed for every season. For season 1, supply starts on 15 Jan for Sungai Manik scheme followed one month later on 15 Feb. for Labu Kubong. For season 2, the supply dates are 15 July and 15 Aug. respectively. These dates are gazetted.

The is no central control for irrigation management and scheme operational procedure is not available. Its O&M procedures depends mostly on field staff experience and judgement.

There is no telemetric system in this sub-project. Communications between central office and headwork is by telephone only.

In order to overcome the shortage of water at the downstream sections of the scheme, 13 mobiles pumps deployed.

O&M cost is estimated at about RM 145/ha. (Table III-5). The typical costs of O&M of channels and structures are shown in Table III-28. Channel clearing is performed every two months by farmers through the respective JKKK at the rate of RM 0.01776/m^2 (RM 0.00165/ft^2).

A performance assessment program has begun and the indicators adopted are Relative Water Supply, Water Productivity Index and Cropping Intensity.

A Water User Group formation plan is under study. A model being considered is the one practiced by farmers in Chui Chak.

Land leveling program has been initiated by the DOA but it is still relatively low. The total number of lots to be considered is 3,499 lots.

2.6 IADP Seberang Perak

The O&M of this granary is the responsibility of DID Perak Tengah located at Bandar Sri Iskandar. However the O&M staff for the scheme is based at the DID Project Office complex in Sungai Dedap. The scheme is divided into 2 command areas namely Right Bank Canal (RBC) and Left Bank Canal (LBC). It is further sub-divided into blocks, 4 (Blocks A,B,C,D) in LBC and 3 (Blocks E,F,G) in RBC (Table III-1). FELCRA is responsible for the operations of the tertiary system within their area. The staff density is 14/1000 ha. and costing RM 85/ha. (Table III-6, III-29).

The scheme is apparently not gazetted.

Season 1 begins in February until mid-July and season 2 from August to early February. These dates and other field activities are gazetted.

There is no updated systems operations manual for this scheme. The O&M staff rely mainly on their experience and judgement in managing the system. The main daily monitoring parameters are the water levels in the Perak River and the main and secondary canals. The main intake point is at Teluk Sena.

There is no telemetry system for irrigation in this scheme. The only water level telemetry station in Teluk Sena is for flood level monitoring only. Communications between Teluk Sena and the main office is by telephone. There are no telephone links between the tidal gates and the main office.

The design duty is 5.75 l/s/ha. (12.5 acres/cusec) for 7 days presaturation at the farm lot level. Normal supply duty is at 1.2 l/s/ha. (60 acres/cusec). For irrigation scheduling, the RBC and LBC areas are divided into 3 schedules namely I, II and III at 14 days interval between schedules. In each schedule, the supply is staggered into 2 with 1 week difference between staggers.

At the farm level, 150 mm diameter offtake is provided to serve 2 lots totalling 2.4 ha (6 acres). The maximum capacity is 22.6 l/s (0.80 cusec) for a command of 300 mm. The type used here is the double flap type.

Drainage module adopted here is 7.5 l/sec/ha (68 cusec/sq.mile) for a 1 in 5 years return interval and 48 hours duration.

Performance assessment program is not yet implemented here but this scheme has been selected to be the first scheme to work towards obtaining ISO 9002 certification.

Channel clearing works are awarded to either Village Heads, Block Heads or the Area Farmers' Organization. The rate is RM 0.01776/m^2 (RM 0.00165 / ft^2). This is carried out on 4 cycles per year.

The annual O&M cost is estimated to be at RM 123/ha. (Table III-5). Typical O&M cost for channels and structures are shown in Table III-30. Thus the average O&M cost for this scheme is RM 123/ha.

There are no Water Users' Groups (WUGs) formed in this sub-project.

Land leveling program has not been formalized. The total number of lots involved is

6,008 lots.

2.7 IADP Kemasin-Semerak

Irrigation development for this scheme is divided into 2 phases. Phase 1 is the Kemasin area comprising the Jelawat Rusa Scheme and Lower Kemasin Scheme. Phase 2 are the schemes in the Semarak area in the south. The Lower Kemasin (1384 ha) and Jelawat Rusa (261 ha) schemes were completed in 1991/92. These schemes are still under the responsibility of the Project Office and not handed over to the State DID. Upon completion, DID Bachok is expected to take over its O&M of the Kemasin schemes and DID Pasir Putih the Semerak Schemes. Using the present DID Pasir Putih set-up, the staff density is estimated to be 21/ha. costing RM 140/ha.

The Lower Kemasin Scheme is divided into blocks (about 60 ha each) (Table III-1). Each block is further divided into Service Units (SUs) about 12 ha. each and with independent intakes. In turn, each SU is divided into 4 plots of nearly equal size. This area size is to achieve presaturation in 10 days. The design capacity is based on peak irrigation duty of 2.06 l/s/ha for 40 days presaturation period. For the Jelawat Rusa Scheme, the area is divided into Zones, each with its own independent irrigation and drainage system. Further area sub-division is as per Lower Kemasin Scheme. The irrigation design duty is also similar.

The planting season follows KADA and is set at 2 weeks after the season start for KADA. For season 1/96, water supply date was on 15 April and supply cut-off on 12 August. For season 2/96 in the Jelawat Rusa and Kemasin Hilir Schemes, supply was on 1 October and cut-off on 15 February.

There is no telemetry system installed. Telecommunications between the central office, one tidal gate station, eight pump stations and one mobile pump station is by 150 MHz band radio links.

Irrigation development for the schemes in the Semarak area has not begun. Presently, these schemes are either with inadequate irrigation facilities or rain-fed areas managed by the DID Pasir Putih District and the DOA. Present O&M cost is estimated at RM 50/ha. (Table III-5) but this is expected to double to about RM 100/ha. upon increased channel densities of the new system.

Performance Assessment Program has just begun and the indicators selected for this scheme are Relative Water Supply (RWS), Presaturation Time Requirement (PTR), Cropping Intensity (CI), and Water Productivity Index (WPI).

Water User Groups have not been planned yet.

For land leveling, the total number of lots involved will be 16,641 lots.

2.8 IADP Ketara (Besut)

The Besut scheme is managed by DID Northern Terengganu District. The scheme is divided into 4 Compartments. Each is sub-divided into ISAs and within each ISA are blocks

(Table III-1). The irrigation staff density is 11/1000 ha. costing RM 70/ha. (Table III-6, III-31, III-32).

The scheme is gazetted as an irrigation area. Irrigation rates imposed here is RM10.16 per ha.(RM 4.00 per acre) (Table III-3).

Season 1 starts in March and ends in August whilst season 2 begins in September and ends in February the following year.

For irrigation supply schedules is referred as Phase I and Phase II areas. Phase I comprise Compartments 1, 2/1 and 4 and Phase II compartments 2/2 and 3. There are two main intakes. One is the Besut Barrage serving compartments 1,3 and 4 (total area 3,781ha.). The other intake is the Angga headworks serving compartment 2 (1,319 ha.).

Water supply is in two schedules. Phase I is supplied first for presaturation time of 14 days at 2.94 l/s/ha. After 14 days, Phase II area supply begins at the same rate. After presaturation, the irrigation duty is reduced to 1.2 l/s/ha (60 ac/cusec). Total irrigation period is about 150 days.

Water supply adequacy is sensitive to the water levels at the Besut and Angga barrages.

The annual O&M cost for this scheme is about RM 180/ha. (Table III-5). Table III-33 to III-34 show typical costs of O&M of channels and structures. Clearing works are given to the Farmers' Groups.

Performance assessment program is still at its early stages. The indicators selected for this project are Relative Water Supply (RWS), Cropping Intensity (CI) and Water Productivity Index (WPI). Initial findings for WPI are 0.168 kg/m^3 for compartment 2 and 0.067 kg/m^3 for compartments 1,3 and 4.

No telemetry system exist for monitoring the irrigation and drainage network in this scheme. Telecommunication between the central office and main gate station/main pump stations is by telephone.

To improve water management, the Besut scheme begun to reorganize farmers' groups based on the command area of an intake. This scheme is the only granary implementing the formation of Water Users' Group. Under this exercise the number of ISAs were reorganized into 30 WUGs. The National Water Management Training Center (NWMTC) provided consultancy services for the WUG pilot project at Kubang Depu.

Land leveling program has just begun. Out of a total 5,790 lots (5,174 ha), 5,210 lots (4,656) need land leveling. Of these only 30 lots (23 ha.) have been leveled. Status of land leveling and in-field channel works is shown in Table III-35.

3. MODERNIZATION PLAN FOR WATER MANAGEMENT AND OPERATIONS AND MAINTENANCE (O&M)

3.1 General

(1) National definition of Granaries and database standardization.

The physical boundaries of each Granary must be clearly defined. At the same time definitions and terminologies referring to the administrative structure of the Granaries must be standardized and adopted by all agencies involved in their management. Some of the terminologies that appear to have different connotations between agencies are Granary Areas, Gross Areas, Net Areas, Paddy Parcel Areas, Irrigable Areas, Lot, Paddy Lot, and Plot. Some of these areas may change over time. Thus a base year must be defined so as to effectively monitor performance and changes. All lots, owners, farmers, Farmers' Groups, Water Users' Groups, Paddy mini-estates within the Granary must be registered and the registrar be maintained and kept. This register and all information should be structured based production areas namely Scheme, Compartments, Blocks, ISAs and ISUs.

In addition to the above, a register of land preparation and harvesting contractors should be maintained.

The Paddy Production Statistic Committee whose secretariat is based is DOA should be responsible for this exercise. It should work closely with the respective IADP PMUs.

(2) Gazette the Granary schemes under the Irrigation Act.

The present status of the Granaries with respect to Irrigation Act must be reviewed and all these areas must be gazetted. Although the District Office will continue to collect irrigation rates, the DID should keep a record of all gazetted lots and the annual irrigation rates collected. A record of irrigation rates imposed, total amount collected and a comparison with annual actual O&M cost should be published or made known to the farmers through the PPK. This is to sensitize farmers' and systems operators on irrigation O&M. In time, the difference between cost and farmers' contibution could be used to justify a review of irrigation rates.

A register of Water User Groups should be kept and maintained. This is with a view to subsequently register them as Irrigation Groups as proposed under the review of the Irrigation Act.

The DID should initiate this exercise with the cooperation of State Government.

(3) Gazette the Granary as Farmers' Development Area.

This proposal is subject to adoption of the proposal for LPP to take the lead in Granary management. Refer to Chapter 3. In any case the LPP and the respective PPK should integrate their registrar of farmers in the Granary based on the same as proposed above to the Paddy Production Statistics Committee.

The LPP should initiate this program with the cooperation of the Paddy Statistics

Committee.

(4) Develop a National standard performance assessment indicators and procedures for the Granaries.

The target for the Granaries is to achieve 65% self-sufficiency level. Present practice is to assess yield and estimate production. A more comprehensive procedure should be developed which may include cross-checking with paddy sales by farmers. The data should be able to positively identify high and low production areas within each Granary. The performance indicators would be total granary production vs. 65% self-sufficiency level, total granary production vs total National production and individual Granary contribution to National total.

Other performance assessment indicators related to modernization that reflect Granary efficiency are timeliness of field activities (planned vs. actual dates), input-output comparison (yield vs fertiliser; yield vs other chemicals) and cost related indicators. The DID has initiated a performance assessment program and the indicators adopted are Relative Water Supply, Water Productivity Index and Cropping Intensity.

As these relates to national level statistics, the Paddy Production Statistic Committee should take the lead and supported by the IADP PMUs.

3.2 Water Management

(1) Irrigation database and information system

A comprehensive database and information system are necessary for the modernized Granary irrigation management. Experience has shown that interest in during database system set-up is high at the on-set of the project but decline rapidly upon commissioning and subsequent management. The monitoring and updating exercises are often neglected. The database design should thus be for key data only, maintained by separate department/sections and form a part of the daily work activities of the staff. For a modern Granary irrigation system information management, the most important criteria is that it is built on the same framework and defined by standard terminologies and references. An updated inventory survey is necessary. This should also include all land acquired by the Federal and State Governments for irrigation purpose.

Table III-36 shows the key information that must be kept by the DID office responsible for the O&M of the Granary irrigation system. Most of the items are directly within the purview of the DID's duty and responsiblity. For this, the data maintenance is most convenient if undertaken by the respective sections e.g. Administration & Finance for staff, emolument and contracts data; the control centre for rainfall and irrigation; the sub-offices for maintenance records. Those data and information that are not directly within DID's purview but important for O&M of the scheme e.g. collection of irrigation rates, register of farmers, lots, yields and production. The DID should at least have copies of these and have the information reformatted to suit the irrigation administration framework. In this case the contents should be categorised

by Granaries Compartments, Blocks, ISAs and ISUs. For ease of data updates and maintenance and cross reference, the other Departments/Agencies should be encouraged to follow the same format.

(2) Water management plan

The Granaries must be managed as "efficient paddy producing factories" and thus the water management objective supporting this is:

"to ensure adequate and timely water supply and removal for intensive paddy cultivation twice a year, every year".

Water supply dates still form the pivot for all farm activities planning within and between seasons in the Granaries. This is dictated by the regional rainfall pattern and is outside the control of systems managers. Therefore timeliness of operations is the essence. The water management plan should be developed emphasizing on timeliness and accuracy by new modern work procedures supported by modern technology, increased staff performance and productivity, on-farm infrastructure improvement, land consolidation and human resource development. These are discussed further in foregoing sections.

The implemetation period should be over the NAP3 time frame which is upto the year 2010.

3.3 Operations and Maintenance

(1) Adopt ISO 9002 standards for irrigation O&M

The O&M of the Granaries must take the lead in achieving high standard of management. The Irrigation Division of the DID has initiated efforts for irrigation O&M to comply to ISO 9002. IADP Seberang Perak was selected to be a pilot scheme for this program.

The initial exercise towards achieving ISO 9002 itself would compel systems managers to review existing O&M manuals and management procedures. The ISO 9002 format is adopted for IADP Pulau Pinang O&M Manuals. These however are for specific tertiary systems and in most instances, does not relate to the system as a whole. The manual is also designed for office reference only. There is a need for an overall system manual and also an edited version for field staffs. In preparation for more farmers' participation, a simplified version should be produced for them.

There should also be a separate manual for maintenance of the canals, drains and structures and with standard specifications.

It is recommended that the DID implement a simultaneous program for all Granaries towards achieving the ISO 9002 certification.

(2) Telemetry, automation and computerization

This is in line with the national information technology (IT) agenda. In irrigation, IT will increase system management efficiency and effectiveness through faster and accurate data and information transfer. The system will also support a more compact O&M team, increases productivity and provides opportunities for job enrichment.

For all the Granaries, two systems are proposed namely the Water Management System (WMS) and the Irrigation Monitoring and Feedback System (IMFS). Automation for pumps and gates are also proposed. These systems will be supported by an extensive telemetric system. Details of this are given in item 3.6 (3).

A central control station for irrigation management must be established in all Granaries. This center will coordinate all water management decisions on ground. The IMFS will be connected to all DID sub-offices or Farmers' Development Centres where farmers' will receive current irrigation and agriculture information for their areas.

The DID will be the implementing agency.

(3) Reorganizing O&M responsibility

The modern system expects the farmers to be more involved and responsible in its O&M. It is proposed that tertiary systems operations are gradually handed over to the farmers 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. This process can be achieved through the formation of WUGs (see item 3.3 (6)).

In the process, the roles of DID field staff will be affected. Field staffs are defined as those whose scope of work is 100% on irrigation O&M. These includes Senior Irrigation Inspectors, Irrigation Inspectors, Irrigation Technicians, Pump Operators, Gatekeepers or Linesmen and General Workers. The S.I.Is, I.Is, Irrigation Technicians are key personnels for the overall systems operations. So too are the pump operators who operates primary and secondary pump stations. Therefore these staff must be retained for overall scheme management.

The handover would therefore directly affect the gatekeepers/linesmen and general workers. Their functions are for O&M of structures and general maintenance works such as river clearing. Generally, they form 80% of the total field staff strength and account for 80% of the total field staff salary and emolument. A breakdown of their assignment distribution in terms of primary, secondary and tertiary system is not yet available but discussions with the DID offices, it appears that 80% are involved in tertiary systems O&M. Using this as an assumption to estimate field staff reduction (Table III-37), indicative figures derived are shown below:

Note above figures refer to field staff only

Scheme	Staff No	Annual Cost (RM)	Proposed Staff No	Proposed Annual Cost (RM)	Reduction (RM)	% reduction	Reduction RM/ha
Kerian	198	2,032,689	62	688,453	1,344,236	34	61
Besut	54	356,042	16	145,808	210,234	41	40

For Kerian Scheme, the impact is a 57% reduction on overall staff strength and 61% reduction on staff cost/ha. For Besut, it is 68% reduction on overall staff strength and 55% reduction on staff cost/ha. The average of these figures are 63% for overall staff reduction and 58% staff cost/ha. reduction. Applying these figures for the other Granaries, the estimated impact on overall O&M staff and cost is summarized below:

IADP	Office/ Scheme	Present			After staff reduction		
		Total staff	No/1000ha.	Cost/ha '97	Total staff	No/1000ha	Cost/ha
P.Pinang	SPU	204	21	186	75	8	78
	SPT	80	53	410	30	20	172
Kerian/ S.Manik	Kerian	239	11	100	103	5	39
	Sg. Manik	131	19	157	48	7	66
Sbg. Perak	Sbg. Perak	120	14	87	44	5	37
Kemasin/ Semerak	scheme not ready						
Besut	Besut	56	11	72	18	3	32

Whilst these reductions relieves the financial and administrative burden of the DID, it may not be a 100% relief for the government as a whole. This is because consideration should be given to the farmers taking over the tertiary system. The Kubang Depu WUG experience show that the farmers are willing to operate their system without any monetary compensation. However, discussions with the Besut DID staff and some members of the WUG committee indicated that some form of allowance or contribution to the committee's fund would be welcome. Thus it may be possible to transfer staff reduction costs to encourage the WUG management. Out of the average RM 70/ha. staff cost reduction, perhaps RM 20/ha can be considered for each WUG.

(4) Re-packaging O&M contracts and indents works

The estimated 1997 DID expenditure on irrigation O&M of the 5 Granaries is more than RM 10 million (Table III-4 to III-6). These works cover canals, drains, coastal buds, structures, pumps and buildings maintenance. These are mostly undertaken by private contractors through contracts, quotations and numerous indents particularly for channel clearing works. In addition DID staff also undertake some of the O&M works. In Kerian for example, about 23% of the maintenance works are by DID staff. Also in Kerian, the number

of indent works awarded annually is over 800.

(5) Irrigation Performance Assessment

Irrigation efficiency values often referred to are field application efficiency (Ea), distribution efficiency (Eb), conveyance efficiency (Ec) and irrigation system efficiency (Es). Among these parameters, the conveyance and distribution efficiency figures are generally achievable. This is because the main losses are due to seepage, which may be assessed from empirical formula and can be solved technically. The most difficult aspect is application efficiency. It is difficult to estimate, varies between farms and farmers and requires a balance between management and engineering solutions. In Malaysia there are no records actual quantitative evaluation of this parameter in any of the schemes. In the planning and design of irrigation system in the country, values adopted are assumed figures. The values often used ranges from 55% to 70%. Irrigation efficiency values are not often referred to during operations. The exception is in the Kerian Scheme where under the "manage-as-plan" program, efficiency values Ea, Eb and Ec are used as coefficients to determine supply levels for different water demand status (Teh S.K, (1989); Irrigation management in the Kerian Irrigation Scheme. Proceedings of the seventh Afro-Asian Regional Conference of the International Commission on Drainage and Irrigation; Valera, A, Mohd Nor, M.D. (1991); Design-Management Interactions of Malaysia's Kerian Irrigation Scheme; IIMI). Irrigation efficiencies however has value connotation i.e. the higher the value, the better it is (P.S. Rao; (1993); Review of Selected Literature on Indicators of Irrigation Performance; IIMI). A higher efficiency figure however, is not necessarily better than a lower one. For example, a system may have a high efficiency value in operation but is in fact supplying more water than is required by the farmers (demand). Target efficiency levels are useful for planning and design purposes.

Since the Granaries are already in the operational stage, a more neutral (as opposed to the "value" connotation of the efficiency parameters) indicator is proposed. This relates the amount of water available or delivered to the amount used for crop production (P.S. Rao (1993) and is referred as the Relative Water Supply (RWS). The RWS relates (in the form of a ratio) supply (irrigation + effective rain) to demand (evapotranspiration + seepage and percolation). This is more meaningful for operations purposes since the principal aim is to ensure that supply at least equals demand (RWS=1) and not specifically to increase systems efficiency values. It is therefore recommended that for system management, the RWS is to be developed as the performance indicator for irrigation systems rather than focusing on irrigation efficiency. In any case, the inverse of RWS approximates efficiency values. There are no particular targets for RWS. However, a rapid assessment by the DID for the Kerian Scheme ("Assessment of selected performance indicators for paddy irrigation schemes- Kerian Scheme", DID, 1995) indicated a range of RWS values between 1.49 and 2.04 (average 1.65.

There are a number of other performance indicators used around the world (Rao, P.S. 1993. Review of selected literature on indicators of irrigation performance. IIMI) which could be considered by the DID. However, at this point in time, it is recommended that the DID focus on the three primary indicators selected namely Relative Water Supply (RWS), Water Productivity Index (WPI) and Cropping Intensity (CI). A target of 1.4 (approximately equivalent to 70% efficiency) is perhaps a practical RWS target. For WPI the target should be

0.3 to 0.5 kg/cu/m (Valera & Mohd Nor, 1991) and for the CI at 190%.

(6) Water Users' Groups

A program to form Water Users' Groups (WUGs) is at initial stages and led by the DID. The WUGs will increase farmers' responsibility towards irrigation management. The most important expectation from these groups would be improved timeliness of field operations to maintain cropping schedules every season, efficient water management and O&M. Over time, the WUGs would be expected to undertake the tertiary level O&M. Ideally, the boundaries of the WUG should be the same as the boundaries of the Farmers' Groups. This would require reorganising existing Farmers' Groups as was done for Kubang Depu. However it is expected that not all can meet this criteria. In these cases, where overlapping occurs, the committee member in charge of water management will represent the Farmers' Group in the WUG. Also, as provided by the guidelines for the formation of WUGs, a farmer can be a member of all the WUGs where he is operating a farm. As in the case of IADP Pulau Pinang, the formation of WUGs can be taken as a strategy to organise farmers who up to now, have opted not to join any Farmers' Groups.

Formation of WUG requires intensive promotion by field officers. There is also a need to develop training program for each WUG. All these training should be done on-site. A special training program for WUG leaders should be developed. For on-site training, a two separate one-day sessions is proposed. For the WUG leaders, one 3-days training duration is proposed at National Water Management Training Centre. The estimated cost for training is RM 5/person/day for on-site training and RM 400/person/day for training at the NWMTC.

Based on available figures for Pulau Pinang, Kerian and Besut, it is estimated that the number of WUGs to be formed for the five Granaries is 334 (Table III-38) and summary below. The average training cost is RM 12/ha. and the total cost for the training both on-site and off-site is RM 1,220,000,000. The formation and training of WUG should be given priority since it is one of the key success factor in the modernization program. Thus it is proposed that the time frame for their formation be within 5 years. The annual target would then be 68 WUGs/year. The one-day on-site training program will be once during the off-season and once during the main season during the initial crop growth stage when farm activities are relatively low.

Estimated numbers of WUG to be formed and training costs

IADP/Scheme	Farmers (Nos)	WUGs (Nos)	Total Training Cost (RM)
Pulau Pinang	7,301	125	373,010
Kerian-Sg.Manik			
Kerian	13,485	84	336,450
Sg. Manik	4,030	36	126,700
Sbg Perak	2,333	20	71,330
Kemasin-Semerak	11,889	39	212,490
Besut	3,054	30	102,540
Total	42,092	334	1,222,520

However, the membership size range from 77/WUG (Pulau Pinang) to 282/WUG

(Kerian) and averages at 177/WUG. It is practical to train them in batches of 50 members persons per session. Thus each WUG will have to be divided into 2 or 3 training groups.

The off-site training for WUG leaders will involve 668 members (2 from each 334 WUGs). Limiting each training session to 40 members, then the number of training sessions will be 17. Therefore, NWMTC will need to run an average of 3 training sessions for WUG leaders every year.

This overall program is led by the DID. The NWMTC should be responsible for developing and executing the training. On the field coordination and implementation is by IADP PMUs supported by the DID, DOA and LPP/PPK.

WUG formation target, training programs and training cost are shown in Table III-39 to III-44.

(7) National Water Management Center

Apart from the training and development of WUGs, the NWMTC should also review current training program to account for the system modernization process. This include the use and development of the computerised Irrigation Water Management System, the telemetric system and the Farmers' Irrigation Monitoring and Feedback System.

3.4 On-farm Infrastructure

Physical improvement refers to on-farm infrastructure development comprising land levelling, in-field channels and control boxes and land consolidation. The table below summarizes the on-farm infrastructure works and cost for the Granaries water management system improvement.

Granary	Lots for improvement (nos.)	Area for land leveling (ha.)	In-field channel (km)	In-field control boxes (nos.)	Total estimated cost (RM)
1 Pulau Pinang	12,920	8,597	1,290	3,439	3,320,730
2 Kerian-Sg Manik					
a. Kerian	12,651	18,389	2,757	7,356	7,174,420
b. Sg. Manik	3,149	5,783	876	2,313	2,238,130
3 Sbg. Perak	2,348	3,605	541	1,442	1,393,420
4 Kemasin-Semerak	15,998	1,645	247	1,097	622,075
5 Ketara (Besut)	5,211	4,656	699	3,105	1,874,250
Total	52,165	42,675	6,410	18,752	16,663,025

Blocks E,F & G managed by FELCRA as paddy estate not included. Q'ties of Kemasin/Semerak are only for Jelawat Rusa and Kemasin Hilir sub-schemes.

The estimate is based on the assumption that 90% of the total number of lots and paddy areas need the infrastructure improvement works.

The land leveling will be based on the DOA's specification of zero grading at +/- 5 cm accuracy over 100% of 10m x 10m grid points. It is estimated that 40% of the land leveling works will be by the DOA at RM 250/ha. The remaining 60% will be the private sector at RM 350/ha. The PPK will be encouraged to undertake these works.

For in-field channels, the criteria is to achieve a density of 150m/ha. Construction cost is estimated at RM 0.35/m. For the control boxes, the cost is estimated at RM 60 each and for two boxes for every lot.

The total estimated cost for these works is RM 16.7 million. Thus the on-farm infrastructure cost is about RM 350/ha.

If farmers' are charged RM 150/ha. as their contribution to these works, then the cost to the Government will be reduced to RM 200/ha. and the revised total cost is RM 9.4 million.

Assuming that all these on-farm infrastructure works on the 42,675 ha. are to to be begin in 1999 and completed by 2006 i.e. over a 8-year period, then on average, the annual target for land leveling would be 5,334 ha a year. Comparing this with DOA's plan for 1998 to execute 6,138 ha (2,928 ha. by DOA and 3,220.5 ha by private sector), then the annual target for the five Granaries is achievable if given priority.

For in-field channel, the annual target for the 5 Granaries over the same 8 year time frame will be 801 km/year and for the control boxes, 2,344 nos./year. Comparing as above, the 1998 target by DOA for field channel is 474 km and control boxes at 2,967 nos. There is therefore a need to increase the capacity to contruct the field channels at 801 km/yr and installing the control boxes is achievable in that time frame.

Summary of in-field infrastructure improvement is shown in Table III-45. Detail of proposed on-farm infrastructure improvement and its cost are shown in Table III-46 to III-54.

3.5 Land Consolidation

All granaries should aim for larger farm plots through land consolidation. This is through removal of field bunds (*batas*) but without legal rearrangement of lot boundaries. Studies indicated that 10 to 20 ha. plot size is optimum for fully mechanized farming. However, it deemed practical for these Granaries to aim for 3 to 5 ha. plots sizes. This is achieved through consolidation of adjacent plots. This exercise requires good promotion to get the consensus of lot owners. Ideally it should be performed concurrent with the on-farm infrastructure works described above.

The number of paddy lots and target consolidated lots are shown below:

IADP	No. of Farmers (no.)	No. of lots (no.)	Area (ha.)	Estimated no. of consolidated farms (no.)
1 Pulau Pinang	7,301	14,231	9,601	1,920
2 Kerian-Sg. Manik				
a. Kerian	13,485	16,641	23,560	4,712
b. Sg. Manik	4,030	3,499	6,318	1,264
3 Sbg Perak	2,333	2,609	4,005	801
4 Kemasin-Semerak	11,889	17,775	6,895	2,298
5 Besut	3,054	5,790	5,164	1,721
Total				12,716

Each consolidation aims for a 5 ha farm plot in west coast schemes and for a 3 ha in east coast schemes
For Seberang Perak excluding blocks E,F & G managed as a paddy estate by FELCRA

To form 12,716 consolidated farms, each over 8 years would mean an average formation of 1,590 nos./year.

The above is quite a high target considering that considerable effort is needed to obtain the farmers and lot owners' consent. Implementing this land consolidation program therefore would require a specially developed approach and by a team of trained specialists. The IADP PMUs should lead this program with assistance from the DOA. The PPK should also be a member of this team.

Target formation of consolidated firms is shown in Table III-55.

3.6 Water Management Facilities

A compact team of O&M personnel must be supported as much as possible by a system that simplifies data collection and processing for quick and accurate decision-making. The appropriate technology is already available for this for the modernization program the following are recommended namely a telemetry system, a computerised irrigation water management system and an irrigation monitoring and feedback system.

(1) The telemetry system

The telemetry system generally comprise:

- Telecommunications network,
- Rainfall and water level telemetry system,
- Gated structures/pump monitoring system,
- A computer system with display panels, and,
- Gated structures/pump remote control system.

For each of the Granaries, a central control station should be established to manage the

overall system network. Authority for decision-making should clearly defined. The water management system planning and operations must be supported by a computer (refer Fig. III-2 to III-4). Water level monitoring at main structures in the primary and secondary canals and drains as well as rainfall data will be collected by telemetry.

The system must be integrated with manual field reporting system by O&M personnel. Their feedback can be either via telephone or radio sets.

All the data collected will then be input into a hydrological and hydraulic models for determination of status of water availability, water requirement, allocation and water distribution. The decision-making model should also advise on the necessary structure gate settings and pump operations.

Where possible, automation should be considered for pump and structure operations. This is especially for those located at remote areas and where stationing full-time staff is difficult. However, before implementing this, adequate data is important for any decision. Thus, the telemetry system could, at the initial phase, also be used to monitor operations of gates and pump with the potential for automation. Based on the analysis of accumulated data, a remote control system may then be installed at selected structures.

Telemetry system for monitoring is also useful to assess the structure/pump performance in the long run so that timely and appropriate preventive measures can be taken to prevent major systems failure.

The computer system should also be for system inventory management and a farmers' feedback information service.

The recommended steps towards installing the above facilities are as follows:

Step 1

(a) Establish a telecommunication network (already existing for Kerian sub-scheme. This will provide a link between the central control station with all other remote stations. The system could be using public telephone lines, private cable lines or radio links (150 MHz/450 MHz band). For remote gates and pump stations, private cable links or radio links may be more cost effective.

(b) Install rainfall and water level telemetry gauging stations at the necessary locations (similar to existing stations in Kerian sub-scheme).

(c) Install an appropriate computer system. Existing computer systems in the DID O&M office may need upgrading to increase their capacity to handle higher data volumes and processing from the telemetry and monitoring network.

Step 2

(d) Convert manual systems with motorized system for main gated structures and electrification system for diesel pumps.

(e) Install gated structure/pump monitoring system.

Step 3

(f) Install remote control system for gated structures and pumps.

The outline of water management facilities plan for the five (5) granary areas subjected to further study are shown in Fig. III-5 to III-10.

(2) Irrigation Water Management System (IWMS)

This is a computer model for determining daily irrigation distribution volumes. The model is based on a water balance model between effective rainfall, available supply and crop water requirement. The basic input are collected via telemetry namely rainfall and water levels. Other input that can be collected via telemetry are those necessary to estimate crop evapotranspiration. Detail of Irrigation Water Management System is shown in Annex-IX.

(3) Irrigation monitoring and feedback system

The irrigation monitoring and feedback system (IMFS) is to provide updated irrigation and farm activity information so that farmers can respond in good time to take necessary preparatory steps, adhere to schedules and alert them on any change of status. The system also serves the same functions for O&M field staff particularly to alert them of any potential delays so that timely corrective measures can be initiated.. In addition, the system can be utilized as a communication medium for agriculture extension services and general information. Being a common monitoring system, it will strengthen coordination between irrigation managers, agriculture managers, the PMU of the IADP office and of course the farmers.

The proposed IMFS is a computer based system using the telephone line communication. This system allows the systems manager to produce. author, schedule and distribute multimedia messages and information for TV output. Since a telephone line is used, the information can be transmitted and displayed at any number of stations from a single control center.

Within a granary, the basic system comprise a master station connected to one or more player stations on site. The master station is the source of all information presentations and controls presentation schedules of the player stations. Subsequently, the system can be upgraded to one with multi-master stations and interlinked with each other. Ultimately, the system can be extended to be an inter-granary network with links to the Ministry of Agriculture and any relevant Federal and State Departments.

The main criteria on choice of system is that the information must be is easily updated, the display simple messages and carries good visual impact. The recommended software for the system is the SCALA Infochannel.

The basic content of the IMFS can be divided into three segments:

(a) Irrigation and Farm activities

(b) Agronomic

(c) Administrative

(a) Irrigation and farm activities

In this segment, the contents are

- irrigation schedule,
- alert messages on dates of field activities,
- farmers preparatory works necessary, and,
- status of field activities.

Water management information which includes rainfall and water supply and water level status at the Besut Barrage and Angga Barrage, and current information on operations and maintenance.

(b) Agronomic

This segment comprise messages pertaining to

- recommended farm and crop husbandry practices.
- alert messages on DRIP, and,
- current issues and problems such as pest and disease outbreaks and recommended management.

(c) Administrative

The administrative segment comprise

- administrative and motivational messages from IADP PMU and component heads, DID O&M section and even from Farmers' Group and WUG leaders,
- paddy production statistics (yields and production) and targets, and,
- news on current issues.

Fig. III-11 to III-12 show the schematic diagrams of the proposed irrigation monitoring and feedback system.

The proposed IMFS network for the Granaries and total cost are shown in Table III-56 to III-59 and summarised below:

IADP/Office	Master (Nos.)	Player (Nos.)	Additional TV (Nos.)	Total Cost (RM)	Notes
Pulau Pinang	1	11	3	685,850	
Kerian-Sg Manik					
Kerian	1	10	3	646,800	
Sg Manik	1	5	1	417,150	
Shg Perak	1	10	1	642,400	
Kemasin-Semerak	1	9	4	609,950	
Ketara (Besut)	1	11	4	688,050	
Min. of Agric		1	2	43,450	
DID HQ		1	2	43,450	
DOA HQ		1	2	43,450	
Total	6	59	22	3,850,550	

(4) Integration of the Water Management System and the Irrigation Monitoring and Feedback System

To ensure that the systems installed functions effectively, they must be managed and operated in an integrated manner. Most important is to appreciate that both systems have their own specific purpose and that the O&M staff work procedure is an integral component.

The Water Management System (WMS) collects data on water resources and irrigation for use of the technical personnel i.e. the O&M staff of the DID. The data and information presentation are thus technical in nature but easily understood by the systems operators. The basic data are rainfall and water level information. These data are transformed into decision-making information mainly on water availability status and system allocation levels.

On the other hand, the Irrigation Monitoring and Feedback System (IMFS) is targeted to mainly for the farmers and field staffs. These must be less technical in nature and easily understood. Thus data obtained form the WMS must be suitably represented for the IMFS. The water level and rainfall data collected through the WMS can be directly connected to the IMFS via a computer link and programming. Only the display format will differ. The key information necessary for farmers are rainfall, water level and supply conditions.

Apart from the systems computer linkage, the planning input and actions of the PMU, the DID, DOA, LPP/PPK and BERNAS components of the IADP is critical. These must be well supported by field staff for activity feedback update and ensuring that information transmission to farmers is executed.

A season's planning information must be provided by the PMU and the respective components at the start of every season. Clear targets for each activity is critical and should be input into the IMFS. During a season's operations, monitoring feedback must be provided by the field staff as part of their work program. A feedback format and schedule must be set-up. A weekly reporting and updating must be carried out with allowances for insertion of urgent and important messages at any time necessary.

Overall, farmers' response to the information is the main concern. From the onset, the field staff must encourage leaders of the farmers' groups to constantly refer to the IMFS for updated information and to ensure that the farmers' groups undertake positive action in response to the information. Gradually, the system should allow for feedback information to

be provided by each farmers groups via the manager of the player stations. In the case of Besut, this will be the respective DID Compartment Stations. Farmers' response to the information must be relayed back to central control by the Compartment Stations. This is turn should be indicated in the subsequent information transmission by the Central Control.

4. DETAILED MODERNIZATION PLANS FOR 3 SELECTED GRANARY SCHEMES

4.1 Introduction

4.1.1 General

The three selected schemes are Kerian, Besut and IADP Pulau Pinang (excluding Sungai Burung Scheme). This chapter provides a more detailed analysis of the proposed improvement plans for water management system and O&M. The general recommendations for improvement are already outlined in Chapter 3 but are summarized below for completeness.

4.1.2 Summary of improvement plan

(1) General

(a) Define Granary boundaries and standardize terminologies and database.

(b) Gazette the Granary schemes under the Irrigation Act.

(c) Gazette the Granaries as Farmers' Development Area.

(d) Develop standard Granary performance assessment indicators.

(2) Water management system

(a) Develop irrigation database and information system.

(b) Develop a water management plan emphasising on timeliness of operations.

(3) Operations and Maintenance

(a) Adopt ISO 9002 standards for irrigation O&M.

(b) Install telemetry system, computerization and set-up a central control station for O&M.

(c) Reorganize O&M responsibility for farmers' to undertake tertiary system management.

(d) Re-package O&M contracts and indent works for larger packages.

(e) Develop irrigation performance assessment procedures.

(f) Form Water Users' Groups (WUGs).

(4) On-farm infrastructure

(a) Land levelling, in-field channel and control box construction.

(b) Land consolidation.

4.2 Kerian Scheme

4.2.1 General

(1) Central Control Station

The Kerian Scheme management has already a central control station set-up in the DID Bagan Serai office. This will be strengthened through the upgrading of the telemetry system computerization.

4.2.2 Reorganizing O&M responsibility

The modern system expects the farmers to be more involved and responsible in its O&M. It is proposed that tertiary systems operations are gradually handed over to the farmers 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. This process can be achieved through the formation of WUGs (see item 4.2.2 (6)).

In the process, the roles of DID field staff will be affected. Field staffs are defined as those whose scope of work is 100% on irrigation O&M. These includes Senior Irrigation Inspectors, Irrigation Inspectors, Irrigation Technicians, Pump Operators, Gatekeepers or Linesmen and General Workers. The S.I.Is, I.Is, Irrigation Technicians are key personnels for the overall systems operations. So too are the pump operators who operates primary and secondary pump stations. Therefore these staff must be retained for overall scheme management.

Estimated O&M Field Staff reduction for Kerian

Scheme	% Staff size reduction (%)	% total staff cost reduction (%)	O&M staff cost reduction (RM/ha)
Kerian	69	34	61

For the overall staf reduction, i.e including non-field staff, the impact on O&M staff figures are summarized below:

IADP	Office/ Scheme	Present			After staff reduction		
		Total staff	No/1000ha.	Cost/ha '97	Total staff	No/1000 ha	Cost/ha
Kerian-Sg. Manik	Kerian	239	11	100	103	5	39

From the above, figures the staff strength reduction is 57% and staff cost per/ha. is 61%.

(1) Re-packaging O&M contracts and indents works

The total estimated O&M expenditure in 1997 for Kerian Scheme is nearly RM 5 mil. Out of this, about RM 1.4 mil (28%) are undertaken through indent works totaling over 1,100 numbers. Apart from this, the DID also perform O&M works using its own staff. As for IADP Pulau Pinang, it is proposed that a larger contract packages contract over 3 years or 5 seasons is awarded for normal clearing works as well as desilting, minor repair works and pump maintenance. Preference can be given to the PPK.

(2) Water Users' Groups

IADP Kerian-Sg. Manik initiated a WUG pilot project at Pulau Pinang began its WUG program 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 in table III-60.

Blocks	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

Formation of WUG requires intensive promotion by field officers. There is also a need to develop training program for each WUG. All these training should be done on-site. A special training program for WUG leaders should be developed. For on-site training, a two separate one-day sessions is proposed. For the WUG leaders, one 3-days training duration is proposed at National Water Management Training Centre. The estimated cost for training is RM 5/person/day for on-site training and RM 400/person/day for training at the NWMTC. These training sessions should include promoting in-field infrastructure development program and land consolidation.

4.2.3 On-farm infrastructure improvement

Physical improvement refers to on-farm infrastructure development comprising land levelling, in-field channels and control boxes and land consolidation. Table III-61 shows the lots and extent of land leveling requirement for the Kerian Scheme.

The table below summarizes the on-farm infrastructure works for Kerian Scheme.

Comaprtment	Lots for improvement (nos.)	Area for land leveling (ha.)	In-field channel (km)	In-field control boxes (nos.)
A	1,955	2,402	360	961
B	2,803	3,822	573	1,529
C	2,039	3,575	536	1,430
D	1,665	2,103	315	841
E	1,082	1,700	255	680
F	1,246	2,050	308	820
G	411	675	101	270
H	1,450	2,062	309	825
Total	12,651	18,389	2,757	7,356

The land leveling will be based on the DOA's specification of zero grading at +/- 5 cm accuracy over 100% of 10m x 10m grid points. It is estimated that 40% of the land leveling works will be by the DOA at RM 250/ha. The remaining 60% will be the private sector at RM 350/ha. The PPK will be encouraged to undertake these works.

For in-field channels, the criteria is to achieve a density of 150m/ha. Construction cost is estimated at RM 0.35/m. For the control boxes, the cost is estimated at RM 60 each and for two boxes for every lot.

Assuming that all these on-farm infrastructure works on the 18,389 ha. are to to be begin in 1999 and completed by 2006 i.e. over a 8-year period, then on average, the target for land leveling would be 2,299 ha./year.

For in-field channel, the annual target over the same 8 year time frame will be 345 km/year and for the control boxes, 920 nos./year.

However, for compartments B and C, these works can only proceed after completing the polder drainage project totalling 4,500 ha. The program for this project is not yet finalized but a 300 ha. pilot project is already under construction.

4.2.4 Land Consolidation

All granaries should aim for larger farm plots through land consolidation. This is through removal of field bunds (*batas*) but without legal rearrangement of lot boundaries. Studies indicated that 10 to 20 ha. plot size is optimum for fully mechanized farming. However, it deemed practical for these Granaries to aim for 5 ha. plots sizes. This is achieved through consolidation of adjacent plots. This exercise requires good promotion to get the consensus of lot owners. Ideally it should be performed concurrent with the on-farm infrastructure works described above.

The number of paddy lots and target consolidated lots are shown below and shown in Table III-62.

Compartment	No. of Farmers	No. of lots	Area	Estimated no. of consolidated farms
	(no.)	(no.)	(ha.)	(no.)
A		1,955	2,402	480
B		2,939	4,001	800
C		2,285	3,960	792
D		2,624	3,362	672
E		1,538	2,344	469
F		1,773	2,697	539
G		1,385	1,830	366
H		2,142	2,964	593
Total	13,485	16,641	23,560	4,712

Each consolidation aims for a 5 ha. farm plot.

To form 4,712 consolidated farms of 5 ha. each over 8 years would mean an average formation of 589 farms/year.

The above is quite a high target considering that considerable effort is needed to obtain the farmers and lot owners' consent. Implementing this land consolidation program therefore would require a specially developed approach and by a team of trained specialists. The IADP PMU should lead this program with assistance from the DOA. The PPK should also be a member of this team.

4.2.5 Water Management Facilities

(1) Irrigation Water Management System (IWMS)

This is a computer model for determining daily irrigation distribution volumes. The model is based on a water balance model between effective rainfall, available supply and crop water requirement. The basic input are collected via telemetry namely rainfall and water levels. Other input that can be collected via telemetry are those necessary to estimate crop evapotranspiration.

(2) Irrigation monitoring and feedback system

The irrigation monitoring and feedback system (IMFS) is to provide updated irrigation and farm activity information so that farmers can respond in good time to take necessary preparatory steps, adhere to schedules and alert them on any change of status. The system also serves the same functions for O&M field staff particularly to alert them of any potential delays so that timely corrective measures can be initiated.. In addition, the system can be utilized as a communication medium for agriculture extension services and general information. Being a common monitoring system, it will strengthen coordination between irrigation managers, agriculture managers, the PMU of the IADP office and of course the farmers.

The proposed IMFS is a computer based system using the telephone line

communication. This system allows the systems manager to produce, author, schedule and distribute multimedia messages and information for TV output. Since a telephone line is used, the information can be transmitted and displayed at any number of stations from a single control center.

Within a granary, the basic system comprise a master station connected to one or more player stations on site. The master station is the source of all information presentations and controls presentation schedules of the player stations. Subsequently, the system can be upgraded to one with multi-master stations and interlinked with each other. Ultimately, the system can be extended to be an inter-granary network with links to the Ministry of Agriculture and any relevant Federal and State Departments.

The main criteria on choice of system is that the information must be is easily updated, the display simple messages and carries good visual impact. The recommended software for the system is the SCALA Infochannel.

The basic content of the IMFS can be divided into three segments:

(a) Irrigation and Farm activities

(b) Agronomic

(c) Administrative

(a) Irrigation and farm activities

In this segment, the contents are

- irrigation schedule,
- alert messages on dates of field activities,
- farmers preparatory works necessary, and,
- status of field activities.

Water management information which includes rainfall and water supply and water level status at intake and canals, and current information on operations and maintenance.

(b) Agronomic

This segment comprise messages pertaining to

- recommended farm and crop husbandry practices.
- alert messages on DRIP, and,
- current issues and problems such as pest and disease outbreaks and recommended management.

(c) Administrative

The administrative segment comprise

- administrative and motivational messages from IADP PMU and component heads,

DID O&M section and even from Farmers' Group and WUG leaders,
- paddy production statistics (yields and production) and targets, and,
- news on current issues.

IADP/Office	Master (Nos.)	Player (Nos.)	Additional TV (Nos.)	Total Cost (RM)	Notes
PMU			1		
DID Component			1		
DOA Component (Spg. Tiga)		1	1		
DID O&M	1	1			
Central Control					
FDC		6			
PPK		2			
Total	1	10	3	646,800	

(3) Integration of the Water Management System and the Irrigation Monitoring and Feedback System

To ensure that the systems installed functions effectively, they must be managed and operated in an integrated manner. Most important is to appreciate that both systems have their own specific purpose and that the O&M staff work procedure is an integral component.

The Water Management System (WMS) collects data on water resources and irrigation for use of the technical personnel i.e. the O&M staff of the DID. The data and information presentation are thus technical in nature but easily understood by the systems operators. The basic data are rainfall and water level information. These data are transformed into decision-making information mainly on water availability status and system allocation levels.

On the other hand, the Irrigation Monitoring and Feedback System (IMFS) is targeted to mainly for the farmers and field staffs. These must be less technical in nature and easily understood. Thus data obtained form the WMS must be suitably represented for the IMFS. The water level and rainfall data collected through the WMS can be directly connected to the IMFS via a computer link and programming. Only the display format will differ. The key information necessary for farmers are rainfall, water level and supply conditions.

Apart from the systems computer linkage, the planning input and actions of the PMU, the DID, DOA, LPP/PPK and BERNAS components of the IADP is critical. These must be well supported by field staff for activity feedback update and ensuring that information transmission to farmers is executed.

A season's planning information must be provided by the PMU and the respective components at the start of every season. Clear targets for each activity is critical and should be input into the IMFS. During a season's operations, monitoring feedback must be provided by the field staff as part of their work program. A feedback format and schedule must be set-up. A weekly reporting and updating must be carried out with allowances for insertion of urgent and important messages at any time necessary.

Overall, farmers' response to the information is the main concern. From the onset, the field staff must encourage leaders of the farmers' groups to constantly refer to the IMFS for updated information and to ensure that the farmers' groups undertake positive action in response to the information. Gradually, the system should allow for feedback information to

be provided by each farmers groups via the manager of the player stations. The DID Kerian has a long experience in centralized water management system. Thus integration of the systems will not be difficult. The primary field offices are in the FDCs and the O&M staff in-charge will be reporting feedbacks to the central control stations. Farmers' response to the information must be relayed back to central control by the Compartment Stations. This is turn should be indicated in the subsequent information transmission by the Central Control.

4.3 Besut Scheme

4.3.1 General

(1) Central Control Station

A central control station is proposed located at Ketara Project Office. This will be managed by the O&M unit of the DID Besut already based here. This will provide improved irrigation management decisions which is primarily based on the water level and supply situations at the Besut and Angga Barrage. Its establishment is related to the proposal to establish a telemetric and computerised irrigation water management system (discussed under item 4.2.5(1)).

4.3.2 Reorganizing O&M responsibility

The modern system expects the farmers to be more involved and responsible in its O&M. It is proposed that tertiary systems operations are gradually handed over to the farmers 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. This process can be achieved through the formation of WUGs (see item 4.2.2(6)).

In the process, the roles of DID field staff will be affected. Field staffs are defined as those whose scope of work is 100% on irrigation O&M. These includes Senior Irrigation Inspectors, Irrigation Inspectors, Irrigation Technicians, Pump Operators, Gatekeepers or Linesmen and General Workers. The S.I.Is, I.Is, Irrigation Technicians are key personnels for the overall systems operations. So too are the pump operators who operates primary and secondary pump stations. Therefore these staff must be retained for overall scheme management.

Based on an assumption of 80% reduction for gateskeepers and general workers, the expected O&M staff cost reduction for the Besut Scheme is RM 40/ha after a 70% overall field staff reduction.

Estimated O&M Field Staff reduction for the Besut Scheme

% Staff size reduction (%)	% total staff cost reduction (%)	O&M staff cost reduction (RM/ha)
70	41	40

The impact on the overall O&M staff strength and cost for the Besut Scheme is summarized below:

Present			After staff reduction		
Total staff	No/1000ha.	Cost/ha '97	Total staff	No/1000 ha	Cost/ha
56	11	72	18	3	32

(1) Re-packaging O&M contracts and indents works

The estimated 1997 DID expenditure on irrigation O&M for Besut scheme is RM 963,000/yr and mostly in the form of indent works to PPK or Farmers' Groups. As with other schemes, it is proposed that these works be packaged into one or more larger packages over a longer period. Apart from administrative relief, this move would increase farmers participation in O&M job allocation. In the long term, a single package over a longer duration would encourage the contractors to invest in better equipment and training. It is recommended that the O&M packages should also include all other O&M works such as pump stations, desilting works and general repairs.

(2) Water Users' Groups

The Besut Scheme has reorganised 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, a two separate one-day sessions is proposed. For the WUG leaders, one 3-days training duration is proposed at National Water Management Training Centre. The estimated cost for training is RM 5/person/day for on-site training and RM 400/person/day for training at the NWMTC. These training sessions should include promoting in-field infrastructure development program and land consolidation. WUG formation targets and training cost estimates is shown in Table III-63.

The average size of WUG training is summarized below:

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

It is proposed that the time frame for their training be within 5 years. On average, the target number of training is 6 WUGs a year. The one-day on-site training program will be once during the off-season and once during the main season during the initial crop growth stage

when farm activities are relatively low.

With the membership size of about 102 members for each WUG, it may be better to run training sessions by sub-dividing each WUG into 2 or 3 smaller groups.

The off-site training at NWMTC for WUG leaders will involve 60 members (2 from each 30 WUGs). Thus, 2 sessions of 30 participants each is adequate. This program should be given priority as they are key members neccesary to support the WUG and modernization program.

4.3.3 On-farm infrastructure improvement

Physical improvement refers to on-farm infrastructure development comprising land levelling, in-field channels and control boxes and land consolidation. Table III-64 shows the lots and extent of land leveling requirement for the Besut Scheme and is summarized below.

Compartment	Lots for improvement (nos.)	Area for land leveling (ha.)	In-field channel (km)	In-field control boxes (nos.)
1	1,172	1,111	167	741
2	962	1,017	153	678
3	1,544	1,175	176	783
4	1,534	1,353	203	903
Total	5,212	4,656	698	3,105

The estimate is based on the assumption that 90% of the total number of lots and paddy areas need the infrastructure improvement works.

The land leveling will be based on the DOA's specification of zero grading at +/- 5 cm accuracy over 100% of 10m x 10m grid points. It is estimated that 40% of the land leveling works will be by the DOA at RM 250/ha. The remaining 60% will be the private sector at RM 350/ha. The PPK will be encouraged to undertake these works.

For in-field channels, the criteria is to achieve a density of 150m/ha. Construction cost is estimated at RM 0.35/m. For the control boxes, the cost is estimated at RM 60 each and for two boxes for every lot.

Assuming that all these on-farm infrastructure works on the 4,656 ha. are to to be begin in 1999 and completed by 2006 i.e. over a 8-year period, then on average, the target for land leveling would be 582 ha./year.

For in-field channel, the annual target over the same 8 year time frame will be 87 km/year and for the control boxes, 388 nos./year.

4.3.4 Land Consolidation

All granaries should aim for larger farm plots through land consolidation. This is

through removal of field bunds (*batas*) but without legal rearrangement of lot boundaries. Studies indicated that 10 to 20 ha. plot size is optimum for fully mechanized farming. However, it deemed practical for these Granaries to aim for 3 ha. plots sizes. This is achieved through consolidation of adjacent plots. This exercise requires good promotion to get the consensus of lot owners. Ideally it should be performed concurrent with the on-farm infrastructure works described above.

The number of paddy lots and target consolidated lots are shown below and in Table III-65.

Compartment	No. of Farmers (no.)	No. of lots (no.)	Area (ha.)	Estimated no. of consolidated farms (no.)
1	654	1,302	1,235	411
2	509	1,069	1,148	383
3	858	1,715	1,306	435
4	1,028	1,704	1,475	492
Total	3,054	5,790	5,164	1,721

Each consolidation aims for a 3 ha. farm plot.

To form 1,721 consolidated farms of 3 ha. each over 8 years would mean an average formation of 215 nos./year.

Land consolidation will require considerable effort to obtain the farmers and lot owners' consent. Implementing this land consolidation program therefore would require a specially developed approach and by a team of trained specialists. The IADP PMUs should lead this program with assistance from the DOA. The PPK should also be a member of this team. Land consolidation estimate is shown in Table III-65.

4.3.5 Water Management Facilities

(1) Irrigation Water Management System (IWMS)

This is a computer model for determining daily irrigation distribution volumes. The model is based on a water balance model between effective rainfall, available supply and crop water requirement. The basic input are collected via telemetry namely rainfall and water levels. Other input that can be collected via telemetry are those necessary to estimate crop evapotranspiration.

(2) Irrigation monitoring and feedback system

The irrigation monitoring and feedback system (IMFS) is to provide updated irrigation and farm activity information so that farmers can respond in good time to take necessary preparatory steps, adhere to schedules and alert them on any change of status. The system also serves the same functions for O&M field staff particularly to alert them of any potential delays so that timely corrective measures can be initiated.. In addition, the system can be utilized as a communication medium for agriculture extension services and general information. Being a

common monitoring system, it will strengthen coordination between irrigation managers, agriculture managers, the PMU of the IADP office and of course the farmers.

The proposed IMFS is a computer based system using the telephone line communication. This system allows the systems manager to produce. author, schedule and distribute multimedia messages and information for TV output. Since a telephone line is used, the information can be transmitted and displayed at any number of stations from a single control center.

Within a granary, the basic system comprise a master station connected to one or more player stations on site. The master station is the source of all information presentations and controls presentation schedules of the player stations. Subsequently, the system can be upgraded to one with multi-master stations and interlinked with each other. Ultimately, the system can be extended to be an inter-granary network with links to the Ministry of Agriculture and any relevant Federal and State Departments.

The main criteria on choice of system is that the information must be is easily updated, the display simple messages and carries good visual impact. The recommended software for the system is the SCALA Infochannel.

The basic content of the IMFS can be divided into three segments:

(a) Irrigation and Farm activities

(b) Agronomic

(c) Administrative

(a) Irrigation and farm activities

In this segment, the contents are

- irrigation schedule,
- alert messages on dates of field activities,
- farmers preparatory works necessary, and,
- status of field activities.

Water management information which includes rainfall and water supply and water level status at the Besut Barrage and Angga Barrage, and current information on operations and maintenance.

(b) Agronomic

This segment comprise messages pertaining to

- recommended farm and crop husbandry practices.
- alert messages on DRIP, and,
- current issues and problems such as pest and disease outbreaks and recommended management.

(c) Administrative

The administrative segment comprise

- administrative and motivational messages from IADP PMU and component heads, DID O&M section and even from Farmers' Group and WUG leaders,
- paddy production statistics (yields and production) and targets, and,
- news on current issues.

The proposed IMFS network for the Besut Scheme and total cost is summarised below:

Location	Master (Nos.)	Player (Nos.)	Additional TV (Nos.)	Total Cost (RM)	Notes
PMU			1		
DID Component			1		
DOA Component			1		
DID Central Control	1	1	1		
DID District Office		1			
Besut Barrage		1			
DID Compartment Stations		4			
PPK					
Farmers Centres		4			
Total	1	11	4	688,050	

The initial installation will be for the Central Control Station and one DID Compartment Station.

(3) Integration of the Water Management System and the Irrigation Monitoring and Feedback System

To ensure that the systems installed functions effectively, they must be managed and operated in an integrated manner. Most important is to appreciate that both systems have their own specific purpose and that the O&M staff work procedure is an integral component.

The Water Management System (WMS) collects data on water resources and irrigation for use of the technical personnel i.e. the O&M staff of the DID. The data and information presentation are thus technical in nature but easily understood by the systems operators. The basic data are rainfall and water level information. These data are transformed into decision-making information mainly on water availability status and system allocation levels.

On the other hand, the Irrigation Monitoring and Feedback System (IMFS) is targeted to mainly for the farmers and field staffs. These must be less technical in nature and easily understood. Thus data obtained form the WMS must be suitably represented for the IMFS. The water level and rainfall data collected through the WMS can be directly connected to the IMFS via a computer link and programming. Only the display format will differ. The key information necessary for farmers are rainfall, water level and supply conditions.

Apart from the systems computer linkage, the planning input and actions of the PMU, the DID, DOA, LPP/PPK and BERNAS components of the IADP is critical. These must be well supported by field staff for activity feedback update and ensuring that information transmission to farmers is executed.

A season's planning information must be provided by the PMU and the respective components at the start of every season. Clear targets for each activity is critical and should be input into the IMFS. During a season's operations, monitoring feedback must be provided by the field staff as part of their work program. A feedback format and schedule must be set-up. A weekly reporting and updating must be carried out with allowances for insertion of urgent and important messages at any time necessary.

Overall, farmers' response to the information is the main concern. From the onset, the field staff must encourage leaders of the farmers' groups to constantly refer to the IMFS for updated information and to ensure that the farmers' groups undertake positive action in response to the information. Gradually, the system should allow for feedback information to be provided by each farmers groups via the manager of the player stations. In the case of Besut, this will be the respective DID Compartment Stations. Farmers' response to the information must be relayed back to central control by the Compartment Stations. This is turn should be indicated in the subsequent information transmission by the Central Control.

4.4 IADP Pulau Pinang

4.4.1 General

(1) Central Control Station

Although the four scheme, Muda, Pinang Tunggal, Sg. Jarak and Sg. Kulim are 4 distinct irrigation areas, the water resources management are inter-related through inter-basin transfer from Sg. Muda via the Jarak Transfer Canal. This system management requires good knowledge and understanding of water supply situations in all the related basins (Sg. Kerek, Sg. Jarak and Sg. Kulim). There is therefore a need to establish a central control station to oversee the overall system management. This is also in line with the proposal to establish a telemetric and computerised irrigation water management system (discussed under item 4.3.5(1)). This central control station should be located at the DID Seberang Jaya Office in Seberang Perai.

4.4.2 Reorganizing O&M responsibility

The modern system expects the farmers to be more involved and responsible in its O&M. It is proposed that tertiary systems operations are gradually handed over to the farmers 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. This process can be achieved through the formation of WUGs (see item 4.4.2(6)).

In the process, the roles of DID field staff will be affected. Field staffs are defined as those whose scope of work is 100% on irrigation O&M. These includes Senior Irrigation Inspectors, Irrigation Inspectors, Irrigation Technicians, Pump Operators, Gatekeepers or

Linesmen and General Workers. The S.I.Is, I.Is, Irrigation Technicians are key personnels for the overall systems operations. So too are the pump operators who operates primary and secondary pump stations. Therefore these staff must be retained for overall scheme management.

Based on an assumption of 80% reduction for gateskeepers and general workers, the expected O&M staff cost reduction for the Sg. Muda Scheme is RM 129/ha representing a 64% field staff reduction. Similarly for Sg. Kulim Scheme, the O&M staff cost reduction is RM 45/ha. and 64% field staff size reduction. For Sg. Jarak nor reduction is proposed as the present strength is already considered compact.

Estimated O&M Field Staff reduction

Scheme	% Staff size reduction (%)	% total staff cost reduction (%)	O&M staff cost reduction (RM/ha)
Sg. Muda	64	53	38
Sg. Jarak	0	0	0
Sg. Kulim	64	53	45

Since complete data for the other scheme (Pinang Tunggal) is not available, the overall staff reduction estimate for the Seberang Jaya DID Office is not directly possible. Under this circumstance, the estimation will have to be based on other schemes. In this case, the Besut Scheme field staff size characteristics in percentage terms are quite similar to that for Sg. Muda Scheme. Thus adopting an overall staff (field staff + non-field staff) reduction of 41% and O&M cost reduction of RM 38/ha (using Sg. Muda Scheme as representative for all other schemes in SPU and Sg. Kulim for SPT), the impact on O&M figures are summarized below:

IADP	Office/ Scheme	Present			After staff reduction		
		Total staff	No/1000ha.	Cost/ha '97	Total staff	No/1000 ha	Cost/ha
P.Pinang	SPU	204	21	186	120	12	148
	SPT	80	53	410	39	26	365

From the above, figures obtained for SPT appears not reasonable due to discrepancy in the original basic data. Until this is confirmed, the figures for SPT should be viewed carefully.

Considering SPU figures only, the annual staff cost reduction is 20%. For the whole area under SPU and SPT (12,959 ha.), the estimated staff cost reduction is RM 492,442 per year (based on RM 148/ha).

(1) Re-packaging O&M contracts and indents works

The estimated 1997 DID expenditure on irrigation O&M for IADP Pulau Pinang is RM 1.72 mil/yr. Out of these about RM 1.2 mil are undertaken by farmers through indent works. More than 300 indent jobs are administered by the DID staff every year. Recently, the DID signed a single contract amounting RM x mil. for 2 years duration with the State Farmers' Organization Association. Thus administratively, the DID now manages one large contract instead of 300 small ones. This is an administrative relief for the DID. Also this move increases farmers participation in O&M job allocation. In the long term, a single package over

a longer duration would encourage the contractors to invest in better equipment and training. It is recommended that the O&M packages should also include all other O&M works such as pump stations, desilting works and general repairs.

(2) Water Users' Groups

IADP Pulau Pinang began its WUG program at the end of 1997. The planned targets are shown below:

Scheme	Total Target WUG	Planned 1997	Planned 1998	Balance
Sg Muda	105	6	61	38
Sg Kulim	10	3	7	0
P. Tunggal	7	0	2	5
Pdg. Menora & Pk. Tampang	3	0	2	1
sub-total	125	9	72	44
Sg. Burung	3	0	1	2
Total	128	9	73	46

Although the Sg. Burung Scheme is not within the scope of this study, the numbers to be formed is small and is included in the cost analysis.

As far as possible the existing Farmers' Groups boundaries will be adjusted to concur with the WUGs. However, there provisions that some overlapping will occur especially for Farmers' Groups with well bonded membership and financially strong. In this situation, the committee member in charge of water management will represent the Farmers' Group in the main WUG. IADP Pulau Pinang also see this program as a strategy for farmers who opt not to join any Farmers' Group to be organize under the WUGs as water is an important input for all. As a member of a WUG, these farmers will indirectly be involved in the Farmers' Groups issues.

Formation of WUG requires intensive promotion by field officers. There is also a need to develop training program for each WUG. All these training should be done on-site. A special training program for WUG leaders should be developed. For on-site training, a two separate one-day sessions is proposed. For the WUG leaders, one 3-days training duration is proposed at National Water Management Training Centre. The estimated cost for training is RM 5/person/day for on-site training and RM 400/person/day for training at the NWMTC. These training sessions should include promoting in-field infrastructure development program and land consolidation.

The average size of WUG formation is summarized below:

	Farmers	WUG	Area/WUG (ha/WUG)	Farmer/WUG
IADP P.Pinang	7,301	125	76	58

It is proposed that the time frame for their formation be within 5 years. On average, the target formation will be to form 25 WUGs a year. This is well within the annual target (1988)

as set by the PMU (73 WUGs). The one-day on-site training program will be once during the off-season and once during the main season during the initial crop growth stage when farm activities are relatively low.

With the membership size of about 43 members for each WUG, it may be possible to run training sessions without sub-dividing them into smaller groups.

The off-site training at NWMTC for WUG leaders will involve 25 members (2 from each 125 WUGs). Limiting each training session to around 40 members, then the number of training sessions will be 7. This program should be given priority as they are key members neccesary to support the WUG and modernization program. WUG formation targets and training cost estimate is shown in Table III-66.

4.4.3 On-farm infrastructure improvement

Physical improvement refers to on-farm infrastructure development comprising land levelling, in-field channels and control boxes and land consolidation. Table III-67 shows the lots and extent of land leveling requirement for IADP Pulau Pinang Schemes.

The table below summarizes the on-farm infrastructure works and cost for IADP Pulau Pinang.

Scheme	Lots for improvement (nos.)	Area for land leveling (ha.)	In-field channel (km)	In-field control boxes (nos.)
Sg. Muda	10,129	6,564	985	2,626
Pinang Tunggal	1,123	697	105	279
Sg Jarak	384	283	42	113
Sg Kulim	1,284	1,053	158	421
Total	12,920	8,597	1,290	3,439

The estimate is based on the assumption that 90% of the total number of lots and paddy areas need the infrastructure improvement works. The average cost of the above works is RM 579/ha.

The land leveling will be based on the DOA's specification of zero grading at +/- 5 cm accuracy over 100% of 10m x 10m grid points. It is estimated that 40% of the land leveling works will be by the DOA at RM 250/ha. The remaining 60% will be the private sector at RM 350/ha. The PPK will be encouraged to undertake these works.

For in-field channels, the criteria is to achieve a density of 150m/ha. Construction cost is estimated at RM 0.35/m. For the control boxes, the cost is estimated at RM 60 each and for two boxes for every lot.

Assuming that all these on-farm infrastructure works on the 8,597 ha. are to to be begin in 1999 and completed by 2006 i.e. over a 8-year period, then on average, the target for land leveling would be 1,075 ha./year.

For in-field channel, the annual target over the same 8 year time frame will be 161 km/year and for the control boxes, 430 nos./year. In-field infrastructure improvement works

and cost estimates is shown in Table III-67.

4.4.4 Land Consolidation

All granaries should aim for larger farm plots through land consolidation. This is through removal of field bunds (*batas*) but without legal rearrangement of lot boundaries. Studies indicated that 10 to 20 ha. plot size is optimum for fully mechanized farming. However, it deemed practical for these Granaries to aim for 5 ha. plots sizes. This is achieved through consolidation of adjacent plots. This exercise requires good promotion to get the consensus of lot owners. Ideally it should be performed concurrent with the on-farm infrastructure works described above.

The number of paddy lots and target consolidated lots are shown below:

Scheme	No. of Farmers	No. of lots	Area	Estimated no. of consolidated farms
	(no.)	(no.)	(ha.)	(no.)
Pulau Pinang	7,301	14,231	9,601	1,920

Each consolidation aims for a 5 ha. farm plot.

To form 9,601 consolidated farms of 5 ha. each over 8 years would mean an average formation of 1,200 nos./year.

The above is quite a high target considering that considerable effort is needed to obtain the farmers and lot owners' consent. Implementing this land consolidation program therefore would require a specially developed approach and by a team of trained specialists. The IADP PMUs should lead this program with assistance from the DOA. The PPK should also be a member of this team. Land consolidation estimates is shown in Table III-68.

4.4.5 Water Management Facilities

(1) Irrigation Water Management System (IWMS)

This is a computer model for determining daily irrigation distribution volumes. The model is based on a water balance model between effective rainfall, available supply and crop water requirement. The basic input are collected via telemetry namely rainfall and water levels. Other input that can be collected via telemetry are those necessary to estimate crop evapotranspiration.

(2) Irrigation monitoring and feedback system

The irrigation monitoring and feedback system (IMFS) is to provide updated irrigation and farm activity information so that farmers can respond in good time to take necessary preparatory steps, adhere to schedules and alert them on any change of status. The system also serves the same functions for O&M field staff particularly to alert them of any potential delays

so that timely corrective measures can be initiated.. In addition, the system can be utilized as a communication medium for agriculture extension services and general information. Being a common monitoring system, it will strengthen coordination between irrigation managers, agriculture managers, the PMU of the IADP office and of course the farmers.

The proposed IMFS is a computer based system using the telephone line communication. This system allows the systems manager to produce. author, schedule and distribute multimedia messages and information for TV output. Since a telephone line is used, the information can be transmitted and displayed at any number of stations from a single control center.

Within a granary, the basic system comprise a master station connected to one or more player stations on site. The master station is the source of all information presentations and controls presentation schedules of the player stations. Subsequently, the system can be upgraded to one with multi-master stations and interlinked with each other. Ultimately, the system can be extended to be an inter-granary network with links to the Ministry of Agriculture and any relevant Federal and State Departments.

The main criteria on choice of system is that the information must be is easily updated, the display simple messages and carries good visual impact. The recommended software for the system is the SCALA Infochannel.

The basic content of the IMFS can be divided into three segments:

(a) Irrigation and Farm activities

(b) Agronomic

(c) Administrative

(a) Irrigation and farm activities

In this segment, the contents are

- irrigation schedule,
- alert messages on dates of field activities,
- farmers preparatory works necessary, and,
- status of field activities.

Water management information which includes rainfall and water supply and water level status at intake and canals, and current information on operations and maintenance.

(b) Agronomic

This segment comprise messages pertaining to

- recommended farm and crop husbandry practices.
- alert messages on DRIP, and,
- current issues and problems such as pest and disease outbreaks and recommended management.

(c) Administrative

The administrative segment comprise

- administrative and motivational messages from IADP PMU and component heads, DID O&M section and even from Farmers' Group and WUG leaders,
- paddy production statistics (yields and production) and targets, and,
- news on current issues.

The proposed IMFS network for the Granaries and total cost is summarised below:

IADP/Office	Master (Nos.)	Player (Nos.)	Additional TV (Nos.)	Total Cost (RM)	Notes
Pulau Pinang	1	11	3	685,850	
Total					

(3) Integration of the Water Management System and the Irrigation Monitoring and Feedback System

To ensure that the systems installed functions effectively, they must be managed and operated in an integrated manner. Most important is to appreciate that both systems have their own specific purpose and that the O&M staff work procedure is an integral component.

The Water Management System (WMS) collects data on water resources and irrigation for use of the technical personnel i.e. the O&M staff of the DID. The data and information presentation are thus technical in nature but easily understood by the systems operators. The basic data are rainfall and water level information. These data are transformed into decision-making information mainly on water availability status and system allocation levels.

On the other hand, the Irrigation Monitoring and Feedback System (IMFS) is targeted to mainly for the farmers and field staffs. These must be less technical in nature and easily understood. Thus data obtained form the WMS must be suitably represented for the IMFS. The water level and rainfall data collected through the WMS can be directly connected to the IMFS via a computer link and programming. Only the display format will differ. The key information necessary for farmers are rainfall, water level and supply conditions.

Apart from the systems computer linkage, the planning input and actions of the PMU, the DID, DOA, LPP/PPK and BERNAS components of the IADP is critical. These must be well supported by field staff for activity feedback update and ensuring that information transmission to farmers is executed.

A season's planning information must be provided by the PMU and the respective components at the start of every season. Clear targets for each activity is critical and should be input into the IMFS. During a season's operations, monitoring feedback must be provided by the field staff as part of their work program. A feedback format and schedule must be set-up. A weekly reporting and updating must be carried out with allowances for insertion of urgent and important messages at any time necessary.

Overall, farmers' response to the information is the main concern. From the onset, the

field staff must encourage leaders of the farmers' groups to constantly refer to the IMFS for updated information and to ensure that the farmers' groups undertake positive action in response to the information. Gradually, the system should allow for feedback information to be provided by each farmers groups via the manager of the player stations. In the case of Besut, this will be the respective DID Compartment Stations. Farmers' response to the information must be relayed back to central control by the Compartment Stations. This is turn should be indicated in the subsequent information transmission by the Central Control.

TABLES

Table III-1: Irrigation Administrative Structure

A) IADP Pulau Pinang

IADP	Reference	Total	Breakdown				Notes
P Pinang	Scheme	4	Muda	Pinang Tunggal	Sg Jarak	Kubin	
		16	6	2	2	6	
	ISA	125	105	7	3	10	Framework for WUGs

B) IADP Kerian-Sg Manik

Scheme	Reference	Total	Breakdown								Notes
Kerian	Region	2	Kerian Laut				Kerian Darat				
	Compartment	8	A	B	C	D	E	F	G	H	
	Blocks	28	3	5	4	4	3	3	3	4	
	ISA	84	20 (A&B)		4	17	22 (E&F)		21 (G&H)		Framework for WUGs
	ISU	471	168 (A&B)		86	61	61 (E&F)		103 (G&H)		

Scheme	Reference	Total	Breakdown					Notes
Sg Manik	Scheme	2	Sg Manik			Labu Kubong		
	Blocks	5	No.1	No.2	No.3	No.4	No.5	

C) IADP Seberang Perak

IADP	Reference	Total	Breakdown							Notes
Sbg Perak	Command Area	2	Left Bank Canal (LBC)				Right Bank Canal (RBC)			
	Blocks	7	A	B	C	D	E	F	G	
	Area (ha)	8,873	949	653	1,837	1,131	1,539	1,426	1,537	

D) IADP Kemasin-Semerak

IADP	Reference	Total	Breakdown		Notes
Kemasin-Semerak	Phases	2	Kemasin (Phase 1)	Semerak (Phase 2)	Phase 2 is still under planning
	Schemes	8	Kemasin Hilir Jelawat Rusa	Semerak Hilir Semerak Hulu Semerak Selatan Semerak Barat Sg Yong-Gaat Jerum Rasau	

Scheme	Reference	Total	Breakdown					Notes
Jelawat Rusa	Zones	5	A0	B0	B1	C0	C1	
	Area (ha)	1,384	373	211	256	268	276	Gross area
	Service Units (SU)		33	20	25	24	24	av.12ha/SU
	Plots		Generally 4 plots per SU					
Kemasin Hilir	Blocks	5	A	B	C	D	E	<60ha/Block
	Area (ha)	260.5	125	15.6	24.3	35.6	60	except A=190ha
	Service Units (SU)		11	1	2	3	5	av.12ha/SU
	Plots		Generally 4 plots per SU					

E) IADP Kelara (Besut)

IADP	Reference	Total	Breakdown				Notes
Besut	Compartment	4	1	2	3	4	
	ISA	30	8	5	8	9	Framework for WUGs
	Blocks	166	21	26	51	68	

Table III-2: Nos of farmers, lots and paddy parcel area of the 5 Granaries

(Paddy parcel lots and area source: Paddy Production Statistics Secretariat, DOA)

IADP	Scheme/ Sub-scheme	Blocks/ Compartment	Nos of farmers	Nos of lots*	Area* (ha)	Av. Area (ha/lot)	Av.area/ farmer (ha/farmer)	Notes
(1) Pulau Pinang	Muda sub-scheme	M1		2,186	1,365	0.62		
		M2		911	741	0.81		
		M3		2,500	1,495	0.58		
		M4		666	350	0.53		
		M5		3,281	2,220	0.68		
		M6		1,495	921	0.62		
				11,129	7,092	0.64		
	Kubm sub-scheme	K2		467	394	0.84		
		K3		553	388	0.70		
		K4		407	392	0.96		
				1,427	1,174	0.82		
	Pinang Tunggal sub-scheme	P1A		337	170	0.50		
		P2		911	648	0.71		
				1,248	818	0.66		
	Sg Jarak sub-scheme	Pokok Tampang		193	161	0.83		
		Padang Menova		234	207	0.88		
				427	368	0.86		
		Total IADP P. Pinang	7,303	14,231	9,452	0.66	1.29	
(2) Kerian-Sg Manik	Kerian Scheme	A		1,955	2,402	1.23		
		B		2,939	4,001	1.36		
		C		2,285	3,960	1.73		
		D		2,624	3,362	1.28		
		E		1,538	2,344	1.52		
		F		1,733	2,697	1.52		
		G		1,385	1,830	1.32		
		H		2,142	2,964	1.38		
			13,485	16,643	23,560	1.42	1.75	
	Sg. Manik	1		913	1,279	1.40		Sg Manik Block
		2		523	996	1.90		-ditto-
		3		676	1,437	2.13		-ditto-
		4		864	1,694	1.96		Labu Kubong Block
		5		523	1,019	1.95		-ditto-
			4,030	3,499	6,425	1.84	1.59	-ditto-
(3) Sbg Perak	Sbg Perak	A		761	848	1.11		
		B		311	614	1.97		
		C		660	1,415	2.14		
		D		877	1,128	1.29		
			2,333	2,609	4,005	1.54	1.72	
		E		1,062	1,484	1.40		Blocks E,F,G under
		F		1,186	1,336	1.13		FELCRA paddy estate
		G		1,191	1,304	1.09		
				3,399	4,124	1.21		2.43 Standard lot size/farmer
				6,908	8,129			
(4) Kemasin-Semerak			11,849	17,775	9,522	0.54	0.80	
(5) Ketara	Besut	1	659	1,302	1,234	0.95		
		2	509	1,069	1,130	1.06		
		3	858	1,715	1,306	0.76		
		4	1,028	1,704	1,504	0.88		
			3,054	5,790	5,174	0.89	1.69	
		Grand Total	39,259	61,335	58,257	0.95	1.47	

* Lot is paddy lot and Area is paddy parcel

Table III-3: Irrigation Rates

State	RM per acre	RM per ha.		Granaries
Perlis	RM5.00 RM12.00	RM12.36 RM29.65	Outside MADA Within MADA	MADA
Kedah	RM 1.40 to RM 6.00 RM12.00	RM 3.46 - RM 14.83 RM29.65	Outside MADA Within MADA	MADA
Pulau Pinang	RM 4.00 to RM 14.00	RM 9.88 - RM 34.59		IADP Pulau Pinang IADP Kerian-Sg Manik
Perak	RM 3.00 to RM 5.00	RM 7.41 - RM 12.36		IADP Kerian-Sg Manik IADP Seberang Perak
Selangor	RM 5.00 to RM 6.00	RM 12.36 - RM 14.83		IADP Barat Laut Selangor
Negeri Sembilan	RM3.00	RM7.41		
Melaka	RM 6.00 to RM 7.00	RM 14.83 - RM17.30		
Johor	RM 6.00 to RM 7.00	RM 14.83 - RM 17.30		
Pahang	-	-		
Terengganu	RM4.00	RM9.88		IADP KETARA (Besut)
Kelantan	RM5.00 RM10.00	RM12.36 RM24.71	Outside KADA Within KADA	KADA, Kemasin-Semerak
Sarawak	-	-		
Sabah	-	-		

Table III-4: O&M Cost of the Granaries (excluding staff costs)

IADP	Scheme/Sub-scheme	Year	Area (ha)	Canal Length (km)	Cost (RM)	Drain Length (km)	Cost (RM)	Bunds Length (km)	Cost (RM)	Structures (RM)	Total (RM)	O&M Cost per ha (RM/ha)	Notes
Pulau Pinang	Sungai Muda	1994	7,117.00	104.55	165,938.55	82.54	171,153.27	8.46	12,477.88	380,520.00	730,089.70	102.58	
	Sungai Muda	1995	7,117.00	133.88	176,968.74	115.50	144,562.86	8.43	8,599.62	423,120.00	753,251.22	105.84	
										Average	741,670.46	104.21	
	Pinang Tunggal	1994	1,497.00	42.16	73,382.92	23.45	53,398.20	10.18	14,458.44	198,355.00	339,594.66	226.85	
	Pinang Tunggal	1995	1,497.00	42.16	61,457.66	23.45	44,060.31	10.18	12,422.04	202,275.00	320,215.01	213.90	
										Average	329,904.84	220.38	
	Sungai Jarak	1994	789.00	35.93	56,084.82	21.91	35,816.55	0.00	0.00	54,050.00	145,951.37	184.98	
	Sungai Jarak	1995	789.00	35.93	50,405.28	21.91	32,853.75	0.00	0.00	53,150.00	136,409.03	172.89	
										Average	141,180.20	178.94	
	Sungai Kulim	1994	3,556.00	113.90	169,412.90	119.70	154,313.60	0.00	0.00	49,350.00	373,076.50	104.91	
	Sungai Kulim	1995	3,556.00	113.90	181,799.30	119.70	154,361.60	0.00	0.00	49,350.00	385,510.90	108.41	
										Average	379,293.70	106.66	
Kerian/ Sg. Manik	Kerian	1994	22,169.00	730.93	1,015,396.91	782.94	1,573,938.62	106.81	159,007.29	1,957,916.56	4,706,259.38	212.29	
		1995	22,169.00	725.25	1,015,073.51	807.46	1,623,291.92	117.43	174,819.70	1,701,124.47	4,514,309.60	203.63	
										Average	4,610,284.49	207.96	
	Sg. Manik	1994	7,017.00	1,108.98	229,444.00	333.22	134,394.00	66.38	177,852.00	449,233.00	990,923.00	141.22	
		1995	7,017.00	881.58	191,207.00	376.96	179,722.00	65.83	48,480.00	609,215.00	1,028,624.00	146.59	
										Average	1,009,773.50	143.90	
Sbg. Perak	Sbg. Perak	1994	8,708.00	225.00	282,621.00	257.80	775,990.00	0.00	0.00	15,066.00	1,073,677.00	123.30	
		1995	8,707.00	225.00	282,621.00	257.80	736,484.00	0.00	0.00	51,905.00	1,071,010.00	123.01	
										Average	1,072,343.50	123.15	
Kemasin-Semerak	Pasir Putih District Irrigation Schemes	1994	2,476.00	82.86	67,804.00	2.20	7,961.00	0.00	0.00	52,823.21	130,248.81	52.60	All the future Semerak schemes are in Pasir Puteh
		1995	2,476.00	82.86	72,167.00	2.20	4,700.00	0.00	0.00	20,253.12	97,120.12	39.22	
										Average	113,684.47	45.91	Scheme figures used for estimating purposes
KETARA	Besut	1994	5,195.00	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1,019,320.24	196.21	
		1995	5,195.00	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	925,140.00	178.08	
		1996	5,195.00	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	726,672.00	139.88	
										Average	890,377.41	171.39	

Data source: DID survey 1996

Area, length include non-granary areas managed by the respective DID offices

Table III-5: Average total and per ha. O&M costs of the Granaries

IADP	Scheme/Sub-scheme	Staff Cost per ha (1995) (RM/ha)	Staff Cost per ha (1997) (RM/ha)	Average Total O&M Cost 1995 RM	Average Total O&M Cost 1997 RM	Average O&M Cost per ha.1995 RM/ha	Average O&M Cost per ha.1997 excl. staff cost RM/ha	Average O&M Cost per ha.1997 incl. staff cost RM/ha	Irrigation Rates (highest imposed) RM	% Irrigation Rate of total av. O&M cost (excl.staff) %	% Irrigation Rate of total av. O&M cost (excl.staff) %	Notes
Pulau Pinang	Sungai Muda	179	186	741,670.46	802,191	104	113	299	34.59	31	12	Average 1995 price is assumed to be the average of prices for 1995 and 1996
	Pinang Tunggai	179	186	329,904.84	356,825	220	238	425	34.59	15	8	Average 1997 price at 1995 price @ 4% increment per annum
	Sungai Jarak	179	186	141,180.20	152,701	179	194	380	34.59	18	9	Average staff cost for Sg.Muda,P.Tunggal & Sg.Jarak based on SPU District
	Sungai Kulim	394	410	379,293.70	410,244	107	115	525	34.59	30	7	Average staff cost for Sg. Kulim based on SPT District
					1,721,960							
Kerian/ Sg. Manik	Kerian	96	100	4,610,284.49	4,986,484	208	225	325	12.36	5	4	
	Sg. Manik	151	157	1,009,773.50	1,092,171	144	156	313	12.36	8	4	
Sbg. Perak	Sbg. Perak	84	87	1,072,343.50	1,159,847	123	133	221	12.36	9	6	
Kemasin-Semerak	Pasir Putih District Irrigation Schemes	140	146	113,684.47	122,961	46	50	195	12.36	25	6	Pasir Putih District taken as present indicative figures and for comparison only
KETARA	Besut	69	72	890,377.41	963,032	171	185	257	9.88	5	4	
				Total	10,046,455							

Table III-6: Estimated O&M Staff Cost

IADP	District/Scheme/Sub-scheme	Year	Area (ha)	Salary & Emolument (RM)	Total staff (No)	Staff Cost per ha (RM/ha)	Staff/1000ha No/1000ha	Notes
Pulau Pinang	Seberang Perai Utara (SPU)	1994	9,729.00	1,733,353.00	204	178	21	SPU manages Sg. Muda, Pinang Tunggal and Sungai Jarak Schemes
	Seberang Perai Utara (SPU)	1995	9,729.00	1,740,157.00	204	179	21	SPU manages Sg. Muda, Pinang Tunggal and Sungai Jarak Schemes
				Average	204	179	21	
	Seberang Perai Tengah (SPT)	1994	1,497.00	602,521.00	83	402	55	SPT manages Sungai Kulim Schemes
	Seberang Perai Tengah (SPT)	1995	1,497.00	575,751.00	77	385	51	SPT manages Sungai Kulim Schemes
				Average	80	394	53	
Kerian/ Sg. Manik	Kerian	1994	22,169.00	1,861,698.72	240	84	11	
	Kerian	1995	22,169.00	2,363,776.57	238	107	11	
				Average	239	96	11	
	Sg. Manik	1994	7,017.00	1,007,518.00	143	144	20	
	Sg. Manik	1995	7,017.00	1,103,217.00	118	157	17	
				Average	131	151	19	
Sbg. Perak	Sbg. Perak	1994	8,708.00	707,489.00	120	81	14	
	Sbg. Perak	1995	8,708.00	747,120.00	120	86	14	
				Average	120	84	14	
Kemasin-Semerak	Pasir Putih District	1994	2,476.00	351,377.60	53	145	21	All Semerak schemes
	Pasir Putih District	1995	2,476.00	332,436.78	53	134	21	are in managed by this District
				Average	53	140	21	
KETARA	Besut	1994	5,195.00	355,063.17	56	68	11	
	Besut	1995	5,195.00	365,570.00	56	70	11	
	Besut	1996	5,195.00	361,600.00	56	70	11	
				Average	561	69	11	

Table III-7: Average staff strength, density and cost per ha.

IADP	District/Scheme/Sub-scheme	Total staff (No)	Staff/1000ha No/1000ha	Staff Cost per ha (1995) (RM/ha)	Staff Cost per ha (1997) (RM/ha)	Notes
Pulau Pinang	Seberang Perai Utara (SPU)	204	21	179	186	1995 Average Price is taken as the average of 1994 and 1995 Costs
	Seberang Perai Tengah (SPT)	80	53	394	410	1997 Average Price is based on 1995 average @ 2% increase per annum
Kerian/	Kerian	239	11	96	100	
Sg. Manik	Sg. Manik	131	19	151	157	
Sbg. Perak	Sbg. Perak	120	14	84	87	
Kemasin-Semerak	Pasir Putih District	53	21	140	146	
KETARA	Besut	56	11	69	72	

Table III-8: Field Staff for Irrigation O&M for IADP Pulau Pinang

Field Staff	Muda Scheme							
	Block	M1	M2	M3	M4	M5	M6	Notes
	Total							
1 Senior Irrigation Inspector (SII)	2	1 (M1,M2,M3)			1 (M4,M5,M6)			
2 Irrigation Inspector								
3 Irrigation Technician	5	1	1	1	1 (M4,M5)		1	
4 Gatekeeper (R11)	27	6	3	5	2	7	4	
5 Pump Operator	4		2	(M1,M2,M3 ,M4,M5)			2	
6 General Worker (R11)	18		18	(M1,M2,M3 ,M4,M5,M6)				
	56							

Field Staff	Sg Jarak				Pinang Tunggal			
	Block	Pokok Tampang	Padang Menora	Notes	Block	P1A	P2	Notes
	Total				Total			
1 Senior Irrigation Inspector (SII)	1	1 (both schemes)						
2 Irrigation Inspector								
3 Irrigation Technician	1	1 (both schemes)				-n.a -		
4 Gatekeeper (R11)	5	2	3					
5 Pump Operator	4	2	2					
6 General Worker (R11)	2	1	1					
	13							

Field Staff	Kulim Scheme							
	Block	K1	K2	K3	K4	K5	K6	Notes
	Total							
1 Senior Irrigation Inspector (SII)	1	1 (K1 - K6)						
2 Irrigation Inspector								
3 Irrigation Technician	3	1 (K1&K2)		1 (K3&K4)		1 (K5&K6)		
4 Gatekeeper (R11)	8	2	1	1	1	3 (K5&K6)		
5 Pump Operator	3	1	1				1	
6 General Worker (R11)	20	5 (K1&K2)		7 (K3&K4)		8 (K5&K6)		
	35							

Table III-9: Field Staff Strength and Emolument (salary + allowances) for Irrigation O&M for IADP Pulau Pinang

A Muda Scheme

Field Staff	Nos (1997)	% of total staff	RM/yr/staff (1996)	Total (1996) RM/yr	RM/yr/staff (1997)	Total (1997) RM/yr	% of total cost	Proposed strength*	% of total staff	Revised Cost RM/yr (1997)	% of total cost	Total Annual Reduction (RM)	% total Cost Reduction	Cost reduction per ha (RM/ha)	Note
1 Senior Irrigation Inspector (SII)	2		23,321	46,642	23,787	47,575		2		47,575					1997 cut rate price @ 2% annual increase
2 Irrigation Inspector			16,374		16,701	0				0					*Staff reduction at 80% item 5 & 6
3 Irrigation Technician	5		16,800	84,000	17,136	85,680		5		85,680					Administrative area taken at 7,117 ha
4 Pump Operator	4		9,132	36,528	9,315	37,259		4		37,259					
Total 1,2,3 & 4	11	20		167,170		170,513	33	11	55	170,513	71				
5 Gatekeeper (R11)	27		7,931	214,137	8,090	218,420		5		43,684					
6 General Worker (R11)	18		6,673	120,114	6,806	122,516		4		24,503					
Total 5 & 6	45	80		334,251		340,936	67	9	45	68,187	29				% field staff reduction:
Total	56			501,421		511,449		20		238,701		272,749	53	38 /ha	

Field Staff is defined as those work scope at 100% O&M on site

A Sg Jawak Scheme

Field Staff	Nos (1997)	% of total staff	RM/yr/staff (1996)	Total (1996) RM/yr	RM/yr/staff (1997)	Total (1997) RM/yr	% of total cost	Proposed strength*	% of total staff	Revised Cost RM/yr (1997)	% of total cost	Total Annual Reduction (RM)	% total Cost Reduction	Cost reduction per ha (RM/ha)	Note
1 Senior Irrigation Inspector (SII)	1		23,321	23,321	23,787	23,787		1		23,787					1997 cut rate price @ 2% annual increase
2 Irrigation Inspector			16,374	0	16,701	0				0					No staff reduction proposed as the size
3 Irrigation Technician	1		16,800	16,800	17,136	17,136		1		17,136					is already compact
4 Pump Operator	4		9,132	36,528	9,315	37,259		4		37,259					
Total 1,2,3 & 4	6	46		76,649		78,182	59	6	46	78,182	59				
5 Gatekeeper (R11)	5		7,931	39,655	8,090	40,448		5		40,448					
6 General Worker (R11)	2		6,673	13,346	6,806	13,613		2		13,613					
Total 5 & 6	7	54		53,001		54,061	41	7	54	54,061	41				
Total	13			129,650		132,243		13		132,243		0	0	0	

Field Staff is defined as those work scope at 100% O&M on site

A Sg Kulim Scheme

Field Staff	Nos (1997)	% of total staff	RM/yr/staff (1996)	Total (1996) RM/yr	RM/yr/staff (1997)	Total (1997) RM/yr	% of total cost	Proposed strength*	% of total staff	Revised Cost RM/yr (1997)	% of total cost	Total Annual Reduction (RM)	% total Cost Reduction	Cost reduction per ha (RM/ha)	Note
1 Senior Irrigation Inspector (SII)	1		23,321	23,321	23,787	23,787		1		23,787					1997 cut rate price @ 2% annual increase
2 Irrigation Inspector			16,374	0	16,701	0				0					*Staff reduction at 80% item 5 & 6
3 Irrigation Technician	3		16,800	50,400	17,136	51,408		3		51,408					Administrative area taken as 3,556 ha
4 Pump Operator	3		9,132	27,396	9,315	27,944		3		27,944					
Total 1,2,3 & 4	7	20		101,117		103,139	34	7	56	103,139	72				
5 Gatekeeper (R11)	8		7,931	63,448	8,090	64,717		2		12,943					
6 General Worker (R11)	20		6,673	133,460	6,806	136,129		4		27,226					
Total 5 & 6	28	80		196,908		200,846	66	6	44	40,169	28				% field staff reduction:
Total	35			298,025		303,986		13		143,309		160,677	53	45 /ha	

Field Staff is defined as those work scope at 100% O&M on site

Table III-10: O&M Cost of canals, drains and bunds for Sungai Muda Scheme (1995)

Item	Top Width (m)	Depth	Length (km)	Clearing Frequency (cycle/yr)	Clearing Rate/Km (RM/km)	Clearing Total (RM)	Desilting Frequency (1.5 yrs)	Desilting Rate/Km (RM/km)	Desilting Av. Annual Total (RM)	Repairs (RM)	Total	Notes
1 Earth canal	>10	Varies	44.26	3	440.00	58,416.60	5	1,000.00	8,851.00		67,267.60	
	6-10	Varies	23.53	3	420.00	29,644.02	5	1,000.00	4,705.40		34,349.42	excl. all other sizes
	3-6	Varies										
	<3	Varies										
	<3	<1.2										
2 Lined canal	Varies	Varies	66.10	3	380.00	75,351.72					75,351.72	
		Total				163,412.34			13,556.40		176,968.74	
3 Earth Drain	>30	Varies										
	15-30	Varies	1.87	3	460.00	2,581.98	3	2,000.00	1,234.86		3,816.84	
	10-15	Varies	86.85	3	430.00	112,031.34	3	2,000.00	57,318.36		169,349.70	
	6-10	Varies	20.60	3	350.00	23,479.44	3	2,000.00	13,593.36		37,072.80	
	3-6	Varies	7.19	3	300.00	6,470.10	3	2,000.00	4,744.74		11,214.84	
	<3	Varies										
	<3	<1.2										
		Total				144,562.86			76,891.32		221,454.18	
4 Coastal bund/ Rivers	>2.5 (bund)	Varies	8.43	2	510.00	8,599.62	5	1,000.00	1,688.20			
	<2.5 (bund)	Varies										
		Total items 1-4				316,574.82			92,133.92		408,708.74	

Data source: DID survey 1996
Area, length include non granary areas managed by the respective DID offices

Table III-11: O&M cost of structures for Sg Muda Scheme (1995)

	Item	Nos	O&M Cost per unit: Maintenance (RM)	Operations (RM)	Total Cost per unit (RM)	Total (RM)	Notes
1	Structures						
a	Dam						
b	Headworks						
c	Pump Stations	4	1,500.00	94,680.00	96,180.00	384,720.00	
d	Tidal Gates	2	500.00	500.00	1,000.00	2,000.00	
e	Other Irrigation & Drainage structures (incl. farmroads)	776	25.00		25.00	19,400.00	
f	Crossings (excl. farmroads)						
2	Staff Quarters	17	1,000.00		1,000.00	17,000.00	
	Total					423,120.00	

Data source: DID survey 1996
Area, length include non-granary areas managed by the respective DID offices

Table III-12: O&M Cost of canals, drains and bunds for Pinang Tunggal Scheme(1995)

Item	Top Width (m)	Depth	Length (km)	Cleaning Frequency (cycles/yr)	Cleaning Rate/km (RM/km)	Cleaning Total (RM)	Desilting Frequency (1 : x yrs)	Desilting Rate/km (RM/km)	Desilting Av. Annual Total (RM)	Repairs (RM)	Total	Notes
1 Earth canal	>10	Varies	21.93	3	450.00	29,404.15	5	1,000.00	4,385.80		33,989.95	
	6-10	Varies	17.66	3	410.00	21,720.57	5	1,000.00	3,531.80		25,252.37	
	3-6	Varies	2.58	2	330.00	1,700.16	5	1,000.00	515.20		2,215.36	
	<3	Varies										
	<3	<1.2										
2 Lined canal	Varies	Varies										
		Total	42.16			53,024.88			8,432.80		61,457.68	
3 Earth Drain	>30	Varies										
	15-30	Varies	5.12	3	670.00	10,297.23	3	2,000.00	3,381.18		13,678.41	
	10-15	Varies	1.77	3	430.00	2,280.72	3	2,000.00	1,166.88		3,447.60	
	6-10	Varies	13.98	3	330.00	13,842.18	3	2,000.00	9,228.12		23,070.30	
	3-6	Varies	2.58	3	280.00	2,163.84	3	2,000.00	1,700.16		3,864.00	
	<3	Varies										
	<3	<1.2										
		Total	23.45			28,583.97			15,476.34		44,060.31	
4 Coastal bund/ Rivers	>2.5 (bund)	Varies										
	<2.5 (bund)	Varies	10.18	2	510.00	10,385.64	5	1,000.00	2,036.40		12,422.04	
		Total items 1-4				91,994.49			25,945.54		117,940.03	

Data source: DID survey 1996
Area, length include non-granary areas managed by the respective DID offices

Table III-13: O&M cost of structures for Pinang Tunggal Scheme (1994)

	Item	Nos	O&M Cost per unit: Maintenance (RM)	Operations (RM)	Total Cost per unit (RM)	Total (kM)	Notes
1	Structures						
a	Dam						
b	Headworks						
c	Pump Stations	2	2,000.00	95,200.00	97,200.00	194,400.00	
d	Tidal Gates						
e	Other Irrigation & Drainage structures (incl. farmroads)	115	25.00		25.00	2,875.00	
f	Crossings (excl. farmroads)						
2	Staff Quarters	5	1,000.00		1,000.00	5,000.00	
	Total					202,275.00	

Data source: DID survey 1996
Area, length include non-granary areas managed by the respective DID offices

Table III-14: O&M Cost of canals, drains and bunds for Sg Jarak Scheme (1995)

Item	Top Width (m)	Depth	Length (km)	Clearing Frequency (cycles/yr)	Clearing Rate/km (RM/km)	Clearing Total (RM)	Desilting Frequency (1:x yrs)	Desilting Rate/km (RM/km)	Desilting Av. Annual Total (RM)	Repairs (RM)	Total	Notes
1 Earth canal	>10	Varies	12.57	3	440.00	16,588.44	5	1,000.00	2,513.40		19,101.84	
	6-10	Varies	1.17	3	380.00	1,332.66	5	1,000.00	233.80		1,566.46	
	3-6	Varies										
	<3	Varies										
	<3	<1.2										
2 Lined canal	Varies	Varies	22.19	3	380.00	25,300.02	5	1,000.00	4,438.60		29,738.62	
		Total	35.93			43,221.12			7,185.80		50,406.92	
3 Earth Drain	>30	Varies										
	15-30	Varies										
	10-15	Varies										
	6-10	Varies	19.75	3	430.00	25,480.00	5	1,000.00	3,950.40		29,430.48	
	3-6	Varies	2.15	3	310.00	2,002.29	3	2,000.00	1,420.98		3,423.27	
	<3	Varies										
	<3	<1.2										
		Total	21.91			27,482.37			5,371.38		32,853.75	
4 Coastal bund/ Rivers	>2.5 (bund)	Varies										
	<2.5 (bund)	Varies										
	Total items 1-4		57.83			70,703.49			12,557.18		83,260.67	

Data source: DID survey 1996
Area, length include non-granary areas managed by the respective DID offices

Table III-15: O&M cost of structures for Sg Jarak Scheme (1995)

Item	Nos	O&M Cost per unit: Maintenance (RM)	Operations (RM)	Total Cost per unit (RM)	Total (RM)	Notes
1 Structures						
a Dam						
b Headworks	2	500.00	500.00	1,000.00	2,000.00	
c Pump Stations	3	2,500.00	12,300.00	14,800.00	44,400.00	
d Tidal Gates						
e Other Irrigation & Drainage structures (incl. farmroads)	30	25.00		25.00	750.00	
f Crossings (incl. farmroads)						
2 Staff Quarters	6	1,000.00		1,000.00	6,000.00	
Total					53,150.00	

Data source: DID survey 1996
Area, length include non-granary areas managed by the respective DID offices

Table III-16: O&M Cost of canals, drains and bunds for Sg Kulim Scheme (1995)

Item	Top Width (m)	Depth	Length (km)	Clearing			Desilting			Repairs (RM)	Total	Notes
				Frequency (cycles/yr)	Rate/km (RM/km)	Total (RM)	Frequency (1:x yrs)	Rate/km (RM/km)	Av. Annual Total (RM)			
1 Earth canal	>10	Varies	8.08	3	1,150.00	27,876.00	10	1,000.00	808.00		28,684.00	
	6-10	Varies	8.73	3	600.00	15,714.00	5	400.00	698.40		16,412.40	
	3-6	Varies	55.74	3	500.00	83,610.00	5	300.00	3,344.40		86,954.40	
	<3	Varies	2.57	3	400.00	3,084.00	5	250.00	128.50		3,212.50	
	<3	<1.2										
2 Lined canal	Varies	Varies	38.78	3	400.00	46,536.00					46,536.00	
		Total	113.90			176,820.00			4,979.30		181,799.30	
3 Earth Drain	>30	Varies										
	15-30	Varies										
	10-15	Varies	3.00	2	500.00	3,000.00	10	800.00	240.00		3,240.00	
	6-10	Varies	40.04	3	450.00	54,054.00	5	500.00	4,004.00		58,058.00	
	3-6	Varies	73.36	3	400.00	88,032.00	5	300.00	4,401.60		92,433.60	
	<3	Varies	3.30	3	350.00	3,465.00	5	250.00	165.00		3,630.00	
	<3	<1.2										
		Total	119.70			148,551.00			8,810.60		157,361.60	
4 Coastal bund/ Rivers	>2.5 (bund)	Varies										
	<2.5 (bund)	Varies										
	Total items 1-4		233.60			325,371.00			13,789.90		339,160.90	

Data source: DID survey 1996

Area, length include non-granary areas managed by the respective DID offices

Table III-17: O&M cost of structures for Sg Kulim Scheme (1995)

	Item	Nos	O&M Cost per unit: Maintenance (RM)	Operations (RM)	Total Cost per unit (RM)	Total (RM)	Notes
1	Structures						
a	Dam						
b	Headworks	1	3,000.00	3,000.00	6,000.00	6,000.00	
c	Pump Stations	4	4,000.00	4,500.00	8,500.00	34,000.00	
d	Tidal Gates						
e	Other Irrigation & Drainage structures (incl. farmroads)	274	25.00		25.00	6,850.00	
f	Crossings (excl. farmroads)						
2	Staff Quarters	5	500.00		500.00	2,500.00	
	Total					49,350.00	

Data source: DID survey 1996

Area, length include non granary areas managed by the respective DID offices

Table III-18: Water User Group formation and targets for IADP Pulau Pinang, Kerian Scheme and Besut Scheme

IADP	Total target WUG	Planned 1997	1998	Balance	Notes
1 IADP Pulau Pinang					
Sungai Muda	105	6	61	38	1 Pilot Project to be implemented at end of 1997
Sungai Kulim	10	3	7	0	
Pinang Tunggal	7	0	2	5	
Padang Menora & Pokok Tampang	3	0	2	1	
Sungai Burung	3	0	1	2	
Total	128	9	73	46	
2 Kerian Scheme					
Compartment A1	20				Pilot Project in Tebok Pantoi launched Dec,1997
Compartment C	4				No overall program yet for WUG formation
Compartment D	17				
Compartment E1	22				
Compartment G1	21				
Total	84				
3 Besut Scheme					
Compartment 1	8				Pilot Project in Kubang Depu
Compartment 2	5				All WUGs already formed
Compartment 3	8				
Compartment 4	9				
Total	30				

Table III-19: Land levelling and in-field channel works status for IADP Pulau Pinang, Sg. Muda Scheme (1997)

Item	Total	Block						Notes
		M1	M2	M3	M4	M5	M6	
1 No of farmers involved	n.a	n.a	n.a	n.a	n.a	n.a	n.a	
2 Lots								
(a) Total Nos. of Lots	11,129	2,186	911	2,590	666	3,281	1,495	Data from Paddy Production
(b) Total Area (ha)	7,092	1,365	741	1,495	350	2,220	921	Statistic Secretariat, DOA
3 Lots identified for levelling								
(a) Nos	11,129	2,186	911	2,590	666	3,281	1,495	Assuming all lots need
(b) Area (ha)	7,092	1,365	741	1,495	350	2,220	921	levelling
4 Lots already levelled								
(a) Nos	n.a	n.a	n.a	n.a	n.a	n.a	n.a	
(b) Area (ha)	528	77	74	50	0	265	62	
5 Remaining lots to be levelled								
(a) Nos	n.a	n.a	n.a	n.a	n.a	n.a	n.a	
(b) Area (ha)	6,564	1,288	667	1,445	350	1,955	859	
6 In-field channels								
(a) Already constructed (km)	n.a	n.a	n.a	n.a	n.a	n.a	n.a	
(b) To be constructed (km)	n.a	n.a	n.a	n.a	n.a	n.a	n.a	

Table III-20: Land levelling and in-field channel works status for IADP Pulau Pinang, Pinang Tunggal scheme (1997)

Item	Total	Block		Notes
		P1A	P2	
1 No of farmers involved	n.a	n.a	n.a	
2 Lots				
(a) Total Nos. of Lots	1,248	337	911	Data from Paddy Production
(b) Total Area (ha)	818	170	648	Statistic Secretariat, DOA
3 Lots identified for levelling				
(a) Nos	1,248	337	911	Assuming all lots need
(b) Area (ha)	818	170	648	levelling
4 Lots already levelled				
(a) Nos	n.a	n.a	n.a	
(b) Area (ha)	121	0	48	
5 Remaining lots to be levelled				
(a) Nos	n.a	n.a	n.a	
(b) Area (ha)	697	170	600	
6 In-field channels				
(a) Already constructed (km)	n.a	n.a	n.a	
(b) To be constructed (km)	n.a	n.a	n.a	

Table III-21: Land levelling and in-field channel works status for IADP Pulau Pinang, Sungai Jarak scheme (1997)

Item	Total	Block		Notes
		Pokok Tampang	Padang Menora	
1 No of farmers involved	n.a	n.a	n.a	
2 Lots				
(a) Total Nos. of Lots	427	193	234	Data from Paddy Production
(b) Total Area (ha)	368	161	207	Statistic Secretariat, DOA
3 Lots identified for levelling				
(a) Nos	427	193	234	Assuming all lots need
(b) Area (ha)	368	161	207	levelling
4 Lots already levelled				
(a) Nos	n.a	n.a	n.a	
(b) Area (ha)	85	85	0	
5 Remaining lots to be levelled				
(a) Nos	n.a	n.a	n.a	
(b) Area (ha)	283	76	207	
6 In-field channels				
(a) Already constructed (km)	n.a	n.a	n.a	
(b) To be constructed (km)	n.a	n.a	n.a	

Table III-22: Land levelling and in-field channel works status for IADP Pulau Pinang, Sg. Kulim Scheme (1997)

Item	Total	Block			Notes
		K1b & K2a	K3	K4	
1 No of farmers involved	n.a	n.a	n.a	n.a	
2 Lots					
(a) Total Nos. of Lots	1,427	467	553	407	Data from Paddy Production
(b) Total Area (ha)	1,174	394	388	392	Statistic Secretariat, DOA
3 Lots identified for levelling					
(a) Nos	n.a	467	553	407	Assuming all lots need
(b) Area (ha)	1,174	394	388	392	levelling
4 Lots already levelled					
(a) Nos	n.a	n.a	n.a	n.a	
(b) Area (ha)	121	48	0	73	
5 Remaining lots to be levelled					
(a) Nos	n.a	n.a	n.a	n.a	
(b) Area (ha)	1,053	346	388	319	
6 In-field channels					
(a) Already constructed (km)	n.a	n.a	n.a	n.a	
(b) To be constructed (km)	n.a	n.a	n.a	n.a	

Area and lots refer to paddy parcels

Table III-23: Field Staff for Irrigation O&M for Kerian Scheme

Field Staff	Total	Kerian Laut: A (PP)	A	B	C	D	Kerian Darat: E	F	G	H	Notes
	Compartment										A(PP) is in P. Pinang
1 Senior Irrigation Inspector (SII)	2			1 (Kerian Laut)				1 (Kerian Darat)			
2 Irrigation Inspector	6	1	1 (A&B)		1	1	1 (E&F)		1 (G&H)		
3 Irrigation Technician	20	2	4 (A&B)		3	3	4 (E&F)		4 (G&H)		
4 Gatekeeper (R11)	61	6	14 (A&B)		9	8	13 (E&F)		11 (G&H)		
5 General Worker (R11)	109	3	26 (A&B)		17	14	20 (E&F)		29 (G&H)		
	198										
		12	45		30	26	38		45		Total excl.SII

Table III-24: Field Staff Strength and Emolument (salary + allowances) for Irrigation O&M for Kerian Scheme (1995)

Field Staff	Nos (1997)	% of total staff	RM/yr/staff (1995)	Total (1995) RM/yr	RM/yr/staff (1997)	Total (1997) RM/yr	% of total cost	Proposed strength*	% of total staff	Revised Cost RM/yr (1997)	% of total cost	Total Annual Reduction (RM)	% total Cost Reduction	Cost reduction per ha (RM/ha)	Note
1 Senior Irrigation Inspector (SII)	2		22,652	53,304	23,567	47,134		2		47,134					1997 out turn price @ 2% annual increase
2 Irrigation Inspector	6		11,051	66,306	11,497	68,985		6		68,985					Staff reduction at 80% item 4 & 5
3 Irrigation Technician	20		11,355	227,100	11,814	236,275		20		236,275					Administrative area taken as 22,169 ha
Total 1,2 &3	28	14.14		346,710		352,394	17.34	28	45.16	352,394	51.19				
5 Gatekeeper (R11)	61		9,314	568,154	9,884	602,930		12		120,586					
6 General Worker (R11)	109		9,314	1,015,226	9,884	1,077,366		22		215,473					
Total 4 & 5	170	85.86		1,583,380		1,680,296	82.66	34	54.84	336,059	48.81				% staff reduction:
Total	198			1,930,090		2,032,689		62		688,453		1,344,236	34	61	69

Field Staff is defined as those work scope is 100% O&M on site

Table III-25: O&M Cost of canals, drains and bunds for Kerian Scheme (1995)

Item	Top Width (m)	Depth	Length (km)	Clearing			Desilting			Repairs (RM)	Total	Notes
				Frequency (cycles/yr)	Rate/km (RM/km)	Total (RM)	Frequency (1:X yrs)	Rate/km (RM/km)	Av. Annual Total (RM)			
1 Earth canal	>10	Varies	446.79	5	216.54	483,741.05	4	3,494.00	390,271.07			
	6-10	Varies	278.46	4	113.52	126,442.24	4	210.00	14,619.15			All sizes and incl.concrete lined canals
	3-6	Varies										
	<3	Varies										
	<3	<1.2										
2 Lined canal	Varies	Varies										
		Total	725.25			610,183.29			404,890.22		1,015,073.51	
3 Earth Drain	>30	Varies										
	15-30	Varies										
	10-15	Varies	807.49	5	227.36	917,949.40	4	3,494.00	705,342.52			All drains
	6-10	Varies										
	3-6	Varies										
	<3	Varies										
	<3	<1.2										
		Total	807.49			917,949.40			705,342.52		1,623,291.92	
4 Coastal bund/ Rivers	>2.5 (bund)	Varies	117.43	5	297.74	174,819.70					174,819.70	
	<2.5 (bund)	Varies										
		Total items 1-4	1,650.17			1,702,952.39			1,110,232.74		2,813,185.13	

Data source: DID survey 1996

Area, length include non-granary areas managed by the respective DID offices

Table III-26: O&M cost of structures for Kerian Scheme (1995)

Item	O&M Cost			Unit Cost (RM)	Notes
	Maintenance (RM)	Operations (RM)	Total Cost (RM)		
1 Structures					
a Dam	72,550.00	219,600.00	292,150.00		figures are for both items a & b
b Headworks					
c Pump Stations		238,829.50	238,829.50		
d Tidal Gates	50,315.91	43,524.00	93,839.91		
e Other Irrigation & Drainage structures (incl. farmroads)	900,509.06	158,996.00	1,059,505.06		
f Crossings (excl. farmroads)					
2 Staff Quarters	16,800.00		16,800.00	1,200.00	
Total	1,040,174.97	660,949.50	1,701,124.47		

Data source: DID survey 1996

Area, length include non-granary areas managed by the respective DID offices

Table III-27: Land levelling and in-field channel works status for the Kerian Scheme (1997)

Item	Total	Compartment								Notes
		A	B	C	D	E	F	G	H	
1 No of farmers involved	13,485	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	
2 Lots										
(a) Total Nos. of Lots	16,641	1,955	2,939	2,285	2,624	1,538	1,773	1,385	2,142	
(b) Total Area (ha)	23,560	2,402	4,001	3,960	3,362	2,344	2,697	1,830	2,964	
3 Lots identified for levelling										
(a) Nos	16,641	1,955	2,939	2,285	2,624	1,538	1,773	1,385	2,142	The assumption is
(b) Area (ha)	23,560	2,402	4,001	3,960	3,362	2,344	2,697	1,830	2,964	that all lots need levelling
4 Lots already levelled										
(a) Nos	3,990	0	136	246	959	456	527	974	692	
(b) Area (ha)	5,171	0	179	385	1,259	641	647	1,155	902	
5 Remaining lots to be levelled										
(a) Nos	12,651	1,955	2,803	2,039	1,665	1,082	1,246	411	1,450	
(b) Area (ha)	18,389	2,402	3,822	3,575	2,103	1,700	2,050	675	2,062	
6 In-field channels										
(a) Already constructed (km)	213	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	
(b) To be constructed (km)	1,400	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	Targeted for year 2000

Table III-28: O&M Cost of canals, drains and bunds for Sungai Manik (1995)

Item	Top Width (m)	Depth	Length (km)	Clearing Frequency (cycles/yr)	Clearing Rate/km (RM/km)	Clearing Total (RM)	Desilting Frequency (1:x yrs)	Desilting Rate/km (RM/km)	Desilting Av. Annual Total (RM)	Repairs (RM)	Total	Notes
1 Earth canal	>10	Varies										
	6-10	Varies										
	3-6	Varies	109.00		6 125 to 150	55,174.00		2 750 to 2,000	41,232.00		96,406.00	All sizes and incl. concrete lined canals
	<3	Varies										
	<3	<1.2										
2 Lined canal	Varies	Varies										
		Total				55,174.00			41,232.00		96,406.00	
3 Earth Drain	>30	Varies										
	15-30	Varies										
	10-15	Varies										
	6-10	Varies	85.40		2 150 to 225	44,008.00		5 2760 to 3,260.00	23,180.00		67,188.00	All sizes
	3-6	Varies										
	<3	Varies										
	<3	<1.2										
		Total				44,008.00			23,180.00		67,188.00	
4 Coastal bund/	>2.5 (bund)	Varies										
Rivers	<2.5 (bund)	Varies										
		Total items 1-4				99,182.00			102,119.00		201,301.00	

Data source: DID survey 1996

Area, length include non-granary areas managed by the respective DID offices

Table III-29: Estimated Field Staff Emolument (salary + allowances) for Irrigation O&M for Sbg Perak (1995)

	No	RM/yr/staff	Total RM/yr	Notes
Field Staff				
1 Senior Technician	1	25,710.00	25,710.00	
2 Irrigation Inspector	2	14,488.00	28,976.00	
3 Irrigation Technician	6	11,824.00	70,944.00	
4 General Worker (R11)	90	6,595.80	593,622.00	
	99		719,252.00	

Table III-30: O&M Cost of canals, drains and bunds for Sbg Perak (1995)

Item	Top Width (m)	Depth	Length (km)	Clearing			Desilting			Repairs (RM)	Total	Notes
				Frequency (cycles/yr)	Rate/km (RM/km)	Total (RM)	Frequency (1:x yrs)	Rate/km (RM/km)	Av. Annual Total (RM)			
1 Earth canal	>10	Varies	194.76	4	323.00	251,629.92					251,629.92	
	6-10	Varies	30.57	4	254.00	31,059.12					31,059.12	
	3-6	Varies										
	<3	Varies										
	<3	<1.2										
2 Lined canal	Varies	Varies										
		Total	225.33			282,689.04					282,689.04	
3 Earth Drain	>30	Varies	131.96	4	660.00	348,374.40						
	15-30	Varies	198.91	4	475.00	377,929.00	5		9,890.00			
	10-15	Varies										
	6-10	Varies										
	3-6	Varies										
	<3	Varies										
	<3	<1.2										
		Total	330.87			726,303.40			9,890.00		736,193.40	
4 Coastal bund/ Rivers	>2.5 (bund)	Varies										
	<2.5 (bund)	Varies										
		Total items 1-4	556.20			1,008,992.44			9,890.00		1,018,882.44	

Data source: DID survey 1996

Area, length include non-granary areas managed by the respective DID offices

Table III-31: Field Staff for Irrigation O&M for IADP Ketara (Besut)

Field Staff	Compartment	1	2	3	4	Notes
	Total					
1 Senior Irrigation Inspector (SII)	1	1 (Comp 1 - 4)				
2 Irrigation Inspector	1	1				
3 Irrigation Technician	3		1	1	1	
4 Linesman (R11)	21	6	5	5	5	
5 Pump Operator	2	2				
6 General Worker (R11)	26	4	9	8	5	23 on contract (indent) basis
	54					
		13	15	14	11	excl SII

Table III-32: Field Staff Strength and Emolument (salary + allowances) for Irrigation O&M for IADP Ketara (Besut).

Field Staff	Nos (1997)	% of total staff	RM/yr/staff (1994)	Total (1994) RM/yr	RM/yr/staff (1997)	Total (1997) RM/yr	% of total cost	Proposed strength*	% of total staff	Revised Cost RM/yr (1997)	% of total cost	Total Reduction (RM)	% total Cost Reduction	Cost reduction per ha (RM/ha)	Note
1 Senior Irrigation Inspector (SII)	1		21,897	21,897	23,237	23,237		1		23,237					1997 out turn price @ 2% annual increase
2 Irrigation Inspector	1		12,547	12,547	13,315	13,315		1		13,315					Reduction assumed at 80% of 5 & 6
3 Irrigation Technician	3		12,547	37,641	13,315	39,945		3		39,945					Administrative area taken as 5,195 ha.
4 Pump Operator	2		7,893	15,786	8,376	16,752		2		16,752					
Total 1,2,3 & 4	7	13		87871		93,249	26	7	43	93,249	54				
5 Linesman (R11)	21		7,335	154,035	7,784	163,463		4		32,693					
6 General Worker (R11)	26		3,600	93,600	3,820	99,329		5		19,866					
Total 5 & 6	47	87		247635		262,792	74	9	57	52,558	36				% field staff reduction:
Total	54			335,506		356,042		16		145,808		210,234	41	40	70

Field Staff is defined as those work scope is 100% O&M on site

Table III-33: O&M Cost of canals, drains and bunds for Besut Scheme (1994)

Item	Top Width (m)	Depth	Length (km)	Clearing Frequency (cycles/yr)	Clearing Rate/km (RM/km)	Clearing Total (RM)	Desilting Frequency (1 x yrs)	Desilting Rate/km (RM/km)	Desilting Av. Annual Total (RM)	Repairs (RM)	Total	Notes
1 Earth canal	>10	Varies	8.10	1			1					
	6-10	Varies	20.50	1			1					
	3-6	Varies	7.10	1			1					
	<3	Varies	12.50	1			1					
	<3	<1.2										
2 Lined canal	Varies	Varies	201.60	1			1					
		Total	249.80			83,052.00			20,763.00	254,400.00	358,215.00	
3 Earth Drain	>30	Varies										
	15-30	Varies										
	10-15	Varies	38.00	1			1					
	6-10	Varies	60.00	1			1					
	3-6	Varies	50.50	1			1					
	<3	Varies	33.70	1			1					
	<3	<1.2	60.50	1			1					
		Total	242.70			85,355.40			311,421.60	140,118.00	566,925.00	
4 Coastal bund/ Rivers	>2.5 (bund)	Varies										
	<2.5 (bund)	Varies										
		Total items 1-4				168,407.40			362,184.60	394,518.00	925,140.00	

Data source: DID survey 1996
Area, length include non-granary areas managed by the respective DID offices

Table III-34: O&M cost of structures for Besut Scheme (1995)

	Item	Nos	O&M Cost per unit Maintenance (RM)	Operations (RM)	Total Cost per unit (RM)	Total (RM)	Notes
1	Structures						
a	Dam						
b	Headworks						
c	Pump Stations			28,380.24		28,380.24	
d	Tidal Gates						
e	Other Irrigation & Drainage structures (incl. farmroads)		7,200.00			7,200.00	
f	Crossings (excl. farmroads)			58,600.00		58,600.00	
g	Staff Quarters						
	Total					94,180.24	

Data source: DID survey 1996
Area, length include non-granary areas managed by the respective DID offices

Table III-35: Land levelling and in-field channel works status for the Besut Scheme (1997)

Item	Total	Compartment				Notes
		1	2	3	4	
1 No of farmers involved	3,054	659	509	858	1,028	
2 Lots						
(a) Total Nos. of Lots	5,790	1,302	1,069	1,715	1,704	
(b) Total Area (ha)	5,174	1,234	1,130	1,306	1,504	
3 Lots identified for levelling						
(a) Nos	5,210	1,171	962	1,543	1,534	
(b) Area (ha)	4,656	1,111	1,016	1,176	1,353	
4 Lots already levelled						
(a) Nos	30	30	0	0	0	
(b) Area (ha)	23	23	0	0	0	
5 Remaining lots to be levelled						
(a) Nos	5,181	1,142	962	1,543	1,534	
(b) Area (ha)	4,633	1,088	1,016	1,176	1,353	
6 In-field channels						
(a) Already constructed (km)	244.5	63.7	39.8	70.7	70.3	
(b) To be constructed (km)	0	0	0	0	0	No new channels planned

Table III-36: Data and Information to be kept/maintained by DID Office for O&M

Basic Data/Information	Key Information and data	Coordinating Agency/Sources
Scheme plan (base year)/landuse Structure/facilities plans		
Scheme boundaries	Gross & net areas, district,mukim	DID HQ
Highways, Federal & State roads	location, route	
Town limits		District council
Kampung	Name, location	
Rivers, reservoirs	Name, length,size	
Catchment boundaries	Area, water resource yields	
Canals	Length, size	
Drains	Length, size	
Farmroads	Length, size	
Structures, Pumphouses	Types,size	
Paddy lots/parcels	Nos	DOA;District Office
Compartments,Blocks, ISAs, ISUs	Gross & Net Areas	
Problem areas, type of problem	Extent,level of seriousness	DOA
Land leveling	Extent; levels	DOA
Topography; levels	Bench marks, survey plans	
References		
Irrigation and Drainage Act		
Commissioning reports		
Handover documents	Certificates, files	
Operations Manuals		DID HQ
Maintenance manuals		DID HQ
Land acquisition plans	Plans, value, Federal/State ownership	
Gazetted areas,lots	year,amount	District Office
Irrigation rates	year,amount	District Office
Irrigation rate collection	year,amount	District Office
Areal photos	year	
Register of paddy lots/parcels	base year	DOA; Committee for Paddy Production Investigation
Register of Farmers	base year	DOA;LPP/PPK
Register of Farmers' Groups	base year	DOA;LPP/PPK
Register of Water Users' Groups	base year	DOA
Irrigation management/operations		
Rainfall	daily,monthly,annual,30 days driest	
Streamflows		
Water levels		
Supply		
Demand		
Production schedules	planned; actual	DOA
Irrigation schedules	planned; actual	
Flood records		
Staffing		
Post	nos, filled, vacancies	
Position	nos,filled,vacancies	
Oragnization chart		
Duty list		
Finance		
Budget& Expenditure	Federal;State,salary,emoluments	
Contracts, indents	Works;location;value	
Production		
Planted area	Compartment; Scheme	DOA;PMU
Yields	Compartment; Scheme	DOA;PMU
Total production	Compartment; Scheme	DOA;PMU
Performance indicators		
Relative Water Supply		
Cropping Intensity		
O&M cost		

Table III-37: Overall staff size and annual staff cost/ha. reduction for the Granaries

IADP	District/Scheme/Sub-scheme	Area (ha)	Total staff (No)	Staff/1000ha No/1000ha	Staff Cost per ha (1997) (RM/ha)	Total staff after reduction (No)	Staff/1000ha after reduction No/ha	Staff Cost/ha after reduction RM/ha	Staff cost/ha reduction RM/ha	Estimated total cost reduction RM	Notes
Pulau Pinang	Seberang Perai Utara (SPU)	9,729	204	21	186	75	8	78	108	1,049,565	1995 Average Price is taken as the average of 1994 and 1995 Costs
	Seberang Perai Tengah (SPT)	1,497	80	53	410	30	20	172	238		1997 Average Price is based on 1995 average @ 2% increase per annum
											Average staff size reduction 63%
Kerian/	Kerian	22,169	239	11	100	103	5	39	61	1,352,309	Average staff cost/ha reduction 58%
Sg. Manik	Sg.Manik	7,017	131	19	157	48	7	66	91	638,968	
Sbg. Perak	Sbg.Perak	8,708	120	14	87	44	5	37	50	439,406	
Kemasin-Semerak	Pasir Putih District	2,476	53	21	146	-	scheme not ready		-		
											Average staff cost RM/ha. reduction=
KETARA	Besut	5,195	56	11	72	18	3	32	40	207,800	70
											(exclude SPT figures which appears exceptional)

Table III-38: Water Users Group sizes and formation training cost

IADP/Scheme	Area (ha)	Farmers (Nos)	WUGs (Nos)	Area/WUG (ha/WUG)	Farmers/WUG (Nos/WUG)	On-site training cost (RM)	Off-site training cost (RM)	Total Cost (RM)	Cost/ha (RM/ha)	Notes
1 Pulau Pinang	9,832	7,301	125	79	58	73,010	100,000	173,010	18	1 Area is net area
										2 Nos of farmers are estimated figures and based on nos. of farm households
2 Kerian	23,671	13,485	84	282	161	134,850	67,200	202,050	9	3 On site training is 2 times 1 day duration each at RM 5/person/day
										4 Off-site training is at NWMTC 5 days duration +2 days travel for WUG leaders (2 per WUG) at RM 400/person/day
3 Ketara (Besut)	5,164	3,054	30	172	102	30,540	24,000	54,540	11	5 IADP Pulau Pinang exclude Sg. Burung scheme
Average				178	107				12	
Estimates based on average figures derived above										
4 Sg. Manik	6,318	4,030	36	177	102	40,300	28,556	68,856	12	
5 IADP Seberang Perak	3,605	2,333	20	177	102	23,330	16,294	39,624	12	5 Area exclude Blocks E,F & G under FELCRA
6 IADP Kemasin-Semerak	6,895	11,889	39	177	102	118,890	31,164	150,054	12	
Total Estimated	55,485	42,092	334			420,920	267,214	688,134	12	

Table III-39: WUG formation target

IADP/ Scheme	Blocks	WUGs (Nos)	Annual Target (WUG/yr)	Year 0	1	2	3	4	5	6	7	8	9	10	11	12	Notes
Pulau Pinang	Sungai Muda	105		67	38												Planning targets set by IADP P Pinang Yr 0 @ '98
	Sungai Kulim	10		10													
	Pinang Tunggal	7		2													
	Padang Menora & Pokok Tampang	3		2	1												
	Total	125		81	39	0	0	0	0								
Besut	Compartment 1	8	formed														All WUGs already formed
	Compartment 2	5	formed														
	Compartment 3	8	formed														
	Compartment 4	9	formed														
	Total	30															
Kenan	Compartment A&B	20	4		4	4	4	4	4								
	Compartment C	4	1		1	1	1	1	0								
	Compartment D	17	3		3	3	3	3	5								
	Compartment E&F	22	4		4	4	4	4	6								
	Compartment G&H	21	4		4	4	4	4	5								
	Total	84	17		16	16	16	16	20								
Sg. Manik	Sg. Manik	36	7		7	7	7	7	8								
Sbg Perak	IADP Seberang Perak	20	4		4	4	4	4	4								
Kemasin-Semerak	IADP Kemasin-Semerak	39	8		8	8	8	8	7								
	Overall total	334	67	81	74	35	35	35	39								

Table III-40: Proposed WUG on-site training programs for the Granaries

IADP/ Scheme	Blocks	Farmers (Nos)	WUGs (Nos)	Farmers/WUG (No/WUG)	On-site Training Groups	Nos of 1-day sessions	Annual Target (session/yr)	Year 0	1	2	3	4	5	6	7	8	9	10	11	12	Notes
																					Max size per group 40
Pulau Pinang	Sungai Muda		105		2	420	84		84	84	84	84	84								
	Sungai Kulim		10		2	40	8		8	8	8	8	8								
	Pinang Tunggal		7		2	28	6		6	6	6	6	4								
	Padang Menora & Pokok Tempang		3		2	12	2		2	2	2	2	4								
	Total	7,301	125	58		500	100		100	100	100	100	100								
Besut	Compartment 1	659	8	82	2	33	7		7	7	7	7	5								
	Compartment 2	509	5	102	3	25	5		5	5	5	5	5								
	Compartment 3	858	8	107	3	43	9		9	9	9	9	7								
	Compartment 4	1,028	9	114	3	51	10		10	10	10	10	11								
	Total	3,054	30			153	31		31	31	31	31	29								
Kenan	Compartment A&B		20		4	161	32		32	32	32	32	33								
	Compartment C		4		4	32	6		6	6	6	6	8								
	Compartment D		17		4	137	27		27	27	27	27	29								
	Compartment E&F		22		4	177	35		35	35	35	35	37								
	Compartment G&H		21		4	169	34		34	34	34	34	33								
	Total	13,485	84	161		676	135		134	134	134	134	140								
Sg. Manik	Sg. Manik	4,030	36	102	3	184	37		37	37	37	37	36								
Sbg Perak	IADP Seberang Perak	2,333	20	102	3	102	20		20	20	20	20	22								
Kemasin-Semerak	IADP Kemasin-Semerak	11,889	39	102	3	199	40		40	40	40	40	39								
	Total	42,092	334			1,814	363		362	362	362	362	366								

Table III-41: Estimated training cost for WUG on-site training programs for the Granaries

IADP/ Scheme	Blocks	Farmers (Nos)	WUGs (Nos)	Farmers/WUG (No/WUG)	On-site Training Groups/WUG	Nos of 1-day sessions	Total Cost (RM)	Year 0	1	2	3	4	5	6	7	8	9	10	11	12	Notes
Pulau Pinang	Sungai Muda		105		2	420	60,900		12,180	12,180	12,180	12,180	12,180								Max size/training group 40 Cost @RM5/person
	Sungai Kuhim		10		2	40	5,800		1,160	1,160	1,160	1,160	1,160								Av.group size= (No/WUG)/(Group/WUG)
	Pinang Tunggal		7		2	28	4,060		870	870	870	870	580								
	Pedang Menora & Pokok Tampang		3		2	12	2,250		392	392	392	392	682								
	Total	7,301	125	58		500	73,010		14,602	14,602	14,602	14,602	14,602								
Besut	Compartment 1	659	8	82	2	33	6,590		1,400	1,400	1,400	1,400	990								
	Compartment 2	509	5	102	3	26	5,090		1,000	1,000	1,000	1,000	1,090								
	Compartment 3	656	6	107	3	43	8,580		1,800	1,800	1,800	1,800	1,380								
	Compartment 4	1,028	9	114	3	51	10,280		2,000	2,000	2,000	2,000	2,280								
	Total	3,054	30			153	30,540		6,200	6,200	6,200	6,200	5,740								
Kenan	Compartment A&B		20		4	161	32,401		6,440	6,440	6,440	6,440	6,641								
	Compartment C		4		4	32	6,440		1,200	1,200	1,200	1,200	1,640								
	Compartment D		17		4	137	27,571		5,440	5,440	5,440	5,440	5,811								
	Compartment E&F		22		4	177	35,621		7,040	7,040	7,040	7,040	7,461								
	Compartment G&H		21		4	169	32,817		6,600	6,600	6,600	6,600	6,417								
	Total	13,485	84	161		676	134,850		26,720	26,720	26,720	26,720	27,970								
Sg. Manik	Sg. Manik	4,030	36	102	3	184	40,300		8,104	8,121	8,121	8,121	7,833								
Sbg Perak	IADP Seberang Perak	2,333	20	102	3	102	23,330		4,575	4,575	4,575	4,575	5,030								
Kemasin-Semerak	IADP Kemasin-Semerak	11,889	39	102	3	199	118,890		23,897	23,910	23,910	23,910	23,263								
	Overall total	42,092	334			1,814	420,920		84,097	84,128	84,128	84,128	84,438								On site av. cost/WUG (RM/WUG)= 1,260

Table III-42: Proposed WUG off-site training programs for the Granaries (at the National Water Management Training Center)

IADP/ Scheme	Blocks	WUGs (Nos)	Total WUG Leaders	Off-site Training Groups	Nos of 3-day sessions	Year 0	1	2	3	4	5	6	7	8	9	10	11	12	Notes
Pulau Pinang	Sungai Muda	105	210																
	Sungai Kulim	10	20																
	Pinang Tunggal	7	14																
	Padang Menora & Pokok Tampang	3	6																
	Total	125	250	7	7		2	2	3										
Besut	Compartment 1	8	16																
	Compartment 2	5	10																
	Compartment 3	8	16																
	Compartment 4	9	18																
	Total	30	60	2	2		1	0	1										
Kerian	Compartment A&B	20	40																
	Compartment C	4	8																
	Compartment D	17	34																
	Compartment E&F	22	44																
	Compartment G&H	21	42																
	Total	84	168	4	4		1	1	2										
Sg. Manik	Sg. Manik	36	72	2	2		0	1	1										
Sbg Perak	IADP Seberang Perak	20	40	1	1		0	1	0										
Kemasin-Semerak	IADP Kemasin-Semerak	39	78	2	2		0	1	1										
	Total	**334**	**668**	**18**	**18**		**4**	**6**	**8**										

Table III-43: Estimated cost for WUG off-site training programs for the Granaries (at the National Water Management Training Center)

IADP	Blocks	WUGs (Nos)	Total WUG Leaders	Off-site Training Groups	Nos of 3-day sessions	Total Cost (RM)	Year 0	1	2	3	4	5	6	7	8	9	10	11	12	Notes
Pulau Pinang	Sungai Muda	105	210			252,000														@ 2 leaders/WUG @RM400/day/person
	Sungai Kulim	10	20			24,000														
	Pinang Tunggal	7	14			16,800														
	Padang Menora & Pokok Tampang	3	6			7,200														
	Total	125	250	7	7	300,000		85,714	85,714	128,571										
Besut	Compartment 1	8	16			19,200														
	Compartment 2	5	10			12,000														
	Compartment 3	8	16			19,200														
	Compartment 4	9	18			21,600														
	Total	30	60	2	2	72,000		36,000	0	36,000										
Kerian	Compartment A&B	20	40			48,000														
	Compartment C	4	8			9,600														
	Compartment D	17	34			40,800														
	Compartment E&F	22	44			52,800														
	Compartment G&H	21	42			50,400														
	Total	84	168	4	4	201,600		50,400	50,400	100,800										
Sg. Manik	Sg. Manik	36	72	2	2	86,400		0	43,200	43,200										
Sbg Perak	IADP Seberang Perak	20	40	1	1	48,000		0	48,000	0										
Kemasin-Semerak	IADP Kemasin-Semerak	39	78	2	2	93,600		0	46,800	46,800										
	Overall total	334	668	18	18	801,600		172,114	274,114	355,371										Off site training cost/WUG (RM/WUG) 2,400

Table III-44: Summary of estimated cost for WUG off-site and on-site training programs

IADP	Training	WUGs (Nos)	Training Sessions (Nos)	Total Cost (RM)	Year 0	1	2	3	4	5	6	7	8	9	10	11	12	Notes
Pulau Pinang	On-site training	125	500	73,010		14,602	14,602	14,602	14,602	14,602								Off-site program: at NWMTC @ 2 leaders/WUG @RM400/day/person
	Off-site training	125	7	300,000		85,714	85,714	128,571										
	Total	125		373,010		30	100,316	143,173	14,602	14,602								On-site program: All WUG members 2 x 1-day sessions @RM5/person/day
Besut	On-site training	30	153	30,540		6,200	6,200	6,200	6,200	5,740								
	Off-site training	30	2	72,000		36,000	0	36,000										
	Total			102,540		42,200	6,200	42,200	6,200	5,740								
Kenan	On-site training	84	676	134,850		26,720	26,720	26,720	26,720	27,970								
	Off-site training	84	4	201,600		50,400	50,400	100,800										
	Total	84		336,450		77,120	77,120	127,520	26,720	27,970								
Sg. Manik	On-site training	36	184	40,300		8,121	8,121	8,121	8,121	7,816								
	Off-site training	36	2	86,400		0	43,200	43,200										
	Total	36		126,700		8,121	51,321	51,321	8,121	7,816								
Sbg Perak	On-site training	20	102	23,330		4,575	4,575	4,575	4,575	5,030								
	Off-site training	20	1	48,000		0	48,000	0										
	Total	20		71,330		4,575	52,575	4,575	4,575	5,030								
Kemasin-Semerak	On-site training	39	199	118,890		23,910	23,910	23,910	23,910	23,250								
	Off-site training	39	2	93,600		0	46,800	46,800										
	Total	39		212,490		23,910	70,710	70,710	23,910	23,250								
	Overall total																	
	On-site training	**334**	**1,814**	**420,920**		**84,128**	**84,128**	**84,128**	**84,128**	**84,408**								
	Off-site training	**334**	**18**	**801,600**		**172,114**	**274,114**	**355,371**	**0**	**0**								
	Total	334		1,222,520		256,242	358,242	439,499	84,128	84,408								

Table III-45: Summary of in-field infrastructure improvement for the 5 Granaries (Paddy parcel lots and area source: Paddy Production Statistics Secretariat, DOA)

IADP	Nos of lots*	Area* (ha)	Av. Area (ha/lot)	Lots for infra.improv (Nos.)	Area for infra. improv. (ha.)	Leveling by DOA (ha.)	Leveling by DOA (RM)	Leveling by Private Sect. (ha.)	Leveling by Private Sect. (RM mil.)	Total Cost of leveling (RM)	In-field channel constr. (km)	Cost of In-field channel constr. (RM)	In-field control boxes (Nos.)	In-field control boxes (RM)	Total on-farm infra improv. (RM)	Notes
																Assumptions:
(1) Pulau Pinang	14,231	9,601	0.67	12,920	8,597	3,439	859,750	5,158	1,805,300	2,665,050	1,290	451,500	3,439	204,180	3,320,730	a) 90% of lots & area need infra improvement.
																b) 40% of land leveling by DOA @ RM 250/ha.
(2) Kerian-Sg.Manik																c) 60% of land leveling by Private Sector @ RM 350/ha.
																d) In-field channel density @ 150m/ha. cost @ RM0.35/m
(a) Kerian	16,641	23,560	1.42	12,651	18,389	7,356	1,839,000	11,033	3,861,550	5,700,550	2,757	964,950	7,356	508,920	7,174,420	e) 2 control boxes for every lot @ RM 60/box
(b) Sg. Manik	3,499	6,318	1.81	3,149	5,783	2,313	578,250	3,470	1,214,500	1,792,750	876	306,600	2,313	138,780	2,238,130	
(3) Sby Perak	2,609	4,005	1.54	2,348	3,605	1,442	360,500	2,163	757,050	1,117,550	541	189,350	1,442	86,520	1,393,420	Blocks E,F,G not included; managed by FELCRA
(4) Kemasin-Semerak	17,775	6,895	0.39	15,998	6,025	658	164,500	987	345,450	509,950	247	86,329	1,097	65,796	662,075	
(5) Kerian	5,790	5,164	0.89	5,211	4,656	1,863	465,750	2,793	977,550	1,443,300	699	244,650	3,105	186,300	1,874,250	
Total	60,545	55,543		52,277	47,055	17,071	4,267,750	25,604	8,961,400	13,229,150	6,410	2,243,379	18,752	1,190,496	16,663,025	

Note : Cost of Kemasin/Semerak covers only Jelawat Rusa and Kemasin Hulir sub-schemes.

Table III-46: Proposed land leveling targets for implementation by DOA

IADP/ Scheme	Scheme/Block/ Compartment Scheme	Area for infra. improv. (ha.)	Leveling by DOA (ha.)	Av. Annual Target	Year												Notes
					0	1	2	3	4	5	6	7	8	9	10	11	12	
Pulau Pinang	Sg Muda	6,564	2,626	328		328	328	328	328	328	328	328	328					
	Pinang Tunggal	697	279	35		35	35	35	35	35	35	35	35					
	Sg. Jarak	283	113	14		14	14	14	14	14	14	14	14					
	Sg Kulim	1,053	421	53		53	53	53	53	53	53	53	53					
	Total	8,597	3,439	430		430	430	430	430	430	430	430	430					
Ketara (Besut)	Compartment 1	1,111	444	56		56	56	56	56	56	56	56	56					
	Compartment 2	1,017	407	51		51	51	51	51	51	51	51	51					
	Compartment 3	1,175	470	59		59	59	59	59	59	59	59	59					
	Compartment 4	1,353	542	68		68	68	68	68	68	68	68	68					
	Total	4,656	1,863	233		233	233	233	233	233	233	233	233					
Kerian	A	2,402	961	120		120	120	120	120	120	120	120	120					
	B	3,822	1,529	306		0	0	0	306	306	306	306	306					infield improvement for B&C after polder drainage project
	C	3,575	1,430	286		0	0	0	286	286	286	286	286					
	D	2,103	841	105		105	105	105	105	105	105	105	105					
	E	1,700	680	85		85	85	85	85	85	85	85	85					
	F	2,050	820	103		103	103	103	103	103	103	103	103					
	G	675	270	34		34	34	34	34	34	34	34	34					
	H	2,062	825	103		103	103	103	103	103	103	103	103					
	Total	18,389	7,356			550	550	550	1,141	1,141	1,141	1,141	1,141					
Sg Manik		5,783	2,313	289		289	289	289	289	289	289	289	289					
Sbg Perak		3,605	1,442	180		180	180	180	180	180	180	180	180					
Kemasin-Semerak		6,025	658	82		82	82	82	82	82	82	82	82					
	Overall Total	47,055	17,071	1,214	0	552	552	552	552	552	552	552	552					

Table III-47: Cost estimate for land leveling by DOA

IAPO/ Scheme	Scheme/Block/ Compartment Scheme	Area for infra. improv. (ha.)	Leveling by DOA (ha.)	Total Cost (RM)	Year													Note
					0	1	2	3	4	5	6	7	8	9	10	11	12	
Pulau Pinang	Sg Muda	6,564	2,626	656,500		82,063	82,063	82,063	82,063	82,063	82,063	82,063	82,063					Land leveling by DOA @ RM 250/ha.
	Pinang Tunggal	697	279	69,750		8,719	8,719	8,719	8,719	8,719	8,719	8,719	8,719					
	Sg. Jarak	283	113	28,250		3,531	3,531	3,531	3,531	3,531	3,531	3,531	3,531					
	Sg Kulim	1,053	421	105,250		13,156	13,156	13,156	13,156	13,156	13,156	13,156	13,156					
	Total	8,597	3,439	859,750		107,469	107,469	107,469	107,469	107,469	107,469	107,469	107,469					
Ketara (Besut)	Compartment 1	1,111	444	111,000		13,875	13,875	13,875	13,875	13,875	13,875	13,875	13,875					
	Compartment 2	1,017	407	101,750		12,719	12,719	12,719	12,719	12,719	12,719	12,719	12,719					
	Compartment 3	1,175	470	117,500		14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688					
	Compartment 4	1,353	542	135,500		16,938	16,938	16,938	16,938	16,938	16,938	16,938	16,938					
	Total	4,656	1,863	465,750		58,219	58,219	58,219	58,219	58,219	58,219	58,219	58,219					
Kenan	A	2,402	961	240,250		30,031	30,031	30,031	30,031	30,031	30,031	30,031	30,031					
	B	3,822	1,529	382,250		0	0	0	76,450	76,450	76,450	76,450	76,450					infield improvement for B&C after polder drainage project
	C	3,575	1,430	357,500		0	0	0	71,500	71,500	71,500	71,500	71,500					
	D	2,103	841	210,250		26,281	26,281	26,281	26,281	26,281	26,281	26,281	26,281					
	E	1,700	680	170,000		21,250	21,250	21,250	21,250	21,250	21,250	21,250	21,250					
	F	2,050	820	205,000		25,625	25,625	25,625	25,625	25,625	25,625	25,625	25,625					
	G	675	270	67,500		8,438	8,438	8,438	8,438	8,438	8,438	8,438	8,438					
	H	2,062	825	206,250		25,781	25,781	25,781	25,781	25,781	25,781	25,781	25,781					
	Total	18,389	7,356	1,839,000		137,406	137,406	137,406	285,356	285,356	285,356	285,356	285,356					
Sg Manik		5,783	2,313	578,250		72,281	72,281	72,281	72,281	72,281	72,281	72,281	72,281					
Sbg Perak		3,605	1,442	360,500		45,063	45,063	45,063	45,063	45,063	45,063	45,063	45,063					
Kemasin-Semerak		6,025	658	164,500		20,563	20,563	20,563	20,563	20,563	20,563	20,563	20,563					
	Overall total	47,055	17,071	4,267,750	0	441,000	441,000	441,000	588,950	588,950	588,950	588,950	588,950					

Table III-48: Proposed land leveling targets for implementation by Private Sector

IADP/ Scheme	Scheme/Block/ Compartment Scheme	Area for infra. improv. (ha.)	Leveling by Priv. Sector (ha.)	Av. Annual Target	Year													
					0	1	2	3	4	5	6	7	8	9	10	11	12	
Pulau Pinang	Sg Muda	6,564	3,938	492		492	492	492	492	492	492	492	492					
	Pinang Tunggal	697	418	52		52	52	52	52	52	52	52	52					
	Sg. Jarak	283	170	21		21	21	21	21	21	21	21	21					
	Sg Kulim	1,053	632	79		79	79	79	79	79	79	79	79					
	Total	8,597	5,158	645		645	645	645	645	645	645	645	645					
Ketara (Besut)	Compartment 1	1,111	666	83		83	83	83	83	83	83	83	83					
	Compartment 2	1,017	610	76		76	76	76	76	76	76	76	76					
	Compartment 3	1,175	705	88		88	88	88	88	88	88	88	88					
	Compartment 4	1,354	812	102		102	102	102	102	102	102	102	102					
	Total	4,657	2,793	349		349	349	349	349	349	349	349	349					
Kenan	A	2,402	1,441	180		180	180	180	180	180	180	180	180					
	B	3,822	2,293	459		0	0	0	459	459	459	459	459					infield improvement for B&C after polder drainage project
	C	3,575	2,145	429		0	0	0	429	429	429	429	429					
	D	2,103	1,262	158		158	158	158	158	158	158	158	158					
	E	1,700	1,020	128		128	128	128	128	128	128	128	128					
	F	2,050	1,230	154		154	154	154	154	154	154	154	154					
	G	675	405	51		51	51	51	51	51	51	51	51					
	H	2,062	1,237	155		155	155	155	155	155	155	155	155					
	Total	18,389	11,033	1,379		824	824	824	1,712	1,712	1,712	1,712	1,712					
Sg Manik		5,783	3,470	434		434	434	434	434	434	434	434	434					
Sbg Perak		3,605	2,163	270		270	270	270	270	270	270	270	270					
Kemasin-Semerak		8,570	987	123		123	123	123	123	123	123	123	123					
	Total	49,601	25,604	3,201		2,646	2,646	2,646	3,533	3,533	3,533	3,533	3,533					

Table III-49: Cost estimate for land leveling by Private Sector

IADP	Scheme/Block/ Compartment Scheme	Area for infra. improv. (ha.)	Leveling by Priv. Sector (ha.)	Total Cost (RM)	Year 0	1	2	3	4	5	6	7	8	9	10	11	12	Notes
Pulau Pinang	Sg Muda	6,564	3,938	1,378,300		172,288	172,288	172,288	172,288	172,288	172,288	172,288	172,288					
	Pinang Tunggal	697	418	146,300		18,288	18,288	18,288	18,288	18,288	18,288	18,288	18,288					
	Sg. Jarak	283	170	59,500		7,438	7,438	7,438	7,438	7,438	7,438	7,438	7,438					
	Sg Kulim	1,053	632	221,200		27,650	27,650	27,650	27,650	27,650	27,650	27,650	27,650					
	Total	8,597	5,158	1,805,300		225,663	225,663	225,663	225,663	225,663	225,663	225,663	225,663					
Kelara (Besut)	Compartment 1	1,111	666	233,100		29,138	29,138	29,138	29,138	29,138	29,138	29,138	29,138					
	Compartment 2	1,017	610	213,500		26,688	26,688	26,688	26,688	26,688	26,688	26,688	26,688					
	Compartment 3	1,175	705	246,750		30,844	30,844	30,844	30,844	30,844	30,844	30,844	30,844					
	Compartment 4	1,354	812	284,200		35,525	35,525	35,525	35,525	35,525	35,525	35,525	35,525					
	Total	4,657	2,793	977,550		122,194	122,194	122,194	122,194	122,194	122,194	122,194	122,194					
Kerian	A	2,402	1,441	504,350		63,044	63,044	63,044	63,044	63,044	63,044	63,044	63,044					Leveling for B&C after polder drainage project
	B	3,822	2,293	802,550		0	0	0	160,510	160,510	160,510	160,510	160,510					
	C	3,575	2,145	750,750		0	0	0	150,150	150,150	150,150	150,150	150,150					
	D	2,103	1,262	441,700		55,213	55,213	55,213	55,213	55,213	55,213	55,213	55,213					
	E	1,700	1,020	357,000		44,625	44,625	44,625	44,625	44,625	44,625	44,625	44,625					
	F	2,050	1,230	430,500		53,813	53,813	53,813	53,813	53,813	53,813	53,813	53,813					
	G	675	405	141,750		17,719	17,719	17,719	17,719	17,719	17,719	17,719	17,719					
	H	2,062	1,237	432,950		54,119	54,119	54,119	54,119	54,119	54,119	54,119	54,119					
	Total	18,389	11,033	3,861,550		288,531	288,531	288,531	599,191	599,191	599,191	599,191	599,191					
Sg Manik		5,783	3,470	1,214,500		151,813	151,813	151,813	151,813	151,813	151,813	151,813	151,813					
Sbg Perak		3,605	2,163	757,050		94,631	94,631	94,631	94,631	94,631	94,631	94,631	94,631					
Kemasin-Semerak		8,570	987	345,450		43,181	43,181	43,181	43,181	43,181	43,181	43,181	43,181					
	Total	49,601	25,604	8,961,400		926,013	926,013	926,013	1,236,673	1,236,673	1,236,673	1,236,673	1,236,673					