4.1.5 Agricultural Improvement Plan

(1) Proposed Cropping Pattern and Cropping Intensity

The present irrigation schedule of each study area is summarized as shown in Fig.2.1.1 "Present Cropping Schedule in the Study Area". Based on the water balance study according to the present schedule, the peak requirement of irrigation water in Besut scheme is beyond availability of water and the shortage of water is one of the reasons of low cropping intensity in Besut scheme. In Kerian scheme, water supply meets demand of 180 % of the annual cropping intensity. However, the mechanization in some areas of Kerian scheme is still limited due to low bearing capacity, and the working efficiency for farming is remarkably low. The non-adherence to the planting schedule is caused by the low working efficiency of the manual land preparation and transplanting, then the cropping intensity is confined to the low level as the result. In case of Pulau Pinang, Sungai Manik, Seberang Perak and Kemasin/Semerak, irrigation water is enough even for 200% of cropping intensity.

Based on the result of the water balance study, the proposed cropping schedule in Besut scheme is examined considering the water availability, flood effected period and rainfall during harvesting period. It is judged that the original cropping schedule is suitable from the viewpoints of water availability and farming activity, and applying the original cropping schedule, 175% of annual cropping intensity can be achieved. A major problem in the compartments A, B and C of the Kerian scheme, which are ill-drainage areas, is the non-adherence to cropping schedule by farmers, resulting that harvesting time in some areas falls into the rain season due to delay of cropping season, and pest and disease control for paddy becomes difficult because of existence of different growth stages of paddy in the paddy field. The drainage improvement is very important to avoid delay of cropping schedule with mechanizing farming. In the organic soil areas mainly located in Compartment D, the tramline system (soil improvement along the line) is proposed also for utilization of agricultural machines. Considering the availability of irrigation water, dry direct seeding methods will be introduced at 100% in off season and wet direct seeding methods will be introduced in main season except for organic soil areas. The annual cropping intensity is expected to be 200% in Kerian scheme. The annual cultivation area and cropping intensity are shown in Table 4.1.2 "Proposed Cropping Intensity based on the Proposed Cropping Pattern" and summarized as below.

(Unit: %)

Name of Schmeme	Main season	Off season	Annual
Pulau Pinang	100	100	200
Kerian	100	100	200
Sungai Manik	100	100	200
Seberang Perak	100	100	200
Ketara (Besut)	100	75	175
Kemasin/Semarak	100	100	200

(2) Proposed Farming Practices

(a) The improvement of the mechanization

Presently, major farming works such as the land preparation, harvesting and transportation are done comparatively efficiently using agricultural machines, though the

difference situations are recognized among the areas. However, the managing works like seeding and application of fertilizer and chemicals are still done by the manual operation or walking machines, and the work efficiency of these works is confined to the low value. In order to improve the working efficiency of the managing works, mechanization system by integrated works is proposed as shown below. Tractors for the management works will ran on the limited way which is set in the paddy fields.

(i) Mechanization system for Wet seeding
Land preparation (tractor + rotary) => Paddling (tractor + paddy harrow) => Seeding (tractor + power blower/granule applicator or broadcaster) => Fertilizing and chemical application (tractor + granule applicator/carpet duster/boom sprayer) => Harvesting (combine harvester)

(ii) Mechanization system for Dry seeding
Land preparation (tractor + rotavator) => Seeding and pressing (tractor + power blower/granule applicator or broadcaster and rear bucket or land roller) => Fertilizing and chemical application (tractor + granule applicator/carpet duster/boom sprayer) => Harvesting (combine harvester)

(b) Fertilizer application

Fertilization application is one of the important factors which influence the paddy yield. Fertilizers, especially NPK (N: Nitrogen, P: Phosphate, K: Kalium, potassium) are needed for every season to get high and stable yield. Optimum fertilizer application is depend on the following factors :

(i) Soil fertility status
(ii) Fertilizer application time, fertilizer application amount and type of fertilizer
(iii) Farm management such as the method of land preparation, plant density, weed, pest and disease control, and water management, etc.

The application ratio of NPK suggested for direct seeding is 100 : 40 : 30 kg/ha, which is recommended by MARDI and followed by DOA. It is obvious that subsidy fertilizer usage of 80 : 30 (40) : 20 kg/ha for transplanting are not sufficient at areas where direct seeding methods are adopted. Additional fertilizers are needed at most of the study areas because the nutrient composition in the subsidy fertilizer are insufficient for the direct seeding plant. Besides, the amount and timing of application of fertilizers should be done correctly as shown below considering the vegetative phase and generative phase stage.

N : 1st - 1/4, 2nd - 1/4 and 3rd - 1/2 on 15 - 21 days after sowing, 45 - 50 days after sowing and panicle initiation stage, respectively
P : 15 - 21 days after sowing together with N
K : 15 - 21 days after sowing together with N

The application rates and times of nitrogen fertilizer in FELCRA in Seberang Perak, Changkat Jong and Skinchang in which high paddy yields are obtained, are beyond MARDI and DOA recommendation amount. However, the most of farmer in the study areas depend on the only subsidized fertilizer. A majority of farmers apply fertilizer

once or twice a season. The reasons of low dosage amount of nitrogen fertilizer are as follows:

(i) Farmers apply only government subsidized fertilizer for saving production cost.
(ii) Farmers do not have strong desire to earn more paddy production.

In order to solve the problem of the shortage of the farmers' fund for inputs, the promotion of the agricultural loan or group loan is effective. It is important to spread the technology and knowledge to the farmer through the agricultural extension and the practice in the pilot demonstration farm. The enhancement of agricultural extension through farmers groups is important for promoting the application of more fertilizer. It is one of the realistic and useful plans to promote some model farm groups in order to spread modern technology. Other than NPK fertilizers, secondary element (Ca : calcium, Mg : magnesium and S : Sulfur) and micro element (Fe : iron, Zn : zinc, Cu : copper and B : boron) are also needed at certain areas.

The effect of the additional fertilizer usage for yield increment in each area depend on the soil fertility status and plant management level, etc. In order to identify the suitable amount and ratio of fertilizer application, soil and plant analysis of each season should be established. The results of some researches and studies done by DOA and MARDI (based on the DRIS : Diagnosis and Recommendation Integrated System) show the NPK optimum fertilizer amount and ratio for all granary areas in Peninsular Malaysia as follows :

N	:	80 - 120 kg / ha
P2O5	:	30 - 50 kg / ha
K2O	:	30 - 40 kg / ha

Considering the above mentioned and discussion with concerned staff of MARDI, DOA and MADA, the fertilizer amount and timing recommended by MARDI will basically be followed. At the same time, introduce and acceleration of the DRIS is recommended in order to establish the suitable fertilizer application amount for each area.

(c) Introduction of new recommendable variety

A new paddy variety, code-named MR185 is released in July, 1997. The seed of MR185 is available and the planting of MR185 has started. The growth period of this variety is almost same as MR84, and it is suitable for the direct seeding method. The result of the yield trial examination recorded the high yields. There is no inferiority in the quality of MR185 as well in comparison with MR84. DOA plans to diffuse MR185. DOA plans to increase production of the seed of MR185 gradually from 1997 and will produce the seed of MR84 with 5,800 tons (approximately 50%) and MR185 with 5,000 tons (approximately 43%) per year in 1999. DOA will place these two varieties in the main varieties after 2000. Two varieties of MR84 and MR185 should be introduced in order to avoid the spread of diseases in the single variety and promote variety diversification.

(d) Pest, disease and weed control

Weed control especially during initial stage of paddy plant is one of the important farming practices to expect higher yield. The use of herbicide is unavoidable for continuous large scale crop production successfully. Proper ploughing/puddling is important to ensure uniform germination in order to assist weed control through the management of the water depth in the paddy field. As for land preparation, more than three times of preparation are effective in weeds control and promotion of the germination of the paddy. According to the result of the field test in MADA, two times of land preparation and one paddling should be done for the Wet direct seeding and two times of land preparation and pressing after seeding should be adopted for dry direct seeding.

The indiscriminate use of agro-chemicals for pests and diseases is wasteful of farm budget and harmful from the health and environmental viewpoints. It is proposed to reduce the dosage amount and times of chemicals as much as possible through adoption of effective use of agro-chemicals, like a initial stage control. The rotation of patrol will be adopted among the member of farmers' group. The use of motorbike will be effective for mobility. In order to enable access to the trouble spot affected by pest and disease, the layout of narrow pass in the paddy field is important. The management works by walking in submerged paddy field are very hard and the working efficiency is very low. However, the introduction of the new technology (tramline) makes management works in the submerged paddy fields by machines possible, and it is expected the improvement of the working efficiency. The Integrated Pest Management (IPM) recommended by DOA should also be considered to be applied in the study areas as a mitigation measure for reducing possible adverse effects of using insecticides, herbicides and other forms of agro-chemical in rice production.

The proposed agriculture improvement plan is summarized below and details are shown in Table 4.1.3 "Proposed Farming Practices".

I. Land preparation	Wet	Land preparation 2 times	Tractor + rotavator
		Paddling 1 time	Tractor + paddy harrow
	Dry	Land preparation 2 times	Tractor + rotavator
		Pressing 1 time	Tractor + roter bucket/land roller
II. Seeding	Seed rate	(60-80 kg/ha)	
	Wet	power blower/granule applicator/broadvaster	
	Dry	power blower/granule applicator/broadcaster	
III. Fertilizer application		$N:P_2O_5:K_2O$=100-120:30-50:30-40	
		Subsidized: Mixture 200kg/ha and Urea 100kg/ha	
		Additional: Mixture 100kg/ha and Urea 40kg/ha	
IV. Harvesting		Combine harvester	

(e) Others

(i) Compliance of irrigation schedule and enhancement of management system

The various farming practices, such as land preparation, water management, fertilizer application, pest and disease control, weed control, harvesting, etc. are done through

the paddy cultivation period. Compliance of the irrigation schedule and uniformity of farm works at block level are essential to improve work efficiency.

Under the present condition, it can be seen in some areas that the paddy planting is delayed sometime by the unsuitable water distribution or shortage of irrigation water. However, these problems or constraints will be solved after implementation of improvement works proposed in this study. Hence, the farm management will become more important in order to make farmers follow the irrigation schedule. For managing inclusively, it is necessary to improve the management system for paddy farming as follows:

- Enhancement of the management system

  It is important that farmers are aware of the significance of compliance of the irrigation schedule. The farm management function and activity of Project Management Unit (PMU) should be encouraged in order to take care of farmers and uniformly manage the farm works at scheme level. The proper arrangement for farm works is very important in order to smoothly carry out farm works. Generally, many farmers are not aware of the significance of the arrangement. The management staff should encourage farmers to undertake suitable activities. The main function of the management system is as follows:

  - preparation of farming schedule for clarifying work and necessary inputs
  - arrangement and order of the agricultural inputs in accordance with farming schedule
  - arrangement of time schedule of contract works for land preparation and harvesting, etc.

  FOA which is a member of PMU will arrange time schedule of contract works for land preparation and harvesting according to the farming schedule based on the proposed resister or the data base.

- Agricultural mechanization training

  With the introduction of mechanization system by integrated works based on the four wheels tractors, the improvement of the working precision by farm machines will be an important factor for farming activities. In order to improve the working precision, the education and training for the staff of agricultural machinery section of the water users group are indispensable. Under the guidance of DOA, the training will be held at the Farm Mechanization Centers. About 30 staffs will be trained at one time based on the present capacity of the facility in the center. The training program will be set considering the local conditions of the respective areas. The training at the Farm Mechanization Center will be done for a representative from each group in the beginning stage. In addition to the above training, on-the-job training in cooperation with DOA, FOA and PPK will be carried out for each block leader and farmers who operate farm machines. The trainings in the Farm Mechanization Centers and fields should be carried out every year for the improvement of the farmer's technology.

• The quality control of the contract work

The agriculture in Malaysia faces the farm labor shortage and an aging farmer problem. In order to overcome these problems, the mechanized farming mainly carried out by contractors has spread as the country level. The group farming and farm collectivization as counter measures are also on the recent trend. The contractors will play a more important role in the Malaysian agriculture activities in future. As for the nature of the contractor, the quality of the contract work exerts a big influence on the paddy growth and the yields. Therefore, the training of the personnel who supervise the contract works and make the quality control of the contract work will be proposed. The farmer in the agricultural machinery section of the proposed farmers' groups will bear this duty. The basic data and information on contractor such as number of machinery, work record, technical level etc. are not available at present. It is difficult for the staff of PMU to arrange time schedule of contract works without such kind of information. It is, therefore, proposed that PMU shall establish the data base system in order to grasp the present condition of the contractors. By establishing and effective use of the data base, the selection and arrangement of proper contractors will be done smoothly. When some problems occur, prompt copings will become possible.

• The effective use of Irrigation Monitoring and Feedback System

The proposed irrigation monitoring and feedback system is the quite effective as the information tool and in grasping the working progress. The effective use of this system will make farm works smooth and publication of the timely information possible.

(ii) Land leveling

The various farming practices, such as land preparation, fertilizer application, pest and disease control, weed control, harvesting, etc. are done through the paddy cultivation period. The precise control of irrigation water is necessary to carry out farming practices effectively. Land leveling is indispensable to ensure uniform germination and plant growth, to assist weed control, and to use irrigation water effectively.

(iii) Paddy lot size

The paddy plot size in the study area varies from 0.2 to 2.4 ha/plot. In order to attain the more effective farm management, the followings are considered:

- The better work efficiency of machine is achieved under large plot size.
- The paddy plant will grow uniformly over the extensive area.

The large paddy plot size has the advantage of the better work in efficiency and possibility of uniform plant growth. Hence, land consolidation as the structural field adjustments for large farm operations is proposed based on the samples of advanced areas, like Kampong Pelet and Kubur Panjang in Malaysia. It does not involve legal realignment of lot boundaries and changes in ownership. It is expected that the sense of solidarity as group farmer will begin to grow in among the farmers, and this will contribute to the enhancement of the formation of the group for farming. The one plot size is proposed to be 3 ha in the schemes located on the east coast and 5 ha on the west

coast considering different present conditions. It is essential to coordinate with the development stage of farmers' group.

(3) Anticipated Crop Yield

It is expected that unit yield of paddy would increase considerably on account of adequate irrigation water supply and improved farming practices through the modernization of irrigation water management. Under the implementation of the project, the anticipated yield of paddy in the study area is set up at 5.5 ton per ha. In estimating the anticipated yield of paddy, available yield data are taken into consideration. The yield records in paddy fields of Besut area which practice DRIS show the high level as shown in following table. Further, in the advanced areas such as Changkat Jong and Skinchang, the yields reach 6 -7 ton per ha. Judging from these available data, with the necessary production inputs and effective extension support, a yield level of 5.5 ton per ha are recommendable and achievable. The implementation of this project is expected to contribute to the achievement of the goal for NAP.

(Unit: t/ha)

DRIS plot	1	2	3	Average
Plot 1	6.0	5.5	5.2	5.6
Plot 2	5.8	5.5	5.4	5.6
Plot 3	5.5	5.7	5.3	5.5
Plot 4	5.7	5.5	5.2	5.5

Source: Special Meeting to Increase the Paddy (Rice) Production, Department of Agriculture, 1996

(4) Marketing

Marketing improvement plan consists of three components, namely, a) introduction of modern harvesting method, b) marketing by group and c) diversification of market destination.

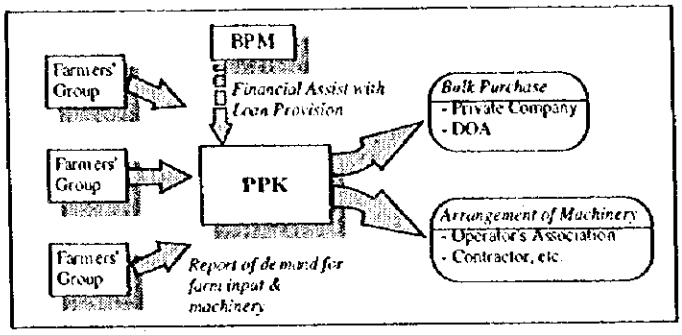
(a) Modern harvesting method

Bulk handling is the major harvesting method prevailing in the study area. This method has the advantages in reducing transportation cost, saving of manpower, elimination of drudgery. Therefore, where the guni-sack handling is still dominant such as Kerian, harvesting method should be shifted to bulk handling. Shifting to bulk handling would be the basic step for paddy marketing improvement. For the implementation, improvement of infrastructure (farm roads) and dissemination of knowledge regarding the advantages of bulk handling will be necessary.

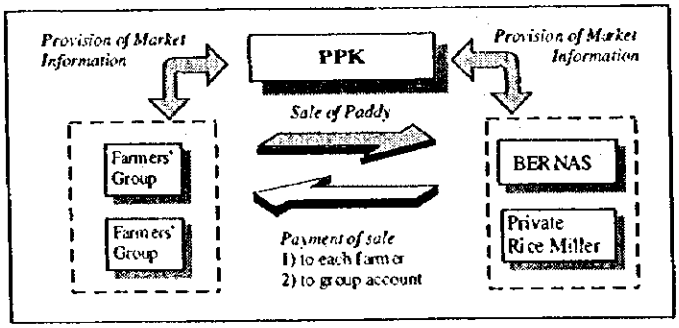
(b) Group Marketing

In order to have a negotiation power to discount the purchase price of farm input, group purchase of farm input would be recommended. Besides, arrangement of machinery should be also promoted in order for farmers to be able to adhere cropping schedule and to attain cheaper hiring cost. In practical, necessary amount of farm input and requirement of machinery will be confirmed at each farmers' group level and be reported to PPK. PPK will purchase the input from private company, NAFAS or others based on the report from farmers' groups. Arrangement of machinery will be done in

the same procedure. For the payment, PPK basically use its own fund and collect from the farmers after the harvest or deduct from farmers' sale. Supplementary, BPM will assist PPK's fund by providing loan such as revolving loan for the purchase of input. Conceptual diagram of farm input arrangement is shown as below.

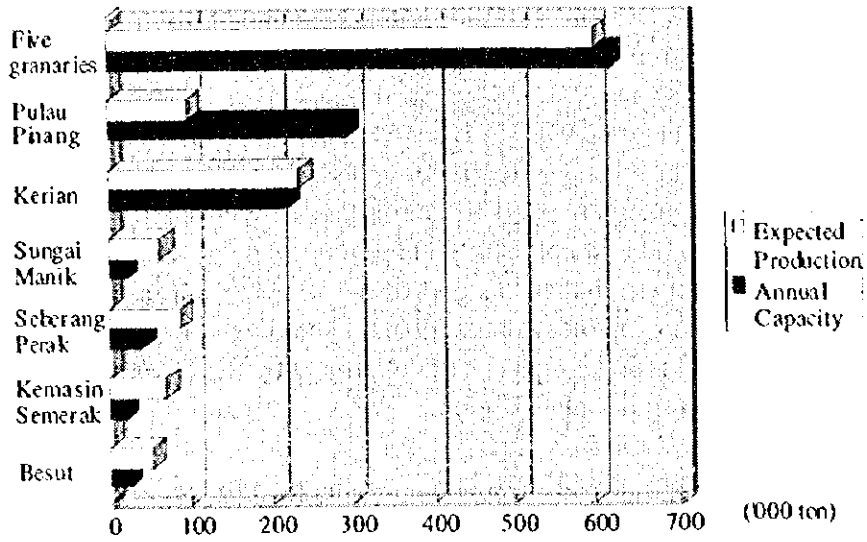


As to the marketing of paddy, group selling by farmers' group should be promoted in the first stage. Group selling has advantages in negotiation power, easiness in arrangement of harvester and transportation. In addition, in order to avoid concentration of paddy in one mill at same time, cropping schedule should be strictly adhered and market information should be provided through PPK. Presently, PPK collects paddy from member farmers and sell their paddy to millers. In this process, PPK gathers information on rice mills and utilizes them for its marketing. These information which are presently utilized within PPK should be also provided to farmers' groups. In the first stage, return of sale would be paid directly to each farmer. As the management capability of farmers' group be strengthened, sale will be paid to the group account and paid to each farmer after the deduction of loan amount. As the farm management is upgraded to mini-estate, sale of paddy will be done through PPK or estate management unit and sale will be distributed to the farmers according to their share holdings. Procedure of paddy marketing will be as follows :



(c) Market Diversification

Diversification of selling destination should be done because of two reasons. One is to avoid the concentration on one mill at a same time. As it is shown in the figure below, the present capacity of rice mills in each area will be not able to cover its expected production in the future except Pulau Pinang. In total of five granaries, however, milling capacity is large enough to cover the future production. In this regard, concentration on one mill at same time should be avoided, otherwise present rice mill facility is not capable to cope with future milling demand.



Note: Expected production is calculated assuming 5.5 t/ha and expected cropping intensity for each area.

Another reason for diversification is to have better selling condition such as higher price by selecting sale destination, since some private millers offer higher price or price incentives, transportation and so on. For the provision of information, which is important in selecting sale destination, PPK should play a main role. In addition, PPK should advice to allocate paddy so as not to concentrate on one mills at a same time.

4.1.6 Reinforcement Plan of Farmers' Organizations

(1) Farmers' Organization

The proposed Master Plan approach to reinforcing farmers' organization in water management takes into consideration the following factors :

(a) Differences in socio-cultural setting, socio-economic status, levels of production, factors contributing to the varying levels of production, irrigation systems design and different levels of progress of farmers' organization - this factor implies that the approach and the strategies to reinforce farmers' organization would have to be adapted or adjusted to suit the local conditions in order to be effective.

(b) Water being the central focus in the proposed modernization - this means that water management shall be the basis of reinforcing the roles of farmers' organization. Water users' group (WUG) approach is proposed in this context. As farm neighborhood and common water sources take priority over village neighborhood, it follows that re-orientation or adjustment of the farm layout is necessary under this approach.

(c) Water Users' Group should be the avenue for greater farmer participation in O&M activities at the tertiary level - participation in these activities shall be promoted on group rather than on individual basis. As for O&M activities, it is conceptualized that there are 6 stages of the nature of involvement. As shown in Fig. 4.1.11 "Conceptualized Stage & Nature of Farmer Participation in Water Management System", the first four stages

typify the current situations in the granary areas, while the fifth and sixth represent possible future development.

(d) The need to integrate these WUGs to the overall national organization systems - this is to ensure operational effectiveness as well as sustainability. This calls for organizational adjustments and streamlining of functions of all agencies involved in farmers' organization on both short and long term basis. In this respect, there is a need to consider structural changes as part of the strategic approaches to sustain whatever progress to be achieved through the modernization exercise. The above consideration is parallel to current policy emphasis as underlined by the National Agriculture Policy as well as by the Seventh Malaysia Plan.

Following are the proposed steps in reinforcing the farmers' organization :

(a) Strengthening the foundation of farmers' organization at the project level

This is applicable and necessary in :

(i) areas where active participation rate of farmers in PPK is still low, or

(ii) where their participation in paddy farming is still marginal (being more involved in non-paddy activities such as in tobacco cultivation as in the Kemasin/Semerak granary), or

(iii) where the percentage of farm households directly engaged in paddy farming as full time farmers is low (as in Pulau Pinang), or

(iv) where there is a great demand by local farmers to become members of either ladang kelompok or mini-estate.

Strengthening at this level involves:

- Delineation or demarcation of boundaries based on water regime or irrigation system boundaries rather than on administrative, village or residential boundaries.
- Intensive efforts in membership drives, social engineering, extension, training & mobilization (involving model farmers or high achievers). Consideration should be given for the setting up of kursus tempatan (local courses) as is practiced by MADA and as has been stressed by the World Bank, under extension program.
- Establishment of Inter-granary Task Force comprising experienced staff of DID, DOA, PPK and the National Water Management Training Centre (NWMTC). One of the main functions of the Task Force is to ensure a well co-ordinated plan of actions in relation to the delineation of physical boundaries, identification of problems and constraints and solutions as well as details of forming water users' group.
- Establishment of a Water Management Unit under PMU of IADP. This is to ensure focused attention and prolonged commitment of the agencies (IADPs) toward Water Users' Group and water management in general.

- Establishment of pro-team Inter-granary WUG Leaders Council. This is necessary to smoothen and expedite the implementation of the proposed modernization program. This council shall be the interest articulation channel or the communication link between the farmers and the implementing as well as the decision making agencies. As the program would also involve large scale land leveling as well as land consolidation, and as land consolidation can be very sensitive socially and politically, farmers' support is very vital indeed. The council shall interact with the proposed Inter-granary Task Force in this challenging program.

(b) Strengthening institutional support at the Federal, State, PMU levels

This will ensure well co-ordinated and sustained commitments in reinforcing farmers' organization. A highly co-ordinated strong committee as proposed is indeed very vital as the program will involve extensive land leveling and land consolidation as part of water management systems modernization. Expert advice from state governments, especially the District Offices, Department of Land & Mines, besides others, is very crucial and necessary indeed.

(c) Promotion of Mini Estate

This is imperative in areas where :

(i) group of farmers who have been actively engaged in ladang kelompok for so long are now desirous of upgrading their farming mode to mini-estate type (as was indicated by farmers' group who are members of the Special Youth Land Development Scheme (RTBK) under the supervision of DOA in Seberang Perak).

(ii) there is a serious labor shortage, compounded by the declining interest of younger generation toward paddy farming and the equally pressing issue of ageing of experienced farmers.

(iii) there is a need or a decision to develop tracts of idle lands (as in the case of Kampung Pelet in Pulau Pinang) either by the farmers themselves or as joint venture project with the private sector probably under contract farming arrangement.

(d) Reinforcing or Establishing Water Users' Group

Under current practice, water management matters in both ladang kelompok and mini-estate have been placed under the charge of a committee member, besides other functions such as crop protection, farm machinery, agronomic and socio-religious affairs. What is necessary in this case is the effort to reinforce or strengthen the existing roles of water management following the Guidelines For The Formation Of Water Users' Groups In Malaysia. In new areas or localities where farmers are yet to be organized, it is more preferable to immediately organize them into ladang kelompok based on irrigation systems boundary. Efforts to develop WUG would then ensue. The

proposed organization chart of farmers' group is presented in Fig.4.1.12 "Organization Chart and TOR of Water Users Group".

Once these WUGs are strengthened and reinforced, efforts to get them to participate in O&M works to be given by the water authority (DID) could then be organized. It is envisaged that Stage III in the conceptual framework would be operational. Here the farmers can be mobilized as they are now organized either under ladang kelompok and/or mini-estate. In this respect however, it would be more convenient for farmers organized under PPK to be given the contract works than those under ladang kelompok of DOA given the need for formalities (entities that are legally registered with sound financial/accounting system, etc.). The case in point is in Pulau Pinang where the State DID as awarded a RM 2.284 million worth of O&M works to PPK through the State Farmers' Organization. However this constraint could be overcome if these ladang kelompok (under DOA) are registered as yunit pertanian kecil or farmers unit of PPK for legitimization purpose. At the implementation stage of the modernization program, these WUGs could be mobilized to support and expedite on-farm infrastructure works including land leveling and in some cases land consolidation. Over time there should then be a progressive building up of WUG's capacity to become more involved in bigger income-generating projects that would generate benefits to their member-farmers. As their commercial orientation and more importantly their financial management capability is strengthened and given the institutional framework within which they operate (namely PPK), these WUGs could then be mobilized to actively engage in related farm-based enterprises on their own or as joint venture partners with outside investors as for instance in contract farming business with, say BERNAS. This would pave the way for WUGs to participate in related privatization program, as envisaged in Stage V and Stage VI in Fig.4.1.11 "Conceptualized Stage & Nature of Farmer Participation in Water Management System".

(2) Agricultural Support Services

(a) Human Resource Development

Human resources development is also a necessary program in order to strengthen farmers' organization, to enhance their function and size , and to establish smooth relationship among the federation of agencies and organizations concerned. This is to address the presence of vast amount of real and potential resources available among the heads, the womenfolk, the children and the youth in the rural community. Besides, strengthening of the organizational skills for large scale farming should also be focused on. In this context, strong linkage among key players, i.e. DID, DOA and FOA will be necessary.

(i) Training

Upon reorganization and formal linkages between the Farmers Groups and the PPK, special integrated training programs for the groups must be developed by the DID, DOA, FOA and the Water Management Unit of the IADPs. The National Water Management Center should lead this exercise and its subsequent implementation. The objective of this training is to develop the Farmers' Groups to

a level that the tertiary O&M facilities can be confidently handed over to them. Through the same exercise, the groups' capacity to undertake large scale farm management must be developed since the modernized water management system will be planned for such farming approach.

(ii) Monitoring

Monitoring activities such as study on present condition and problems, evaluation, setting-up of the target and preparation of the improvement plan, are crucially important for the management of the organizations. In addition to the monitoring of the business aspect, the monitoring of organization itself is proposed, since management of organization is deeply related with the perception of member farmers. The data obtained through this monitoring works will be stored in the database of each organization and those data will be under the general control of FOA. The items to be monitored are as follows.

- Water Management
- Farming Practice (Schedule, Cropping Intensity, Unit Yield, Production, Insects and Weed, Labor Input)
- Accounting Statement
- Purchase/Selling Records
- Minutes of Meetings
- Management Problems and Others

(b) Agricultural Research

The practice of direct seeding in rice cultivation is now normal in the Peninsular Malaysia since the introduction in the middle of 1970's. The research activities are mainly done by MARDI and MADA, and technical reports and papers are available as references. However, these useful technology do not spread at farm level. The current technology adopted by farmers are largely based on their own and other enterprising or progressive farmers' experiences through try and error. The appropriate and standard technology on direct seeding needs to be established and spreaded for paddy farmers especially in the granary areas. The following items is necessary :

- Compilation of farm management handbook (a tentative name) as text book for farmers
- Promoting new research theme for group farming or mini-estate
- Close linkage between agricultural research and agricultural extension

(c) Agricultural Extension

Since 1983, DOA has been making efforts towards organizing of the farmers' group and strengthening of group farming. The agriculture extension system has been modified to a "group farming approach" based on the T&V system. As for the extension system, the previous T&V system adopted by DOA will be followed. For the enhancement of the extension activities, the recruitment of more officers is one of the effective counter measures. However, it is suggested to improve "tools for effective extension" such as computer, and computer network. The modernization of agricultural extension system and method is considered effective measure to improve agricultural

extension as well as modernization of irrigation management system. The main points of the improvement plan for agricultural extension are as follows:

(i) Data collection, supply and extension through computer network system
The irrigation schedule monitoring and feedback system with computer network is proposed as one of the O&M system improvement plan. The proposed system should be used for agricultural data collection, supply and timely extension through computer two-way network system or effective use of existing DOA home-page.

(ii) Promotion of DRIS (Diagnosis Recommendation Integrated System)
The introduction and acceleration of DRIS is essential for establishing the suitable fertilizer application amount for each study area. Other than NPK, secondary and micro elements should also be considered. DOA components in the study area have begun to introduce DRIS and this activity should be promoted.

(iii) Review of management skills
For establishment of farmers' organizations and mini-estates, operational skills and management techniques of organizations need to be refined with cooperation of PPK. It is important that the skills include knowledge on management of equipment and machinery that enable farmers to consider cost and benefit; then, they can curtail expenditures.

(iv) Project monitoring
When a project is implemented, it is important to evaluate the project and monitor issues and problems, which contribute to the improvement of the project activities. It is also suggested that a monitoring system for the project be formulated. Items to be monitored should be able to produce database for computer analysis, and these are listed as below.

- weather and hydrology
- water management
- record of maintenance and management of facilities
- record of farming practice (farm schedule, cropping intensity, yield per unit, productivity, crop damage including diseases, insect attack and weed problems
- farmers' organization
- information on contractors

(d) Rural Credit

There are few problems observed in loan utilization by individual farmers. However, there is still a room for improvement by simplifying application procedure and shortening the time for loan realization. Besides loan disbursement to individuals, demand for loan utilization by farmers' group will be expected to increase as the grouping of farmers proceeds. In this regard following points should be considered.

(i) Establishment of Farmers' Group
In the initial stage, farmers' group will need its own group account and fund for operating group. This fund would be collected from member farmers and, in some

cases, financial assistance form outside agency would be needed. Besides, where the farmers' group become well managed, financial assistance would be necessary for upgrading themselves into mini-estate. For these purpose, BPM or LPP should provide loan to establish group account or assisting loan for upgrading especially in their initial stage.

(ii) Loan for Farm Input Purchase

As the purchase of farm input will be done in group, seasonal demand for purchasing loan would be increase. In this regard, purchase loan such as Padi Loan, which is presently provided by BPM to individual farmers, should be available for group. In addition, Padi Loan by revolving loan system should also be considered in the future.

(iii) Loan for contractor

In accordance with the mechanization of paddy farming, loan demand for agricultural machinery is expected to increase. Presently, loan for machinery procurement is already available both for farmers and contractors. However, utilization of this loan by contractors are not much common yet. Accordingly, loan disbursement for contractors should be enhanced so that various type of entities are able to come in paddy farming industry. In connection with marketing improvement, loan repayment should be also changed. In the initial stage, collection of loan repayment would be done at group level especially for farm input purchase, and it would be collected by group leader or committee member of farmers' group. When paddy sale shift from individual selling to group selling, repayment should be deducted from the return before reimburse to member farmers. By applying this system, the problem of defaulter can be reduced especially for input purchasing.

(e) Contractors for Agricultural Activities

For current agricultural activities, heavy works such as land preparation/land consolidation, harvesting are carried out by contractors. As mentioned above, quality control of contract works is very important for farmers. It is proposed that the contractors' association be established to strengthen a relationship between farmers and contractors, and to introduce the group contract system between farmers' group and contractors' association, which will make the arrangement of farm works smooth. The organization of contractor will improve the rationalization of the contract works and be profitable for both of farmers and contractors.

4.2 Initial Environmental Examination (IEE)

4.2.1 Objective of IEE

Environmental impact assessment is required as described in the guidelines issued by the DOE of Malaysia. According to EIA Order 1987, environmental impact assessment is necessary when development is taken place after 1 April 1988. However, all of the irrigation schemes proposed in this project had started well before the EIA Order came in effect.

Therefore, the initial environmental examination (IEE) was conducted following the JICA's environmental guidelines. The IEE is considered as a suitable form of environmental impact assessment at present time. Objectives of this IEE are listed as below.

(a) To describe detailed activities of the study,
(b) To survey present conditions of natural and social environments within and around the study areas,
(c) To predict, in a brief and relatively rough manner, potential impacts on natural and social environments within and around the study areas, and
(d) To recommend whether an EIA is further required or not, and to formulate its Terms of Reference (TOR) if required.

4.2.2 Method of IEE

Initial Environmental Examination (IEE) is a quick form of environmental impact assessment and existing information and data are normally used for a judgment. For natural environment, most of the data used to judge a level of impact are presented in the section 2.1.11 "Environment" of this report. Possible impacts on "sensitive ecosystems" (e.g. mangrove forests) due to deterioration of water quality are main concern of this study. Water quality data were collected primarily at the Department of Environment. Furthermore, Departments of Wildlife Conservation, Forestry and Fisheries were visited to gather information on natural environment around the study sites.

For social environment, public participation was attained with questionnaire. It was conducted as part of farm survey in which 500 questionnaires were distributed to IADP Pulau Pinang (100), IADP Kerian/Sungai Manik (175), IADP Seberang Perak (100), IADP Kemasin/Semerak (65) and IADP Ketara (Besut) (60).

The environmental check-list of the International Commission on Irrigation and Drainage (ICID) is regarded as a suitable measurement on overall environmental impacts in Malaysian (Lin and Noor 1994). This check-list covers both natural and social environments and was used for this IEE.

4.2.3 Results of IEE

(1) Natural Environment

Construction of additional facilities and land clearing are not main portion of this study, and it is unlikely to cause significant impacts on physical environment. Use of chemicals (e.g. fertilizer, herbicide and pesticide) is already a common agricultural practice, so that it is difficult to reduce the amount of chemicals being used at a significant scale. It is more realistic to assume that considerable amount of chemical compounds will continue to be used. Therefore, excessive use of chemical compounds is the key factor to be considered as a main source of environmental impacts in the study. However, detrimental factors that require immediate attention have not been identified with the check-list of ICID in this study as shown in Table 4.2.1 "Environmental Check-list of the International Commission on Irrigation and Drainage".

Water Quality Index (%) collected in this study ranged from 72.1% (Sg.Kurau in Kerian Scheme) to 87.6% (Sg.Besut in Besut Scheme). This range is acceptable for wildlife including aquatic life, but the water with values less than 80% is considered as slightly polluted for general use. COD is one of the most important parameters to indicate a level of chemical substance in water. Sg.Kurau (21.9 to 28.1 mg/l) in Kerian Scheme and Sg. Batang Padang (26.9 mg/l) in Sungai Manik Scheme showed relatively high values of COD, which indicates that the water in those rivers contains a higher level of chemicals.

Mangrove forests, mudflats and peat swamp forests in the vicinity of the study sites are considered as sensitive ecosystems, and that these areas must be fully considered in terms of environmental conservation. Extensive mangrove forests exist at downstream of both IADP Kerian/Sungai Manik and IADP Seberang Perak Schemes in Perak State, and water quality in some waterways in those schemes are relatively polluted. It does not seem that the level of pollution is serious at present time, but it is uncertain that the current water quality will be maintained. Additional chemical use that causes significant environmental impacts is possible, so it is imperative to establish a long-term environmental monitoring system.

(2) Social Environment

Public participation is important to understand the acceptability of development by the public, especially by local residents. Majority of the respondents (85%) answered that present irrigation facilities can be improved. As a result of the questionnaire, 63% of the respondents are aware of a minimum level of toxicity in terms of using chemicals for agriculture, and 76% of them are actually maintaining the minimum level. This result indicates that local farmers tend to minimize chemical use to avoid negative effects. Most of the respondents (81%) knew that owls can be used for controlling mice and rats, but only 38% of those people had practical knowledge about the technique. Only 26% of the respondents knew that a technique of using other biological agents such as ducks and fish to control pests (i.e. insects) is available.

Mangrove forests also hold great socio-economic importance supporting commercial fish and prawn fisheries, sustainable exploitation for timber, protecting the coastline from erosion and providing many different products to local communities in Malaysia. Matang Forest in Perak State can produce between 140 to 200 tons of timber per hectare by two commercial thinning with a 30-year rotation. Therefore, any damage to the mangroves potentially cause negative impacts to social environment as well.

(3) Mitigation and Abatement Measures

Proposed project focuses on upgrading existing facilities for irrigation, so there is no activity, which needs to be redesigned immediately to avoid negative impacts on physical environment. However, it is likely that a considerable amount of agro-chemicals will continue to be used to reach the rice production aimed by NAP. Although serious detrimental effects associated with the use of agro-chemicals were not identified in this study, water quality data presented in this report do not seem to be sufficient enough to make a decisive judgment. Water samples must be collected at adequate locations throughout the year. There is no systematic water quality monitoring system to check particularly a level of agro-chemicals in the

water used for irrigation. Therefore, it is imperative that a long-term environmental monitoring system be established to maintain adequate condition of natural environment.

Furthermore, monitoring population trends of wildlife species and biological diversity within paddy fields and the surrounding areas may also be useful to detect any changes in environment. Wetlands including paddy fields are used by a number of wildlife species, and most of them are sensitive to changes in water quality, toxicity in aquatic food webs and disturbance of terrestrial habitats. Therefore, changes in status of wildlife living in and around wetlands can be an indicator of the degradation of an ecosystem. It is, therefore, worthwhile if an environmental monitoring system includes a systematic wildlife survey. For example, brief count of migratory birds can be useful, but it requires more information to discuss a possibility of establishing such a system.

One of the most practical and effective methods of reducing the use of chemicals on paddy fields is probably further development of Integrated Pest Management (IPM) of the Department of Agriculture. This is a unique and environmentally safe approach that is to use biological agents such as catfish and owls to control weeds and pests. The program is still in a pilot study level and has not been fully implemented yet. More information on IPM is required to discuss how it should be refined.

4.3 Cost Estimate for Development

4.3.1 Basic Conditions and Assumptions for the Cost Estimate

For estimating the project costs, it is assumed that domestic products and services in Malaysia would be used in accordance with the Malaysian governmental policy. Reference construction cost are obtained through unit cost analyses based on tender documents for similar construction projects in and around the Project areas as well as the Government Standard Price published by DID. Construction prices are updated up to October 1997 level by multiplying Consumer Price Index published by Central Bank of Malaysia and Statistics Department.

Project cost comprises of improvement of system infrastructure, improvement of in-field infrastructure, establishment of water management and monitoring system, training of water users' group. It is broadly divided into (i) initial investment cost, (ii) replacement cost and (iii) O&M cost. Initial investment cost is further divided into direct construction cost, physical contingency, engineering cost, and administration and management cost.

4.3.2 Cost Estimate for Five Granaries

(1) Initial Investment Cost

Initial investment cost for each granary is summarized below and shown in Table 4.3.1 to Table 4.3.5 "Initial Investment Cost".

(Unit : 1,000 RM)

scheme	Initial investment cost			
	System infra	In-field infra	Water management	Total
Pulau Pinang	32,060	4,316	10,307	46,683
Kerian	78,379	21,881	15,499	115,759
Sungai Manik	28,198	2,911	6,385	37,494
Seberang Perak	20,288	1,814	8,985	31,087
Kemasin/Semerak	1,700	861	1,651	4,212
Besut	26,796	2,435	4,447	33,678

Note : The above infrastructure cost in Kemasin/Semerak covers works only for Jelawat Rusa and Kemasin Hilir sub-scheme.

(2) Replacement Cost and O & M Cost

For successful achievement of modernization of water management system, it is inevitable to keep suitable condition of irrigation infrastructures. Therefore, taking into consideration of deterioration of irrigation structures due to passage of time, replacement cost for infrastructures, which covers 20% of initial cost, is assumed to be appropriated every 20 years. For replacement cost for water management / monitoring system, initial equipment cost is applied every 10 years. O&M costs which are expected to occur every year are estimated at RM 304 /ha/year for infrastructures and RM 250,000 /year for water management system. The result for each scheme is summarized as follows:

(Unit : 1,000 RM)

scheme	Replacement cost		O & M cost per year
	Infrastructures (every 20 years)	Water management (every 10 years)	
Pulau Pinang	7,275	7,928	3,169
Kerian	20,053	11,922	7,412
Sungai Manik	6,222	5,053	2,171
Seberang Perak	4,420	7,111	2,897
Kemasin/Semerak	512	1,270	750
Besut	5,846	3,421	1,820

Note : The above replacement and O&M costs for infrastructures in Kemasin/Semerak cover those only for Jelawat Rusa and Kemasin Hilir sub-scheme.

(3) Training Cost for Water Users' Group

Training for Water users' groups, which are to be formatted for the project, is planned at both off-site (National Water Management Training Center) and on-sites. The former is executed on 2 leaders from each group for three years and the latter is done on all members of groups for five years. The training cost is summarized below :

(Unit : RM)

scheme	Number of group	Cost		
		Off-site	On-site	Total
Pulau Pinang	125	300,000	73,010	373,010
Kerian	84	201,600	134,850	336,450
Sungai Manik	36	86,400	40,300	126,700
Seberang Perak	20	48,000	23,330	71,330
Kemasin/Semerak	39	93,600	118,890	212,490
Besut	30	72,000	30,540	102,540

4.4 Project Evaluation

4.4.1 General

In order to assess the economic viability of the project, preliminary economic evaluation is carried out for each granary according to the conditions set as below. As for Kemasin/Semerak area, since flood mitigation project is still under the process and irrigation facility is not completed yet, evaluation is not carried out for this granary.

(i) The economic useful life of the project is 50 years
(ii) All prices are expressed at 1997 price
(iii) The exchange rate is fixed at US$1.00=RM4.4=Yen129.5 as of January 1997
(iv) The Standard Conversion Factor is calculated to be 0.987

4.4.2 Economic Cost

The project cost to be used in the economic evaluation consists of construction cost, training cost, operation and maintenance cost and replacement cost. Economic cost is calculated by deducting the transfer payment from the financial project cost and multiplying with the Standard Conversion Factor. The economic cost of construction and training for each scheme are shown as below.

(Unit : 1000RM)

Items	Pulau Pinang	Kerian	Sungai Manik	Seberang Perak	Besut
I. System Infrastructure	30,661	74,958	26,967	19,403	25,626
II. In-field Structure	4,074	20,653	2,748	1,712	2,298
III. Water Management/Monitoring System					
1. Telemetry & Telecontrol System	9,211	14,356	5,667	7,969	3,458
2. Feedback System	903	853	598	848	906
IV. Training of Water Users Group	349	316	119	67	96
Total	45,198	111,136	36,099	29,999	32,384

Annual operation and maintenance cost is calculated by applying the Standard Conversion Factor to the financial cost, and the replacement cost is calculated by deducting the transfer payments and multiplying with the Standard Conversion Factor. The economic cost for operation and maintenance and for replacement are summarized as follows:

(Unit : 1000RM)

Items	Pulau Pinang	Kerian	Sungai Manik	Seberang Perak	Besut	Remarks
1. O & M Cost	3,169	7,412	2,171	2,897	1,820	Annual
2. Replacement Cost						
- System Infrastructure	6,132	14,992	5,393	3,881	5,125	Every 20 years
- In-field Structure	815	1,761	550	342	460	Every 20 years
- Tram Line		2,370				Every 10 years
- Water Management	7,086	11,043	4,359	6,130	2,660	Every 10 years
- Feedback System	694	656	598	848	697	Every 10 years

4.4.3 Economic Benefit

The expected benefits from the project are increase of the production owing to the improvement of water management and farming practice, and reduction of labor input owing to the mechanization. These benefits will be reflected by the increase of yield, increase of cropping intensity and reduction of labor cost. The comparison of "with-project case" and "without-project case" for each scheme is shown below.

(Unit : 1000RM)

Items	Pulau Pinang	Kerian	Sungai Manik	Seberang Perak	Besut
1. Unit Yield (t/ha)					
without-case	2.80	2.94	3.05	3.53	3.18
with-case	5.50	5.50	5.50	5.50	5.50
2. Cropping Intensity (%)					
without-case	189	164	191	191	164
with-case	200	200	200	200	175
3. Labor Input (man-day)					
without-case*	13	10.9(58)	10.3	18.8	12.9
with-case	3.8	3.8	3.8	3.8	3.8

* : The figure in parenthesis indicates the labor input for transplanting.

The project benefit is defined as the difference between the net production value of "with-project case" and "without-project case" conditions. For the "without-project case", it is assumed that present condition will continue through the project life of 50 years and there will be no change in the yield, cost and return. The project benefit will start to realize after the completion of the construction of facilities and reach the target yield after 5 years of the completion. The benefit at the full developed stage is calculated as below.

(Unit : 1000RM)

Scheme	Net Irrigation Area (ha)	Net Production Value (without)	Net Production Value (without)	Incremental Value
Pulau Pinang	9,601	19,960	49,660	29,700
Kerian	23,560	37,880	119,630	81,750
Sungai Manik	6,318	13,210	32,680	19,470
SeberangPerak	8,708	24,890	45,040	20,150
Besut	5,164	11,030	21,570	10,540

4.4.4 Economic Evaluation

Based on the project cost and benefit estimated above, the economic internal rate of return (EIRR) is calculated for each scheme. The results are summarized as below.

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

The result of preliminary evaluation indicates that all the schemes are economically viable with EIRR higher than 10%. Among the 5 schemes, Kerian scheme shows highest economic viability with 25.3% of EIRR, followed by Pulau Pinang and Sungai Manik.

4.5 Development Priority and Implementation Program

4.5.1 Recommendation on Rationalization of Granary Areas

The National Agriculture Policy (NAP) defines eight (8) Granary Areas in Peninsular Malaysia. These are MADA, IADP Pulau Pinang, IADP Kerian / Sungai Manik, IADP Seberang Perak, IADP North West Selangor, KADA, IADP Kemasin Semerak and IADP Ketara (Besut). The total net irrigation area of the Granaries is about 217,000 ha.

In the course of field works in the Phase I, there appears to be a possibility for rationalization of some of the Granaries. This refers particularly to the Sungai Burung Sub-Scheme in IADP Pulau Pinang Scheme and the Sungai Manik Sub-Scheme of IADP Kerian / Sungai Manik Scheme.

(1) Sungai Burung Sub-Scheme of IADP Pulau Pinang

The Sungai Burung Sub-Scheme of IADP Pulau Pinang with the net irrigation area of about 230 ha is located in Balik Pulau on the island of Pulau Pinang. This scheme appears to be unstable in relation to paddy production due to insufficient water resources and lack of farmer's intention for paddy cultivation, and with the expected non-agricultural development currently being considered by the State Government for the area, its sustainability to remain as an active component of the granary area in the IADP Pulau Pinang is doubtful. It is reported that the Sungai Pinang Scheme which is located at just north of the Sungai Burung Scheme is converted from paddy areas into other crops at present. Therefore, the Sungai Burung Scheme could be considered for exclusion from the granary areas but to still remain under the IADP Pulau Pinang. In order to maintain the total area of the Granaries, a replacement scheme with the size being equal or more should be determined.

(2) Sungai Manik Sub-Scheme of IADP Kerian / Sungai Manik

The Sungai Manik Sub-Scheme (about 6,300 ha of net irrigation area) was included into the IADP Kerian / Sungai Manik Scheme to facilitate administration of the World Bank Loan for the project implementation. The project implementation is now completed. Geographically, Sungai Manik area is about 125 km away from the Project Management Office located in Bagan Serai. This large physical separation results in various administrative constraints in terms of scheme management. In fact beginning 1997, the Sungai Manik Sub-Scheme is managed nearly independent from the main office in Bagan Serai. As the World Bank package is now completed, it is timely to review the necessity of the management link between Kerian and Sungai Manik Schemes.

Just within 30 km radius of the Sungai Manik Project Office in Teluk Intan, there exist the granary area of IADP Seberang Perak (about 8,700 ha of net irrigation area) and the secondary granary area of Changkat Jong (about 2,000 ha of net irrigation area), and these three(3) areas are within the same river basin of Perak. Administratively, it seems practical that IADP Seberang Perak Scheme be combined with the Sungai Manik Sub-Scheme to form one granary area. To replace the exclusion of Sungai Burung Scheme of IADP Pulau Pinang, the Changkat Jong area could be included in the new granary. The generally more progressive

group of farmers in Changkat Jong would be serve as a model or as a reference group in promoting further progress in paddy production among farmers in Sungai Manik and Seberang Perak Schemes. In this way the number of granary will remain the same and the total area is not reduced but slightly increased. The area of Kerian Scheme (about 23,700 ha of net irrigation area) is still substantial to qualify as a granary area.

From an irrigation management perspective, two DID district offices are involved namely DID Perak Tengah at Sri Iskandar and DID Perak Hilir in Teluk Intan. However, for the Seberang Perak Scheme, the O & M team is based at the DID Project Office in Sungai Detap. With the major aspects of the implementation of Seberang Perak Scheme mostly completed, there is no single project management unit currently managing this scheme. Some blocks of the scheme are being managed by FELCRA and other blocks by individual farmers, youth groups and ex-servicemen. Being a granary by combining with Sungai Manik Scheme and Changkat Jong Scheme, an integrated approach could improve scheme performance and sustainability.

Integration of the three(3) schemes (Seberang Perak, Sungai Manik and Changkat Jong) will improve cost effectiveness because :

(a) of its relative close distance to each other,
(b) the integrated size could reduce future improvement cost in terms of Ringgit / ha, and
(c) of improved operation and maintenance if the central control system can be established.

4.5.2 Selection of Priority Schemes for Feasibility Study

For selecting priority schemes for the Phase II - Feasibility Study, the following items are taken into consideration :

(1) Location
(2) Scale of scheme
(3) Water availability for irrigation
(4) Irrigation and drainage facilities
(5) Water management system
(6) Cropping intensity and unit yield of paddy
(7) Farm income
(8) Farmers' organization
(9) Competition with industrialization

Table 4.5.1 "Comparison of Five Granary Schemes for Selection of Priority Schemes" shows the comparison of the five(5) granary schemes for the above items, and the proposed selection priority for the Feasibility Study is discussed as follow :

Among the five(5) granary schemes, only two(2) schemes namely, IADP Kemasin Semerak Scheme and IADP Ketara(Besut) Scheme are located on the east coast of Peninsular Malaysia. The IADP Kemasin Semerak Scheme is still at infancy stage. Focus now is on flood

mitigation before improvement of agricultural area. Present project status is that irrigation facilities are completed only in the Kemasin Hilir and Jelawat Rusa sub-schemes of the Kemasin area, and the irrigation development in the remaining six(6) sub-schemes of the Semerak area are still at planning and detailed design stages. Therefore, this Kemasin Semerak Scheme is excluded from selection of priority schemes for the Feasibility Study, and the IADP Ketara(Besut) Scheme is selected as only one scheme located on the east coast with the following features :

- Water resource is inadequate for double cropping,
- Its cropping intensity for the recent five years (1990-1994) is the second lowest of the five(5) schemes,
- Project infrastructure is completed but irrigation water management system is very weak,
- No telemetry system for irrigation system management exist,
- It is the only scheme implementing a pilot project on formation of Water User Groups, and
- Income from paddy production is the second lowest of the five(5) schemes.

Out of three(3) schemes namely, IADP Kerian/Sungai Manik, IADP Pulau Pinang and IADP Seberang Perak which are located on the west coast of Peninsula Malaysia, IADP Seberang Perak Scheme is not selected as the priority scheme because this scheme has the highest cropping intensity and average paddy yield for the recent five(5) years in the five schemes, no shortage of irrigation water from Perak river, and a lead example of good management by FELCRA.

The IADP Kerian / Sungai Manik Scheme is designated as one of the eight(8) major granary schemes, however the Sungai Manik scheme is independent of the Kerian scheme and geographically its area is about 125 km away from the Project Management Office located in Bagan Serai mentioned in the previous section. Therefore, it is proposed that only the Kerian scheme be selected as the priority scheme for the Feasibility Study with the following reasons :

- This scheme has the largest irrigation area among five(5) schemes and the development of this scheme will contribute significantly to raise paddy production in the granary areas,
- The present crop intensity and yield are still low,
- Irrigation and drainage facilities are completed but some of them are required to be rehabilitated and improved,
- Poor drainage condition in the lower area hampers the introduction of direct seeding and farm mechanization,
- Poor discipline in relation to irrigation schedule and irregular tapping of water cause shortage of irrigation water ,
- Telemetry system for irrigation system management exists but not yet completed, and
- Farmers' organizations are not well developed.

For the IADP Pulau Pinang Scheme, it is proposed that the Feasibility Study be undertaken only for areas on the mainland side of the granary excluding the Sungai Burung

sub-scheme (230 ha) located in the island of Pulau Pinang due to the reasons mentioned in the previous section. The key features of this scheme are shown below.

- The surrounding areas are fast developing into housing and industrial use. Special measures should be taken to defend this granary from encroachment of non-paddy development,
- Irrigation and drainage facilities are completed but some of them are required to be rehabilitated and improved,
- No telemetry system for irrigation system management exist,
- Its average yield for the recent five(5) years is the lowest of the five(5) schemes though its cropping intensity is high, and
- Areawise, it is the second largest of the five schemes.

From the above, three(3) granary schemes such as Kerian, Besut and Pulau Pinang (Seberang Perai only) are selected as the priority schemes for the Feasibility Study.

4.5.3 Project Implementation Schedule

(1) General

The works for modernization of water management system in the granary areas are formulated from the hardware and software viewpoints. The former consists of rehabilitation / improvement of system infrastructures and in-field infrastructures and establishment of water management / monitoring facilities, and the latter comprises of formation and training of water users' group. In order to achieve the target yield of 5.5 ton/ha in 2010 in the National Agricultural Policy as mentioned in Section 3.2.1 "The National Agricultural Policy on Paddy", it is scheduled that the works are to be commenced from 1999 and completed in 2006. The selected three granary schemes (Kerian, Besut and Pulau Pinang) in the previous section will be implemented preferentially, however, implementation in Sungai Manik and Seberang Perak is also required urgently, taking into consideration of the target year of the National Agricultural Policy. In Kemasin / Semerak scheme, it is essential to complete on-going Flood Mitigation Project as early as possible and to start the modernization works.

(2) Implementation Plan for Rehabilitation and Improvement of System Infrastructure

Items of rehabilitation and improvement of system infrastructure consist of mainly those for irrigation, drainage and road facilities. The order of priority for execution of those works are explained in Section 4.1.3 "Improvement Plan for System Infrastructure". However, taking into consideration that improvement of in-field infrastructures shall be executed based on the establishment of major system infrastructures and all works be completed in 2006, each work shall start in 1999. The executing agency of this works is DID.

(3) Implementation Plan for Improvement of In-field Infrastructure

Improvement of in-field infrastructures is land leveling and construction of in-field channels and control boxes. 40 % of the area required land leveling will be executed by DOA and the remaining 60 % by private sectors managed by PPK. Construction works of in-field channels and control boxes will be executed by DOA. These works will be also commenced in

1999 and completed in 2006. Target of the respective works in the granaries except Kemasin/Semerak scheme is estimated at 5,129 ha/year for land leveling, 770 km/year for in-field channel and 2,207 nos./year for control box. Land consolidation will be implemented by close cooperation among DOA, IADP PMU and LPP/PPK and be completed in 2006. Annual target of consolidated farmhouse is 1,215 houses/year.

(4) Implementation Plan for Establishment of Water Management / Monitoring Facilities

Facilities for water management system consist of communication links, telemetry system for rainfall and water level observation, monitoring system for gates and pumps, computer system and telecontrol system for gates and pumps. Establishment of those facilities is implemented in following order :

(i) Establishment of communication links, rainfall station, water level gauges and computer system, ------> (ii) Introducing electric moving gates for telecontrol and establishment of monitoring system for telecontrol gates and pumps, ------> (iii) Establishment of remote control system for telecontrol gates and pumps

Installation of water level gauges and control gates shall be executed in parallel with the improvement works of system infrastructures mentioned above (2). Monitoring feedback system will be introduced to the whole area at four years, in order of the master station, player stations. The works are executed by DID.

(5) Implementation Plan for Formation of Water Users' Group and Training

The work will be carried out in 5 years from 1999, because it will become the big key to achieve the modernized water management. Number of water users' group in the granary area is estimated at 377 groups and annual target of group formation is 67 group/year. As for the training of the water users' group, off-site training at National Water Management Center in three years and on-site training in five years are programmed. Two leaders from each group joint off-site training and all group members participate off-site training. Number of participants in a session is planned to be about 40 persons. Off-site training is managed by DID and on-site training is executed by IADP PMU.

The implementation schedule of the works for modernization of water management system in the granary areas is presented in Fig. 4.5.1 "Implementation Schedule" and its disbursement schedule is given in Table 4.5.2 "Disbursement Schedule".

4.6 Conclusion and Recommendation

4.6.1 Conclusion

The Economic Internal Rate of Return (EIRR) of four(4) granary schemes except for Kemasin/Semerak scheme where flood mitigation project is currently under progress, ranges from 11.0% to 25.3%. It can be said that the Project are technically feasible and economically viable with a viewpoint of national economy. Through the study, the Project is justified summarized as below:

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

(b) Reduction of the number of the DID stuff by transferring responsibility on the operation and maintenance of the tertiary canal system to farmers' organizations enables to improve and streamline management systems.

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

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

4.6.2 Recommendation

The Project will increase rice production and contribute to secure stable source of food, so it is concluded that this is a realistic and appropriate plan for reaching the target of the NAP. It is, therefore, recommended that this project be implemented as soon as possible. Strategic plans to increase production and maintenance of granary areas are summarized in the following:

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

(b) Expedition of flood mitigation project in Kemasin/Semerak Scheme
There is a precondition for Kemasin/Semerak Scheme that the on-going flood mitigation project must be completed and appropriate irrigation facilities will be established by the time of implementation of the proposed modernization program. with the consideration of reaching the target of the NAP by the year 2010, the flood mitigation program must be completed as soon as possible.

(c) Establishment of meteo-hydrological stations in the Besut river basin and check of function of Peringat hydrological station in the Kemasin river

No discharge records are available for the both upstream of Besut and Angga rivers that are main water sources of the Besut Scheme. There is presently a problem of water shortage in this scheme, and it is predicted that more amount of water will be required for other sectors than agriculture in the future. Therefore, it is recommended that meteo-hydrological stations be established at the upstream of the existing Besut and Angga barrages as soon as possible to grasp the actual discharges of rivers. There is a Peringat hydrological station for Kemasin River that is a main waterway in Kemasin/Semerak Scheme, but no record has been taken since 1990. Additional irrigation is supposed to be provided by KADA, but it is necessary to check the function of the station to assure the amount of additional irrigation water.

(d) Establishment of water users group

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

(e) Consensus of farmers toward land consolidation

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

(f) Durability of the Project

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

PART - V

FEASIBILITY STUDY FOR SELECTED THREE GRANARY SCHEMES

5.1 Kerian Scheme

5.1.1 Area-wise Conditions in the Scheme

The Kerian Scheme is located at the north west corner of the State of Perak. The town of Bagan Serai is located in the center of the Kerian Scheme area and it is about 100 km north of Ipoh, the capital of Perak. The scheme with 23,560 ha of the net paddy area cultivated, is divided into eight (8) compartments namely A, B, C, D, E, F, G and H. Compartments A, B, C & D are located on the coastal side referring to as Kerian Laut. On the other side, Compartments E, F, G & H are located on the inland/upland region near Bukit Merah Reservoir to the east of Bagan Serai Town. These upland compartments are referred to as Kerian Darat.

The area-wise present conditions for eight (8) compartments are summarized as shown in Table 5.1.1 "Area-Wise Conditions in Kerian Scheme". The irrigation schedule in Kerian area is divided into three(3) patterns for Compartments A to C, D to F and G to H. In Compartments A to C, transplanting is still practiced and mechanization is limited because of poor drainage conditions. The crop yields of Compartment D to F are lower than the another compartments due to organic soils in these areas. On the other hand, Compartments G to H have high rate of mechanization and high cropping intensity.

5.1.2 Proposed Modernization Plan

(1) System Management

(a) 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 and computerization.

(b) Reorganizing O&M responsibility

The review of field staff positions and proposed reduction is based on assuming 80% reduction for gatekeepers and general workers. The derived figures is summarized below:

Scheme	Nos (1997)	Total Cost (1997) (RM)	Proposed Nos.	Revised Cost (RM)	Annual Reductin (RM)	% Cost Reduction	O&M Staff Cost Reduction (RM/ha)
SII	2	-	2	-	-	-	-
II	6	-	6	-	-	-	-
Irrigation Technician	20	-	20	-	-	-	-
Sub-total	28	352,394	28	352,394	-	-	-
Gatekeeper	61	-	12	-	-	-	-
General Worker	109	1,680,296	22	336,059	-	-	-
Total	198	2,032,689	62	688,453	1,344,236	34	61

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

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

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

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

The total estimated O&M expenditure in 1997 for Kerian Scheme is nearly RM 5 million Out of this, about RM 1.4 million (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. 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.

(d) Water Users' Groups

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

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

The average size per WUG is 280 ha/WUG with Compartment C at 990 ha/WUG. These appears to be rather large compared to IADP Pulau Pinang at 76 ha/WUG and Besut at 172 ha/WUG. Comparing membership size of 161 farmers/WUG for Kerian

with 58 farmers/WUG in Pulau Pinang and 102 farmers/WUG in Besut, the Kerian membership size per WUG is also large. It is recommended that the area and farmers membership size for Kerian be reduced to at most about 175 ha/WUG at 100 farmers/WUG. This is in comparison with figures from Besut Scheme which appears to be a manageable size. If this criteria is adopted, the average WUG numbers will increase to 135 WUGs.

Two one-day training session on-site is proposed for all WUG members and one three-day training off-site at the National Water Management Training Center for 2 leaders of each WUG. These training sessions should include promoting in-field infrastructure development program and land consolidation. 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.

(2) Telemetry and Telecontrol System

The present rainfall and water level telemetry system was installed in 1989. The telemetry system comprises one central station, one repeater station and 24 remote stations using 150MHz radio link as shown in Table 5.1.2 "Existing Telemetry Facilities" and Fig.5.1.1 "Existing Telemetry System". The function of this telemetry system is to acquire rainfall data and water level data automatically at two hours interval. The present data acquisition performance is poor (less than 70% at October 1997) due to deterioration of equipment and radio links as well as inadequate maintenance. In addition, there exists no computer system for processing data collected through the above telemetry system. It is proposed that the existing telemetry system be replaced with a new system because the existing system has been in operation for eight(8) years and is technologically outdated. The new system shall be adopted under the "open system" condition so that the system be able to maintain quality, increase reliability and improve O&M. The proposed new system is as follows :

(a) Establishment of a central control station with the master equipment of telemetry system at DID Bagan Serai Office

(b) Establishment of observation network : 4 rainfall remote stations and 44 water level remote stations, of which locations are shown in the next section (3) System Infrastructure.

(c) Establishment of communication system : 150 MHz radio link

(d) Establishment of computer system
  (i) Irrigation Water Management System (IWMS)
    - Computer program for estimating daily rainfall, discharge, irrigation water requirement, gate opening level, pump operation time, etc.
    - Hardware and software necessary for IWMS
      • Hardware : CPU - MMX 200MHz
        RAM - 64MB
        Storage - 4GB (8GB)

CD ROM - 16X
Network Interface - Ethernet / 10BASE-T

- OS : Window 95
- Software : Microsoft Office 95 Professional Edition
  Visual Basic 5.0 Professional Edition
- Printer : Network Color Printer IEEE802.3 10BASE-T
- Network : Hub IEEE802.3 10BASE-T

(ii) Irrigation Monitoring and Feedback System (IMFS)

- Proposed IMFS network for the Kerian scheme

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

- Hardware and software necessary for IWMS

Items	Master Station	Play Station
- Hardware	(Desktop)	(Notebook)
• CPU	MMX 200MHz	MMX 166MHz
• RAM	64MB	32MB
• Network interface	Ethernet / 10BASE-T	—
• Storage	4.0 GB	2.0 GB
• CD ROM(inner)	16X	8X
- OS	Window 95	Window 95
- Software		
• Scala Information	IC Master software	IC Player software
• Multimedia	Scala MM200	—
• Business Soft	Microsoft Office Pro.	Microsoft Office Pro.

(e) Establishment of gate/pump telecontrol system : locations of the existing gates and pumps to be motorized for remote control are shown in the following section (3) System Infrastructure.

(3) System Infrastructure

(a) Irrigation Facilities

Through the water balance study, it is confirmed that required irrigation water can be supplied by Bukit Merah Reservoir and Bogak Pump Station. However, due to the difficulty to secure the required water level at several diversion points, water shortage is sometimes found in the downstream areas. Accordingly, it is proposed to provide

regulating structures with a monitoring function connecting with telemetry system for proper water distribution. The existing diversion structures are relatively in well conditions, however, replacement of gates is required at a part of damaged portions. Further, concrete lining is to be introduced to main and secondary canals in order to reduce canal losses because it does not leave much space for available irrigation water in the scheme. Rehabilitation and improvement plans for irrigation facilities in the scheme are summarized below and shown in Table 5.1.3 "Rehabilitation and Improvement Plan of System Infrastructure".

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

(ii) Provision of regulating structures : 7 nos. on main canal , 8 nos. on secondary canal

(iii) Rehabilitation of damaged structures : Replacement of diversion gates 16 nos., replacement of gate spindle 2 nos.

(b) Drainage Facilities

Improvement of drainage facilities in Compartment A, B and C is the most important measures in the scheme, which aims to increase baring capacity of the fields for direct seeding and large scale mechanized farming. Moreover, drainage improvement in Compartment D is also essential, where organic soil exists. DID has a drainage improvement plan for about 4,500 ha mainly in Compartment B and C as Drainage Polder Project, consisting following items :

- Construction of bund
- Construction of additional drainage gates
- Desilting of existing drains
- Provision of additional drainage pipe
- Construction of new drains
- Provision of drainage pump

Pilot project covering 330 ha has been commenced in June 1997 and is to be completed in March 1998. Based on the plan of the drainage polder project, improvement plans for drainage facilities in Kerian scheme are given below and presented in Table 5.1.3.

(i) Rehabilitation and construction of drainage gates : Tidal gate 2 nos., drainage control structures 120 nos.

(ii) Desilting of drains : 580 km

(iii) Construction of bund : 153 km

(iv) Construction of additional drains : 17 km

(v) Provision of drainage pump : 10 nos.

(vi) Others : Drainage pipes, etc.

(c) Farm Roads

Alignment of farm roads in the scheme is relatively well and those roads are being utilized not only for farming but also for other purposes such as living transportation, communication and commerce. Farm roads along main and secondary canals have sufficient width for traveling of vehicle and farm machinery, however, those surfaces are in dumpy conditions in the rainy season. Road width along several tertiary canals is insufficient for farm machinery traveling, which is about 1.0 m. Accordingly, pavement of road surfaces along main canals and widening of tertiary roads are proposed in taking consideration of large scale mechanized farming and future growth of the region. Improvement plans of farm road in the scheme are summarized below :

(i)	Pavement	:	Asphalt pavement along main canals 40 km
(ii)	Widening	:	100 km along tertiary canals

(d) Water Management Facilities

Since it does not leave much space for available irrigation water in the scheme, advantage of storage capacity of Bukit Merah Reservoir should be maintained avoiding to take excess water as well as reducing canal losses mentioned above. In accordance with the basic concept in Part - III "The Modernization Concept for the Granaries", it is proposed to introduce a central management system for adequate intake and proper water distribution, providing control and monitoring points at major intake and diversion structures together with rainfall stations at the representative locations of the scheme. Those points are classified into key points, second points and third points depending on their importance.

(i) Key Control Point
The Kerian scheme consists of eight (8) compartments and same irrigation schedule is applied within the respective compartment. Therefore, five (5) key control points are proposed at Bukit Merah Reservoir, Bogak Pump Station and three (3) diversion points in order to regulate intake water and diversion water to the compartments. Water level gauges, remote control gates and remote control panels for pumps are installed at those points.

(ii) Second Control Points
Other than key control points, three (3) second control points are planned at the diversion structures, of which inadequate operation gives much affects to proper water distribution in the scheme. At those points, water level gauges and remote control gates are also provided.

(iii) Key Monitoring Points
Seven (7) key monitoring points are established on main canals with an interval of about 1,000 ha command, in order to confirm whether the water distribution is proper or not. These points are installed on regulating structures (check gate) provided through improvement works of irrigation facilities. Water level gauges are equipped at the points to check canal discharge as well as supply water level.

(iv) Second Monitoring Points

Eight (8) second monitoring points are proposed at beginning of secondary canals commanding more than 500 ha, to inspect distributed discharge by water level gauges.

(v) Third Monitoring Points

8 compartments are comprised of 28 irrigation service blocks in the scheme. Thirteen (13) third monitoring points are added to the above key and second points in order to check water distribution to those irrigation service blocks.

Table 5.1.4 "Required Works for Control and Monitoring Points" shows locations and required works for provision of those control and monitoring points.

(e) Rainfall Stations

Effective use of rainfall to irrigation as well as avoiding excess water supply is essential for saving water from the water sources. For this purpose, rainfall stations are provided at the representative locations of the scheme in order to calculate daily water requirement and to execute proper operation of water distribution through the control and monitoring points mentioned above. Since Kerian scheme has a large scale of irrigation area (about 24,000 ha), pattern of rainfall is different in region by region. In taking consideration of this and irrigation schedule of each compartment, following four (4) rainfall stations are proposed for water management in the scheme. Those are existing stations, however, the installment are to be replaced due to their superannuating.

- Station Jalan Bahru : for Compartment A,B and C
- Station Alor Pancor : for Compartment D, E and F
- Station FCD Simpang Empat : for Compartment G
- Station Bukit Merah : for Compartment H

The control points, monitoring points and rainfall stations are to be connected with telemetry and telecontrol system for the central management as presented in Fig. 5.1.2 "Layout of Water Management / Monitoring Facilities".

(4) In-field Infrastructure

Physical improvement refers to on-farm infrastructure development comprising land leveling, in-field channels and control boxes. The table below summarizes the in-field infrastructure works for Kerian Scheme.

Compartment	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 covering 100% of 10m x 10m grid points. It is estimated that 40% of the land leveling works will be by the DOA. The remaining 60% will be the private sector. The PPK will be encouraged to undertake these works. For in-field channels, the criteria is to achieve a density of 150m/ha. Two(2) control boxes are provided for one consolidated lot.

(5) Land Consolidation

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

Compartment	No. of Farmers (no.)	No. of Lots (no.)	Area (ha.)	Average Area/Lot (ha/lot)	Av. no of Lots per Consoli-dation (no.)	No. of Consoli-dated Farms (no.)
A	-	1,955	2,402	1.23	4	480
B	-	2,939	4,001	1.36	4	800
C	-	2,285	3,960	1.73	3	792
D	-	2,624	3,362	1.28	4	672
E	-	1,538	2,344	1.52	3	469
F	-	1,773	2,697	1.52	3	540
G	-	1,385	1,830	1.32	4	366
H	-	2,142	2,964	1.38	4	593
Total	13,485	16,641	23,560	1.42	4	4,712

Each consolidation aims for 5 ha farm plot. The above target is high considering that considerable effort necessary for 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.

(6) Agriculture

(a) Cropping Schedule

The original cropping schedule in Kerian scheme is divided into 3 schedules, which was set up on the basis of the transplanting cultivation method. However direct seeding methods are already being widely practiced in the scheme in order to overcome shortage of farm labor and save production cost and is increasing the rate. Therefore, the actual

cropping schedule becomes different from the original one by changing the planting method.

In Kerian scheme, the irrigation schedule is adjusted for every crop season by Planting Schedule Committee which is composed of the representatives of concerned organizations like DID, DOA, MARDI and LPN. The farmers' request is also reflected in determining the irrigation schedule. Now, three different kinds of planting methods are practiced in Kerian scheme, namely transplanting, dry direct seeding and wet direct seeding. This makes the irrigation management more complicated. The unification of the planting method is desirable for the simplification of irrigation water management. From the viewpoint of cost saving, time and manpower, it is essential that manual transplanting should be replaced by direct seeding.

A land consolidation project is being carried out to improve drainage conditions in the Kerian scheme. After the completion of the project, the adoption of direct seeding methods will become possible in the whole Kerian scheme. The proposed cropping schedule is decided taking into account the water availability and rainfall condition during the harvesting period, etc. as shown in Fig.5.1.3 "Original and Proposed Cropping Schedule".

Considering the result of water balance study in the Kerian scheme, dry direct seeding methods will be introduced at 100% in off-season and wet direct seeding methods will be introduced in main-season except for organic soil areas, which occupy about 17% of the total area. The annual cropping intensity is proposed at 200% in the Kerian scheme. The areas demarcated for three schedules are summarized in the following table:

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

(b) Planting method and Mechanization

A major problem which the Kerian scheme faces is the non-adherence to cropping schedule. The majority of farmers in compartment F, G and H adhere the planting schedule, while it is difficult for many farmers in Kerian Laut especially compartment A, B and C to follow the planting schedule. In those areas, land preparation is still done by manually, since mechanization is still limited due to low bearing capacity. Hence, the mechanization ratio in these areas still remains at low level. Farmers living in ill-drainage areas where are not accessible by machines, can not apply direct seeding method, since direct seeding requires a thorough land preparation and leveling by tractors. The non-adherence to the planting schedule is caused by the difficulty to carry out the manual land preparation and manual transplanting on time due to labor shortage. Steps are being taken under the land conservation pilot project conducted by IADP

Kerian/Sg. Manik to improve the load-carrying capacity of the soils in the priority areas in the Kerian and Sg. Manik Schemes by the construction of field bunds and drain ditches (Pembinaan Batas dan Parit Ladang). The pilot project which is fully funded by IADP Kerian-Sg. Manik, commenced in 1984 and will be continued by the year of 2000. These field bunds and drain ditches will improve in-field water management efficiency and effectiveness which helps in the formation of plough (hard) pan in the soil required for mechanization.

The full mechanized farming should be introduced into the whole Kerian scheme. Utilization of some small/medium size 4 W tractor (30 hp class) and harvester (3-4 ton class) will also be considered during the transition period by the time when the bearing capacity reaches the sufficient level in the organic soil areas. At present, the number of 4W tractors in the area is estimated at 189 units, which are hold by the Farmers Mechanization Center and contractors, and they are used for the contract farm work. After implementation of the project, it is estimated that 263 4W tractors will be necessary at a peak period during the cropping season. Assuming that the existing number of 4W tractors be kept in the future, the farmers' groups will own deficient numbers between peak requirement and availability. The harvesting work is being conducted with the contract basis and will also be done by the contract work with combine harvesters owned by contractors and FMC in future. The farmers' groups will own chopper spreader attached on the outlet of the combine harvester considering working efficiency of land preparation. The chopper spreader is used commonly for chopping and spreading the residue. The farmers' groups will also own some necessary managing implements for fertilizing and chemical application. The managing implements include light weight 4W tractor (10-20 hp class) for management and implements (attachments) such as broad caster, power blower, boom sprayer carpet duster, etc.

As mentioned above, small/medium size 4 W tractor (30hp class) and harvester (3-4 ton class) will be introduced in the organic soil areas which are characterized by low bearing capacity. These machinery will be own by the farmers' groups. The FMC will also own about one third of the necessary numbers of small/medium size 4 W tractor and harvester in accordance with the basic operation policy.

The estimated number of the agriculture machine based on the mechanization plan is summarized in the following table :

(Unit: Nos.)

Machinery/equipment	Necessary	Availability	Purchase
I. 4W tractor			
1. 60hp class	263	189*	74
2. Management tractor (10-20hp class)	145		145
II. Implements			
Lime spreader	42		42
Rotavator	161	87	74
Paddy harrow	60		60
Rearbucket or Land roller	41		41
Granule applicator/Broadcaster	96		96
Boom sprayer	44		44
Carpet duster	28		28
III. Combine harvester (6t class)	45	45	
chopper spreader	45		45
Low bearing capacity area			
I. 4W tractor			
1. 30hp class	95	32	63
2. Management tractor (10-20hp class)	41		41
II. Implements			
Lime spreader	18		18
Rotavator	68	5	63
Paddy harrow			
Rear bucket or Land roller	17		17
Granule applicator/Broadcaster	29		29
Boom sprayer	9		9
Carpet duster	9		9
III. Combine harvester (3t class)	19	6	13
chopper spreader	19	6	13

*: 20 by FMC Kerian, 169 by contractors (including farmer), Source: FMC Kerian and IADP Kerian

The proposed mechanization farming system by integrated work is as shown below.

Mechanization system for Wet seeding

Two times of Land preparation (tractor + rotavator) => Paddling (tractor + paddy harrow) => Seeding (tractor + power blower/granule applicator or broadcaster) => Fertilizing and chemical application (tractor + granule applicator/carpet duster/boom sprayer) => Harvesting (combine harvester)

Mechanization system for Dry seeding

Two times of Land preparation (tractor + rotavator) => Seeding and pressing after seeding (tractor + power blower/granule applicator or broadcaster and rear bucket or land roller) => Fertilizing and chemical application (tractor + granule applicator/carpet duster/boom sprayer) => Harvesting (combine harvester)

Under the Wet direct seeding system, land preparation should be done two times and paddling should be done one time after land preparation. These operations are effective in weeds control and land leveling. Two times of land preparation and pressing after seeding should be adopted for dry direct seeding. The pressing after seeding under dry seeding system is not common farming practice now. However, it is reported by MADA that pressing after seeding under the dry seeding system is effective in germination and establishment of paddy.

The 4W tractor for management will ran on the fixed way (tramline) which be set up in the paddy field in 10m or 15m interval. The tramline in low bearing capacity area like the organic soil areas shall improve soil conditions by using soil amendment input. The management tractor will be able to run on the tramline under the submerged paddy field. Application of fertilizer and chemicals will be done using the suitable implements like broadcaster, granule applicator, boom sprayer, etc. as the attachments with the management tractor.

(c) Paddy varieties and management practices

(i) Paddy varieties

MR84 and MR185 should be introduced as recommendable varieties. According to the result of the field test done by MADA, the most suitable number of paddy plants is estimated at 150-180 number per square meter. The seeding amount of paddy is decided between 60 - 80 kg/ha on the presumption that one thousand grain weight is 26g and the average germination rate is 60-65% based on the data of MADA experiments.

(ii) Fertilizer application

Most of farmers in Kerian area depend on the subsidized fertilizer only. A majority of farmers apply fertilizer twice a season, and some farmers apply fertilizer only once a season. The significant of scheduled fertilizing activities should be stressed onto the farmers. The fertilizer application method according to the MARDI recommendation should be adopted in Kerian area.

The majority of soils in Kerian area are suitable soil for paddy cultivation as shown Table 5.1.5 "Soil Classification and Suitability for Paddy". With the exception of the organic rich soils, most of the soils do not face fertility problems. In general, it can be said that the Kerian coastal plain where compartment A, B and C are located, is a fertile area and has the potential to support good plant growth with good yields. In the organic areas, strong acid conditions exist as indicated by the low pH values. In these areas, the exchangeable aluminum in the soils is very high and is one of the causes of the acidity. The organic rich soils experience high acidity and high conductivity especially at depth. The aluminum content is also high and may exert toxic effects on plant growth. However, this can be easily corrected with proper lime application. The higher rate of fertilizer application amount with lime would be recommended in these areas. At the same time, the apply of not only NPK but also minor elements dressing should also be considered by introducing DRIS as mention in the Master Plan. The proposed fertilizer amount and apply timing is as follows:

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

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

The additional elements application is recommended for the organic soil areas located in Kerian scheme.

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

(d) Pest and Weed Management

As for the weed control, two times of herbicide applications for wet direct seeding and three times of herbicide applications for dry direct seeding are recommended. Regarding the insect, the damage of Brown Hopper occurred sometimes in the past. It is important to pay attention to the occurrence of this harmful insect. Chemical application to control the weed, pest and decease should be carefully done with special attention to the environmental aspect. For the pest and weed control, proper measure should be made in line with DOA recommendations. IPM (Integrated Pest Management) method should be accelerated in the Kerian scheme.

The proposed farming practice for the Kerian scheme is shown in Table 5.1.6 "Proposed Farming Practices".

(e) Marketing

Improvement of marketing system basically consists of (i) improvement of harvesting methods, (ii) group arrangement of harvesting machinery and group purchase/sale, (iii) blanket purchase and sale through PPK.

As peculiarities regarding the marketing condition in Kerian scheme, following 3 points should be considered:

- existence of middlemen in the marketing channel
- Guni-sack handling is still applied in some area.
- Expected production will exceed present milling capacity of the Kerian area.

(i) Improvement of harvesting methods

Guni-sack handling is still applied in Kerian scheme. There are two reasons for farmers to use Guni-sack handling as their harvesting method. One reason is inadequate farm road that lorry cannot access the field. The other reason is farmers' conservativeness in applying new method. In this regard, improvement of farm road and dissemination of the knowledge regarding the advantages of bulk handling method should be promoted in order to shift the harvesting method to bulk handling.

(ii) Integration/elimination of middlemen from the marketing channel

Because of involvement of middlemen in the process of farm input purchase and paddy sale, farmers often do not have choice in selecting sale destination or purchasing source. Besides, since arrangement of input and machinery is

made according to the schedule of middlemen, it sometimes conflicts with the cropping schedule set by IADP staff. Therefore, it is necessary to establish direct relationship between farmers' groups and relating agencies (both for input supply and paddy sale). However, it should be considered that, in some cases, middlemen themselves are farmers and well functioning in the present situation. In this case, these middlemen should be integrated into the group system rather than just eliminating. And if these middlemen are not functioning well in the farmers' group, they would be replaced by the member farmers according to the frame-work of group system.

(iii) Diversification of Sale Destination

In future, when the target yield (5.5t/ha) is achieved and cropping intensity is improved to 200%, it is estimated that the paddy production will exceed present milling capacity by 40,000 ton. Therefore, sale destination should be enhanced and diversified more to the outside of scheme, especially to the neighboring area such as Pulau Pinang.

(f) Rural Credit

The credit needs to be expected in the future would be (i) loan for establishment of farmers' group, (ii) loan for purchase of farm input, and (iii) loan for procurement of agricultural machinery. Basically, short term loan and paddy loan presently provided by PPK and BPM will be intensified by applying to farmers' group in addition to individual farmers. Besides, demand for agricultural machinery loan is expected to increase as the mechanization proceeds. In Kerian scheme, it is estimated that RM31.1 million will be necessary for the procurement of machinery. BPM or PPK should prepare to have enough fund to cover this amount. As to the loan scheme, FOA's KPPP loan or BPM's agricultural machinery loan should be utilized for this purpose. Each farmers will pay rental fee of machinery and this fee will be collected by group basis and be allotted for the repayment of loan and O&M cost.

(7) Farmers' Organization

Analysis of the farmers' organisation in Kerian scheme shall be made on the basis of (a) modes of farming (either individual or group-based), (b) mode of farming arrangements (solely individual or individuals who engage in contract farming with rice millers for instance) and (c) organisational arrangements (roles of private business individuals and government agencies including FOA, DOA, DID, and (d) roles of farmers' groups (ladang kelompok both under the supervision of DOA and PPK) especially in relation to water management. Based on such analysis some preliminary proposals shall be made.

(a) Present Situation

With regard to mode of farming, in the Kerian scheme farming can be categorised into both individual and group-based. Out of the total of 13,485 farm households, 5,115 or 37.9% are reported to be involved in group-based farming either in ladang kelompok under DOA's supervision or PPK's. This means that a sizeable number of 8,370 farm

households or 62% are still engaged in individual-based farming. There have been cases where some individual farmers have entered into some kid of contractual farming arrangements with local private rice millers. This arrangement is a new development and is not widespread. However it is worth monitoring as it can be a reference to efforts to develop commercially oriented paddy farming as is emphasised by the government. Among those who are engaged in group-based farming, 1,380 or 27% are involved in ladang kelompok (group farming) under the supervision of PPK while a majority of 3,735 or 73% are members of ladang kelompok under the supervision of DOA.

In terms of land area, out of the total of 23,560 hectares in the Kerian scheme, 8,313 hectares or 37.9% are involved in group-based farming under the supervision of both DOA and PPK. Formation of ladang kelompok under DOA takes into consideration the existing physical boundaries of irrigation system. This is indicated by the distribution of 50 such ladang kelompok which 'fit well' within the 8 irrigation compartments (A to H) in both Kerian Laut and Kerian Darat sub-schemes. However at least based on the preliminary information, most of the ladang kelompok under PPK do not coincide with irrigation systems boundaries. This is quite understandable as the basis of formation of these ladang kelompok has bee non-farm boundaries such as mukim. kampung etc., rather than irrigation system boundaries. One noteworthy observation in the Kerian scheme is the incidence of overlapping in terms of project area and probably in terms of common target group that are involved in ladang kelompok of both DOA and PPK. Preliminary information gathered indicates a total of eight cases of such overlapping.

(b) Proposed Modernization Plan

Based on the preliminary observation, information and data as well as implications derived therefrom, several key issues under the social engineering (soft-wares) aspect together with related proposals are hereby presented. Among them are the following :

(i) The presence and availability of tremendous amount of potentials - biological yield potentials, human potentials (expertise, experience practical knowledge of both the farmers and the government staff) as well as organisational competency - that can be mobilised to support the proposed modernisation program. Mobilisation of these resources has to be undertaken under the proposed organisational arrangements. Within the improved granary management system, well planned and co-ordinated capacity building programs need to be further strengthened. These programs would have to include the formulation of socially-acceptable extension strategies necessary for promoting and accelerating the implementation of the proposed modernisation systems. In this respect MADA's kursus tempatan (or local courses) extension approach should be a useful guide. Inter and intra-granary farmer mobilisation program should be emphasised and promoted. The initiative of some farmers from Sungai Manik sub-project to develop some sort of experience-sharing with their counterparts from Chui Chak farmers' groups should be emulated and institutionalised as an effective method of extension. Systems operations and maintenance (O&M) is another critical area where farmers' group could meaningfully participate in. This water management

function should be rightly undertaken by the farmers through the so-called water user group or WUG. However this concept of WUG is yet to be fully implemented in the Kerian scheme although records have shown that the idea to implement this WUG has been started way back in 1980's on the initiatives of DOA and DID staff in Simpang Tiga area. Currently the IADP of Kerian-Sungai Manik is seriously preparing to launch this WUG program in one of the localities on a pilot project basis. The roles of Inter-granary Task Force for the formation of WUGs along with the proposed Inter-granary WUG leaders' Council (which can be established at a later date than the former) should be formalised. And in this respect the National Water Management Training Centre should be playing an instrumental role.

(ii) The immediate need to re-organise farmers who are involved in ladang kelompok according to the layout of the irrigation systems. This exercise is necessary in order to develop efficient farm-based 'organic production units' centring around common water sources. This method would greatly enhance the water management as well as farm management functions which could in turn improve the adherence of the farmers on irrigation as well as planting schedules. This enhanced farm management would lead to higher crop production from these organic production units.

(iii) The necessity to build the existing farmers' groups' capacity, capability in the management and operation of their overall farm operations and to give greater opportunities to them to take over O&M functions of the tertiary systems. It is in this context that their water management function need to be enhanced through the formation of water user groups (WUGs)

(iv) Upgrading those ladang kelompok that are 'high achievers' in terms of productivity achievement, group coherence, group leadership quality who displays high potentials, to mini-estates. The need to upgrade these ladang kelompok into mini-estates could be real when some key factors are considered. One of these is the gradually declining interest among owner-farmers especially those who are ageing, to continue operating their individual farms. Furthermore increasing level of financial security among these farmers (through monthly remittances and other secondary sources for instance) further exacerbate the declining interest to operate their farms. In addition the declining interest among younger generation toward paddy farming surely would create some sort of a vacuum which has to filled up somehow. One alternative option is to get these farmers to agree to a management team to manage the farms on a mini-estate basis. Regarding this upgrading exercise, there is a necessity to use more quantitative criteria besides other qualitative ones which have been practised all these years. Such criteria should include actual productivity achievement records, high standard of water management etc., as against the somewhat qualitative and some times arbitrary standards such as visual assessment by agency staff.

(v) Another factor that is becoming critically important at the farm level is the role and 'influence' of combine harvesters. The fact that direct seeding method of paddy farming calls for timely operations means that the owners, operators as well as 'brokers' should be given a more central role in decision making process pertaining to farm operations and activities. It is hereby proposed that the combine harvester owners are represented along with farmers groups' leaders and agency staffs in the Committee For The Preparation Of Planting Schedules. This approach would greatly facilitate he establishment of a more functional and cordial working relationship among farmers, harvester owners, operators/brokers and government staff to enable smooth and co-ordinated farm operations.

(vi) Based on the existing contract farming arrangements involving few individual farmers and the private sector (rice millers) in the Kerian scheme, more organised efforts should be undertaken to establish similar arrangement that would involve both good performing ladang kelompok (and later mini-estates) with the private sector including BERNAS. This arrangement should serve as a useful starting point and should pave the way for greater business synergy between these farm-based 'organic production units' and the private sector. This approach or strategy should not only be confined to the Kerian-Sungai Manik scheme but also to the other granary areas in the country.

5.1.3 Cost Estimate

(1) Basic Conditions and Assumptions for the Cost Estimates

Unit Prices of the respective works of Kerian Scheme are estimated based on the contract prices of similar works taken from Muda Irrigation Scheme in IADP Pulau Pinang which is adjacent to Kerian Scheme area and the Government Price Schedule issued in 1993. Consumer Price Index issued by the Central Bank of Malaysia and Statistics Department was used for updating prices to October 1997 level. Reference data for the cost estimates are as follows:

(a) Muda Irrigation Project, Block M1A, 1996, Pulau Pinang
(b) Standard Price for Construction Works, 1992/1993, DID

(2) Construction Cost

Initial investment costs for the scheme, which is divided into the works for system infrastructure, in-field infrastructure and water management / monitoring facilities, comprise direct construction cost, physical contingency (15% of direct construction cost), engineering cost (10% of direct construction cost), administration and management cost (5% of direct construction cost). Those are summarized below and shown in Table 5.1.7 to Table 5.1.10 "Direct Construction Cost". The details are given in Annex VII "Cost Estimate".

(Unit : RM)

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

(3) Replacement Cost and O & M Cost

20% of initial construction cost every 20 years is adopted for replacement cost of infrastructures. For replacement cost for water management / monitoring system, initial equipment cost is applied every 10 years. O&M costs which are expected to occur every year are estimated at RM 325 /ha/year for infrastructures and RM 250,000 /year for water management system. The replacement and O & M costs for the scheme is summarized as follows:

(Unit : 1,000 RM)

Item	Cost
Replacement cost	
- Infrastructure (every 20 years)	21,754
- Water management/monitoring (every 10 years)	11,924
O & M cost (annual)	7,943

(4) Training Cost for Water Users' Group

Training for 84 water users' groups, which are to be formatted in this works, will be planned at both off-site (National Water Management Training Center) and on-sites. The former is executed for three years and 2 leaders from each group participate. The latter is done on all members of groups for five years. The costs are estimated at RM 336,450 consisting of RM 201,600 for off-site training and RM 134,850 for on-site training. The details are given in Table 5.1.11 "Training Cost for Water Users' Group".

5.1.4 Implementation Schedule

(1) General

Taking into consideration of the achievement of the target of the National Agricultural Policy in 2010, the works for modernization of water management system in the scheme such as improvement of system infrastructure and in-field infrastructure and establishment of water management / monitoring system will be commenced from 1999 and completed in 2006. Training of water users' group, which will be put the management of tertiary system, will be executed in parallel with the above works.

(2) Implementation Plan for Rehabilitation and Improvement of System Infrastructure

A degree of execution priority of rehabilitation and improvement of system infrastructure in the scheme is put in order of (i) drainage facilities, (ii) irrigation facilities, (iii) farm road and (iv) water management facilities. However, taking into consideration that improvement of in-field infrastructures shall be executed based on the establishment of major

system infrastructures as well as all work completion in 2006, execution of the above improvement works has arrangement in a row and it is started in 1999. Periods of respective work are planned 3 years for drainage improvement, 4 years for irrigation improvement and 2 years for farm road improvement. The executing agency of the works is DID.

(3) Implementation Plan for Improvement of In-field Infrastructure

Improvement works of in-field infrastructures will be executed in parallel with those for system infrastructure and will be completed in 2006. Among 18,389 ha of required land leveling area, 7,356 ha will be executed by DOA and the remaining 11,033 ha will be done by private sectors managed by PPK. Construction works of in-field channels and control boxes will be executed by DOA with the target of 345 km/year and 920 nos./year, respectively. Land consolidation will be implemented by close cooperation among DOA, IADP PMU and LPP/PPK. Annual target of consolidated farmhouse is 589 houses/year. Implementation in Compartment B and C will be commenced from the fourth year after completion of drainage improvement works.

(4) Implementation Plan for Establishment of Water Management / Monitoring Facilities

Implementation for the establishment of water management/monitoring facilities is scheduled in 3 years with the execution order of (i) Establishment of communication links, rainfall station, water level gauges and computer system, (ii) Introducing electric moving gates for telecontrol and establishment of monitoring system for telecontrol gates and pumps, (iii) Establishment of remote control system for telecontrol gates and pumps. Installation of water level gauges and control gates shall be executed in parallel with the improvement works of system infrastructures mentioned above (2). Monitoring feedback system will be introduced in 4 years, in order of the master station, player stations. The works are carried out by DID with referring to on-going Besut Pilot Project.

(5) Implementation Plan for Formation of Water Users' Group and Training

The work will be carried out in 5 years from 1999. 84 water users' groups will be formatted in Kerian Scheme and annual target of group formation is estimated at 17 group/year. As for the training of the water users' group, off-site training at National Water Management Center in 3 years and on-site training in 5 years are programmed. 168 persons consisting of 2 leaders from each group joint off-site training and all group members participate off-site training. Number of participants in a session is planned to be about 40 persons. Off-site training will be executed at four groups while on-site training will be done at 135 sessions/year. Off-site training is managed by DID and on-site training is executed by IADP PMU.

The implementation schedule of the works for modernization of water management system in Kerian Scheme is presented in Fig.5.1.4 "Implementation Schedule" and its disbursement schedule is given in Table 5.1.12 "Disbursement Schedule".

5.1.5 Project Evaluation

(1) General

The project evaluation is made from economic and financial viewpoints in order to assess the feasibility of the project in Kerian scheme. Economic evaluation is made by using Economic Internal Rate of Return (EIRR), Benefit-Cost Ratio (B/C) and Net Present Value (NPV). In addition, sensitivity analysis is made for the cases of (i) increase of construction cost, (ii) decrease of benefit by applying EIRR. For the financial aspect, farm budget of typical farm size is prepared and analyzed. In addition, repayment capacity of farmers is also examined for the procurement of agricultural machinery (Annex VIII "Project Evaluation").

(2) Economic Evaluation

(a) Basic Condition

Economic evaluation is carried out based on the following conditions.

(i) The economic useful life of the project is 50 years from the start of the Project.
(ii) All prices are expressed in 1997 constant price (end of 1997).
(iii) The exchange rate is fixed at US$1.0=RM4.4=Yen129.5 as of January, 1998.
(iv) The economic price of local currency portions is calculated by applying the Standard Conversion Factor (0.987).
(v) Economic price or cost is calculated by omitting transfer payments such as tax, subsidy and interest.
(vi) Economic prices of farm input (Urea, TSP, Potash) and tradable farm produce (paddy) are estimated based on the World Bank projection of world market prices for 2005 in constant 1997 terms.
(vii) The part of unskilled labor is converted to the economic value by applying the conversion factor of 0.987 with considering labor scarcity in Malaysia.
(viii) The construction components are converted to economic value applying Construction Conversion Factors which are calculated on the basis of proportions of local and foreign costs, transfer payments and other local costs at the local portion.
(ix) The build-up period from the completion of land consolidation and construction of facilities is assumed to be five years. The benefit is assumed to increase year by year and reach its full value in the 12th year after the commencement of the project.

(b) Economic Cost

The economic cost of the project is calculated based on the basic conditions mentioned above and by applying Construction Conversion Factors to the financial cost.

(Unit :1,000RM)

Items	Financial	Economic
I.System Infrastructure	83,749	80,093
II.In-field Structure	25,024	23,620
III. Water Management / Monitoring System		
1. Telemetry & Telecontrol	14,632	14,359
2. Feedback System	15,501	15,211
IV. Training for WUG	337	316

Economic cost of O&M cost and replacement cost are summarized in the table below.

(Unit : 1,000RM)

Items	Financial	Economic	Remarks
1. O & M Cost	7,907	7,804	Annual
2. Replacement Cost			
- System Infrastructure	16,750	16,019	Every 20 years
- In-field structure	1,866	1,761	Every 20 years
- Tram Line	3,139	2,963	Every 10 years
- Water management system	11,256	11,045	Every 10 years
- Feedback system	668	656	Every 10 years

(c) Economic Benefit

Economic price of tradable goods is estimated based on the World Bank projection of world market prices. For non-tradable goods, present market price is applied as economic price. Value of unskilled labor is calculated by applying the Standard Conversion Factor with considering the labor scarcity in Malaysia. The expected benefit from the project are increase of paddy production owing to improved farming practice and water management and reduction of labor input owing to farm mechanization. These benefits are assumed to be reflected in the increase of yield, increase of cropping intensity and reduction of labor cost. The project benefit is defined as the difference of the net production value between "with-project case" and "without-project case". For the "without-project case", it is assumed that present condition will continue through the project life of 50 years and there will be no change in the yield, cost and return. The benefit at the full developed stage is calculated as below.

(Unit : 1,000RM)

Net Production Value (without case)	37,880
Net Production Value (with case)	119,630
Incremental Benefit	81,750

(d) Economic Evaluation

Based on the project cost and benefit estimated above, the cost and benefit flow is prepared as in Table 5.1.13 "Benefit and Cost Flow" and EIRR, B/C and NPV are calculated as below.

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

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

(Unit : %)

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

The above results indicate that the project is economically viable showing 24.1% of EIRR, 2.59 of B/C and RM277 million of NPV. While the sensitivity analysis indicated that the project viability is insensitive against adverse effects of cost increase and benefit decrease.

(2) Financial Analysis

(a) Farm Budget Analysis

The farm budget analysis is made by assuming that average land holding size of 1.54ha is equivalent for typical farm operation size. After the implementation of the project, both gross farm income and net farm income are expected to increase to a great extent. Net reserve of farmers is also expected to increase from RM510 per year to RM5,410 per year. The farm budget for present condition and "with-project case" are shown in the following table.

(Unit : RM)

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

(b) Procurement Cost of Agricultural Machinery

The loan scheme of BPM or FOA would be utilized for the procurement of agricultural machinery. Farmers will pay the rental fee for procured machinery and this fee will be set as equivalent to the present rental fee. The loan repayment will be allotted from this rental fee. Procurement cost and interest of loan and total repayment amount are estimated as below.

(Unit : 1,000RM)

Procurement Cost of Machinery (Loan Principal)	31,927
Interest (Repayment period 5years, rate 6.5%)*	4,566
Total repayment amount	36,493
Average annual repayment	7,299
Annual Repayment per ha (RM/ha/year)	310
Annual machinery using cost in "with case" (RM)	529

*: Annual repayment for principal is assumed to be RM 6.2 million.

From the above table, average repayment amount per hectare is about RM310, while the present rental fee is RM529. With this rental fee of RM529, farmers still can earn RM2,820 per ha in the "with-project" condition. Therefore, it would be possible for farmers to repay the loan and operation and maintenance cost. Besides, imposing the rental fee which is equivalent to the present condition would be acceptable for the farmers.

5.2 Ketara (Besut) Scheme

5.2.1 Area-wise Conditions in the Scheme

The Besut Scheme is located at the north-western corner of the State of Terengganu immediately adjacent to the State of Kelantan. The scheme consists of two(2) sub-schemes, namely Besut Sub-scheme and Angga Sub-scheme. Further, the sub-schemes are separated into four (4) compartments, Compartments 1, 3, 4 in Besut Sub-scheme and Compartment 2 in Angga Sub-scheme. The total net paddy area cultivated is 5,164 ha, of which 4,182 ha is in Besut Sub-scheme and 982 ha in Angga Sub-scheme. The area-wise present conditions for four (4) compartments are summarized as shown in Table 5.2.1 "Area-Wise Conditions in Besut Scheme". As shown in this table, there are no big differences in cropping intensity and yield in 4 compartments.

5.2.2 Proposed Modernization Plan

(1) System Management

(a) Central Control Station

A central control station is proposed located at Ketara Project Office and 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 computerized irrigation water management system.

(b) Reorganizing O&M responsibility

The review of field staff positions and proposed reduction is based on assuming 80% reduction for gatekeepers and general workers. The derived figures are shown below:

Scheme	Nos (1997)	Total Cost (1997) (RM)	Proposed Nos.	Revised Cost (RM)	Annual Reduction (RM)	% Cost Reduction	O&M Staff Cost Reduction (RM/ha)
SII	1	-	1	-	-	-	-
II	1	-	1	-	-	-	-
Irrigation Technician	3	-	3	-	-	-	-
Pump Operator	2	-	2	-	-	-	-
Sub-total	7	93,249	7	93,249	-	-	-
Linesman	21	-	4	-	-	-	-
General Worker	26	262,792	5	52,558	-	-	-
Total	54	356,041	16	145,807	210,234	59	40

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

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

(c) 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 3 years or 5 seasons.

(d) Water Users' Groups

The Besut Scheme has reorganized its Farmers' Groups to conform to the ISA units. This is also referred to as the WUG boundaries. There are now 30 WUGs. Although Besut has implemented the WUGs, training is still necessary as up to now, only those members in Kubang Depu pilot project are given exposure. This is also necessary to promote land consolidation. 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 Center. The WUG characteristics are summarized below.

Compartment	Farmers (Nos.)	WUG (N0s.)	Area/WUG (ha)	Farmer/WUG (Nos.)
1	659	8	154	82
2	509	5	226	102
3	858	8	163	107
4	1,028	9	167	114
Total/Average	3,054	30	172	102

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.

(2) Telemetry and Telecontrol System

Presently, there is no telemetry system for water management in this area. Only two(2) rainfall gauge stations exist for flood warning system but these gauges are not telemetered. Gates of Besut and Angga barrages which are major water management structures, are controlled locally. The following telemetry and telecontrol system is proposed for modernization of water management in Besut area :

(a) Establishment of a central control station with the master equipment of telemetry system at IADP Ketara Office

(b) Establishment of observation network : 3 rainfall remote stations and 38 water level remote stations, of which locations are shown in the next section (3) System Infrastructure.

(c) Establishment of communication system : 150 MHz radio link

(d) Establishment of computer system

(i) Irrigation Water Management System (IWMS)

- Computer program for estimating daily rainfall, discharge, irrigation water requirement, gate opening level, pump operation time, etc.
- Hardware and software necessary for IWMS
  - Hardware : CPU - MMX 200MHz
    RAM - 64MB
    Storage - 4GB (8GB)
    CD ROM - 16X
    Network Interface - Ethernet / 10BASE-T
  - OS : Window 95
  - Software : Microsoft Office 95 Professional Edition
    Visual Basic 5.0 Professional Edition
  - Printer : Network Color Printer IEEE802.3 10BASE-T
  - Network : Hub IEEE802.3 10BASE-T

(ii) Irrigation Monitoring and Feedback System (IMFS)

- Proposed IMFS network for the Ketara(Besut) scheme

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

- Hardware and software necessary for IWMS

Items	Master Station	Play Station
- Hardware	(Desktop)	(Notebook)
• CPU	MMX 200MHz	MMX 166MHz
• RAM	64MB	32MB
• Network interface	Ethernet / 10BASE-T	—
• Storage	4.0 GB	2.0 GB
• CD ROM(inner)	16X	8X
- OS	Window 95	Window 95
- Software		
• Scala Information	IC Master software	IC Player software
• Multimedia	Scala MM200	—
• Business Soft	Microsoft Office Pro.	Microsoft Office Pro.

(c) Establishment of gate/pump telecontrol system : locations of the existing gates and pumps to be motorized for remote control are shown in the following section (3) System Infrastructure.

(3) System Infrastructure

(a) Irrigation Facilities

As described in Part - II "Present Conditions of the Five Granaries", existing irrigation facilities in the scheme have been in superannuated conditions, and proper water distribution is being disturbed by leakage of water from Besut Barrage gates, difficulty of operation of Angga intake gates, damage of canal diversion gates, insufficient canal height, etc. Further, it seems difficult to achieve the target crop intensity under the available water from Besut and Angga Barrage estimated in the water balance study. Accordingly, the recovery of effective water intake from both barrages is put on the highest priority works in the scheme. In addition, rehabilitation and improvement of irrigation facilities as well as provision of water management facilities are also to be executed for reducing canal losses and adequate water distribution. Those plans are summarized below and given in Table 5.2.2 "Rehabilitation and Improvement Plan of System Infrastructure".

(i) Replacement of Angga Barrage

Due to long time use of about 50 years and manual operation type of Angga barrage gates, operation of both intake and barrage gates can not be done properly and renewal of Angga Barrage is proposed. In taking consideration of seasonal fluctuation of water level in Angga river, which sometimes reaches up to 6 times of gate height in October to December, and smooth flow of the flood, same type as the present barrage is planned for the replacement. Dimensions of gates are shown below : (refer to Fig. 5.2.1 "Implementation Plan of Angga Barrage")

- Barrage gates : Radial gate 2 nos., width 7.6m and height 1.2 m each
- Intake gate : Sluice gate 2 nos., width 1.3 m and height 1.0 m each

Those gates are to be connected with telemetry and telecontrol system for the central management.

(ii) Rehabilitation of Besut Barrage Gates

In order to maintain required intake water level, settlement of water leakage from Besut Barrage gates is urgently required. DID has two improvement programs of the barrage, which are a repair plan of barrage gates as a short term measure and a renewal plan of the barrage as long term programs called "Besut Barrage Improvement Plan". However, details of the latter have not been published yet because the final plan is under examination. Since present condition downward intake is unchanged in both plans, repair of barrage gates shown below is adopted in this study.

- Barrage gate : Roller gate 4 nos., width 12.32 m and height 2.95 m each 3 intake gates, which are electric moving slide type with 1.93 m width and 2.49

m height, are in well conditions. These gates are modified for telecontrol operation in provision of the water management system.

(iii) Rehabilitation and Improvement of Irrigation Facilities

Since available water for irrigation in the scheme is rather limited, it is essential to save canal losses and distribute water effectively. Concrete lining, reshaping of canal, repair of damaged diversion gates, provision of regulating structures, etc. are proposed for these measures as shown below and the details are given in Table 5.2.2.

- Concrete lining : Main canals 4.4 km, secondary canals 16.9 km, tertiary canals 3.0 km
- Heightening of lining : Main canals 8.8 km, secondary canals 2.8 km
- Provision of regulating structures : 5 nos. on main canal, 1 no. on secondary canal
- Rehabilitation of damaged structures : 74 nos.

(b) Drainage Facilities

Condition of drainage facilities in the scheme is relatively well, however, a part of downstream area is flooded in October to December. Accordingly, following improvement works are planned :

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

(c) Farm Roads

Asphalt pavement for un-paved portions of farm road along main canals, and widening and laterite pavement along tertiary canals are proposed. Up to 2.5 m widening is planned in taking consideration of mechanized farming. Details are shown in Table 5.2.2.

(i) Pavement along main canal : Asphalt pavement 8 km
(ii) Widening and laterite pavement along tertiary canals : 27 km

(d) Water Management Facilities

In addition to the improvement of irrigation facilities mentioned in the above (a), proper operation of diversion gates as well as even water distribution is important in Besut scheme. For this purpose, central water management system is introduced providing control and monitoring points at intake and major diversion structures, and rainfall station at representative locations in the scheme. Those points are classified into key point, second point and third point.

(i) Key Control Point

The Besut scheme consists of four (4) compartments and those are irrigated in two phases (phase-I for Compartment 1, 4 and a half of Compartment 2 and phase-II for Compartment 3 and remainder of Compartment 2). Therefore, three (3) key control points are proposed at Besut and Angga intakes and one (1) diversion point in order to regulate intake water and diversion water to the

compartments. Water level gauges and remote control gates are installed at those points.

(ii) Second Control Points
Two (2) second control points are provided at the diversion structures to get more proper water distribution in the scheme. At those points, water level gauges and remote control gates are also provided.

(iii) Key Monitoring Points
Monitoring points are established at the diversion points E, M, O on Besut main canal and point W on Angga main canal, of which mis-operation gives much affects to the proper water distribution in the respective compartment. These points are installed on regulating structures (check gate) provided through improvement works of irrigation facilities. Water level gauges are equipped at the points to check whether diversion gate operations are adequate or not.

(iv) Second Monitoring Points
Five (5) second monitoring points equipped water level gauges are proposed in order to get more accurate water distribution within the compartments.

(v) Third Monitoring Points
4 compartments are comprised of 30 irrigation groups (Kumplan Pertani). Nineteen (19) third monitoring points are added to the above key and second points in order to check water distribution to those irrigation groups.

Table 5.2.3 "Required Works for Control and Monitoring Points" shows locations and required works for provision of those control and monitoring points.

(e) Rainfall Stations

Effective use of rainfall to the irrigation, following three (3) rainfall stations are provided at the representative locations of the scheme in order to calculate daily water requirement and to execute proper operation of water distribution through the control and monitoring points mentioned above.

- Besut Barrage : for Compartment 1
- Point O of Besut main canal : for Compartment 3 and 4
- Point R of Angga main canal : for Compartment 2

The control points, monitoring points and rainfall stations are to be connected with telemetry and telecontrol system for the central management as presented in Fig. 5.2.2 "Layout of Water Management/Monitoring Facilities".

Drainage water is utilized for irrigation in the scheme by six (6) recycle pump stations as shown in Table 5.2.4 "List of Recycling Pump". Effective use of those pumps through the central water management is essential to hold water shortage to a minimum. DID has a construction plan of Paya Peda Dam at upper reach of Angga Barrage. Since the plan includes

stable supply of irrigation water to Besut Scheme, it is recommended to accelerate this plan in the future.

(4) In-field Infrastructure

Physical improvement refers to on-farm infrastructure development comprising land leveling, in-field channels and control boxes. The table below summarizes the in-field infrastructure works for Besut Scheme.

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	699	3,105

The land leveling will be based on the DOA's specification of zero grading at +/- 5 cm accuracy covering 100% of 10m x 10m grid points. It is estimated that 40% of the land leveling works will be by the DOA. The remaining 60% will be the private sector. The PPK will be encouraged to undertake these works. For in-field channels, the criteria is to achieve a density of 150m/ha. Two(2) control boxes are provided for one consolidated lot.

(5) Land Consolidation

The land consolidation targets for Besut scheme are shown below.

Compartment	No. of Farmers (no.)	No. of Lots (no.)	Area (ha.)	Average Area/Lot (ha/lot)	Av. no of Lots per Consoli-dation (no.)	No. of Consoli-dated Farms (no.)
1	654	1,302	1,235	0.95	3	411
2	509	1,069	1,148	1.07	3	383
3	858	1,715	1,306	0.76	4	435
4	1,028	1,704	1,475	0.87	3	492
Total	3,054	5,790	5,164	0.89	3	1,721

Each consolidation aims for 3 ha farm plot. 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 PMU should lead this program with assistance from the DOA. The PPK should also be a member of this team.

(6) Agriculture

(a) Cropping Schedule

The existing irrigation schedule and the original one of Besut scheme is summarized as shown in Fig. 5.2.3 "Present and Proposed Cropping Schedule". The original irrigation schedule was sifted to the existing one in order to avoid the shortage of water

supply in compartments 3 and 4. However, the existing schedule is risky for flood damage, if land preparation be delayed. Usually, flood happens in Besut scheme on November and December, and damages paddy plants. It results in postponing the cultivation schedule and missing the coming off- season cultivation. The original irrigation schedule is recommended in order to avoid the risk of flood. In the schedule, the first season crops is defined as off-season crop which lasts from March until September. The second season crop is called as main-season crop with a cultivation period between September and March. The proposed cropping schedule should be determined considering the water availability, flood effected period and harvesting period. The wet direct seeding method is presently common in the Besut scheme, and this method would be applied principally, however the partial introduction of the dry direct seeding (for approximately 20% of the planted area in off-season) will also be recommended in order to avoid high peak water demand during pre-saturation period in off season. The 175% of cropping intensity will be obtained by the improvement cropping pattern. The phase-wise planted areas are summarized as follows:

(Unit: ha)

Compartment	Area
Phase 1	
1, 4 and part of 2	3,439.9
Phase 2	
3 and part of 2	1,723.4

(b) Planting Method and Mechanization

At present, the land preparation is generally done under submerged soil condition. The majority of the farmers conduct two times of land preparation. The first ploughing is done by the 4 wheels tractor on the contract basis. Second land preparation is done by the 2 wheels tractor owned by farmers. The utilization of 2 wheels tractor for land preparation is popular in the Besut scheme, however 2 wheels tractor is not suitable for effective mechanization in future, considering the work efficiency and the introduction of the large scale mechanized farming. Indeed, the existing 2 wheel tractors are used only for second ploughing. The utilization of the 4 wheel tractors should be recommended as the improvement plan for mechanization. 4 wheels tractors should gradually take place of existing 2 wheel tractors according to the renovation of them. At present, the peak 4 W tractor requirement for 1st land preparation is estimated at around 110 numbers. The necessary 4W tractors are provided by IADP Ketara, the contractors and FMCs in and around the Besut, and 2nd land preparation depends on more than 600 numbers of 2 W tractors owned by individual farmers.

After the introduction of 4W tractor operation system, the tractor requirement for land preparation under the project condition is estimated at about 129 at the peak period. The farm mechanization will be partially supported by the private sector (contractors) in future. Farmers Mechanization Center (FMC) in Besut area will provide their own tractors and arrange the mobilization from other FMCs. The farmers' groups will own the deficient numbers between peak requirement and availability. The farmers' groups will also own some necessary managing implements for fertilizing and chemical application. The managing implements include light weight 4W tractor (10-20 hp class)

for management and implements (attachments) such as broad caster, power blower, boom sprayer carpet duster, etc. Harvesting work will be done on the contract basis with combine harvesters owned by contractors and FMC in future. The farmers' groups will own chopper spreader attached on the outlet of the combine harvester considering working efficiency of land preparation. The chopper spreader is used commonly for chopping and spreading the residue. Based on the formulated detailed plan for mechanization, the necessary numbers of machinery and implements are estimated and summarized as below.

(Unit: Nos.)

Machinery/equipment	Necessary	Availability	Purchase
I. 4W tractor			
1. 60hp class	129	74*	55
2. Management tractor (10-20hp class)	42		42
II. Implements			
Lime spreader	16		16
Rotavator	82	27	55
Paddy harrow	31		31
Rearbucket or Land roller	3		3
Granule applicator/Broadcaster	35		35
Boom sprayer	14		14
Carpet duster	14		14
III. Combine harvester (6t class)	23	23	
Chopper spreader	23		23

*: 20 by FMC Besut, 14 by IADP Besut, 10 by contractors (including farmer) and 30 by FMC Kelantan, source: FMC Besut and IADP Besut

The proposed mechanization farming system by integrated work is as shown below.

Mechanization system for Wet seeding

Two times of Land preparation (tractor + rotavator) => Paddling (tractor + paddy harrow) => Seeding (tractor + power blower/granule applicator or broadcaster) => Fertilizing and chemical application (tractor + granule applicator/carpet duster/boom sprayer) => Harvesting (combine harvester)]

Mechanization system for Dry seeding

Two times of Land preparation (tractor + rotavator) => Seeding and pressing (tractor + power blower/granule applicator or broadcaster and rear bucket or land roller) => Fertilizing and chemical application (tractor + granule applicator/carpet duster/boom sprayer) => Harvesting (combine harvester)

Under the Wet direct seeding system, land preparation should be done two times and paddling should be done one time after land preparation. These operations are effective in weeds control and land leveling. Two times of land preparation and pressing after seeding should be adopted for dry direct seeding. The pressing after seeding is recommended, because it is reported by MADA that pressing after seeding under the dry seeding system is effective in germination and establishment of paddy.

(c) Paddy varieties and management practices

(i) Paddy varieties

MR84 and MR185 should be introduced as recommendable varieties. According to the result of the field test done by MADA, the most suitable number of paddy plants is estimated at 150-180 number per square meter. The seeding amount of paddy is decided between 60 - 80 kg/ha on the presumption that one thousand grain weight is 26g and the average germination rate is 60-65% based on the data of MADA experiments.

(ii) Fertilizer application

Majority of the farmers apply the subsidized fertilizer of about 80kgN/ha only. Most farmers apply fertilizer 2 times, but some farmers still apply all subsidized fertilizer one time. The MARDI fertilizer recommendation should be basically adopted to whole the scheme. The significant of scheduled fertilizing activities should be stressed onto the farmers.

The soils in Besut scheme are marginal for paddy cultivation because of the low pH, the low fertility and flood hazard as shown in Table 5.2.5 "Soil Classification and Suitability for Paddy". The danger of the flood can be avoided by the introduction of the proposed clopping schedule. Hence, the usage of additional fertilizer is effective in order to increase the paddy yield. More fertilizer application such as N:P (P_2O_5):K (K_2O)= 120:40:40 (kg/ha) will be recommended to lower fertility areas. Lime should be added to the low pH soil areas to prevent the ferrous poisoning effect and cure the soil acidity. Furthermore, as Magnesium (Mg) seems to be effective for paddy production based on the result of the DRIS pilot project in Besut scheme, application of Mg is recommended. Application of Ca and Mg will be adopted in the low pH areas which cover about 75% of the scheme. The area-wise optimum rate and amount of fertilizer will be obtained through the practice of DRIS.

The proposed fertilizer amount and apply timing is as follows:

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

The additional elements application is recommended for the low pH area located in Ketara (Besut) scheme.

Calcium fertilizer (GML) : 2.5 ton/ha before first land preparation
Magnesium fertilizer : 130 kg/ha before first land preparation

(d) Pest Management

As for the weed control, two times of herbicide applications for wet direct seeding and three times of herbicide applications for dry direct seeding are recommended. Chemical application to control the weed, pest and decease should be carefully done with special attention to the environmental aspect. For the pest and weed control, proper measure should be made in line with DOA recommendations. Regarding the rat damage, in Besut area, more rat damages occurred in the past in comparison with two other areas. It is important to pay attention to the occurrence of this problem. IPM (Integrated Pest Management) method should be accelerated in the area. The biological management system, especially the use of owls should be increased for biological rat control. The proposed farming practice for Kerian is shown in Table 5.2.6 "Proposed Farming Practices".

(e) Marketing

As peculiarity of the marketing condition in KETARA (Besut) scheme, following 3 points should be considered:

- all the farmers belong to farmers' group
- group purchase is partly practiced by farmers with using groups' bank account
- expected production will exceed present milling capacity of Besut area.

(i) Enhancement of Group Purchase / Selling

In Besut area, farmers' groups are already rearranged based on the irrigation system and all the farmers belong to these groups. Besides, groups are promoted to open group account and to practice group purchase by using this account. Therefore, this promotion should be continued so that all the groups will practice group purchase. On the other hand, farmers' preference to the particular brand name of farm input prevents members from having consensus on group purchase. In this regard, dissemination of knowledge regarding the farm inputs, especially their ingredients and effects, should be made so that farmers can reach consensus more easily.

(ii) Diversification of Sale Destination

In future, when the target yield (5.5t/ha) is achieved and cropping intensity is improved to 175%, it is estimated that the paddy production will exceed present milling capacity by about 20,000 ton. Therefore, sale destination should be enhanced and diversified more to the neighboring area such as KADA and area where the milling capacity is large enough such as Pulau Pinang.

(f) Rural Credit

As in the case of other two areas, the credit needs to be expected in future would be (i) loan for purchase of farm input and (ii) loan for procurement of agricultural machinery. Short term loan and paddy loan presently provided by PPK and BPM will be intensified by applying to farmers' group in addition to individual farmers. As to the procurement

of agricultural machinery, it is estimated that RM10.1 million will be necessary. BPM or PPK should prepare to have enough fund to cover this amount.

(7) Farmers' Organization

(a) Present Situation

In Besut scheme, the existing set-up - characterised by the already re-organised and adjusted farmers' group or kumpulan petani or KPs that coincide with the irrigation systems boundaries or layout, a co-ordinated and functioning Task Forces for each of the four compartments - is apparently ready to be involved in the proposed modernisation of irrigation water management systems. the efforts that have taken KETARA almost eighteen years finally have established a reasonably strong foundation for the 'take off'. A total of 3,054 farmers within the entire scheme have been organised and re-organised into what is now known as kumpulan petani or KPs. There are now 30 KPs (from the original 78 when the program was started) in the scheme which covers an area of 5,164 hectares. The area comes under the command localities of two PPKs, namely PPK Gerai and PPK Kerandang. Most of the farming activities such as purchase of seeds, securing of machinery services, purchase of farm inputs are done on group basis.

As for the organisational arrangements, it has been observed on the ground as well as based on available data, that there is a well established and co-ordinated set-up where major departments (DOA,PPK and DID) are actively represented at almost all levels, from the head office of KETARA right down to the irrigation service units and compartments. The establishment of Task Forces for all the four compartments, comprising staff of DOA and DID components of the PMU has been instrumental in preparing the ground for the admittedly tedious and difficult social engineering works. The roles of these Task Forces is evidently significant as a communication media (or interest articulation channel) between the farmers and the authority (KETARA). Equally significant is their role in identifying and solving problems and constraints that impede achievement of high yields. A reasonably well defined scope of works of the Task Forces in relation to daily farm-related management and extension activities enhances program implementation.

It is quite evident also that despite the fact that all the farmers are members of the PPK, the latter does not participate directly in the day-to-day management of the scheme especially the farmers' affairs. Rather PPK 'gives way' to a more co-ordinated and integrated team comprising representatives of key agencies namely DOA, DID and PMU itself. In terms of water management function, a water user group (WUG) or kumpulan pengurusan air or KPA has been established quite recently (1996) on a pilot project basis in Kubang Depu. Though more 'fine tuning' efforts have to be done on this WUG, one thing noteworthy about this WUG is that its operational boundary equals the irrigation command block boundary, and that equals the area of responsibility of the farmers' group (KPs).

(b) Proposed Modernization Plan

Given the already formed farmers' organisation, the existing physical infrastructures and the preliminary headway in farmer mobilisation and extension activities, what need to be done further in terms of farmers' organisation are the following :

(i) Capacity building efforts aimed at both the farmers' groups and agency staff in critical areas such as water utilisation and management, project management planning, implementation and monitoring, group dynamics (that include team building), farm management techniques and other related aspects. The role of the National Water Management Training Centre is necessary in this regard. A formal assessment of training needs is imperative and some kind of a Master Plan on Training and Mobilisation should be pursued. This Master Plan shall serve as a basis or a guideline for long term capacity building program.

(ii) Enhancing the current extension activities for the purpose of establishing what can be termed as smooth inter- personal relationship (SIR) aimed at the three critical group relations namely, farmer-to-farmer, farmer-to-officer, and officer-to-officer. This shall address the frequently quoted issues of 'no communication', 'under communication' and 'miscommunication' that often impede project implementation.

(iii) Based on recently noticeable trend where individual farmers within the KPs expand their farming operation (by renting in larger amount of lands), there should be proper monitoring to 'capture' this development. Information and data on this aspect can assist efforts to upgrade these KPs into mini-estates in the future as these enterprising individual farmers can be the core group of managers. This strategy to develop mini-estates that are 'internally-initiated and externally facilitated' can be more promising as they are conceived and fostered by the local farmers themselves (as compared to 'externally-initiated and facilitated type of mini-estates) assisted by agency staff.

(iv) There is a need to strengthen a sense of belonging of members of farmers' groups or KPs to their respective irrigation blocks which they have to efficiently manage in terms of water use and water management. In this respect initial efforts to develop KP Funds are worth focusing as these funds could serve as some kind of 'referents' to which their interests and efforts could then be directed. However the issue of legality has to be addressed at since collection of funds has to observe certain established rules and procedures. Developing slogans, uniforms, pondok wakaf (small huts traditionally used as places for rest and refreshments during transplanting and harvesting) which could now be improvised and transformed into resource centres at strategic locations in each irrigation block, are some of the possible options.

(v) On the management of KPs especially in improving their farm operations, there is a need for the inclusion of representatives of combine harvesters or their 'brokers' in relevant committees. This is to ensure a well co-ordinated and synchronised farm decisions and farm operations.

5.2.3 Cost Estimate

(1) Basic Conditions and Assumptions for the Cost Estimates

Unit Prices of the respective works of Besut Scheme are estimated based on the contract prices of similar works taken from Besut Irrigation Project in Terrenganu as well as the Government Price Schedule issued in 1993. Consumer Price Index issued by the Central Bank of Malaysia and Statistics Department was used for updating prices to October 1997 level. As for replacement of Angga Barrage, repair of Besut Barrage gates as well as major canal structures, it made efforts to obtain the latest information from the site office and local contractors. Reference data for the cost estimates are as follows:

(a) Besut Irrigation Project, Compartment 1 & 2, 1996, Ketara
(b) Standard Price for Construction Works, 1992/1993, DID

(2) Construction Cost

Initial investment costs for the scheme, which is divided into the works for system infrastructure, in-field infrastructure and water management / monitoring facilities, comprise direct construction cost, physical contingency (15% of direct construction cost), engineering cost (10% of direct construction cost), administration and management cost (5% of direct construction cost). Those are summarized below and shown in Table 5.2.7 to Table 5.2.10 "Direct Construction Cost". The details are given in Annex VII "Cost Estimate".

(Unit : RM)

Item	Direct cost	Contingency,engineering administration cost	Total
System infrastructure	21,460,600	6,438,200	27,898,8000
In-field infrastructure	1,874,300	562,200	2,436,500
Water management	3,421,000	1,026,500	4,447,500
Total	26,755,900	8,026,900	34,782,800

(3) Replacement Cost and O & M Cost

Replacement cost of infrastructures is estimated at 20% of initial construction cost every 20 years. While, for replacement cost of water management / monitoring system, initial equipment cost is applied every 10 years. O&M costs which are expected to occur every year are estimated at RM 257 /ha/year for infrastructure and RM 250,000 /year for water management system. The replacement and O & M costs for the scheme is summarized as follows:

(Unit : 1,000 RM)

Item	Cost
Replacement cost	
- Infrastructure (every 20 years)	6,068
- Water management/monitoring (every 10 years)	3,421
O & M cost (annual)	1,577

(4) Training Cost for Water Users' Group

Training for 30 water users' groups, which have been formatted, will be planned at both off-site (National Water Management Training Center) and on-sites. The former is executed for three years and 2 leaders from each group participate. The latter is carried out on all members of groups for five years. The costs are estimated at RM 102,540 consisting of RM 72,000 for off-site training and RM 30,540 for on-site training. The details are shown in Table 5.2.11 "Training Cost for Water Users' Group".

5.2.4 Implementation Schedule

(1) General

The works for modernization of water management system in the scheme such as improvement of system infrastructure and in-field infrastructure and establishment of water management / monitoring system will be commenced from 1999 and completed in 2006, in taking into consideration of the accomplishment of the target of the National Agricultural Policy in 2010. Training of water users' group, which will be put the management of tertiary system, will be carried out in parallel with the above works.

(2) Implementation Plan for Rehabilitation and Improvement of System Infrastructure

A degree of execution priority of rehabilitation and improvement of system infrastructure in the scheme is put in order of (i) replacement of Angga Barrage, (ii) Repair of Besut Barrage gates, (iii) irrigation facilities, (iv) drainage facilities, (v) farm road and (vi) water management facilities. However, taking into consideration of the implementation schedule for improvement of in-field infrastructure as well as all work completion in 2006, execution of the above improvement works has arrangement in a row and it is started in 1999. Periods of respective work are set in 3 years for replacement of Angga Barrage, 2 years for repair of Besut Barrage gates, 3 years for irrigation improvement, 1 year for drainage facilities and 2 years for farm road improvement. The executing agency of the works is DID.

(3) Implementation Plan for Improvement of In-field Infrastructure

Improvement works of in-field infrastructures will be executed in parallel with those for system infrastructure and will be completed in 2006. Among 4,656 ha of required land leveling area, 1,863 ha will be executed by DOA and the remaining 2,793 ha will be done by private sectors managed by PPK. Construction works of in-field channels and control boxes will be executed by DOA with the target of 87 km/year and 388 nos./year, respectively. Land consolidation will be implemented by close cooperation among DOA, IADP PMU and LPP/PPK. Annual target of consolidated farmhouse is 215 houses/year.

(4) Implementation Plan for Establishment of Water Management / Monitoring Facilities

Implementation for the establishment of water management/monitoring facilities is scheduled in 2 years with the execution order of (i) Establishment of communication links, rainfall station, water level gauges and computer system, (ii) Introducing electric moving gates for telecontrol and establishment of monitoring system for telecontrol gates and pumps, (iii)

Establishment of remote control system for telecontrol gates and pumps. Installation of water level gauges and control gates shall be executed in parallel with the improvement works of system infrastructures mentioned above (2). Monitoring feedback system will be introduced in 3 years, in order of the master station, player stations. The works are carried out by DID, in relation with on-going Besut Pilot Project.

(5) Implementation Plan for Formation of Water Users' Group and Training

Training of 30 water users' groups, which have been formatted, will be carried out in 5 years from 1999. Off-site training at National Water Management Center in 3 years and on-site training in 5 years are programmed. 60 persons consisting of 2 leaders from each group joint off-site training and all group members participate off-site training. Off-site training will be executed at two groups while on-site training will be carried out at 31 sessions/year. Off-site training is managed by DID and on-site training is executed by IADP PMU.

The implementation schedule of the works for modernization of water management system in Besut Scheme is presented in Fig. 5.2.4 "Implementation Schedule" and its disbursement schedule is given in Table 5.2.12 "Disbursement Schedule".

5.2.5 Project Evaluation

(1) General

The project evaluation is made from economic and financial viewpoints in order to assess the feasibility of the project in Besut scheme. Economic evaluation is made by using Economic Internal Rate of Return (EIRR), Benefit-Cost Ratio (B/C) and Net Present Value (NPV). In addition, sensitivity analysis is made for the cases of (i) increase of construction cost, (ii) decrease of benefit by applying EIRR. For the financial aspect, farm budget of typical farm size is prepared and analyzed. In addition, repayment capacity of farmers is also examined for the procurement of agricultural machinery (Annex VIII "Project Evaluation").

(2) Economic Evaluation

(a) Basic Condition

Economic evaluation is carried out based on the following conditions.

(i) The economic useful life of the project is 50 years from the start of the Project.
(ii) All prices are expressed in 1997 constant price (end of 1997).
(iii) The exchange rate is fixed at US$1.0=RM4.4=Yen129.5 as of January, 1998.
(iv) The economic price of local currency portions is calculated by applying the Standard Conversion Factor (0.987).
(v) Economic price or cost is calculated by omitting transfer payments such as tax, subsidy and interest.
(vi) Economic prices of farm input (Urea, TSP, Potash) and tradable farm produce (paddy) are estimated based on the World Bank projection of world market prices for 2005 in constant 1997 terms.

(vii) The part of unskilled labor is converted to the economic value by applying the conversion factor of 0.987 with considering labor scarcity in Malaysia.

(viii) The construction components are converted to economic value applying Construction Conversion Factors which are calculated on the basis of proportions of local and foreign costs, transfer payments and other local costs at the local portion.

(ix) The build-up period from the completion of land consolidation and construction of facilities is assumed to be five years. The benefit is assumed to increase year by year and reach its full value in the 12th year after the commencement of the project.

(b) Economic Cost

The economic cost of the project is calculated based on the basic conditions mentioned above and by applying Construction Conversion Factors to the financial cost.

(Unit : 1,000RM)

Items	Financial	Economic
I.System Infrastructure	27,899	26,681
II.In-field Structure	2,437	2,300
III. Water Management / Monitoring System		
1. Telemetry & Telecontrol	3,525	3,459
2. Feedback System	923	906
IV. Training for WUG	102	96

Economic cost of O&M cost and replacement cost are summarized in the table below.

(Unit : 1,000RM)

Items	Financial	Economic	Remarks
1. O & M Cost	1,577	1,557	Annual
2. Replacement Cost			
- System Infrastructure	5,580	5,336	Every 20 years
- In-field structure	487	460	Every 20 years
- Water management system	2,711	2,661	Every 10 years
- Feedback system	710	697	Every 10 years

(c) Economic Benefit

Economic price of tradable goods is estimated based on the World Bank projection of world market prices. For non-tradable goods, present market price is applied as economic price. Value of unskilled labor is calculated by applying the Standard Conversion Factor with considering the labor scarcity in Malaysia. The expected benefit from the project are increase of paddy production owing to improved farming practice and water management and reduction of labor input owing to farm mechanization. These benefits are assumed to be reflected in the increase of yield, increase of cropping intensity and reduction of labor cost. The project benefit is defined as the difference of the net production value between "with-project case" and "without-project case". For the "without-project case", it is assumed that present condition will continue through the project life of 50 years and there will be no change in the yield, cost and return. The benefit at the full developed stage is calculated as below.

(Unit : 1,000RM)

Net Production Value (without case)	11,031
Net Production Value (with case)	21,565
Incremental Benefit	10,534

(d) Economic Evaluation

Based on the project cost and benefit estimated above, the cost and benefit flow is prepared as in Table 5.2.13 "Benefit and Cost Flow" and EIRR, B/C and NPV are calculated as below.

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

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

(Unit : %)

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

The above results indicate that the project is economically viable showing 11.2% of EIRR, 1.14 of B/C and RM6.2 million of NPV. While the sensitivity analysis indicated that the project viability is insensitive against adverse effects of cost increase and benefit decrease.

(2) Financial Analysis

(a) Farm Budget Analysis

The farm budget analysis is made by assuming that average land holding size of 1.29ha is equivalent for typical farm operation size. After the implementation of the project, both gross farm income and net farm income are expected to increase to a great extent. Net reserve of farmers is also expected to increase from RM400 per year to RM3,050 per year. The farm budget for present condition and "with-project case" are shown in the following table.

(Unit : RM)

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

(b) Procurement Cost of Agricultural Machinery

The loan scheme of BPM or FOA would be utilized for the procurement of agricultural machinery. Farmers will pay the rental fee for procured machinery and this fee will be set as equivalent to the present rental fee. The loan repayment will be allotted from this rental fee. Procurement cost and interest of loan and total repayment amount are estimated as below.

(Unit : 1,000RM)

Procurement Cost of Machinery (Loan Principal)	10,057
Interest (Repayment period 5years, rate 6.5%)*	1,438
Total repayment amount	11,495
Average annual repayment	2,299
Annual Repayment per ha (RM/ha/year)	445
Annual machinery using cost in "with case" (RM)	523

*: Annual repayment for the principal is assumed to be RM2.3 million.

From the above table, average repayment amount per hectare is about RM445, while the present rental fee is RM523. With this rental fee of RM523, farmers still can earn about RM2,860 per ha in the "with-project" condition. Therefore, it would be possible for farmers to repay the loan and operation and maintenance cost. Besides, imposing the rental fee which is equivalent to the present condition would be acceptable for the farmers.