The run-off up to the flat lowland is rapid, but the floods do not concentrate into certain streams. The paddy fields seem to provide a flood control storage in the area.

The proposed upstream Bukit Lembu reservoir has a catchment area of 0.4 km^2 at the dam site of which the lower catchment is being developed for orchards, while the remainder is covered by forests with a mountainous topography. The slope of the catchment is steep, which causes rapid run-off through two small streams.

The catchment area of the proposed Ketapang dam is 0.6 km^2, consisting of similar topography and vegetation cover to that of the upstream Bukit Lembu dam.

No major stream/river exists in any of the catchments of the proposed dam sites. Overland flow through paddy fields will be collected and stored in the proposed Bukit Lembu reservoir, while two streams which are considered to be temporary or seasonal are the sources for the upstream Bukit Lembu reservoir, and a stream called Sg. Ketapang is the main source for the Ketapang reservoir. The water from the catchments is being used mostly for rainfed paddy cultivation. No major water use for non-agricultural purposes was confirmed.

5.4.3 Geology

(1) Topography and geology

The project area is located in the northwest of Pulau Langkawi, near Langkawi Airport. It consists of alluvial plains following the coast, and mountains whose peaks ranges in altitude from 100 to 200 m. The area is underlain by Carboniferous sedimentary rocks intruded by granitic rocks of Triassic age. The fresh outcrops of the basement rocks, however, cannot be seen in and around the project area, due to the deep weathering and the alluvial deposits.

There are three proposed dam sites. They are:

1) Upstream Lembu
2) Lembu
3) Ketapang

Upstream Lembu and Lembu are located in the same valley where there is not a definite river course. The former locates between hillside slopes showing a comparatively narrow valley. The latter, however, is in the middle of the alluvial plain (paddy field) formed widely

in the valley. Ketapang is located on the upper reaches of the another nameless river which cuts a comparatively deep valley in the vicinities of the proposed dam site.

(2) Geological investigations

Geological investigations were carried out as shown in Table 5.2.1.

1) Upstream Lembu (KH-1; Left; D=5.0 m)

0.00 m to 1.00 m	Top soil	Brown, medium stiff clayey silt with gravel and roots (N=6)
1.00 m to 4.75 m	Alluvium	Brown to grey, medium to very stiff silty clay or clayey silt with a lot of gravel (N=11-50+)
4.75 m to 5.00 m	Residual soil	Brown to grey hard clayey silt with weathered rock fragments (silt stone)

The results of KH-1 suggest the following.

- From a geological viewpoint, the minimum depth of excavation for the dam foundation would be 1.0 m (up to the base of the top soil)
- As the coefficient of permeability of the foundation material (3.5 m to 4.0 m deep) indicates a low value ($k=3.71 \times 10^{-8}$ m/sec), measures against through the foundation seepage would not be required.

Note:
Generally, even in the case of a high dam, the target value of the coefficient of permeability after foundation treatment such as grouting is about 1×10^{-7} m/sec.

2) Lembu (KH-2:Left:D=10.0 m)

The originally planned number of boreholes (2) with a depth of 5.0 m each, was changed to one borehole, 10.0 m deep, due to the presence of deep soft layers (N<10) at the first borehole.

0.00 m to 1.00 m	Top soil	Brown to grey, very soft clayey silt with gravel and roots (N=2)
1.00 m to 10.0 m	Alluvium	Brown to grey, silty clay with some sand, soft until 5.0 m deep but stiff to very stiff below that

(N=5-20) Interbeded with soft clay layers (N=3-4) including organic matter at 3.2 m to 3.5 m and 6.0 m to 6.45 m deep, and with sand layers at 3.5 m to 4.8 m and 7.0 m to 8.0 m deep, respectively.

The results of KH-2 suggest the following.

- The dam foundation excavation depth would be 1.0 m (up to the base of the top soil) at the minimum. In the case of a dam higher than 5.0 m, however, careful study on stability and settlement of the foundation will be required, due to the presence of soft layers (N=2 to 8) up to 7.0 m deep.
- The coefficient of permeability of the foundation material shows low value($k<1x10^{-8}$ m/sec), therefore measures against seepage through the foundation would not be required.

Note:
According to Terzaghi and Peck's theory, in the case of clayey soil, the relationship between "N"(value of SPT) and "qac"(bearing capacity:$tf/m^{2)}$ is as follows.

qac=1.2N

On the other hand, assuming "g_t (unit weight of the soil)=2 tf/m^3, and the cross section of a dam is an isosceles triangle, the absolute value of "p"(load per unit area:tf/m^2) of the dam will be the same as the dam height in meters, in spite of the slope gradients.
If the dam height is 5 m, "p" on the foundation will be 5 tf/m^2. Therefore, if the absolute value of "qac"=1.2N < proposed dam height in meters, it can be judged roughly whether stability and settlement analyses of the dam foundation will be necessary.

3) Ketapang (KH-3; Left; D=10.0 m, KH-4; Right; D=7.0 m)

a) KH-3

0.00 m to 1.20 m	Top soil	Brown to grey soft clayey silt with gravel and roots(N=4)
1.20 m to 5.30 m	Alluvium	Brown to grey medium to stiff clayey silt with gravel (N=8-11)
5.30 m to 10.0 m	Residual soil / Completely weathered rocks	

		Brown to grey very stiff to hard clayey silt with weathered rock fragments (mud stone) (N=36-50+)

b) KH-4

The original planned depth of 10.0 m was changed to 7.0 m, due to the appearance of hard basement rocks at 5.1 m depth.

0.00 m to 0.95 m	Top soil	Brown to grey, soft to medium clayey silt with roots(N=5)
0.95 m to 3.00 m	Alluvium	Brown to grey stiff to very stiff clayey silt with a lot of gravel (N=19)
3.00 m to 5.10 m	Residual soil/Completely weathered rocks	Brown very stiff clayey silt with a lot of weathered rock fragments (silt stone) (N=19)
5.10 m to 7.10 m	Rocks	Weathered rocks (limestone)

The results of KH-3 and KH-4 suggest the following.

- From the geological viewpoint, the minimum depth of the dam foundation excavation would be 1.0 m to 1.2 m.
- The coefficients of permeability show comparatively high values (k=1.27 to 1.05×10^{-6}m/sec), therefore measures against foundation seepage, such as the provision of an impervious blanket needs to be investigated.

(3) Soil-mechanical test

A sample for the soil-mechanical test on the dam construction material was collected from the proposed borrow areas near the project area. It is an existing borrow area under mining, and consists of residual soils of granitic rocks. The test results show the quality of material is good for a homogeneous type dam, especially in its permeability and shearing strength properties.

5.4.4 Agriculture

A. Present Conditions

(1) Land Use

Present land use of the farm land is only paddy cultivation during the rainy season. There are no crops in the dry season due to lack of water. FOA's records show that the Kedawang Farmers Organization holds 173 ha of paddy land with 130 farmers as FOA members.

(2) Soils and Land Capability

Soil assessment was surveyed at two points; Kampung Bohor Masjid situated in an alluvial terrace, and Kampung Ketapang situated at the higher part of the terrace. Two kinds of soil series were identified. Kampung Bohor Masjid has Gong Chenak series which is light brown gray to grayish in color, and sandy clay to clay (fine clay) with high mottles in the subsoil.

Kampung Ketapang has Lubuk Kiat series which is light brownish gray to light yellowish brown, and sandy clay to clay with yellowish red iron mottles. Both soils are washed away by heavy rains and floods every year, and the surface soil of 20 cm shows a high content of sand, and an evident plough-pan was not observed.

Characteristics and properties of these soils are summarized as follows:

Gong Chenak series: Clay texture with 25-45% sand, 15-25% silt, and 40-55% clay, low available water with moderate to moderate-slow water permeability, soil pH of 4.8 in the plough layer and of 5.7 in the subsoil, moderate content of organic carbon at 20 cm depth, and low in CEC.

Lubuk Kiat series: Slightly lower clay content at 35-45%, low to very low available water with moderate water permeability , adequate soil pH of 5.0 at 20 cm depth and of 4.8 at 30-50 cm depth, moderate carbon content at 20 cm depth, and low in CEC.

These two types of soils are moderately suitable for paddy and annuals such as vegetables or other field crops. As there is sandy soil in the upper 20 cm, melon and tobacco are suitable with irrigation, during the dry season. The risk in this area is the occurrence of flash floods which cause widespread crop damage. Even in May or June, there are some unseasonable flash floods, and the cropping pattern in the dry season should be limited to before the end of April.

(3) Agricultural Production

According to the farmers interview survey, the average paddy yield per ha is calculated at 3.7 t/ha with 288 kg of fertilizer used. Using this average yield, the paddy yield of the paddy growing area (173 ha) at Kedawang unit (130 farmers) is roughly estimated as 640 tons in total which means a gross production (return) of approximately RM 460,000.

(4) Population and Agricultural Employment

According to the farmers interview survey, the farm families at Kedawang in Langkawi are mostly aged. 43% of all the house owners are over 60 years old, and the average age of each house owner is 56 years old; 80% are more than fifty and only 20% are 40-45. The youngest children are around 10 years old. The average number of family members in each house is 4.2, excluding 2 children living outside. 40% of families have less than three members.

In Langkawi, there are many job opportunities in the tourism industry, and therefore, full time farmers are mostly 58 years old on the average. The survey on the main jobs of house owners is shown as follows:

Home farming	19 farmers	(54%)	
Tourism industry	7 farmers	(20%)	Hotel, Taxi, Shop, etc.
Fishery	4 farmers	(11%)	Including boat owners
Public work	2 farmers	(6%)	
Others	3 farmers	(9%)	

The number of family members who can work are very few. 74% of all the houses answered only one (house owner), and the total average is only 1.3 /family. As to the farmer's successor, the answers were negative with 50% of "No" and 50% of "no reply" by full time farmers.

(5) Farm Size and Land Tenure

Farm land has not been divided into equality succession in Langkawi, and the size of farm land for each farmer seems to be a little larger than in other areas. At Kedawang unit with 173 ha and 130 farmers, the average acreage for every farmer is calculated as 1.3 ha/farmer.

In the farmers survey totaling 35 samples, the average land owned is 1.1 ha / farmer. The distribution of land ownership by 35 farmer samples is shown as follows:

0.2-0.6 ha	13 farmers (37%)	6.7 ha (17%)	Av. 0.5 ha / farmer
0.8-0.9 ha	6 farmers (17%)	5.0 ha (13%)	Av. 0.8 ha / farmer
1.0 ha	6 farmers (17%)	6.0 ha (16%)	Av. 1.0 ha / farmer
1.2-1.6 ha	6 farmers (17%)	8.1 ha (21%)	Av. 1.4 ha / farmer
more than 2 ha	4 farmers (17%)	12.6 ha (33%)	Av. 3.2 ha / farmer
Total	35 farmers(100%)	38.4 ha(100%)	Av. 1.1 ha / farmer

(6) Farm Management and Marketing

Farm management for paddy cultivation is operated by the individual farmer with the help of FOA, which supports the farmers in machinery services for land preparation and harvesting and in providing subsidized fertilizers. Kedawang area is a designated paddy production area in the Langkawi development plan. Marketing is also aided by FOA, generating good prices due to the demand from many tourists.

(7) Economics of Farm Operation

The average cost and return in paddy production per ha using the broadcasting method (direct sowing)at Kedawang area are shown by the farmers interview survey as follows:

Cash outlay (ha)	1) Machinery cost	RM 512 (L.P. and Harvest)
	2) Agro-chemicals	RM 15
	3) Seeds (purchased)	RM 70 (60 kg)
	4) Fertilizer (subsidized)	0 (300 kg)
Family labour	30 man-days / ha (referred from DOA report)	
Yield (ha)	3,700 kg	
Gross return (ha)	RM 2,664 (@RM 0.72 / kg)	
Net return (ha)	RM 2,067	
Net return per day	RM 69 / day	

(8) Farm household economy

Paddy cultivation suits aged farmers, as it requires unit labour hours of only 19 man-days per hectare a crop if machines are used for transplanting. According to the DOA data, an average farmer who holds 1 hectare of paddy field can get a cash income of about RM 1250, of which RM 285 is derived from the family members' effort.

B. Agricultural Development Plan

(1) Land Use

Out of a total of 173 ha of paddy land at Kedawang, 23 ha is proposed for the new development of agriculture and agro-tourism. This includes about 7 ha of an excavated pond,

approximately 2 ha of a right-of-way, a parking area and tourist facilities, and 10 ha of a rain shelter, and 4 ha of double cropping of paddy.

The pond will be designed not only for irrigation, but also as a tourist attraction including, a wooden bridge, a fishing place, and fish breeding. The rain shelter will be planned for year round multi-purpose farming with vegetables, melon, flowers, orchids, nursery herb, and tree crops. Therefore, the rain shelter is to be developed as an intensive farming program, and most of the other remaining paddy land will also be improved by drainage canals and land leveling.

(2) Farming and Cropping Plan

Farming and cropping is planned for 4 ha of double cropping paddy, and 10 ha of rain shelter, and improved paddy cultivation during the rainy season.

Exhibition of Paddy Cultivation (4 ha)

For use as a tourist attraction, an operating exhibition of paddy cultivation all year round is desired. However, the heavy rain season from the middle of August to the end of December, should be carefully considered in planning the cropping patterns of year round cultivation. Three patterns of double cropping paddy cultivation are planned. With these patterns using 4.5 months of variety in the rainy season and 3.5 months of variety in the dry season, harvesting will be realized in May, June and July, as well as December, January and February.

1) The 1st land preparation in July and sowing in August, and the 1st harvesting in December; the 2nd land preparation and sowing in January, and the 2nd harvesting in May.
2) The 1st land preparation in August and sowing in September, and the 1st harvesting in January; the 2nd land preparation and sowing in February, and the 2nd harvesting in June.
3) The 1st land preparation in September and sowing in October, and the 1st harvesting in February: the 2nd land preparation and sowing in March, and the 2nd harvesting in July.

Rain shelter/netting green house (10 ha)

For the exhibition of other field crops to attract tourists, a rain shelter and a green house are planned as follows:

1) Orchid net shelter	:	4 ha (0.4 ha x 10 units)
2) Net shelter nursery and fruit farm	:	2 ha
3) Flower net house	:	2 ha (0.2 ha x 10 units)
4) Vegetable net house	:	2 ha (0.2 ha x 10 units)

For the above farming management, compost soil is very important, as the soils have to be renewed for each crop, and irrigation has to be used effectively.

Compost making

The annual requirement of compost is roughly estimated at more than 50t for 10 ha of crops. For this purpose, 1 t (1,000 kg) of compost should be produced every week. The main materials for compost will be paddy bran and paddy husks, which will come from Langkawi island. The compost will be mixed with soils and be used for all crops.(Annex V.3.8)

Crop selection

Crop selection is important, and the choice will be discussed later with farmers and related Agencies; FOA, LADA, DOA, DID, etc.
Outline of the crop selection in rain shelter cultivation is shown as follows:

1) Orchid net shelter : 4 ha (0.4 ha x 10 units)
   Valuable varieties should be selected. New varieties can be imported and introduced from Thailand or Singapore.

2) Net shelter nursery and fruit farm : 2 ha
   Tree seedlings of fruit trees and ornamental plants will be selected. Edible herb plants are also popular among tourists. The fruit garden will consist of pineapple, papaya, banana, passion fruit, star fruit, mango (3yrs.variety), etc.

3) Flower net house : 2 ha (0.2 ha x 10 units)
   Bulbous flowers; lily, amaryllis, canna, gladiolus, collar, saffron, etc.
   Perennials; rose, hibiscus, bougainvillea, antherium, etc.
   Annuals; mary gold, gerbera, petunia, begonia, cockcomb, sun-flower, etc.

4) Vegetable net house : 2 ha (0.2 ha x 10 units)
   Fruit vegetables; melon, tomato, capsicum, brinjal, okura, etc.
   Leaf vegetables; cauliflower, lettuce, etc.

Improvement of the Main Season Paddy

Paddy cultivation in the rainy season will be improved by the construction of irrigation and drainage canals and land leveling. With these, the yield can be expected to rise up to 5.5-6.0 tons per ha, compared to 3.0-3.5 tons per ha at present.

(3) Crop Budget and Production Plan

1) The orchid crop budget and proposed production for one unit in 0.4 ha (Annex V.3.9)

1)Initial cost (0.4 ha)	RM 60,000	(By FOA)
2)Annual cost (0.4 ha)	RM 22,000	(By farmers group)
3)Annual gross return	RM 40,000	(50,000 stalks/yr. @RM 0.8)
4)Repayment of initial cost	RM 8,740	(FOA)
5)Annual net return	RM 9,260	(dividing among participants)

2) Crop budget and proposed production in the nursery farm (1 ha) & fruit garden (1 ha)
One ha of the nursery farm can grow around 200,000 plants from seedlings, and in two years 60% of them will be for sale at an average price @RM 1.5.

1)Initial cost (1 ha)	RM150,000	(By FOA)
2)Annual cost (1 ha)	RM 44,000	(By participant farmers group)
3)Annual gross return	RM 90,000	(60,000 plants/yr. @RM 1.5)
4)Repayment of initial cost	RM 26,000	(FOA)
5)Annual net return	RM 20,000	(dividing among participants)

One ha of the fruit garden will be planted with various kinds of annual and short term perennial fruits in three years or so. This farm budget on banana cultivation is estimated as follows:

1) Initial cost (1 ha)	RM 20,000 (By FOA)
2) Annual cost (1 ha)	RM 2,000 (By participant farmers group)
3) Annual gross return	RM10,000 (10,000 kg/yr. @RM 1.0)
4) Repayment of initial cost,	RM 3,000 (FOA)
5) Annual net return	RM 5,000 (dividing among participants)

3) The flower crop budget per year is roughly estimated the same as orchid cultivation. However, the initial cost for a net house will be slightly higher.

1)Initial cost (1 ha)	RM200,000	(By FOA)

2)Annual cost (1 ha)	RM 55,000	(By farmers group)
3)Annual gross return	RM100,000	
4)Repayment of initial cost	RM 29,000	(FOA)
5)Annual net return	RM 16,000	(divided among participants)

4) The vegetable crop budget is calculated as two and half times the cropping of valuable produce such as melons or cauliflowers. (Annex V.3.10-11)

1)Initial cost (1 ha)	RM200,000	(By FOA)
2)Annual cost (1 ha)	RM 25,000	(By farmers group)
3)Annual gross return	RM100,000	(25t in 2.5 times; RM 4/kg)
4)Repayment of initial cost	RM 29,000	(FOA)
5)Annual net return	RM 46,000	(dividing with participants)

5) Crop budget / ha in paddy cultivation by double cropping is proposed as follows:

Cash outlay (ha)	1) Machinery cost	RM 1,024 (L.P.& Harvest; 2 times)
	2) Agro-chemicals	RM 30
	3) Seeds (purchased)	RM 140 (120 kg/ 2 seasons)
	4) Fertilizer (subsidized)	0 (600 kg/ 2 seasons)
Family labour	60 man-days/ha (in 2 seasons)	
Yield (ha)	9500 kg (5t in rainy season; 4.5t in dry season)	
Gross return (ha)	RM 7125 (@RM 0.75/kg)	
Net return (ha)	RM 5931 (Family labor cost is not counted)	
Net return per day	RM 99/day	

6) Fish breeding (0.5 ha; one partition enclosed by a net in the excavated pond)
The fish breeding budget is instructed by DOF(Department of Fishery) as follows:

1) Selected fish: Red Tilaphia (500g), Cat Fish(300g); with 4-6 months breeding.
2) Seed fish cost: RM 0.1/one inch fish
3) Pellet type fish food: RM 1.5/kg
4) FCR (Food Conversion Ratio): 1 : 2 in cage breeding, 1: 1 in free breeding.
5) Sale price: Farm Gate RM 3.5-4.5/kg, with the retail price of RM 5-6/kg.

With these conditions, the breeding of 10,000 Red Tilaphia fish will result in RM 11,500 of net return for half a year, after using RM 1,000 for seed cost and RM 7,500 (5 t) for fish food cost. If rice bran and/or hotel garbage (rice) can be used as a supplementary food, they will save much of the food cost and get more return.

(4) Employment and Working Opportunities

The total requirement of labour in 14 ha of cultivation and fish breeding (0.5 ha) is calculated at approximately 15,000 man-days/year. This means 50 man-days every day. Workable family labour in the Kedawang unit is not available for all the labour requirements in the development plan. Therefore, outside labourers will be used partially by the management of farmers groups and organization with the help of FOA.

(5) Farm Management Plan

An outline of the six programs in the 14 ha of farmland and 0.5 ha of fish pond is summarized in the following table. This will be carried out by the leaders in the group farming organization with the help of FOA.

Programs	Extent	F./ H. Labour	Cost/yr.(RM)	Members of G.F.
1) Orchid	(4 ha)	4,000/ 4,000 m.d.	220,000	20 farmers
2) Nursery & Fruit	(2 ha)	1,500/ 0 (C)	46,000	10 farmers
3) Flower	(2 ha)	2,000/ 2,000 m.d.	110,000	10 farmers
4) Vegetable	(2 ha)	800/ 0 (C)	50,000	5 farmers
5) Paddy exhibition	(4 ha)	240/ 0 (C)	4,776	5 farmers
6) Fish breeding	(0.5 ha)	600/ 0 (C)	17,000	2 farmers

F./H.=Family/ Hired; (C)=Cash outlay; G.F.=Group Farming

Each program will be managed by the group farming organization with two to ten members. The ten orchid units will be managed by two farmers in each unit. All the programs should be supervised by FOA, since the initial cost is to be arranged by FOA, and the bank loan to the farmer groups for the annual cost is also to be guaranteed by FOA.

(6) Marketing Plan

The marketing plan should be discussed by LADA, FOA, DOA and DID. All the produce will be able to find new markets in the tourist industry and in general public use. Demand of tree seedlings, such as fruit trees can be extended by DOA and DID respectively, which can be decided by marketing meetings, and the tree plantation at Padang Saga by DID, will also be arranged by these meetings.

C. Implementation Plan

(1) Government Services

In this project, Government support and services are very important factors as farmers do not have a positive future vision in agricultural development especially on agro-tourism.

DID, LADA, FOA and DOA have to organize one project body with farmer leaders. All the farmers agreed with "Group Farming" in the farmers interview survey. However, it is not clear about the kind of grouping and the kind of management which can be organized in this project area. FOA will take an initiative role to organize farmers with a new DID irrigation system.

With agro-tourism development, the role of LADA is very important. Agro-tourism in this project area has to be consulted with LADA and DOA, since this area is supposed to be developed only for paddy cultivation leased on the report "Langkawi Draft Structure Plan 1990-2005". The government services will be strengthened in marketing support, and this project should be linked with other government or private projects in tourism development.

(2) Farmers Organization

There are 32 farmers organizations under FOA, however, there are no activities for agro-tourism at present. There is a tourism section in FOA, and the coordinated activities with other agencies for farmers organizations will be expected in future. For this project, it is required that farmers make an action group of leaders, and the discussions will be repeated to achieve consensus for the project with FOA. In order to start the project, at least six group leaders on every program will be needed. After the selection of the leaders, every group will organize a study course prepared by FOA and other agencies. At these study meetings, all programs will be reviewed and commencement of the project will be determined. Farmers groups will be the leaders of the project, and FOA will fund the initial investment or arrange bank loans for the projects. Farmers group or organizations will also organize the water management systems for each program, with instructions from DID.

(3) Women's Participation in Development

According to the interview survey, there are no house-wives who are engaged in regular work in outside as well as home farming. They answered that wives only work for house keeping. Therefore, house-wives cannot be expected to be labourers for the project. However, the management of orchid, nursery, or flower farming can be carried out by couples of farm families or all the family members. For tourist attractions, farm operators or the shop clerks done by women in a local costumes will be attractive for the tourists. In this point of view, the project participation of village women will be desired, and women's societies within farmers groups should be organized by FOA and LADA.

5.4.5 Infrastructures

A. Present Conditions

(1) Irrigation and Drainage Facilities

The Lumbu Project area has a simple irrigation canal system consisting of a small excavated pond, off-take gate structures and earth canals. Irrigation water is currently collected by return flow from paddy fields in the upper part of the Lumbu stream area. Irrigation facilities are not known in the Ketapang Project area.

(2) O & M of Irrigation Facilities

The Lumbu Project area meets the operation and maintenance stage under the State DID's supervision and the State DOA's agriculture extension work. The DOA intends to promote a crop diversification program in the Project areas.

(3) Social Facilities

Access roads to both scheme areas are well maintained with asphalt pavement, but farm roads in the area are few and the majority not paved.

(4) Construction Materials

Basic construction materials including cement, reinforcement bars, and PVC & steel pipes, and heavy construction equipment, shall be transported from the Peninsular areas, resulting in higher market prices than the average prices in the Peninsular areas.

B. Water Resources Development Plan

(1) Development Plan

The Langkawi Structure Plan designates the Kedawang area to be maintained as a paddy area. But the paddy fields in the Kedawang area are rainfed and the yield is very low. So the project is aimed to enhance the production level of paddy culture through provision of small reservoirs and irrigation/drainage systems. Other objectives of the project are to promote horticulture (orchid, vegetables, fruits, etc.) with drip irrigation systems and rain shelter, to start aqua culture utilizing the reservoir constructed, and to display the traditional paddy culture as a tourist attraction.

Preliminary surveys were made for potential reservoir sites. The original reservoir sites proposed by DOA and DID were abandoned because of the need of resettlement and small

storage capacity. Finally three sites were chosen for further investigations; they were the Lumbu site (excavated pond - Type B), Upper Lumbu site (low dam - Type A), and Kutapang Site (low dam - Type A). The Upper Lumbu site was abandoned later for economic reasons.

Irrigation water requirements are estimated based on the MADA study. A water balance study was made using 30 years data of reservoir inflow, rainfall, and irrigation water requirements. As a result, it became clear that the paddy culture under the rainfed condition used to suffer from water shortages every year, and that a comparatively small regulating capacity would suffice to eliminate the shortages during the rainy season, and that the dry season paddy cultivation should be given up, because it requires too big a storage capacity. During the dry season, irrigation should only be practiced only for horticulture and a few ha of paddy culture for tourism purposes.

The project area has topography suitable for recycling of irrigation water. A weir and an irrigation system should be constructed just downstream the crossing of the main road with the proposed main drain (about 2 km downstream the Lumbu reservoir) in order to collect and reuse the irrigation water which is released from the Lembu reservoir and used in the upstream area.

Presently there is no drainage system in the project area, which causes flood damage to the paddy crop. It is proposed to provide drainage systems starting from the two reservoir sites down to the sea coast. It is also important to provide a drainage system for the upstream reaches of the Lumbu reservoir, which is necessary for the proposed horticulture.

(2) Irrigation Water Requirements

The irrigation water requirement for the main season paddy is calculated on the direct sowing planting method adhering to procedure in the MADA report No. 86014, and for vegetables is calculated using the procedure in the FAO Irrigation and Drainage Paper No. 24.

Potential evapo-transpiration (ETo) is estimated at 1,345 mm/year using the modified Penman method, based on meteorological data from the Langkawi airport station.

Irrigation methods are designed to be the basin irrigation for the paddy cultivation and the drip and/or micro jet sprinkler irrigation for the horticulture.

For the horticulture, 90% of the potential evaporation is applied in calculating the irrigation water requirement, and effective rainfall is not applied because of the rain shelter cultivation method.

The irrigation water requirements for the design of the irrigation facilities is based on a proposed cropping pattern of the agriculture development plan for the Projects shown below.

Pilot Project	Cropping Pattern	Peak Irrigation Water Requirement (l/sec/ha)
KH-4&5	Main Season Paddy	1.34
	Vegetable	0.43

A detailed calculation and explanation of the irrigation water requirement are described in Annex - 3.

(3) Reservoir Capacity

Reservoir operations of the Lumbu pond and Ketapang dam are calculated for each month based on the estimated runoff at the proposed pond and dam sites, the irrigation requirement, and reservoir water loss from seepage and evaporation. Past runoff from 1961 to 1990 are applied in calculating the reservoir operation.

As a result of these calculations, the following reservoir capacities required to cope with the drought year with a return period of 5 years, is clarified for both the Projects.

Pilot Project/Reservoir	Type of Reservoir	Capacities(1,000 m^3)
KH4&5		
Lumbu	Excavated Pond in Depression	120
Ketapang	Homogenous Earthfill Dam	150

The detailed calculations and explanations of the reservoir operation are described in Annex - 3.

(4) Drainage Water Requirement

The drainage water requirement is computed under the condition of three consecutive days rainfall, with a probability of 80%, and a 3 day drainage period. The three consecutive days rainfall with a return period of 5 years at Langkawi station, is adopted from rainfall data from the past 39 years. The three consecutive days rainfall with a return period of 5 years is 236 mm, and the design discharge of the drainage canals are estimated at 9.1 lit/sec/ha.

C. Project Works

General layout of the water resource development, and the irrigation and drainage development is shown in Fig. 5.4.1. Prominent features of these facilities are as follows:

(1) Water Resource Development Facilities

In designing the Ketapang dam, a stability analysis of the dam slope was made using geological data obtained through a boring survey and a soil mechanical test. Seepage water loss from the dam body and foundation were also examined.

Lumbu Pond (Type B)

Excavated pond in depression	
Total storage capacity	130,000 m^3
Effective storage capacity	120,000 m^3
Dead storage capacity	10,000 m^3
Pond area	7.8 ha
Bund of pond	
Crest elevation of bund	EL 6.5 m
Crest width of bund	5 m
Length of bund	546 m
Height of bund	1.5 m
Excavated depth of pond	1.5 m - 1.0 m
Emergency spillway	
Type of spillway	broad crest weir with gate structures
Design flood discharge	18.4 m^3/sec
Width of spillway	27.2 m
Height of spillway	2.5 m

Ketapang Dam (Type A)

Reservoir	
Total storage capacity	160,000 m^3
Effective storage capacity	150,000 m^3
Dead storage capacity	10,000 m^3
Dam	
Type of dam	Homogenous earthfill dam
Height of dam	14.8 m
Crest width of dam	5 m
Length of dam including grass spillway	175 m
Dam slope	
upstream	1 : 3.0

downstream	1 : 2.5
Crest elevation of dam	EL 27.80 m
Design flood water level	EL 26.49 m
Normal water level	EL 25.70 m
Low water level	EL 17.50 m
Thickness of blanket	area of less than EL. 16 m, 1 m to 3 m area of EL 16 - 18 m, 1 m
Emergency spillway	
Type of spillway	Grass spillway (rectangular chute type)
Design flood discharge	7.9 m^3/sec
Base elevation of chute channel	EL 26.06 m
Total length	129 m
Base width of spillway	13 m
Inside slope of lower channel	1 : 1.5
Gradient of channel	1 : 200
Height of lower channel	1 m
Culvert spillway	
Type of spillway	Tower type (box type)
Design flood discharge	5.3 m^3/sec
Crest elevation of spillway	EL 25.70 m
Height of spillway	8.2 m
Type of barrel	box barrel 1.8 m x 1.5 m x 1 no.
Total length of barrel	94.6 m
Incidental facilities	Operation bridge, total length 18 m of 3 spans
Access road	
Type of road	Pavement road with laterite (w = 3 m)
Total length	400 m
Width of road	5 m

(2) Irrigation and Drainage Facilities

<u>Lumbu Project area</u>

Irrigation area	110 ha (paddy, 100 ha in main season and horticulture, 10 ha in all seasons)
Pump station	1 site 20 m^2
Pump	Volute pump 1.5 kw (h=10 m) 2 units.
Pipeline	PVC pipeline, 1.85 km
Irrigation canal	8.0 km of 6 nos.

Related structures	
Intake structure	2 nos.
Turnout	4 nos.
Siphon	3 nos.
Cross drain	25 nos.
Demolishing of existing structures	3 nos.
Drainage canals	5.5 km of 8 nos.
Related structures	
Drop structure	10 nos.
On farm facilities	Drip and/or micro jet sprinkler irrigation facilities 10 ha
Land leveling	35 ha of paddy field

Ketapang Project area

Irrigation area	70 ha (paddy, 60 ha in main season and horticulture, 10 ha in all seasons)
Pipeline	PVC pipeline, 2.4 km
Irrigation canal	2.8 km of 2 nos.
Related structures	
Intake structure	1 no.
Cross drain	6 nos.
Drainage canals	2.8 km of 1 no.
Related structures	
Drop structure	2 nos.
On farm facilities	Drip and/or micro jet sprinkler irrigation facilities 10 ha
Land leveling	13 ha of paddy field

D. Construction Plan

Mechanical construction methods will be applied for construction. Major construction consists of the dam and related structures, and the excavated pond, and related facilities.

The diversion of river flow during the construction of the Ketapang dam will be made by culvert spillway. Prior to commencement of the dam embankment, construction of the barrel portion of the culvert spillway shall be completed. The construction program of the dam body is scheduled to start from both hillsides to the center of the dam.

The diversion work during the excavation of the Lembu excavated pond and bund, will be entrusted to the main drain, (DB-2) and the bund of the pond will be entrusted to the gate structures of the emergency spillway. Therefore, construction of the main drain and emergency spillway shall be given priority in the construction schedule.

The main construction works are, the Ketapang dam embankment and the bund of the Lembu pond, the excavation of the pond, the main drain and the emergency spillway of the Ketapang dam, and concrete work and piling works of the Lembu emergency spillway. The construction volume of these works are estimated at about 122,000 m^3 of embankment, about 226,000 m^3 of excavation, about 1,400 m^3 of concrete works, and about 950 m of piling works.

Taking into consideration the construction volume mentioned above, the construction schedule is estimated at 11 months, consisting of 2 months for mobilization, preparatory work and demobilization periods, and 9 months for the construction period.

E. Project Cost Estimate

(1) Unit Price Analyses

The unit prices of the respective works of the project are estimated by up dating the bidding prices of similar works of other projects in Langkawi, and the Government price schedule issued in 1993, which uses the annual inflation rate of commodity issued by the Central Bank of Malaysia. The unit prices of these works are estimated at 1994 price levels.

The updated unit prices of the respective works are shown in Annex - 3.

(2) Construction Cost Estimate

The total construction cost, consisting of direct construction costs, land acquisition costs and physical contingency is estimated at about RM 10,616,800 for the Lumbu Project and about RM 5,222,300 for the Ketapang Project at 1994 price levels, as shown below.

Physical contingency is estimated at 15 % of the direct construction cost.

	Description	Cost (RM)	
		Lembu	Ketapang
1	Direct Construction Cost	4,541,400	3,486,300
2	Land Acquisition	4,713,000	689,700
3	Physical Contingency	681,200	523,000

4	Engineering Cost	454,200	349,000
5	Administration Cost	227,000	174,300
	Total	10,616,800	5,222,300

The detailed cost estimates are shown in Annex-3.

5.4.6 Project Evaluation

A. Project Benefits

The project benefits consist of three portions. One is an incremental production of paddy; from a unit production of 3.7 tons per hectare to 6 tons due to the overall betterment of the water management (We can avoid a calculation of input subsidy by presuming that the same volumes of input are used in the both "with" and "without" situation.). The second is from the income of a 10 ha horticulture plot , and the third is income from fish culture in the reservoirs (applicable only in Lembu area).

For the estimation of benefits from the plot, vegetable cultivation is used. It gives a relatively higher income and has a ready made market in the island. In our agronomist's scheme some other crops like flowers, trees, and orchids are included. This is because of the need of diversification in crops to attract tourists and to improve the scenery of the island. The difference could be regarded as contribution to tourism, which is the raison d'etre of the island.

We presume two hectares of the surface of the reservoir be utilized for fish culture in Lembu reservoir.

The financial data of paddy growing are from DOA and those of combined horticulture plot of ten hectares are based on our agronomist's and MARDI's estimates.

B. Evaluation of the Project

(1) EIRR

a. Assumption for cost estimates

Land use in the island is controlled by LADA. So is the price of the land. We, therefore, presume that the economic price of the land be zero, though land acquisition costs make up 44 percent of the total cost.

Dredging cost is included in the annual O&M costs.

b. Economic internal rate of return (EIRR)

The EIRR of the project in the Lembu irrigation area is estimated at 10% (See Table 5.4.1), and that of the project in Ketapang is estimated at 11% (See Table 5.4.2). The value would be considered reasonable as rice growing itself is not at all a lucrative business.

c. Sensitivity analysis

1) Lembu

The market prices of vegetables and fish may undergo a change, and technical problems in cultivation may occur. So, if we assume a 10% decrease in net income, the EIRR would be estimated at 9%. Though our total cost estimates include physical contingencies equivalent to 15% of the estimate, a further increase of 10% in construction costs decreases the EIRR down to 9%. When both happen simultaneously, the EIRR is 8%.

2) Ketapang

(i) Benefit 10% decrease	:	EIRR = 11%
(ii) Cost 10% increase	:	EIRR = 10%
(iii) (i)*(ii)	:	EIRR = 10%

(2) Financial consideration

Water rates would be shared by all water users of the reservoir-canal-drainage system to cover at least the maintenance and operation cost of the system.

(3) Labour force situation

The declining population could only be compensated by importing the labour force. At present most of the incoming job seekers are employed in the tourist industries.

(4) Household economy

There would be no change in labour hours in paddy cultivation between "with" and "without" situation. An average farmer of the area who holds a hectare of paddy field can get a cash income of about RM 2,900 of which RM 300 is derived from the family members' effort in the fields. Water shortage in the dry season will prevent them from growing double crops. Wages would be paid to those who joined the group activities on the plot or the reservoir.

5.4.7 Environmental Issues

(1) Present Environmental Conditions

One of the major policies of the Langkawi structure plan 1990-2005 by the Langkawi District Council is to develop and sustain Langkawi as a major tourist destination, since the tourism sector is the main catalyst for Langkawi's economic growth. Therefore, tourism activities shall be the basis for the overall economic growth. An attractive and conducive environment for tourism shall be created in line with Langkawi's function as an international tourist destination. Agriculture areas, especially paddy fields, shall be preserved as a tourist attraction.

At present mainly paddy cultivation is carried out in the Lembu reservoir project area during the main season. In the area adjacent to the upstream Lembu reservoir project area, rubber, rambutan, banana, and durian are grown. The area surrounding the project area is a hilly area covered with forest cover. Therefore the area has a cool atmosphere which is good for the tourists. Besides the Lembu reservoir area is adjacent to the main road which is also favourable for tourism. Most of the Ketapang reservoir area is covered with rubber, durian, and rambutan. The area is managed by RISDA and now rubber tapping is not done in the area.

The soil belongs to Gong Chenak series and Lubuk Kiat series, which are suitable for paddy, vegetables, tobacco, and melon. There is no major wild life in the area except for some monkeys and wild pigs, and buffaloes and cows are reared by some farmers. Most of the farmers in the area are fishermen and are engaged in paddy farming only as a part time activity. Tourism related activities will earn them more income.

The major environmental problems include flooding and soil erosion caused by heavy rain. The drainage canals which will be proposed in this study should lessen this problem.

(2) Water Quality

Water quality samples were taken at 3 locations; 1. Sg. Jenali, 2. Sg. Bukit Lembu and 3. Sg. Ketapang.

As shown in Table 5.4.3, pH at Sg.Jenali at the upstream Lembu reservoir is slightly acidic and at the other two locations, it is close to neutral. pH is within the INWQS value of 5 to 9 of irrigation water. The main parameters including dissolved oxygen, BOD, COD and ammoniac nitrogen are also well within the INWQS values. EC is very low and the salinity is negligible. Colour, turbidity, dissolved solids, and suspended solids of water are also less

than the standard for raw water supply. Hardness, chloride, fluoride, and silica are also within the INWQS values.

(3) Environmental Impacts of the Project

The significant positive environmental impacts in the project area will be improvement in land use, water balance, and flooding. Socio-economic impact within the farming community is also expected to be significant. Agro-tourism in the project area will enable farmers to earn more income.

A part of the paddy field at the Lumbu reservoir area needs to be converted to a small, non-reversible reservoir. However, this shift shall be considered as unavoidable in the development of paddy fields downstream and for agro-tourism purposes. The adverse negative impact shall occur due to land acquisition from the farmers for the construction of the small reservoir. However if the compensation cost to the farmers is reasonable, land acquisition may not be a problem for small reservoir development.

As stated in policy 7 (Table 5.4.4), it is mentioned in the Langkawi Structure Plan (1990-2005) that the paddy areas shall be preserved. However it is mentioned that developments related to tourism will be permitted to allow the local population to reap maximum benefits from the sector, provided the following criteria are met.

i) Sites for development are between 1.2-2.0 ha
ii) They are located in proximity to existing developments
iii) The proposed development is suitable and in harmony with the surrounding development and design characteristics.
iv) The proposed development complements the existing development and activities.

Verification should be made with the Langkawi district council and the related organization before commencement of the small reservoir development at the Lembu reservoir area. Since agro-tourism will have a significant contribution on tourism in Langkawi, the small reservoir development project will become important in the area.

5.4.8 Agro-Tourism

Among all the study areas selected for small reservoir development, Langkawi has the maximum potential for agro-tourism development. Langkawi has many tourist resources such as coastal areas/ sandy beaches, navigable marine waters, rivers and waterfalls, attractive environmental features, and an unique social and historical background which presents a high

potential for tourism development. The tourism sector is the main catalyst for Langkawi's economic growth. The number of tourists in 1989 was 400,000 of which 78% are from Malaysia and the ASEAN region especially, Singapore. International tourists from Australia, Europe, USA, Japan etc. are relatively low at 22%.

Langkawi Structure Plan (1990-2005) was prepared by Langkawi District Council to promote, develop, and guide the development of Langkawi in line with the aspirations of developing it into a major tourist destination whilst improving the socio-economic status of the population with emphasis on the preservation of the natural environment. Some of the major policies proposed under the Langkawi Structure Plan relating to tourism and the environment are shown in Table 5.4.4.

New strategies and more tourist attractions need to be identified to develop Langkawi into a major tourist destination. This will include measures such as the upgrading and diversification of tourist attractions as well as the provision of supporting services capable of meeting the demands and requirement of the tourists. Besides, sufficient opportunities should be given to the local population to participate in the growth of the tourism sector. Agro-tourism using paddy areas and vegetable farming is one strategy which can attract more tourists.

Transportation to Langkawi is possible by sea and air. There are public and private transport services to all major attractions. The proposed Lumbu reservoir is located adjacent to the road. Therefore the study area can be reached easily. Only additional farm roads need to be provided. The tourist can visit the study area and tour around the study area by walking along the farm roads and can stay there for 2 to 3 hours. Since there are many other tourist attractions in Langkawi and the tourist normally stays for one to two days, they would prefer to visit this place as a temporary stopover or resting place while enjoying the agricultural environment. The agro-tourism development shall be constructed to attract both national and international visitors.

The following tourist facilities are proposed in the area and the schematic view of agro-tourism facilities is presented in Fig. 5.4.2.

i) Wooden bridge over the small reservoir
ii) Wooden pathway inside the paddy fields
iii) Sunshine shelters and orchid gardens
iv) Small rest houses - These resting places shall be built in between the paddy fields where 6 - 10 persons can rest.
v) Refreshment shops - These shops can serve small meals and drinks.
vi) Parking area - For the tourists
vii) Souvenir and agricultural products stall - Some of the products from the farms can be sold in these shops along with the other Langkawi souvenirs.

viii) Trees and flowers along the roads - These will improve the landscape and attract more tourists.

The above facilities shall be constructed with the cooperation of LADA and farmers cooperative and the management of these facilities shall be done by the farmers cooperative. The farmers' cooperative shall make contract with the tourist organizations and major hotels to attract the tourists. Tourists income shall be shared by the farmers according to their contribution to these facilities.

5.5 BUKIT SEDANANG (MA16).....Melaka State

5.5.1 General

The Bukit Sedanang project area is located about 33 km east of the Melaka city. It is a FELCRA settlement scheme with an area of 253 ha and about 100 settlers. The main crops are rubber, durian, jack fruits, chempedak, and cacao. Due to inadequate irrigation, all durian trees have died. Orchid culture was introduced later. The scheme was not able to provide enough job opportunities for the settlers and the wage was low.

The Melaka Integrated Agriculture Development Programme (MIADP) has a plan to initiate an agro-tourism development programme in 240 ha located just east of the Bukit Sedanang scheme.

The Montangor dam of this project will provide both the FELCRA scheme and the MIADP project with irrigation water.

Objectives of the project are:

i) to revitalize the FELCRA scheme through rehabilitation of the durian cultivation providing a small reservoir and an irrigation system;

ii) to promote women's participation in the development through expansion of the orchid culture in the FELCRA scheme by providing irrigation water; and

iii) to assist the MIADP tourism project providing irrigation water for horticulture.

There is no major environmental problem in relation to the project.

5.5.2 Climate, Hydrology and Water Resources

Melaka state is known as one of the driest states in Peninsular Malaysia, where annual rainfall is no more than 2,000 mm. The rainfall pattern in this area shows two periods of maximum rainfall sandwiched by periods of minimum rainfall. In general, the primary maximum occurs in October - November while the secondary maximum occurs in April - May. On the other hand, the primary minimum occurs in January - February with the secondary minimum in June - July. The mean annual rainfall at the nearest DID rainfall station*4 is 1729

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*4/ Bukit Senggeh, Jasin (DID No.2324032), 1953 -1990

mm with the maximum monthly rainfall of 212 mm in November, and the minimum of 90 mm in February. The rainfall pattern through the year is shown in Fig. 5.2.1.

The catchment areas of the proposed reservoirs has been mostly developed for rubber trees and their inter-crops, such as cocoa, pasture, durian, etc. Most of the catchments are hilly with swamps situated in between. Since the soil cover of the catchments has sandy textures, the flood sediment load is considered higher, particularly during the development stage.

The main stream in/around the project area is the Ayer Montangor and its tributaries. The primarily proposed reservoir site is located on the Ayer Montangor itself with a catchment area of 2.35 km^2, while the second candidate site is situated on a tributary with a catchment of 0.47 km^2 which is still bigger than that of the existing pond in the area. The water of these two streams is not being used in the project area. Some paddy areas were confirmed on the downstream of the Ayer Mentangor, but farmers have mostly abandoned cultivation because of shortages of water and labor. Only a small-scale vegetable farm (1 ha) is being operated under MIADP downstream of the area.

5.5.3 Geology

(1) Topography and Geology

The project area is located about 10 km northwest of Jasin. The area is mountainous showing comparatively gentle slopes and ranging in altitude from 60 m to 200 m. It is underlain by granitic rocks of Triassic age. The fresh outcrops of the basement rocks, however, cannot be seen in and around the project area, due to the deep weathering and the alluvial deposits.

The proposed dam-site is on the lower reaches of the Sungai Ayer Montangor, one of tributaries of the Sungai Kesang and is located in the FELCRA farm. In the vicinity of the proposed dam-site, the valleys are broad and shallow, and in some bottoms of them, swamps are formed.

(2) Geological investigation

The original plan of drilling two boreholes with a depth of 5 m each was changed to one borehole with a depth of 10.0 m, due to the presence of deep soft layers (N<10) at the first borehole.

a) MA-1: Right bank : D = 10.0 m

0.0 m to 1.9 m	Top soil	Light brown, very soft sandy silt with some organic matter and roots (N=2)
1.9 m to 10.0 m	Residual soil	Yellowish brown to whitish pink, medium to stiff, sandy silt (N=5-10)

The result of MA-1 suggests the following:

- The dam foundation excavation depth would be 2.0 m at the minimum. If the proposed dam is higher than 5 m, careful study on stability and settlement of the foundation will be required, due to the presence of soft ground (N=5 to 10) up to at least 10 m deep.

- The coefficient of permeability shows comparatively high values ($k=1.2 \times 10^{-6}$m/sec), therefore measures against seepage through the foundation needs to be investigated.

(3) Soil-mechanical test

A sample for a soil-mechanical test on the dam construction material was collected from the cut slope in the proposed borrow area near the project area. It consists of residual soil of granitic rocks. The test results of this sample also show the quality of materials is good for a homogeneous type dam.

(4) Design parameters

The design parameters for permeability of the foundation and dam material were derived from the test results. The values of the UU test results in the Project MA 16 are extremely high and are probably not representative of the soil samples. Therefore, "c" of 52.5 (kPa) and "ø" of 27.5 (deg.) which are the averages of the UU test results in the Project KH4/5 and the Project TR44, are recommended as the design parameters of the UU test results in the Project MA16.

Furthermore, there are no test results to analyze stability and settlement of the foundation. In a stability analysis, "c"(cohesion) and "ø"(friction angle) are the main parameters. According to Terzaghi and Peck's theory, in case of clayey soil, the relationship between "N"(value of SPT) and "c" are as follows.

$$c=2N/3 \ (tf/m^2)$$

Where, assuming ø=0 for the critical case, stability of the foundation can be analyzed.

Within many parameters which indicate the characteristics of consolidation settlement, "mv"(coefficient of compressibility) is the main one for a total quantity of settlement. Generally, "mv" can be obtained from a laboratory test. A.W.Skemton, however, advanced "mv" of 6 x 10^{-4} m^2/kN(at p=1x10^2 kN/m^2, p:load) as a general value for normally consolidated clay. By using this value of "mv", a total quantity of settlement can be calculated.

As described above, test results of the dam material are available for design parameters except for the UU test results in the Project MA16, however, attention should be paid that all mechanical test results show a tendency for higher values (lower value in the permeability) than those predicted empirically from the physical test results.

Further testing in laboratory and in the field during the detailed design stage is recommended for the final determination of reliable parameters. In further testing, attention should be particularly paid to the following:

a) The compaction test should be carried out using low energy, for example the "Standard compaction test" in BS, because the proposed dam is small.
b) The other physical tests should be carried out based on the results (optimum moisture content, maximum dry density, etc.) of the compaction test with low energy, mentioned above.
c) Adjustment of test equipment and preparation of specimens.

Topography on the left bank of the proposed dam-site (dam-base) looks like a local land-slide area, and its slide plane is inferred topographical around the base and the top soil. Any measures against land slide do not seem to be necessary, because the excavation line of the proposed dam foundation is planned on the base of the top soil, and almost all of the land-slide block will be excavated and removed. Drillings, however will be required to confirm the land-slide block on the left bank and the river bed at the detailed design stage.

5.5.4 Agriculture

A. Present Conditions

(1) Land Use

The total farmland area of FELCRA (Bkt. Sedanan) is 253 ha, which includes 75 ha of rubber trees, 30 ha of durian, 24 ha of jack-fruits, 14 ha of chempedak, 10 ha of cacao, and

100 ha of grassland. The rubber trees are planted in one third of an area of fruit trees and grassland, using the "Hedge planting technique". All the tree plantation in 1992 was funded by a World Bank loan. Rubber, jack-fruits and chempedak trees are growing well, while, durian and some cacao have died from insufficient water and a low organic matter content. A cattle project was also introduced in 1992 by an allocation from MIADP (Melaka Integrated Agriculture Development Project) through the Veterinary Department, successfully breeding 178 heads.

Of the three projects (Orchid, Poultry and Fishery) started in 1991 by FELCRA's own budget, only the orchid project has continued with 0.4 ha of 33,600 pots.

(2) Soil and Land Capability

The soil has a uniform brownish yellow color and a sandy clay subsoil. Locally it is called the Bungor series, which is a medium textured soil with about 30-45% clay and 40-50% sand in the top 50 cm. The silt content is fairly constant at 10-20%. The available water is low, and hence irrigation will be definitely beneficial to crops. Water permeability is very low due to soil compaction and soil structural degradation. pH is acidic at 4.2 to 4.4.

The major problem is the compacted top soil and the low organic matter content which cause difficulties in early crop establishment. The compacted top soil can be rehabilitated by inputting organic matter. Bungor soil at the Bukit Sedanan site together with an application of a moderate amount of lime and sufficient organic matter, is suitable for most fruit trees.

(3) Agricultural Production

Rubber trees were planted in February 1992, using the "Hedge Planting Technique", consisting of two lines of rubber trees between other crops, totaling one third of the area.

The planting of fruit trees and pasture was completed in June 1992, consisting of:

Rubber & Jack-fruit	36 ha :	12 ha of rubber and 24 ha of jack-fruit
Rubber & Chempedak	21 ha :	7 ha of rubber and 14 ha of chempedak
Rubber & Durian	46 ha :	16 ha of rubber and 30 ha of durian
Rubber & Pasture	120 ha :	40 ha of rubber and 80 ha of pasture
Pasture (Mono-crop)	20 ha	
Cacao (Mono-crop)	10 ha	(High density, by MARDI)

Orchid plantation was started in April 1991 in 0.4 ha of net covered land.

There are now 33,600 pots of orchids of the following varieties:

Dendrobium Sonia 28	10,800 pots
Dendrobium Sonia 17	8,820 pots
Mokara Chark Kuan	4,730 pots
Dendrobium Sonia 17 M2	4,400 pots
Other varieties	4,850 pots

The yearly total sale of orchid flowers at approximately 30,000 stalks amounts to a gross return of RM 15,000. The annual cost of production is estimated at RM 9,400 and the net return is roughly estimated at RM 5,600.

The dairy project, started in January 1992 with 30 head of cows, has been successful with an average milk production of eight liters/day/head. The total head of cattle as of June 1994, including the introduction of 35 cows in 1993, are as follows:

No. of cows	92 heads
Male calf	46 heads
Female calf	40 heads

(4) Population and Agricultural Employment

The total population of 96 settler families is 586, averaging six family members, including house owner, wife, and four children. The average ages of the house owner is 41, the eldest child is 13, and the youngest is 5. 52 house owners (54%) out of 96 replied that their main job was FELCRA farming work. While, 28 house owners (29%) were engaged in non-farming work outside FELCRA. The remaining 16 house owners (17%) worked as outside plantation labourers. 40% of housewives could not work due to having small aged children. Total working days/family/year on an average is 410; 170 days are spent on FELCRA farming work and 240 days are spent on outside work. When working outside, commuting buses are provided by employers, but it takes 30-40 minutes to reach the working places in Melaka.

(5) Farm Size and Land Tenure

253 ha of the total farm land belongs to FELCRA, and 33 ha of village area, including 4.3 ha of housing area consisting of 108 houses in five blocks, are managed by the State Government.

(6) Farm Management and Marketing

Farming operation is managed by FELCRA staff with technical advice from MARDI, the Veterinary Department, the Rubber Research Institute, and DOA. Orchid flowers are

marketed to hotels and other outlets. The MIADP and the Veterinary Department have helped to find a market for milk and have introduced cows, for the dairy project.

(7) Economics of farm management

FELCRA Bukit Sedanan (FBS) is one of six core re-settlement projects run by FELCRA Melaka. The FBS is established on a piece of state land under the state's group settlement act. The final stage of the FBS would be reached when the settlers' organization would run the farm in a profitably. Until that stage is reached, the FELCRA Melaka has taking the responsibility of managing the plantation as a caretaker in an American sense, while the settlers remain wage earners.

(8) Farm household economy

Regular estate workers are getting a monthly salary of RM 300. As the rubber plantation and several fruit orchards are at their developing stage, the FBS cannot hire all the settlers at the moment. It hires some of them on irregular basis with a daily wage of RM 9.

B. Agricultural Development Plan

(1) Land Use

The main farming plans include a durian re-plantation and an orchid extension.

Around 3,000 durian trees in a 30 ha area planted in 1992, almost perished due to insufficient water and low organic matter content. FELCRA prepared drum cans and drip irrigation especially for the durian but as the durian was so sensitive to these conditions, they did not survive. The re-plantation in this 30 ha will be carefully planned to establish seedlings in an environment with enough organic matter and irrigation.

The orchid extension plan was requested to be located around the settlers' houses in the village area. The size of the netting facility will be same as the present one (0.4 ha). The housing area is divided into five blocks, and each block will plan to have a 0.4 ha of netting facilities with an irrigation system. This village complex (33 ha) including infrastructures and social amenities was set up by the State Government, so land use for orchid net facilities have to be coordinated with the State Government's plan.

In addition to these two programmes, is the MIADP planned upland irrigation programme of 25 ha. This plan has been proposed by the State Government as a land development programme through MIADP for the purpose of agro-tourism development.

(2) Farming and Cropping Plan

Durian seedlings can be grown in new orchid houses by the settlers in association with MARDI and FELCRA. In the farmers meetings held in the FELCRA office in June 1994, some settlers showed a keen interest to create a nursery farm for fruit trees. When the settlers have learned technology to maintain the nursery farm, they will be able diversify into orchid cultivation or other alternatives. For nursery production, it is very important to prepare good soil with sufficient organic matter.

Cow-dung from the cattle farm should be systematically utilized as compost combined with palm oil waste and rubber saw-dust arranged by FELCRA. A large amount of compost has to be prepared for the plantation of 3,000 durian trees in 30 ha. Also, other tree crops will require compost every year before they mature.

Durian seeding will be planned in Aug. and September before the rainy season of October and November. The durian seeds will be introduced from Muar in Johor. A durian plantation will be planned for two years later using two-year old seedlings. Layout of planting, testing of the drip irrigation system and the advanced application of compost will be scheduled before the planting in September and October.

The orchid extension is proposed as group farming with ten settlers for every one unit. The major working labour, except for the initial construction, will be women working four hours (half day) every day. The orchid plan will be aided by FELCRA staff who have gained much experience in the last four years. This cooperation will especially be needed for the introduction of new varieties of high value, including Dendro S.S., and Aranda L.C. According to the 0.4 ha orchid plan (Annex V.3.1) by MARDI, the minimum production is 100,000 stalks per year and the minimum gross income is RM 80,000. However, the proposed target for this project is estimated at half of this figure.

(3) Crop Budget and Production Plan

The durian crop budget and proposed production per ha is summarized as follows:

This table was compiled using data from MARDI and DOA study books. The yield was planned at 70% of achievement in each year. (Annex V.3.2)

Production cost (per yr.)	1st yr.	2nd/3rd/4th yr.	After 5th yr.
1) Seedling trees (100 plants)	RM 300	0	0
2) L.P.& Planting labour	RM 800	0	0
3) Fertilizer & organic matter	RM 300	RM 460	RM 1,100
4) Agro-chemicals	RM 170	RM 417	RM 660
5) Weeding labour, etc.	RM 400	RM 400	RM 200
total Cost/year	RM 2,000	RM 1,300	RM 2,000

6) Harvesting labour cost: After 8th year, RM 200 per 1,000 kg (1t)

Yield & Production (per yr.)	1st to 7th yr.	8th to 13th yr.	After 14th yr.
1) Yield (kg/ha)	0	7,900	9,200
2) Gross return (RM 3/piece)	0	RM 13,500	RM 15,800
3) Net return	-RM 1,700	RM 9,900	RM 12,000

The orchid crop budget and proposed production for one 0.4 ha unit (Annex V.3.3) is summarized as follows:

1) Initial cost	RM 60,000	(Bank loan to farmers group)
2) Annual cost	RM 22,000	(do.)
3) Annual gross return	RM 40,000	(50,000 stalks/yr. @RM 0.8)
4) Repayment of initial cost	RM 8,740	(Bank loan repayment)
5) Annual net return	RM 9,260	(dividing among ten participants)

(4) Employment and Working Opportunity

The durian nursery and the initial investment for the durian plantation needs 2,400 man-days of labour. The total annual maintenance of durian trees will be 600 man-days of additional labourers until the 7th year, when another 3,600 man-days/year of harvest labourers will be needed each year.

The orchid program will need 2,500 man-days of labour in the initial investment stage, and 25 man-days (half-day work by 50 women) of regular work each day in the five units will be created by group farming (cooperative management).

Besides these two programs, a compost manufacturing factory and a plastic resin handicraft facility will require five man-days of labourers every day, all the year round.

In total, the annual employment or working opportunities in FELCRA will be increased to approximately 30,000 man-days/year which is a rise of 80% from the present 16,659 man-days of employment.

(5) Farm Management Plan and Farm Budget

The durian program will be managed by FELCRA. Hired labour costs should be planned as at least RM 10 per day. The orchid program will be managed by a settlers group of ten settlers selected and guaranteed by FELCRA and will use a Bank loan for the initial investment cost of construction of net facilities, sprayers, seedlings and other farm inputs. This loan repayment will be shared by the ten group members at RM 73/month each. Each

group member earns RM 273 monthly with 15 days of work or 30 days of half-day work. Therefore, the net income per member will be RM 200/month.

For the first two years, the managing of the orchid program should be assisted by FELCRA, while a group manager of the members will take turns with monthly duty. After two years if all the members agree, group members will be able to select an orchid manager and a treasurer.

(6) Marketing Plan

Since the durian plantation and other tree crops, require a large amount of compost, a compost manufacturing factory is proposed in the FELCRA, Bukit Sedanan site. FELCRA has a palm oil factory in Muar, which burns its oil palm wastes. Oil palm trucks are going from Melaka to Muar full of oil palm, but returning empty. FELCRA staff of the agricultural division at the head office in Kuala Lumpur. have eagerly requested to include a compost factory to utilize the oil palm waste as well as the cow dung in Bukit Sedanan.

FELCRA will help the settlers' orchid program to find new markets but presently, a lot of waste flowers or useless flowers will remain unsold.

The women's society in the project area requested part time work in handicrafts at the FELCRA women's meeting held in June 1994. Therefore, a handicraft facility of coating dried orchid flowers is proposed with plastic resin for this project (Annex V.3.5). According to a similar plastic resin factory in Batu Cave KUALA LUMPUR., the initial investment for the machine costs around RM 20,000, and the production capacity per one person/day (woman labourer) is 100 key-holders. With this facility, around 10% of the orchid produce will be used for handicraft accessories. For this facility, a drying technology is the most important factor. An electronic range can be used for this purpose.

The marketing of these accessories can be done in tourist areas all over the country as they are new and very cheap products.

FELCRA staff at the head office have recommended the use of a special loan for small scale industries for this programme.

C. Implementation Plan

(1) Government Services

Many government agencies are related to this project and FELCRA Bukit Sedanan. As already mentioned, the financial allocation for the constructions of infrastructures and social amenities were contributed by the State Government, the dairy project was financed by MIADP, and the technical advice is given by MARDI, Veterinary Department, Rubber Research Institute, and DOA.

A new assistance and support services for irrigation facilities by DID will yield much benefit for the settlers as well as the related agencies and FELCRA. Irrigation facilities in the durian farm (drip irrigation) and the orchid farm (mist blower) should be operated and maintained by DID for a few months after the completion of the facilities. Before handing-over the facilities to FELCRA or farmers groups, DID have to instruct and advise on the operation and maintenance of the facilities.

FELCRA should consult with the MARDI staff and get technical advice on durian plantations and orchid cultivation.

As for the compost factory, FELCRA staff in head office have to arrange the lorries and compost materials such as oil palm waste and saw-dust. MARDI, DOA, MIADP, and Veterinary Department will help in compost making and usage. The compost will be used not only for tree crops, grass land, and orchids in the project area, but also for other areas of FELCRA.

Durian plantation and a compost factory are planned as a FELCRA managing project. However, the orchid program and a handicraft manufacturing facility are planned as semi-FELCRA projects. The management of these two programs will be handed over to the farmers group (farmers organization) in the near future after the group members learn about the management of these facilities. FELCRA staff have to help in management of the farmers groups for the first few years.

(2) Farmers Organization

The project development committee has been organized since 1991, holding monthly meetings with FELCRA and other agencies in order to communicate on economic activities and grouping operations. There are six committee members among farmers (96 settlers). They are not representatives of each Block, and three members were selected from Block 3. Therefore, a block-wise organization has to be set up in every block especially in the

women's society in order to plan an orchid farm using group farming with ten members each. The orchid and handicraft plan will start at Block 3 or Block 2 at the first stage since most farmers agree to operate with group farming.

Settlers interest in the farming in each Block as surveyed by the farmers interview is shown below:

Block	Houses	Work in Felcra	/ Outside	Will of G.F	Farm successor
Block 1	17	10	7	5	1
Block 2	21	10	11	16	13
Block 3	20	13	7	20	19
Block 4	20	10	10	7	5
Block 5	18	10	8	12	6

G.F.= group farming

(3) Women's Participation in Development

According to the result of farmers interview survey (Annex V.2), 57 settlers answered that only the husband works in their families, 51 settlers have small children under three years old, and there are 24 working wives including 6 FELCRA labourers. There is a kindergarten established two years ago with help of JOCV(JICA volunteer) but there is no day-nursery for small children. Wives holding small children cannot go to work outside. Therefore, the orchid and handicraft program will help women, enabling them to work in a part time jobs near their houses.

The Women Society established in 1991 has to be re-structured for each Block in order to start the orchid and handicraft program. With this program, 55 women will be able to work every half day with a wage of RM 200/month.

5.5.5 Infrastructures

A. Present Condition

(1) Irrigation and Drainage Facilities

The FELCRA area has existing irrigation facilities including a mini-dam with a height of 7 m, a small reservoir of about 20, 000 m^3, and a pump and simple pipe line system for a few hectares. On-farm irrigation is also carried out in some orchard areas and orchid houses using a drip irrigation system.

The MIADP area has no existing irrigation facilities.

(2) Social Facilities

Since a resettlement project for sea fishermen has been implemented in the FELCRA area, social infrastructure in and around the FELCRA area including access and farm roads, electric distribution lines, domestic water supply facilities, and accommodation has been constructed and is well maintained at present.

B. Water Resources Development Plan

(1) Irrigation Water Requirements

In accordance with discussions among FELCRA, State DID and the JICA Study Team during the field survey period of the Feasibility Study, the typical type and/or kind of orchard used for the calculation of the irrigation water requirement was adopted as durian.

Horticulture cultivation in MIADP area is of a general type for all seasons.

The irrigation water requirement for durian and vegetables is basically calculated by adhering to the procedure of the FAO Irrigation and Drainage Paper No. 24, and durian is also calculated in reference to the MARDI's paper "Estimated water requirement of some Malaysian commercial fruit crops" from the Prosiding Symposium Buah-buahan Kebangsaan 1991.

Potential evapo-transpiration (ETo) is estimated at 1,354 mm/year using the modified Penman method, based on meteorological data from the Melaka airport station.

Irrigation methods are designed as drip irrigation for durian and drip and/or micro jet sprinkler irrigation for vegetables.

For vegetable cultivation, 90% of the potential evaporation is applied in calculating the irrigation water requirement, and effective rainfall is not applied because of the rain shed cultivation method.

The irrigation water requirement for the design of irrigation facilities is based on a proposed cropping pattern of the agriculture development plan for the Projects shown below.

Pilot Project	Cropping Pattern	Peak Irrigation Water Requirement (l/sec/ha)
MA16	Durian	0.39
	Horticulture	0.42

A detailed calculation and explanation of the irrigation water requirement are described in Annex - 3.

(2) Reservoir Capacity

Reservoir operations of the Montagor dam are calculated for each half month period based on the estimated runoff at the proposed dam site, the irrigation requirement, and reservoir water loss from seepage and evaporation, involving the effective storage of the existing farm pond in the FELCRA area. Reservoir operation calculations are made using runoff data from 1960 to 1990.

As a result of these calculations, the reservoir capacity required to cope with the drought year with a return period of 5 years, is clarified as follows :

Pilot Project/Reservoir	Type of Reservoir	Capacities(1,000 m^3)
MA16 Montangor	Homogenous Earthfill Dam	230

The detailed calculation and explanation of the reservoir operation are described in Annex - 3.

(3) Drainage Water Requirement

Since drainage facilities for the Project are not required because of the use of rain shelter orchard plantation and vegetable cultivation, drainage water requirement is not computed.

C. Project Works

The general lay out of the water resource development and irrigation development is shown in Fig. 5.5.1. Prominent features of these facilities are as follows:

(1) Water Resource Development Facilities

In designing the Montangor dam, a stability analysis of the dam slope was confirmed using geological data obtained through a boring survey and a soil mechanical test. Seepage water loss from the reservoir, especially that from the dam foundation were also examined.

Montangor Dam and Reservoir

Reservoir

Total storage capacity 250,000 m^3

Effective storage capacity	230,000 m^3
Dead storage capacity	20,000 m^3
Dam	
Type of dam	Homogenous Earthfill
Height of dam	11.5 m
Crest width of dam	5. 0 m
Length of dam including grass spillway	246 m
Dam slope	
upstream	1 : 3.0
downstream	1 : 2.5
Crest elevation of dam	EL 56.50 m
Deign flood water level	EL 55.20 m
Normal water level	EL 54.00 m
Low water level	EL 49.00 m
Emergency spillway	
Type of spillway	Grass spillway (rectangular chute type)
Design flood discharge	8.4 m^3/sec
Base elevation of chute channel	EL 54.54 m
Total length	212 m
Base width of spillway	8 m
Inside slope of lower channel	1 : 1.5
Gradient of channel	1 / 200
Height of lower channel	1 m
Culvert spillway	
Type of spillway	Tower type (box type)
Design flood discharge	4.3 m^3/sec
Crest elevation of spillway	EL 54.00 m
Height of spillway	9 m
Type of barrel	box barrel 1.8 m x 1.5 m x 1 no.
Total length	88.5 m
Incidental facilities	Operation bridge, total length 20 m of 3 spans
Access road	
Type of road	Pavement road with laterite (w =3 m)
Total length	260 m
Width of road	5 m

(2) Irrigation and Drainage Facilities

Irrigation area	61.9 ha (durian 36.9 ha in FELCRA area, and vegetable 25 ha in MIADP area)
Pump station	3 sites (FELCRA area 2 sites, MIADP area one site)
Pump(Submergible pump)	
2.5 kw (h=20 m)	2 units.
4.0 kw (h=30 m)	4 units.
7.0 kw (h=50 m)	2 units.
Pipeline	PVC pipe line, FELCRA area 3.6 km and MIADP area 0.2 km
Farm pond	I site (MIADP area), 300 m^3
On farm facilities	Drip irrigation facilities 61.9 ha

(3) Infrastructures for the Projects

Demolishing and reconstruction of existing culvert	1 no.

D. Construction Plan

Mechanical construction methods will be applied for construction of the Project. Major construction consists of the Montagor dam and related structures, a pump station and a farm pond.

The diversion of river flow during the construction of the dam will be made by culvert spillway. Prior to commencement of the dam embankment, construction of the barrel portion of the culvert spillway shall be completed. The construction program of the dam body is scheduled to start from both hillsides to the center of the dam.

The main construction volume, including the dam body embankment and the excavation of emergency spillways of the Montagor dam, and concrete work of the culvert spillway, are roughly estimated at about 55,000 m^3 of embankment, about 33,000 m^3 of excavation, and about 500 m^3 of concrete works.

Taking into consideration the construction volume mentioned above, the construction schedule is estimated at 9 months, consisting of 1 month for mobilization, preparatory work and demobilization periods, and 8 months for the construction period.

E. Project Cost Estimate

(1) Unit Price Analyses

The unit prices of the respective works of the project are estimated by up dating the bidding prices for similar works of other projects in Melaka, and the Government price schedule issued in 1993, which uses the annual inflation rate of commodity issued by the Central Bank of Malaysia. The unit prices of these works are estimated at 1994 price levels.

The updated unit prices of the respective works are shown in Annex - 3.

(2) Construction Cost Estimate

The total construction cost, consisting of direct construction costs, land acquisition costs and physical contingency is estimated at about RM 4,795,500 at 1994 price levels, as shown below.

Physical contingency is estimated at 15% of the direct construction cost.

	Description	Cost (RM)
		Bukit Sedanang
1	Direct Construction Cost	3,688,800
2	Land Acquisition	0
3	Physical Contingency	553,300
4	Engineering Cost	368,900
5	Administration Cost	184,500
	Total	4,795,500

The detailed cost estimates are shown in Annex-3.

5.5.6 Project Evaluation

A. Project benefits

Project benefits are represented by the production from 37 ha of durian orchard and 2 ha of orchid nurseries. Both are new investments with necessary facilities being provided by this project. The latter will be an expansion of the existing nursery of 0.4 hectares

The financial data of both durian orchard and orchid nursery are from MARDI except the costs of orchid cultivation which is based on our agronomist's calculation.

The water use of our proposed dam is shared by the MIADP project which is to be implemented at the left bank. We presume that the MIADP would grow vegetables on 25 ha of its project area with the intensity of 300% and that a unit net income of the cultivation would be RM 10,000 /ha/crop.

B. Evaluation of the project

(1) Some suggestions on FELCRA's activities

A differentiation of categories of costs between recurrent and research in the activities of FBS may somewhat relieve the dilemma it has been in. FBS itself, seems to be an experimental venture. Teaching fishermen how to practice agriculture might be as difficult as inducing nomadic people to lead pastoral lives.

It might as well help young residents to form an agricultural club, like 4H club to give them chances to observe, experiment, or participate in some of the interesting farm activities.

Crèche operation:

The subsidy may be shared by some relatively well-off parents to certain extents; but not much any more. The rest, however, ought to be transferred to the coffer of the concerned ministry, as it could only be maintained by the federal level. The child care forms itself, after all, the backbone of the national social security and human resources development policies.

(If the teachers' ability is improved as is stipulated by the Ministry of Human Resources, a teacher could take care of ten children at a time instead of five with monthly salary of RM 350. The subsidized salary at the local level would be reduced to RM 15 per child from RM 30.)

(2) EIRR

a. Assumption for cost estimates

Costs of the dam construction is shared by the MIADP project which is to be implemented at the left bank of the Mentangor river. The formula is (37 + 2*3)/(37 + 2*3 + 25*3) = 36%. According to their plan they will grow vegetables, so intensity of water use in horticulture is presumed to be three times more than for orchards.

b. Economic internal rate of return (EIRR)

We calculate the EIRR of both FELCRA and MIADP projects combined.
EIRR is estimated at 21%. (See Table 5.5.1) This fact indicates that if market and work force are available vegetable cultivation could achieve a higher net income than fruit cultivation.

c. Sensitivity analysis

The market prices of both fruits and vegetables may change, and technical problems during cultivation may occur. So if we assume 10% decrease in net income, the EIRR would be estimated at 17%. Though our cost estimates include 15% physical contingencies, a further increase of 10% in construction costs decreases the EIRR down to 19%. When both happen simultaneously, the EIRR is 16%.

(3) Financial consideration

Maintenance work of the pump stations and pipelines with dip irrigation systems would be better carried out by the management of FELCRA Bukit Sedanan with its own budget arrangement. Water rates would be shared with MIADP to cover the maintenance and operation cost of the dam.

(4) Labour force situation

Our project will provide some employment opportunities in FBS area to the settlers, especially orchid nursery work for women. It will be a step forward to achieving group farming when FBS becomes a fully developed plantation.

(5) Household economy

The generation of job opportunities within FBS area will make some of the so far latent labour force, especially women with children, economically active.

5.5.7 Environmental Issues

(1) Present Environmental Conditions

The project was started in Bukit Sedanan as a Fishermen Resettlement Project with a cultivation area of 254 ha. The new village area of 39 ha was set up with infrastructures and social amenities. The farm roads in the project area cover an area of 15 ha and the swampy and river area occupy an area of 23 ha. The soil is Bongor series which is suitable for tree crops. The soil is local alluvium in the lowland area but is unsuitable for cultivation especially during the rainy season. There is no flooding problem in the study area, and there is natural drainage outlets to small streams.

The major vegetation in the study area includes rubber, cacao, jack fruit, cempedak, durian, and pasture. Glyricidia is planted adjacent to cacao to act as a shadow crop, and will be poisoned after 3 years. Orchids which are grown over 0.4 ha include dendrobium, oncidium, mokara, and aranda.

There are 178 dairy animals and 30,000 broilers. There is no major wild life in the study area, except for occasional cobras from the nearby forest. There are tilaphia, grass carp, and big head carp in the existing pond, and there are catfish and quail in the swampy areas.

There is a Women's Organization in the farm which is called FELCRA's Dynamic Women Society (WADIRA - Wanita Dinamic FELCRA) which carries out activities like conducting classes on sewing, cooking, and religion. At present 6 women are employed in FELCRA farm and 30 women are working in the factories in the nearby area.

There is no serious common disease in the project area, except for one case of asthma, two cases of leg pain, one case of gall stone, one case of brain disease, two cases of heart disease, and four cases of blood pressure among the 586 farm family members.

The major environmental problem in the study area is soil erosion in the hilly areas. Concrete structures were built in the village area to prevent soil erosion, and some of the swampy area near the village area is planted with grass cover. However due to land clearing, erosion has occurred in the farm area. Because of sediment transportation, the existing pond depth has reduced from 5 m to 3 m at the center. A drain was already constructed to clear soil sediments but this has been a tedious process. Movement of soils from the earthen roads is also high and there is a necessity to upgrade them to laterite roads. However because of budget problems, these roads are planned to be constructed only after 2 or 3 years when the project is finished. At present, only the main access to chicken farms and dairies are provided with laterite roads.

(2) Water Quality

In Bukit Sedanan, Melaka, water quality samples were taken at 4 locations; 1. the existing pond, 2. the pond near the durian farm, 3. Sg.Montangor tributary, and 4. Sg.Montangor tributary at the forestry area.

As shown in Table 5.5.2, pH of the water is slightly acidic; however the pH is within the Interim National Water Quality Standard (INWQS) range of 5 to 9. In Malaysia, many crops thrive even when the pH is 4.5. The main parameters including dissolved oxygen, BOD, COD, and ammoniac nitrogen are also well within the standard values. EC is very low and the salinity is negligible.

The colour of water is an important parameter for aesthetic considerations and the standard of colour for drinking water is 15, and for raw water less than 150. The colour of the water at these three locations is less than the standard for raw water supply. Turbidity, dissolved solids, and suspended solids of the water are also less than the standard for raw water supply.

Alkalinity of the water is lower than the recommended value of 20 mg/l. Hardness, chloride and fluoride of the water are within the standard values. There is no standard on the limit of silica for irrigation water and a standard of 50 mg/l is recommended for drinking water, however the silica level is low in all the three locations.

The iron contents of the water at the pond near the durian farm (location 2) and at the Sg. Mentangor tributary (location 3) are higher than the irrigation water standard of 1 mg/l. Normally 1 mg/l is recommended for sprinkler irrigation; and 5 mg/l and 20 mg/l is recommended for flood irrigation and fine texture soils, respectively Although 1 mg/l is used as the interim standard value, the international standards of 1 to 5 mg/l are recommended for

sprinkler irrigation by the University of Malaya consultant group on water quality (DOE,1986). Foliar injury of tobacco plants occurs when waters with high iron are sprinkled over the leaves. The levels of iron are normally higher in reducing conditions such as ground water, and lakes. The toxicity of iron is usually related to acid conditions which cause great solubility of iron. In Melaka, because of stagnate water with poor aeration, the iron contents were slightly high. Recommended methods for removal of iron from water include aeration and settling, and precipitation to make the water alkaline.

(3) Environmental Impacts of the Project

Significant positive impacts of the project are expected with regard to the water balance of the project area. At present the durian crops seem to be suffering in water stress and the development of irrigation facilities will provide enough water for these crops. The land use shall also improve significantly after the availability of more water for irrigation. The farm is planning to increase the number of broilers by 25,000 after the implementation of this small reservoir development project. The socio-economic conditions are also expected to improve through this project. At present 59 settlers are employed in the farm and the project is expected to provide employment for at least 15 more settlers.

The negative impacts of the project shall be soil erosion and soil sedimentation which may occur due to land clearing. However this problem can be solved by covering land with suitable crops or grass after the construction of the small reservoir.

5.5.8 Agro-Tourism

The project area is located 33 km from Melaka. Many tourists from Singapore and other places are visiting Melaka. However the historical area in Melaka is relatively limited and especially for the tourists visiting for the second time, there are very few places to see. So tourists have to spend their time shopping and on other activities. The project area is located on the main road to Selandar with access from Melaka and is accessible by bus and taxis. The project area is located at 12 km from Auyin hill which is also an important tourist attraction in the area. Adjacent to the project area, there is an MIADP area which is being planned as a tourism area with dear farming and horticulture.

In regard to agro-tourism, the project area is suitable for fruit parks including durian, cempedak, and jack fruit. The orchid area shall also be increased, and fishing activities shall also be carried out in the existing pond. If chalets, rest houses and restaurants are built, the tourists can stay at the site for one or two days.

Although FELCRA also has an idea to develop agro-tourism in this project area, the immediate attention is focused on continuing the present farming activities. Most of the fruit trees like durian are at the beginning stage and full fruit cultivation may start only after 4 to 5 years. Once the full cultivation starts, FELCRA can pay back the loan to the World Bank, which was obtained for developing the area. Only then the area can be handed over to the farmers. Therefore agro-tourism will not be considered by FELCRA for some period of time.

5.6 KELOMPOK KANGAR MERLIMAU (JR10).....Johor State

5.6.1 General

The project area is located about 5 km east of Parit Sulong, Batu Pahat District. It comprises an orchard of 36 ha on hill slopes A group of farmers started fruit cultivation in 1986. Fruit trees used to suffer from water stress during the dry season.

Objectives of the project are:

(i) to modernize the fruit cultivation providing irrigation and farm access; and
(ii) to develop agro-tourism taking advantage of its location on the tourism route from Singapore.

A spring at the skirt of the hill is used as a water source. There will be no particular environmental problem related to the project.

5.6.2 Climate, Hydrology and Water Resources

Climatic characteristics in this area are similar to those of MA16. The rainfall distribution in a year also shows a similar pattern to Bukit Sedanan, Melaka, but the amount of rainfall in/around this area is more, 2,347 mm per year.*5 The rainfall pattern through the year is shown in Fig. 5.2.1. Both in terms of quantity and distribution of rainfall, this project area has the best potential among the pilot projects.

Parit Kangkar Merlimau, an artificial drain, is running through the project area receiving consistent flows from near-by springs. A notable characteristic of this catchment is its high and stable base flow in spite of its small catchment area of 1.4 km^2. During the field investigations, it was confirmed that the discharge of the drain is constant even after short dry periods of one week. The minimum discharge measured during the study period was 40 l/sec.*6 According to the farmers living along the drain, the water level in the drain is almost constant throughout the year, and seldom has flooded.

It is considered that the peat soil layer which covers the lowland in the area has a high water holding capacity, sustaining a consistent flow and a flood-free condition. There are

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*5/ Rainfall records at Parit Sulong (DID No.1929064), 1951-1990

*6/ Based on the records until the end of August 1994.

several springs along a swampy area on the right bank of the drain. This drain and near-by springs are considered to be the main water source for this area. Since this water comes from the springs, the water itself is very clean and clear without any sediment.*7 Farmers are currently taking this water for domestic use. Drinking water is being extracted from a well located on the hill side of the right bank.

5.6.3 Agriculture

A. Present Condition

(1) Land Use

The total farmland area managed by a farmers group of 36 farmers is 111 ha. Of this, a newly developed area of 36 ha on a hillside consists of fruit trees, including durian, duku langsat, dukong, rambutan, mangosteen, chempedak, and banana. These were planted in 1987-88 by the farmers group with assistance from DOA. The other 75 ha is small holding plantations of rubber, oil palm, and coffee. Most of the plantation crops have already matured, and are the main source of the farm's income.

(2) Soil and Land Capability

Three soil series are found in the area; the Serdang series which is brownish yellow and very sandy and dominates the upper part of the hill, the Yong Peng series which is dark reddish brown and very clayey at the middle of the hill, and Shallow peat in the low land which is dark organic matter with very little sand, silt and clay.

Characteristics and properties of those soils are summarized as follows:

Serdang series:	Sandy loam to sandy clay loam , high water permeability, low pH at 4.1 , 1.5-2.5% of organic carbon, and low to very low CEC (Cation Exchange Capacity).
Yong Peng series:	High clay content at 60% and more, low available water, acidic pH at 4.2-4.4, moderate carbon content (1.5-3.0%), and low to moderate CEC.
Shallow peat (Nami series):	More than 90% of organic material and less than 10% of sand, silt and clay, high water table 10 to 30 cm from the surface, very acidic pH at 3.8-4.1, and very high CEC.

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*7/ Refer to the Annex VI, "Environment".

Serdang and Yong Peng series are moderately suitable for most fruit trees. The major constraints are the long steep slopes, and the low natural fertility of low pH and CEC with scarce organic matter. The shallow peat area is recommended for vegetables, banana, and pineapple.

(3) Agricultural Production

The total number of fruit trees is 3,140 trees, excluding 3,500 (4 ha) of banana. The details are as follows:

1) Durian	2,084 trees	approx. 21 ha
2) Duku Langsat	405 trees	4 ha
3) Dukong	293 trees	3 ha
4) Rambutan	189 trees	2 ha
5) Mangosteen	99 trees	1 ha
6) Chempedak	70 trees	1 ha
7) Banana	3,480 trees	4 ha

Most of the fruit trees have not matured. Except for the banana, production is only 6% (RM 510/ha/year) compared to an expected income (RM 8,700/ha/year) in the future.

The banana's average yield is around 10 t /ha.

(4) Population and Agricultural Employment

The total population of 36 farm families is 191, excluding 77 separately living children. The average family size is five members, which includes the house owner, wife and three or four children. There are 20 children over 18 years old who live with their parents. The average age of the house owner is 51 years old, except for one farmer aged 105 years old. 19 farmers are full time farmers, 14 are part time farmers who have other regular jobs including teacher, technician, hospital attendant, and factory worker, and 3 farmers earn their income through pensions.

Total working days are 18,000 man-days (500 /family) combining 34% of home farming and 66% of outside work. 16 housewives (44%) are engaged more or less in home farming or in outside jobs, and 18 children are working only in outside jobs.

(5) Farm Size and Land Tenure

Farm size ranges from 0.3 ha to 3 ha based on the number of trees as shown below :

Maximum fruit tree owners 310 fruit trees (3 ha)

Minimum fruit tree owners 14 fruit trees (0.2 ha)

more than 200 fruit trees	4 farmers	10 ha
100-199 fruit trees	9 farmers	13.5 ha
50--99 fruit trees	11 farmers	7.7 ha
20--49 fruit trees	7 farmers	2.1 ha
1--19 fruit trees	3 farmers	0.3 ha
Presently preparing	2 farmers	2.4 ha

Out of 36 ha, approximately 23.5 ha is owned by 13 farmers, and the remaining 12.5 ha is owned by 23 farmers. The former are full time farmers, and the latter are mostly part time farmers.

(6) Farm Management and Marketing

The farmers group (Kelompok tani) was organized by DOA, and an extension worker is always attached to this group. The group has a meeting hut, and a DOA officer and extension worker have been helping in the management of fruit tree cultivation.

Batu Pahat is a famous fruit production district, known as "Johor three" together with Muar and Pontian. This project area is covered by the south-west Johor DOA extension office situated in Yong Peng city. The DOA staff members in this project give excellent cooperation to the farmers and have good knowledge of fruit cultivation. DOA also assist in the marketing of fruit products through private dealers not only in the domestic market, but also in Singapore.

(7) Economics of Farm Operation

The production cost and return of 23.5 ha by the 13 farmers are summarized as follows:

1)	Nos.of total fruit trees	2,141 trees (out of 3,140 trees by 36 farmers)	
2)	Nos.of harvesting trees	343 trees (out of 497 trees by 36 farmers)	
3)	Annual cost for fruit tree maintenance	RM 26,625	RM 1,133/ha
4)	Fertilization cost	RM 14,780	RM 630/ha
5)	Fruit gross return	RM 12,000	RM 510/ha
6)	Expected future return	RM 205,000	RM 8,700/ha

The farm operation by the 36 farmers in total calculation, including small holding plantation tree crops, 73% of which are already in harvest, is summarized as follows:

1)	Nos.of total tree crops	18,517 trees (3,140 fruit trees & 15,377 plantation trees)	
2)	Nos.of harvesting trees	11,799 trees(497 fruit trees & 11,302 plantation trees)	
3)	Annual cost for all tree crops	RM 36,203	RM 326/ha
4)	Fertilization cost	RM 19,942	RM 180/ha
5)	Total gross return	RM 119,610	RM 1,078/ha
6)	Expected future return by all tree crops	RM 488,700	RM 4,403/ha
7)	Total work days / yr. at present	6,738 man-days/yr.	61 m.d/ha /yr.
8)	Hired labourers	1,263 man-days/yr.	11.4 m.d/ha/yr.
9)	Total net return 5) - 3)	RM 83,407	RM 751/ha
10)	Net return per working day 9) / 7)	RM 12.4	

(8) Farm Household Economy

The orchard is only eight years old, and no members live on the produce from the project areas. The majority of the members are involved in agriculture near the project site. There is only one full-time fruit grower among the members.

B. Agricultural Development Plan

(1) Land Use

The land use has not changed in 36 ha of the fruit tree area. It is necessary to install a new drip irrigation system with pipe lines. These on-farm works should be done by the farmer's own efforts with the guidance of DOA staff. With maturing of the fruit trees, the access farm roads for the transportation of harvested fruits, should be upgraded. These problems on irrigation and land use shall be discussed in the farmers group meetings with DOA staff.

(2) Farming and Cropping Plan

The main subject of this project is water management and the effective use of fertilization. After completion of the irrigation system, too much irrigation water without the application of organic matter will cause soil erosion in the steep hill-side, especially the upper part of the very sandy soil. Therefore, careful managing of water and fertilization will be needed. The application of higher amounts of compost or organic matter is one of the solutions to solve this problem.

(3) Crop Budget and Production Plan

Durian can to be harvested in the 7th or 8th year, which is the age of the durian in this project area. However, the maturing seems to be delayed due to insufficient water and organic matter. Therefore, the crop budget for the maintenance of the durian has to be strengthened for the fertilization of enough organic matter with the irrigation project. According to the DOA guide-book on durian cultivation, 4,000 kg of compost and 900 kg of compound fertilizer per ha are recommended (40 kg of compost and 9 kg of fertilizer per tree), after the 8th year.

Fertilizer is expensive and not very effective on the steep slope of the project area. Therefore, at least 50 kg/tree of compost should be applied before the chemical fertilizer in order to achieve high yields in the future. The cost of compost will be reduced through cost group operation of compost making. Durian production will achieve the target of 8t /ha within 5 or 6 years, and the final target of 9t /ha, after 7 or 8 years. The targets were planned as 70% of the DOA book.

(4) Employment and working opportunities

For this project, the additional labour requirement necessary for water management and fertilization of the 36 ha area will be 3,744 man-days/yr., at a rate of 2 m.d/ha/week.

(5) Farm Management Plan and Farm Budget

The farm management plan will be discussed in the farmer group meetings with the help of DOA staff. They should take note of following subjects :

1) Schedule of on-farm water management by group operation
2) Systematic arrangement of farm inputs such as fertilizer, compost, etc.
3) Scheduled application of compost and lime with group operation
4) Cooperative work in the preparation of access roads for harvesting

The management will be lead by 13 large scale fruit farmers. The farm budget on the maintenance of fruit trees will be proposed by DOA staff by modifying a model budget of durian production as outlined in the following table (Annex V.3.6).

Production cost (per ha / yr.)	after the 8th year
1) Compost (5,000 kg)	RM 500
2) Fertilizer	RM 1,100
3) Agro-chemical	RM 300
Total cost/year	RM 1,900/ha /yr.
6) Weeding and harvesting labour (Family labour)	

Yield & Production (per yr.)	8th to 13th yr.	After 14th yr.
1) Yield (kg/ha)	8,000 kg	9,000 kg
2) Gross return (RM 3/piece)	RM 13,700	RM 15,800
3) Net return	RM 11,800	RM 13,900

(6) Marketing Plan

The marketing plan of the farm produce will be prepared by DOA, based on the growth of the fruit trees. The marketing plan of farm inputs, compost making, and supply to every farm, will be organized and supervised by DOA as a group operation. The marketing of fertilizer and lime will also be assisted by DOA.

C. Implementation plan

(1) Governmental Services

Since this has been a DOA project since 1986, DOA has provided many services to the farmers group. Fortunately, the group members also have a high level of knowledge on tree crops cultivation, and they are rather rich farmers with small holding plantation tree crops. The fruit trees in 36 ha will be in the growing stage for a few years more, and it is likely that the maturity of the trees may be delayed due to insufficient water supply and poor compost application in the past, because of steep slopes on the hill. After this irrigation project, DOA staff has to instruct the methods on tree crops management with irrigation and compost arrangement in detail, by attending the farmers group meetings at the project site. DID has to help DOA for irrigation not only in the construction works, but also in on-farm water management.

(2) Farmers Organization

This farmers group (Kelompok) was one of the first organized groups in Johor State, and also registered as a cooperative. As mentioned already, the 13 leading farmers out of the

36 members are mostly full-time farmers covering more than 60% of fruit land and production. Therefore, irrigation facilities will be designed first for these 13 farmers since they are full-time farmers, and they should be responsible to supply water for the other adjoining farmers and to operate and maintain on-farm water management in each block.

Another major work in the farmers group (Kelompok) is to make compost with the help of DOA staff. Compost making will be carried out in some leaders' farm houses. By using a simple machine, they can sell compost to the other farmers. The supply of compost materials, such as oil palm waste, saw-dust, and molasses can be arranged by DOA.(Annex V.3.7). Chicken-dung will be needed more in future for the purpose of compost making, and therefore every house should enlarge poultry farming.

(3) Women's Participation in Development

According to the interview survey, women's working days total only 3,500 man-days (19%) by 16 house-wives among the total 18,000 man-days of all the farmers. However, most wives keep some chickens and goats in their house yards. Every farm house holds 20-30 chickens, and chicken-dung is a good organic manure for trees crops. In the average case, annual chicken-dung is estimated at around 150-200 kg, but due to free raising all the chicken-dung cannot be collected. When making the compost by molasses, the compost can be fed to chickens with kitchen garbage. The number of chickens will increase rapidly and will result in enough chicken-dung for 36 ha of fruit trees. Therefore, women will play an important role in the development of the fruit tree project.

5.6.4 Infrastructures

A. Present Condition

(1) Irrigation and Drainage Facilities

Small drip irrigation plots of about 0.2 ha are scattered in the hill slope, and the water resource is seepage water from a domestic water tank constructed on the hill top and/or water pumped up from the Kangar Merlimau stream.

(2) Social Facilities

Access roads to the Project area are one State road and one access road to the domestic water supply tank which is constructed at the hill top. Both access roads are well maintained, but farm roads in the Project areas have not been constructed. An electric distribution line has not been constructed in and around the Project area.

B. Water Resources Development Plan

(1) Irrigation Water Requirements

The majority of orchards are durian, with some dokong and duku orchards. The irrigation water requirement for the Project area is calculated on a summation of the irrigation water requirements of each 3 crops.

The irrigation water requirement is calculated using the procedure of the FAO Irrigation and Drainage Paper No. 24, and also the MARDI paper, "Estimated water requirement of some Malaysian commercial fruit crops", from the Prosiding Symposium Buah-buahan Kebangsaan 1991.

Potential evapo-transpiration (ETo) is estimated at 1,120 mm/year using the modified Penman method, based on meteorological data from the Johor Baruh International Airport station.

Irrigation methods are designed as drip irrigation because of the orchard cultivation.

The irrigation water requirement for the design of the irrigation facilities is shown below.

Pilot Project	Cropping Pattern	Peak Irrigation Water Requirement (l/sec/ha)
JR-10	Durian, Dokong & Duku	0.25

A detailed calculation and explanation of the irrigation water requirement are described in Annex - 3.

(2) Reservoir Capacity

Reservoir operations at the proposed pump station site are calculated for each half month period based on the estimated runoff, irrigation requirement, and reservoir water loss from seepage and evaporation. Past runoff from 1952 to 1990 are applied in calculating the reservoir operation. As a result of the calculation, it can be clarified that water for irrigation is sufficient and reservoirs and/or ponds for irrigation are not required. Therefore, the reinforcement of facilities of existing springs and the integration of water resources such as springs and the Kangar Merlimau stream, shall be required for the Project.

A detailed calculation and explanation of reservoir operations are described in Annex-3.

(3) Drainage Water Requirement

Since the proposed orchard of durian, dokong and duku will be planted on the hill slope and evacuation of excess water will naturally flow out, drainage facilities in the Project area are not envisaged. The existing Kangar Merlimau stream will need to be widened down steam at the intake gate structure, enabling the flood discharge of a return period of 10 years, to flow out at 3.6 m^3/sec.

C. Project Works

General layout of the water resource development and the irrigation and drainage development is shown in Fig. 5.6.1.

Prominent features of these facilities are as follows :

(1) Water Resource Development Facilities

Bund of spring	H x W x L, 1.0 m x 3.5 m x 90 m
Spillway of bund	H 0.7 m x L 2.0 m x W 2.3 m
Intake gate structure	1 no.
Gate structure	1 no.
Canals	460 m of 2 nos.
Drains	85 m

(2) Irrigation and Drainage Facilities

With regard to the layout of the PVC pipeline, the occurrence of water hammers in the pipeline are examined during the cessation of the water supply, using longitudinal sections of the pipeline and the energy line of water in the pipeline.

Irrigation area	50 ha
Pump station	3 sites
Pump(multi stage pump)	
7.5 kw (h=70 m)	4 units.
11.0 kw (H=70 m)	2 units.
Pipeline	1,840 m
Pressure regulation valve box	1 no.
Farm road	1,780 m

On farm facilities Drip irrigation facilities 50 ha

(3) Infrastructures for the Projects

Access road to pump houses : 605 m (3 nos)

D. Construction Plan

Mechanical construction methods will be applied for construction of the Project. Major construction consists of the pump station, pipe line, and access and farm roads.

The main construction volume including the embankment of the access and farm roads, and the concrete work of the pump station, are roughly estimated at about 11,600 m^3 of embankment, about 3,000 m^3 of excavation, and about 150 m^3 of concrete works.

Taking into consideration the construction volume mentioned above, the construction schedule is estimated at 6 months, consisting of 1 month for mobilization, preparatory work and demobilization periods, and 5 months for the construction period.

E. Project Cost Estimate

(1) Unit Price Analyses

The unit prices of the respective works of the project are estimated by up dating the bidding prices for similar works of other projects in Johor State, and the Government price schedule issued in 1993, which uses the annual inflation rate of commodity issued by the Central Bank of Malaysia. The unit prices of these works are estimated at 1994 price levels.

The updated unit prices of the respective works are shown in Annex - 3.

(2) Construction Cost Estimate

The total construction cost, consisting of direct construction costs, land acquisition costs and physical contingency is estimated at about RM 1,242,300 at 1994 price levels, as shown below.

Physical contingency is estimated at 15% of the direct construction cost.

	Description	Cost (RM) K. Kangar Merlimau
1	Direct Construction Cost	944,100
2	Land Acquisition	15,000
3	Physical Contingency	141,600
4	Engineering Cost	94,400
5	Administration Cost	47,200
	Total	1,242,300

The detailed cost estimates are shown in Annex-3.

5.6.5 Project Evaluation

A. Project benefits

Project benefits are represented by durian orchard. The area is schematically divided into two blocks; one, a plot of 23.5 ha is planted with durian trees of eight years old, and another plot of 12.5 ha is going to be planted with durian seedlings after the new irrigation system is provided.

The benefit from the first plot will be derived from an incremental production of durian trees due to the introduction of the project. The one from the second will come from the production of durian trees.

The financial data of durian cultivation are from MARDI.

B. Evaluation of the project

(1) EIRR

a. Economic internal rate of return (EIRR)

The EIRR of the project is estimated at 20%. (See Table 5.6.1)

b. Sensitivity analysis

With ten per cent decrease in benefit, the EIRR is estimated at 19%. Then 10% increase of cost changes the EIRR to 19%. If both cases take place simultaneously, the EIRR goes down to 17%.

(2) Financial consideration

Water rates would be shared by all water users of the system to cover at least its maintenance and operation cost.

(3) Labour force situation

In this area, the domestic labour market in agriculture sector is very tight. Foreign immigrants mainly those from Jawa and Sumatra islands, legal or otherwise, have been filling the gap.

(4) Household economy

It would have been sometime for the members to redeem their individual investment in the orchard.

5.6.6 Environmental Issues

(1) Present Environmental Conditions

The project was started in February, 1986 and was registered on December 14, 1993. The project area is a Malay reserved area. The soil belongs to Serdang Series, Yong Peng series and Batang Morban series, which are suitable for growing fruit crops. Durian is susceptible to water logging and there is no water logging problem in this soil. Mainly fruits are cultivated in the project area, which includes durian, duku langsat, dukong, sukun, petai, and rambutan. Also banana and coconut are grown in some parts of the areas.

Spring water is used to irrigate 5 ha of fruits. Since the area is swampy, water is drained naturally through surface drainage. However, sometimes where there is heavy rain, water drains to the downstream side and floods the area up to 30 cm height for a short period of time.

There is no major wildlife in the project area except for a few monkeys. Most of the houses are rearing chickens and one farmer has a small sheep farm of 120 sheep.

The housing for the farmers is made by the farmers themselves. There is a women development group which looks after the women development activities. About 10 women are involved in the farm activities and the rest are full time house wives.

There is no serious common disease in the project area, except for one case of asthma, and one case of handicapped person, among 191 farm family members.

There is no major environmental problem in the project area, except for a small amount of soil erosion and the flooding problem in the low lying areas from the hilly areas during heavy rains. However the erosion problem has been reduced by terracing and by suitable planting and grass land covering.

(2) Water Quality Survey

In Kelempok Kangkar Merlimau, water quality samples were taken at two locations; 1. the existing pond and 2. Pt.Kangkar Limau.

As shown in Table 5.6.2, pH of the water is slightly acidic; however the pH is within the Interim National Water Quality Standard (INWQS) range of 5 to 9. The main parameters including dissolved oxygen, BOD, COD, and ammoniac nitrogen are also well within the standard values. EC is very low and the salinity is negligible.

The colour of the water is less than the standard for raw water supply. Turbidity, dissolved solids and suspended solids of the water are also less. Alkalinity of the water is lower than the recommended value of 20 mg/l. Hardness, chloride, and fluoride of the water are within the standard values. There is no standard on the limit of silica for irrigation water and a standard of 50 mg/l is recommended for drinking water, however, the silica level is low in the two locations.

(3) Environmental Impacts of the Project

Water balance of the project area is expected to improve through the implementation of the project. The socio-economic impact within the farming community is also expected to be significant. Agro-tourism in the project area will enable the farmers to earn more income. Agro-tourism will also improve the marketing of fruit products. Additional employment opportunities will be available for women. The project area is very small and a major negative impact is not expected through the implementation of the small reservoir development.

5.6.7 Agro-tourism

Since Johor state is the southern most state, it acts as a gateway for tourists from Singapore. The project area is situated 14 km from Batu Pahat on the road of Muar - Batu Pahat - Yong Peng. Another area Kg. Mohd. Nor is located adjacent to the project area and

also has high potential for tourism with fruit farming and modern technology vegetable farming. All the villages have water, electricity, and telephone facilities. Therefore these sites have a potential of attracting tourists especially those from Singapore and the local area. One of the important concepts proposed in this project area is fruit picking and consumption at the site. This concept not only helps the farmer to earn more income but also overcomes the problem of marketing. The tourism facilities include the following:

i) Fruit Center (Fruit Park) - The tourists can go inside and pick up the fruits like rambutan. There will be a fruit center (shop), where the tourists can buy and eat the fruit.

ii) Small rest houses - A resting place with toilet facilities.

iii) Refreshment shops - These shops can serve small meals and drinks.

iv) Parking area - For the tourists

In the project area, there are farmers groups to organize the following activities :

i) Agro-tourism

ii) Economy

iii) Farmers cooperative

iv) Social activities

The agro-tourism farmers group shall be responsible for the maintenance and management of the facilities.

5.7 PASIR NERING (TR44) .....Terengganu State

5.7.1 General

The project area is located about 4 km southwest of Kuala Brang, Huluh Terengganu District. It comprises an area of 42 ha including ex-paddy fields and rubber forests. As one of the crop diversification programmes of the State DOA, roselle cultivation has been practiced to a small extent. There is a State owned roselle processing factory.

Objective of the project is to increase farmers income through expansion of the roselle cultivation by providing irrigation, drainage and other infrastructures.

Water resource for the irrigation is the Peching river. There is no particular environmental problem in this project area.

5.7.2 Climate, Hydrology, and Water Resources

The meteorological condition in Terengganu is largely dominated by the north-east monsoon. The rainfall pattern in the eastern region in which the project area is situated shows a distinct rainy season from November to January and a dry period from February to August. The mean annual rainfall in the catchment is 3,058 mm*8 which is the highest among the five project areas. Even in dry months, they received precipitation of over 140 mm. The rainfall pattern throughout the year is shown in Fig. 5.2.1.

The project area is located on the flat undulating land adjacent to Sg. Terengganu, the largest river in Terengganu. Three rivers are running through the project area; Sg. Peching, Sg. Udang, and Sg. Por. The catchment area of Sg. Por has a long and narrow shape of which the upstream part is mountainous covered by forests, while that of Sg. Peching is composed of hilly rubber tree areas and a flat lowland expanding on the right bank of Sg. Terengganu. The catchment of Sg. Udang is sandwiched between Sg. Peching and Sg. Por with hilly or undulating topography.

The catchment areas of Sg. Peching, Sg. Por, and Sg. Udang at the considered dam or intake sites are 4.8 km^2, 18.2 km^2, and 2.4 km^2, respectively. In terms of the location and water availability, Sg. Por is considered to be the best water source. However, floods in this area are very severe, and permanent structures across the river require large spillways against

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*8/ Rainfall station Paya Kemat (DID No.5029036), 1956 - 1990

the floods. On the other hand, the proposed crop for this area is 40 ha of roselle, which originates from arid regions and requires less water. Taking these into consideration, Sg. Por is not considered to be a suitable water source for a reservoir.

Paya Kemat*9 pumping scheme is being operated by DID on the upstream of Sg. Por supplying irrigation water for paddy (60 ha) in the main season. Some water is being extracted from Sg. Peching via a pipeline to Pasir Nering village for domestic purposes.

5.7.3 Geology

(1) Topography and geology

The project area is located about 20 km southwest of the center of Kuala Berang town. It is hilly area with about 30 m in altitude, and showing gentle slopes and broad, shallow valleys. The area is underlain by granitic rocks of Triassic age. The fresh outcrops of the basement rocks, however, cannot be seen in and around the project area, due to the deep weathering and the alluvial deposits.

The proposed dam-site is on the lower reaches of the Sungai Peching which is one of tributaries of the Sungai Terengganu, and is located in a rubber plantation. The Sungai Peching meets the Sungai Por and flows into the Sungai Terengganu, 1 km and 2.5 km downstream from the proposed dam site, respectively.

(2) Geological investigation

a) TR-1: Right: D=10.0 m

0.00 m to 2.00 m	Top soil	Light brown soft silty clay with roots (N=3)
2.00 m to 8.90 m	Alluvium	Light brown to light grey, very soft to soft silty clay or clayey sand (N=0-2) Interbeded with sand and gravel layer at 2.0 m to 3.5 m deep, and very soft silty sand layers (N=0-1) including organic matter at 6.2 m to 7.0 m and 8.7 m to 8.9 m deep.
8.90 m to 10.6 m	Residual soil	Brown hard sandy silt (N=6-50+)

*9/ Paya Kemat pump scheme was completed in 1981. Two diesel pumps (3 cusec x 2, head 4 m) are being operated. Irrigated area on the average (1983 - 1987) is 41 ha. (source *Database of Non-granary Irrigated Areas, DID)

b) TR-2 : Left: D=9.0 m

The original planned depth of 10.0 m was changed to 9.0 m, due to the appearance of hard basement rocks at 6.8 m.

0.00 m to 0.95 m	Top soil	Brown, very soft sandy silt with roots (N=0)
0.95 m to 6.80 m	Residual soil	Brown to grey, very soft until 3.5 m deep (N=2) but stiff below that (N=9-11), sandy silt. Below 5.0 m, greenish grey hard sandy silt with gravel (N=50+)
6.80 m to 9.00 m	Rocks	Weathered granite

The results of TR-1 and TR-2 suggest the following.

- The dam foundation excavation depth would be 1.0 m to 2.0 m at the minimum. In design work of the dam, very careful attention on stability and settlement of the foundation will be required, due to the presence of soft layers (N=0 to 6) up to 10.5 m deep, especially in the valley along the right bank of the river.
- The coefficients of permeability of the foundation materials show low values (k=2.82 to 2.65x10^{-7}m/sec), therefore measures against seepage through the foundation would not be required.

(3) Soil-mechanical test

A sample for a soil-mechanical test on the dam construction material was collected from the proposed borrow area near the project area. It is the existing small borrow area and consists of residual soils of the granitic rocks. The test result of this sample also shows good quality for a homogeneous type dam material.

5.7.4 Agriculture

A. Present Condition

(1) Land Use

The project area of 42 ha of farm land where paddy cultivation ceased during the last 5 or 7 years has been organized by DOA as a vegetable farmers group of 13 farmers since 1992, growing chili, long-beans, cucumber, etc. In 1993, 2.4 ha of the land was designated by DOA as a main vegetable production area with a drip irrigation system. As the cultivation

of chili has two main constraints, marketing and viral diseases, the DOA recommended papaya cultivation, but the group members did not agree due to uncertain market conditions.

Roselle, (an industrial crop originally from the Sudan: a kind of hibiscus, used for juice material) was introduced to this farmers group in February 1994 by the State DOA, which had started the roselle industry. Since the first crop of roselle in the 2.4 ha area from February to August 1994 showed a satisfactory result, a second cultivation was started in another 10 ha by 35 farmers in July 1994.

(2) Soil and Land Capability

The soil indicates an alluvial nature and evident soil changes including poor structure and low permeability due to paddy cultivation using a dense plough-pan of about 10-15 cm thick. Two soil types were identified; the Tok Yong series which is brown to brownish yellow clay found at higher elevations, and the Chempaka series which is brown to reddish yellow silty clay found at lower elevations.

Characteristics and properties of these soils are summarized as follows:

Tok Yong series:	Clay texture with 15-25% sand, 20-35% silt and 40-50% of clay, low available water with high to moderate water permeability, mildly acidic pH at 4.6-4.7, moderate content of organic carbon, and low to moderate CEC (Cation Exchange Capacity).
Chempaka series:	Slightly higher silt content at 30-40%, low available water with moderately slow water permeability , mildly acidic pH at 4.5-4.7, moderate carbon content, and low to moderate CEC.

These two types of soils are moderately suitable for vegetables, field crops and roselle. As available water is low in the upper 50 cm, irrigation is essential for most annual crops. The soils are difficult to work under wet conditions and crop damages may result from temporary surface ponding. Therefore, the ridge and fallow system, with small drainage canals, is recommended.

(3) Agricultural Production

Roselle cultivation is suitable for farmers together with extensive management and guaranteed marketing from DOA. Roselle is very resilient to pests and diseases.

The first cropping of roselle (February-August 1994) was satisfactory, with a result of 6 t/ha of yield by 13 members of the farmers group. The DOA extension officer reports that

the clay soil in Pasir Nering is more suitable for roselle than the sandy soil in other roselle production areas.

The second cropping was planted at the beginning of July 1994 in another new 10 ha using 35 members of the farmers group. The DOA extension office anticipates 7 to 8 t/ha of yield in October and November 1994.

Since the farm gate price of roselle is RM 0.7 per kg which is same as paddy, a gross return/ha of roselle is calculated at two times that of paddy cultivation.

(4) Population and Agricultural Employment

Kampung Pasir Nering is a small village with 95 houses and approximately 600 population. 79 farm families are holding 42 ha of land. Total farm family members are estimated at around 500 at 6.4/family, averaging a 50 year old house owner, a wife, and four children. The eldest child is already over 20 years old, 40% of which are living outside the farm families, and 60% (47 children in estimate) are living together with the farm families. Therefore, the average workable family labour is quite high at 3.2, amongst the 34 interviewed sample farmers.

The total working man-days in each family average 830 days, including 290 days in home farming and 540 days in outside working. Home farming includes the cultivation of roselle, corn, vegetables and fruit trees. Most (70%) of the outside jobs include work as hired labourers in rubber plantations at neighbouring villages.

(5) Farm Size and Land Tenure

The average farm size is 0.5 ha (42 ha / 79 farmers); however, the 34 interviewed farmers, who are the participants of a new group cultivating roselle, hold 28 ha of land (0.8 ha each). Farm size distribution amongst the 34 farmers is shown as follows:

Farm size(ha)	Nos. of farmers	Area(ha)
0.1 ha	4	0.4 ha
0.2 ha	4	0.8 ha
0.4 ha	9	3.6 ha
0.8 ha	7	5.6 ha
1.2 ha	6	7.2 ha
1.6 ha	4	10.4 ha
Total	34	28.0 ha

(6) Farm Management and Marketing

The farm management of roselle is planned and coordinated by the DOA district office at Kuala Berang, situated 10 km west of the project area. There is a DOA staff member who is recording the roselle management and production. As the roselle extension is associated with the state government program, DOA staff are very cordial and have good communication with the farmers. The marketing of roselle is also aided by DOA, who arrange the collection of harvested produce with lorries from the factory. The factory manager said that the capacity of roselle manufacturing is 20 t/day of harvested materials, however, only 3 t/day are collected at present.

(7) Economics of Farm Operation

The production cost per ha in the first crop of roselle (February-August 1994) is estimated at RM 470/ha using 270 kg of fertilizer and 1,200 kg of chicken-dung. With 6 t/ha of yield and RM 4,200/ha of gross return, the net return is calculated at RM 3,730/ha. In this first cropping, the cost of seeds and land preparation was subsidized by DOA.

In the second crop, DOA has planned to increase fertilization to 540 kg of fertilizer and 1,875 kg of chicken-dung. However, DOA staff are aware that some farmers will not carry out the plan due to financial problems. The new cost of production is RM 40/ha, even if other costs are subsidized by DOA. Based on this cost and a yield of 8 t/ha, the return will be RM 5,600/ha in gross and RM 4,760/ha in net with an increment of RM 1,030/ha in net return.

(8) Farm Household Economy

Roselle is a crop which requires intensive labour at the time of harvest. The average roselle grower with a 0.3 hectare plot (one crop a year) has a cash income of about RM 400 from 218 man-days of family labour.

B. Agricultural Development Plan

(1) Land Use

The double cropping of roselle is proposed to be extended to the whole area of 42 ha. The enlargement of the cropping area in stage development every year is planned as follows:

Year	Cropped area	Total cropped area/yr.	Single/Double crop area	Crop intensity	
1995	12 ha	12 ha	12 ha	0	100%
1996	24 ha	36 ha	12 ha	12 ha	150%
1997	36 ha	63 ha	9 ha	27 ha	175%
1998	42 ha	84 ha	0	42 ha	200%

(2) Farming and Cropping Plan

Cropping pattern

To enable double cropping of roselle, the seeding of the second crop has to be inter-cropped before completing the harvesting of the first crop. An outline of the cropping pattern is designed as follows:

1) Land preparation : starting in mid-January, finishing in mid-February.
2) First seeding : starting in February, finishing in mid-February.
3) Harvesting of first crop : in May , June, July (2.5-3 months)
4) Second seeding : starting in mid-June, finishing at the end of June
5) Cutting-off of first crop : end of July
6) Harvesting of second crop : in September, October, November (2-2.5 months)
7) Cutting-off of second crop : end of November.

Cropping Space

The present cropping space is 6 ft x 3 ft and the number of plants total 6,000 per ha. At present, farmers do not trim the roselle, however, trimming is needed for uniform growing. Therefore, a 5 ft. line spacing is recommended to facilitate trimming and harvesting, and to produce a high yield. With this spacing of 5 ft x 3 ft, the number of plants will increase to 7,000/ha, which will increase the yield by more than 10%. Inter-cropping in the second seeding, while the first crops are harvested, will be sown in the middle of the 3 ft spacing of the first crops.

Land Preparation

The cost of seeds and land preparation for the first crop, was subsidized by DOA; however, these costs should be charged to farmers at cost price. According to the cost estimates on roselle cultivation by the State DOA, the seed cost is RM 70 for 2 kg/ha, and the land preparation cost is estimated at RM 1,042/ha.

Fertilizer Application

It is proposed to apply 700 kg of fertilizer, 1,000 kg of lime and, 3,500 kg of chicken-dung per ha, on the basis of 100 grams of fertilizer/plant, 140 grams of lime/plant, and 500 grams of chicken-dung/plant for 7,000 plants/ha. This is designed for a target of 10 t/ha yield and compares with the DOA planning for the second crop (July-December 1994) calculated as 90 grams of fertilizer and 300 grams of chicken-dung per plant for 6,000 plants/ha. These split applications will be coordinated by DOA.

(3) Crop Budget and Production Plan

Crop Budget per ha

1) Seed cost (2 kg)	RM 70	
2) Land preparation	RM 1,000 (once a year)	
3) Fertilizer (700 kg)	RM 630	
4) Lime (1,000 kg)	RM 200	
5) Chicken-dung (3,500 kg)	RM 560	
6) Agro-chemicals (4.5L)	RM 85	
Total	RM 2,545	RM 4,090 with double cropping.

Production Plan

Single cropping:	1) Yield/ha :	10 ton/ha
	2) Sale price :	@RM 0.7/kg = RM 700/ton
	3) Gross return :	RM 7,000
	4) Net return :	RM 4,455
Double cropping:	1) Yield/ha :	18 ton/ha (10 t/ha and 8 t/ha)
	2) Sale price :	@RM 0.7 /kg = RM 700/ton
	3) Gross return :	RM 12,600
	4) Net return :	RM 8,510

(4) Employment and Working Opportunity

The labour requirement/ha for a single crop of roselle cultivation is proposed as follows:

1) Seedling (2 kg of seeds)	10 man-days
2) Seedling care and supplementary planting	10 man-days
3) Trimming and shaping	10 man-days

4) Fertilization	10 man-days
5) Chemical dosage	5 man-days
6) Harvesting	60 man-days
Total	105 man-days/ha

When all the 79 farmers participate in the roselle project, the average crop acreage of one farmer will be 0.5 ha. Therefore, the labour requirement for every farm family will be approximately 50-55 man-days for a single cropping. Double cropping, will require 100-110 man days /yr.

(5) Farm Management and Farm Budget

DOA recommends a standard management for roselle cultivation. The roselle management is carried out individually for each farm. Farm input such as seeds, chicken-dung, fertilizer, and agro-chemicals are supplied to the farmers group by paying cash on delivery. The planting schedule is relayed through group meetings, and the initial land preparation is through a DOA subsidy. Roselle seeds are provided free of cost. The schedule for harvesting and produce collection is arranged by DOA, with farmers sending the produce by factory lorries.

The average Farm budget of 0.5 ha for each farmer is calculated as follows:

Cash outlay	1) Seeds (1 kg)	RM 35
	2) Land preparation	RM 500
	3) Fertilizer (350 kg)	RM 315
	4) Lime (500 kg)	RM 100
	5) Chicken-dung (1,750 kg)	RM 280
	6) Agro-chemicals (2.25L)	RM 50
Single crop: Total cash outlay		RM 1,280
Double crop:Total cash outlay		RM 2,060
Labour requirement for single crop:		50-55 man-days
		For double crop:100-110 man-days
Yield per 0.5 ha:		5,000 kg (single crop), 9,000 kg (double crop)
Sale price (Farm Gate Price) :		@RM 0.7/kg
Gross income:		RM 3,500/yr.(Single crop); RM 6,300/yr.(Double crop)
Net income:		RM 2,220/yr.(Single crop); RM 4,240/yr.(Double crop)
Net income/working day:		RM 40 or RM 39/day (Single or Double crop)

(6) Marketing Plan

Marketing is fully arranged and supported by DOA. The roselle factory has sufficient capacity to enlarge.

C. Implementation Plan

(1) Governmental Services

This project is a DOA project, and all the farming activities including marketing are arranged by DOA with good communication with the farmers. When irrigation facilities are completed by DID, DOA will be able to develop the area. The project is promoted by the DOA district office, Hulu Terengganu, with capable staff offering guidance of the farmers organization as well as farming extensions. Therefore, DID will be able to hand over the irrigation facilities to DOA after completion with detailed instructions on their operation and maintenance.

(2) Farmers Organization

The farmers group of 13 farmers has been expanded to 22 farmers and 33 farmers year by year. The final size is proposed to be expanded to all the 79 village farmers. For the smooth extension of roselle cultivation and the effective use of irrigation, the group and organization should be strengthened with the help of DOA. Several communication groups with a leader are recommended to be organized. And also some technical members for roselle cultivation and irrigation must be elected in group farmers meetings. With the enlargement of the roselle cropping area, the arrangement of harvesting labourers will need to be discussed. In order to carry out a double cropping system, a labour exchange or cooperative labour use is recommended.

(3) Women's Participation in Development

Out of the 34 farm families interviewed, 25 wives (74%) are working in home farming, including roselle cultivation. Actually the roselle project has been developed as a job opportunity for women in this village. Only 4 women (12%) are engaged in outside jobs. Four other women are involved in house keeping. Through the implementation of the project, women's participation shall be increased, since the women have trouble in earning money in this isolated village. In roselle cultivation women are diligent and hard working.

It is recommended that a Women's Society shall be established, which shall play an effective role in roselle cultivation.

5.7.5 Infrastructures

A. Present Condition

(1) Irrigation and Drainage Facilities

The areas have existing irrigation facilities, including a pump station and pipe line covering about 2 ha. A simple sprinkler irrigation system is used for vegetable cultivation using water from the Peching stream under the State DOA's crop diversification program.

(2) Social Facilities

An access road of about 2.5 km to the Project area from the main road has been opened. This is un-paved, however jeep access is possible during the rainy season. The access road extends to nearly the center of the Project area and 2 simple bridges have been constructed using concrete poles. An electric distribution line has not been constructed in the Project area.

B. Water Resource Development Plan

(1) Irrigation Water Requirements

The main crop of the Project area is roselle. The irrigation water requirement for roselle is calculated following the procedure of the FAO Irrigation and Drainage Paper No. 24, and the State DOA' s information and opinions based on his experience in roselle plantation in other areas.

The crop coefficient (Kc) of roselle has not been clarified from the experimental roselle farm in the State, but was estimated using sub family crops of roselle, such as lady's fingers, based on the State DOA's information and opinions.

Potential evapo-transpiration (ETo) is estimated at 1,241 mm/year using the modified Penman method, based on meteorological data from the Kuala Terengganu station.

The irrigation method is designed as a micro jet sprinkler irrigation.

The irrigation water requirement for the design of irrigation facilities is shown below.

Pilot Project	Cropping Pattern	Peak Irrigation Water Requirement (l/sec/ha)
TR44	Roselle	0.44

A detailed calculation and explanation of the irrigation water requirement are described in Annex - 3.

(2) Reservoir Capacity

Reservoir operations at the proposed pump station site are calculated for each half month period based on the estimated runoff of the irrigation requirement and the reservoir water loss from seepage and evaporation. Past runoff from 1960 to 1991 are applied in calculating the reservoir operation.

As a result of these calculations, the reservoir capacity is clarified as follows :

Pilot Project/Reservoir	Type of Reservoir	Capacities(1,000 m^3)
TR-44	Excavated Pond	0.1

A detailed calculation and explanation of the reservoir operation are described in Annex-3.

(3) Drainage Water Requirement

The drainage water requirement in the Project area is computed under the condition of three consecutive days rainfall, with an exceeding probability of 80%, and a three day drainage period. The three consecutive days rainfall with a return period of five years at Kuala Terengganu station, is adopted from rainfall data of the past 35 years.

The three consecutive days rainfall with a return period of five years is 310 mm, and the design discharge of the drainage canals is estimated at 12.0 lit/sec/ha.

The river treatment works of Peching river are developing a pump station, so a design flood with a return period of 10 years was adopted. The design flood discharge is estimated at 27.95 m^3/sec.

C. Project Works

General layout of the water resource development, and the irrigation and drainage development is shown in Fig. 5.7.1.

Prominent features of these facilities are as follows :

(1) Water Resource Development Facilities

Excavated pond	H x W x L, 1.5 m x 5 m x 15 m
Gate structures	2 nos.
River treatment	short cut of existing river courses
	length 130 m
	bottom width of lower channel 5 m

(2) Irrigation and Drainage Facilities

Irrigation area	42 ha
Pump station	1 site
Pump (volute pump)	
3.0 kw (h=20 m)	2 units.
Pipeline	3,300 m
Farm road	2,400 m
Farm road culvert	8 nos.
Access road to pump station	60 m
On farm facilities	Micro jet sprinkler irrigation facilities 42 ha

(3) Infrastructures for the Projects

Rehabilitation of existing access road (pavement)	1,300 m
Extension of electric distribution line	1 km

D. Construction Plan

Mechanical construction methods will be applied for construction of the Project. Major construction consists of the pump station, pipeline, and access and farm roads.

The main construction volume including the embankment of the access and farm roads and the concrete work of the pump station, are roughly estimated at 5,300 m^3 of embankment, about 2,000 m^3 of excavation, 270 m of piling work and about 50 m^3 of concrete works.

Taking into consideration the construction volume mentioned above, the construction schedule is estimated at five months, consisting of one month for mobilization, preparatory work and demobilization periods, and 4 months for the construction period.

E. Project Cost Estimate

(1) Unit Price Analyses

The unit prices of the respective works of the project are estimated by up dating the bidding prices of similar works of other projects in Terengganu State, and the Government price schedule issued in 1993, which uses the annual inflation rate of commodity issued by the Central Bank of Malaysia.

The updated unit prices of the respective works are shown in Annex - 3.

(2) Construction Cost Estimate

The total construction cost, consisting of direct construction costs, land acquisition costs, and physical contingency is estimated at about RM 864,800 at 1994 price levels as shown below.

Physical contingency is estimated at 15% of the direct construction cost.

	Description	Cost (RM)
		Pasir Nering
1	Direct Construction Cost	665,200
2	Land Acquisition	0
3	Physical Contingency	99,800
4	Engineering Cost	66,500
5	Administration Cost	33,300
	Total	864,800

The detailed cost estimates are shown in Annex-3.

5.7.6 Project Evaluation

A. Project benefits

The project benefits consist of the incremental production of roselle. We assume that the amount of labour will remain equal under "with" and "without" conditions.

The financial data of roselle growing are from DOA, except the input cost in the "without" situation, which is provided by our agronomist.

B. Evaluation of the project

(1) EIRR

a. Economic internal rate of return (EIRR)

The EIRR of the project is estimated at 20%. This value is considered attractive for this remote rural area where there are few viable agricultural projects.(See Table 5.7.1.)

b. Sensitivity analysis

The market price of roselle has been set by DOA for the time being. However, technical, financial or labour constraints of growing roselle may occur. If we introduce a plan that gradually increases the area, which is suggested by our agronomist (see attached table to the cash flow table), the EIRR is estimated at 15%.

A 10% increase in cost changes the EIRR to 15%. If both cases take place simultaneously, the EIRR goes down to 13%.

(3) Financial consideration

The water rate would be shared by all water users of the system to cover at least its maintenance and operation cost.

(4) Labour force situation

Those families who do not have enough members to engage in roselle cultivation can not enter into it, as seasonal labourers cannot be found easily in this area.

(5) Household economy

Average roselle growers with 0.5 hectare plot with two crops have an annual cash income of about RM 4,200 using 242 man-days of family labour. This is equivalent to RM 2,700 using the rural wage level of RM 11. If hired hands are used, the income will reduce.

5.7.7 Environmental Issues

(1) Present Environmental Conditions

It is a DOA project area of 42 ha where roselle crop is newly planted as a trial crop over an area of 12.4 ha. Initially roselle was planted over an area of 2.4 ha and an additional 10 ha

was planted on January 20, 1994. All roselle is sold to a roselle factory which makes roselle. The factory also cooperates with the farmers for transporting the roselle from the farm.

In adjacent to the project area, there are rubber trees which belong to the farmers. Some of the rubber trees are very old and RISDA has a program to replant them. Apart from the rubber trees, there are bushes and small trees in the nearby area. Most of the farmers in the project area are doing rubber tapping in the nearby area, which is the main source of their family income.]

The soil in the area belongs to two series, one is Tok Yong series which covers an area of 20 ha area and the other is Cempaka series which extends over an area of 22 ha. There is no major wild life in the project area except for few monkeys and snakes. Buffaloes and cows are reared by some of the farmers.

There are no serious common diseases in the project area, except for two cases of heart attacks and one case of high blood pressure among 288 farm family members.

There are no major environmental problems in the project area except for occasional flooding in Sungai Por during heavy rain and the flooding water drains out naturally.

(2) Water Quality Survey

In Pasir Nering, Terengganu, water quality samples were taken at 3 locations; 1. Sg. Perching, 2. Sg. Udang, and 3. Sg. Por.

As shown in Table 5.7.2, pH of the water is slightly acidic; however the pH is within the Interim National Water Quality Standard (INWQS) range of 5 to 9. The main parameters including dissolved oxygen, BOD, COD, and ammoniac nitrogen are also well within the standard values. EC is very low and the salinity is negligible.

The colour of water is an important parameter for aesthetic considerations and the standard of colour for drinking water is 15 and for raw water less than 150. The colour of the water at these three locations is less than the standard for the raw water supply. Turbidity, dissolved solids, and suspended solids of the water are also less than the standard for raw water supply.

Alkalinity of the water is lower than the recommended value of 20 mg/l. Hardness, chloride, fluoride, silica, and iron are within the standard values.

(3) Environmental Impacts of the Project

At present an irrigation facility is available only for 2.4 ha area and with the provision of irrigation facilities through small reservoir development, the water balance of the project area will improve. Apart from roselle, the farmers can also cultivate other fruit crops in the future. Socio-economic impact within the farming community is also expected to be significant. It will also provide additional employment opportunities for women.