2.2 Agriculture

2.2.1 Outline of Agriculture in Malaysia

The total area of Malaysia is 32,800,000 ha, of which 10,168,000 ha (31%) is suitable for agriculture, 20,300,000 ha (62%) is forest, and the rest is settlement area and others. (See Table 2.2.1)

Historically, Malaysia has been an agricultural country, being one of the largest producers in the world of rubber, oil palm, and tropical timber. The agriculture sector is dominated by plantation crops. In 1990, Malaysia's agricultural land was 5,500,000 ha, out of which oil palm occupied 1,984,000 ha followed by rubber covering 1,833,000 ha and cocoa of 420,000 ha. Paddy is the main food crop with 650,000 ha of cropped area. Recently the oil palm areas have tended to increase but areas of rubber, cocoa and paddy are decreasing. A host of miscellaneous crops like pepper, fruits, vegetables, flowers, tobacco, maize, and tapioca are also grown in smaller areas. (See Table 2.2.2) Livestock farming is mainly poultry and pig production. Beef and mutton production is far less than consumption. The dairy industry is still small. Marine fisheries produce 950,000 tons of fish annually. There is also marine and freshwater aqua culture of cockles, fish and prawns.

It is anticipated that oil palm and rubber will maintain the leading role in the Malaysian agriculture. The production of oil palm will expand at 4.5% per annum during 6MP period and reach 7,600,000 tons in 1995. In the long run, oil palm is predicted to contribute over one third of the total value added to the agriculture, forestry and fishery sector. Rubber, fish, sawlogs, and cocoa follow oil palm in terms of value added in 1995. (See Table 2.2.3 and Table 2.2.4)

The Government emphasizes food production. NAP (1992-2010) predicts the per capita consumption, outputs and self sufficiency levels of main food items until the year 2010. Very high growths are anticipated for vegetables, fruits, livestock and fish; 8.2%, 6.3%, 6.0% and 5.5%, respectively. On the contrary, the self sufficiency level of rice is set out to be 65% after the year 2000, which means no increase in production is necessary. (See Table 2.2.5 and Table 2.2.6)

During 5MP, the Government launched 15 projects of the Integrated Agricultural Development Program (IADP). It has been designed to provide an integrated package of infrastructure and support facilities including irrigation and drainage, flood control, roads and agricultural support services. Fifteen IADPs covered 3.5 million ha benefiting 273,900 farm households, and these will be continued in 6MP.

Average household income in most IADPs exceeds the National Poverty Line Income (about RM 400 per month). However, increments in total income originating from farm income is substantially less than the increases due to off-farm work. The sustained and fairly high growth rate of the economy, increased urbanization and the consequent opportunities for off-farm employment, complemented by substantial releases of labour hours due to expanded mechanization, especially in paddy areas, have widened the potentials for income increases. Real income of all those groups whose total incomes almost entirely come from labour incomes have declined since the year 1985 by 10.3% or 2% per annum. A major impact of the burden of increases in the general price level would be felt by FELDA settlers and double cropped paddy growers, where the major portion of income comes from agriculture, as compared to the unorganized small holders who would be more able to absorb some of this decline through off-farm activities. Incidence of poverty is rather high where opportunities for off-farm incomes are scarce.

In 1986, 725,000 ha of fallow land existed. To increase the productivity of this land and uneconomic farms, consolidation and rehabilitation of land together with use of modern technology and provision of a better infrastructure have been implemented. In 5MP, 151,102 ha of land were made more productive in this way including 38,000 ha of fallow land which was largely replanted with oil palm. In 6MP, 185,500 ha will be improved.

Aiming at the generation of job opportunities and establishment of economically sized farms, 782,179 ha of new lands were developed during 1984-90. However, there are certain limits in employment generation due to difficulty in obtaining economically sizeed farms. Also, the plantation sector is trying to reduce labour input due to the wages hike. As a result, agricultural employment in 1990 was almost the same as 1985 with a reduced share of the total labour force. Although the availability of new land is now limited, some will still be opened. Only 162,708 ha will be made available in 6MP.

Each government agency executes various agricultural development programmes as follows:

(1) DOA -Department of Agriculture

According to the planning division of DOA, the present upland crop area of 40,000 ha will be expanded to 80,000 ha by the year 2010, and a strategic plan is under way for intensive extension of fruit and vegetable cultivation with pipe irrigation using sprinkler or drip irrigation.

At present, experimental pilot areas for fruit and vegetables in thirteen districts with the application of sprinkler and drip irrigation have been executed in 6MP (1991-95). On the basis of this achievement, 50 drip irrigation areas and 50 sprinkler areas will be programmed every year in 7MP (1996-2000).

Vegetable production areas were designated for 7,870 ha and 141 sites in 57 districts out of 82 districts in Peninsular Malaysia.

(2) FOA -Farmers Organization Authority (LPP)

Farmers organization holds 181 areal branches (PPK) in Peninsular Malaysia under 11 State Farmers Organization (PPN) and a Central National Organization (NAFAS). Each areal farmers organization is directly managed by government officers with one AGM (Areal General Manager) and four GM (General Managers).

Farm land improvement in 7,100 ha at 108 sites has been budgeted for three years from 1992 to 1994. Most activities aim at effective use of idle paddy land e.g. improvement of drainage, diversification into fruits or vegetable, setting-up of pumping facilities, etc.

1992	42 areas	2,000 ha	RM. 12.97 million	RM. 6,500/ha
1993	30 areas	3,033 ha	RM. 22.00 million	RM. 7,250/ha
1994	36 areas	2,067 ha	RM. 16.40 million	RM. 7,934/ha
Total	108 areas	7,100 ha	RM. 51.37 million	-------

(3) FELCRA -Federal Land Consolidation & Rehabilitation Authority

Main activities of land rehabilitation is to develop fallow upland areas aiming to increase farm family income and land productivity. During 5MP (1986-90), 117,800 ha of rubber, oil palm, paddy, cacao cultivation were developed as plantations. By the end of 1990, a cumulative total of 247,000 ha and 93,500 participant families benefited from FELCRA.

To manage the FELCRA schemes, FELCRA adopts the share system. Each scheme is regarded as an estate with settlers owning shares in the estate. When the scheme comes into production, settlers are given a dividend after deducting their loan obligations to FELCRA.

(4) FELDA -Federal Land Development Authority

As of the end of 1990, FELDA had developed about 871,600 ha of new land, and settled a total of 119,300 families through its schemes. Planted crops were oil palm, rubber, sugar cane, cacao, coffee, etc. Settlers are given land ownership title on an individual basis by the State Government after completion of the loan repayment.

(5) RISDA -Rubber Industry Small holders' Development Authority

RISDA was established to facilitate rubber small holders in replanting and to achieve a higher standard of living. Small holders are provided with replanting grants and the authority helps to organize the replanting programmes.

By 1990, about 1,050,000 ha of small holdings have been replanted with 550,000 small holders. The emphasis for RISDA under 5MP (1991-95) is on the replanting of less productive areas (around 210,000 ha) with oil palm or other cash crops. This replanting programme will benefit around 100,000 families.

(6) BPM - Malaysia Farmers Bank

Credit and incentives for agriculture would also be needed. Most of the big businesses obtained their finance from banks which, in 5MP, amounted to an estimated RM 9.9 billion. Small holders obtain their credit from the Centralized Agriculture Credit Scheme (SPKP) under Bank Pertanian Malaysia (BPM). In the 5MP, SPKP loans totaled RM 78 million and benefited 6,700 farmers and fishermen. Incentives for crop production in the 5MP cost a total of RM 525 million (RM 397 million or 76% was subsidized for paddy fertilizers) and benefited 611,800 families. Another RM 360 million alone was spent to support the paddy price. Overall, the incentives will continue in 6MP.

(7) FAMA - Federal Agricultural Marketing Authority

Farmers' involvement in marketing was promoted in 5MP by FAMA creating 132 farmers' markets. Thirty seven segaria stalls were set up as outlets for fresh milk. FAMA in collaboration with private companies promoted marketing of Malaysian fruits abroad, especially in East Asia, Europe and the Middle East. LKIM established seven fisheries complexes with freezer and ice facilities, and an auction system to maximize returns to fishermen.

(8) MARDI - Malaysian Agricultural Research and Development Institute

Research and development by MARDI will continue to play a vital role for developing new technologies for production as well as consumption. The emphasis in R&D will be in improving productivity and achieving sustainability in the growth of the agriculture sector.

2.2.2 Crops for Irrigation

Under the agro-climatic condition in Malaysia, irrigation would be required partly or fully for vegetables, fruits, paddy, flowers, tobacco, etc. Some of irrigation projects for these crops would rely the water source on small reservoirs. Fish ponds for aqua culture also may depend on small reservoirs. Descriptions on these sub-sectors are given below.

(1) Vegetables

The production of vegetables has greatly expanded in recent years. There will be a continuing demand for fresh vegetables. Vegetable production will be intensified to meet the growing demand in the country as well as for exports.

According to MOA's statistics, the area (cropped area) and production of vegetables in Peninsular Malaysia were 14,362 ha and 254,491 tons in 1986, which increased to 30,943 ha and 569,955 tons in 1990, respectively. The growth rate was 22% per annum. (See Table 2.2.7 and Table 2.2.8)

The production value was RM 490 million in 1989, of which fruit vegetables was the biggest followed by spice vegetables and leafy vegetables. (See Table 2.2.9)

Export volume has grown from 92,756 tons and RM 28.4 million in 1985 to 240,064 tons and RM 67.9 million in 1990. The import volume has also grown by 71,073 tons and RM 76.8 million. Malaysia will remain a net importer of vegetables, because most of the imported bill is for vegetables like potato, shallot, onion and garlic which are unsuitable for Malaysian conditions, even in the highlands. (see Table 2.2.10)

Main production areas of vegetables are 7,870 ha at 141 areas, and the most productive areas as of 1991 are shown below.

Cabbage	Pahang : 691 ha, 80% of Peninsular Malaysia
Tomato	Pahang : 315 ha, 70% of P.M.

Cucumber	Kelantan : 2,656 ha, 50% ; Johor :1,207 ha, 20% of P.M.
Long bean	Johor : 2,025 ha, 45% of P.M.
Chili	Perak : 2,512 ha, 50% ; Johor :1,049 ha, 20% of P.M.

The areas of Chili in Perak and Cucumber in Kelantan increased by about 2,000 ha in 1991 due to DOA's extension services.

Sufficient land has to be made available for vegetable production near urban centers and in the highlands. There is much to be done to fully realize the potential of the vegetable industry for the country. In NAP, both short-term and long-term strategies have been presented.

The short-term strategy is to increase production in existing areas through the use of better planting materials and management. For this, extension efforts, credit facilities and improved marketing efforts will be made. Group farming will be encouraged to reduce the production cost and facilitate supply and marketing operations.

The long-term strategy is to increase vegetable growing areas and to encourage large scale management of farms larger than 20 ha. The new areas to be developed will be near urban centers and in highlands. The use of modern machinery and irrigation will be encouraged.

The success of the strategies has been obvious from the large increase in area planted and production obtained. However, the following problems shall remain in the industry: shortage of vegetable land, transport problems, no corporate involvement for the estimated 23,800 vegetable farmers, lack of marketing information system, post harvest handling and packing, pesticide residues, research and extension efforts for ecological farming to produce safe food, and research for temperate vegetables.

Despite the problems faced by the vegetable industry, there are few sectors of agriculture which are dynamic and exciting. Notwithstanding the high growth rate in the past, the future beckons even more strongly. The Ministry of Agriculture has projected that from 1995 to 2010, demand and production would almost be doubled and exports will rise by 150%.

JICA Study Team estimated the magnitude of vegetable farm development required for the production targeted by NAP (1992-2010). Based on the assumption that the yield would increase at 1% per annum, the cropped area must be expanded by four times from 31,000 ha in 1990 to 122,000 ha in 2010. Supposing that i) the annual crop intensity

would be 250%, ii) 90% of vegetable farms would be equipped with irrigation facilities, and iii) 50% of irrigation projects would rely on the water source of small reservoirs (others would rely on ground water, rivers, and irrigation canals), the required development areas by small reservoirs would be 5,800 ha during 1990-2000 and 9,200 ha during 2001-2010. If the project area averages 40 ha, the number of projects will be 145 during 1990 - 2000 and 230 during 2001 - 2010. (See Table 2.2.11)

(2) Fruit

As the country develops and real incomes rise, more people can spend money on fruit. Also as the population increases and more people move to towns, they are increasingly buying fruit which previously they had grown themselves. Consumption of fruits locally has grown 10.2% a year in the period of 1985-1990 or in value terms from RM 1,777 million to RM 2,889 million. MARDI estimates that for a 1% rise in income, the consumption of fruits increases by 0.35%.

During 5MP period, the Government advocated nuclear fruit estates to promote large scale production of fruit. These estates will be set up by the private sector and will provide technology back-up, and processing and marketing facilities for the surrounding small holders producing the same fruit. To further accelerate the development of the fruit industry, the Government set up a Malaysian Fruit Industry Council in 1987 to encourage cooperation between the public and private sectors to further develop and coordinate the expansion of the fruit industry.

In order to promote the fruit industry, a number of incentives have been introduced to encourage large scale cultivation, processing and export of Malaysian fruits. They include both tax incentives and incentives for financing. The tax incentives are given in the form of pioneer status, investment tax allowance, agricultural allowances, deduction for capital expenditure, and expenses for research and development. For the export of fresh fruits, there are export allowances, double deduction for the promotion of export and export credit insurance premiums and industrial building allowances. Incentives for financing are given through the New Investment Fund (NIF) for cash crop cultivation and the Asean-Japan Development Fund (AJDF) loan scheme.

Between 1987-90, considering only ventures requiring a minimum investment of RM 2.5 million, 71 companies applied for and obtained licenses to cultivate fruit. The total value of the proposals was RM 359 million.

An important factor in the increase of fruit cultivation has been the participation of government agencies and the private sector. Up to 1989 the DOA through its fruit promotion schemes had organized 1,015 projects for fruit. These involved 25,695 small holders and covered 10,991 ha. The DOA provided agricultural support services and planting materials. Other government agencies like FELCRA, FELDA, RISDA and FOA have also been involved in the development of orchards on a mini estate or group farming basis. For the period 1986 -90, over 30,000 ha were developed by these agencies. Participation of the private sector, which includes state agencies and their subsidiaries as well as individual entrepreneurs has also been significant. They developed 20,000 ha during 1985-90. Their participation has been encouraged by state governments which have made available state land and provided incentives.

The involvement of FAMA has been important. It invested RM 12.6 million for marketing infrastructures and providing incentives.

The effect of NAP in stimulating fruit cultivation has been dramatic. In 1985, the area of fruit in Peninsular Malaysia was 119,000 ha, most of which were small holdings of low productivity. By 1990, the area under fruit grew to 162,000 ha, which was a 38% increase. In Peninsular Malaysia, there have been large increases in areas under star fruit, papaya, watermelon, durian, duku/langsat, rambutan and jackfruit. As a result of all the efforts, the production of 15 fruits in Peninsular Malaysia has soared from 852,517 tons in 1985 to 1,102,735 tons in 1989, an increase of 29%. The most significant increases have been in production of durian, guava, watermelon, cempedak and duku/langsat. Most of the increases have occurred in the states of Johor, Perak, Sarawak, Sabah, Terengganu, Selangore and Kedah. (See Table 2.2.12, Table 2.2.13, Table 2.2.14 and Table 2.2.15)

Exports of fresh fruits have increased from 116,795 tons to 378,756 tons in the same period, an increase in 224%. But, the export value did not rise as much - only from RM 70.1 million to RM 117.1 million. The major export growths came from durian, banana, watermelon, papaya, and star fruit. The major export markets for Malaysian fruits have been Singapore and Hong Kong. (See Table 2.2.16)

In the same period, the contribution of the fruit industry to national GDP increased from RM 634 million to RM 1,853 million, or 192%. Durian contributed most to the fruit GDP at 60%, followed by banana (10%) and cempedak (5%).

The undoubted success of the fruit industry in recent years has been achieved despite its various constraints. Holdings are often small in size and uneconomic and the

government has encouraged group farming to overcome this problem. There is also limited access to export markets because of quarantine and sanitary requirements.

In spite of all the problems, the potential for fruits remains vast. There is a large market for fruit juices and fruit products like jams, purees, dried fruits and pastes. In 1990, RM 98.6 million of fruit products were produced locally of which RM 45 million were exported. With per capita consumption of fruit juice alone in the EEC at 10 to 40 litres and that of US at 20 to 25 litres, the global trade in fruit and vegetable juice is worth well over RM 11 billion, of which Malaysia's share is less than 0.5%.

Malaysia is spending RM 200 million on importing fruits. In recent years, prices of primary products have fallen considerably in real terms so that the profitability in agriculture is increasingly moot. Large areas of rubber are no longer tapped and cocoa fields have been felled and replanted with other crops. Under this background, the search for alternative crops of higher value has intensified. Fruit has been identified as a priority crop for agricultural development.

The Government outlined two main strategies for implementing NAP on fruits.

- Planting of fruits in existing fruit areas. In this orchards which are uneconomical will be rehabilitated and restructured into more productive units.

- Fruit will be cultivated on a commercial or estate basis in areas formerly planted with other crops.

The Ministry of Agriculture set forth targets for the area and production of fruits. The area is expected to grow from 138,558 ha in 1985 to 331,786 ha in 2000 and 630,451 ha in 2010.

JICA Study Team estimated the magnitude of small reservoir development required to achieve the targets. Assumptions are made that irrigation would be needed for durian, banana, water melon, star fruit, etc. and that 50% of new development area for fruits would depend on the water source of small reservoirs. Then, the fruit development areas to be irrigated by small reservoirs would be 50,348 ha during 1990 - 2000 and 118,269 ha during 2001 - 2010. (See Table 2.2.17)

(3) Paddy

The area under paddy has been declining slowly and steadily since 1975. However, in recent years, there has been a small increase in the cultivated area. Of the national area, about 70% are in Peninsular Malaysia, 8% in Sabah, and 23% in Sarawak. By far the largest paddy growing area is MUDA with just under 190,000 ha. With the decline in the paddy area, production of paddy and rice have also fallen, although the fall has not been as steep as the decline in area. Yields have been steady with the use of high yield planting materials and better irrigation facilities offsetting the shortage of labour. (See Table 2.2.18 and Table 2.2.19)

Local production of rice in recent years have only provided for a 70% self-sufficiency level. Annual imports of over 300,000 - 400,000 tons are required to satisfy domestic demand. Among the suppliers of rice, Thailand has remained the largest. (See Table 2.2.20)

Malaysia also imports about 800,000 tons of wheat and 800,000 tons of sugar.

The decline in paddy cultivation is largely due to the reason that it is an uneconomic activity even among agricultural undertakings. Paddy occupies just under 10% of the agricultural land area in the country, but its contribution to value-added is only 5%. Under free market conditions, the decline would have been even steeper than what has occurred. But as a staple and strategic food, it is obviously impossible to leave it entirely to the vagaries of the market.

Since 1980, the government has offered a price subsidy of RM 16 per 100 kg of paddy produced in Peninsular Malaysia. This was extended to both Sabah and Sarawak in subsequent years. In 1990, the subsidy was increased by 50% to RM 24 per 100 kg and cost the government RM 360 million. Another subsidy is given for fertilizer input, costing the government RM 100 million a year.

NAP has decided to decrease the self- sufficiency level of paddy production by 65% by the year 2010 with only eight main granary areas and 74 secondary granary schemes. Therefore, Johor, Melaka, Negeri Sembilan and Pahang, where there are no main granary areas, have only 2,000-3,000 ha each of paddy cultivation area in both seasons in one year. Pulau Pinang, having 2,000 ha (1,000 ha each in both seasons) of paddy cultivation area as a main granary, shows a very low unit yield in 1990/91 and 1991 of 2.1 t/ha and 2.5 t/ha, respectively. Perlis, Kedah, Kelantan, having the most important

granaries of MADA and KADA, show 310,000 ha of paddy crop areas and 65% of all the paddy production in Peninsular Malaysia.

The uneconomic nature of paddy cultivation can be ameliorated by research and development. If higher yields can be obtained and mechanization used will minimize the labour requirement, higher incomes can be obtained notwithstanding the low prices.

Research is largely done by MARDI.Several new varieties have been released over the years, some of which are now widely planted. Cultural practices have been researched and, increasingly, mechanized direct seeding is superseding the old labour intensive transplanting by hand.

Practically all the paddy produced is processed into rice. This is done by commercial mills and the National Paddy and Rice Authority (LPN). As of 1990, there were 541 commercial mills and 36 LPN mills, with the former having 85% of the total milling capacity in Peninsular Malaysia.

(4) Aquaculture

Fish is a very important component of the diet in Malaysia and constitutes 60 to 70% of the animal protein intake. Demand for fish has grown considerably in recent years. In 1990, marine fishery landings were 951,307 tons, valued at over RM 1.96 billion. This almost reached the 6MP target for 1995. Malaysia also imported 228,549 tons of relatively low value fish, mainly from Thailand, valued at RM 406 million. Exports were an estimated 163,709 tons, worth RM 630 million.

Production from aquaculture was 52,303 tons, valued at RM 131 million or on 6% and 7% of the marine fisheries production in volume and value respectively.

Traditionally, Malaysian fisheries have been inshore. This has reached saturation point and catches have stabilized in recent years. To increase fish production, recourse has to be made to offshore fishing and aqua culture. In NAP the approach outlined is to maintain the inshore fisheries through proper management and conservation, and to promote offshore fisheries and aquaculture. It is projected that by 2000, the catch from offshore fisheries would have increased by 400,000 tons and aquaculture by 150,000 tons.

Aqua culture is not new in Malaysia. But, it was not until recent years that, when faced with declining catches and rising prices, a boost was given by greater investment

and institutional involvement from government agencies. By 1990, 5800 ha were used for pond culture, 5540 ha for cockles, and 319,838 m^2 for cage and raft culture. There were also shrimp and freshwater fish hatcheries producing fry for culture. Six companies were manufacturing aqua culture feed.

The future for aqua culture in Malaysia is bright. The warm climate permits year-round production and the skilled labour backed by research and government encouragement are positive contributors to its success. In addition, there are vast areas where aqua culture can be practiced. It is estimated that there are about 110,000 ha of coastal areas suitable for shrimp culture, 2,000 ha of coastal mudflats for cockles, 20,000 ha for the excavation of ponds, 6,000 ha of disused mining pools and 206,000 ha of lakes and reservoirs. The potential production from these areas is conservatively estimated at 593,000 tons.

The government plans that production by the year 2010 would be 200,000 tons which include 33,000 tons of shrimp, 85,000 tons of freshwater fish/prawns, 22,000 tons of seabass, 20,000 tons mussels/oysters and over 40,000 tons of cockles.

Parallel with the growth in cultivation of edible fish, there is a meteoric rise in aquarium fish production. Popular types produced were mollys, goldfish, carps, angelfish, gouramies, discus and arrowana. It is expected that the production would reach 470 million fries by the year 2010.

(5) Floriculture

Malaysian floriculture production has increased from RM 8 million in 1986 to RM 71 million in 1991. Malaysia has an equable climate making the growing of plants possible the whole year round. The lowlands are warm and moist making them ideal for the cultivation of orchids. The highlands are cool making it possible to grow temperate flowers. Thus very few flowers cannot be grown in Malaysia and this, together with skillful labour, gives an advantage.

In 1991, there were 1,286 ha under floriculture of which the three most dominant states are Pahang, Johor and Selangor. Floriculture is divided into three groups: cut flowers, ornamental plants, and potted plants. In Malaysia, the bulk of the trade is in fresh cut flowers - both temperate flowers and orchids.

Floriculture is a high cost, high risk venture. It takes RM 200,000 to establish an acre of flower farm. This high cost limits the number of entrepreneurs entering the

business. Some government support in getting financial assistance would be necessary to boost the industry.

(6) Tobacco

Tobacco cultivation is a relatively new industry in Malaysia, starting only in 1959 when Malaysian Tobacco Company first grew the crop on an 8 ha site in Kelantan. Although it has spread to Terengganu, Pahang, Kedah, Perlis, Melaka, Negeri Sembilan and Johor, and the area increased tremendously (10,000 ha in 1991), it has remained as a small industry.

The Lembaga Tembakau Negara (LTN or the National Tobacco Board) was formed in 1973 to look after the industry. The industry can be divided into four sectors: growers, curers, cigarette manufacturers, and the LTN as the regulatory and coordinating body. Due to the high price commanded by the end product, tobacco is considered as one of the most profitable crops to grow.

2.2.3 Agro Economy

(1) Labour Force

Most of the farmers in Peninsular Malaysia are the part-time farmers, whose income mainly depends on plantation employment. There has been a shortage of labour availability in the plantation industry. In Johor, where there are a lot of plantations, a labour shortage of 5,000 workers was reported in 1991.

Monthly wages for plantation labour are RM 292 for rubber tappers, RM 320 for oil palm harvesters, RM 270 for cacao harvesters, and RM 235 for others.(Facing 2020, The challenges to the plantation industry, ISIS Malaysia, 1992). Each worker is also provided with other benefits such as free accommodation, water and subsidized electricity, medical benefits, creche etc. and these could total in excess of RM 100.

Our field reconnaissance survey found a sample in Pahang showing the rubber plantation wage was RM 10 per day, and the farmer was engaged for 20 days or so a month. At Sik district in Kedah, where there was no plantations but a Japanese garment factory, the daily wage was only RM 8 for young women labourers. In Pulau Pinang, where the most rapid progress on industrialization is going on, the wage is RM 30/day and there is always a shortage of workers.

(2) Market Prices of Farm Produce

The retail price of rice is around RM 1.00/kg, and paddy price at farm gate is RM 0.75/kg including RM 0.16/kg of government subsidies.

The retail prices per kg at Kuala Lumpur as of Jan. and Feb.94 is RM 3-9 for fish, RM 2-5 for vegetable, RM-14 for local meat and mutton (half of the imported price), RM 4-6 for chicken (50% increase for the Chinese new year), and RM 1.8 for 10 eggs (500g).

The imported farm produces such as potato (RM 1.5/kg), onion (RM 1.6/kg), garlic (RM 2.0/kg), and dry chili (RM 4.0/kg) are cheap and remain steady.

(3) Crop Budget and Family Income

a. Paddy

According to the data on the cost and returns of paddy production by DOA, the net returns per ha of paddy cultivation is in the range from RM. 840 to RM. 1000 by both transplanting and broadcasting in Kedah and Kelantan as shown in the following Table.

State	Seeding type	Cost **	Yield	Gross Return	Net Return
Kelantan	Broadcasting	RM. 1,462	3,293 kg	RM. 2,451	RM. 889
Kedah	Broadcasting	RM. 2,051	3,924 kg.	RM. 2,920	RM. 869
Kelantan	Transplanting	RM. 1,807	3,293 kg.	RM. 2,749	RM. 942
Kedah	Transplanting	RM. 2,435	3,924 kg	RM. 3,276	RM. 841

** Fertilizer Cost which is given as free subsidy by FOA (LPP) is not included.
Source : DOA Planning Division (Dec. 1993)

If farmers want to earn RM. 10,000 of annual income from paddy cultivation in this level of return, they need to cultivate 10 ha of single crop or 5 ha of double crops. In case he must lease land from neighbours, paying RM 150-200/season/ha of rental cost, he needs to cultivate more than 12 ha per annum.

b. Fruit

Fruits which can provide income from the first year are water melon, pineapple, banana, papaya etc. Guava and star-fruits can bear some fruits in the second year, however, the maturity age for these fruits are six and nine years old, and the maturity terms are 7 years and 17 years, respectively. Although the production costs before fruit bearings have to be invested in advance, the average net return per annum can be calculated as follows: durian (RM 11,850/ha), orange (RM 7,800/ha), star-fruits (RM 7200/ha), guava (RM 5,900/ha), etc.

c. Vegetables

According to the MARDI report " Cost & return estimation for crops " 1992, the costs and returns in high value vegetable cultivation are shown as follows :

Crop	Per ha Cost	Yield /ha	Unit Price	Gross R/ha	Net Return/ha
Chili	11,936	12,000 kg	RM. 2.0/kg	24,000	12,064
Cabbage	7,267	20,000 kg	RM. 1.1/kg	20,900	13,633
Tomato	11,704	25,000 kg	RM. 0.8/kg	20,000	8,296
Long beans	11,652	20,000 kg	RM. 1.1/kg	22,000	10,348
Cucumber	10,361	30,000 kg	RM. 0.7/kg	21,000	10,639
Brinjal	7,572	20,000 kg	RM. 0.8/kg	16,000	8,428

The crop area depends on the capacity of family labour. In the case of two labourers both husband and wife, the cultivable acreage is 0.4 ha at the most, and triple cropping for this 0.4 ha results in around 1 ha, generating RM 10,000 of family income. Then, the remaining acreage can be planted with perennial crops or fruit trees which do not require as much labour.

d. Fishery

In case of fishery ponds, RM. 10,000 per year/ farm of the income target can be obtained with RM. 3,500 per annum of the production cost (running cost) by counting on six months rotation at the rate of 0.5 in feeding coefficient.

In the fish ponds in paddy fields at Bukit Jalutong in Pulau Pinang, supervised by DOF, the feeding efficiency was 0.5. While, in the cage fishery at Temoh pond in Perak utilizing a tin mining pond, the food and the produce are equivalent in weight. This means that the feeding co-efficient is nearly 1.0. So, cage fisheries need good market prices or high value fish varieties.

e. Off-farm Income

Most of the off-farm income depends on the work at plantations such as rubber or oil palm. Other labour opportunities can be found at the factories in industrialized areal towns.

The level of wages is around RM 350 monthly or RM 4,000 per year. Additional farming income is estimated at around RM 1,000 per year, and consequently the total annual family income amounts to only RM 5,000 which is close to the poverty line of RM 4,800 per year.

2.3 Climate and Hydrology

(1) Climate and season of Peninsular Malaysia

The characteristics of the climate of Malaysia are uniform temperature, high humidity and ample rainfall, which arise mainly from the maritime exposure of the country.

Though the wind over the country is generally light and variable, there are, however, some uniform periodic changes in the wind flow patterns. Based on these changes, four seasons are distinguished, namely, the southwest monsoon, northeast monsoon and two shorter inter monsoon seasons.

The southwest monsoon is usually established in the later half of May or early June and ends in September. The prevailing wind flow is generally southwesterly and light. The northeast monsoon usually commences in early November and ends in March. During this season, steady easterly or northeasterly winds prevail. The more severely affected areas are the east coast states.

(2) Rainfall

The seasonal variation of rainfall in Peninsular Malaysia is of three main types.

i) Over the east coast districts, November, December and January have the maximum rainfall, while June and July are the driest months in most districts.

ii) Over the rest of the Peninsular with the exception of the southwest coastal area, the monthly rainfall pattern shows two periods of maximum rainfall separated by two periods of minimum rainfall. The primary maximum generally occurs in October - November while the secondary maximum generally occurs in April - May. Over the northwestern region, the primary minimum occurs in January - February with the secondary minimum in June -July while elsewhere the primary minimum occurs in June - July with the secondary minimum in February.

iii) The rainfall pattern over the southwest coastal area is much affected by early morning "Sumatras" from May to August with the result that the double maxima and minima pattern is no longer discernible. October and November have the maximum rainfall and February has the minimum rainfall. The March - April - May maximum and the June - July minimum are absent or indistinct.

(3) Necessity of Irrigation

The average monthly rainfall and the drought monthly rainfall of a 5 year return period for 37 river basins in Peninsular Malaysia (Fig. 2.3.1) are shown in Table 2.3.1 and Table 2.3.2. The average monthly evaporation at principal meteorological stations in Peninsular Malaysia is shown in Table 2.3.3 and the crop factors (Kc) of main crops are shown in Table 2.3.4.

Incorporating the maximum evaporation of 5.8 mm/day in Alor Setar and the maximum crop factor of 1.2 for vegetables, the maximum evapotranspiration of vegetables is calculated to be 209 mm/month. Since all the river basins in Peninsular Malaysia have at least a month or a few months of drought period when monthly rainfall is far less than 209 mm, it can be said that irrigation is absolutely necessary to relieve the crops which are not so resistible to water stress. Further, irrigation is indispensable for recent commercial farms, because it is used not only for meeting water requirements of crops but also for quality control of produce and other marketing purposes.

2.4 Geology

In Peninsular Malaysia a mountainous spine known as the Main Range (or Banjaran Titiwangsa) runs from the Thai border to Negeri Sembilan on the western flank of the Peninsular, effectively separating the eastern part of the peninsular from the western and rising to more than 2,100 m above sea level in places. A considerable part of the interior of Kelantan, Terengganu and Pahang is also mountainous and contains the highest peak in the Peninsular, Gunung Tahan which reaches 2,187 m in elevation.

As a result of the configuration of the country and of the heavy rainfall, there are many rivers which, until just over one hundred years ago, formed the main arteries for trade and travel. The longest of these rivers is the Sungai Pahang (475 km), followed by the Sungai Perak (400 km) and the Sungai Kelantan.

Geologic tectonically, Peninsular Malaysia forms part of the Sunda Shield, one of the stable cratonic blocks. The western margin of this block is situated in the Indian Ocean along the off-shore of Sumatra Island. Where as Sumatra is seismically and volcanically active recently, Peninsular Malaysia situated back inside the cratonic block is fairly stable in both aspects. Its fold-mountain system, the dominant regional trend of which is northerly to north-northwesterly, is a southerly continuation of that extending from eastern Myanmar through

Thailand, Peninsular Malaysia, the Banka and Billiton Islands of Indonesia, and eastward into Indonesian Borneo.

The geology of Peninsular Malaysia ranges in age from the Cambrian to the Quaternary as shown in Fig. 2.4.1. The pre-Triassic rocks are essentially marine whereas the post-Triassic rocks are characteristically non-marine. The Triassic rocks themselves are of both marine and non-marine origins but general, the non-marine where present, occur in the Upper Triassic. The bulk of the Peninsula's sedimentary rocks falls within the Carboniferous to the Triassic periods, which indicates that the greater part of the area lay below the sea during that time. The rocks consist of repeated series of sandstones and shales interbedded with limestones and volcanic rocks. These rocks are found most extensively in Pahang and Kelantan, with extensions into the surrounding states.

Almost half of the total surface area of the Peninsular consists of granite which forms the Main Range as well as the lesser ridges. Although many of the granite bodies are aligned parallel to the structure trend, they do not always occupy the anticlinal ridges of the sedimentary covers and some of the smaller bodies are found to cut across the structural trend. The granite is believed to be mainly of the Triassic Age, and during its emplacement the older sedimentary rocks into which it was intruded folded and buckled into the ranges that make up the present topography of the Peninsular. The granite is fairly uniform in character and is likely to be the main source of most of the economic minerals.

The youngest formation, Quaternary deposits, almost all of which are alluvium, consist mainly of unconsolidated to semi-consolidated gravel, sand, clay, silt, and peat formed by the erosion of the older rocks over long periods, and are distributed over the coastal terrains forming the soft ground areas which occur around the peninsular with a width of from 10 to 20 km, and floors of some of the inland valleys. These deposits reach to depths of more than 180 m and 150 m below mean sea level in the west and east coasts respectively, and contain valuable concentrations of tin ore. The deposits inshore can be grouped into four lithostratigraphic units, namely:

a. Simpang Formation
   Continental, fluviatile sediments made up gravel, sand, clay and silt of Pleistocene age. The bulk of the placer tin is derived from this unit which overlies bedrock.

b. Kempandang Formation
   Pleistocene marine sediments made up of clay with shells and sand.

c. Gula Formation

Holocene gray to greenish-gray marine to estuarine clay and subordinate sand covering the coastal areas of Peninsular. Included in this unit are the beach ridges, mangrove, and the riverine nipah deposits.

d. Beruas Formation

Fluviatile-estuarine-lacustrine deposits, made up of clay, sandy clay, sandy gravel, silt and peat of the Holocene age. This unit overlies the Simpang Formation, filling channels, depressions as well as overlying bedrock at several places.

Above all the Quaternary deposits, the two Holocene formations, Gula and Beruas are specially important in civil engineering works, because of the peat layers present. The main peat layer's distributed areas are Perak, Selangor, western Johor, and Pahang.

Besides the stratified units and the granitic activities described above, laterite, bauxite, cave deposits, and intrusive and extrusive igneous activities have been recorded in several parts of the country.

Regional metamorphism is widespread and most of the Paleozoic and Mesozoic rocks show slight to moderate deformation. In general, the older rocks show a greater degree of metamorphism than the younger rocks. Contact metamorphism is not intense. The contact metamorphosed rocks generally form narrow aureoles around the igneous rocks.

Faulting is common in all rocks. Three prominent sets of fault are observed. The oldest is a northerly trending set of normal faults followed by a younger set of northwesterly trending wrench faults and a still younger set of north-north-easterly trending wrench faults. The youngest is at most post-Early Cretaceous in age.

2.5 Irrigation Development in Malaysia

2.5.1 Present Condition of Irrigation

Although Malaysia is blessed with surface water (566 billion m^3 per annum), it is estimated that only 10% of the total amount is readily available to satisfy the demands of agriculture, domestic, industry and power. This is due to the non-uniform distribution of rainfall throughout the year; mostly during the rainy months, in order to offset the needs of the dry season, a number of large reservoirs have been constructed and to date 66 are in operation.

The DID manages 14 of these dams with heights ranging from 8 to 44 m and storage between 0.2 and 93 million m3.

In Malaysia, paddy irrigation has been predominant for a long time. There are irrigated paddy fields and rainfed paddy fields; the former is sub-divided into granary areas and non granary areas. The granary area is a large scale irrigated paddy area which the Government intends to conserve for paddy production for the foreseeable future; while the non granary area may be converted for other uses. Apart from paddy irrigation, upland irrigation for vegetables and fruits has increased recently .

In Peninsular Malaysia, the paddy irrigation area totals 294,000 ha, of which 196,000 ha is covered by the eight granary areas and the remaining 98,000 ha by the 830 non granary areas.

The operation and maintenance of all the paddy irrigation systems is the Government's responsibility. The O/M of the Muda irrigation scheme in the Kedah and Perlis states is the responsibility of MADA; that of the Kemubu, North Kelantan and other 13 granary schemes in the Kelantan state is the responsibility of KADA. The O/M of other granary and non granary irrigation schemes is DID's responsibility.

The Government is implementing IADP including the granary and non granary areas. The IADP is an overall programme containing the construction and improvement of infra-structures, operation and maintenance, and agricultural extension. There are 14 IADPs with a total area of 4,880,000 ha including 2,360,000 ha of agricultural lands. Flood mitigation and drainage works are predominant.

According to the statistics of the Fishery Department, there are 19,259 fish ponds in Peninsular Malaysia with 3,574 ha of area and 12,483 fish farmers. In addition, there are 380 tin mining ponds totalling 644 ha.

Large dam development needs a high financial investment (RM 0.5 - 1.3 mil/mil m^3) as well as specific expertise. It also takes a long period (from concept plan, construction, and filling) before coming into operation (between 5 to 10 years or more). Its construction also involves land acquisition, compensation, and resettlement of people. A number of such dams have been identified and in various stages of implementation (e.g.. Berris Dam, Paya Peda Dam and Reman Dam).

At the same time, the agriculture sector is continuing its development in line with the National Agriculture Policy. Among the significant changes currently is the development of commercial farming. Compared to traditional farms, commercial farms have a number of special characteristics and one of them is irrigation. Irrigation is necessary not only to increase yield and quality but to ensure continuity of supply and consistency of quality so as to meet market demands all the time.

A stable water resource is an important component in an irrigation system. For agriculture water resources development, a number of challenges must be faced:

a. Commercial farms are not large (10 - 50 ha) and scattered (not contiguous).

b. Their implementations are not simultaneous and cannot wait for large reservoirs to be completed.

c. Competition for water within the agriculture sector (due to expansion of irrigated agriculture) and between sectors is increasing.

In addressing the above issues, commercial farmers have developed their own water resources in various forms. Their degree of success has not been evaluated but a number of issues arising are :

a. Unregulated developments can result in unfair distribution of water,

b. There are no standards in planning, design and operation of their structures. This situation can be a threat to the safety of the surrounding areas.

c. Social issues are not easily addressed by individual commercial farmers (e.g.. getting permission from landowners involved, to construct or to enlarge existing channels/rivers) and this can be a constraint to development.

d. In the Perlis state, a host of small reservoirs and irrigation schemes which have intake weirs on the same river are competing for water. The downstream areas are suffering from drought during the dry season and flood during the wet season. Basin-wide water management systems for both the rainy and dry seasons should be established. At the same time, on farm water management particularly for the diversified crops irrigation during the dry season should be improved to enhance the irrigation efficiency.

2.5.2 Upland Irrigation and Equipment

One of the fast growing supporting industries for Malaysian agriculture is the irrigation equipment. Total sales increased from RM 2 million in 1987 to RM 5 million in 1990 and are estimated to reach RM 15 million in 1992. The demand for irrigation equipment has largely been due to the increased popularity of vegetables and fruit farming, and the shortage of labour which has particularly hit these farms.

In vegetable farming, the most labour intensive operations have been weeding, watering and harvesting. Weeding was largely solved by plastic mulch which was used to cover the planting beds and prevent weeds from growing. Holes were made for the vegetables to grow through. The need for watering was solved by the use of irrigation. Recently, import duties on irrigation equipment, especially polyethylene tubing, were lowered substantially enabling prices to be reduced by about 30%. This, coupled with the worsening labour situation, has made irrigation very regular. But, unfortunately for vegetable farmers, labour saving harvesting has not made much headway and it is still picked by hand.

Recently, farmers in Malaysia began to use rain shelters for the vegetable cultivation; the Government is also encouraging its use. A rain shelter is a house or roof made of plastic sheets to protect the plant body from direct rain. Use of the rain shelter makes irrigation indispensable.

Fruit farming in Malaysia essentially grows table fruit, as the fruit processing industry is still in its infancy. For this market, not only is yield important but also regularity of supply and product appearance. Unirrigated and exposed to the vagaries of nature, all three factors are extremely variable, making quality control and marketing difficult. Thus, irrigation is now an absolute necessity for commercial fruit farming.

The perceived value of irrigation in vegetable and fruit farming is now so great that no new commercial venture is likely to start without any provision for it. Also many of the older farms, previously without irrigation, have been installing equipment, with the result that almost all commercial fruit and vegetable farms have irrigation.

Historically, sprinkler irrigation was the most popular system. It was the cheapest to install, and when water was freely available and fuel cheap, wastage was not problem. Even the cost of a large pump did not deter use. But today, with a more variable climate of prolonged and severe droughts and water shortages, economy in water use is an important consideration. It must not be forgotten that in a drought, however mild, when the need for irrigation is the greatest, it is also the most difficult time to find water.

Thus, there is now a trend towards micro-irrigation systems which have the lowest water loss as well as the cheapest operation cost. This new preference was helped by the government's decision to reduce the tax on polyethylene tubing which forms the bulk of the system cost.

There are also crop factors to be considered in choosing an irrigation system. Obviously, a crop like durian with a few widely spaced trees would be most suitable for micro irrigation. It is only necessary to bring water to the roots of the individual durian trees. On the other hand, leafy vegetables like spinach would have too many plants to be point-irrigated. and a sprinkler system would be more effective.

The problem of pests and diseases should be considered. Blanket wetting of the whole area by splinkler would raise the humidity and encourage the spread of fungal diseases. Also, by wetting the crop plants, pesticides are washed off and may need more frequent application.

Installation of an irrigation system requires considerable expertise, of which local farmers do not have, especially since irrigation is relatively new to the country. In installing an irrigation system, there are three approaches that can be taken. A farmer with requisite knowledge can design and build the system himself. A farmer with some mechanical skills but somewhat lacking in the knowledge of irrigation can get his system designed by the equipment sellers. Finally it is possible to purchase an irrigation system on a turnkey basis.

The cost of an irrigation system can vary considerably depending on the system selected and the crop it is intended for. Other factors that can affect cost include the size of the system, terrain, and the quality and source of the water. Table 2.5.1 shows indicative costs of sprinkler and micro-irrigation for some local crops for which irrigation is most often used.

2.6 Environment

(1) Agencies Involved in Environmental Management

In Malaysia, the environmental issues are handled simultaneously by the Federal, State and Local Governments. The Federal Government, through mainly the Department of Environment (DOE) and other agencies like the Department of Irrigation and Drainage (DID) plays the key role in environmental planning and management. The State Government on the other hand is mainly concerned with land development and resource exploitation, and

environmental issues had not always been given a higher priority until recently. The local government, through the Municipal District Council, scrutinizes and processes all local, structural and development plans with the help of some state departments who provide technical advice in specialized areas.

(2) Organizational Structure of Department of Environment

The Department of Environment under the Ministry of Science, Technology and Environment is the major organization for formulating environmental policies of the Government of Malaysia. The main works of DOE are as follows :

i) Implementing environmental laws and regulations

ii) Supporting the States to carry out these laws

iii) Research and development

The organizational structure of DOE is shown in Fig. 2.6.1. The Department of Environment is headed by a Director General. There are four functional divisions at the headquarters, Administration, Control, Prevention and Development, and there are ten regional (state) offices. The main functions of the State offices are to carry out environmental quality monitoring and enforcement of the Environmental Quality Act, 1974 (Amendment) 1985 as well as the various regulations made under the Act.

(3) Environmental Policy Objectives, Laws and Regulations

National environmental policy objectives are as follows :

a. To maintain a clean and healthy environment;

b. To maintain the quality of the environment in relation to the needs of the growing population;

c. To minimize the impact on the environment of the growing population and their activities relating to mineral exploration, deforestation, agriculture, urbanization, tourism, and the development of other resources;

d. To balance the goals for socio-economic development and the need to bring the benefits of development to a wide spectrum of the population against the maintenance of sound environmental conditions;

e. To place more emphasis on prevention rather than on curative measures, by preserving the country's unique and diverse cultural and natural heritage;

f. To incorporate an environmental dimension in project planning and implementation, by determining the implication of the proposed projects and the costs of the required environmental mitigation measures through the conduct of EIA studies; and

g. To promote greater cooperation and increased coordination among relevant Federal and State authorities as well as among ASEAN Governments.

(4) Environmental Laws and Regulations

In order to achieve national environmental objectives, the Department of Environment adopts a strategy based on pollution control and prevention. The Environmental Impact Assessment (EIA) which was made a mandatory requirement under section 34A of the Environmental Quality Act, 1974 requires anyone who intends to carry out a prescribed activity to first conduct a study to assess the environmental impact that will arise from the prescribed activity as well as the mitigating measures to overcome them. The Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987 specifies 19 broad categories of activities requiring EIA prior to project approval or implementation as shown in the Annex 6.1.

The enforcement of the Environmental Quality Act, 1974 and the regulations thereunder continue to play a significant role in environmental management. The list of regulations under the EQA 1974 and the other environmentally related legislations are shown in Annex 6.2.

This strategy requires commitment and close cooperation of all parties involved in implementing the EIA Procedure in Malaysia, including the project proponent, the assessor or consultant, the relevant approval authority, the enforcement agency (DOE), and experts as well as the public and public interest groups.

The EIA procedure adopted in Malaysia consists of three major steps. The steps in the EIA procedure, which are shown in Fig. 2.6.2, can be described as follows :

1. A Preliminary Assessment relates to the initial assessment of the impacts due to those activities that are prescribed.
2. A Detailed Assessment is undertaken for those projects for which significant residual impacts have been predicted in the Preliminary Assessment.
3. A review of EIA reports is carried out internally by the DOE for preliminary assessment reports and by an ad hoc review panel for detailed assessment reports.

(5) Environmental Prevention

In line with Sixth Malaysia Plan (1991-1995), the Department of Environment (DOE) has been actively promoting the incorporation of environmental dimensions in the planning of projects by various government agencies. Plans are examined to ensure any environmentally sensitive areas such as residential areas, schools, forest reserves, and national parks that exist within a certain radius are adequately buffered to avoid adverse environmental impacts due to development activities. In the assessment the Department also ensures that the potential operator has taken appropriate measures to control and abate pollution at the planning stage of the project.

2.7 Agro-Tourism

While 'Environmental friendly agriculture' is one of the most important concepts considered in agriculture development projects in Malaysia, 'Agrotourism' has also gained its importance from the late 1980s. With tourism being one of the largest industries, a lot of focus has been paid on tourism combined with agriculture development.

Malaysia celebrated 1990 and 1994 as 'Visit Malaysia Year' to welcome the foreign tourists. It has earned RM 1.6 billion in the first five months of Visit Malaysia Year, 1994 and the number of visitors increased by 22.2 percent compared with the corresponding period last year. The Ministry of Agriculture instructed all the State Governments to draw up comprehensive programmes to boost the agro-tourism industry.

There are many agro-tourism parks in Malaysia including Malaysia Agriculture Park, Shah Alam, Sekayu Agriculture Park, Terengganu, State Agriculture Park, Sg.Udang, Melaka, Padang Saga Dam, Langkawi, Konk Kong Agriculture Park, Johor, Indera Mahkota Agriculture Park, Kuantan, and Pahang. There are also marine parks in Terengganu, Pahang, and Kedah.

The preservation and protection of the environment against both over-exploitation of natural resources and pollution of the environment will become more important in the development of tourism. A balanced emphasis is given to the development of tourism in the international and domestic markets. Tourism programmes and projects should be selective and should include the control of pollution, sewerage discharge, and soil erosion as well as the preservation of forests and other ecosystems.

Since fruit and other activities take years to develop after planting, agro-tourism is a time consuming and land consuming activity. Several factors had to be determined to sustain its competitive edge. The quality of basic facilities like accommodation, toilets, communication, water and electricity supplies were among the factors considered.

III. BASIC CONCEPT FOR SMALL RESERVOIR DEVELOPMENT

3.1 Objectives and Basic Concepts of Small Reservoir Development

The National Agricultural Policy (1992-2010) aims at the maximization of income through the optimal utilization of resources in the agriculture sector. It also presents strategies to realize the objective. Small reservoir development will provide an opportunity to incorporate a number of goals and strategies of NAP (1992-2010). If small reservoirs merely supplied water to users, they would not be justifiable as a national project. Small reservoir projects should be formulated within the framework of the national agricultural policy to achieve its targets. The small reservoir project should be a "water-based agricultural development approach" or an "integrated mini agricultural development model".

The objective and basic concept of the small reservoir development would be as follows:

(1) Expanded food production

Small reservoirs provide water sources for irrigation of vegetables, fruits and other high value crops which are needed to expand production according to the NAP (1992-2010);

(2) Water resources development

Sustainable development of water resources through appropriate investments in engineering infrastructure for irrigation, drainage, and farm access should be promoted. The merits of small reservoirs are low investment cost, simple design, less environmental hazards, easy construction, quick yielding, and easy O/M. As far as possible, it does not involve resettlement of people and land acquired is not large. Priority is for irrigation for diversified crops but agro-tourism, fisheries, domestic and industrial supply aspects are also considered.

(3) Reorganization of the farm production system and structure

Uneconomic farm sizes, labour shortages, irrigation and drainage limitations, aging farm population, and inadequate farm price policies are problems faced by the agriculture sector of Malaysia. Solutions have been sought in the expansion of mini-estates, group farmings and other forms of centralized management systems which enhance the involvement in development programmes of farmers, women, and farmers' organizations including the private sector.

(4) Optimizing resource use

Following the in-situ development policy, effective and systematic utilization of abandoned land and idle land is accelerated and realization of productivity and other efficiency gains in both crop and non-crop subsectors is promoted.

(5) Agro-based industries development

Agricultural surpluses are used to complement and support agro-based industries.

3.2 Type of small reservoir

There are 5 types of small reservoirs. (Refer to Fig. 3.2.1 Conceptual Diagram of Small Reservoir Development)

Type A : Low dam built on a small river having a dam height of less than 15 m, a storage capacity of less than 10 million m^3 (1000 ha-m) and a catchment area of less than 50 km^2;

Type B : Pond built by excavation, dyking or installation of regulating structures in swamp, low-lying land or abandoned paddy field;

Type C : Pond formed by utilizing an oxbow along an abolished river course:

Type D : Reservoir created by widening a river width, excavating a riverbed or heightening of river banks upstream of an existing weir ; and

Type E : Reservoir utilizing a tin mine pond or a natural lake.

3.3 Required Irrigation Development by Small Reservoirs

The required irrigation development areas by small reservoirs are estimated to meet the targeted production of vegetables and fruits set forth in the NAP (1992-2010). Numbers of the project area are also estimated assuming one project area is 40 ha. (See Table 2.3.5 and Table 2.3.11)

	1990-2000	2001-2010	Total
Vegetables	5,800 ha (145 projects)	9,200 ha (230 projects	15,000 ha (375 projects)
Fruits	50,300 ha (1,258 projects)	118,300 ha (2,957 projects)	168,600 ha (4,215 projects)

Irrigation areas of flowers, tobacco and paddy relying on small reservoirs are considered much smaller than those of the above two crops.

3.4 Implementation of Small Reservoir Development

Among the important aspects that are being considered are:

a. Implementation model

   1) Farmers/owners construct and operate
   2) Government construct and farmers/owners operate
   3) Government construct and operate

b. The roles of agencies/individuals involved in the projects such as PPK, DOA, FELCRA, MARDI, DID including financial agencies.

c. Guidelines for planning and management of small reservoirs.

3.4.1 Examination of on-going Crop Diversification Program

In 1989 a crop diversification study was carried out in 924 non-granary irrigation schemes. This study has identified eight categories of crop diversification and appropriate schemes representing the category. Following the study, a new program called "Crop Diversification" was introduced under 6MP (1991 - 1995). A total of RM. 3.5 million was allocated. To date RM 3 million has been spent for 15 projects totaling 500 ha.

There are a number of models presently used in project implementation:

a. Project identification by LPP/PPK based on land owned (land-based approach) and other agencies to provide the necessary support.

b. Existing projects facing specific problems such as inadequate infrastructure e.g.. drains and farm roads, and the relevant agencies (e.g. DID, DOA) providing "problem releasing" services to overcome the problems or to increase production area.

c. Project initiated by specific committees of the State or District level. Each agency to provide technical support and services based on their financial allocation and programs available in each Department.

The above approach has a number of weakness:

a. low coordination especially when departmental priorities differ.

b. low project identification and conceptionalization as well as poorly defined project scope.

However, the above approach is still applicable in certain situations especially if the area involved is small or farmer population is small. These models are also applicable if input from one agency is greater than the others.

3.4.2 Proposed integrated mini-project approach

The small reservoir study identified an alternative approach to project implementation which may be applied to promote and expedite the crop diversification program. This is the "water-based" approach for agriculture development. This project has identified 266 small reservoir sites which could be further developed.

This model encourages mid-level officers from any agency such as DOA, DID, Veterinary Services Department, and Fishery Department to be project promoters. These officers are close to the farmers and have first hand knowledge of potential project areas. Technical support should be provided by their respective Headquarters through the formation of an integrated team made up of officers from relevant agencies. Alternatively, private sector consultancy services may be employed for feasibility studies and detailed design.

Financially, the Financial Vote 1,4600: Crop Diversification Program may be utilized not just for infrastructure but also for necessary services and equipment/material support for on-farm facilities. Farmers/PPK should be encouraged to finance this themselves (with loans from the Bank of Agriculture) through regulations.

During planning and implementation, PPK or IADP should be the lead agency.

A model for the implemention of small reservoir developments is shown in Fig. 3.4.1

3.5 Focal Points in Implementation of Small Reservoir Development

(1) Identification and Formulation of Project

The small reservoir development takes a process of identification, planning, design, construction, and O/M. Details of the each process are shown in the "Guide Lines".

Project formulation and identification must be carried out in a systematic manner. Most important for the project proponent (District engineers) is to assure basic questions or understand basic criteria for small reservoir development. This can start with identification of reasonable potential/existing small reservoir sites (capable of storage up to 1000 ha m or 10 million cu. m) and the availability of existing agriculture area. Viability depends on many factors but most important is a group of farmers/PPU interest, area to be developed, type of crop, production level, water demand and infrastructure need, cost of production, value of output expected, market outlet, etc.

Effective implementation plan depends on many factors. One of the most important is good project implementation, assessment of feasibility and coordination between agencies. This is very dependent on the people of the project especially the State Directors, District Engineers/Agriculture officers, etc.

(2) Government's Supports

A number of issues need to be resolved if the private sector is to be encouraged to invest in agriculture/small reservoir development:

a. Government may need to assist in land issues for small reservoir and related infrastructure development.
b. Government could also consider bearing the capital cost required and subsequently transfer facilities to be operated and maintained by the private sector (or the main investor).
c. Specific assistance may be required to facilitate/regulate rental of agriculture lands to protect the interest of investors as well as land owners.
d. To extend favourable credit facilities.
e. To review agriculture investment facilities similar to "pioneer status" in industrial development.

For the immediate plan, the year 1995 should focus on the preparation of detailed design and implementation plan of the pilot projects which could be immediately implemented at the on-set of 7MP.

(3) Cost Sharing

In Malaysia, the Government has responsibility for the execution of public works. If the Government implements the small reservoir development, the construction costs for main facilities will be borne by the Government. The main facilities of the small reservoir development may include the reservoir and appurtenant facilities, main irrigation and drainage channels and related structures, and roads and related structures. On-farm facilities and equipment such as sprinkler, rain shelter, etc. will be paid by beneficiary farmers. But there may be loan facilities from the Malaysia Agriculture Bank (BPM).

In case the private sector implements the small reservoir development, the same loan facilities will be available. Since a number of small reservoir developments are anticipated in future, it is recommended that the Government would decide terms and conditions of BPM's loan for the small reservoir development in advance.

There will be cases that the Government (DID) constructs small reservoirs and hands them over to the private sector for operation. In such cases, the O/M costs must be borne by the beneficiaries.

(4) Site Reservation

For DID, identification of existing and potential reservoir sites is important. For existing sites, the assessment should include improvement, rehabilitation, etc. For potential sites, specific management plans to conserve and reserve the site should be undertaken for future use. Some examples would be to develop them first as tourism spots, national parks, or other public uses until such time they are needed for small reservoirs.

(5) O/M of Small Reservoirs

In Malaysia, the Government takes overall responsibility for the operation and maintenance of irrigation systems which are constructed by the Government. Applying this rule, the Government may undertake the O/M of small reservoir projects. But, there will be some small reservoir projects which are implemented and operated solely by private investors.

Recently, there has been a move towards "privatization" and "commercialization". In this line, the O/M of irrigation systems may be handed over to the private sector (PPK or Water Users Association). The private sector will be capable of undertaking the O/M of small reservoir projects technically and financially, as there are many examples of this in many countries.

(6) Registration of Small Reservoirs

There is a need to keep a register of all small reservoirs owned by government agencies and the private sector. Since there is no regulation on their maintenance and safety, the initial step would be for the Government (DID) to carry out periodic inspection and advise owners on safety or operation improvement plans. In the long run, legal measures must be taken to ensure proper maintenance of these structures. Training of personnel is also important.

Data and information management by each District is necessary. The standard basin proposed in the National Water Resources Study (1982) should be used as a basis and the agriculture development plan should be interfaced with this.

In the long run, for commercial farming, water shortage is not necessarily the major issue, but a reliable and stable water supply are very important.

A sample resistration form for small reservoirs is shown in Fig. 3.5.1.

IV. PHASE I STUDY (SMALL RESERVOIR IDENTIFICATION SURVEY)

4.1 Results of Phase I Study

The purpose of the Phase I Study was to identify existing and potential small reservoir development in Peninsular Malaysia and to select pilot projects for small reservoir irrigation development. Details of the Phase I Study are presented in Annex-I.

The identification survey was implemented in two stages. The first stage survey was carried out using Questionnaire I to grasp the total framework of the Study. The Questionnaire I has only 13 routine questions such as the name of project, code number, location of project, purpose of project, priority, etc. The survey was conducted by State DIDs. It took three weeks to complete the Phase I survey. As a result, 266 potential small reservoir sites were identified and a long list was formed based on them.

Main statistics are shown below.

a) Type of Small Reservoir;

Type	A (small dam on stream)	112	(42%)
Type	B (pond in depression or swamp)	95	(36%)
Type	C (oxbow of abolished river)	8	(3%)
Type	D (upstream of existing weir)	35	(13%)
Type	E (tin mine pond or lake)	13	(5%)
	(unapecified)	3	(1%)
	Total	266	(100%)

b) Purpose of Reservoir

Irrigation		240	(45%)
	Paddy	128	(24%)
	Vegetables	141	(27%)
	Fruits	89	(17%)
	Others	30	(6%)
Domestic Supply		30	(6%)
Industrial Use		12	(2%)
Fisheries		46	(8%)
Agro-tourism		54	(10%)
Total		531	(100%)

c) Benefits

Irrigation	Area (ha)	37,678
	Family (No.)	40,259
Domestic Supply	Family (no.)	151,170
Industry	Factory (no.)	5,566
Fishery	Pond (ha)	1,148

d) Land Ownership

Government	(no. of projects)	109
Private	(no. of projects)	127
Mixed and others		30
Total		266

e) Environmental Problems

Water quality	(no. of projects)	41
Soil erosion	(no. of projects)	17
Flooding	(no. of projects)	4
Drought	(no. of projects)	4
Water logging	(no. of projects)	10
River erosion	(no. of projects)	3

f) Priority of Project in State's View

Priority 5 (highest)	(no. of projects)	123
Priority 4	(no. of projects)	66
Priority 3	(no. of projects)	34
Priority 2	(no. of projects)	13
Priority 1 (lowest)	(no. of projects)	6
blank	(no. of projects)	24

The second stage survey was conducted on 116 short listed projects using Questionnaire II which was designed to collect more detailed information of each site regarding hydrology, irrigation and drainage, geology, agriculture, agro economy and environment. In parallel with the survey, JICA Study Team made reconnaissance surveys on 33 priority projects which were proposed by State Coordinating Officers. Base on both surveys, JICA Study Team selected 18 candidate pilot projects.

4.2 Selection of Pilot Projects

Basic concepts for the selection of pilot projects and themes for the feasibility study are as follows:

a. Pilot projects should have different characteristics from each other, there is no point to undertaking feasibility studies of pilot projects having similar characteristics;

b. Pilot projects should represent specific local conditions and include local problems to be solved;

c. Pilot projects should include not only DID owned projects but also those owned by other government agencies such as DOA, MARDI, FELCRA, etc.

d. The feasibility study should cover themes such as:

   i) irrigated vegetables or fruits cultivation;

   ii) paddy and diversified crops irrigation;

   iii) water management of small reservoirs in Perlis State;

   iv) strategic land use study of inundation schemes in Pahang State;

   v) utilization of tin mine ponds and surrounding areas in Perak State; and

   vi) cooperation with the national tourism programme of Langkawi.

DID finally decided the following 12 pilot projects.

1) Simpang Geti (PR1) and Tasik Melati (PR4) Perlis State

Both DID schemes are irrigating mainly paddy during the rainy season and diversified crops, particularly tobacco, during the dry season on a limited extent. The objective of the project is to expand the cultivation of tobacco and diversified crops during the dry season through improvement of water management.

2) Kedawang (KH4/5) Langkawi, Kedah State

Projects are proposed by DID (KH4) and DOA(KH5) for the same objective area. The area is rainfed paddy fields cultivating yearly single crops. In Langkawi, tourism development programmes are under way by the public and private sectors. The government decided to preserve the Kedawang area as an agriculture area for the future.

Objectives of the project are to stabilize the paddy production during the rainy season, to produce vegetables to meet the increasing demands of tourists, and to contribute to agro-tourism. Project works may include construction of small reservoirs, irrigation and drainage system, and other necessary infrastructures.

3) MARDI Commercial Orchard (NS1) Jelebu, Negeri Sembilan State

This is a commercial orchard of 200 ha run by MARDI. Although various fruit trees were already planted with a drip irrigation system, many durian trees are dying due to an insufficient irrigation supply. The objective of the project is to construct a new small reservoir with sufficient storage capacity.

4) Paya Lanting (PH20) Maran, Pahang State

The project area is a former inundation scheme and has been abandoned since 1981. The proposed project is to construct a small reservoir in the middle reaches of the valley for fish culture and to grow vegetables in the downstream area by improving drainage.

5) Pasir Nering (TR44) H.Tgganu, Terengganu

The project area is one of the poverty areas in Terengganu State. Farmers group already started roselle cultivation with drip irrigation under the guidance of the DOA district office. The objective of the project is to expand the roselle and fruit area through construction of a small reservoir and irrigation / drainage system.

6) Skim Maras (TR3) K.Tggnu, Terengganu State

The objective of the project is to expand the paddy irrigation area through construction of a small reservoir utilizing tin mine ponds.

7) Bdg. Permatung Sunkai (KN16) Pasir Puteh, Kelantan

The project was started by a group of farmers for vegetable cultivation and domestic water supply. Water is taken from a small stream. A well and overhead tank are under construction. Farmers intend to expand the area with a small reservoir proposed upstream of

the present intake. The objective of the project is to construct a small reservoir and a connecting channel.

8) Kelompok Kangkar Merlimau (JR10) Batu Pahat, Johor State

The project is undertaken by a farmers cooperative with the guidance of DOA, and is aiming at fruit cultivation under irrigation. The area is hilly. A small pond exists and another pond is proposed. Objectives of the project are to increase fruit production by means of a small reservoir and irrigation system and to promote agro-tourism.

9) Bukit Sedanan (MA16) Jasin, Melaka State

This is a FELCRA settlement scheme. The area was planted with fruit, vegetables, and rubber. Some fruit trees have died due to inadequate irrigation. Since the scheme cannot provide settlers with enough job opportunities, some settlers are working outside to earn their livelihood. Revitalization of the scheme is needed.

The Melaka Integrated Agricultural Development Programme (MIADP) is also planning an agro-tourism project close to the east of the FELCRA scheme.

The objective of the project is to construct a small reservoir and water supply system to both the FELCRA and MIADP areas. The floriculture will increase women's participation in the development.

10) Skim Tok Bedu (PP3) SP Utara, P. Pinang State

There is an oxbow and an abolished river course near the project area. Objectives of the project are to stabilize paddy irrigation and to introduce vegetable cultivation utilizing the oxbow as a small reservoir. There is also an environmental problem (water pollution from pig waste).

V. PHASE II STUDY (FEASIBILITY STUDY)

5.1 Projects for the Feasibility Study

At the Steering Committee's meeting held on March 10, 1994, it was decided that JICA will conduct feasibility studies on the following 5 pilot projects:

1) Simpang Geti (PR1) and Tasek Melati (PR4)	Perlis State
2) Kedawang (KH4/5).....	Langkawi Island, Kedah State
3) Bukit Sedanan (MA16).....	Melaka State
4) Kelompok Kangkar Merlimau (JR10).....	Johor State
5) Pasir Nering (TR44).....	Terengganu State

At the same committee meeting, it was also decided that DID will conduct feasibility studies of the remaining 5 pilot projects with technical advice from the JICA Study Team. Later, however, DID's studies were reduced to the following three projects.

1) MARDI Commercial Orchard (NS1)	Negeri Sembilan State
2) Bendung Ptmg Sungkai (KN16).....	Kelantan State
3) Skim Tok Bedu (PP3).....	Pulau Pinang State

5.2 Study Items and Criteria of the Feasibility Study

A Hydrological Evaluations

(1) Water resources

The monthly rainfall distributions observed at rainfall stations near the pilot projects are shown in Fig. 5.2.1. The average annual and monthly runoffs for the pilot projects, which were estimated by using the modified water balance model described in detail in Annex II, "Meteorology and Hydrology", are summarized below.

Runoff Depth

UNIT : mm

PROJECT AREA		MONTH 1	2	3	4	5	6	7	8	9	10	11	12	ΣRoff A	ΣRain B	% A/B
PR1	S.GETI	13	8	10	11	22	13	24	29	57	77	104	72	**440**	1529	29%
PR4	T.MELATI	30	11	13	14	28	36	34	46	88	119	137	84	**640**	1745	37%
KH4	KEDAWANG	20	15	19	25	78	118	156	177	245	282	197	72	**1404**	2589	54%
MA16	BKT.SEDANAN	41	16	29	56	64	37	16	21	30	63	106	80	**557**	1718	32%
JR10	K.MERLIMAU	100	68	78	99	111	75	74	78	78	100	139	127	**1127**	2347	48%
TR44	PASIR NERING	283	110	64	41	64	52	61	63	106	154	279	512	**1790**	3089	58%

ΣRoff : Total runoff

ΣRain: Mean annual rainfall for the period of calculation

Framed values : Minimum runoff

Runoff Volume

PROJECT AREA		Total Runoff Depth (mm)	Catchment Area (km2)	Runoff Volume (ha·m) main	second	others	Total
PR1	S.GETI	440	55.0	1860	233	326	2420
PR4	T.MELATI	640	5.7	270	39	56	365
KH4	KEDAWANG	1404	3.5	340	123	28	491
MA16	BKT.SEDANAN	557	2.4	-	-	-	131
JR10	K.MERLIMAU	1127	1.4	-	-	-	158
TR44	PASIR NERING	1790	4.9	273	212	384	868

NOTE:

CROP & SEASON	MAIN	SECOND
S.Geti	Paddy (Aug-Dec)	Tobacco (Jan-Apr)
T.Melati	Paddy (Aug-Dec)	Tobacco (Jan-Apr)
Kedawang	Paddy (Aug-Dec)	Vegetable (May-Jul)
Bkt.Sedanan	Tree crops	
K.Merlimau	Tree crops	
Pasir Nering	Roselle(Jan-Jun)	Roselle(May-Dec)

(2) Flood

The design of hydraulic structures depends very much on the expected flood discharge. If the river is gauged and the length and quality of data available is adequate, then a straight forward analysis or the discharge data using for instance the Gumbel Frequency analysis or the Log-Pearson frequency analysis could be carried out. However, in case of small reservoir development, of which water sources and catchments are comparatively small, these records rarely exist.

DID has developed several procedures to estimate rain storms or regional floods using limited data or information. Hydrological Procedure (HP) No.4, "Magnitude and Frequency of Floods in Peninsular Malaysia (1974, Revised and updated 1984) gives flood estimation technique based on regional analysis. Frequency analysis were carried out on available data using the Gumbel Extremal Type I theory. Hydrological Procedure No.5, "Rational Method of Flood Estimation for Rural Catchments in Peninsular Malaysia (1974 Revised and updated 1989) along with No.1, "Estimation of the Design Rainstorm in Peninsular Malaysia (1973 Revised and updated 1982) provides peak flood discharges for rural catchments of areas up to 100 km^2. These two procedures (No.4 &5) give peak flood discharges, while Hydrological Procedure No.11, "Design Flood Hydrograph Estimation for Rural Catchments in Peninsular Malaysia (1976) gives not only the peak discharge but also volume of floods, i.e., the total flood hydrograph. In using these procedures, physical characteristics such as area, shape, slope, topography, and vegetation of catchments should be known, since the magnitude of floods largely depends on these catchment characteristics.

The following table shows the estimated flood peaks for the five pilot projects estimated by using the above-mentioned procedures.

unit : cumec

Project Area		Hydrological Procedures		
		HP4	HP5 *	HP11
PR4	Tasek Melati	6.9	16.1	15.5
KH4	Bkt. Lembu	5.0	18.4	14.5
	Up Bkt. Lembu	0.8	2.6	4.0
	Ketapang	1.3	3.3	5.8
MA16	Ayer Mentangor	2.5	7.2	12.7
	Durian area	0.8	2.0	3.3
JR10	K. Merlimau	5.2	6.9	10.5
TR44	Sg. Perching	21.4	61.3	43.0
	Sg. Por	71.0	209.8	145.1

The results by HP5, Rational Method, give the largest values except in dry areas where the adopted run-off coefficients for the regional formula are low. Consequently, in dry regions, HP11 gives the highest values. It is recommended to compare the results of the procedures and adopt the highest values for the design purpose. It should be noted that the results of HP4 are applicable only for catchments of more than 20 km^2.

Regarding the "Type A (small dam)" reservoir, the Probable Maximum Flood (PMF), which is generally used for determination of the design flood, is recommended to be evaluated in case the scale of dam is comparatively big in terms of dam height (nearly or higher than 10 m), or influence on the downstream is assumed as large.

In this study, the PMFs were estimated for the Ketapang Dam of KH4 Kedawang in Kedah and for the Air Mentangor Dam of MA16 Bukit Sedanan in Melaka. Probable maximum precipitations (PMP) estimated for the near-by projects of the two project areas were used for calculating the PMFs following the procedure mentioned in the HP5. Consequently, the PMFs for the Ketapang Dam and the Air Mentangor Dam were estimated at 16.3m^3/sec and 21.6m^3/sec, respectively, of which details are mentioned in Annex II, "Meteorology and Hydrology, 3.2.6 Discussion".

(3) Sediment

All rivers transport a certain amount of sediment, suspended in the flow cross-section or moving along the bed. As they approach the reservoir, the velocity is reduced and the coarser sediment settles down in the head reaches of the reservoir. The finer sediment is maintained in suspension and is deposited in the reservoir. This deposition of silt gradually reduces the available storage capacity of the reservoir and is, therefore, an important factor in planning.

In general, the mean annual sediment production is expressed in the following formula:

$$q_s = KA^n \qquad (1)$$

where, q_s : mean annual sediment production (m^3/km^2/year)
A : catchment area (km^2)
K, n : constant

The constant "n" is normally a negative value meaning that the specific sediment production (m^3/km^2/year) decreases as the catchment area increases. This is because of the larger sediment storage function and higher percentage of plains in bigger catchments. In Japan, -0.7 is used for the constant "n", where in India, -0.2 to -0.5 is applied.

In Malaysia, no long-term sampling of bed loads has been taken, and only suspended load records at 53 DID hydrological stations are available. The rate of the bed load was assumed at 10 to 20% of the total sediment load in "National Water Resources Study Malaysia, Perlis-Kedah-Pulau Pinang Regional Water Resources Study", and the rate of 20% was finally adopted.

In this study, stations for suspended load measurement were selected in terms of the catchment area (less than 1000 km^2). The sediment transport was estimated by converting the transported suspended load in tons to the total sediment volume in m^3 assuming that;

i) the bed load is 20% of the total sediment load, and ii) the specific weight of the deposit is 1.0 ton/m^3

Four groups according to the sedimentation rates are as follows.

Sedimentation rate	Area
Very high	Part of Selangor (Sg. Batu, Sg. Semenyih), Perak (Sg. Cenderiang), Pahang (Sg. Lepar)
High	Selangor, Lower Pahang river basin Central Perak (Ipoh, Kampar, Tapah)
Low	Perlis, Melaka
Intermediate	Others

(4) Sedimentation rate for the proposed water sources

According to catchment areas and groups to which the project areas belong, the sedimentation rates were obtained as shown below;

Project	Water source	Catchment area	Sedimentation rate			
PR1	Simpang Geti	55.00 km^2	≈150	m^3/km^2/year	≈8,300	m^3/year
PR4	Tasek Melati	5.70 km^2	≈260	m^3/km^2/year	≈1,480	m^3/year
KH4	Lembu	3.50 km^2	≈300	m^3/km^2/year	≈1,050	m^3/year
	Upper Lembu	0.34 km^2	≈530	m^3/km^2/year	≈ 180	m^3/year
	Ketapang	0.60 km^2	≈460	m^3/km^2/year	≈ 280	m^3/year
MA16	Ayer Mentangor	2.35 km^2	≈325	m^3/km^2/year	≈ 760	m^3/year
	Durian area	0.47 km^2	≈485	m^3/km^2/year	≈ 230	m^3/year
JR10	Kangkar Merlimau	1.40 km^2	≈370	m^3/km^2/year	≈ 520	m^3/year
TR44	Sg. Peching	4.85 km^2	≈270	m^3/km^2/year	≈1,310	m^3/year
	Sg. Por	18.20 km^2	≈190	m^3/km^2/year	≈3,560	m^3/year
	Sg. Udang	2.40 km^2	≈320	m^3/km^2/year	≈ 770	m^3/year

B. Geology

Five pilot project sites were selected for the JICA Feasibility Study from the Phase I Study. Among the five pilot projects, geological investigations at the dam-sites and soil-mechanical tests for dam materials were conducted on three project sites (5 dam-sites in 3 projects) during the Phase II Study. They are Project KH4 and KH5 in Kedah, Project TR44 in Terengganu, and Project MA16 in Melaka. On the other hand, the other three project sites were selected for the GOM(DID) Feasibility Study: Project PP3 in Pulau Pinang, Project KN16 in Kelantan, and Project NS1 in Negeri Sembilan. The necessary geotechnical advice

was also provided for DID's feasibility studies on these three projects only during the period of stay in Malaysia, in accordance with the agreement between GOJ and GOM.

The geological investigations were carried out at the dam-sites and consist of core drilling with borehole tests (Standard Penetration Test and Permeability Test). The core drilling was carried out using hydraulic-feeding rotary drilling rigs with triple tube core barrel (Mazier Sampler). In cases where rock was encountered, rock corings were carried out. Core samples taken through the drilling were arranged in core boxes in order and then stored in a DID warehouse. Standard Penetration Tests according to the USBR Specification were performed to evaluate the strength of unconsolidated deposits and completely weathered rock zones. Borehole Permeability Tests according to the BS(British Standard: Open-end, falling head method) were performed to estimate the coefficient of the permeability.

Soil-mechanical tests for the dam material were carried out on samples collected from cut faces at the proposed borrow areas. All tests were carried out in a laboratory in Kuala Lumpur in accordance with the BS procedure. Testing items are as follows.

Physical Test	- Specific Gravity
	- Natural Water Content
	- Grain Size Analysis
	- Liquid/Plastic Limit Test
Mechanical Test	- Compaction Test
	- Permeability Test
	- UU Triaxial Compression Test
	- CU Triaxial Compression Test with measurement of pore pressure

The bill of quantities for the geological investigations performed in the field are shown in Table 5.2.1. And the results of the soil mechanical tests for dam embankment materials are shown in Table 5.2.2.

C. Agriculture

The Agricultural Survey includes a farmers meeting, an interview survey, and a soil assessment survey for each project.

The farmers interview survey was conducted on around 300 farmers, and obtained in 261 effective answer-sheets as follows:

Code	Total families	Village	Interviewed families	Effective answers	% of samples
PR 1	Simpang Geti	75*	70	60	80%
KH 4	Kedawang	130	40	35	27%
MA16	Bukit Sedanan	96	107	96	100%
JR10	K.K.Merlimau	36	36	36	100%
TR44	Pasir Nering	79	41	34	43%

* Tasek Melati (Aloh Baroh) was not surveyed.

The soil assessment survey was carried out by a local soil specialist consultant.

At the five project sites, eleven soil pits were excavated and 22 soil samples were taken for laboratory testing on pH and particle size. The Checking of soil layers was done using auger. In actuality, the physical and chemical properties of the soil, were mostly estimated on the expert knowledge of the consultant.

Generally speaking, the soil in assessment shows that available water is low (less than 10%), the organic carbon content is low (less than1.5%) except the peat soil in the low lands at the Johor site, and the acidic level of the pH is less than 5.0, excepting the Perlis site.

D. Irrigation and Drainage

(1) Field Survey

During the field survey, a topographical survey, detailing existing water resource facilities, irrigation and drainage facilities, and a survey on construction material and equipment were carried out.

The topographical survey, mentioned below, was carried out by local contractors under JICA Study Team's supervision.

The total survey quantity for all the pilot projects are summarized below.

	Quantity		
Description	4 Projects for JICA	3 Projects for DID	Total
Reservoir area	143 ha	57.1ha	200.1ha
Dam axis	1800 m	600 m	2400 m
Irrigation area	147 ha	35 ha	182 ha
Canal route	2.4 km	21.5 km	23.9 km

Topographical maps of the reservoir and irrigation areas are prepared on a scale of 1:1,000 with a contour interval of 0.5 m for ordinary areas and 1.0 m for hilly areas.

In order to clarify the preliminary development plan of the respective Project sites, detailed field investigations on existing structures in and around the Project areas including farm ponds in the MA-16 area, intake structures in the KH4/5 area, and some alternative dam axis in the Project areas of KH4/5 and TR44 and JR10, were undertaken.

Surveys on the cost of construction materials and equipment have been carried out in the respective States concerned with the Projects. Through the surveys, market prices of construction materials, labour wages, equipment costs and current tenders and/or contract prices of similar types of projects located adjacent to the respective pilot project sites were collected. Construction costs of on-farm development facilities including drip and sprinkler irrigation facilities and pumps were also collected.

(2) Irrigation Water Requirement

The irrigation water requirement for the respective Projects is calculated based on the proposed cropping pattern of the agriculture development plan. This proposes that crops are cultivated, following the procedure of the MADA report No. 86014 for paddy cultivation, and the FAO Irrigation and Drainage Paper No. 24 and/or MARDI's paper "Estimated water requirement of some Malaysian commercial fruit crops" from the orchard and vegetable Prosiding Simposium Buah-buahan Kebangsaan, 1991.

Potential evapo transpiration (ETo) is estimated by the modified Penman method, using meteorological data from stations located near the Project areas.

Irrigation methods are designed as basin irrigation for paddies under direct sowing, drip irrigation for orchards and drip and/or micro jet sprinkler irrigation for vegetables.

Regarding vegetable cultivation, 90% of the potential evaporation is applied to the calculation of irrigation water requirement. Effective rainfall is not applied due to use of the rain shed cultivation method.

Design irrigation water requirement for irrigation facilities in the respective Projects are estimated using the drought annual rainfall with a return period of 5 years.

(3) Water Balance Calculation

Reservoir operation calculation at the proposed dams and/or ponds is calculated by using the estimated runoff at dams and/or ponds, and the seasonal irrigation requirement and water loss from reservoirs such as seepage water and evaporation.

The calculation period is adopted for month and/or half month periods using runoff data from the past 30 years.

Reservoir capacities of dams and/or ponds are designed to supply irrigation water sufficiently under the drought year with a return period of 5 years.

(4) Drainage Water Requirement

Drainage water requirement is calculated under the condition of three consecutive day rainfall with an exceeding probability of 80%, and three days of drainage period. The three consecutive day rainfall with a return period of five years are calculated by the Gumbel method, using rainfall data of more than ten years from the respective Project areas.

(5) Design

The design standard for dams and related structures, irrigation canals and drains, and pump stations and related structures are based on the draft design criteria on small reservoir development projects discussed between DID and JICA Study Team during the field survey, the Design Standard of DID, including the Design Manual for Water Conveyance System and the Drip Irrigation Systems Design Manual and Design Standards issued by Ministries of the Japanese Government.

Dam spillways are designed using the design flood discharge with a return period of 100 years. Dimensions of the dam are based on the results of a stability analysis of dam slope and seepage water discharge from reservoirs.

The stability analysis of the dam slope is based on geological data obtained through the boring survey and soil mechanical test.

(6) Cost Estimate

The unit prices of the respective works of the projects are estimated by updating the bidding prices of similar works in the same regional areas and the Government price schedule issued in 1993, using the annual commodity inflation rate issued by the Central Bank of Malaysia.

The unit prices of the respective works for the Projects are updated to the September 1994 price level.

(7) Construction Plan

Mechanical construction methods will be basically applied to construction of the Project.

The diversion of river flow during construction of the dam will be entrusted to the culvert spillway. Prior to the 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.

E. Project Evaluation

The common denominators in the appraisals of the five projects are dealt here.

a. First of all, these proposed projects are consistent with some of the long-term national agricultural policy objectives namely, maximization of farm income, optimum utilization of limited water resources and emphasis on in situ development. They also aim at relieving some of the major constraints in the agricultural sector such as labour shortages and inflexibility of institutional policy instruments by encouraging women's participation and interaction between farm communities and government bodies.

The overall introduction in this report discusses the necessity of small reservoirs in the context of agriculture. It aims at stabilizing the water supply by reducing uneven precipitation, and enhancing the stability of the banks of the lower reaches of the dam. Thirdly, the farming communities will also be stabilized by execution of the projects.

This process could be further facilitated if the concerned administrations at different levels and sub-sectors would coordinate each other and interact with the communities giving them pertinent advice and relevant support.

The government policies' effect on competitiveness in Malaysia is among the top four in the world.*

* 1. Singapore, 2. Hong Kong, 3. New Zealand, 5. Switzerland, 6. United States.
Source: IMD & World Economic Forum: 1994.

In the domain of federal agricultural administration, though, activities of individual departments come to the fore and coordinating work by MOA seems to be kept back. This arrangement ought to be brought back into alignment in order to highlight the

function of the planning division of MOA. Without demarcating the division of labour among the different departments in formulating any consolidated national project, utmost success could not always be achieved.

As to the financial sources, DID will bear all the initial investment costs that are enumerated in the project cost list. Further down, the costs of each cultivation scheme will be footed by farmers' or related organizations. They will find their own source of investment according to their credit worthiness. Likewise, DID could charge water rates to the organizations concerned to cover O&M costs of the irrigation facilities.

(The projects will also take account of the water rights in the reaches below the reservoirs.)

b. Project appraisal

The principal aim of this analysis is to roughly evaluate the viability of the water use development scenarios provided by the projects. It will calculate the efficiency of the capital investment to the projects.

In order to raise overall income and, at the same time, mitigate acute labour shortage in the farming communities, a prerequisite is to find more than two income earners in each household. This automatically means women's participation in economic activities above their subsistence level in agriculture, or, in the case of such suburban areas as the MA-16 project site, in other industries. This movement could only be fortified by spreading networks of social security, i.e., medical care, school and crèche. Public systems of the first two are well established in Malaysia, but the country lags in the development of a public child care system, especially in rural areas.

c. The method of appraisal:

EIRR is used as a criterion to judge capital use efficiency.

One of the major tangible and estimable benefits that would be derived from smoothing out effects on the water regimes by the water stored in small reservoirs is an increase in farm production. In this appraisal, we count only this value as the benefit of the project.

d. Other benefits:

Flood control: If properly maintained, floods of less than one hundredth probability will become harmless, and the damage that would be caused by floods of a greater scale would be reduced. (Tangible benefit but not counted quantitatively)

Fish culture : As is being carried out at FELCRA Bukit Sedanan, small reservoirs can be used as fish breeding ponds. The catch can be sold at outside markets or distributed within the water users community at market price. (Tangible benefit but not counted quantitatively)

Social stability: Secured water use for farming would reduce conflicts among the members of the community, and could eventually increase the equity among members, which would in turn allow the community to express itself more vigorously in regard to the outside world. (Non-tangible benefit)

Local amenities: If properly maintained, newly built reservoirs could be added to existing local amenities. Water fronts combined with these areas or commercial agricultural farms may create agro-tourism which will generate income.(tangible but difficult to enumerate)

e. General presumption in the EIRR calculation:

Basic assumptions for this analysis, including conversion of financial values into economic values are as follows:

(1) The financial value of commodities are set at September 1994. All the prices are expressed in Malaysian Ringit.

(2) With no restriction in the exchange of foreign currencies, the shadow exchange rate is set at one. This means we could assume that the standard conversion factor is one.

(3) The economic value of labour and commodities except land, are set at their financial prices. (Distortions of the local prices of the imported portion of the equipment are difficult to assess. We make a note on the net value of paddy at the KH section .)

(4) The economic value of the land acquired is set at zero. PR1 and PR4 are exceptions.

(5) The project life is set at 30 years including one year of construction period.

(6) The annual O/M costs of the component structures are set at 0.5% of their construction costs. MA16 is an exception.

F. Environmental Issues

1) Survey of Present Environmental Conditions

An environmental survey was carried out in the five project areas to find out the present environmental conditions and the major environmental problems of the study area. The major environmental components of the selected sites including physiochemical, biological, and human were studied. The major environmental components surveyed are as follows :

A. Physicochemical
   Land, Surface Water, Groundwater, Atmosphere, and Noise

B. Biological
   Species and Populations and Habitats and Communities

C. Human
   Health and Safety, Social and Economic Factors, and
   Aesthetic and Cultural Factors

2) Water Quality Survey

Since water quality is one of the most important environmental components for the development of small reservoirs, a detailed water quality study was carried out.

The field parameters including pH, Temperature, EC, Dissolved Oxygen (DO), Turbidity, and Salinity were measured using a water quality checker. For the lower ranges of electrical conductivity measurement, an EC meter with lower range was used. Chemical Oxygen Demand (COD) was also measured, by pack test.

Water samples were collected at the water sources of the project sites and were analyzed at the Chemistry Department of Malaysia. The following parameters were analyzed.

Colour	BOD	Ammoniac Nitrogen	Nitrate Nitrogen	
Total Solids	Dissolved Solids	Suspended Solids		Alkalinity
Hardness	Calcium	Magnesium	Potassium	Sodium
Iron	Silica	Chloride	Phosphate	Sulphate

These are the parameters used by DID to interpret the water quality of irrigation water. The Interim National Water Quality Standard of Malaysia (INWQS) is shown in Table 5.2.3. The results of the water quality survey for each project area are discussed in the later sections.

3) Environmental Impacts Survey

An environmental impacts survey was carried out to find out the environmental impacts on the major environmental components by the implementation of the project. The environmental impacts were surveyed using an environmental assessment matrix. The opinions of the project engineers, district agricultural officers, farm managers and local farmers were included in this survey.

G. Agro-tourism

DID proposed to include the agro-tourism concept in the small reservoir development. The small reservoirs apart from serving as the water source for agriculture, can also be used for tourism purposes such as fishing and other recreational activities. Besides the tourists can also participate in the agriculture activities like fruit picking. An agro-tourism survey was carried out in the following project areas to identify the potential for development:

1. KH4/5 - Kawasan Padi, Kedawang, Langkawi, Kedah
2. JR16 - Kelompok Kangkar Merlimau, Batu Pahat, Johor
3. MA16 - Bukit Sedanan, Jasin, Melaka
4. PR4 - Simpang Geti and Tasek Melati, Perlis

At present, Pasir Nering Project at Terengganu has relatively little potential for tourism development. Therefore this area was not included in the agro-tourism survey. The relevant information was collected in the above four project areas on the following aspects :

1. Present agricultural conditions and the possibility of introducing fruit, orchid gardens, and pot flowers
2. Involving tourists in agriculture related activities like fruit picking, etc.
3. Possibility of using small reservoir for fishing and other recreational activities
4. Present infrastructure and recreational facilities in the project area.

5.3 SIMPANG GETI (PR1) and TASEK MELATI (PR4).....Perlis State

5.3.1 General

Both schemes are located in a flat plain about 10 km northeast of Kangar, the capital of Perlis State. The Simpang Geti scheme has an area of 105 ha and the Tasek Melati scheme (alias Alor Baroh) has an area of 232 ha. Presently the paddy cultivation is practiced in about 240 ha or 70 % of the total area during the rainy season (the rest is fallow) and only 10 ha in the Simpang Geti scheme is planted with tobacco during the dry season.

The Simpang Geti scheme has an irrigation system starting from the Ngolang weir on the Ngolang river. In the highest upstream reaches of the Ngolang river, there is a sugar cane plantation of 8,000 ha managed by Perlis Plantation Berhad (PPB) and FELDA who own more than 300 ponds and use the harvested water for sugarcane irrigation. In between the sugar plantation and the Ngolang weir, there are several intake weirs abstracting water for paddy irrigation. Hence, the total amount of water available at the Ngolang weir is very limited. Tobacco cultivation in the dry season is barely possible, only using 8 small ponds excavated in the Simpang Geti area. To resolve the water shortage problem, DID constructed a link canal from the Timah Tasoh dam in 1993.

The Tasek Melati scheme has an irrigation system starting from the Tasek Melati pond. Since the catchment area and storage capacity of the Tasek Melati pond is only 6 km^2 and 40,000 m^3, irrigation water is insufficient for the paddy cultivation even during the rainy season. The above-mentioned link canal passes through the Tasek Melati scheme area so that water from the Timah Tasoh dam is also available for the Tasek Melati scheme.

Objectives of the pilot project are to expand the tobacco cultivation area during the dry season. The expansion of the cultivation area can be expected only if water becomes available from the Timah Tasoh dam. It is proposed as a first step to obtain water allocation from the Timah Tasoh dam, and then to implement on-farm works in order to improve drainage conditions.

There will be no environmental problem in relation to the pilot project. In regard to agro-tourism, the Tasek Melati pond is also used as a park.

5.3.2 Climate, Hydrology and Water Resources

The project areas are situated in one of the driest areas in the Peninsula. Many of water resource difficulties in this area are brought on by this dry condition.

In Perlis, the main season starts in August and ends in November. Nearly 50% of the annual rainfall is observed during this season while a distinct dry period is observed from January to February*1. Mean annual rainfall at Bukit Temiang, which is the nearest DID rainfall station to Tasek Melati, is 1,817 mm, while that of Ngolang for Simpang Geti is 1,613 mm.*2 The rainfall pattern throughout the year in Bukit Temiang is shown in Fig. 3.2.1.

The water of Lake Tasek Melati is used not only for tourist activities but also for irrigation. Alor Baroh scheme (232 ha) and Bukit Tau scheme (95 ha), which are both operated by DID receive water from Lake Tasek Melati and its near-by pond.

Simpang Geti scheme (105 ha) was designed to receive water from the link canal from the Timah Tasoh dam, and Sg. Ngolang. However the scheme is located on the downmost reaches of the Timah Tasoh link canal and the Sg. Ngolang river. It is very easy to judge that Simpang Geti, even if it has two water sources, will suffer from water shortages during dry periods, without proper water management.

The largest water users in the Ngolang catchment are considered to be the sugarcane plantation of PPB and FELDA, which cover more than 8,000 ha (See Fig. 5.3.1).

5.3.3 Agriculture

A. Present Condition

(1) Land Use

Paddy lands of both schemes total to 337 ha: 105 ha in Simpang Geti and 232 ha in Alor Baroh (commanded area of the Timah Tasoh pond). However, around 30% of these lands are unused. Paddy cultivation is done as a single crop in the rainy season, and only tobacco is cultivated in the dry season. Tobacco cultivation in the dry season is practiced by 40 farmers in only 10 ha.

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*1/ Based on long-term (1967 - 1990) rainfall records at DID station 6502010, Bkt Temiang.

*2/ Mean value for 1983 to 1990.

(2) Soils and Land Capability

A soil survey was carried out in Simpang Geti. The soils were identified to be mostly of the Bukit Tuku series, which is grayish brown sandy loam or an olive brown sandy clay. Characteristics and properties of Bukit Tuku soils are summarized as follows:

Bukit Tuku series: 40-80% of sand, less than 10% of silt and 10-40% of clay; available water is low to very low, water permeability is moderate to high, adequate pH at 6.1 to 6.6, low organic carbon content, low CEC.

According to a technical book on tobacco published by MARDI, Bukit Tuku soil is classified as a marginal soil for tobacco cultivation. However, there is another agro-ecological explanation based on yield standards; suitable areas yield more than 1,000 kg/ha, marginal areas yield 500-700 kg/ha, and unsuitable areas yield less than 500 kg/ha. The yield level of tobacco at Simpang Geti was established at 1,000 kg/ha by an interview survey, indicating that the soil and climate at Simpang Geti is suitable for tobacco cultivation.

(3) Agricultural Production

Total paddy production in Simpang Geti and Alor Baroh is roughly estimated as 960 t, averaging 4.0 t/ha from 240 ha, which is the actual cropped area, totaling 70% of the total land. A soil specialist estimated a lower yield of 2.5-3.5 t/ha due to poor soil capacity, and DOA extension workers estimated the yield as 3.0-3.5 t/ha. However, the farmers interview survey indicated an average yield of 4.18 t/ha. Therefore, the average yield was estimated as 4.0 t/ha.

Tobacco production is estimated at 120 t averaging 12 t/ha from 10 ha cultivated by 40 farmers. Based on the hearing survey of tobacco farmers, 10,000 seedlings are planted per ha, and the yield is 1.0-1.5 kg/plant (1.2 kg/plant on the average).

(4) Population and Agricultural Employment

The farmers interview survey was conducted on 60 farm families in Simpang Geti, covering two thirds of a total 90 paddy farmers, which is estimated at 0.8 ha/farmer for an average paddy crop and 70% of actual cropping farm land. Using the same method, 200 paddy farmers in Alor Baroh were evaluated. Consequently, the total population of farm families in the project area in Simpang Geti and Alor Baroh at Tasek Melati is approximately 1,100 people, with 290 farm families and approximately 4 members per family.

The average age of the house owners is 55. Among the interviewed farmers, 35 house owners (58%) out of 60 farmers are more than 55 years old, and 15 house owners (25%) are

over 60 years old. Therefore, some children have left their houses, and the remaining children are 25 years old on the average. The number of persons who can work in each family amounts to 3 out of 4 due to the old age of some members. 86% of tobacco farmers are included in the 3 or 4 member families. The distribution of family size and tobacco farmers, of the interviewed 60 farmers, is shown below:

Family size distribution		Family size of Tobacco farmers	
6 members family	1		
5 members family	8	5 members family	4 tobacco farmers
4 members family	30	4 members family	23 tobacco farmers
3 members family	13	3 members family	9 tobacco farmers
2 members family	8	2 members family	1 tobacco farmers
Total	60	Total	37

Total working man-days per family is 773, of which 80% is spent on family farming. Half of the total farmers are engaged only in family farming.

(5) Farm Size and Land Tenure

According to the farmers interview survey in Simpang Geti, the distribution of land owner-ship is shown as follows:

0.2-0.3 ha	4 farmers (7%)	1.0 ha (2%)
0.4 ha	17 farmers (28%)	6.8 ha (14%)
0.5-0.6 ha	2 farmers (3%)	1.1 ha (2%)
0.8 ha	23 farmers (38%)	18.4 ha (37%)
1.0-1.4 ha	7 farmers (12%)	7.9 ha (16%)
1.8-2.4 ha	7 farmers (12%)	15.0 ha (29%)
Total	60 farmers(100%)	50.2 ha(100%)

(6) Farm Management and Marketing

Farming operations of paddy and tobacco cultivation are carried out by the individual management; however, FOA, LTN and DOA assist in these cultivation. In tobacco cultivation, LTN (National Tobacco Board) decides the allocation of the tobacco crop area, and provides many services such as seedlings, fertilizers, technical advisors, marketing, etc. through FOA and the Barn owners.

(7) Economics of Farm Operation

There are three methods of paddy cultivation; transplanting, broadcasting, and machinery planting. According to a hearing survey at a farmers meeting in Simpang Geti,

60% of paddy cultivation is carried out by transplanting, 25% by broadcasting, and 15% by machinery planting, with transplanting yielding the highest.

Cost and return of paddy cultivation in Simpang Geti are summarized as follows:

Cash outlay (ha)	1) Machinery cost	RM 720 (L.P. and Harvest)
	2) Agro-chemicals	RM 87
	3) Hired labour	RM 50 (5 man-days)
	4) Seeds (self-provided)	0 (40 kg)
	5) Fertilizer (subsidized)	0 (300 kg)
Family labour	61 man-days/ha	
Yield (ha)	4,180 kg	
Gross return (ha)	RM 2,926 (@RM 0.7/kg)	
Net return (ha)	RM 2,069	
Net return per day	RM 34/day	

Cost and return of tobacco cultivation in Simpang Geti are summarized as follows:

Cash outlay (ha)	1) Land preparation	RM 625 (3 times of rotary)
	2) Seedling (10,000)	RM 40 (10 flats)
	3) Fertilizer (750 kg)	RM 125 (RM 450 of subsidy)
	4) Chemicals(15 kg)	RM 70
Family labour	343 man-days/ha	
Yield (ha)	12,000 kg	
Gross return (ha)	RM 6,600(@RM 0.55/kg)	
Net return (ha)	RM 5,740	
Net return per day	RM 17 / day	

(8) Farm household economy

Average tobacco growers with 0.4 hectare plots have an annual net income of about RM 2,300 from 140 man-days of family labour (equivalent to RM 1,400 in about four and a half months at the rural wage level).

B. Agricultural Development Plan

(1) Land Use

Land use for paddy cultivation will not be changed during the rainy season from September to December. During tobacco cultivation in the dry season, the crop acreage is planned to be extended to 150 ha in two areas: 50 ha in Simpang Geti and 100 ha in Alor Baroh. This enlargement will be concentrated in the Alor Baroh area since around 10 ha of tobacco crop from 75 ha of paddy crop has presently been extended in the Simpang Geti area.

(2) Farming and Cropping Plan

Since paddy cultivation is not planned for the dry season in this project, only tobacco cultivation will be mentioned in this report.

Cropping Pattern

Farmers can get 25 day-old seedlings from the Barn owner nursery in the middle of January, and have to keep them for around 20 days in their own nursery for the first week. Land preparation for tobacco transplanting will be carried out from the middle of January to the end of the month. Transplanting will be done in the morning over several days. Instruction on nursery care and fertilization will be made by LTN through the Barn owner and FOA.

Irrigation is needed three times, in the week following replanting, 20 days after, and 60 days after replanting.

Harvesting of leaves will continue for two months from the beginning of April to the end of May. During harvesting, the quality of leaves are checked by LTN through the Barn owner.

Cropping space

Actual spacing is usually 4 feet (120 cm) line spacing x 3 feet (90 cm) crop spacing with a cropping of 4,000 seedlings per acre (0.4 ha). LTN recommends 6,000 plants/acre (15,000/ha) which means a spacing of 3.5 feet line spacing x 2 feet crop spacing.

In this report, a 3.5 feet line spacing and 2.5 feet crop spacing is recommended.

With this spacing, the number of plants will be 5,000/acre, (12,500/ha).

Land preparation

Land preparation and ridge making are very important for effective irrigation and uniform crop growing. The desirable height of the ridge should be 30 cm, and the irrigation should be 20 cm deep. If a tractor ridger is available, labour can be saved, and ridges can be made more evenly.

(3) Crop Budget and Production Plan

The proposed acreage of tobacco cultivation is 150 ha including the present 10 ha, and the proposed number of participants is 300 including the present 40 farmers. This means that each Tobacco farmer will have a Tobacco cultivation area of 0.5 ha with 6,000 plants.

Crop budget of tobacco cultivation in one ha is planned as follows:

Cash outlay (ha)	1) Land preparation	RM 425 (2 times of rotary)
	2) Ridger service	RM 200 (by ridger)
	3) Seedling (13,000)	RM 52 (13 flats)
	4) Fertilizer (750 kg)	RM 125 (RM 450 of subsidy)
	5) Chemicals(15 kg)	RM 70
	6) Hired labor	RM 2,250 (150 m.d.; RM 15/m.d.)
Family labor		150 man-days/ha
Yield (ha)		14,400 kg (1.2 kg per plant by 15 leaves)
Gross return (ha)		RM 8,640 (@RM 0.60/kg)
Net return (ha)		RM 5,518
Net return per day		RM 37/day

Total production of 150 ha with 300 farmers in the project area will be 2,160 t/yr., and the net production will be calculated as RM 827,700 per annum.

(4) Employment and Working Opportunities

Tobacco farming families are mostly four member families with three families working on tobacco cultivation which is considered a high labour industry.

The total labor requirement for the new tobacco project is estimated as 45,000 man-days per year, and a half of that will be hired from outside laborers. The tobacco project will provide a new working opportunity to not only the 300 farm families generating around RM 3,000 per year of additional income, but also to the 22,500 man-days of hired laborers at a wage of RM 15 per day.

(5) Farm Management Plan and Farm Budget

According to the tobacco farmers in Simpang Geti, they decide in two meetings in July and December when tobacco cultivation starts. Organizing tobacco farmers is planned by the Barn owner or FOA. For the new areas, FOA has to arrange a Barn owner by consulting with LTN. Therefore, the farmer leaders meeting will be headed by the FOA manager with DID and LTN. In this meeting, the Barn farmers and the number of participants will be discussed. With the decision of the participants, DID has to make an irrigation plan for the dry season, and FOA will arrange the farmers group meetings with LTN to decide on tobacco extension and tobacco irrigation.

The farm budget of tobacco cultivation varies by the size of cultivation as follows:

Crop size	Plants nos.	Cash cost	Gross income	Net income	Labour(family/hired)
0.25 ha	3,000 plants	RM 217	RM 2,160	RM 1,943	75 m.d.(75 / 0)
0.4 ha	5,000 plants	RM 347	RM 3,456	RM 3,109	120 m.d.(120 / 0)
0.5 ha	6,000 plants	RM 886	RM 43,20	RM 3,434	150 m.d.(120 / 30)
0.8 ha	1,0000 plants	RM 2,494	RM 6,912	RM 4,418	240 m.d.(120 / 120)
1.0 ha	12,500 plants	RM 3,122	RM 8,640	RM 5,518	300 m.d.(150 / 150)
1.25 ha	15,500 plants	RM 4,460	RM 10,800	RM 6,340	375 m.d.(150 / 225)

(6) Marketing Plan

Tobacco leaves will be sold to the Barn owner at prices of RM 0.45 to RM 0.80 per kg depending on the quality. Before selling, farmers have to partially dry the harvested leaves, and band them. This post-harvest processing is very important and is often done by women.

C. Implementation Plan

(1) Governmental Services

This project is specially selected by DID as a model project in water management systems for the dry season. The necessity of irrigation in the dry season for the introduction of new crops or for crop diversification will be expected to increase in the future. Therefore, DID has to concentrate its effort to establish a systematic irrigation management in dry season crop cultivation in collaboration with FOA and DOA.

In some cases, DID will need to aid pumping using mobile pumping lorries for the farming groups. Tobacco irrigation can be easily scheduled with the help of LTN and FOA.

FOA has to organize the tobacco farmers groups under every Barn owner with the help of LTN. In November or December, Tobacco cultivation meetings should be held, headed by the FOA manager with the attendance of LTN, DID and all the participant farmers. At the meeting, irrigation systems, tobacco crop technology, and farmers communication in the organization will be discussed by every related agency.

(2) Farmers Organization

Two kinds of farmers organization or farmers groups have to be set up. One is the water users groups of the same water sources or water canals. These groups will be helped by DID. The leaders of the groups will be registered in the DID office, and the information and communication between DID and it's beneficiaries will be in their charge. The other is organized by FOA through the Barn owners and LTN. These are a kind of marketing group

in farm inputs and farm produce. The Barn owners can be leaders, and will have close contact with LTN and FOA.

(3) Women's Participation in Development

In this project area, almost all house wives are working in their home farming since their youngest children are already around 25 years old. Therefore, when the tobacco cultivation is introduced in this project area, many jobs, including nursery care, transplanting, harvesting, and post-harvest processing, will be suitable for women. From this point of view, women's participation in the project development will be much appreciated.

5.3.4 Infrastructures

A. Present Conditions

(1) Irrigation and Drainage Facilities

The Simpang Geti area is 105 ha and the Tasek Melati area (alias Alor Baroh) is 232 ha.

The Simpang Geti scheme has an irrigation system starting from an intake weir on the Ngolang river. In the highest upstream reaches of the Ngolang river, there is a sugar cane plantation of 8,000 ha managed by Perlis Plantation Berhad (PPB) and FELDA who own more than 300 ponds and use the harvested water for sugarcane irrigation. In between the plantation and the Ngolang weir, there are a few more intakes abstracting water for 1000 ha of paddy irrigation. Therefore, available water at the Ngolang weir is very limited. In the Simpang Geti area, there are 8 ponds managed by the DID. Total storage of the ponds is 60,000 m^3, which is barely adequate to grow 10 ha of tobacco during the dry season. The total amount of water available is insufficient for further development. To solve the problem, DID constructed a 4 km long link canal to convey water from the Timah Tasoh dam in 1993.

The Tasek Melati area has an irrigation system starting from the Tasek Melati pond. Since the catchment area and storage capacity of the Tasek Melati pond are only about 6 km^2 and 45,000 m^3, irrigation water is insufficient. According to the simulation study made in the current study, an additional storage capacity of 450,000 m^3 would be necessary for 232 ha of single crop of paddy cultivation during the rainy season. The Tasek Melati area cannot grow any crops during the dry season without a water supply from the Timah Tasoh dam. The Tasek Melati area also can get water from the Timah Tasoh dam, because the link canal passes the Tasek Melati area on the way to the Ngolang weir. The Tasek Melati pond has an agro-tourism purpose and is also used as a park.

Since the water distribution plan of the Timah Tasoh reservoir is not finalized yet, there is a possibility for Simpang Geti and Tasek Melati to obtain water from the dam. The objective

of this project is to increase the irrigated area for diversified crops cultivation, particularly tobacco, during the off-season using appropriate water allocation from the Timah Tasoh dam, and an improvement of farm conditions, particularly drainage.

During the rainy season, floods sometimes occur in 20 ha to 50 ha with an inundation period ranging from a couple days to 10 days. Natural rivers such as the Santan River and the Ngolang River are also used as main drains. The Ngolang River and tributary located near the Simpang Geti Scheme will be maintained to evacuate drainage water, but the tributary of the Santan River located around the Tasek Melati scheme will be rehabilitated, especially the lower stream section of the tributary.

(2) O/M of Irrigation Facilities

Irrigation and drainage facilities of both schemes are in the operation and maintenance stage of the projects under the State DID's supervision, and are being maintained.

(3) Social Facilities

An inspection road for the main canal and farm roads which network about 15 km in and around the project areas, have been constructed and are being maintained.

B. Water Resources Development Plan

The proposed cropping pattern for the project is an extension of the planting area of tobacco from the present 10 ha to 150 ha in the off season. (Simpang Geti scheme: from 10 ha to 50 ha and Tasek Melati scheme: 0 ha to 100 ha) The tobacco cultivation of 10 ha in the Simpang Geti scheme area will use the water of the existing 8 ponds, while the remaining 140 ha in both schemes will rely on the diversion from the Timah Tasoh dam. The amount of the diversion water is estimated at 977,000 m^3 per annum. (See Table 5.3.1)

Drainage Water Requirement

For further development of tobacco cultivation, drainage development of the field, especially the lower stream sections of the tributary shall be taken into consideration. The drainage water requirement is computed under the condition of three consecutive days rainfall and 3 days of drainage period. The three consecutive days rainfall is adopted as the probable rainfall with a return period of 5 years. This is based on rainfall data from the past 25 years at BKT Temiang hydrological station for Tasek Melati, and rainfall data from the past 8 years at LDG Perlis Utara hydrological station for Simpang Geti.

The design discharge of drainage canals are estimated at 6.5 lit/sec/ha for Tasek Melati and at 5.9 lit/sec/ha for Simpang Geti.

C. Project Works

The general layout of irrigation and drainage development is shown in Fig. 5.3.2, and the prominent features of these facilities are as follows:

(1) Irrigation and Drainage Facilities

Tasek Melati Project	
Irrigation area	232 ha (paddy, 232 ha in main season and tobacco, 100 ha in off season)
Drainage canal	1.6 km of 3 new drains
Rehabilitation of the tributary of the Santan river	1 km
Culvert	2 nos.
Simpang Geti Project	
Irrigation area	105 ha (paddy, 105 ha in main season and tobacco, 50 ha in off season)
Drainage canal	1.6 km of 3 new drains
Culvert	1 nos.

(2) Infrastructures for the Projects

Farm and inspection roads	
Tasek Melati Scheme Area	1.6 km
Simpang Geti Scheme Area	1.6 km

D. Construction Plan

Mechanical construction methods will be applied for the excavation of the river and new drains, and construction schedule is estimated at 4 months, consisting of 1 month for mobilization, preparatory work, and demobilization periods and 3 months for the construction period.

E. Project Cost Estimate

(1) Unit Price

The unit prices of the respective works of the project are estimated by up dating the Government price schedule issued in 1993, using an 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 400,900 for the Tasek Melati Project and about RM 261,000 for the Simpang Geti Project at 1994 price levels, as shown below.

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

	Description	Cost (RM) T. Melati	S. Geti
1	Direct Construction Cost	180,973	82,618
2	Land Acquisition	165,600	153,600
3	Physical Contingency	27,147	12,392
4	Engineering Cost	18,100	8,270
5	Administration Cost	9,050	4,120
	Total	400,870	261,000

The detailed cost estimates are shown in Annex-3.

5.3.5 Project Evaluation

A. Project benefits

We count only the incremental benefits derived from the increase in the tobacco growing area. The financial data of tobacco growing are of our agronomist.

B. Evaluation of the project

(1) EIRR

a. Assumption for cost estimates

An increase in the density of drainage requires acquisition of privately owned farm land within the project area. Therefore, the lands have their own opportunity cost. In our cost estimate, land acquisition costs take up 59% of the total cost for the Simpang Geti project area, and 41% for the Alor Baroh area. In this project we assume that the opportunity cost of the land is equivalent to the estimated financial value.

The construction cost of the link canal is not counted as the project cost. (it is regarded as a sunk cost)

b. Economic internal rate of return (EIRR)

The EIRR of the project in Tasek Melati irrigation area is estimated at 50%, and Simpang Geti is estimated at 31%. (See Table 5.3.2 and Table 5.3.3)
The value would be considered quite attractive due to the sunken costs of the link canal. It is necessary to make good use of the canal system to enhance the land productivity.

c. Sensitivity analysis

As the market price of tobacco is well regulated, and volume of sales can be anticipated, there is little risk in selling the leaves provided that the quality of produce is maintained. Therefore, a sensitivity analysis for these projects is not necessary.

(2) Financial consideration

Water rates would be shared by all water users of the canal to cover at least the maintenance and operation cost of the canal in addition to the production cost of water at the Timah-Tasoh dam gate.

(3) Labour force situation

Those families which do not have enough members to engage in tobacco growing may hire seasonal labourers. The farmers' organization can act as an employment agency to control the quality of labour, which includes conducting a guidance course in tobacco growing.

(4) Household economy

Typical tobacco growers with 0.4 ha plot will earn an annual net income of about RM 3,100 by 120 man-days of family labour, which is equivalent to RM 1,400 in about four months and a half by the rural wage level. If one engages hired labour, a reduction of income will eventuate. An increase of net income from the present situation would mainly be attained by improved drainage.

5.3.6 Environmental Issues

(1) Present Environmental Conditions

In Simpang Geti, paddy is grown in the main season and tobacco is grown in the off-season. The soil belongs to Bukit Tuku series which is suitable for tobacco cultivation and moderately suitable for paddy, and melon. At present there are 8 ponds in the Simpang Geti area managed by DID. But the total amount of water available is not sufficient and better

water management is necessary to improve the land use and to increase the irrigated area during the off-season. Coconut and rubber trees are grown near the ponds along the road. There is no major wildlife in the project area. With regard to water management, the major environmental problem is the competition in water use between the upstream and the downstream side areas. In the upstream side there is 8,000 ha area managed by Perlis Plantation Berhad (PPB) and FELDA. Mainly sugarcane is grown in the area and FELDA and PPB own more than 300 ponds in each of their areas. The water harvested in these ponds is used for irrigating sugarcane, and the downstream side farmers are complaining of shortages of water. There is a necessity to introduce a standard or regulation with regards to water use.

In the Tasek Melati project area, paddy is cultivated during the main season and in the off-season tobacco is grown. The inflow for the Tasek Melati pond comes from the upstream catchment area of about 6 km^2. The ground cover around the Tasek Melati includes Alternartra, Japanese grass, Hemigraphis Cholorata, Japanese roses, and Rheo spathacea. 3' - 5' plants including Duranta gold, Bougainvillea, and Calathea. Muntingia Calabura (cherry), Morianda Citrifolia (mankudu), Acacia Auricilaraformis (Akacia) are trees growing around the pond. Tasek Melati pond is also used as a tourist attraction. There is an elephant park, a children's park, and a small restaurant near the pond. There is a wooden pathway crossing the pond. A Tasek Melati festival is also planned within 1994 to make it popular among locals and tourists. The main environmental problem in the Tasek Melati pond is the deposit of debris, wastes and algae, although cleaning of the pond is carried out regularly by DID.

(2) Water Quality Survey

Water quality samples were taken at 9 locations, Simpang Geti (Pond 1), Simpang Geti (Pond 2), Ngolang headworks, Tasek Melati (upstream), Tasek Melati (downstream), Sg.Rupoh, Timah Tasoh Dam, Sg.Jerneh, and Paya headworks. As shown in Table 5.3.4 and Table 5.3.5, pH of the water is slightly higher than the neutral value; however pH values at all the locations are within the Interim National Water Quality Standard (INWQS) value of 5 to 9.

Tasek Melati is used for recreation. However DO (dissolved oxygen) in this pond is lower than the INWQS for class IIB (Table 5.2.3). This is mainly due to the accumulation of wastes and debris in the pond. As shown in Table 5.3.5, DO at the Ngolang headworks was low during the first measurement on July 6, 1994 because of the discharge of waste from the factory upstream. Although the factory has 6 treatment ponds, sometimes when there is an overflow, the waste is discharged into the river system. However in all the locations COD and DO values are within the INWQS values for irrigation.

Normally a hardness level of 100 mg/l is recommended for drinking water for aesthetic considerations and hardness is not detrimental to crops. In fact, hard waters are more beneficial to crops owing to the Ca value (FAO, 1982). Water hardness is higher than the drinking water standard at all the locations except for the Timah Tasoh Dam. Alkalinity of water is also high. Alkalinity represents the total content of dissolved bicarbonate, carbonate, and hydroxide ions. Being the major buffering system, the carbonate neutralizes acids and bases, thus reducing fluctuations in pH. Therefore alkalinity is not harmful for crop growth. Chloride, fluoride, iron, and silica contents in the water are also lower than the INWQS values.

(3) Environmental Impacts of the Project

Improved water management in Simpang Geti and Tasek Melati is expected to significantly enhance the environment with regard to water balance and land use of the project area. The irrigation and drainage condition of the area will also improve. The cropping area will increase in the off-season which will increase the income of the farmers. The employment opportunities of the farmers will also improve. On the whole, it is expected to have a positive impact on society and no major negative impact is expected through improvement of the water management.

5.3.7 Agro-Tourism

Tasek Melati, which is located 8 km from Kangar, is a tourist attraction in Perlis State. There is a small elephant (statue) park, and a children's park with slides and swings near the pond. Walk ways are built within the lake. There is also a jogging course around the lake and a small restaurant.

As discussed already, the water quality of the Tasek Melati does not satisfy INWQS for recreational purpose. Tasek Melati is a swampy area and wastes come from the inflow water upstream, including domestic wastes, and debris. Therefore periodic cleaning is essential for this park. At present there is no entrance fee for the park. However the number of tourists visiting the lake is very low. Around 50 to 100 tourists visit the lake during weekends.

At present DID is involved in cleaning the pond and other activities. Since Perlis DID is involved in irrigation, drainage ,water management, and IADP activities in the state, it might be difficult for them to concentrate on the tourism aspect of this pond. Therefore, privatization of this pond shall be one possible solution to improve the tourism potential of Tasek Melati.

5.4 KEDAWANG (KH4/5).....Kedah State

5.4.1 General

The Kedawang area is located in the west of Langkawi Island and south of the Langkawi airport. It comprises rainfed paddy fields of about 400 ha in the hilly area extending to the sea coast. The Government's policy is to develop Langkawi as a major tourist destination. Therefore, all economic activities in Langkawi should somehow be related to tourism. According to the Langkawi Structure Plan, the Kedawang area is to be conserved as a paddy area in the future.

Objectives of the Kedawang project are :

i) to stabilize paddy production during the rainy season providing small reservoirs and irrigation / drainage systems,

ii) to start horticulture (orchid, vegetables, fruit, floriculture, etc.)using drip irrigation and rain shelters, in answer to the increasing demands of tourists;

iii) to start aqua culture utilizing the small reservoir; and

iv) to maintain several hectares of year-round paddy cultivation as a tourist attraction.

Three candidate sites for small reservoirs were investigated: Lembu site (Type B - excavated pond), Upper Lembu site (Type A - low dam) and Ketapang site (Type A - low dam). The Upper Lembu site was later abandoned, because it was found uneconomic. There is no particular environmental problems in the project areas.

5.4.2 Climate, Hydrology and Water Resources

Seasons in Langkawi island is dominated by the south-west and north-east monsoons. The former influences weather conditions from April to November when 92%*3 of annual rainfall occurs causing marked wet seasons. During the latter monsoon, winds tend to dry out passing over the Central Mountain Range and only low rainfall occurs. The annual rainfall amounts to nearly 2,600 mm. The rainfall pattern through the year is shown in Fig. 5.2.1.

The catchment area for the proposed Bukit Lembu dam is 3.5 km^2 of which the lower half is paddy fields and the upper area is covered by forests with mountainous topography.

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*3/ Based on DID rainfall records at Ulu Melaka (6397112), monthly mean rainfall from 1953 to 1990.