THE GOVERNMENT OF MALAYSIA
MINISTRY OF AGRICULTURE
DEPARTMENT OF IRRIGATION
AND DRAINAGE (DID)

JAPAN INTERNATIONAL
COOPERATION AGENCY
(JICA)

THE FEASIBILITY STUDY
ON
SMALL RESERVOIR DEVELOPMENT
IN
PENINSULAR MALAYSIA

VOLUME I

MAIN REPORT

March 1995

NIPPON KOEI CO., LTD.

PACIFIC CONSULTANTS INTERNATIONAL

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PREFACE

In response to a request from the Government of Malaysia, the Government of Japan decided to conduct a feasibility study on Small Reservoir Development in Peninsular Malaysia and entrusted the study to the Japan International Cooperation Agency (JICA).

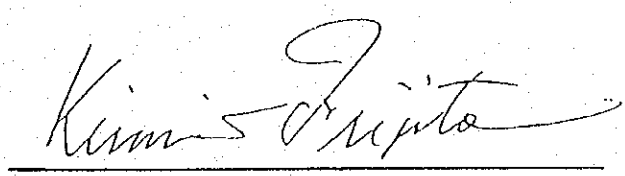
JICA sent to Malaysia a study team headed by Mr. Toshihito Otani, Nippon Koei Co., Ltd., four times between August 1993 and January 1995.

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

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

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

March 1995



Kimio Fujita

President

Japan International Cooperation Agency

March, 1995

Mr. Kimio Fujita
President
Japan International Cooperation Agency

Dear Sir,

LETTER OF TRANSMITTAL

We are pleased to submit our final report for " The Feasibility Study on Small Reservoir Development in Peninsular Malaysia." The Study has been executed by a consortium of Nippon Koei Co., Ltd. and Pacific Consultants International from 1993 to 1995 according to the Scope of Work for the Study agreed between the Government of Malaysia and JICA on 16th February 1993.

This 20-month study was started with an identification survey of potential small reservoir projects in Peninsular Malaysia followed by the selection of pilot projects and a detailed feasibility study on five pilot projects. The report comprises three volumes: Main Report, Annexes, and Guidelines. The Main Report summarizes results of the feasibility study. The Annexes present detailed technical studies from each expert. The Guidelines are prepared for the future use of the project promoters, either of the Government or the private sector, dealing with the planning, design and management of small reservoir development projects.

The Government of Malaysia formulated the National Agricultural Policy 1992-2010 incorporating goals and strategies for the coming two decades. NAP envisages a huge increase in the demand of fruits, vegetables and fish, and accordingly sets up self sufficiency levels and production targets of these commodities for the years 2000 and 2010. In order to expand the production and promote technical innovation, investments would be necessary for the water resource and irrigation development as well as fish pond development for aquaculture. Small reservoirs provide opportunities for these purposes. Small reservoirs have many interesting advantages such as cheap construction cost, quick yielding of benefit, and minor environmental hazards. This study proposes small reservoir development as " a water-based agricultural development approach" or " an integrated mini agricultural development model" to achieve the production targets set forth by NAP.

In parallel with JICA's study, DID also conducted a feasibility study on three other small reservoir pilot projects with technical assistance of the JICA Study Team. This was specially requested by DID in order to increase the efficiency of transfer of knowledge. Both JICA and DID Study Teams worked together in the same office exchanging views and technical know-how. Although this parallel work was a new experience for JICA and DID, it has proven a very efficient method for "transfer of knowledge", and more emphatically, it will ensure the smooth implementation of the small reservoir project because of the local engineers' familiarity to the project gained through their participation in the project planning.

Finally, all members of the Study Team wish to gratefully acknowledge the assistance extended to them by the personnel of JICA, the Advisory Committee, related Ministries and officials of the Malaysian Government, and Malaysian individuals. The Study Team sincerely hopes that the study results will contribute to the future water resources development of Malaysia and to her economic development.

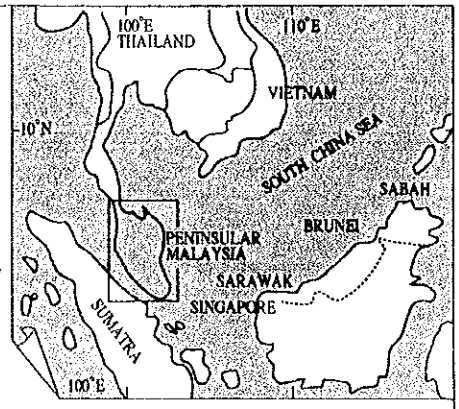
Yours sincerely,

大谷俊人

Toshihito Otani
Team Leader

LOCATION MAP

SMALL RESERVOIR DEVELOPMENT IN PENINSULAR MALAYSIA



KEY MAP

Kedawang (KH4 & 5)

PERLIS

Simpang Geti & Tasik Melati (PR1 & 4)

THAILAND

KANGAR

KUAH

P.LANGKAWI

ALOR SETAR

6°N

KEDAH

Bdg.Permatung Sunkai (KN16)

KOTA BHARU

N

Skim Tok Bedu (PP3)

Skim Maras (TR3)

GEORGE TOWN

P.PINANG

KUALA TERENGGANU

Pasir Nering (TR44)

PERAK

KELANTAN

TERENGGANU

IPOH

4°N

MARDI Commercial Orchard(NS.1)

KUANTAN

PAHANG

SELANGOR

WILAYA PERSEKUTUAN

KUALA LUMPUR

Paya Lanting (PH20)

SHAH ALAM

NEGERI SEMBILAN

SEREMBAN

Bukit Sedanan(MA16)

MELAKA

Kelompok Kangkar Merlimau (JR10)

MELAKA

2°N

JOHOR

JOHOR BAHRU

SINGA PORE

102°E

104°E

LEGEND

- National Boundary
- State Boundary
- Capital of State
- Small Reservoir Pilot Projects;

Pilot Projects studied by JICA

1 Kedawang(KH 4& 5)
2 Simpang Geti & Tasik Melati(PR 1 & 4)
3 Pasir Nering(TR 44)
4 Bukit Sedanan(MA 16)
5 Kelompok Kangkar Merlimau(JR 10)

Pilot Projects studied by DID

1 Skim Tok Bedu(PP 3)
2 Bdg. Permatung Sunkai(KN 16)
3 MARDI Commercial Orchard(NS.1)

SUMMARY

1. Objectives of the Study

The Feasibility Study on Small Reservoir Development in Peninsular Malaysia has been executed by JICA from 1993 to 1995 under a technical cooperation programme to Malaysia. The Scope of Work, which was agreed between the Government of Malaysia and JICA in February 1993,.set forth the objectives of the Study as follows:

1) To identify and evaluate existing and potential small reservoir development in Peninsular Malaysia;

2) To select small reservoir irrigation pilot projects and undertake feasibility studies; and

3) To establish guidelines for the planning, design and operation and maintenance of small reservoirs for irrigation.

2. Background of the Study

Malaysia has an area of 330,000 km^2 and is blessed with ample water resources. It is estimated the annual total surface water yield is 566 billion m^3, of which only 10% is readily available to satisfy the demands of agriculture, domestic, industry and power sectors. The total water demand was 8.7 billion m^3 in 1980, which is forecast to increase to 15.2 billion m^3 by the year 2000 and 30 billion m^3 by the year 2020.

Agriculture takes up more than 70% of the total water demand. In the past, the majority of agricultural water use was for paddy irrigation. However, the number of commercial farms has increased recently, cultivating diversified crops including fruits, vegetables, and flowers in response to domestic and international demands. For commercial farms, irrigation is indispensable, because it is needed not only for the mitigation of water stress but also for the quality control of produce and the guarantee of supply to market. Since the scale of commercial farms is rather limited, small reservoirs are adequate as a water source for irrigation.

Small reservoirs have many advantages. Compared to large dams, they are easy to construct, relatively cheap and quick yielding. Most of them create low environmental

impacts. They provide opportunities to reuse water downstream, thus increasing water utility. Small reservoirs generate water resources not only for agriculture but also for domestic and industrial supply, aquaculture, and agro-tourism.

Malaysia has had little experience in small reservoir development, necessitating the establishment of an implementation system and technical guidelines. Recognizing these needs, a feasibility study on small reservoir development in Peninsular Malaysia was initiated.

3. Basic Concepts for Small Reservoir Development

A. Objectives 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. Small reservoir development will provide opportunities to incorporate a number of the goals and strategies of NAP (1992-2010). The small reservoir development project will be a "water-based agricultural development approach" or an "integrated mini agricultural development model". It will be formulated within the framework of NAP (1992-2010) in order to achieve the following goals and targets.

(1) Expanded food production

Small reservoirs provide irrigation water for vegetables, fruit, and other high value crops whose production is encouraged to expand by NAP (1992-2010);

(2) Water resources development

Sustainable development of water resources should be promoted through appropriate investments in engineering infrastructure for irrigation, drainage and farm access. Small reservoirs will efficiently serve this purpose because they have many advantages including low investment costs, simple design, minor environmental hazards, easy construction, quick yielding, and easy operation and maintenance (O/M). In most cases, resettlement of people is not necessary and land acquisition is limited. Priority is given to irrigation for diversified crops, but agro-tourism, aquaculture, and domestic and industrial water supplies are also taken into consideration.

(3) Reorganization of the production system and structure

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

(4) Optimizing resources use

Following the in-situ development policy, effective and systematic utilization of abandoned land and idle land is accelerated and the 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 the agro-based industries.

B. Type of Small Reservoirs

There are five types of structures for small reservoirs as follows:

Type A : Low dam built on a small river, having a dam height of less than 15 m, a storage capacity of less than 1 million m^3 (100 ha-m), and a catchment area of less than 50 km^2;

Type B : Pond built by excavation, or dyking, or installation of regulating structures, in swamp, or 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 river banks upstream of an existing weir ; and

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

4. Required Irrigation Development by Small Reservoirs

The area and number of irrigation projects required to achieve the production targets set up by NAP (1992-2010).have been estimated below. Assumptions are made that 50% of the total irrigation area relies on small reservoirs for its water source and that the average project area is 40 ha.

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

5. Implementation of Small Reservoir Development

Important aspects in the implementation of small reservoir development are as follows:

(a) Implementation models in relation to the privatization policy of the Government.

i) Farmers/owners construct and operate;
ii) Government construct and farmers/owners operate; and
iii) Government construct and operate.

(b) The role of agencies/individuals involved in the project such as the Area Farmers Organization (PPK), Department of Agriculture (DOA), Federal Land Consolidation and Rehabilitation Authority (FELCRA), Malaysian Agricultural Research and Development Institute (MARDI), Department of Irrigation and Drainage (DID), and Agricultural Bank of Malaysia (BPM).

(c) Guidelines for planning and management of small reservoirs.

(1) Proposed Integrated Mini-project Approach

The current small reservoir study identified an alternative approach to project implementation which may be applied to promote and expedite the crop diversification program. It is the " water-based" approach for agriculture development.

This model encourages mid-level officers from any agencies such as DOA, DID, Veterinary Services Department, and Fishery Department to be project promoters. These officers are nearest 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 budget for the 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, the Farmers Organization Authority (LPP) or the Integrated Agricultural Development Project (IADP) should be the lead agency.

(2) Project Identification and Formulation

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 and the availability of existing agricultural areas. Viability depends on many factors but most important is the interest of the farmers group or the State Farmers Organization (PPN), 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 coordination between agencies. This depends mainly on the people concerned with the project especially the State Directors, District Engineers/Agriculture Officers, etc.

(3) Government's Support

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 agricultural lands to protect the interest of investors as well as land owners.

(d) Favourable credit facilities should be provided.

(e) Agriculture investment facilities similar to the "pioneer status" in industrial development shold be reviewed.

For the immediate schedule, the year 1995 should focus on completion of detailed design and implementation plan of the pilot projects which could be immediately implemented at the on-set of the Seventh Malaysia Plan (7MP).

(4) 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. 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 by itself, the same loan facilities will be available.

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

(5) Site Reservation

From the DID side, identification of existing and potential reservoir sites is important. For existing sites, the assessment should include improvement, rehabilitation, etc. For potential sites, a specific management plan 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.

(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.

6. Phase I Study (Identification Survey)

A. Identification of Small Reservoirs

The Phase I Study identified 266 potential small reservoir sites which are categorized as follows:

a) Type of Small Reservoir		Number of sites	
Type A	(small dam on stream)	112	(42%)
Type B	(pond in depression or swamp)	95	(36%)
Type C	(upstream of existing weir)	8	(3%)
Type D	(tin mine pond or lake)	35	(13%)
Type E	(no remark)	3	(1%)
	Total	266	(100%)

b) Purpose of Reservoir		Number of sites	
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 (number)	40,259
Domestic Supply	Family (number)	151,170
Industry	Factory (number)	5,566
Fishery	Pond (ha)	1,148

d) Land Ownership

	Number of sites
Government	109
Private	127
Mixed and others	30
Total	266

e) Environmental Problems

	Number of sites
Water quality	41
Soil erosion	17
Flooding	4
Drought	4
Water logging	10
River erosion	3

B. Selection Criteria for Pilot Projects

The criteria for 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 undertake feasibility studies on two pilot projects which have similar characteristics;

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

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

d) The feasibility study would 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 in Langkawi.

C. Pilot Projects for the Feasibility Study

On March 10, 1994, the Steering Committee decided five pilot projects to be taken up by JICA for the feasibility study and another five pilot projects by DID. DID's study areas were later reduced to three pilot projects.

A. JICA

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

B. DID

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

7. Phase II Study (Feasibility Study)

A. SIMPANG GETI and TASEK MELATI (PR 1&PR 4)....Perlis State

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 paddy cultivation is practiced in about 240 ha or 70% of the total area during the rainy season (the rest is vacant) 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 uppermost 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, 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 are only 6 km^2 and 40,000 m^3, irrigation water is insufficient for 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 Tasik Melati scheme.

Objectives of the pilot project are to expand the tobacco cultivation area during the dry season from the present 10 ha to 150 ha. 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. The irrigation requirements for the tobacco cultivation of both schemes is estimated at 977,000 m^3 per annum.

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

Salient features of the project are as follows:

<u>Simpang Geti Scheme</u>

Land Use Plan			
	Present land use	Dry season	tobacco 10 ha
	Proposed land use	Dry season	tobacco 50 ha
Water Resource Plan		Existing sources plus supplementary supply from the Timah Tasoh dam	
Main Project Works		Drain	1.6 km
		Farm road	1.6 km
Construction Cost			RM 261,000
EIRR			31%

Tasek Melati Scheme

Land Use	Present Condition	Dry season	fallow
	Future condition	Dry season	tobacco 100 ha
Water Resources Plan		Existing sources plus supplementary supply from the Timah Tasoh dam	
Main Construction Works		Drain	1.6 km
		Farm road	1.6 km
		Improvement of Satan river	1.0 km
Construction Cost			RM 401,000
EIRR			50%

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

The Kedawang area is located in the west of Langkawi Island and south of 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 preserved as a paddy area in the future.

Objectives of the Kedawang project are:

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

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

iii) to develop aquaculture by utilizing the small reservoir to be constructed; 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 uneconomical. There is no particular environmental problems in the project areas.

Salient features of the project are as follows:

Lembu Project

Land Use Plan		
Present land use	Wet season	paddy 100 ha
Proposed land use	Wet season	paddy 100 ha
	Year round	horticulture 10 ha
Water Resource Plan	Type B small reservoir	
	Total capacity	130,000 m^3
	Effective storage	120,000 m^3
	Land acquisition	7.8 ha
Main Project Works	Small reservoir	1 no.
	Irrigation canal	9.5 km
	Pump station	1 no.
	Drainage canal	5.5 km
	Land leveling	35 ha
	Drip system	10ha
Construction Cost		RM 10,617,000
EIRR		10%

Ketapang Project

Land Use Plan		
Present land use	Wet season	paddy 60 ha
Proposed land use	Wet season	paddy 60 ha
	Year round	horticulture 10 ha
Water Resource Plan	Type A small reservoir	
	Total capacity	160,000 m^3
	Effective storage	150,000 m^3
Main Project Works	Homogeneous earthfill dam	1 no.
	- Dam height	14.8 m
	- Length of dam	164 m
	Irrigation and drainage system	
	- Pipeline	2.4 km
	- Irrigation canal	1.6 km
	- Drainage canal	2.8 km
	- Drip system	10 ha
	- Land leveling	13 ha
Construction Cost		RM 5,222,000
EIRR		11%

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

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

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

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

Objectives of the project are:

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

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

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

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

Salient features of the project are as follows:

Land Use Plan		
FELCRA Scheme	Present land use	fallow
	Proposed land use	durian 37 ha
		orchid 2 ha
MIADP Project	Present land use	to be reclaimed
	Proposed land use	horticulture 25 ha
Water Resource Plan	Type A small reservoir	
	Total capacity	250,000 m^3
	Effective storage	230,000 m^3
Main Project Works	Homogeneous earthfill dam	1 no.
	- Dam height	11.5 m

	- Length of dam	236 m
Irrigation and drainage system		
	- Pipeline	3.8 km
	- Pumping station	3 nos.
	- Farm pond	1 no., 300 m^3
	- Drip system	61.9 ha
Construction Cost		RM 4,795,000
EIRR		21%

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

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

Objectives of the project are:

i) to modernize the fruit cultivation by providing irrigation and farm access; and

ii) to develop agro tourism taking advantage of its locatiion on the tourism route from Singapore.

A spring at the skirt of the hill is used as a water source.

Salient features of the project are as follows:

Land Use Plan		
	Present land use	durian 37 ha
	Proposed land use	durian 37 ha
Water Resource Plan	Type B small reservoir	
	Capacity	100 m^3
Main Project Works	Irrigation and drainage system	
	- Pipeline	1.84 km
	- Pumping station	3 nos.
	- Farm road	1.78 km
	- Drip system	37 ha
Construction Cost		RM 1,242,000
EIRR		20%

11. PASIR NERING (TR 44) .....Terengganu State

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

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

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

Salient features of the project are as follows:

Land Use Plan			
	Present land use	roselle	2 ha
	Proposed land use	roselle	42 ha
Water Resource Plan	Type B small reservoir on the Peching river		
		capacity	100 m^3
Main Project Works	Irrigation, drainage and other infrastructures		
		- River improvement	130 m
		- Pipeline	3.3 km
		- Pumping station	1 nos.
		- Farm road	2.4 km
		- Micro jet system	42 ha
		- Pavement of road	1.3 km
		- Electric wire	1.0 km
Construction Cost			RM 865,000
EIRR			20%

12. Conclusions and Recommendations

(1) There are five types of small reservoirs; the most common types are the low dam constructed on a small river (Type A) and the pond excavated in a depression or abandoned paddy fields (Type B).

Small reservoirs are used not only for irrigation but also for aquaculture, agro-tourism, and domestic and industrial water supply.

Small reservoirs are characterized by low construction cost, simple design, quick yielding of benefits, easy operation and maintenance, and cause minor environmental problems.

(2) The current feasibility study on five small reservoir pilot projects has reached a conclusion that all the projects are economically feasible in terms of the economic internal rate of return (see Summary Table on the next page).

Two projects in Langkawi have rather low EIRRs, because their main crop is paddy. The Kedawang area has been designated as a paddy area by the Langkawi Structure Plan.

The two projects in Perlis have extremely high EIRRs, which are attributable to the high return of tobacco cultivation and the sunk cost of the link canal from the Timah Tasoh dam.

(3) All the five pilot projects would require more labour input as the production is expanded. The labour shortage is one of the constraints for the economic development of Malaysia. If the pilot projects should experience insufficient family labour, the labour shortage would be alleviated by group farming and/or hired labour.

(4) According to the preliminary environmental assessment, all the five pilot projects were within the environmental dimensions prescribed by the Environmental Quality Act 1974 and therefore any Environmental Impact Assessment (EIA) was unnecessary. Most of small reservoir projects would require no EIA in this regard.

A water quality survey revealed that there will be no water quality problem related to the five pilot projects.

(5) In conclusion, all the five pilot projects are feasible from technical, economic and environmental points of view.

It is recommended that the Government would consider to implement the pilot projects during the Seventh Malaysia Plan (7MP) period.

(6) The small reservoir development project would generally be very feasible and viable as the present feasibility studies have clarified.

The small reservoir development project would be useful to achieve the production targets of NAP (1992-2010) particularly for the production of high value commodities such as vegetables, fruit, flowers, and fish.

It is recommended that the Government would substantially start the small reservoir development project in parallel with the implementation of the pilot projects taking into account the limited time period up to the year 2010.

(7) It is recommended that the Government would establish a project implementation system for the small reservoir development covering all phases of project implementation including the identification, planning, design, construction, and operation and maintenance.

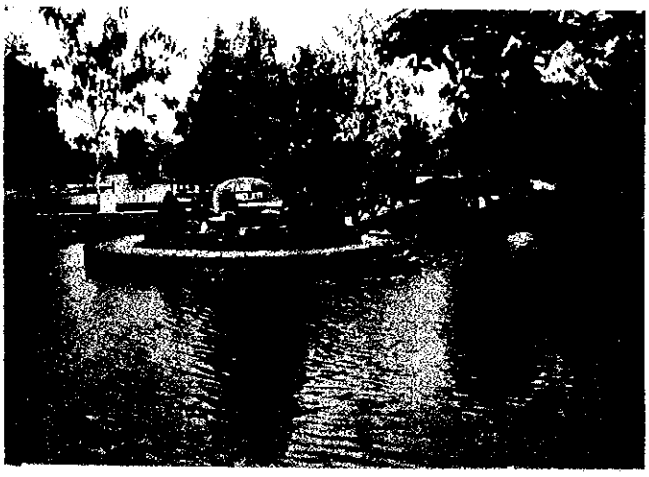
It is recommended that first of all the Government would take action to disseminate the basic concepts of small reservoir development to the private sector concerned, including the farmers' organizations, through government agencies at the Federal and State levels.

It is recommended that the Government would establish an inter-departmental coordinating committee for the small reservoir development.

SUMMARY OF FEASIBILITY STUDY OF FIVE PILOT PROJECTS

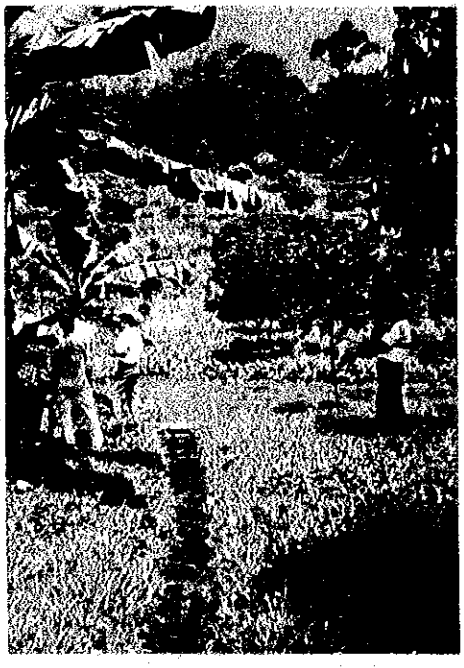
State	Project	Code	Cropping Pattern	Small Reservoir	Main Project Works	Project Costs (RM)	Unit Cost (RM/ha)	EIRR (%)
Perlis	**Simpang Geti**	(PR1)	(present) Dry season : 10 ha of tobacco (proposed) Dry season : 50 ha of tobacco	Existing (Type B)	Drain : 1.6 km Farm road : 1.6 km	261,000	5,200	31
	Tasek Melati	(PR4)	(present) Dry season : fallow (proposed) Dry season : 100 ha of tobacco	Existing (Type B)	Drain : 1.6 km Farm road : 1.6 km	401,000	4,000	50
Kedah	**Kedawang** (Lembu reservoir)	(KH4/KH5)	(present) Wet season : 100 ha of paddy Dry season : fallow (proposed) Wet season : 100 ha of paddy Year round : 10 ha of horticulture	Lembu Pond (Type B) Capacity : 130,000 m3 Pond area : 7.8 ha	Irrig. canal : 9.5 km Drain : 5.5 km	10,617,000	96,500	10
	Kedawang (Ketapang dam)	(KH4/KH5)	(present) Wet season : 60 ha of paddy Dry season : fallow (proposed) Wet season : 60 ha of paddy Year round : 10 ha of horticulture	Ketapang Dam (Type A) Capacity : 160,000 m3 Dam height : 14.8 m Dam length : 164 m	Irrig. canal : 1.6 km Drain : 2.8 km	5,222,000	74,600	11
Melaka	**Bukit Sedanan**	(MA16)	(present) FELCRA Scheme : fallow MIADP area : to be reclaimed (proposed) FELCRA Scheme : 37 ha of durian; 2 ha of orchid MIADP area : 25 ha of horticulture	Mentagor Dam (Type A) Capacity : 250,000 Dam height : 11.5 m Dam length : 236 m	Pump station : 3 nos. Pipeline : 3.8 km Drip system : 62 ha	4,795,000	74,900	21
Johor	**Kelompok Kangkar Merlimau**	(JR10)	(present) Perennial : 37 ha of durian (proposed) Perennial : 37 ha of durian	Pond (Type B) Capacity : 100 m3	Pump station : 3 nos. Pipeline : 1.8 km	1,242,000	34,500	20
Terengganu	**Pasir Nering**	(TR44)	(present) Year round : 2 ha of roselle (proposed) Year round : 42 ha of roselle	Pond (Type B) Capacity : 100 m3	Pump station : 1 no. Pipeline : 3.3 km	865,000	20,600	20

Bukit Sedanan Study Area (Melaka State) Proposed Montagor Reservoir Site



Tasik Melati Scheme-Agro-Tourism Pond/
Irrigation Reservoir (Perlis State)

Kedawang Study Area (Kedah State)
View of Paddy Field



Kelompok Kangkar Merlimau Study Area (Johor State)
Proposed Irrigation Area and Existing Pond (Spring Water)

Pasir Nerin Study Area (Terengganu State)
Roselle Cultivation under Crop Diversification Program

THE FEASIBILITY STUDY ON SMALL RESERVOIR DEVELOPMENT IN PENINSULAR MALAYSIA

VOLUME I

MAIN REPORT

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ABBREVIATIONS / ACRONYMS

Plans

OPP1	First Outline Perspective Plan (1971-1990)
OPP2	Second Outline Perspective Plan (1991-2000)
5MP	Fifth Malaysian Plan (1986 - 1990)
6MP	Sixth Malaysian Plan (1991 - 1995)
NAP	National Agricultural Policy
NEP	New Economic Policy
NDP	New Development Policy

Organizations

BPM	Agricultural Bank of Malaysia
DID	Department of Irrigation and Drainage, MOA
DOA	Department of Agriculture
DOE	Department of Environment, MST&E
DOF	Department of Fishery
DSM	Department of Survey and Mapping, MLCD

EIA	Environmental Impact Assessment
EPU	Economic Planning Unit
FAMA	Federal Agricultural Marketing Authority, MOA
FAO	Food and Agricultural Organization
FELCRA	Federal Land Consolidation and Rehabilitation Authority
FELDA	Federal Land Development Authority
FO	Farmers Organization
FOA	Farmers Organization Authority
IADP	Integrated Agricultural Development Programme
JICA	Japan International Cooperation Agency
JKR	Jabatan Kerja Raya (Department of Public Works), MOW
JPS	Jabatan Pengairan dan Saliran (DID)
KADA	Kemubu Agricultural Development Authority
LADA	Langkawi Area Development Authority
LPN	National Paddy and Rice Board
LPP	Farmers Organization Authority
LTN	National Tobacco Board
MADA	Muda Agricultural Development Authority
MARDI	Malaysian Agricultural Research and Development Institute
MMS	Malaysian Meteorological Service
MOA	Ministry of Agriculture
MOF	Ministry of Finance
MLCD	Ministry of Land and Cooperative Development
MOW	Ministry of Works
MPI	Ministry of Primary Industries
MRD	Ministry of Rural Development
MST&E	Ministry of Science, Technology and Environment
NAFAS	National Farmers' Organization
NASH	National Association of Small Holders
NPRB	National Paddy and Rice Board (LPN)
PPK	Area Farmers Organization (AFO)
PPN	State Farmers Organization (SFO)
RDC	Rural Development Corporation
RISDA	Rubber Industry Smallholders Development Authority
SADC	State Agricultural Development Corporation
UPAM	United Planning Association of Malaysia
UPM	Malaysian Agricultural University

States

PR	Perlis
KH	Kedah
PP	Pulau Pinang
PK	Perak
SG	Selangor
NS	Negeri Sembilan
MA	Melaka
JR	Johor
KN	Kelantan
TR	Terengganu
PH	Pahang

Others

Bkt.	Bukit (Hill)
EIRR	Economic Internal Rate of Return
cusec	Cubic feet per second
cumec	Cubic meter per second
EIA	Environmental Impact Assessment
FIRR	Financial Internal Rate of Return
FORTRAN	Formula Translation
F/S	Feasibility Study
ft	Feet
GDP	Gross Domestic Products
GIS	Geographical Information Satellite
GNP	Gross National Products
ha	Hectare
INWQS	Interim National Water Quality Standard of Malaysia
Jl., J.	Jalan (street)
kg	Kilogram
Kg.	Kanpung (village)
Kp.	Kelompok (group)
km	Kilometer
Ldg.	Ladang (town)
m	Meter
MCM	Million Cubic Meter
M/P	Master Plan

O/M	Operation and Maintenance
RM	Malaysian dollar (Ringgit)
S/W	Scope of Work
Sg. S.	Sungai (river)
TCM	Thousand Cubic Meter

UNIT OF MEASURE

Length			
	1 inch	0.02540	meter
	1 foot	0.30480	meter
	1 yard	0.91440	meter
	1 chain	20.1168	meter
	1 mile	1,609.3	meter
Area			
	1 acre	4,047	m^2
		0.4047	ha
	1 ha	10,000	m^2
	1 km^2	100	ha
		1,000,000	m^2
	1 ft^2	0.092903	m^2
Volume			
	1 English gallon	4.54596	liter
	1 U.S. gallon	3.78533	liter
	1 ha m	10,000	m^3
	1 acre feet	1,233.48	m^3
Weight			
	1 pound	0.4536	kg
	1 ton	1000	kg
Others			
	1 inch to 1 mile	1 /63360	
	1 cusec	0.028317	m^3/sec
	1 cumec	1.0	m^3/sec
	1 atm	1,013.25	mb
		29.9213	Hg inch

I. INTRODUCTION

1.1 General

This is the draft final report of " the Feasibility Study on Small Reservoir Development in Peninsular Malaysia". The Study has been executed by JICA from 1993 to 1995 as a technical cooperation programme to Malaysia.

Malaysia has an area of 330,000 km^2 and is blessed with ample water resources. It is estimated the annual total surface water yield is 566 billion m^3, of which only 10% is readily available to satisfy the demands of agriculture, domestic, industry and power sectors. The total water demand was 8.7 billion m^3 in 1980, which is forecasted to increase to 15.2 billion m^3 by the year 2000 and 30 billion m^3 by the year 2020.

Agriculture takes up more than 70% of the total water demand. In the past, the majority of agricultural water use was for paddy irrigation. However, the number of commercial farms has increased recently, cultivating diversified crops including fruits, vegetables, and flowers in response to domestic and international demands. For commercial farms, irrigation is indispensable, because it is needed not only for the mitigation of water stress but also for the quality control of produce and the guarantee of supply to market. Since the scale of commercial farms is rather limited, small reservoirs are adequate as a water source for irrigation.

Small reservoirs have many advantages. Compared to large dams, they are easy to construct, relatively cheap and quick yielding. Most of them create low environmental impact. They provide opportunities to reuse water downstream, thus increasing water utility. Small reservoirs generate water resources not only for agriculture but also for domestic and industrial supply, aquaculture, and agro-tourism.

The National Agricultural Policy (1992-2010) focuses on high value crops such as fruits and vegetables, since they, together with fisheries and livestock, are expected to be the driving force for GDP growth of the agriculture sector. Small reservoirs could greatly contribute to the development of these sub-sectors. The small reservoir development project provides a small-scale water-based agriculture development model.

Malaysia has had little experience in small reservoir development, necessitating the establishment of an implementation system and technical guide lines. Recognizing these needs, a feasibility study on small reservoir development in Peninsular Malaysia was initiated.

1.2 Scope of Work

The scope of work for "the Feasibility Study on Small Reservoir Development in Peninsular Malaysia" was agreed between the Government of Malaysia and JICA on 16 February, 1993. It set forth the objectives of the study, study area, Phase I and Phase II studies, schedule and reporting. The scope of work is presented in Annex I.

1.3 Objectives of the Study

The scope of work sets forth the objectives of the study as follows:

1) To identify and evaluate existing and potential small reservoir development in Peninsular Malaysia:

2) To select small reservoir irrigation pilot projects and undertake feasibility studies: and

3) To establish guidelines for the planning, design and operation and maintenance of small reservoirs for irrigation.

1.4 Related Agencies and Committees

JICA is the executing agency of the study. JICA entrusted the study to a study team comprising seven engineers of Nippon Koei Co., Ltd. and Pacific Consultants International. JICA also organized an advisory committee to support the study team.

The counterpart agencies of the Government of Malaysia are the Economic Planning Unit (EPU), the Prime Minister's Department, and the Department of Irrigation and Drainage (DID), the Ministry of Agriculture. Organization charts are shown in Fig. 1.4.1, Fig. 1.4.2, and Fig. 1.4.3. To administer the Study, EPU and DID established a Steering Committee and a Technical Committee, respectively. Both committees held meetings four or five times during the study period to discuss the work plan and the results of the Study.

The State DID appointed a state coordinating officer responsible for the study at a state level. The state coordinating officers for the 11 states in Peninsular Malaysia conducted the Small Reservoir Identification Survey in cooperation with other state agencies. The JICA Study Team contacted with and collected data from other government agencies pertaining to the project at federal and state levels including MOA, DOA, PPK, FELCRA, MARDI, IADP, LTN and LADA.

During the phase I Study, the JICA Study Team employed a local consultant, " Sepakat Setia Perunding SDN. BHD.", on a sub-contract basis to assist the state coordinating officers in the Small Reservoir Identification Survey and to establish a data base on the survey data. During the Phase II Study, the JICA Study Team employed three local contractors on a sub-contract basis and entrusted them with the Topographic Survey, Geological Survey and Farm Household Survey / Soil Survey.

During the Phase II Study, DID organized a feasibility study team to conduct feasibility studies on three small reservoir pilot projects and to detail design one of the three pilot projects. Both JICA and DID Study Teams worked together in the same office and exchanged know-how and experience.

1.5 Outline of the Study

The Study consists of the Phase I Study and the Phase II Study. The latter is sub-divided into field work in Malaysia and work in Japan. The Phase I Study was carried out from August 1993 to March 1994; the Phase II Study was conducted from May 1994 to December 1994. A national seminar will be held in Langkawi in January 1995.

More details of the Phase I Study are given in Chapter IV and Annex I and those of the Phase II Study are presented in Chapter V and Annex II - VII.

1) Phase I Study

The main objectives of the Phase I Study were to identify and evaluate existing and potential small reservoir development in Peninsular Malaysia and to select small reservoir irrigation pilot projects. The JICA Study Team prepared an inception report which contained an approach to the Study, work plan, and time schedule. The report was explained and discussed at the Technical Committee meeting and the Steering Committee meeting held in August 1993.

The identification survey of potential small reservoirs was conducted on a state basis by the state coordinating officers with the assistance of the local consultant. The JICA Study Team developed the concept for small reservoirs and prepared the criteria and survey forms for the identification survey. A workshop was held at the DID Ampang Research and Training Centre on October 14, 1993 to explain and discuss the criteria and survey forms.

The identification survey was carried out divided into two stages. The first stage survey was conducted over three weeks using a simple survey form to grasp the overall

potential of small reservoirs. As a result, 266 potential sites were identified and registered. The second stage survey was conducted on 116 short listed potential sites to collect basic data required for the selection of the pilot projects. The survey took three months using detailed questionnaires regarding hydrology, irrigation and drainage, geology, agriculture and agro-economy, and environment. In parallel to the second stage survey, the JICA Study Team conducted a reconnaissance survey on 33 potential sites proposed by the state coordinating officers. On the basis of both surveys, 18 candidate pilot projects were chosen and submitted to the DID.

DID selected twelve pilot projects which were then summarized to ten feasibility study areas. The Steering Committee of March 10, 1994 approved the pilot projects. And it was agreed between JICA and GOM that in the Phase II Study JICA would undertake feasibility studies on five pilot projects and DID would implement feasibility studies on the remaining five projects using technical advice from the JICA Study Team.

2) Phase II Study

The objectives of the Phase II Study were to undertake feasibility studies on five pilot projects and to establish guidelines for the planning, design, and O/M of small reservoirs for irrigation. Another objective was to provide technical advice to DID's feasibility studies.

The field works under the Phase II Study were carried out for four months from May 1994 to September 1994. The JICA Study Team entrusted the Topographic Survey, Geological Survey, and Farm Household Survey/Soil Survey to local contractors on a sub-contract basis. Other field surveys such as the Hydrological Survey, Irrigation and Drainage Survey, Agricultural Survey, Economic Survey, and Environmental Survey (Water Quality Survey) were conducted by the JICA Study Team with DID's cooperation. The JICA Study Team formulated preliminary plans for the five pilot projects which were brought to each site and discussed among the related agencies.

The work in Japan continued from October to December 1994. A draft feasibility report and draft guidelines were prepared.

3) Seminar

The National Seminar on small reservoir development comprises Part A and Part B. Part A will focus on policy issues pertaining to agriculture, land, water and human resources development. Papers will be presented by senior managers from relevant departments and JICA. Part B is to highlight and discuss technical issues towards formulating a more

systematic and integrated approach for small reservoir development. Papers presented will focus on guidelines for the planning, design and management of small reservoirs for irrigation, and include case studies.

1.6 Reports

JICA Study Team prepared the following reports.

Inception Report in August 1993 ;
Progress Report I in October 1993 ;
Interim Report in March 1994 ;
Progress Report II in September 1994 ;
Draft Final Report in December 1994 ;
Draft Final Guidelines in December 1994 ;
Final Report in March 1995 ; and
Final Guidelines in March 1995.

The Final Report comprises three volumes: Volume I - the Main Report, Volume II - Annexes, and Volume III - Guidelines.

The Main Report describes background, basic concepts, and implementation plan of the small reservoir development in Peninsular Malaysia, selection of pilot projects, feasibility study on five pilot projects, and conclusions and recommendations.

The Annexes contains survey data, analyses, and study procedures with respect to the following eight headings: I - Identification Survey of Small Reservoirs in Phase I Study, II - Meteorology and Hydrology, III - Irrigation and Drainage, IV - Geology, V - Agriculture, VI - Environment, VII - Project Economy, and VIII - Minutes of Meeting.

The Guidelines deals with standards for identification, planning, design, and O/M of small reservoirs for irrigation in Peninsular Malaysia. The Guidelines are subject to improvement and amendment in the future when more experience is accumulated in the small reservoir development.

II. BACKGROUND

2.1 Economic Development Plan and Agriculture Sector

Malaysia has an area of 330,000 km^2, of which Peninsular Malaysia and East Malaysia occupy 130,000 km^2 and 200,000 km^2, respectively. The population was approximately 19 million in 1993. Malaysia is a multi-racial country made up of a mixture of ethnic groups which are dominated by Malay followed by Chinese, Indian and others.

To promote growth with equity and to foster national unity among the various races, the Government formulated the First Outline Perspective Plan (OPP1) covering the 20 year period of 1971-90. Under it, four development plans from the Second Malaysia Plan (1971-75) to the Fifth Malaysia Plan (1986-90) were implemented within the framework of the New Economic Policy (NEP). During this period, GDP grew at an average rate of 6.7% per annum and the incidence of poverty reduced from 42.4% in 1976 to 17.1% in 1990. To accelerate the process of eradicating poverty and restructuring society, the Second Outline Perspective Plan (OPP2) covering the period 1991-2000 was formulated under the New Development Policy (NDP). The Sixth Malaysia Plan (1991-95) and the Seventh Malaysia Plan (1996-2000) are implemented under OPP2.

During the period of OPP1, the agriculture and forestry sector grew at 4.4% per annum, but the share to GDP was dropped from 29.0% in 1970 to 18.7% in 1990. The manufacturing sector's growth was 10.3% per annum during the same period and the share to GDP increased from 13.9% in 1970 to 27.0% in 1990. Malaysia's economic structure has greatly changed during these two decades. The manufacturing sector overtook the agriculture sector in 1987 and since then has played the leading role in the national economy. (See Table 2.1.1)

The decline of the agriculture sector relative to other sectors can be attributed to both international and domestic factors. The international prices of agricultural commodities drastically dropped in real terms during the 1980s. Domestically, the Government's fiscal, monetary and exchange policies placing priority on the manufacturing sector, exhaustion of new arable land available in Peninsular Malaysia, low return of agriculture, hike of production costs, shift of capital and labour from the agriculture sector to other sectors, and so forth attributed to the decline. As a result, during the 1980s vast areas became fallow, and serious labour shortages emerged.

OPP2 sets forth a target that Malaysia's GDP will grow at 7.0% in real terms during 1991-2000. The Government expects the target could be achieved through increased efficiency in the economy, promotion of investment by the private sector, privatization, and human resources development. The agriculture sector is targeted to grow at 3.5% per annum during the OPP2 period. The agriculture sector's share to GDP is anticipated to drop from 18.7% in 1990 to 13.4% in 2000. In contrast, the manufacturing sector is expected to grow at 10.5% per annum and to increase its share of GDP to 37.2% in 2000. (See Table 2.1.2)

According to OPP2, employment by the agriculture and forestry sector will decrease from 31.3% in 1980 and 27.8% in 1990 to 20.0% in 2000, while employment by the manufacturing sector will expand from 19.5% in 1990 to 23.9% in 2000. The mid-term review of 6MP presents a statistic that Malaysia's total working force in 1993 was 7,410,000 persons, of which 1,580,000 persons or 21.3% were engaged in agriculture. Since the agricultural employment was 1,740,000 persons in 1990, it decreased 3.1% per annum during 1990-1993. This indicates agricultural workers are shifting to other sectors at a higher rate than expected.

Although the contribution to GDP declines relativly in other sectors, the role of the agriculture sector will remain significant in Malaysia's economy. Agriculture will continue to be the principal activity in the rural economy. It also provides resources to support the development of other sectors of the economy. To reduce resource outflow from agriculture, the Government adopts supportive fiscal and monetary policies. The Government is also making efforts to remove constraints such as the traditional dual structure between the small holdings and estates, uneconomical farm size, shortage of land, shortage of labour, inadequate food production, insufficient human resource development, fluctuation of agricultural income, etc.

Aiming at maximization of income through the revitalization of the agriculture sector and the efficient use of resources, the Government formulated the National Agricultural Policy (1992-2010). It contains the policy and strategies for sustainable development of the agriculture sector. The basic principles of NAP (1992-2010) are:

a. privatization and growth led by the private sector;

b. market oriented growth;

c. commercialization;

d. modernization;

e. poverty eradication.

Its major strategies are:

a. optimizing resource use;

b. accelerated agro-based industries development;

c. enhancement of R&D efforts and technological diffusion;

d. greater role of the private sector;

e. reformed marketing strategy;

f. expanded food production;

g. human resource development;

h. development of viable and self reliant farmers/fishermen's institutions;

i. restructuring including greater bumiputera (native people) participation.

The agriculture sector would maintain its viability through commercialization with respect to the selection of crops and management system. It is necessary to organize the small holdings into estate type management.

OPP1 emphasized new land development: but OPP2 changed it to the in-situ development. The in-situ development aims at the revitalization of existing and abandoned farm lands, effective utilization of resources, consolidation of land, rehabilitation, replanting, irrigation and drainage, and introduction of advanced technology by farmers.

As the Malaysian economy climbs up the ladder of development, factor prices, particularly labourer's wages have risen. To cope with the labour shortage, employment of foreign labourors will continue as a short term solution.

Agricultural production will be specialized, focussing on high value added and market oriented crops. This will vitalize agriculture and promote the effective use of land resources. The Government will review its support to less viable crops like paddy and encourage a shift to more profitable agriculture, fisheries and forestry activities including oil palm, rubber, cocoa, vegetables, fruit, flowers, aquaculture, and forestry.