PRELIMINARY SURVEY REPORT
ON
SWAMP UTILIZATION IN TRENGGANU TENGAH
MALAYSIA

May 1978

JAPAN INTERNATIONAL COOPERATION AGENCY

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FORWORD

As part of the overall regional development carried out in the southern part of the State of Trengganu which is located on the less developed east coast of Peninsular Malaysia, the Government of Malaysia requested Japan's cooperations in the utilization of the inland swamp area, of 30 thousand ha which is hardly being used for the purpose of promoting mainly agricultural development.

In compliance with this request, the Government of Japan decided to conduct a preliminary survey and sent to Malaysia a seven-men survey team headed by Mr. Kimio Hirai, Senior Irrigation Specialist, Design Division, Agricultural Structure Improvement Bureau, Ministry of Agriculture and Forestry from February 11 to March, 1978 for the Trengganu Swamp Area Agricultural Development.

During it's stay in Malaysia, the team was engaged in a diversity of activities including reconnaissance, data collection, exchange of views with the Malaysian officials concerned with a view to orientating this project in the entire national development plan as well as to identifying the contents of the project and the beneficiary area. The team also conducted studies on the principles, items, scope and methods of studies to be conducted at a later date.

I hope that this report, which contains the result of the study, will be found useful by those concerned in making a detailed feasibility study and in discharging their duties in connection with the project.

I take this opportunity to express my deep gratitude to the competent Malaysian authorities and officials concerned for the assistance and cooperation extended to the study team.

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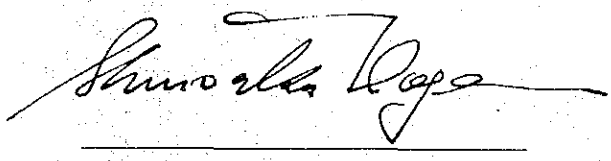
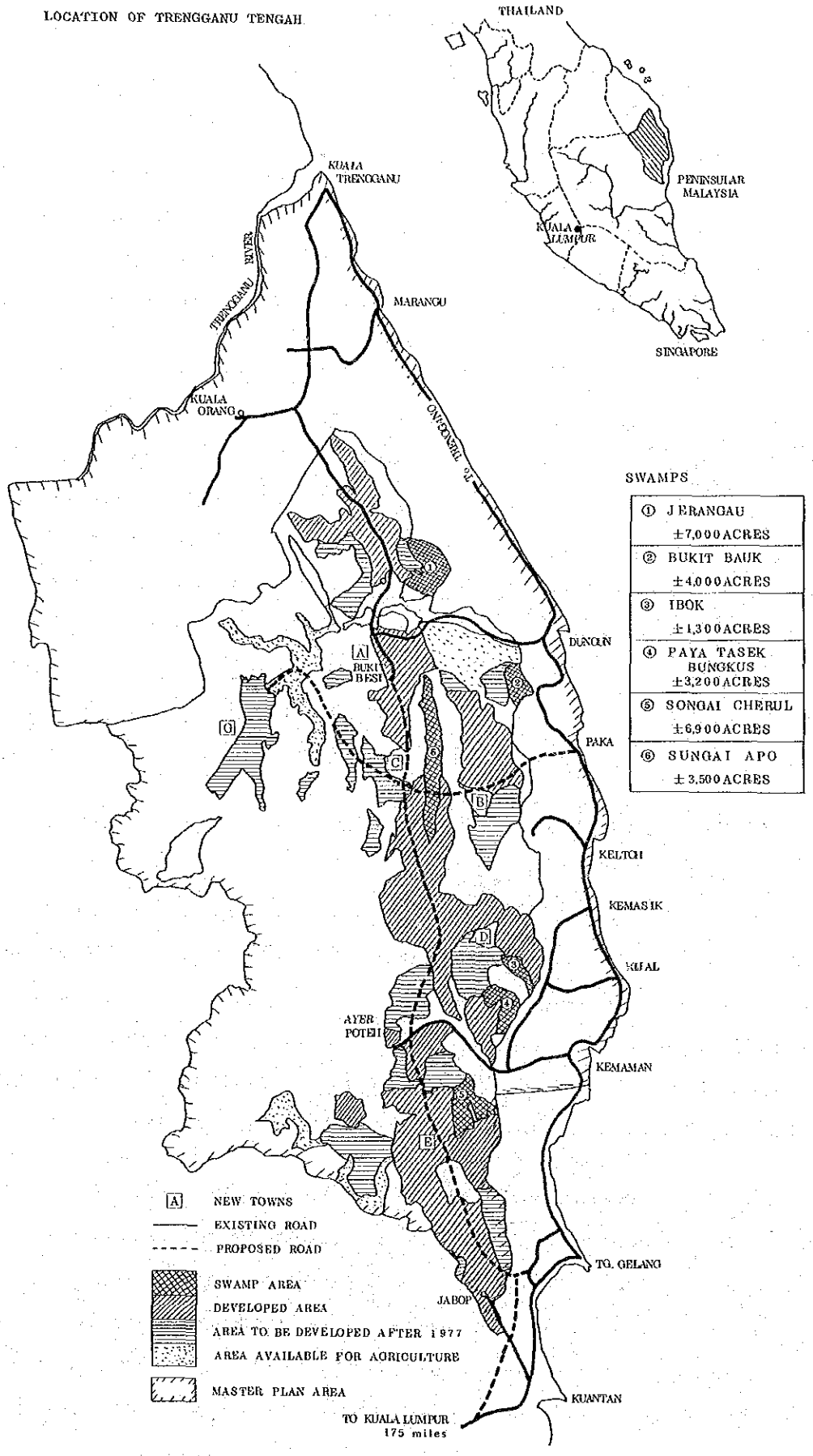


Shinsaku Hogen
President
Japan International
cooperation Agency

LOCATION OF TRENGGANU TENGAH



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CHAPTER I INTRODUCTION

1.1 Objectives and Background of the Survey

(1) The present survey was conducted at a reconnaissance level in response to the request of the Malaysian government to study the potential for development and possibility of effective utilization of the swamp areas (approx. 73,000 acres) which extend sporadically from the central to the southern parts of Trengganu State on the east coast of Peninsular Malaysia.

(2) Trengganu State is situated in the northern part of east coast of West Malaysia, and covers an area of approximately 5,000 square miles. The greater part of its population being engaged in traditional agriculture which is low in productivity, the state is pressed hard for solution of the problems of unemployment and low income level which are both assuming a grave aspect. Nevertheless, the entire state is favoured with excellent natural conditions, embracing extensive protection forests, ideal tourist resorts, and extensive and fertile farmland areas.

(3) In 1973, the Federal Government organized "Trengganu Tengah Development Authority (Lembaga Kemajua Trengganu Tengah; hereafter abbreviated to'KETENGAH") with the view to enforcing a new economic policy in the state. KETENGAH is assigned to the task of planning and implementing various schemes for development of Central Trengganu area (Trengganu Tengah, approx. 1,090,000 acres) which accounts for one-third of the total area of the state.

(4) It is considered that an area of about 460,000 acres in Trengganu Tengah can be developed for agricultural operation. In this potential farmland area, inland swamps cover an area of about 73,000 acres and they have been left intact to date without their effective utilization envisaged under the present Trengganu Tengah Development Plan.

(5) The remainder of the potential farmland area has already been developed (270,000 acres) or is planned to be developed under specific development projects (approx. 58,000 acres).

(6) In order to make Trengganu Tengah Development Plan more effective and fruitful, the Malaysian government is required to provide the guidelines

for development of Trengganu Tengah swamps at the earliest possible date. It has the intention to incorporate relevant survey plans in the reviewal of the Third Malaysia Plan to be made in 1978, and to implement swamp utilization under the Fourth Malaysia Plan to be started in 1981.

(7) The Malaysian government made an informal request for Japan's assistance in the Trengganu Tengah Swamp Utilization Project through the technical cooperation survey team dispatched to Malaysia in June 1977. The present preliminary survey was conducted against the background described above.

1.2 Composition of the Survey Team

PRELIMINARY SURVEY TEAM
FOR
SWAMP UTILIZATION IN TRENGGANU TENGAH

Mr. Kimio HIRAI	Leader	Senior Irrigation Specialist Design Division Agricultural Structure Improvement Bureau Ministry of Agriculture and Forestry
Mr. Masao MORIKAWA	Subleader (Regional Development)	Senior Irrigation Specialist Design Division Chugokushikoku Regional Agricultural Administration Bureau Ministry of Agriculture and Forestry
Mr. Yoshizo MOCHIZUKI	Irrigation and Drainage	Senior Engineer Agricultural Development Consultants Association (ADCA)
Mr. Toru KAMOHARA	Agro-Economy	Planning Coordinator Planning Division Kinki Regional Agricultural Administration Bureau Ministry of Agriculture and Forestry
Mr. Noriaki SHIOJIRI	Agronomy	Chief Agricultural Land Development Section

		Resources Division Kinki Regional Agricultural Administration Bureau Ministry of Agriculture and Forestry
Mr. Terushi EGASHIRA	Cooperation Planning	Senior Officer International Cooperation Division Ministry of Agriculture and Forestry
Mr. Yoshihiro MINE	Coordination	Technical Affairs Division for Agricultural and Forestry Japan International Cooperation Agency

1.3 Itinerary of the Survey Team

Date		Description
Feb. 1	Wed	Departure from Tokyo and arrival at Kuala Lumpur; Consultations with Resident Representative of JICA Office and competent Malaysian officials (EPU, MLRD, KETENGAH, DID, AD and MARDI).
2	Thu	Courtesy call at Japanese Embassy in Kuala Lumpur.
3	Fri	Consultation with EPU.
4	Sat	Data collection.
5	Sun	Flight from Kuala Lumpur to Kuala Trengganu.
6	Mon	Consultations with officials of KETENGAH, EPU, SPU, and MARDI.
7	Tue	Data collection.
8	Fri	Group 1: Visits to DID and Survey Department for consultation. Group 2: Visits to MARDI, SPU and AD for consultation.
9	Sat	General survey of KETENGAH development area.
10	Sun	Data consolidation.
11	Mon	Survey of swamp area (Trengganu area); Visit to FELDA oil palm plantation; Return of Egashira to Japan.

(Date)	(Day)	
Feb.12	Sun	Survey of swamp areas: (1) Bukit Bauk, (2) Sungoi APU, (3) Ibok, (4) Paya Tasek Bungkus.
13	Mon	Survey of swamp areas: (1) Sungai Cherul, (2) Terangau
14	Tue	Consultations with officials of KETANGAH and MARDI.
15	Wed	Trip from Kuala Trengganu to Kota Bharu by car; Visit to KADA.
16	Thu	Trip from Kota Bharu to Kuala Lumpur by plane; Explanation of survey results in outline to competent officials of Malaysian government.
17	Fri	Visit to DID.
18	Sat	Visit to PWD.
19	Sun	Data collection, and preparation of survey report.
20	Mon	- do -
21	Tue	Visit to MAR Return of Leader Hirai to Japan.
22	Wed	Consultation with EPU: Data collection at DA and Publication Unit.
23	Thir	Consultations with EPU and PWD; Data collection at Statistics Department.
24	Fri	Flight from Kuala Lumpur to Kuala Trengganu.
25	Sat	Consultation with KETENGAH officials.
26	Sun	Aerial and ground surveys.
27	Mon	Flight from Kuala Trengganu to Kuala Lumpur.
28	Tue	Preparation of survey report.
Mar 1	Wed	Consultation with MLRD; Data collection.
2	Thu	Consultation with competent officials of Malaysian government.
4	Sat	Data collection at DA.
5	Sun	Departure from Kuala Lumpur and arrival at Tokyo.

1.4 List of Malaysian Officials Concerned

(1) Economic Planning Unit (E.P.U.)

Mr. Rusli bin Haji Hussein Director, Area Planning

Mr. Zulkifli bin A. Hassan	Assistant Secretary
Mr. Ahmad Phesal Talib	Assistant Secretary

(2) Ministry of Land and Regional Development (M.L.R.D.)

Mr. Liew Siew Kim	Principal Assistant Secretary
Mr. Mohammed Izat bin Hassan	Assistant Secretary

(3) Trengganu Tengah Development Authority (KETENGAH)

Mr. Wan Nik bin Ismail	General Manager
Mr. Mamat bin Abdul Rahman	Director, Planning and Evaluation Division
Mr. Abdul Rahman bin Haji Ali	Director, Administration and Finance Division
Mr. Ariffin bin Zakaria	Director, Land and Local Government Division
Mr. Wan Rahman bin Haji Wan Yaakob	Director, Technical Services and Infrastructure Division
Mr. Wan Mohd Nor bin Haji Wan Ahmad	Assistant Director, Planning and Evaluation Division
Mr. Wan Abdul Rahman Ngah	Assistant Director, Project and Implementation Division
Mr. Adam bin Engah	Settlement Officer
Mr. Haji Abdullah bin Ali	Senior Settlement Officer

(4) Malaysia Agricultural Research and Development Institute (MARDI)

Mr. Hashim A. Wahab	Principal Research Officer, Soil Science Branch
Dr. Erh Koon Tee	Research Officer, Soil Science Branch
Mr. B. Gopinathan	Research Officer, Soil Science Branch
Mr. Wan Johari Wan Daud	Head of Station (K. Trengganu)
Mr. Noor Rawi bin Abu Bakar	Research Officer (K. Trengganu)
Mr. Rahman bin Daud	Research Officer (K. Trengganu)
Mr. Saharan bin Haji Anang	Head of Cropping System (K. Trengganu)

(5) Drainage and Irrigation Department (D.I.D.)

Mr. Khoo Soo Hock	Chief Planning Engineer
Mr. Tan Hoe Tim	Senior Engineer (Hydrology)
Mr. Tan Leong Tiam	Senior Engineer (Design)
Mr. Haji Mohd Nor Ghazali bin Omar	Engineer (K. Trengganu)

(6) Agriculture Department

Mr. Ignatius Wong	Senior Agriculture Officer
Mr. Azmi bin Mat Akhir	Agriculture Officer
Mr. Hussein bin Serat	State Director of Agriculture (K. Trengganu)

(7) Public Works Department (P.W.D.)

Mr. Chin Thean Huah	Deputy Director General
Mr. Ho Thian Hock	Director, Design & Research Section
Mr. Chan Chiang Heng	Superintending Engineer, Design & Research Section
Mr. Foo Chee Eng	Superintending Engineer, Road Section
Mr. Hon Too Fang	Senior Executive Engineer, Design & Research Section

(8) Survey Department

Mr. Teh How Kee	General Manager (K. Trengganu)

(9) State Economic Planning Unit

Mr. Mazlan bin Hashim	Deputy State Secretary
Mr. Louis A. Vivian	Agricultural Project Adviser

(10) State Office

Mr. Mamat Abdullah	Representative of State Secretary
Mr. Khalid bin Awang	Assistant State Development Officer

(11) Kemubu Agricultural Development Authority (KADA)

Mr. Abdul Wahid Haji Azahari	General Manager
Mr. Abdul Aziz bin Yusef	Head of Agriculture Section

(12) Federal Land Development Authority (FELDA)

Mr. Husain bin Abas	Supervisor (K. Trengganu)

CHAPTER 2 SUMMARY OF SURVEY RESULTS

2.1 Project Area

Malaysia comprises a total of 13 states, 11 in Peninsular Malaysia and 2 in Kalimantan, and covers an area of 127,581 square miles. West coast of the country is fairly well developed, but east coast and Kalimantan are still underdeveloped, the greater part being covered with virgin jungles. The Malaysian government is making endevaours for the development of these areas, with specific emphasis placed on agricultural development which is being prompted as one of its top priority economic policies.

The survey covered the swamp areas found sporadically in the Trengganu Tengah Development Area which is situated in the southern part of Trengganu State on the east coast of the peninsula and accounts for about one-third of the total area of the state. It was conducted to formulate a swamp utilization plan which can be implemented in harmony with the development of the surrounding hilly areas.

2.2 Meteorology

Trengganu State is situated between lat. 4° and 6° N, so that the whole project area is subject to the influences of tropical monsoons. Hence, average annual rainfall is as large as 100 inches in coastal areas and 140 inches in hilly areas. The wet season usually runs from October to January, though varying slightly by year, and yields a rainfall of about 85 inches. The dry season lasts from February to September and produces about 55 inches of rainfall.

Atmospheric temperature shows virtually no changes through the year, with the daily average temperature ranging from 27°to 28°C.

2.3 Topography and Geology

The state has a relatively mild topography. Mountainous areas have an elevation of 2,500 - 5,000 ft., but they are undulating and covered with jungles and in addition, plateaus and flat plains extend over a comparatively long distance. Hence, the ratio of storm-runoff is not very large relative to the heavy rainfall. However, as rivers are left in the natural state without training or improvement work, flood water collects in flat

plains in the wet season, occasionally bringing the traffic to a standstill even on national highways.

From the viewpoint of soil, hilly areas are composed of reddish brown laterite and reddish yellow or yellowish grey podzolic soil for the most part. The laterite overlies the parent metal derived from acidic rocks including granite. Lowland areas are composed of coastal sand and alluvial soil. The swamp soils can be broadly classified into the following three groups.

(1) Woody peat or forest muck with a thickness of more than 1.0 m, overlying alluvial soil and recording 3.8 - 4.5 of pH value (H_2O).

(2) Reduced soil containing organic substances, ranging from loam to clay loam in texture and recording 4.9 - 5.2 of pH value (H_2O).

(3) Gley soil containing no peat layers at all and ranging from loam to heavy clay soil in texture, and recording 5.1 - 5.3 of pH value (H_2O).

2.4 Agriculture and Economy

Trengganu State is not favourably situated and its economy is still in the initial stage of development. Although it covers an extensive area, it has a population of only 483 thousand (as of 1975) which accounts for only 4% of the country's total. Its population density, 37 persons/km^2, is therefore far lower than the average of West Malaysia which stands at 72 persons/km^2.

The key industry in Trengganu State is agriculture and there are no other industries worthy of mention. Agricultural sectors therefore account for as high as 44% of GDP as against the country's average of 30%. As agriculture is extremely low in productivity relative to other industries, per-capita GDP in the state in 1975 was only M$765 or about 60% of the national average of M$1,250. Thus, the state is the second lowest after Kelantan State in terms of per-capita GDP.

This is clearly reflected in the employment condition of working population. In the industry-wise employment, the state's agriculture, forestry and fisheries occupy a share of 68% as against the country's average of 54%, then come public servants and service industries. Manufacturing industries capable of absorbing labour force are operated

on a subsistence-level and they are very few in number. Hence, the unemployment ratio is higher than the country's average.

Accurate number of households is not known due to the lack of relevant data. Judging from the total population, it is estimated at about 90 thousand, of which nearly 80% is considered to be accounted for by farm and fishery households. Most of farmers are Malays who are operating rubber plantations or paddy fields in a small scale or working as estate or farm labourers, and great many of them are classified as "poverty." The term "poverty" is used to indicate those households whose income is lower than is required for affording foods and daily necessaries of the lowest level. In West Malaysia, poverty-class households account for 44% of all households, 63% of farm and fishery households, 77% of paddy growing farm households, and 79% of farm labourers' households. It is likely that these ratios are higher in Trengganu State. As a consequence, farmers in the state are forced to engage in other jobs, working at rubber plantations or offering their labour services in some other way. However, as there are scanty job opportunities and the wages paid are low, quite a few farmers are unable to earn an income of M$300 a month which is the povery line income necessary for maintaining the lowest level of livelihood.

2.5 Outline of Trengganu Tengah Development Project

KETENGAH (Central Trengganu Development Authority):

Official organization established in 1973 to promote land development and thereby provide increased employment opportunities for the working population in Trengganu State in order to improve the economic footing of the state.

Project area:

1,090,000 acres, of which 600,000 acres are covered by forest land.

Area suitable for agricultural development:

460,000 acres which is classified as follows:

Swamp area - approx. 73,000 acres

Already developed area - approx. 270,000 acres (mostly for oil palm)

Area covered by development plans approved for completion by 1982 - approx. 58,000 acres

Remaining undeveloped area - approx. 59,000 acres

New towns: 8 places designed as follows:

1 x regional centre, with a population of 20,000 (B)

3 x regional centre, with a population of 32,000 (C, D, E)

4 x sub-centre, with a population of 28,000 (A, F, G, H)

Population plan:

1975 - 31,900 persons (settlement from coastal areas)

1980 - 49,000 "

1990 - 100,000 "

Arterial road:

Jerangau - Jabor - Tanjong Gelang Highway (120 miles)

Sea port:

Kuantan port is conceived of as future export port of state's products.

2.6 Survey Results

(1) Reviewal of Malaysian request for Japan's assistance

i) Overall evaluation of the inland swamp areas in Trengganu Tengah.

ii) Preparation of a swamp distribution map on the basis of swamp classification with special reference to regional development plan.

iii) Preparation of topographic and soil maps of a selected area (not greater than 5,000 acres).

iv) Identification of a specific project to be implemented in one or more selected areas, and study of its economic and technical feasibility.

v) Review of utilization prospects of the swamp areas as a whole on the basis of analysis of data and information so far collected.

The Malaysian government attaches special importance to Items iii) and iv) above, and requests urgently that Japan would provide assistance in relevant surveys including a feasibility study which is hoped to be implemented within 1978 for a pilot project to be identified even for one area.

(2) Significance of Trengganu Tengah Development Project in the whole development scheme (Third Malaysia Plan) of the central and local governments

The central government is planning to "promote the development of

eastern coast states which are still in the early stage of development" as one of its top priority policies. This plan covers Trengganu Tengah besides Pahang Tenggara and Johor Tenggara, and aims at increasing per capita GDP to the state's average by 1990. Under this plan, KETENGAH and the state government are making united efforts for the development of Trengganu Tengah to meet the great expectation expressed by local inhabitants.

(3) Collection and analysis of data

Statistical data on meteorology, soil hydrology, crops and agricultural economics are not necessarily sufficient, but surveys have been conducted quite intensively for collection of such data.
(Statistical data covering the swamp areas are not available)
The only topographic map available is the one on the scale of 1/63,000 and it seems to be difficult for ordinary people to obtain it by reason of national defense. For the purpose of feasibility study and rough design, a topographic map on the scale of at least 1/5,000 must be prepared at the earliest possible date.

(4) Development condition of swamp areas

Development of the swamp areas has not been undertaken to date except that paddy is grown in the dry season in part of the peripheral areas to the extent that calls for no particular development.
A master plan for development of Trengganu Tengah was presented in 1974 by a British consultants company called Hanting Technical Services, Ltd., but it excluded the swamp areas. Planning of swamp development project is now urgently called for as the development based on this master plan has already made a considerable progress.

(5) Visits to Research and Experiment Institutes (MARDI at Kuala Lumpur and Trengganu)

MARDI has branches in many different places of the country and its research activities cover a diversity of crops. It also covers fisheries and other research fields falling within the jurisdiction of the Ministry of Agriculture.

(6) Selection of utilization areas and sectors

The team made a field survey in six representative swamp areas with

KETENGAH's staff leading the way, and noted that they were mostly covered by jungles with a variety of vegetation, although grassland and bushland were observed in part of the peripheral area. Development of these areas calls for flood protection and drainage which can be done by proper civil engineering work.

Considering drainage and social conditions, Bukit Bauk (See Fig. 1) seems to be most suited for implementing a pilot project.

As for utilization sectors, agricultural development will have to be given top priority because the swamp areas are too extensive for aquaculture and the jungles cannot be rated high as forest resources, although they can be utilized to an extent.

In selecting suitable crops, due consideration will have to given to socio-economic conditions. Choice will have to be made from among paddy, sago palm, maize, groundnuts, cashew nuts, soybeans, grasses, tobacco, vegetables, fruit trees, etc., with account taken of the soil improvement method.

(7) Review of cooperation system

The team explained the system of Japan's overseas technical cooperation activities to the Malaysian government adding that in the case of the planned swamp utilization, it would be most commendable to make a feasibility study in 1979 on the basis of a master plan to be formulated in 1978. However, the Malaysian government expressed the hope that a pilot project be implemented within 1978 at least in one area in order to be able to incorporate the swamp utilization plan in the intermediate reviewal of the Third Malaysia Plan to be made in 1978.

The situation being such, the team considers it appropriate to prepare the master plan and implement the pilot project concurrently in 1978.

The Malaysian government made it clear that it would leave the Japanese government with the basic concept of master plan, scope of works , and dispatch of experts.

(8) Study of S/W for full-scale survey

i) Crops and production should be made clear on the basis of long-range prospects of the future population, demand-supply situation of foods, agricultural structure, and other factors in the whole state.

ii) Characteristics of swamp soils should be made clear on the basis of careful soil survey in the swamp areas, and suitable crops should be indicated with studies also made on the propoer soil improvement measures.

iii) Hydrological analysis should be conducted with the whole of swamp areas taken as a single basin from the viewpoint of flood protection, and the drainage capacity of swamps should be clarified on the basis of such analysis.

iv) Socio-economic conditions should be clarified for each swamp area to determine its potential for development.

v) Effect of capital investment should be measured with special consideration given to the political factors including the government policy for effective utilization of natural resources and solution of poverty problems.

vi) Priority order of development should be determined for each swamp area by making a comprehensive study of the results of above studies.

vii) Implementation of feasibility study (pilot project) should be considered for swamp areas with high development potential.

For the purpose of these studies, the next phase of study should be a field survey to be completed within September before the advent of the wet season. If the preparation of the master plan and the feasibility study of pilot project are to be carried out concurrently as described above, the survey team will have to comprise the following experts.

(Assignment)	(Number)
Leader	1
Cultivation and soil science	1
Agricultural economics	1
Development planning	1
Hydrology	1
Irrigation and drainage	1
Surveying	2
Livestock farming	1
Fisheries	1
Forestry	1
TOTAL:	11

2.7 Malaysian Contribution to the Next Phase of Study

The Malaysian government was requested to contribute to the next phase of study by making the following arrangements.

i) Exemption of the survey equipment and materials brought by the team from taxes and customs duties.

ii) Supply of transport equipment including cars and an office room needed during the survey period.

iii) Appointment of counterpart experts and assistants who are to cooperate in the survey.

iv) Supply of articles and data required for the survey.

v) Approval for carrying data and materials back to Japan which are needed by the team in conducting design, analysis, etc. after its return to Japan.

The Malaysian government promised to make all the arrangements listed above, although it was pointed that some of the data and materials mentioned in Item v) above may not be permitted to be carried out of the country by reason of security of national defense. Thus, it was clear that the Malaysian government was ready to provide all possible conveniences for the survey.

2.8 Matters Calling for Early Determination

(1) Method of the next phase of study

The Japanese government should determine its policy for the next phase of study as soon as possible in answer to the desires expressed by the Malaysian government.

(2) Period of the next phase of study

Preparations should be made for dispatch of the survey team at latest in July so as to be able to complete the necessary survey activities before the advent of the wet season.

(3) Preparation of topographic map

A topographic map on the scale of 1/5,000 should be prepared.

2.9 Summary of Hanting Report

The master plan of Trengganu Tengah development scheme is derived

from "Regional Planning and Development Study Vol. 1 - IV" which was prepared in 1974 by Hanting Technical Services Ltd., England.
In the Trengganu Tengah development scheme contained in this Hanting Report, the swamp development for which Japan's assistance is requested is not included. In the summary of the Hanting Report given in the following sections, it can be seen how the swamp areas were dealt with and why they were excluded from the Trengganu Tengah development scheme.

2.9.1 Land Use Classification in Trengganu Tengah

In the development scheme formulated by Hanting, the whole area of Trengganu Tengha was classified into the three areas shown below according to the potential for development.

Table 1 Land Use Plan in Trengganu Tengah

	Classification	Acreage (acre)	Remarks
I	Area suitable for agricultural development	214,934	
II	Area suitable for forest planning	642,508	
III	Area excluded from development scheme	241,398	
	Total	1,098,840	

Table 2 Classification of Area Excluded from Hanting's Trengganu Tengah Development Scheme

Area	Acreage (acre)	Remarks
First phase development area	96,688	Development to be completed by 1976 by official and private organizations
Second phase development area	84,710	Development to be completed by 1980 by official and private organizations
Other area	60,000	Farmland for tenant and owner farmers, mining area, city and town areas, etc.
Total	241,398	

As shown below, areas I and II were also classified into five soil type area subdivided into a total of 17 soil group areas according to the suitability of agricultural production. On the basis of this soil classification, the two areas were divided into five classes (A ~ E) depending on the potential for agricultural development.

Table 3 Potentiality Rating for Agricultural Development and Land Use Classification

Development Potential Rating	Soil Classification	Acreage (acre)	Suitable Crops	Land Use Classification
A	1G, 2G, 2d, 3G	110,837	Oil palm, rubber, coconut, cocoa, fruit trees, vegetables, etc.	I. Area suitable for agricultural development
B	3G, 2d, 2G	38,220	Rubber, citrus, mangosteen, etc.	
C	2d, 2G	27,621	Paddy, perennial crops, vegetables, etc.	
D	3d	33,206	Sago palm	
E	3cG	5,050	Marginal agricultural production area	
Subtotal		214,934		
Other area	4do, 4Gc, 5h, 5STP	642,508	Area suitable for forest planning	II. Area suitable for forest planning
Total		857,442		

In connection with the area classified as being suited for agricultural development, Hanting proposed that Class A area and the greater part of Class B area, covering a total acreage of 120,420 acres, be developed in 17 years from 1974 to 1990. Hence, Hanting's agricultural development plan for the period from 1973 to 1990 covered a total of 301,818 acres comprising the said 120,420 acres plus the

first and second development areas which were excluded from the Trengganu Tengah development scheme.

As for the area for forest planning, the following soil classification was presented in Hanting report.

Table 4 Soil Classification of Forest Planning Area

Soil Classification	Acreage (acre)
1 - 3	19,201
4do	12,749
4Gc	37,786
5h, 5STP	572,772
Total	642,508

Notes: Isolated and difficult of access due to the lack of communication facilities

2.9.2. Area Excluded from Agricultural Development Planning

On the basis of Hanting report, a brief account is given below on the soil condition and other characteristics of the area excluded from the agricultural development planning.

Table 5 Development Potential Rating and Soil Classification

Development Potential Rating	Soil Classification	Acreage (acre)	Remarks
A	1G, 2G, 2d, 3G	7,137	Area 1
B	3G, 2d, 2G	21,500	Area 2
C	2d, 2G	27,621	Area 3
D	3d	33,206	Area 4
E	3cG	5,050	Area 5
Subtotal		94,514	
Other Area		642,508	Forest planning area
Total		7367,022	

Notes: Not all of the five areas are composed of a single mass of land.

Characteristics of each area

Area 1 : A mass of land (5,000 acres) covering the greater part of this area is suited for grazing cattle in future, but it has no all-weather road, either existing or under planning. Thus, area 1 was excluded from the agricultural development planning due to the difficulty of access.

Area 2 : This area embraces a mass of land of 21,500 acres which adjoins the above 5,000 acre land, and is suited for rubber production. It was excluded due to the lack of transportation facilities and the difficulty in recruting farm labourers.

Area 3 : This area was excluded by reason of a number of impediments to agricultural production. The whol area is prone to be subjected to seasonal flooding, although the soils are composed maily of Zd and considerably fertile. At present, utilization of this area may be planned mainly for paddy field development. Narrow strips of arable land are found along river valleys. Hanting excluded this area to permit the landowners to keep on with their seasonal cultivation.

Area 4 : This area, called "inland swamp," is submerged through the year. Although sago palm is the only suitable crop at present, the area can be utilized for paddy production if an adequate irrigation and drainage system is established. Exclusion of this area was considered inevitable on account of the high cost required for introducing such an irrigation and drainage system.

Area 5 : This area was excluded because the surface layer was small in thickness (30 - 50 cm) and too hard. However, Hanting reported that the feasibility of utilising this area cannot be denied totally until the data of detailed survey of lower layers become available.

2.9.3 Conclusion

In its report on Trengganu Tengah development scheme, Hanting made specific references to the following points.

(1) Land use plan had been formulated, though in part, before Hanting launched on its regional planning and development study.

(2) Hanting's study was made on the premise that oil palm and rubber would be chosen as main export crops.

(3) Soil map prepared by the Malaysian government was used, so that no soil survey was conducted by Hanting. However, this soil map was based on a survey conducted at a reconnaissance level, and only a part of it was covered by detailed analytical study. Hence, a detailed soil survey should be preferably conducted prior to planning any important development project. (As for swamp areas, Hanting only indicated their presence without touching on their soil texture)

(4) Measurement of area was conducted by means of a planimeter using a topographic map on the scale of 1 in./1 mile (1/63,360), so that the accuracy was not so high.

From the above comments, it can be seen that in formulating the Trengganu Tengah development scheme, Hanting tried to locate areas suited for production of oil palm and rubber and selected therefrom a certain number of areas available for immediate utilisation, giving no heed to the swamp areas.

The swamp areas are submerged during the wet season because their elevation is low relative to the river stage, so that they are hardly utilized at present. The seasonal flooding is due to the total absence of river embankments. Construction of embankments will incur a heavy financial burden if undertaken for agricultural development alone, but its economy must be understood to the full in terms of the benefits derivable from the river training and flood control. It is to be noted that many of the swamps are favourably conditioned in topography and soil texture and can be utilized for agricultural development if suitable measures are taken for river training and drainage.

CHAPTER 3 FUTURE COURSE OF SWAMP DEVELOPMENT

Considered from the viewpoints of civil engineering technology, crop cultivation, farm management, etc., it can be said that the feasiblity of swamp utilization is quite high, although difficulties will be entailed in each of these aspects.

From the data and information on soil condition collected during the survey, the mission arrived at the conclusion that it would be possible to introduce quite a large diversity of crops in the swamp areas. Nevertheless, the validity of introducing highly marketable corps remains to be an important question to be examined in future.

Studies should also be made on the pattern of farm management in order to embody the surrounding hilly areas in the swamp utilization plan for its efficient implementation. An attempt will have to be made, after a prudent prior study, to effect a drastic but essential change to the conventional farm management pattern. These studies and attempt are required to materialize a modern agriculture in the swamp areas in the form of large-scale farm management of extensive operational areas, multiple management combining two or more sectors such as upland crops, paddy, fruit trees, livestock farming, aquaculture, etc., joint utilization of agricultural facilities and machinery, and farmland grouping for collective crop production.

In implementating the swamp utilization, special consideration should be given to environment assessment. As the east coast of Malaysia bears a very small population density (36 persons /km^2) and its industries are still in the early stage of development, pollution problems have not yet been brought to the fore. However, environment assessment can never dispensed with because pollution problems occur after a period of 10 or 20 years, and it should never be taken granted for that the planned swamp utilization would be exempted from pollution problems in future.

From this viewpoint, the findings of the preliminary survey are introduced below for each sector covered to chart the course of future swamp utilization.

3.1 Soil and Crops

As stated in the section introducing the results of field survey in the

swamp areas, the inland swamp situated in the area covered by KETENGAH can be broadly classified into three types.

For the purpose of optimum utilization of the swamp areas, it is necessary to study natural as well as socio-economic conditions of each swamp area so as to be able to map out and implement the most effective and workable development plan.

Considered from the soil conditions alone, Type 1, 2 and 3.1 are favourably conditioned for agricultural production, whereas Type 3.2 consisting of heavy soils is subjected to considerable limitation on agricultural operation and calls for substantial soil improvement (sand dressing, subsoil breaking, addition of organic substances, etc.)

The greater part of the swamps is covered with jungles of broadleaved trees, shrubs and other plants which are considered to include sizable quantities of important tree species, so that it is probable that the swamp utilization will contribute to forestry development in the state to a notable degree. However, the present studies are limited to the most adequate swamp utilization for agricultural production based on the principle of right crop on the right site from the viewpoint of natural conditions such as soil and topography.

3.1.1 Improvement of Swamp Soils

As the swamp areas are extremely poor in drainage condition and submerged in many places, their utilization calls for the following three steps which need to be taken before anything else for the purpose of soil improvement.

i) Completion of drainage facilities for drainage of all swamps.

ii) Input of soil improving materials suited to the crops to be introduced (carbonate precipiated, phosphate, etc.).

iii) Soil reversing and dressing or soil dressing after draining and drying if necessary.

Depth of drainage channels in peat soil areas should be determined in consideration of the possible settlement of ground surface due to soil contraction which could occur by the drainage, drying up, and decomposition of organic substances.

If mechanized farming is to be introduced, the bearing capacity of

ground should be examined carefully and stumps and other obstacles should be removed to permit smooth operation of farm machinery.

Notes: In coastal swamps and lagoon-like swamps, acid sulphate soil is occasionally found. This is caused by the oxidation of iron sulfide accumulated in lower layers after draining and subsequent formation of sulphate. Acid sulphate soil is one of the worst soils which involve extremely difficulty in soil improvement. Swamps likely to contain it should therefore be covered by a careful survey.

3.1.2 Land Utilization in Swamps and Crops

The swamps are poorly drained and submerged constantly in many places, so that they are not favourably conditioned for crop cultivation. Paddy is most suited for cultivation under the existing poor condition, but planting of other crops can be planned if suitable irrigation and drainage structures are provided.

It is to be noted, however, that the drainage condition in the swamp areas is essentially unfavourable for cultivation of deep-rooted crops.

The following figure shows an example of land utilization in the swamps for crop cultivation.

Month / Cropping Pattern	Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
Double cropping of paddy	Nursery period Harvesting period Growing period Growing period Nursery period Harvesting period
Paddy and short-term crops	Paddy Short-term crops
Long-term crops	Long-term crops

Double cropping of paddy will not involve any particular problems as it is already practised in a number of project areas in Trengannu State and its farm management system has already established, though to not a fully workable extent. Since paddy can

be grown under a rather poor drainage condition, its double cropping would be most compatible with the natural conditions in the swamp areas.

For the purpose of effective utilization of land and profitability of paddy cultivation, it is desirable that the paddy fields be so improved that water management can be controlled to an extent for regulating the water supply according to the growth stage.

Paddy plus short-term crops is the cropping pattern in which short-terms crops are to be planted in the dry season (off-season) lasting from April to September after harvesting paddy grown in the wet season (main season). Chilies, soybean, groundnuts, vegetables, tobacco and maize may be cited as suitable short-term crops under this cropping pattern as their planted area is expanding rapidly in the whole of West Malaysia and is also relatively large in Trengganu State. It must be noted, however, that the introduction of these short-term crops presupposes completion of satisfactory drainage work and improvement of soil condition.

Regarding long-term crops, introduction of deep-rooted crops should be avoided because their roots extend down to lower layers which cannot be drained perfectly even if the drainage canals are excavated to a substantial depth. Long-term crops suited for cultivation in the swamps are those which are shallow-rooted and exhibit a high growth rate in West Malaysia. These will include pineapple, cashew nut, pepper and sago palm. Needsless to say, these crops also call for the improvement of drainage and soil conditions as well as for exertion of constant care to prevent the fields from being sumbered in the wet season because of their long growth period.

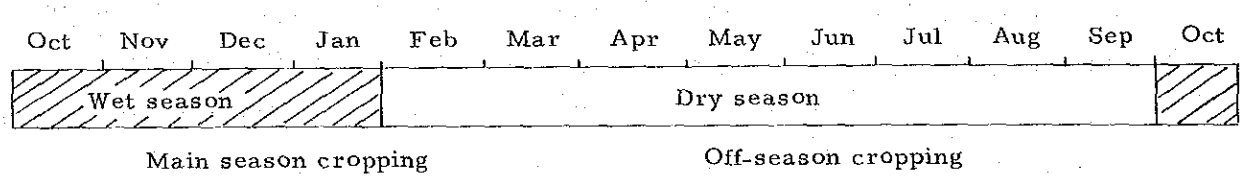
3.1.3 Results of Interviews at Malaysia Agricultural Research and Development Institute (MARDI)

(1) Results of Interviews at Kuala Lumpur Branch of MARDI

1) Irrigation Project Areas in Trengganu State, and Acreage

Project Area	Acreage (acre)
Kuala Trengganu	
1. Nerus Scheme	12,000
2. Pulav Musan	
Besut	
1. Phase (1)	12,000
2. Phase (2)	
Ulu Trengganu	200
Total	24,200

2) Double Cropping System in Irrigation Project Areas



3) Yield per Unit Area

Area	Average Yield per Unit Area in Trengganu State (gantang/acre)	Representative Varieties
Rainfed area	200 - 300	Traditional varieties
Irrigated area	300 - 500	Bahagia Mashuri
Research Institute	500 - 800	Trial cultivation of the above and MR 17, 15, 14, 16, 10

4) Paddy Field Planting System in Trengganu State

Type	Cropping Pattern	Remarks
1	Paddy + Fallowing	Areas without irrigation structure
2	Paddy + Short-term crops	
3	Paddy + Paddy	Irrigated area

5) Typical Short-term Crops in Trengganu State Excluding Paddy, Groundnuts, Maize, Tobacco, Soybeans, Vegetables, and Chilly

6) Average Income of Farm Household

(Average monthly income per paddy growing farm household)

Planted Area (acre)	Income from Paddy Sale (M$)	Income from Labour Services at Rubber Plantations (M$)	Monthly Total (M$)
26	120 - 170	90	210 - 260

7) Target Yield and Management Scale Set by MARDI

4.0 t/ha per farm household with an operational holding of 4 - 6 acres

8) Rate of Self-sufficiency in Foods in Trengannu State

Rice : 60 - 70%

Vegetables : Approx. 50%

(2) Results of Interviews at MARDI at Serdang

1) Pineapple Plantation in Johor State

The MARDI staff interviewed introduced the case of a pineapple plantation which was reclaimed by draining a swamp area where muddy surface soil had a thickness of 10 - 20 ft.

i) The main canal was excavated to a thickness of about 10 ft.

ii) The main difficulties encountered in the development of this pineapple plantation were:

a. Soil improvement (Soil was deficient in nutrients including micronutrients, particularly molybdenum, copper and zinc, but pH value ranged from 3 to 5 and suited to pineapples).

b. Construction of satisfactory drainage facilities.

c. Removal of stumps of large trees (Stumps of large trees had to be pulled out to permit free operation of large-type farm machinery).

2) Crops Suited to Peat Swamps after Drainage Work

Tapioca, chilly, pineapple, vegetables, groundnuts and soybean were cited as suitable crops, although any other crops could be introduced after construction of satisfactory drainage facilities. Deep-rooted crops were not recommended because of their long

growth period and also because they are prone to lodging if the peat soil is small in thickness and poorly drained.

3.1.4 *Field Survey in Kada District, Kelantan State*

Kada district in Kelautan State covers an area of 142,000 acres. Paddy is planted in an area of 80,000 acres of which 81% (65,000 acres) is used for double cropping. Vegetables and tobacco

(1) Cropping Season of Paddy, and Yield per Unit Area

Cropping System	Growing Period	Yield per Unit Area (ton/acre)	Remarks
Single Cropping	Planting Sept - Oct ⟷ Planting Feb - Mar	1.0	1. Yield in long tons 2. Yield in west coast area is large, ranging from 1.25 to 1.5 tons/acre on an average
Double Cropping	Mar - Apr ⟷ Aug - Sept	1.0	

(2) Operational Holding and Farming Income per Farm Household

(Average operational holding and income per farm household)				
Paddy Field (acre)	Rubber and Coconut Plantation, and Fruit Garden (acre)	Total Operational Holding (acre)	Income (M$ /month)	Remarks
1.5 - 2.0	1.0	2.5 - 3.0	150 - 200	M$52 earmarked from the sales proceed of rice is reserved to cover the maintenance and management expenses

Notes; Target monthly household expense for solving the poverty problem is M$300.

(3) Other Findings

1) Seasonal laborers are employed to make up for the manpower shortage in the transplanting season, paying M$3 - 4 to each per month.

2) Owner farmers account for 60% of all farmers and tenant farmers for 40%.

60% of farmland area is cultivated by owner farmers and 40% by tenant farmers.

3) A water charge of M$12 is paid annualy.

4) Cost of infrastructural improvement including irrigation and drainage projects is borne by the central government in full.

3.1.5 Cultural Conditions of Main Tropical Crops

(1) Cultural Conditions of Crops Excluding Paddy

Crop	Cultural Conditions	Cultivation Area in Malaysia
I. Food Crops		
Paddy	Malaysia is favoured with suitable cultural conditions in almost all places.	
Maize	Areas lower than 1,500 m in elevation economically suitable because the growing period becomes longer and the yield smaller with the increase in elevation. Growing period in flat land areas is 80 - 90 days for early-maturing varieties and about 120 days for late maturing varieties, so that three to four crops a year is possible. However, single to double cropping is commendable by reason of soil fertility. Possibility of maize production depends on uniform distribution of rainfall (100 - 150mm) between the time of sowing and the time of maturity. Excessive rainfall and humidity give rise to the occurrence of diseases.	There are many suitable areas, none are cultivated on the commercial basis.
Pulses (Groundnuts)	Soil conditions are more important than climatic conditions. Well-drained soft	Suitable areas are found in many places

	and porous terrain ranging from volcanic soil to sandy soil or loam is most suitable.	
Cassava	Suitable atmospheric temperature during the growing period is about 28°C, and the cultivation period lasts for as long as 8 to 16 months. Monthly rainfall of 100-150mm and well-drained sandy loam are the desirable conditions.	Suitable areas are found throughout the country, but cassava is not regarded as an important crop.
Taro	Loamy clay soil which is fertile and hard to dry is most suitable. Differences in growth condition are hardly presented within the pH range of 4 (acid soil) to 9 (alkali soil). Swamps with an evenly distributed annual rainfall of more than 2,500mm are suited to cultivation. Optimum atmospheric temperature is 25~30°C.	Grown mostly in low-lying swamp areas.
Sago Palm	Low-lying inland swamps in coastal areas with an elevation of less than 400m are suitable. High atmospheric temperature and copious rainfall are also desirable.	Grown in quasinatural condition at present.
II. Sugar Crops		
Sugarcane	Soil should have a sufficient moisture content in the growing period but should be dried up in the ripening period when the sugar content increases. Hence, areas where rainfall distributes itself disinctly into the wet season and the dry season are suitable.	No suitable areas are found due to rainfall distribution in Malaysia.
III. Oil Crops		

Oil Palm	Areas with an annual average temperature of more than 25°C and an annual rainfall of more than 2,000mm where the distinction between the wet and the dry seasons are not very clear are suitable. As for soil condition, sandy loam to clay soil are suited but peat moors and ill-drained areas are not because of poor aeration which prevents the growth of roots. (Production period: 4 - 30 years)	Grown extensively is hilly and low-lying areas with an elevation of less than 200 m.
Coconut Plam	Areas with coastal climate where the annual average temperature is higher than 25°C and subject to little differences between days and nights are suitable. As for rainfall, an average of more than 2,000 mm distributed evenly through the year is desirable. Peat moors or ill-drained areas are not suitable. (Production period: 7 - 30 years)	Grown mostly in flat areas along coastline.
IV. Garden Crops		
Banana	Areas where the temperature ranges from 26°to 28°C with little changes through the year suitable. As for rainfall, uniform year-round distribution is desirable. Since banana is a deep-rooted crop calling for good subterranean aeration, fertile, soft and light soils are most desirable, but any soil ranging from sandy to heavy soils can be used if organic substances are contained in sufficient quantities. As for hydrogen exponent	Grown in many places in the southern part of the country.

	of soil, suitable range of pH value is as wide as 3.0 - 8.0, but weak acid soils are best suited. Poorly drained or heavy soils are not suitable because of poor subterrernean aeration.	
Pineapple	Areas with an annual average temperature of about 25°C and an annual average rainfall of about 2,000mm which is evenly through the year are suitable. As for soil condition, sandy to heavy soils can be used if the top soil is deep enough and well drained. Optimum pH value of soil is 4.5 - 6.0 Notes: In Johor State, a pineapple plantation formed by reclaiming peat soil is operated on a commercial scale. Being located in a low-lying swamp area, the site of the plantation was thoroughly covered with well-planned drainage facilities, but it is deficient of microelements such as molybdenum, copper and zinc. Soil pH value at the site ranges from 3.0 to 5.0.	Suitable areas are found in the southern and western parts.
Coffee	There are three tropical coffee varieties, i.e., Arabic, Lobster and Liberian. Suitable elevation is 600 - 1,500 m for Arabia variety and 200 - 600 m for Lobster variety. Liberia variety has a greater adaptability to changes in elevation and can be grown in lowland areas. Suitable temperature is 16°- 24°C for Arabic variety and 18°- 32°C for Lobster variety. Optimum annual rainfall is 1,000 -	All three varieties are grown in respective suitable areas.

	1,500 mm, and yield declines if the rainfall is greater than 2,000 mm a year. As for soil reaction, a pH range of 4.0 - 7.0 is acceptable, the most adequate being pH 6.0. Well drained humic soil is most desirable.	
Cocoa	Areas where the temperature stands at about 26°C and has small annual and diurnal ranges are suitable. Optimum annual rainfall and pH value are about 2,000 mm and 6.5 - 7.5, respectively. Sandy to heavy soils can be chosen if they are well drained.	Grown in many places on the west coast.
Tea	Marginal isothermal line is 13°C in the coldest month. Areas embracing this isotherm where the highest temperature rises beyond 29°C are not suitable. Optimum elevation and rainfall are 1,000 - 1,500 m and 1,500 - 2,000 mm, respectively. As for pH value, a range of 4.5 - 6.0 is acceptable. Being a deep-rooted crop, tea is suited for cultivation in areas where surface layer is deep, fertile, rich in water-holding capacity, and well drained.	Grown in highland areas.
Tobacco	A period of about 100 days is required for harvesting. Areas having a monthly rainfall of about 1,000 during the growing period and drying up from the time of maturity to the time of harvesting are suitable. Optimum temperature is 20°-27°C. As for soil condition, well drained and aerated soils rich in water-holding capacity are suitable. (In general, loam - sandy loam is most	Suitable areas are found along the Pàhan river.

	suitable)	
V. Condiment Crops		
Pepper	Pepper is a shallow-rooted crop liable to drought damage. Dry weather is impedimental to its growth, although soil should preferably be somewhat dry at the fruiting stage. Pepper gardens are usually opened in newly cleared areas in forestland which are less susceptible to diseases and insect pests than mature paddy fields. (Production period: 4 - 30 years)	Grown throughout the country.
Hot Pepper	Suitable temperature is 25°- 28°C, and seed-setting rate and pungent taste increase with temperature rise. Adequate rainfall distribution is desirable because excessive rainfall prevents drying of seeds and excessive drying lowers the seed-setting rate. Adapatability to soil condition is excellent and practically any type of soil can be used, but sandy loam - loam is most suitable but heavy soil causes irregular growth. Acceptable pH value is wide and ranges from strong acidity to alkalinity, but the optimum value is 5.5 - 7.0 .	Grown throughout the country.
VI. Gum Crops		
Rubber	Areas with an annual rainfall of more than 1,500 mm which is distributed uniformly through the year are suitable. Cultivated soil should be deep, well drained and large in water-holding capacity, and grounwater level should be small. Sandy to heavy clay are suitable,	Grown on plateaus in lowland areas with an elevation of less than 200 m.

	and pH value of 3.0 - 7.8 is acceptable, though optimum valume is 5.0 - 6.0. (Production period: 8 - 30 years)	

Source: Data of Tropical Agriculture Research Centre, and National Institute of Resources of Science and Technology Agency.

(2) Varieties and Characteristics of Paddy Grown in West Malaysia

Item	Variety: Local Carieties	Malinja	Mashuri	Bahagia	Ria(IR8)
Irrigation Condition	Rainfed irrigation				Complete irrigation culture
Stem Length (cm)	More than 110	100-110	100	80-90	70
Lodging Characteristics	Extremely susceptible	Slightly susceptible	Medium	Resistant	More than 90
Dosage of Nitrogen Application(kg/ha)	0-30	30-40	40-60	60-90	20-20
Planting Density (cm)	35 x 35	35 x 35	30 x 30	30 x 30	More than 5
Yield (ton/ha)	1.5-2.9	3.0	4.0	4.0	128
Growing Period (day)	150-250	130-135	130-133	132-142	

Source; Research data on the growth of paddy varieties for double cropping in Malaysia

3.1.6 Growth and pH Value of Crops

	Crop	4.5 - 5.4	5.5 - 5.9	6.0 - 6.9	7.0	7.1 - 7.8
Gramineous Crops	Paddy	○	◎	◎	◎	○
	Barley	△	○	◎	◎	○
	Wheat	○	○	◎	◎	◎
Miscellaneous Cereals & Pulses	Maize	○	◎	◎	◎	○
	Soybean	○	◎	◎	◎	○
	Groundnuts	○	○	◎	◎	○

Crops	4.5 - 5.4	5.5 - 5.9	6.0 - 6.9	7.0	7.1 - 7.8
Tobacco	○	◎	◎	◎	○
Mulberry	○	○	◎	◎	○
Tea	○	◎	◎	○	△
Peas	○	○	◎	◎	○
Turnip	○	◎	◎	◎	○
Carrot	○	◎	◎	◎	○
Chinese cabbage	○	○	◎	◎	○
Cabbage	○	○	◎	◎	○
Spinach	△	○	◎	◎	○
Welsh onion	○	◎	◎	◎	◎
Onion	△	○	◎	◎	◎
Cucumber	○	◎	◎	○	○
Pumpking	○	◎	◎	◎	◎
Water melon	○	○	◎	◎	○
Melon	△	○	◎	○	○
Eggplant	○	○	◎	◎	○
Hot pepper	○	○	◎	◎	○

Source: Reference data on farmland development resources.

3.2 Livestock Farming

Self-sufficiency rate and consumption of meat in Malaysia in 1974 was as shown below.

Kind of Meat	Self-sufficiency Rate (%)	Consumption (kg/person /year)	Growth of Consumption (%/year)
Beef	89	1.67	3.0
Mutton	31	0.29	-7.7
Pork	99	5.25	-1.4
Chicken	100	7.99	6.9
Total		15.2	

The low self-sufficiency in chicken is of no significance because the consumption itself is on a low level. As pork is considered to be consumed

mostly by the citizens of Chinese descendent, it may be said that chicken accounts for the greater part of meat consumption in Malaysia. The per capita annual average consumption (1.52 kg/person/year) is not very large, and the annual growth of consumption shows a minus value for mutton and pork. From these facts, the following inferences may be drawn in connection with the livestock farming in Malaysia.

Chicken holds the top place in meat consumption in Malaysia, with beef recording some growth in recent years. Considering the expected improvement of living standards, it is likely that beef consumption will grow rapidly as evidenced in other countries. It will therefore be necessary to map out a large-scale beef production plan.

Accelerated beef production presupposes the fulfilment of two conditions, i.e., selection of suitable species and assurance of stable feed supply. In general, beef cattle raising in the tropical zone entails the following problems.

i) High atmospheric temperature
ii) Shortage of roughage in the dry season
iii) Parasitic diseases
iv) Lack of raising skill on the part of farmers
v) Low meat productivity of local species

There are two methods of breeding beef cattle. In one method, a large number of species with high performance introduced from abroad are to be used as breeding cattle for multiplication. In the other, a suitable number of herd sires with desirable inheritance are to be imported and mated with cows of local species over some generations for up-grading so as to breed out a species best suited to each locality.

Main beef cattle species current raised in Malyasia are Kedah-Kelantan and Indian Dairy. The former, numbering about 250,000 heads in total, is known to weigh 400 kg for bull and 270 for cow, and its daily weight gain is 250 g/day in about 24 month after birth. The latter totals about 70,000 heads, and its daily weight gain in about the same period after birth is 470 g/day which is greater than that of Kedah-Kelantan.

As a large number of cattle need to be raised to meet the growing demand for beed, it is commendable to import herd sires and mate them with cows of local species for the purpose of promoting cattle raising on

the national level. To develop cattle raising in Trengganu Tengah, however, it will be necessary to study the validity of the plan for importing all breeding sires. If this plan is adopted, then the suitable species would be Drought Master of Australia or American Brahman of the U.S.A. These two species are highly pedigreed from Bosindicus of tropical strain.

Grassland for grazing cattle is found only in few places in Malaysia. At present, cattle left free on wasteland and roads to make them feed on weeds or on paddy fields after harvesting (paddy varieties grown in Malaysia have a long culm length, and harvesting is conducted by reaping the panicle alone). Grassland development in Trengganu Tengah for large-scale cattle raising is a scheme which deserves serious consideration.

Species of gramineous grasses to be grown on grazing land include Para grass, Pangola grass, Guinea grass, African Star grass, and signal grass. As for legunious species, Centro and Stylo may be cited. Gramineous grasses for mowing include Mapier grass and Setaria. Considering the extensiveness and availability of bottom weeds in oil palm and rubber plantations, it may as well be suggested to utilize such plantations for grazing cattle in a suitable number not impedimental to the growth of trees. This will produce fertilization effect on the growth of trees.

3.3 Aquaculture (Fresh Water Pisciculture)

Fresh water fish culture in Malaysia is conducted by utilizing off-season paddy fields as well as in farms created in abandoned tin mine areas. In addition, fish are caught in rivers and lakes. Anuual production of freshwater fish from these two sources is estimated to reach about 26,000 tons. The Malaysian government is planning to promote fish culture in inland swamps including mangrove swamps near the coast for commercial production of shellfish, lobsters and shrimps, oyster, crab and seaweeds, but such commercial fish culture has never been put in practice in a systematic manner.

The 62 fish farms (15.15 acres) in Trengganu State are estimated to produce a total of about 3 - 4 tons of fish, whereas the state's fish catch

at sea exceeds 30,000 tons, accounting more than 10% of the total fish catch of West Malaysia. Thus, fish culture has not gained a stable footing in Malaysian fisheries and is conducted by some farmers as one of side-jobs.

Fish species suited to fish culture in Malaysia are caprs including grass carp and big head carp, catfish, Lampan Jawa and Tilapia, but culture of these species naturally presupposes prudent prior studies on cultural techniques and marketability. As things stand now, it appears to be rather too early to introduce fresh water culture on any large scale.

3.4 Forestry

Forest development and wood processing have long been the mainstay of Malaysian industries, but the forest development in Malaysia has been conducted by cutting and logging trees from extensive natural forest with hardly any reforestation performed for regneration of forest resources or soil and water conservation except for the creation of palm and rubber plantations.

It is not likely that the swamp areas are suited for planting large tree species because of their weak ground condition, but the possibility of planting such species will have be examined. In the forest swamp areas, natural trees of relatively large size are found with bushes and other plants, though varying in density from place to place. As these natural trees are expected to include those with a fairly high commercial value, it is desirable that a survey be conducted in the forest swamps before starting their development. Considering the density of valuable trees and the construction cost of logging roads, swamp development aimed only at logging of trees cannot be economically justified. However, these high-quality natural trees will be useful in promoting agricultural development in the swamp areas, so that their utilization should be incorporated in the swamp utilization plan in order to increase its economic effect.

3.5 Farm Management

The planned swamp utilization will incur a huge amount of capital input because of the natural characteristics and conditions of the swamps and their locations. In order to contribute to enhanced national land

utilisation through the swamp development, it is necessary to study the various swamp conditions including soils, irrigation and drainage and to make a careful review on the necessity, urgency and justifiability of development from a socio-economic point of view.

As already stated, farmers in Trengganu State are extremely poor relative to those in other parts of the country, and they are forced grow mainly rubber, paddy and coconut on a subsistence level. The existing land infrastructure is just too poor and low in productivity, and the farmers' technical level is also low. Technical improvement including fertilization which is studied by MARDI for enhanced paddy production promises to double the present yield level, but the farmers are unable to effect such improvement because their net income is just too small to afford fertilizers and chemicals due to the high intermediate margins charged by middlemen and brokers in the distribution of paddy. This lack of funds on the part of farmers seems to be responsible for the inability to purchase facilities for paddy preparations and the consequent degradation of marketed paddy. Such being the situation, expansion of the management scale alone is not likely to help farms establish sound management and enjoy a satisfactory income unless efforts are made for introduction of mechanised farming, renovation of cultural techniques and practices, and improvement of the farm produce distribution channel. Solution of the prevailing problems will call for a number of measures such as the elevation of the guaranteed floor price of paddy, introduction of a price guarantee system for vegetables, fruits and livestock products, and improvement of the distribution channel through expansion of the activities and agricultural credit services of agricultural cooperative societies and farmers' associations. Settlement of farmers in the swamp areas and expansion of their management scale through the swamp development project will not bring solution for the existing poverty problem. Success of the project depends on whether adequate measures will be taken for improvement of management and distribution channel after settlement. It will be only when such measures are enforced successfully that the settlers feel assured and are enabled to establish sound management, and this will lead to the solution of the poverty problem and at the same time make the project fully justifiable from the

viewpoint of national economy.

From the above viewpoint, items to be given careful consideration at the project planning stage are discussed below, together with profitability comparison of the crops to be introduced.

3.5.1 Study from Managerial Point of View

(1) Utilization of Swamps with Surrounding Areas

Utilization of the land around the swamps needs to be planned suitably according to the location of each swamp area. The reconnaissance disclosed that the swamps have different locational conditions. Specifically, some are close to the main road running near the coast or adjoin paddy fields, rubber or oil palm plantations, or wildland. Some others located in the jungle are far from the branch road or houses. Still others in the jungle are located near the right of way of a highway which is under construction for the new town project in the nearby area. While the site condition thus varies largely from swamp, it can be reasonably said that if a swamp with development potential is surrounded with land for which no specific development project is planned, both the swamp and the surrounding land should be integrated in the swamp utilization plan as this will not only ensure efficient land utilization but also cut down the cost of necessary construction work. However, such utilization of surrounding land does not necessarily mean the introduction of the same crops as will be grown in the swamp area. For example, if a wildland adjoins a swamp area, it will be possible to turn it into a grassland by a simple land improvement work and introduce paddy culture and livestock farming. If, again, a large-scale new town project is planned in a hilly area, multiple farm management integrating a swamp and the surrounding land may as well be planned to grow various crops to be supplied to the new town.

Thus, swamp utilization should be preceded by a careful study of the existing state of land use, community structure and development scheme in the surrounding areas.

(2) Propspects of Crops to be Introduced

Success of farm management in the swamp areas depends, above all

other things, on the selection of suitable crops. While soil and irrigation conditions will set rigid and inevitable limits on the choice of crops, careful consideration should also be given to the marketability of each crop. Sepcifically, the criteria for selection will have to be modified by whether priority should be given to the improvement of nation-wide self-sufficiency in foods or to the export of commercial crops. If commercial crops are to be introduced, the future prospects of their demand on the world market will have to studied in advance. On the other hand, if priority is to be given to the augmented self-sufficiency in foods, then no particular difficulty will be entailed in the selection of crops but there will arise the problem of low profitability and anxiety for the possible reduction in market price in case of overproduction.

In so far as self-sufficiency in rice is concerned, Malaysia attained a high rate of 95% in 1975. If double cropping is promoted with the progress of soil improvement of paddy fields and if cultural practices are improved with the introduction of breeding, fertilization and plant protection technology, paddy production will perhaps increase beyond the nation's demand in no time. Even then, however, it will not be very difficult to convert paddy fields to other crops because they are favoured with better soil condition than the swamps.

It the swamps are found to be suited for paddy field reclamation, it may be planned to turn the entire swamp areas into a paddy field area and convert the existing paddy fields to other crops for the purpose of efficient national land use. Although Malaysia achieved 95% of self-sufficiency in rice in 1975, the population increase envisaged under the Third Malaysia Plan for 1990 is 18,100 thousand for the whole country which is an increase of 45% over 1975. The population increase envisaged for Trengganu State is also as large as 700 thousand or a 44% increase over 1975. Thus, the anticipated population increase may make it necessary to promote paddy field reclamation in a substantial degree even if double cropping is practised widely in future.

The land use plan should be formulated not for the develop-

ment of Trengannu State or Trengganu Tengah alone. It should be so mapped out that the swamps will take part in the enforcement of a master plan for land use and production in the whole country or Trengganu State. Furthermore, it should be implemented in full consideration of the production condition in other parts of the country.

(3) Allocation and Farming Pattern of Land for Independent Management

Farmers in Trengganu Tengah, especially those engaged in paddy production, are operating on a small scale and compelled to earn a substantial portion of their income from non-agricultural sectors on account of the low profitability of their agricultural operation. The greater part of them live in areas facing the main road which runs along the coast, so that they find it relatively easy to secure employment in sectors other than agriculture.

As many of the swamps are found considerably deep in the inland area, they are not favourably located for the farmers to find a job other than agriculture. If the farmers succeed in securing employment in a non-agricultural sector, then they will be prevented from exerting full effort in farm work and this will naturally lead to production drop. Further, the high project cost makes it imperative that the resettlement in the swamp areas be planned for allocation of such size and quality of land that assures the settlers of a fairly high standard of life that can be maintained only by full-time agricultural operation. Allocation of land varies naturally according to the kind of crops to be introduced. While the farm labour requirement differs from crop to crop, it is necessary to plan the selection or combination of crops which promises the maximum of profit within the limits of available family labour force. There will be cases where land productivity is high but labour productivity low or vice versa depending upon the kinds of crops introduced. If capital productivity is to be increased, crop combination which lowers the ratio of fixed capital in the management cost is desirable, and this will call for a firm grasp of production cost as well as working hours by season and type of farm work so as to be able make a most rational selection or combination of crops.

In determining farming pattern, some account will have to taken

of the need for selecting crops suited to dispersion of risk that may result from drastic changes in market price.

(4) Introduction of Modern Agricultural Facilities and Establishment of Distribution Mechanism

Mechanized farming is hardly practised in Trengganu State. Virtually all farmers follow the rather primitive traditional farming practices in which ploughing resorts to water buffalo and manpower and threshing is performed by beating panicles againt a table. If double cropping comes to be practised in an extensive area, therefore, shortage of labour forces resulting from the concurrence of the ploughing and transplanting season and the harvesting season could retard the enlargement of management scale. It will therefore be necessary to plan the introduction of farm machinery such as tractors and combines. (Paddy + paddy) or (paddy + vegetables) will be the suitable cropping pattern for efficient utilization of farm machinery. However, since farm machinery are costly and liable to cause damage on crops, their proper and efficient operation should be ensured through establishment of collective machinery utilization associations, joint purchase by agricultural cooperative societies or farmers' associations, training of operators, and setting up of repair shops.

As for the distribution mechanism, paddy is sold not to the government but to rice dealers and brokers who often beat down the price to an exorbitant extent. Vegetables and fruits are sold directly to consumers at an open-air market or to dealers in most cases, and their prices are not stabilized.

To bring solution for this problem, farmers' associations should be induced to construct their own paddy drying yeards and warehouses so as to materialise direct sales to the government or bulk sales to dealers and cease the prevailing practice in which each individual farmer sells his products at his own discretion. Similar improvement should be effected for vegetables and fruits. Specifically, establishment of collecting and shipping yards and warehouses should be planned for joint shipment, and construction of a large-schale market should also be considered.

(5) Expansion of Organizations Providing Capital Goods, Farm Management Guidance and Extension Services, and Agricultural Credit Services

The Mission was not able to clarify the extent of input of agricultural production materials or the sources of their supply. However, it learned from MARDI in Trengganu State that a yield of 4 tons per ha was attained in its fields by applying 60 kg of N, 40 kg of P and 15 kg of K per ha, whereas the neighbouring farmers recorded only 2 tons of yield per ha because they applied 20 kg of P only. Although application of fertilizers and control chemicals calls for the availability of a certain amount of fund, it is directly conductive to the improvement of productivity and profit. It is therefore important to plan a system under which they can be purchased in bulk at lower cost.

As for farm management guidance and extension service organizations, the Mission was informed that an agricultural mechanization centre and a rural community centre have been established in advanced farming areas. Establishment of a new guidance and extension service station or a system for utilizing MARDI's technological achievements should be planned for the swamp areas, with consideration also given to the assignment of a sufficient number of farm advisors.

In Muda irrigated areas, agricultural credit services are offered by agricultural credit banks. It appears, however, that these banks are not utilized often in other areas. The survey data covering Muda irrigated areas indicates that 56% of all farmers made a loan from merchants for the most part and from relatives. The Mission was also informed that in terms of average amount of loan, banks stood a top followed by pawnshops and retailers in that order.

In order to smoothen the agricultural credit services including the provision of farmers' living expenses and to stimulate their propensity to save, studies should be made on new establishment or expansion of a credit service section within the agricultural cooperative society or farmers' association in each rural community.

(6) Economic Effect of Investment

The effect of the investment on national economy should be studied

carefully with due consideration given to the national finance and the government's loan agreement.

The net value of investment to national economy may show a minus figure for some time after completion of the project, it may be considered a success if a plus value is obtained throughout the durable years of the facilities. As for the economic footing of farmers to be settled in the swamp areas, trial calculation of their target income level should be worked out to study the repayability of the project cost. Further, if the project embraces any plans indispensable for the enforcement of the government policies, adequate measures should be taken for provision of sizable subsidy for farmers, maintenance and management of facilities under the government control, supply or alleviation of interest on loans for farm management, and exemption from taxes and public charges for some time to come. For the purpose of smooth enforcement of these measures, it is advisable to make examination on the fund plan of the government and farmers.

3.5.2 Profitability Comparison of Crops

As stated in the preceding section, introduction of crops in the project area should be effected after a careful and comprehensive study of various aspects of each crop such as future marketing prospects, balance of demand and supply, and profitability. However, it is none but the farmers themselves will actually push forward the agricultural development and they will naturally hope for the introduction and combination of crops which promise the maximum of income within the limits of their family labour force. It is therefore important to make studies on the most advantageous combinations of crops on the basis of the productivity, required labour input and demand-supply balance of each crop.

For the purpose of such studies, MARDI prepared a brief report on the production cost and estimated income for each crop in 1974, which is explained below with some comments.

According to the said report, pepper recorded the highest soil productivity per acre with M$6,563, followed by chilly, tomato, tobacco, Sawi Hijau (a kind of vegetables), Markisa (a kind of fruits),

and peas in this order, all of which registering a value on the M$1,000 mark. Crops which marked low soil productivity were maize, coconut, citoron, paddy, pineapple, sorghum, and coffee. As for labour productivity, oil palm and cashew held the top place with M$40 per day, then come M$38.2 of pepper. Thus, pepper was the highest in both land productivity and labour productivity. Crops with low labour productivity were coffee, peas, Komatsuna (a kind of Chinese cabbage), maize, Chinese cabbage, pineapple and leaf mustard. In general, vegetables registered a low labour productivity because they call for intensive farm work.

Paddy is slightly higher than vegetables in labour productivity, but its soil productivity is notably low. Seen from the viewpoint of profitability alone, therefore, it may be said that paddy is not a very advantageous crop.

Regarding the number of working days which affects labour productivity in a great measure, the crops calling for more than 200 working days per acre were peas (255 days), maize (240 days) and Sawi Hijau (220 days). These crops are not very high in labour productivity, although their soil productivity is fairly high (more than M$1,000 in case of the survey area). There is active demand for some vegetables such as leaf mustard, Komatsuna (a kind of Chinese cabbage) and Chinese cabbage. However, these crops call for 120 165 working days and are low in both land productivity and labour productivity, so that increase of their market price or reduction of their distribution cost is necessary.

Crops needing a smaller number of working days were cashew, coconut, citoron, maize, sorghum and cocoa. All these were fairly high in labour productivity with the exception of maize, but they were low in land productivity. If any sizable amount of income is to be earned by growing these crops, they should be planted in quite an extensive area.

An overall review of land productivity, labour productivity and number of working days indicates that the most advantageous crops are pepper, oil palm, tomato and tobacco. Vegetables and fruits eaten in daily life are relatively low in profitability with the

exception of tomato. It may be said that these crops do not stimulate the farmers' production willingness, although self-sufficiency in their supply is calle for.

Self-sufficiency in rice should also be improved. Although its profitability is low as introduced above, care must be exerted to prevent its production drop because it is the staple food in Malaysia and its stable supply is one of the essential prerequisites to the country's development.

Deep-rooted crops such as oil palm and rubber are not suited for introduction because of the topographic and soil conditions of the swamp areas. It is therefore likely that the crops grown in the swamparea will comprise paddy, vegetables, industrial crops, and shallow-rooted perennial crops. In order to earn the maximum of profit with the minimum of land, multiple management by rotation rather than management for single crop is advantageous as it will make it possible for the farmers to distribute their family labour force efficiently through the year and realise more intensive farm-land use. Especially in paddy field reclamation areas, such crop combinations as "paddy + vegetables," "paddy + industrial crops" and "paddy + vegetables + industrial crops" will yield a greater income than double cropping of paddy which is rather in profitability. Accordingly, land use in the swamp areas should be planned after a careful study of the profitability of each crop and the number of working days required for each kind of farm work.

Table 3.2 Production Cost and Income by Crop
(per Acre)

Unit: M$

Crop	Number of Working Days	Production Cost			Gross Income		Net Profit	Income	Income per Working Day
		Labour Cost	Materials Cost	Total	Yield	Sales Value			
Paddy(Kelantan)	31.5	136.40	82.65	219.05	400	333.40	114.35	250.75	8.0
Paddy(Kelantan)	33.5	145.07	87.40	232.47	600	500.00	267.53	412.60	12.3
Paddy(Kelantan)	35.5	153.72	59.30	213.02	560	423.45	210.43	364.15	10.9
Chilly	240.0	104.00	27.00	131.00	60	240.00	109.00	213.00	8.9
Maize	24.0	104.00	240.28	344.28	3000	360.00	15.72	119.72	5.0
Sorghum	27.5	119.07	139.01	258.08	400	400.00	141.22	260.29	9.5
Peas	255.0	1105.00	353.00	1458.00	88	1355.00	103.00	1002.00	3.9
Groundnuts	40.0	173.20	260.90	434.10	30	1050.00	615.90	789,10	19.7
Leaf Mustard	151.0	655.00	205.00	205.00	120	1176.00	316.00	971.00	6.4
Komatsuna(a kind of Chinese *cabbage*)	165.0	714.00	167.00	881.00	96	960.00	79.00	793.00	4.8
Chinese cabbage	124.0	537.00	189.00	726.00	100	900.00	174.00	711.00	5.7
Tomato	121.0	523.93	1057.00	1580.93	120	3000.00	1479.07	2003.00	16.6
Sawi Hijau	220.0	952.00	322.00	1274.00	76	1915.00	641.00	1593.00	7.2
Cassava	33.0	142.86	325.15	468.04	330	1105.50	619.46	762.35	23.1
Tobacco	147.0	636.00	262.24	898.24	10934	2020.00	1121.76	1757.76	12.0
Banana (P.Embun)	47.0	203.51	86.00	289.51	106	636.00	346.49	550.00	11.7
Coconut(12th and subsequent years)	18.0	77.64	66.00	143.94	6	312.00	168.06	246.00	13.7
Markisa(3rd year)	60.0	259.80	114.00	373.80	15000	1125.00	751.20	1011.00	16.9
Cashew(7th and subsequent years)	15.0	64.95	33.00	97.95	1800	630.00	532.00	597.00	40.0
Citoron(5th and subsequent years)	20.0	86.60	126.00	212.60	80	432.00	219.40	306.00	15.3
Cocoa(8th and subsequent years)	27.0	116.61	137.40	254.31	1620	599.40	345.09	462.00	17.1
Pepper(3rd year)	172.0	744.75	537.72	1282.47	27	7101.00	5818.53	6563.28	38.2
Coffee(3rd and subsequent years)	94.0	407.02	128.78	535.80	35	385.00	150.80	256.22	2.7
Pineapple	48.5	209.99	534.68	744.67	16000	800.00	55.33	265.32	5.5
Oil palm(11th and subsequent years)	20.5	88.77	217.00	305.77	106	1038.80	733.03	821.80	40.1

Source: Cawangan Bkonomi MARDI Mac 1974 Notes: Underlined words are crops names in Malay

3.6 Study from Civil Engineering Point of View

The project area covered by KETENGAH embraces large and small inland swamps estimated to have a total area of about 73,000 acres. If the inland and coastal swamps outisde the project area are added, the estimated total area of swamps in Trengganu State is as large as 300,000 - 350,000 acres.

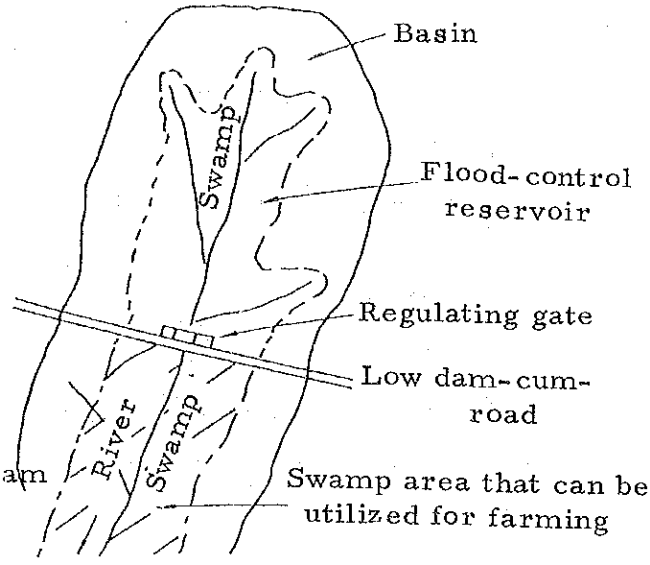
There is no clear definition of coastal and inland swamps by which to draw a distinction between the two. For the convenience of the following discussion, coastal swamps are defined as the swamps subjected to the influences of sea water and inland swamps those not subjected to such influences.

As swamps usually form low-lying flatland along the coast or river banks, they are geographically better conditioned than mountainous forest areas and consequently have higher potential for development. However, as river improvement is extremely delayed in Malaysia and there are embankments at all along any river in Trengganu State, the swamps in the state are flooded in the wet season. Hence, they are not utilized in a systematic manner except that small and relatively well conditioned areas are utilized by the neighbouring farmers.

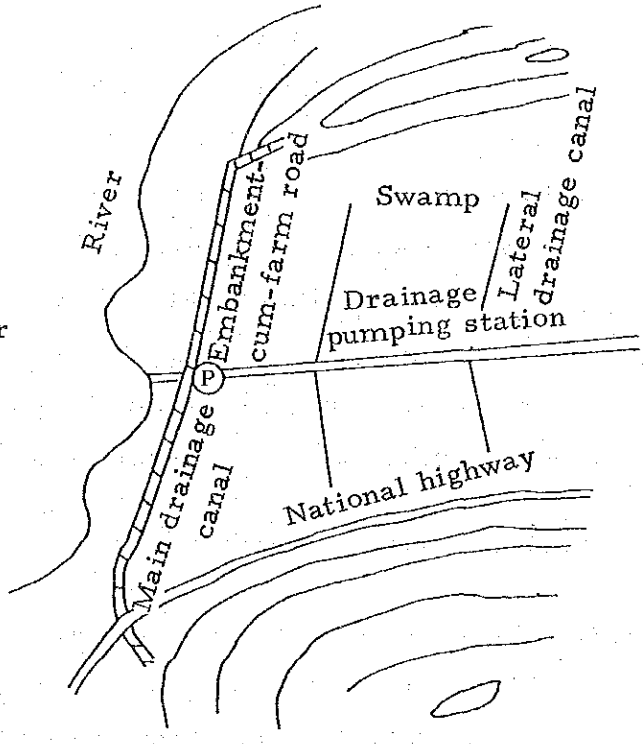
As most of the inland swamps are covered with unexplored jungles, they are expected to incur a considerably higher development cost than hilly areas, although their geographical location is favourable for development. Nevertheless, if their utilization is integrated with that of the existing fields or reclaimed land in the surrounding hilly areas, the resultant development effect will be greater than can be expected from the development of an isolated mountainous jungle area. It was from this viewpoint that the swamp utilization was incorporated in the development scheme of Trengganu State.

Each of the swamps has its own characteristics. From the viewpoint of soil, some are composed of peat soil and some others of heavy soil. Their topography is also versatile, some stretching like a belt along rivers and some others extending deep into inland area from rivers in a circular form. Swamp utilization should therefore be preceded by a careful survey so as to be able to map out a development plan compatible with various natural conditions of each swamp.

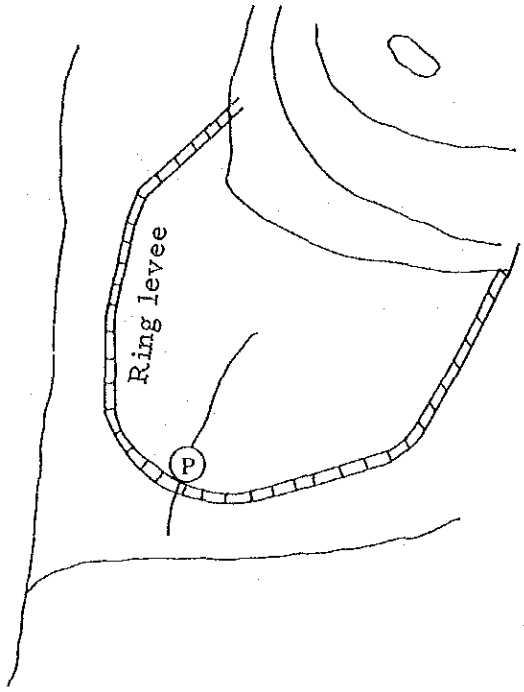
(a) In the case of the narrow swamps stretching along rivers, it was considered that some of them could be turned into farmland by suitable civil engineering work. For instance, if a low dam-cum-road with a height of 5-7 m is constructed on the river as shown on the right to use the upstream section for flood retention, then the swamp along both banks in the downstream section can be utilized for farming. The swamp along the Apu river is an example of such swamps.



(b) Land use was also considered possible for some of the swamps which extend deep into inland area from rivers. In case of these swamps, an embankment-cum-farm road should be constructed along the river to prevent flood invasion, with a drainage pump installed to discharge swamp water from drainage canal. An example of such swamps can be seen in Bukit Bauk area.



(c) As for the swamps in a open and flat area surrounded by rivers, it was thought that some could be utilized if a ring levee and a drainage pump are provided. An example of such swamps can be seen at Jerangau.



Although there were some swamps whose utilization seems to be impossible for some time to come unless large-scale river improvement work is undertaken, the survey disclosed that quite a large number of swamps can be turned into farmland if they are developed in a manner suited to their natural conditions and characteristics.

To cite a few technological problems to be considered in planning swamp utilization, peat soil is liable to consolidation settlement due to drainage and heavy soil calls for permeability improvement. Further, as the project area is rather small relative to the basin, influences of flood on surrounding areas resulting from the embankment construction should be analyzed, although it is not likely that such influences will pose a serious problem in the immediate future.

3.7 Environmental Assessment

3.7.1 Necessity of Environmental Assessment

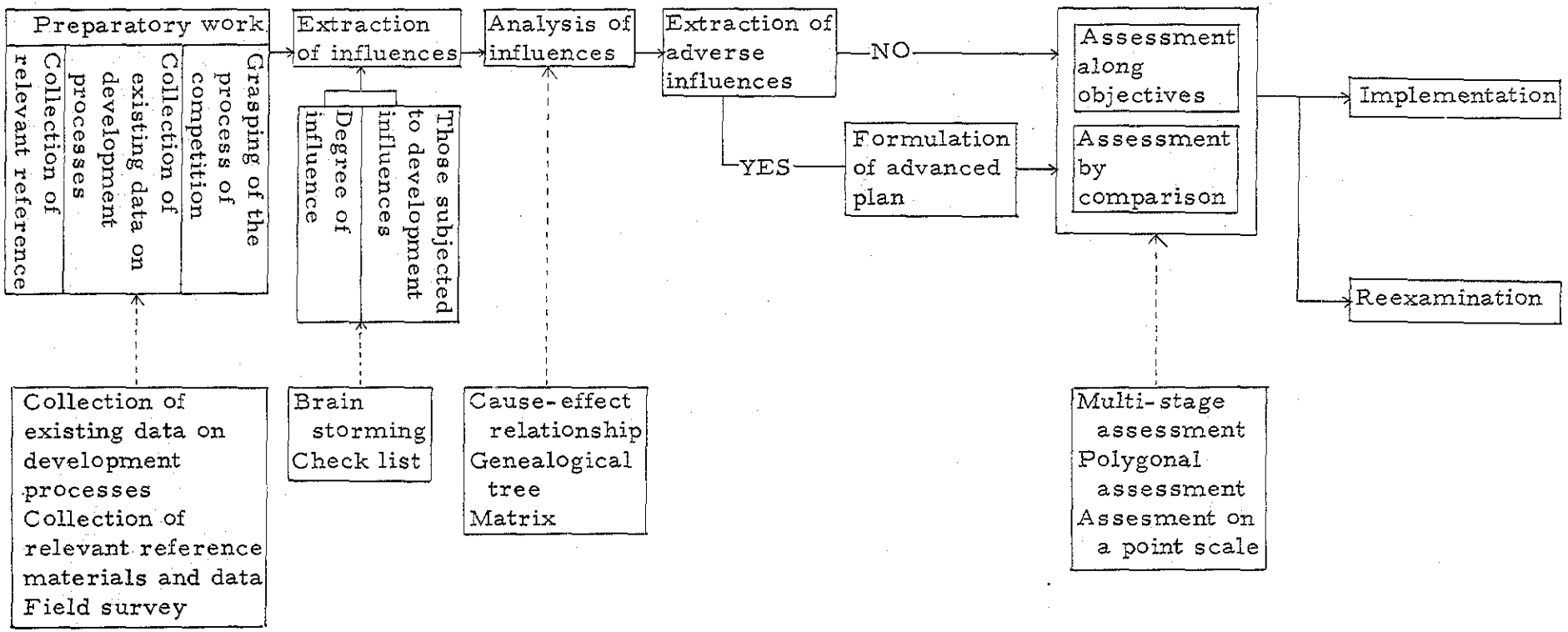
Environmental assessment inclusive of its fundamental concept and methodology is one of the newest fields of science but its importance can never be overvalued. If man seeks safety in his daily life, he finds it necessary to undertake development of some kind or other which is occaisonally accompanied by the occurrence of minus effect.

In some cases, this minus effect presents itself in direct connection with the progress of development. In some other cases, they appear in 10 or 20 years or sometimes even a longer period after the development. The pollution problems which have occurred in many places of the world in recent years are ascribable to the fact that development has been pushed forward almost recklessly in pursuit of its merit without heeding its minus factors.

Environmental assessment is an approach to the prevention of the environmental degeneration ensued from such ill-planned development, but its methodology is not necessarily established so that different methods are applied according to the purpose of assessment. The following chart shows one of the commonest methods of environmental assessment.

Environmental assessment carries a heavy weight in the project as the planned swamp utilization in Trengganu Tengah is a touchstone for similar land use in the many swamp areas distributed throughout Malaysia.

Fig. 3.2 Method of Environment Assessment



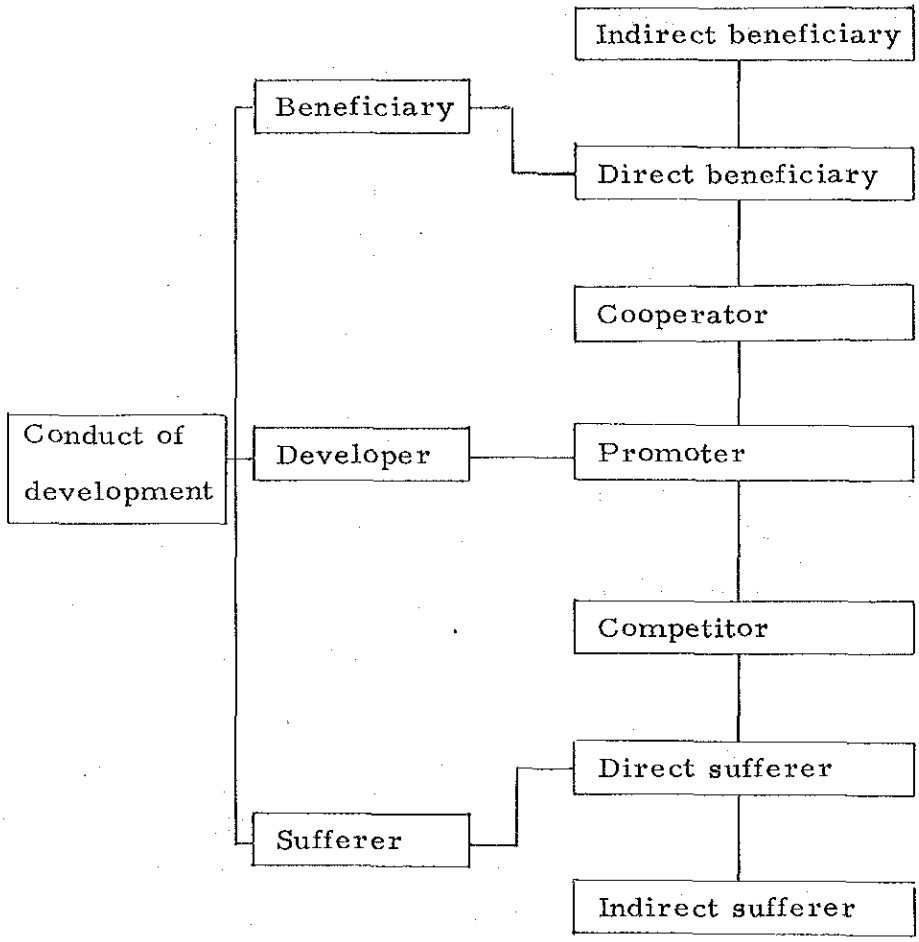
3.7.2 Envrionmental Assessment in Agricultural Development

Assuming that urban and agricultural areas are the representative places of human habitation, it is possible to evaluate the agricultural area, especially its farmland utilization, as having environmental preservation functions. However, advanced farming areas are now confronted not only with the danger of harmful inorganic substances remaining in plant bodies but also with the marked decline of land fertility due to excessive use of farm machinery, chemical fertilizers, and control chemicals which have been applied in the last 10 to 20 years for productivity improvement. Soil is not a mere "vessel" to support the roots of plants and receive fertilizers, but is an organic body in which microorganisms co-exist while decomposing the organic substances produced by plants. Neglect of this fact is one of the causes of the above problems. Heavy application of chemical fertilizers practised in the past may be assigned, among others, to the difficulty in obtaining barnyard manure due to the introduction of mechanised farming and resultant shortage draught animals.

In planning the swamp utilization in Trengganu Tengah, consideration should be given to the possibility of rotational operation involving upland crops, grassland, and livestock farming to maintain balance between productivity and soil conservation.

Physical changes that may be caused by development such as landslide and river contamination as well as their influences on the neighbouring areas should also be studied in advance. Especially in planning the construction of an embankment, careful studies should be made on the resultant changes in the flood characteristics and the flood influences on the opposite bank. The following chart shows the relationship between the beneficiary from development, the developer, and the sufferer from development.

Fig. 3.3


Indirect beneficiary
Beneficiary
Direct beneficiary
Cooperator
Conduct of development
Developer
Promoter
Competitor
Direct sufferer
Sufferer
Indirect sufferer

CHAPTER 4 PROPOSALS FOR FUTURE SURVEY

4.1 Background of the Proposals

The objectives of agricultural development in Trengganu State can be summarized as follows.

(1) Provide employment opportunities for working population

(2) Increase the income of those engaged in agriculture

(3) Modernize the agriculture in Trengganu State

(4) Raise the rate of self-sufficiency in foods in the state

While these objectives presuppose land development as an essential prerequisite, their attainment can be certainly accelerated if the inland swamps distributed in the densely populated flatland are are utilized because there is no need to construct new roads which are an absolute must in the development of mountainous jungle areas and also because the swamps are in the proximity of the existing rural communities and consequently convenient for the settlers. Nevertheless, none of these swamps have actually been utilized on any substantially large scale in the past, and this was the main reason for conducting the present preliminary survey.

At the request of the Malaysian government, the Preliminary Survey Mission collected data and information on the swamp utilization and conducted a reconnaissance in the swamp areas, and obtained the results described in the foregoing pages. Compared with mountainous areas, the swamps are less favourably conditioned for development and incur a higher development cost. Considered only from the economic point view, therefore, their development effect is not high.

However, the significance of swamp utilization should be evaluated from a broader and comprehensive point of view in due recognition of pressing national requirements such as stable supply foods, extermination of poverty, efficient national land use and so forth. Although the planned swamp utilization is difficult and involves many unsolved problems, it is "not impossible." From these cruicial findings, the Mission reached the conclusion that the "Swamp Utilization Study" should be started as soon as practicable and deserves every effort for its early commencement.

The following sequence of utilization study is proposed on the basis of the Mission's findings and conclusion briefed above.

4.2 Sequence of Utilization Study

4.2.1 Preparation of Master Plan

The master plan should cover the area extending soutward from the rightside bank of the Trengganu river, and should be prepared in the following order.

(1) The State of Trengganu should be taken as a single economic unit, and a long-term estimate should be formed on its population, demand-supply situation of foods, agricultural structure and distribution channel for determination of the kinds and yield of crops to be grown.

(2) A soil survey should be conducted in the swamp areas to clarify their soil condition so as to be able to gain a firm grasp of suitable crops.

(3) Hydrological analysis should be made to study the drainage possibility of each swamp for the purpose of selecting a pilot project area.

(4) Socio-economic condition in each swamp area should be made clear.

(5) Calculation of the project cost should be worked out for each type of swamp.

(6) An overall evaluation of each swamp should be made on the basis of Items (2) - (5) above to determine the priority order of development.

(7) A model farm management plan should be implemented in a selected area in order to chart the future course of agricultural development in Trengganu Tengah.

(8) A master plan incorporating the outcomes of Items (1) - (7) should be prepared. While the agricultural development in Trengganu State is intended to achieve the objectives listed in the preceding section, the master plan is required because the current swamp development scheme needs to be reexamined in order to meet the demand for qualitative improvement of Malaysian agriculture.

Juding from the positive attitude evinced by the Malaysian government towards development programmes, it is highly probable that Malaysian agriculture will call in the near future for qualitative improvement such as modernization of farm management, introduction

of mechanized farming, grouping of farmland, and joint cultivation crops.

4.2.2 Formulation of Each Individual Plan

(1) Feasibility study should be conducted in the project area on the basis of the master plan.

(2) In the feasibility study, a more detailed and concrete plan for management and development should be formulated for each area and its economic feasibility should be carefully reviewed.

(3) Survey and planning will be required to be conducted with an accuracy that calls for a topographic map on the scale of 1/5,000, and civil engineering work will be required to be preceded by the presentation of a construction plan conveying its contents.

4.3 Time of Implementation

1978 is the year for mid-term review of the Third Malaysia Plan. The mid-term review is an important task in which the achievements in the first half (2.5 years) of the project period are subjected to a rigid examination in order to effect necessary corrections and improvements to the implementation plan for the latter half (2.5 years) of the project period. The Malaysian government has the intention to take advantage of this mid-term review for incorporation of the survey plan for swamp utilization in the Trengganu Tengah Development Scheme, and to put the swamp utilization plan in full-scale execution under the Fourth Malaysia Plan which will start in 1981. To conform to this schedule, it is necessary to complete the feasibility study for pilot project in 1978 before completion of the master plan. Accordingly, the Malaysian government expressed an ardent desire that the preparation of the master plan and the feasibility study for pilot project would be conducted concurrently, and the Mission approved of its necessity after reviewal. Individual commercial projects are planned to be implemented successively after 1979 according to the master plan.

On the east coast of Malaysia, the wet season lasts from November to January, though this duration is subject to some fluctuation by year. Accordingly, the field survey should be completed before the latter part of October 1978, which in turn calls for the commencement of the survey

preferably in June or at latest in July.

The field survey for master plan preparation will be started in June, with part of analytical study made concurrently in Malaysia, for completion of the dry season survey in September. In December, a supplementary wet season survey will be conducted. Consolidation of survey results will be carried out from December to February for presentation of the survey report in March.

The feasibility study for pilot project will be started in July and completed in September. Consolidation of survey results will be carried out from October to November for presentation of the survey report in December.

4.4 System for Project Implementation

As it is the common practice in Malaysia that many government offices take part in the implementation of development projects, it will be necessary to establish a steering committee for the present swamp utilization project.

The steering committee will be organized with the officials from EPU (international cooperation), PWD (road construction), DID (drainage and river administration), MARDI (agricultural experiments and researches), KETENGAH (regional development in Trengganu Tengah) and its supervising organ, Land and Regional Development.

It will be necessary for the Japanese side to make preparations in order to be able to embark upon the next phase of study at an early date in response to the Malaysian request.

4.5 Selection of Pilot Project Area

Bukit Bauk area is situated on the right bank of the Paka river about 9 miles upstream of its estuary. It is a rectangular land surrounded by hills of less than 500 feet height on three sides and open to the Paka river only on the southern side. The reconnaissance revealed that the surface layer consits of peat soil and the lower layers of heavy soil. The peat soil ranges from 36 to 48 inches in thickness. Thicker peat soil layers are distributed within narrow areas such as former river channels, and are estimated to have a thickness of about 80 inches juding from the growth of large trees. The peat layer is subjected to considerable progress of

humification, and its ground surface becomes dry in the dry season. The swamp in this area adjoins the national highway linking Trengganu and Chubai and embodies a farm road which runs through it in parallel with the Paka river. Dungun, the third largest town in Trengganu State is only about 6 miles from the swamp. By reason of these favourable conditions, Bukit Bauk area was proposed as a desirable pilot project area where swamp development is to be carried out on an experimental basis for collection of data needed for full-scale project implementation. The following table shows the acrea of Bukit Bauk area by type of swamp.

Swamp Classification	Within KETENGAH Area (acre)	Outside KETENGAH Area (acre)	Total (acre)
Hilly Area(government -owned)	2,400	200	2,600
Swamp (government -owned)	3,500 *	400*	3,900
Swamp (T.O.L.)		400*	400
Swamp (private-owned)		100	100
Total	5,900	1,100	7,000

Notes:
1. T.O.L. stands for "Temporary Occupation License" under which the government-owned swamp is leased. The license is effective for three years and can be renewed upon expiration.
2. Asterisks indicate swamp utilization areas having a total acreage of 4,300 acres.
3. The hilly area can be integrated in the swamp utilization area but the available land area is not known.

Fig.4.2 illustrates a conceivable rough plan of development. Under this plan, the farm road along the Paka river will be heightened to turn it into an embankment-cum-road, and a main drainage canal and a main farm road, both running through the swamp in the north-south direction, will be constructed. Lateral canals and branch roads crossing the main canal and the main road respectively will be arranged at suitable intervals, 1 mile for example, for connection with drainage canals and farm roads within the area. The main canal will be provided with a counter-sluice and a drainage pumping station for discharging swamp water. Assuming that about one-third of the hilly area will be integrated in the plan, the estimated

total volume of construction work turns out to be as follows.

Volume of Construction Work

(1)	Development area	:	5,100 acres
(2)	Farmland area, (1) x 0.75	:	3,800 acres
(3)	Embankment length, H 13ft	:	2.65 miles
(4)	Counter-sluice, B=12ft	:	2 sets
(5)	Drainage pump, 40"ϕ, 200		2 units
(6)	Main drainage canal, A=60 sq. yd.	:	2.7 miles
(7)	Lateral drainage canal, A=10 sq. yd.	:	6.7 miles
(8)	Main farm road, A=15 sq.yd.	:	3.5 miles
(9)	Branch farm road, A=6 sq. yd.	:	8.3 miles
(10)	Miscellaneous work	:	1 lot

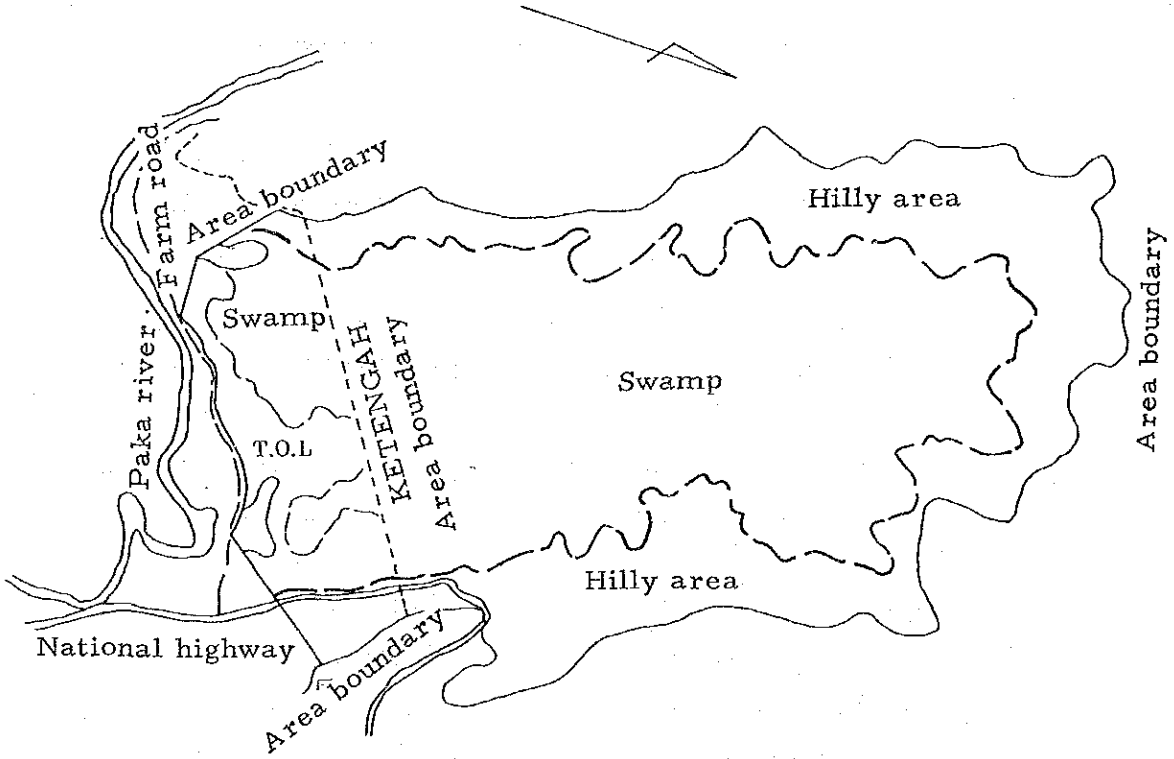


Fig. 4.1 Existing Land Category Classification

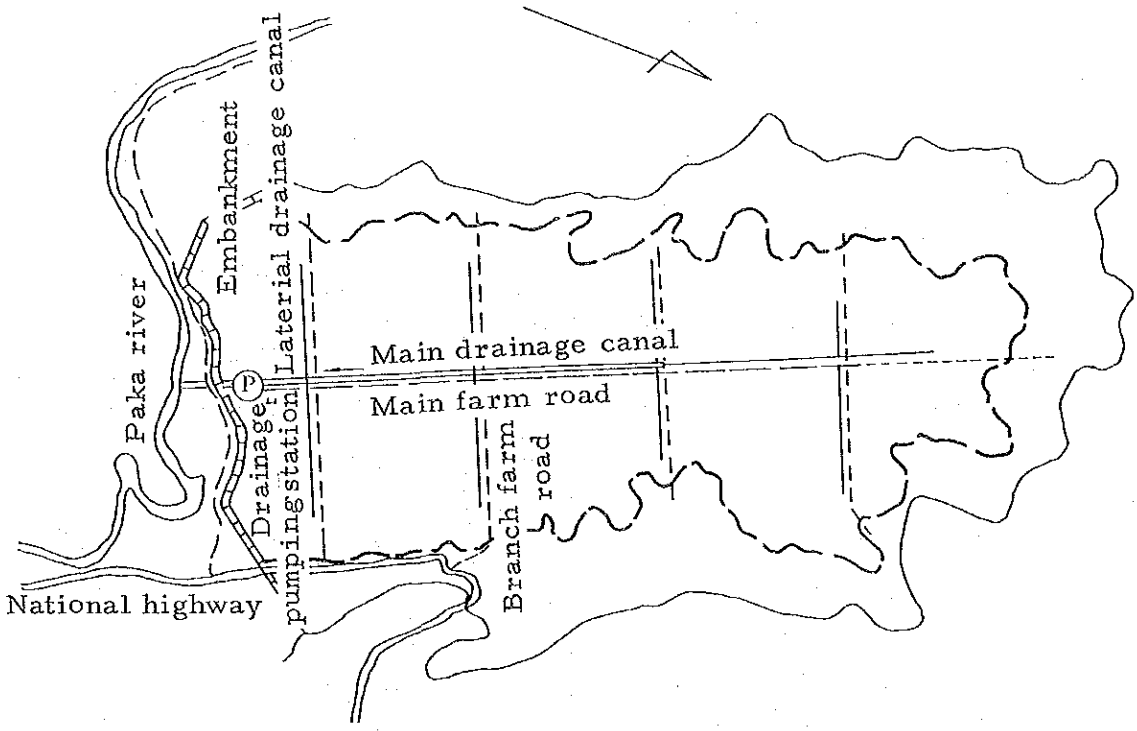


Fig. 4.2 Rough Plan of Development

ANNEX LIST OF COLLECTED DATA

	ANGGARAN KOS PENGELUARN DAN PENDAPATAN JENIS-JENIS TANAMAN DAN TERNAKAN	MARDI	May 1974
o	MARDI	MARDI	
o	Import and Export Trade in Food and Agricultural Products Peninsular Malaysia 1976	Ministry of Agriculture	
o	The KELANTAN River Basin Study Main Report Vol. 4 Agriculture	Colombo Plan Project	1977
o	Presaturation of Padi fFields: Information Paper No.2, 1975	Ministry of Agriculture and Rural Development	
o	Conditions of Contract and Specification Parts 3 to 18 (Besut Project)	DID	
o	DID - MANUAL - 1973	DID	
o	Hydrological Design of Agricultural Drainage Systems	DID	1977
o	Triennial Report of the Drainage and Irrigation Division for the Years 1970, 1971 and 1972	Ministry of Agriculture and Rural Development	1973
o	Acid Sulphate Soils	K. Kanapathy	
o	A Comparative Study of the Rate of Mineralisation of Soil Nitrogen in Peat and Coastal Clay (Selangor Series) Soils under Laboratory Conditions	from Malaysian Agricultural Journal Vol. 47, No. 4 P.C. KEE	1970
o	Potential of Peat for Agriculture MARDI Report No.16, 1974	K.T. Joseph, Chew W.Y. and T.H. Tay	
o	Chemical Analysis of South Malayan Peat Soil	from the Journal of Tropical Geography Vo. 18, 1964 D.B. Parbery & R.M. Venkatachalan	
o	Topographycal Map: scale one inch to one mile 1/63,300	Directorate of National Mapping	
	Semi Detailed Soil Survey of Bukit Bank Area	Ministry of Agriculture	
o	Generalized Soil Map of West Malaysia 1970		
o	Reconnaissance Soil Map Peninsular Malaysia 1968		
o	Soil-Crop Suitability Classification of Peninsular Malaysia 1974		

o	Streamflow Records 1960 - 1965 1965 - 1970	DID	
o	Evaporation in Peninsular Malaysia 1976	DID	
o	Surface Water Resources Map (Provisional) of Peninsular Malaysia	DID	
o	Average Annual Surface Water Resources of Peninsular Malaysia 1976	DID	
o	Magnitude and Frequency of Low Flows in Peninsular Malaysia 1976	DID	
o	Design Flood Hydrograph Estimation for Rural Catchments in Peninsular Malaysia	DID	
o	Rational Method of Flood Estimation for Rural Catchments in Peninsular Malaysia	DID	
o	Rainfall Records 1959 - 1965 1965 - 1970	DID	
o	Data of Meteorological Observation		
o	Tide Table (KUANTAN, TRENGGANU) 1975, 1977	Marine Department	
o	Minimum Geometric Design Criteria for New Roads in Rural Areas	PWD	
o	Construction Cost of Jerangau Jabor Road	PWD	
	Feasibility Study - Jerangau Jabor Road Appendix 1. Geotechnic Report	OVE ARUP & PARTNERS	
o	LAPURAN TAHUNAN 1976 (New Year Report)	Agriculture Department of the State of Trengganu	
o	PERMOHONAN RERUNTUKAN TAMBAHAN RMT (Additional Application Budget)	LKTT	
	Project's Detail Vol.II (Jabor Cocoa Estate) KETENGAH	LKTT	1977
o	Kuantan Urban Development Study Final Report Vol. I - IV	AKB Planners and Development Consultants	1975
o	Regional Planning and Development Study Vol. I - IV	Hunting Technical Services Ltd.	
o	ANGGARAN BELANJAWAN 1978 (Annual Budget Proposal)	LKTT	1977
	1970 Population and Housing Census of Malaysia	Jabatan Perang Kaan Malaysia	1972
o	Third Malaysian Plan 1976 - 1980		

o	Economic Report 1977/78	Ministry of Finance
o	Statistical Digest	Ministry of Agriculture
o	The Present Land Use of Trengganu	Ministry of Agriculture

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