GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY, MALAYSIA

SECTORAL REPORT

VOL. 10

AGRICULTURE

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AGRICULTURE

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COMPOSITION OF THIS VOLUME

This Volume consists of two parts: Part 1 deals with the subject matters of Peninsular Malaysia and Part 2 is devoted to the States of Sabah and Sarawak.

ABBREVIATIONS

(1) Plan

FMP	:	First Malaysia Plan
SMP	:	Second Malaysia Plan
TMP	:	Third Malaysia Plan
4MP	:	Fourth Malaysia Plan
5MP	:	Fifth Malaysia Plan
6MP	:	Sixth Malaysia Plan
7MP	:	Seventh Malaysia Plan
NEP	:	New Economic Policy
OPP	:	Outline Perspective Plan
RESP	:	Rural Environmental Sanitation Program

(2) Domestic Organization

DID (JPT)	:	Drainage and Irrigation Department
DOA	:	Department of Agriculture
DOE	:	Division of Environment
DOF	:	Department of Forestry
DOFS	:	Department of Fishery
DOM	:	Department of Mines
DOS	:	Department of Statistics
EPU	:	Economic Planning Unit
FAMA	:	Federal Agricultural Marketing Authority
FELCRA	:	Federal Land Consolidation and Rehabilitation Authority
FELDA	:	Federal Land Development Authority
ICU	:	Implementation and Coordination Unit
MARDI	:	Malaysian Agricultural Research and Development Institute
MIDA	:	Malaysian Industrial Development Authority
MLRD	:	Ministry of Land and Regional Development
MMS	:	Malaysian Meteorological Service
MOA	:	Ministry of Agriculture
MOF	:	Ministry of Finance

MOH	:	Ministry of Health
MOPI	:	Ministry of Primary Industries
MRRDB	:	Malaysia Rubber Research and Development Board
NDPC	:	National Development Planning Committee
NEB (LLN)	:	National Electricity Board
PORIM	:	Palm Oil Research Institute of Malaysia
PWD (JKR)	:	Public Works Department
RDA	:	Regional Development Authority
RISDA	:	Rubber Industry Small-holders Development Authority
RRIM	:	Rubber Research Institute of Malaysia
SEB	:	Sabah Electricity Board
SEBC	:	State Economic Development Corporation
S(E)PU	:	State (Economic) Planning Unit
SESCO	:	Sarawak Electricity Supply Corporation
UDA	:	Urban Development Authority

(3) International or Foreign Organization

ADAA	:	Australian Development Assistance Agency
ADB	:	Asian Development Bank
ASCE	:	American Society of Civil Engineers
FAO	:	Food and Agriculture Organization of the United Nations
IBRD	:	International Bank for Reconstruction and Development
ILO	:	International Labour Organization
IMF	:	International Monetary Fund
IRRI	:	International Rice Research Institute
JICA	:	Japan International Cooperation Agency
JSCE	:	Japan Society of Civil Engineers
MOC	:	Ministry of Construction, Japan
OECD	:	Organization for Economic Cooperation and Development
OECF	:	Overseas Economic Cooperation Fund, Japan
UK	:	United Kingdom
UNDP	:	United Nations Development Program

UNSF	:	United Nations Special Fund
US or USA	:	United States of America
US/AID	:	United States Agency for International Development
USBR	:	United States Bureau of Reclamation
WHO	:	World Health Organization
WMO	:	World Meteorological Organization

(4) Others

B	:	Benefit
BOD	:	Biochemical Oxygen Demand
C	:	Cost
CIF	:	Cost, Insurance and Freight
COD	:	Chemical Oxygen Demand
D&I	:	Domestic and Industrial
dia	:	Diameter
EIRR	:	Economic Internal Rate of Return
El.	:	Elevation above mean sea level
Eq.	:	Equation
Fig.	:	Figure
FOB	:	Free on Board
FSL	:	Full Supply Level
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
H	:	Height, or Water Head
HWL	:	Reservoir High Water Level
LWL	:	Reservoir Low Water Level
O&M	:	Operation and Maintenance
Q	:	Discharge
Ref.	:	Reference
SITC	:	Standard International Trade Classification
SS	:	Suspended Solid
V	:	Volume
W	:	Width

ABBREVIATIONS OF MEASUREMENT

Length

mm = millimeter
cm = centimeter
m = meter
km = kilometer
ft = foot
yd = yard

Area

cm^2 = square centimeter
m^2 = square meter
ha = hectare
km^2 = square kilometer

Volume

cm^3 = cubic centimeter
l = lit = liter
kl = kiloliter
m^3 = cubic meter
gal. = gallon

Weight

mg = milligram
g = gram
kg = kilogram
ton = metric ton
lb = pound

Time

s = second
min = minute
h = hour
d = day
y = year

Electrical Measures

V = Volt
A = Ampere
Hz = Hertz (cycle)
W = Watt
kW = Kilowatt
MW = Megawatt
GW = Gigawatt

Other Measures

% = percent
PS = horsepower
° = degree
' = minute
" = second
°C = degree in centigrade
10^3 = thousand
10^6 = million
10^9 = billion (milliard)

Derived Measures

m^3/s = cubic meter per second
cusec = cubic feet per second
mgd = million gallon per day
kWh = kilowatt hour
MWh = Megawatt hour
GWh = Gigawatt hour
kWh/y = kilowatt hour per year
kVA = kilovolt ampere
BTU = British thermal unit
psi = pound per square inch

Money

M$ = Malaysian ringgit
US$ = US dollar
¥ = Japanese Yen

CONVERSION FACTORS

	From Metric System	To Metric System
Length	1 cm = 0.394 inch 1 m = 3.28 ft = 1.094 yd 1 km = 0.621 mile	1 inch = 2.54 cm 1 ft = 30.48 cm 1 yd = 91.44 cm 1 mile = 1.609 km
Area	1 cm^2 = 0.155 sq.in 1 m^2 = 10.76 sq.ft 1 ha = 2.471 acres 1 km^2 = 0.386 sq.mile	1 sq.ft = 0.0929 m^2 1sq.yd = 0.835 m^2 1 acre = 0.4047 ha 1 sq.mile = 2.59 km^2
Volume	1 cm^3 = 0.0610 cu.in 1 lit = 0.220 gal.(imp.) 1 kl = 6.29 barrels 1 m^3 = 35.3 cu.ft 10^6 m^3 = 811 acre-ft	1 cu.ft = 28.32 lit 1 cu.yd = 0.765 m^3 1 gal.(imp.) = 4.55 lit 1 gal.(US) = 3.79 lit 1 acre-ft = 1,233.5 m^2
Weight	1 g = 0.0353 ounce 1 kg = 2.20 lb 1 ton = 0.984 long ton = 1.102 short ton	1 ounce = 28.35 g 1 lb = 0.4536 kg 1 long ton = 1.016 ton 1 short ton = 0.907 ton
Energy	1 kWh = 3,413 BTU	1 BTU = 0.293 Wh
Temperature	°C = (°F - 32)·5/9	°F = 1.8°C + 32
Derived Measures	1 m^3/s = 35.3 cusec 1 kg/cm^2 = 14.2 psi 1 ton/ha = 891 lb/acre 10^6 m^3 = 810.7 acre-ft 1 m^3/s = 19.0 mgd	1 cusec = 0.0283 m^3/s 1 psi = 0.703 kg/cm^2 1 lb/acre = 1.12 kg/ha 1 acre-ft = 1,233.5 m^3 1 mgd = 0.0526 m^3/s
Local Measures	1 lit = 0.220 gantang 1 kg = 1.65 kati 1 ton = 16.5 pikul	1 gantang = 4.55 lit 1 kati = 0.606 kg 1 pikul = 60.6 kg

Exchange Rate
(as average between July and December 1980)

$1 = M$2.22
¥100 = M$1.03

PART 1

PENINSULAR MALAYSIA

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1. INTRODUCTION

This Sectoral Report presents the results of agricultural development study covering the present situation of agriculture and the future agricultural development programs in Peninsular Malaysia. Major agricultural commodities of national importance comprise rubber, oil palm, coconut and cocoa as export-oriented crops, and rice as staple food crop for domestic consumption in the nation. Aiming at provision of basic input data for projection of future water demand in sectors agriculturally concerned, the Study was made in line with the outcomes of various technical papers previously prepared by various Federal and State Government agencies. The results of the Study are composed of the projection of future irrigated paddy field which is required in estimating irrigation water demand and the projection of rubber and oil palm harvests which is needed for the estimate of processing water requirement as a component of industrial water supply.

2. BACKGROUND OF AGRICULTURE

2.1 Role of Agriculture

The role of agricultural sector in the national economy of Malaysia is to provide: (1) export earnings for economic development, (2) food for the rapidly growing population, (3) improvement of rural living standards, and (4) gainfull employment for the increasing labour force.

The agricultural sector, including livestock, forestry and fishing in Malaysia, produced M$3.8 x 10^9 at 1970 constant prices with a share of 30.8% of gross domestic value (GDP) in 1970, M$4.8 x 10^9 at 1970 constant prices sharing 27.7% of GDP in 1975 and M$6.2 x 10^9 at 1970 constant prices with the share of 23.6% of GDP in 1980. This sector has still maintained the premier position in gaining the nation's GDP, although the share of manufacturing sector is only slightly lower than that attributable to agriculture.

A large proportion of export earnings has been gained by agriculture of which share is estimated to be M$11.3 x 10^9 or 41% in 1980, resulting in improvement of incomes particularly for the rural habitation. The main agricultural exports consist of rubber, palm oil, sawn timber and logs. Among these export commodities, prices of rubber and palm oil have fluctuated depending upon balance between demand and supply in the world market. These fluctuations, therefore, have closely affected income gains in agricultural sector and the allocation of land resources between both crop plantations.

Traditionally, the agricultural sector could meet the food demand to large extent by its domestic products. However, food and feed imports have rapidly increased with the growing population, the steady shift of young generation from rural to urban areas and the increasing incomes. To meet the domestic demand, import quantities of food and feed raised from M$1.4 x 10^9 in 1975 to M$2.5 x 10^9 in 1980.

According to 4MP, total labour force in Malaysia was 3.68 x 10^6 persons in 1970 among which 1.71 x 10^6 or 51% of the total were engaged in agriculture, forestry, hunting, fishing and agricultural product processing. The preliminary figures in 4MP show that the total labour force in 1980 was 5.38 x 10^6 persons among which 2.07 x 10^6 persons corresponding to 41% of the total were agricultural, animal husbandry and forestry workers, fishermen and hunters.

2.2 Organizations Responsible for Agriculture

There are various agricultural agencies involved in the provision of necessary supporting services in agricultural development activities in Malaysia. The major agencies involved are:

- Department of Drainage and Irrigation (DID)
- Department of Agriculture (DOA)
- Farmers' Organization Authority (FOA)
- Federal Agricultural Marketing Authority (FAMA)
- Bank Pertanian Malaysia (BPM)
- Rubber Industry Smallholders Development Authority (RISDA)
- Federal Land Development Authority (FELDA)
- Federal Land Consolidation and Rehabilitation Authority (FELCRA)
- National Paddy and Rice Authority (NPRA)
- Malaysian Agricultural Research and Development Institute (MARDI)
- Rubber Research Institute of Malaysia (RRIM)
- Malaysian Rubber Development Corporation (MARDEC)
- Palm Oil Research Institute of Malaysia (PORIM)
- Palm Oil Registration and Licensing Authority (PORLA)

DID is responsible for planning, implementation, operation and maintenance of the country's drainage and irrigation schemes. DOA is responsible for agricultural extension services for which Federal DOA formulates national policies and programs and the State DOA provides the grass-root extension services. For farmers planting rubber, RISDA provides extension services. FOA is responsible for rural cooperative activities of the members of the Farmers' Cooperatives (FC). FAMA's main objective is to improve the marketing of agricultural products except oil palm, rubber, pineapple, paddy, fish and livestock which are handled by the agencies concerned. BPM or the Malaysian Agricultural Bank is the main Government institution providing agricultural credit. NPRA or the Lembaga Padi dan Beras Negara (LPN) in the Malaysian name is responsible for controlling the marketing and processing of rice and maintaining a national stockpile. MARDI is responsible for all agricultural research works with the exception of rubber and oil palm, in respect of which research is undertaken by RRIM and POLIM, respectively. The main task of FELDA is to develop new land for oil palm, rubber, sugarcane, cocoa and coffee which is later distributed to eligible persons, the majority of whom are landless farmers or smallholders owing less than 1 ha of land. FELCRA is responsible for rehabilitation of unsuccessful state land schemes and development of new land schemes at a smaller scale than FELDA. MARDEC is responsible with RISDA for setting up central rubber processing factories with a view of to improve the quality of rubber and provide market facilities for rubber smallholders. PORLA is responsible for monitoring the progress made by the various sectors of palm oil industry and ensuring an orderly development and growth of the industry through issuing licences and collecting a cess.

3. PRESENT STATUS OF AGRICULTURAL PRODUCTION

3.1 Present Land Use

The land use survey was carried out by MOA in 1966 to 1967 and 1974 to 1975 through the interpretation of aerial photographs. The reports of the both surveys contain the textual descriptions with statistical data and the maps having varied scale of 1 inch to 1 to 3 miles in the 1966/67 survey but uniform scale of 1 inch to 2 miles in 1974/75 survey. In the 1974/75 land use map, land categories are pictured by 22 symbols for agricultural land use and by 12 symbols for non-agricultural land use.

Recent issues of statistics and study reports are supplementarily used for the review of present land use by State as of 1979. As shown in Table 1, the whole area of Peninsular Malaysia totaling 131,900 km^2 comprised forest land of 64,500 km^2, agricultural land of 35,400 km^2 including tree crop, horticulture and garden crop, and annual crop cultivation areas, and miscellaneous land of 32,000 km^2 consisting of urban and associated lands, grassland, unused and unclassified lands and others at the end of 1979.

Among 35,400 km^2 under cultivation, tree crops occupied 28,510 km^2 or 81% of the total cultivated area as shown in Table 2. Rubber took the most predominant place in tree crop planting of Peninsular Malaysia and its coverage amounted to 17,030 km^2. The area under oil palm increased from 2,610 km^2 to 8,350 km^2 during 10 years between 1970 and 1979. The considerable part of this rapid expansion depended upon the conversion from rubber or coconut area, which was done in many estates under the influence of continuously chronic decline in the international market price of rubber until the first oil crisis in 1974. Out of 6,890 km^2 under annual crops, paddy field shared 4,280 km^2 among which 3,020 km^2 was provided with irrigation facilities.

During the period from 1966 to 1979, substantial changes occurred in the land use in Peninsular Malaysia as shown in Table 3. The total agricultural land increased from 27,300 km^2 to 35,400 km^2 and the total tree crop planting areas increased from 20,800 km^2 to 28,500 km^2. Oil palm of which large-scale commercial plantation in Peninsular Malaysia was introduced in the 1960's showed a dramatic expansion of planting area from 1,000 km^2 in 1966 to 8,400 km^2 in 1979, while rubber planting area sharply dropped from 17,800 km^2 to 17,000 km^2 mainly due to conversion to oil palm field.

The change in land use occurred in each State is as shown in Tables 4 to 8. The noteworthy changes during the above-mentioned period are picked up as below:

(1) In the State of Perlis, the agricultural land increased by 98 km^2 mostly through reclamation of swampland for rice cultivation and opening-up of forest for introducing large scale sugarcane cultivation.

(2) In the State of Kedah, the reduction of forest, scrub forest, grassland ans swamp amounted to 1,461 km^2 out of which 288 km^2 was converted to the agricultural land. The tree crop planting area increased by 303 km^2 and the paddy field expanded from 1,301 km^2 to 1,390 km^2.

(3) In the State of Pulau Pinang, grassland, newly cleared land and swamp totaling 29 km^2 were shifted to urban area around Georgetown and Butterworth, while 136 km^2 of land was newly converted to rubber, oil palm and coconut plantations in the southern part close to Perak State.

(4) In the State of Perak, total increase in agricultural land was 731 km^2 mainly reclaimed from forest, grassland and swamp. In addition, 246 km^2 of land was alienated to mining and quarry sites. Since 1966, oil palm plantation and intertilling of coconuts with cocoa have widely been introduced into coastal areas. The oil palm area raised from 159 km^2 to 900 km^2. The total coconut area was 492 km^2. Though rubber is as the major agricultural crop in this State, its planted area decreased from 2,528 km^2 to 2,252 km^2 due to conversion to oil palm.

(5) In the State of Selangor, the increase in the area under oil palm was 635 km^2, mainly composed of converted rubber area and newly reclaimed swamp and opened-up forest. The forest and grassland were also cleared for expansion of urban area around Kuala Lumpur and allocated to housing development. The total area of forest reduced from 4,275 km^2 to 2,366 km^2.

(6) In the State of Negeri Sembilan, vast forest and grassland were felled and those total extent was 1,972 km^2 out of which 379 km^2 was reserved as newly cleared land in 1974 for the acceleration of agricultural development in this state. The newly planted area was 361 km^2 for oil palm and 423 km^2 for rubber, respectively.

(7) In the State of Melaka, although forest and grassland occupied 289 km^2 or only 18% of the whole state in 1966, 202 km^2 was newly exploited till 1978. The tree crop planted areas increased by 166 km^2.

(8) In the State of Johor, agricultural land increased from 6,132 km^2 in 1966 to 8,458 km^2 in 1979, while forest, grassland and swamp areas decreased from 11,554 km^2 to 5,496 km^2 during the same period. Oil palm shared the majority of the above increased agricultural land and its increased extent was 2,194 km^2.

(9) In the State of Pahang, the tendency of land development was almost same as that in Johor. A total of 8,238 km^2 of forest, grassland and swamp was exploited. Rubber and oil palm played important roles in the agricultural development in this State. The increase in coverage of oil palm was 2,435 km^2.

(10) In the State of Trengganu, tree crop planting areas raised from 691 km^2 in 1966 to 1,340 km^2 in 1979. Out of the increased area of 649 km^2, oil palm shared 662 km^2, and coconut occupied 52 km^2, respectively.

(11) In the State of Kelantan, newly exploited area of forest was 2,840 km^2 against the whole forest area of 12,328 km^2 in 1966. A part of rubber planted area was converted to oil palm and coconut fields.

An inventory of land use pattern is made for 41 river basins, being abbreviated as Basin hereinafter, in Peninsular Malaysia on the basis of land use map portraying land use condition in 1974/75. The result of inventory, as shown in Tables 9 to 20, is employed for projection of irrigated paddy field in the future and for identification of crops grown within flood prone areas at present.

3.2 Rice

3.2.1 Rice cultivation area in Peninsular Malaysia

Historical record on planted area of rice from 1973/74 to 1979/80 is as shown by State in Table 21. The main rice producing zones are Perlis, Kedah, Perak, Selangor, Trengganu and Kelantan. In 1979/80, these States shared 288,400 ha or 90% of total planted area for the main season wet paddy and 192,500 ha or 92% for the dry season wet paddy.

3.2.2 Rice cropping calendar in Peninsular Malaysia

Cropping calendars prevailing in each State of Peninsular Malaysia are summarized in Table 22 and Fig. 1. Land preparation work is usually done with a range of about three months depending upon rainfall as well as availability of natural river flow in the respective rice cultivation areas. The main season cropping starts between June and August in most States with exception of the States of Pulau Pinang and Kelantan starting from September and the States of Johor and Pahang starting from between February and April. The dry season cropping starts between February and April as usual, while, the State of Negeri Sembilan and a part of the State of Johor, it starts from January and June, respectively.

The traditional farming practices which are prevailing in rainfed rice cultivation area is to grow non-improved varieties with photosensitive features and long-maturity period of 150 to 180 days. Through expansion of double cropping area, improved varieties with non-photosensitive characteristics and early-maturity period of 135 to 150 days have been cultivated for both main and off seasons, and further this practice has become common in single cropping area provided with irrigation facilities. Presently, the average application of nitrogen fertilizer is 67 kg/ha and planting density is 10 hills/m^2. Basal fertilization is scarcely undertaken because of less effectiveness under deep water condition on main fields during pre-saturation and nursery periods.

Tables 23 to 25 portray the extent of wet paddy field planted which received no harvest after damaged by flood, drought, pests and diseases from 1973/74 to 1979/80. The damages caused by pests, diseases and drought to the main season crop are usually due to the delay of cropping schedule. Also, the pest damage to the off season crop appears, once the ripening stage falls on the rainy season due to the delay of cropping schedule. The most serious drought damage occurred in the States of Perlis, Kedah, Pulau Pinang and Perak for the dry season crop in 1977/78. In Table 26, historical record on harvested area of wet paddy by State is as shown in Table 26, after deducting the above-mentioned damaged area.

3.2.3 Paddy yield and production in Peninsular Malaysia

As of 1980, 300,200 ha or 70% of the total wet paddy field of 428,000 ha were provided for irrigation facilities, among while 226,100 ha or 75% could also expect irrigation water supply during the dry season. Due to irregular rainfall pattern, uncertain irrigation water supply and lack of adequate drainage system, the harvested area has fluctuated resulting in fluctuation of paddy yield as shown in Table 27.

According to the Paddy Statistics, paddy production in Peninsular Malaysia ranged between 0.91 x 10^6 tons in 1976/77 and 1.09 x 10^6 tons in 1973/74 for the main season and from 0.30 x 10^6 tons in 1977/78 to 0.77 x 10^6 tons in 1975/76 for the dry season during the last six years, as shown in Table 28.

A total of 1.27 x 10^6 tons of milled rice was consumed in Peninsular Malaysia during 1979, among which 1.17 x 10^6 tons were guaranteed by domestic paddy production as shown in Table 29. This fact means that self-sufficiency of rice in Peninsular Malaysia is in the level of 92% based on population estimated in the Paddy Statistics.

3.3 Major Export-oriented Crops

In Peninsular Malaysia, various kinds of perennial and tree crops are grown by private estates and smallholders as well as under land development schemes. Among the tree crops, rubber, oil palm, coconut and cocoa are planted as export-oriented crops and defined as major tree crops in the Study.

Producers of the major tree crops are smallholders and estates in private sectors, and the Governments' agencies such as FELDA, RISDA and FELCRA. The recent record on major crop cultivation areas by producer is as shown in Table 30.

Export amounts by the above-mentioned major crop products in 1979 are reported to be 1.6 x 10^6 tons for dry rubber, 203,000 tons for crude palm oil, 199,000 tons for palm kernel, 1,300 tons for copra, 60,600 tons for coconut oil and 14,500 tons for cocoa, as shown in Table 31.

3.4 Rubber

3.4.1 Planted area

During the previous seven years between 1972 and 1979, total planted area of rubber has been keeping the same level of 1.70×10^6 ha.

In Peninsular Malaysia during 1979, 0.51×10^6 ha or 30% of the total area belonged to private estates and 0.39×10^6 ha or 23% to smallholders. The remaining 0.80×10^6 ha were operated under the management of FELDA, RISDA and FELCRA.

The major producing zones are Johor with the share of 0.46×10^6 ha or 27%, Negeri Sembilan sharing 0.24×10^6 ha or 15% and Perak with the occupation of 0.23×10^6 ha or 13% as shown in Table 32.

3.4.2 Yield and production

As seen from the production records in 1976 and 1979 as shown in Table 33, rubber production slightly decreased from 1.53×10^6 tons in 1976 to 1.50×10^6 tons in 1979. Out of the total production in 1979, estate sector shared 0.60×10^6 tons or 38%, while smallholdings and the Government schemes shared 0.89×10^6 tons or 62%. Through TMP period, rubber production has slightly declined due mainly to the existence of untapped smallholdings, labour shortage in estates and the high rate of conversion from rubber to oil palm during the early 1970s.

3.5 Oil Palm

3.5.1 Planted area

Since the early 1960's when oil palm was introduced into Peninsular Malaysia, its planted area has significantly increased and obtained the second rank in commercial tree crops cultivation as shown in Table 30. In 1979, the planted area totaled 835,000 ha of which producers and their share were private estates having 463,000 ha, land development schemes occupying 307,000 ha and smallholders covering 65,000 ha. Major zones of oil palm cultivation are the States of Perak, Selangor, Johor, Pahang and Trengganu and those share totaled 762,000 ha or 91% in 1979 as shown in Table 34.

3.5.2 Yield and production

Usually, oil palm trees fruit from the fourth year after planted seedlings in Peninsular Malaysia. Its harvesting period is 18 years and peak period of harvest is from the ninth to twelfth years. According to the Oil Palm, Coconut and Cocoa Estates Statistics 1979, a total harvest as fresh fruit bunches of oil palm was 5.86×10^6 tons in 1976 and 9.1×10^6 tons in 1979 as shown in Table 35. In Peninsular Malaysia,

as private estates introduced oil palm plantation earlier than the Government-oriented land schemes, 6.51 x 10^6 tons or 72% of the total production were arisen from the private estates in 1979.

3.6 Coconut and Cocoa

The planted area of coconut amounted to 236,600 ha in 1976 and 246,000 ha in 1979 in the whole Peninsular Malaysia. More than 90% of the total planted area is managed by smallholders. The States of Perak, Selangor and Johor occupied 171,300 ha in 1979, playing an important role in coconut cultivation.

Cocoa is relatively new crop in Peninsular Malaysia. The private estates were the first to undertake the intercropping of cocoa with coconuts. Since then, a high priority has been given by the Government to cocoa as a diversification crop and as a method of increasing the profitability of coconut cultivation by smallholders. As of 1979, the total planted area of cocoa was 48,200 ha of which producers were comprised 20,600 ha of private estates, 7,900 ha of FELDA and 19,700 ha of smallholders.

4. LAND RESOURCES FOR FUTURE AGRICULTURAL DEVELOPMENT

4.1 Soils in Peninsular Malaysia

The information on Peninsular Malaysia's soil condition is based on schematic reconnaissance soil surveys undertaken by MOA.

In Peninsular Malaysia, the origins of soils extending over hilly and rolling lands mainly comprise the weathering of primary rocks such as granite, feldspar and mica, and sedimentary and metamorphic rocks such as sandstone, shale and limestone. As these soils are featured by a rather low moisture holding capacity and low nutrient status, only the soils having good depth are suitable for tree crop plantation.

The soils on terraces along steep and narrow valleys and of undulating plains are rather coarsely textured and well drained. Coupled with the seasonal fluctuation in river flow, these soils are not well suited for intensive agricultural use, especially for irrigated rice cultivation.

In the northern part of west coast area, the soils of riverine plains are of river alluvium with heavy to silty clayey texture and poorly drained. These soils are frequently overlying marine alluvium in the place close to the coast. These soils have slightly better nutrient holding capacity than hilly and terrace soils, but for obtaining optimum yield in rice cultivation much more fertilization is required due to low nitrogen and phosphate contents. This status also predominates in river alluvial soil area of the east coast.

The soils observed in the west coast plains consist of marine alluvium, coarse sands, peat soils and acid sulphate soils in poorly drained swamp areas. These marine alluvial soils which extend over areas above tidal influence are suited for rice cultivation as well as tree crop plantings when provided with drainage facilities. However, deep peat and acid sulphate soils have some problems for performing a large-scale land consolidation scheme due to limitation of the practical development and management methods to avoid acid sulphate or hydrogen sulphide production which is caused by transformation of sulphur contained in these soils.

Tables 38 and 39 show areal extent of soils in each state of Peninsular Malaysia. There exist alluvial soils of 8,900 km^2 on coastal plains, 11,500 km^2 on coastal and/or riverine, 11,200 km^2 on riverine flood plain or low riverine terraces, and 4,400 km^2 on intermediate and higher terraces. Sedentary soils extend over an area of 31,700 km^2 on undulating plains to rolling land, 13,200 km^2 on rolling and low hilly land, and 49,100 km^2 on hills and mountains. The soils of urban and mined land cover 100 km^2 in total.

4.2 Land Resources in Peninsular Malaysia

The soil-crop suitability classification study was made by DOA in 1974 (see Ref. 3). The classification system established in the said study takes into consideration tree crops and rice cultivation besides arable farming as forms of land use. Under this Malaysian system, the soils are growth limitations occurring in them; Class 1 to Class 3 soils have no limitations to at least one serious limitation to crop growth, Class 4 soils are of more than one serious limitation and Class 5 soils are least suitable for crop cultivation. In DOA, the detailed study on the distribution of soils of each class has been carried out based on the above classification system, but it is premature to forecast the outcome.

Other than the DOA's study, RRIM has promoted several studies on soil suitability mainly for rubber followed by oil palm. According to the information from RRIM (Ref. 10), the total potential land for tree crop planting is estimated at 64,000 km^2, including an excellent area of 18,400 km^2 for rubber growing and 23,100 km^2 for oil palm.

The economic crops grown in Malaysia are grouped into 26 kinds based on similarity of soil manage requirements of each crop (Ref. 3). For these respectively grouped crops, all the information upon soil suitability classification are further interpreted to crop suitability classification consisting of three grades such as suitable, marginal and unsuitable. Tables 40 and 41 portray the soil criteria for major crops. The provisional figures made by the Study show the areal extent of six grades for five major crops such as rubber, oil palm, coconut, cocoa and rice as presented in Tables 42 to 45.

The area covered with the alluvial soils and having the grade of suitable to marginal amounts to 8,300 km^2 for rubber, 9,000 km^2 for oil palm and cocoa, 21,000 km^2 for coconut and 18,700 km^2 for rice, respectively. Some portion of the area estimated for one crop overlappes each other.

4.3 Large-scale Irrigation Development Potential in Peninsular Malaysia

In Peninsular Malaysia, almost of all the potential areas with the vast extent have been allotted to the existing and planned major irrigation schemes. It can be said, therefore, that there is no development potential for new reclamation of a large-scale irrigated paddy field from physical viewpoint.

5. AGRICULTURAL DEVELOPMENT POLICY

5.1 Development Policy and Strategy in Peninsular Malaysia

The agricultural policy under FMP will emphasize the improvement of the identified poverty stricken groups particularly the paddy, coconut and rubber smallholders and the fishermen. The cultivation of new and existing cash crops will be given special emphasis for further improvement of the nation's overall balance of payment and further reduction of its dependence on a limited number of foreign-exchange earning commodities. The increase in the total production of food crops and other grains will deeply be regarded to attain self-sufficiency and price stabilization at consumer level. The creation of new employment opportunities in the rural sector will also be given special emphasis.

In Peninsular Malaysia, wide variations in rainfall pattern cause shortage of water, or inadequate drainage of excess water resulting in occurrence of critical periods of crop growth. Planted areas of wet paddy for both main and off seasons have fluctuated chiefly due to choronically unsteady cropping calendar in double cropping area. The major reasons consist of (1) inadequate irrigation water supply originated from lack of tertiary canals and on-farm irrigation service facilities, (2) deep-water condition during main season which often delays land preparatory work and farmers are unable to follow gazetted dates of operations and (3) delayed harvesting work of off season seldom overlapping the following main season's land preparatory and transplanting works. As a result, there have existed non-cropped wet paddy field totalling around 5,000 ha every year for the main season cropping and double-cropped paddy areas have actually been enjoying three crops every two years. Provision for irrigation and drainage facilities is, therefore, required for modification of the natural environment and creation of physical conditions favorable to plant growth in order to stabilize agricultural production and enhance incomes particularly to the smallholders sector.

Irrigation development for the existing rainfed and irrigated single cropping areas, if technically feasible and economically sound, will contribute to significant increase in yields and in total rice production. On the other hand, some of the existing rainfed paddy field will be converted to upland or tree cropping land taking into account lack of irrigation water source or uneconomical investment required for provision of irrigation facilities.

5.2 Future Rice Production Requirement for Self-sufficiency

Up to date, Peninsular Malaysia has constantly imported some amount of rice to meet domestic requirement as shown in Table 29. In 1979, 1.27×10^6 tons of rice comprising 1.17×10^6 tons of domestic paddy and 101,000 tons of imported rice were consumed by a total population of 11.04×10^6 which was estimated by MOA. Per capita consumption went up from 101 kg/y in 1978 to 115 kg/y in 1979. Self-sufficiency rate also improved up to 92% in 1979 in comparison with the rate of 74% in 1978.

The future population which is projected in the socio-economic sector of the Study is to be 13.4 x 10^6 in 1985, 14.8 x 10^6 in 1990 and 17.5 x 10^6 in 2000 for Peninsular Malaysia. As described in Section 5.1 and 5.2, the Federal Government promotes the self-sufficiency policy with regard to staple food production in the whole country. Based on the assumption of per capita milled rice consumption which is 120 kg/y as the national target, the total rice requirement for Peninsular Malaysia is estimated to be 1.61 x 10^6 tons in 1985, 1.78 x 10^6 tons in 1990 and 2.10 x 10^6 tons in 2000, respectively.

5.3 Future Cropping Pattern for Irrigated Paddy Cultivation

Based on the annual isohyet, monthly distribution of rainfall and the location of irrigation areas, the growing seasons of rice are selected taking into consideration the following conditions:

(a) most efficient use of rainfall to reduce irrigation water requirements,

(b) completion of transplanting works before the start of the heavy monsoon rainfalls to reduce the risk of crop damage caused by excess rain water and to reduce the drainage facilities required,

(c) separation of two growing seasons, main and off, to avoid the build-up of rice diseases and pests as well as to reduce farm labor requirements at peak time of farm operation, and

(d) undertaking of the harvest during the dry period to envisage the introduction of mechanized harvesting.

Following these concepts, the main season wet paddy should be grown between July/October and January/March, using varieties which require about 135 days on the main field after transplanting. The off-season wet paddy should be grown between February/March and July/September, using varieties which require around 105 days after transplanting to the main field. Future cropping patterns established are as shown in Fig. 2.

5.4 Projection of Irrigated Paddy Area in Peninsular Malaysia

In the Study, the projection of future irrigated area of paddy field was made for 41 river basins in the year of 1985, 1990, 1995 and 2000. For the projection, the Padi Statistics Projected for the Years, 1980, 1990 and 2000 which was prepared by DID was fully referred as the Study basis. Supplemental figures were taken from DID's draft 4MP, the Annual Reports on Irrigation Scheme Maintained by DID 1975 - 1979, and the Present Land Use of Peninsular Malaysia.

The summary of projection is shown in Table 46 by basin. It is considered that the development of new paddy field will be mainly concentrated in Perak, Endau and Rompin river basins, where there extend potential agricultural land suitable for implementation of major irrigation schemes. The projected area of paddy field newly developed will

increase by 90,000 ha for the first decade till 1990 and by 44,000 ha for the second decade till 2000, respectively.

5.5 Paddy Production Expected by Proposed Irrigation Development

Through provision for proper irrigation water supply system and improved agricultural supporting services, increase in paddy yield could be expected to large extent in both the existing and potential paddy cultivation areas in Peninsular Malaysia. Under the condition that various types of irrigation development will be implemented, paddy yield is anticipated to be 3.2 to 4.2 tons/ha for wet season crop and 3.6 to 4.7 tons/ha for dry season crop in minor scheme areas and 3.5 to 4.5 tons/ha for wet season crop and 4.0 to 4.9 tons/ha for dry season crop in major scheme areas as shown in Table 47.

The paddy yield in proposed irrigation development areas will gradually increase from the yield level under the condition of without project and be attained to the anticipated yield with build-up period of five years. The paddy production will increase from the next crop season after the completion of construction works for irrigation facilities.

The total paddy production by irrigation scheme is estimated as shown in Table 48 for Peninsular Malaysia and in Tables 49 to 59 for the respective States. The estimated paddy production in Peninsular Malaysia is 2.20×10^6 tons being equivalent to 1.43×10^6 tons of milled rice in 1985, 2.51×10^6 tons being equivalent to 1.63×10^6 tons in 1990 and 2.88×10^6 tons being equivalent to 1.87×10^6 tons in 2000, respectively. The above rice production could meet 89% of the rice requirement in 1985, 91% in 1990 and 89% in 2000, respectively.

5.6 Land Development Schemes in Peninsular Malaysia

Under 4MP, the target of new land development is 149,800 ha by FELDA, 32,100 ha by FELCRA and 15,400 ha by RISDA. Further, RISDA has a target of 141,500 ha for replanting and FELCRA undertakes 25,500 ha for rehabilitation. After 4MP, it is assumed in the Study that the increasing rate of oil palm plantation in both the Government and private sectors would be maintained.

Based on the above assumption, the future planting area of oil palm in 1985, 1990 and 2000 is projected as shown in Table 60 for each State in Peninsular Malaysia. The projected planting area will increase to 929,900 ha in 1985, 960,800 ha in 1990 and 1,047,000 ha in 2000, respectively.

To provide basic data in estimating processing water requirement as a component of industrial water demand, future production of oil palm is also projected as shwon in Table 62 for each State based on the anticipated yield as shown in Table 61.

The prospected production of oil palm in Peninsular Malaysia will raise from 8.18 x 10^6 tons of fresh fruit bunch in 1980 to 13.59 x 10^6 tons in 1985, 14.16 x 10^6 tons in 1990 and 20.53 x 10^6 tons in 2000, respectively. Assumption is made for daily operation hour of 16 hours and annual operation period of 300 days including 20% of contingency in the latter. From this assumption, the annual processing requirement of oil palm by Basin is estimated as shown in Table 63.

The future processing requirement of rubber factories by Basin in Peninsular Malaysia is estimated by following the same consideration as mentioned in the above. The projected planted area of rubber as shown in Table 64 will gradually decline from 1.70 x 10^6 ha in 1980 to 1.58 x 10^6 ha in 2000, while the projected production will increase from 1.44 x 10^6 tons in 1980 to 2.20 x 10^6 tons in 2000 as shown in Table 66. This projection is based on the expansion of replanting area for transfer to high yielding materials of rubber resulting in increase in unit yield as shown in Table 65. The processing requirement projected by Basin is as shown in Table 67.

6. AGRICULTURAL BENEFIT ATTRIBUTABLE TO WATER RESOURCES DEVELOPMENT AND MANAGEMENT

6.1 General

In this Study, the agricultural benefit arising from water resources development and management is composed of irrigation development benefit and flood control benefit.

The increase in the irrigation benefit is expected from the proposed irrigation schemes which will provide irrigation water to wet paddy field and be constructed during periods of 4MP to 7MP. The irrigation benefit is assumed to be realized with one year delay from the start of construction works for the proposed irrigation schemes. The build-up period of intensive cropping patterns for the proposed irrigation development schemes is also assumed to be five years.

The flood control benefit in the agricultural sector consists of the flood damage reduction benefit in flood prone areas. The flood damage is counted for paddy, mixed horticulture, rubber, oil palm, coconuts and cocoa. The land enhancement benefit is taken into consideration as a part of irrigation benefit for simplification of discussion in this Study.

6.2 Economic Price of Farm Input and Output

The economic farmgate prices of rice and other internationally marketable crops as well as chemical fertilizers are derived from a projection to 1990 at 1980 constant price level forecasted by IBRD (Ref. 28). The projected farmgate prices are M$640/ton for paddy, M$3,100/ton for dry rubber, M$1,164/ton for coconut as copra, M$211 for oil palm as fresh fruit bunch, M$3,580/ton for cocoa as dry beans, M$722/ton for urea, M$673/ton for triple superphosphate and M$405/ton for potash. The details for the above crops are as shown in Tables 68 to 72.

The economic farm labor wage including family labor is estimated to be M$6.5/d on the basis fo MOA's information. Regarding the other farm inputs and products, annual average prices paid or received by farmers during 1980 are taken into account (Ref. 15).

6.3 Economic Production Cost

The production costs estimated include seeds, fertilizer, agro-chemicals, materials and tools, fuel and oil, draft animal and machinery, employed and family labors, but these exclude taxes, water charges, land rent and repayment for initial investment.

The present and future labor requirements are as shown in Tables 73 to 75 for paddy cultivation and Table 76 for tree crops. The labor requirements for paddy cultivation vary according to the intensity of farming practices, which will increase from 50 to 84 man-days in total under present condition to 74 to 88 man-days under future condition with project for minor irrigation scheme and to 76 to 92 man-days under future condition with project for major irrigation scheme.

The estimated production cost for paddy cultivation in Peninsular Malaysia varies from 456 to 820 M$/ha under present condition 703 to 882 M$/ha under future condition with project for minor irrigation scheme and 783 to 962 M$/ha under future condition with project for major irrigation scheme, as shown in Tables 77 to 79. The average annual economic production cost for tree crop plantation by grower is summarized as shown in Table 80.

6.4 Economic Production Value

The economic gross production value is obtained by multiplying the anticipated crop yield by the economic farmgate price. The economic net production value is then obtained by subtracting the economic production cost from the economic gross production value. The results of calculation for minor irrigation scheme are as shown in Table 81 for the present condition, Table 82 for the future condition without the proposed irrigation development and Table 83 for the future condition with the proposed irrigation development. Those for major irrigation scheme are as shown in Tables 84 and 85 for the respective conditions. The average annual net production value of tree crops is as shown in Table 86 and that of orchard is as shown in Table 87.

The net economic production value of paddy grown in minor irrigation scheme areas under the future condition without project will range between M$443/ha and M$1,233/ha for the main season and between M$775/ha and M$1,400/ha for the dry season. That in major irrigation scheme areas will range between M$735/ha and M$1,273/ha for the main season and between M$834/ha and M$1,393/ha for the dry season. With provision for irrigation in the future, the net value in minor irrigation scheme areas will increase to the range between M$1,345/ha and M$1,853/ha for the main season paddy and between M$1,515/ha and M$2,126/ha for the dry season paddy. In case of major irrigation scheme areas, the net value will increase to the range of M$1,466/ha to M$2,028/ha for the wet season paddy and the range of M$1,704/ha to M$2,234/ha for the dry season paddy.

6.5 Irrigation Development Benefit

In estimating irrigation development benefit, the unit incremental benefit by type of irrigation development is estimated by deriving from the balance of net economic production values between the future conditions with and without project.

There exist five types of irrigation development for minor schemes and eight types for major schemes as shown in Table 88. The increase in irrigated area by basin by type of development in the respective States is as shown for each Malaysia Plan period in Tables 89 to 92 for minor schemes and Tables 93 and 94 for major schemes.

The unit incremental net benefit arising from the respective types of irrigation development is as shown in Table 95 for minor schemes and Table 96 for major schemes. The total incremental net benefit by basin can be obtained through multiplying the unit incremental benefit by the increased irrigation area. In this estimate, it is assumed that the incremental net benefit during the build-up period is 60% of the said benefit at the full development stage for the second year from the commencement of project implementation, 70% for the third, 80% for the fourth, 90% for the fifth, respectively. The total incremental net benefit, which is attributable to the irrigation development implemented during 20 years under 4MP to 7MP, is summarized by basin by type of irrigation development as shown in Tables 97 to 100 for minor schemes and Tables 101 and 102 for major schemes.

For the economic evaluation of the respective irrigation schemes proposed in the Study, the annual equivalents economic cost and benefit are estimated by basin under the condition that the present worth factor is 8% and the project life is 50 years from the commencement of proposed project construction works. The results of estimate are summarized by basin as shown in Tables 97 to 100 for minor schemes and Tables 101 and 102 for major schemes.

The Benefit-Cost Ratios (B/C Ratios) for the proposed irrigation projects are computed by basin as shown in Tables 97 to 100 for minor development schemes and Tables 101 and 102 for major development schemes.

Beneficial farm households by the proposed irrigation projects are estimated based on the assumed land holding size of 1.25 ha per one farm household on an average in the existing paddy cultivation area and 2.43 ha per one farm household migrated into the newly developed paddy cultivation area. The results are as shown in Tables 103 to 106 for minor schemes and Tables 107 and 108 for major schemes. In Peninsular Malaysia, a total of 88,250 farm households will be benefited by implementation of the proposed minor irrigation projects during the period from 1981 to 2000. The number of farm households benefited by major schemes during the same period will be 173,900.

6.6 Flood Damage Reduction Benefit

In this Study, benefits which will be born in the agricultural sector by undertaking the proposed flood control measures comprise flood losses of various crops to be directly reduced by providing with the said measures. Individual farmers and private estates in the existing flood prone areas could utilize their farm lands for more intensive cropping after frequency and duration of flooding will be considerably reduced by the proposed measures. Such benefit can be counted as land enhancement benefit. In order to simplify the discussion on the benefit estimate in

this Study, the land enhancement benefit is included into irrigation development benefit.

The crop production values used in estimating flood damage of annual crops under the Study consist of net production value which is lost by flood and production cost which has already spent before occurrence of flooding. The annual average production values for wet paddy grown in flood prone areas in the respective States are as shown in Table 109.

The crop production values of perennial crops such as oil palm, coconut and cocoa are regarded as replanting cost of seedlings, because young tree crops with the age up to two years old are directly suffering from flooded water. The replanting cost for the above-mentioned tree crops is as shown in Table 110. As for rubber and mixed horticulture, the production loss is taken into account for the calculation of flood damage. The value of production loss for rubber and mixed horticulture is also as shown in Table 110.

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