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VOL. 3 ANNEX C.D
MARCH 1985

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**NATIONAL WATER RESOURCES STUDY, MALAYSIA
PERLIS-KEDAH-PULAU PINANG
REGIONAL WATER RESOURCES STUDY
PART 2
BERIS DAM FEASIBILITY STUDY**

VOL. 3

ANNEX

C. AGRICULTURE

D. IRRIGATION DEVELOPMENT

MARCH 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

NATIONAL WATER RESOURCES STUDY, MALAYSIA
PERLIS - KEDAH - PULAU PINANG
REGIONAL WATER RESOURCES STUDY
PART 2

LIST OF VOLUMES

- Vol. 1 - MAIN REPORT
- Vol. 2 - ANNEX A. SOCIO-ECONOMY
B. DOMESTIC AND INDUSTRIAL WATER SUPPLY
- Vol. 3 - ANNEX C. AGRICULTURE
D. IRRIGATION DEVELOPMENT
- Vol. 4 - ANNEX E. METEOROLOGY AND HYDROLOGY
F. STUDY ON OPERATION OF WATER RESOURCES SYSTEM
- Vol. 5 - ANNEX G. ENGINEERING GEOLOGY
H. CONSTRUCTION MATERIAL
- Vol. 6 - ANNEX I. DESIGN AND COST ESTIMATE
- Vol. 7 - ANNEX J. ECONOMIC ANALYSIS
K. LAND ACQUISITION COST AND ENVIRONMENTAL STUDIES
L. LEGAL AND INSTITUTIONAL ARRANGEMENT

國際協力事業団	
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ABBREVIATIONS

(1) Organization/Plan

4MP (5MP)	:	Fourth (Fifth) Malaysia Plan
DID (JPT)	:	Drainage and Irrigation Department
EPU	:	Economic Planning Unit
FELCRA	:	Federal Land Consolidation and Rehabilitation Authority
FELDA	:	Federal Land Development Authority
IBRD	:	The World Bank
JICA	:	Japan International Cooperation Agency
MADA	:	Muda Agricultural Development Authority
MOH	:	Ministry of Health
MTR	:	Mid-Term Review of 4MP
NEB (LLN)	:	National Electricity Board
NWRS	:	National Water Resources Study
PWA	:	Pulau Pinang Water Authority
PWD (JKR)	:	Public Works Department
RESP	:	Rural Environmental Sanitation Program
RISDA	:	Rubber Industry Smallholders Development Authority
WHO	:	World Health Organization

(2) Others

B	:	Benefit
BOD	:	Biochemical Oxygen Demand
C	:	Cost
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
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
H	:	Height, or Water Head
HWL	:	Normal High Water Level
O & M	:	Operation and Maintenance
Q	:	Discharge
Ref.	:	Reference
SS	:	Suspended Solid
VA	:	Value Added

ABBREVIATIONS OF MEASUREMENT

Length

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

Area

cm² = square centimeter
m² = square meter
ha = hectare
km² = square kilometer

Volume

cm³ = cubic centimeter
l = lit = liter
kl = kiloliter
m³ = 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
HP = horsepower
° = degree
' = minute
" = second
°C = degree in centigrade
10³ = thousand
10⁶ = million
10⁹ = billion (milliard)

Derived Measures

m³/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

	<u>From Metric System</u>	<u>To Metric System</u>
<u>Length</u>	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
<u>Area</u>	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 1 sq.yd = 0.835 m ² 1 acre = 0.4047 ha 1 sq.mile = 2.59 km ²
<u>Volume</u>	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 ³
<u>Weight</u>	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
<u>Energy</u>	1 kWh = 3,413 BTU	1 BTU = 0.293 Wh
<u>Temperature</u>	°C = (°F - 32) · 5/9	°F = 1.8°C + 32
<u>Derived Measures</u>	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
<u>Local Measures</u>	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
(at the end of 1983)

US\$1 = M\$2.312
¥100 = M\$0.998

ANNEX C
AGRICULTURE

TABLE OF CONTENTS

	Page
1. INTRODUCTION	C-1
2. AGRICULTURAL BACKGROUND	C-2
2.1 Role of Agriculture in National Economy	C-2
2.2 Agricultural Production	C-2
2.2.1 Land development	C-2
2.2.2 Cropped area and crop production	C-3
2.3 Supports Services	C-4
2.3.1 Institutions	C-4
2.3.2 Training and extension	C-5
2.3.3 Credit and subsidies	C-5
2.3.4 Processing and marketing	C-6
2.3.5 Research	C-6
2.3.6 Public development expenditure for agriculture ..	C-6
2.4 National Agricultural Policy	C-7
2.5 Self-sufficiency of Staple Food	C-7
3. PRESENT SITUATION OF AGRICULTURE IN THE REGION	C-9
3.1 Natural Circumstances	C-9
3.1.1 Land resources	C-9
3.1.2 Soils	C-9
3.1.3 Agroclimatic condition	C-9
3.1.4 Forest cover	C-10
3.2 Role of Agriculture in Regional Economy	C-10
3.2.1 Gross regional product by agricultural sector	C-10
3.2.2 Employment by agricultural sector	C-11
3.3 Land Use	C-12
3.4 Crop Husbandry Outside Muda Area	C-12
3.4.1 Major crops	C-12

	Page
3.4.2 Paddy cultivation outside Muda area	C-13
3.4.3 Tree crops	C-14
3.5 Paddy Cultivation in Muda Area	C-15
3.5.1 Muda Irrigation Scheme	C-15
3.5.2 Changes in paddy production	C-16
3.5.3 Present status of farm management	C-16
3.5.4 Performance of field activities and present cropping pattern	C-18
3.5.5 Direct seeding	C-18
3.5.6 Pests and diseases	C-19
3.6 Farm Economy	C-19
3.6.1 Highlights of impact evaluation study on Muda II Irrigation Project	C-19
3.6.2 Paddy expenditure and income in Muda area	C-20
3.6.3 Paddy production cost in areas of outside Muda ..	C-21
3.7 Summary of TARC's Study	C-21
4. AGRICULTURAL DEVELOPMENT PLAN	C-23
4.1 Constraints in Agriculture of the Region	C-23
4.2 Development Policy and Strategy	C-24
4.2.1 Policy	C-24
4.2.2 Strategy	C-24
4.3 Projection of Future Irrigation Area	C-25
4.4 Future Cropping Pattern and Farming Practices	C-25
4.4.1 Future cropping pattern outside Muda area	C-25
4.4.2 Future cropping pattern in Muda area	C-26
4.4.3 Future farming practices	C-26
4.5 Anticipated Paddy Yield and Production	C-26
4.5.1 Anticipated paddy yield	C-26
4.5.2 Increase in Paddy production	C-27
4.6 Tree Crop Development	C-27
4.6.1 Future planted area and production of tree crops .	C-27
4.6.2 Processing water requirement	C-28

	Page
5. AGRICULTURAL BENEFIT ATTRIBUTABLE TO WATER RESOURCES DEVELOPMENT AND MANAGEMENT	C-29
5.1 Economic Benefit in Agricultural Sector	C-29
5.2 Economic Prices of Farm Input and Output	C-29
5.3 Economic Production Cost	C-29
5.4 Economic Production Value	C-30
5.5 Economic Irrigation Cost and Benefit	C-30
5.6 Production Foregone	C-31
5.7 Financial Farm Budget	C-31
REFERENCES	C-32

LIST OF TABLES

	Page
1. GDP by Industry of Origin in Malaysia for 1980 - 85	C-35
2. Average Annual Growth Rate of GDP in Malaysia for 1981 - 85..	C-36
3. Employment Estimate by Sector for 1980 - 85	C-37
4. Commodity Exports of Malaysia for 1980 - 85	C-38
5. Gross Export by Sector for 1980 - 85	C-39
6. Progress and Target of Land Development in Malaysia for 1981 - 85	C-40
7. Progress of Cropped Hectarage in Malaysia for 1980 - 85	C-41
8. Progress of Agricultural and Forestry Production in Malaysia for 1980 - 85	C-41
9. Progress of Integrated Agricultural Development Project in Malaysia	C-42
10. Public Development Expenditure for Agricultural Programs for 1981 - 85	C-43
11. Incidence of Poverty by Rural-Urban Strata in Peninsular Malaysia in 1983	C-44
12. Labour Force by Age and Stratum in Peninsular Malaysia for 1980 - 85	C-44
13. Historical Record on Consumption of Rice in Peninsular Malaysia for 1970 - 81	C-45
14. Estimated Supply and Demand Situation for Rice for 1984 - 2000	C-45
15. Breakdown of Rice Supply by Type of Irrigation Scheme in Peninsular Malaysia for 1981 - 2000	C-46
16. Areal Extent of Soils in the Region	C-47
17. Soil Series Identified in Paddy Cultivation Area in the States of Perlis, Kedah and Pulau Pinang	C-48
18. Main Characteristics of the Agroclimatic Regions 1 to 4	C-49
19. Average Monthly Rainfall in the Region	C-49
20. Areal Extent of Forested and Non-Forested Land in the States of Perlis, Kedah and Pulau Pinang as of 1982 ...	C-50

	Page
21. Present Status of Forest Reserve in the States of Perlis, Kedah and Pulau Pinang	C-50
22. Existing Forest Cover in the States of Perlis, Kedah and Pulau Pinang	C-51
23. Gross Regional Product by Industry of Origin in the States of Perlis, Kedah and Pulau Pinang for 1980	C-52
24. Gross Regional Product by Industry of Origin in the States of Perlis, Kedah and Pulau Pinang for 1983	C-53
25. Gross Regional Product by Industry of Origin in the States of Perlis, Kedah and Pulau Pinang for 1985	C-54
26. Average Annual Growth Rate of GRP by Industry of Origin in the States of Perlis, Kedah and Pulau Pinang for 1981 - 83	C-55
27. Per Capita GRP in the States of Perlis, Kedah and Pulau Pinang in 1980, 1983 and 1985	C-55
28. Population and its Related Information in the States of Perlis, Kedah and Pulau Pinang	C-56
29. Present Land Use in the States of Perlis, Kedah and Pulau Pinang	C-57
30. Present Land Use by River Basin	C-58
31. Historical Records on Paddy Cultivation in the States of Perlis, Kedah and Pulau Pinang	C-59
32. Historical Records on Paddy Cultivation Area of Rainfed and Minor Irrigation Scheme Areas in the States of Perlis, Kedah and Pulau Pinang	C-60
33. Typical Cropping Calender of Paddy in the States of Perlis, Kedah and Pulau Pinang	C-61
34. Characteristic of Typical Rice Varieties	C-61
35. Area Planted with Different Rice Varieties in the States of Perlis, Kedah and Pulau Pinang in 1980/81	C-62
36. Historical Records on Paddy Yield and Production of Rainfed and Minor Irrigation Scheme Areas in the States of Perlis, Kedah and Pulau Pinang	C-63
37. Planted Area of Rubber by Producer in the States of Perlis, Kedah and Pulau Pinang as of 1982	C-64
38. Rubber Production by Producer in the States of Perlis, Kedah and Pulau Pinang in 1976 and 1982	C-64

	Page
39. Planted Area of Oil Palm by Producer in the States of Perlis, Kedah and Pulau Pinang as of 1983	C-65
40. Oil Palm Production by Producer in the States of Perlis, Kedah and Pulau Pinang in 1976 and 1982	C-65
41. Historical Record on Paddy Cultivation in MADA	C-66
42. Specific Cultural Planting Schedule in MADA	C-67
43. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1979/I (1/2)	C-68
44. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1979/I (2/2)	C-69
45. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1979/I (1/2)	C-70
46. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1979/I (2/2)	C-71
47. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1979/I (1/2)	C-72
48. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1979/I (2/2)	C-73
49. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1979/I (1/2)	C-74
50. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1979/I (2/2)	C-75
51. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1979/II	C-76
52. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1979/II	C-77
53. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1979/II	C-78
54. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1979/II	C-79
55. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1980/I (1/2)	C-80
56. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1980/I (2/2)	C-81
57. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1980/I (1/2)	C-82

	Page
58. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1980/I (2/2)	C-83
59. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1980/I (1/2)	C-84
60. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1980/I (2/2)	C-85
61. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1980/I (1/2)	C-86
62. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1980/I (2/2)	C-87
63. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1980/II (1/2)	C-88
64. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1980/II (2/2)	C-89
65. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1980/II (1/2)	C-90
66. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1980/II (2/2)	C-91
67. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1980/II (1/2)	C-92
68. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1980/II (2/2)	C-93
69. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1980/II (1/2)	C-94
70. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1980/II (2/2)	C-95
71. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1980/I (1/2)	C-96
72. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1981/I (2/2)	C-97
73. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1981/I (1/2)	C-98
74. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1981/I (2/2)	C-99
75. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1981/I (1/2)	C-100

	Page
76. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1981/I (2/2)	C-101
77. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1981/I (1/2)	C-102
78. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1981/I (2/2)	C-103
79. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1981/II (1/2)	C-104
80. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1981/II (2/2)	C-105
81. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1981/II (1/2)	C-106
82. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1981/II (2/2)	C-107
83. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1981/II (1/2)	C-108
84. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1981/II (2/2)	C-109
85. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1981/II (1/2)	C-110
86. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1981/II (2/2)	C-111
87. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1982/I (1/2)	C-112
88. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1982/I (2/2)	C-113
89. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1982/I (1/2)	C-114
90. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1982/I (2/2)	C-115
91. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1982/I (1/2)	C-116
92. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1982/I (2/2)	C-117
93. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1982/I (1/2)	C-118

	Page
94. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1982/I (2/2)	C-119
95. Record on Progress of Field Activities in Districts I and II of Muda Area for Crop Season 1982/II (1/2)	C-120
96. Record on Progress of Field Activities in Districts I and II of Muda Area for Crop Season 1982/II (2/2)	C-121
97. Record on Progress of Field Activities in Districts III and IV of Muda Area for Crop Season 1982/II (1/2)	C-122
98. Record on Progress of Field Activities in Districts III and IV of Muda Area for Crop Season 1982/II (2/2)	C-123
99. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1983/I (1/3)	C-124
100. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1983/I (2/3)	C-125
101. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1983/I (3/3)	C-126
102. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1983/I (1/3)	C-127
103. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1983/I (2/3)	C-128
104. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1983/I (3/3)	C-129
105. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1983/I (1/3)	C-130
106. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1983/I (2/3)	C-131
107. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1983/I (3/3)	C-132
108. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1983/I (1/3)	C-133
109. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1983/I (2/3)	C-134
110. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1983/I (3/3)	C-135
111. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1983/II (1/2)	C-136

	Page
112. Record on Progress of Field Activities in District I of Muda Area for Crop Season 1983/II (2/2)	C-137
113. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1983/II (1/2)	C-138
114. Record on Progress of Field Activities in District II of Muda Area for Crop Season 1983/II (2/2)	C-139
115. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1983/II (1/2)	C-140
116. Record on Progress of Field Activities in District III of Muda Area for Crop Season 1983/II (2/2)	C-141
117. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1983/II (1/2)	C-142
118. Record on Progress of Field Activities in District IV of Muda Area for Crop Season 1983/II (2/2)	C-143
119. Record on Progress of Field Activities in District I (Muda I Scheme) of Muda Area for Crop Season 1984/I (1/2)	C-144
120. Record on Progress of Field Activities in District I (Muda I Scheme) of Muda Area for Crop Season 1984/I (2/2)	C-145
121. Record on Progress of Field Activities in District I (Muda II Scheme) of Muda Area for Crop Season 1984/I (1/2)	C-146
122. Record on Progress of Field Activities in District I (Muda II Scheme) of Muda Area for Crop Season 1984/I (2/2)	C-147
123. Record on Progress of Field Activities in District II (Muda I Scheme) of Muda Area for Crop Season 1984/I (1/2)	C-148
124. Record on Progress of Field Activities in District II (Muda I Scheme) of Muda Area for Crop Season 1984/I (2/2)	C-149
125. Record on Progress of Field Activities in District II (Muda II Scheme) of Muda Area for Crop Season 1984/I (1/2)	C-150
126. Record on Progress of Field Activities in District II (Muda II Scheme) of Muda Area for Crop Season 1984/I (2/2)	C-151

	Page
127. Record on Progress of Field Activities in District III (Muda I Scheme) of Muda Area for Crop Season 1984/I (1/2)	C-152
128. Record on Progress of Field Activities in District III (Muda I Scheme) of Muda Area for Crop Season 1984/I (2/2)	C-153
129. Record on Progress of Field Activities in District IV (Muda I Scheme) of Muda Area for Crop Season 1984/I (1/2)	C-154
130. Record on Progress of Field Activities in District IV (Muda I Scheme) of Muda Area for Crop Season 1984/I (2/2)	C-155
131. Record on Progress of Field Activities in District IV (Muda II Scheme) of Muda Area for Crop Season 1984/I (1/2)	C-156
132. Record on Progress of Field Activities in District IV (Muda II Scheme) of Muda Area for Crop Season 1984/I (2/2)	C-157
133. Summary of Commencement and Completion Dates of Presaturation/Land Preparation and Harvesting in Muda Area	C-158
134. Progress of Direct Seeding in Muda Area	C-159
135. Comparison of Water Requirement between Transplanting and Direct Seeding Systems	C-160
136. Area Affected by Insect Pests and Paddy Diseases in Muda Area	C-160
137. Farm Family Size and Age Distribution in Sample Areas of Muda Scheme	C-161
138. Land Tenure in Muda Area for 1955 to 1975/76	C-161
139. Farm Size Distribution by Land Tenure in Sample Areas of Muda Scheme	C-162
140. Average Farm Size by Land Tenure Stratum in Whole Sample Areas of Muda Scheme	C-163
141. Parcel and Nursery Characteristics in Sample Areas of Muda Scheme	C-163
142. Labour Use for Paddy Cultivation in Sample Areas of Muda Scheme	C-164

	Page
143. Labour Use for Paddy Cultivation Per Hectare in Sample Areas of Muda Scheme	C-165
144. Hired Labour Utilization Per Farm Household in Sample Areas of Muda Scheme	C-166
145. Labour Use Pattern by Farm Size in Sample Areas of Muda Scheme	C-167
146. Expenditure and Receipt for Farm Activities by Farm Size in Sample Areas of Muda Scheme	C-168
147. Average Paddy Expenditure and Income in Sample Areas of Muda II Scheme	C-169
148. Average Paddy Expenditure and Income in Sample Areas of Non-Muda II Scheme	C-170
149. Paddy Expenditure and Income of Owners in Sample Areas of Muda II Scheme	C-171
150. Paddy Expenditure and Income of Tenants in Sample Areas of Muda II Scheme	C-172
151. Paddy Expenditure and Income of Owner-Tenants in Sample Areas of Muda II Scheme	C-173
152. Paddy Expenditure and Income of Owners in Sample Areas of Non-Muda II Scheme	C-174
153. Paddy Expenditure and Income of Tenants in Sample Areas of Non-Muda II Scheme	C-175
154. Paddy Expenditure and Income of Owner-Tenants in Sample Areas of Non-Muda II Scheme	C-176
155. Average Per Hectare Paddy Expenditure and Income in Sample Areas of Muda II Scheme	C-177
156. Average Per Hectare Paddy Expenditure and Income in Sample Areas of Non-Muda II Scheme	C-178
157. Per Hectare Paddy Expenditure and Income of Owners in Sample Areas of Muda II Scheme	C-179
158. Per Hectare Paddy Expenditure and Income of Tenants in Sample Areas of Muda II Scheme	C-180
159. Per Hectare Paddy Expenditure and Income of Owner-Tenants in Sample Areas of Muda II Scheme	C-181
160. Per Hectare Paddy Expenditure and Income of Owners in Sample Areas of Non-Muda II Scheme	C-182

	Page
161. Per Hectare Paddy Expenditure and Income of Tenants in Sample Areas of Non-Muda II Scheme	C-183
162. Per Hectare Paddy Expenditure and Income of Owner-Tenants in Sample Areas of Non-Muda II Scheme	C-184
163. Average Cost of Paddy Production Per Hectare Per Season in Muda Irrigation Scheme for 1977-79	C-185
164. Average Cost of Paddy Production Per Hectare Per Season in Muda Irrigation Scheme for 1980-82	C-186
165. Comparison of Paddy Production Cost between Direct Seeding and Transplanting Systems	C-187
166. Paddy Production Cost in Outside Muda Area	C-188
167. Double Cropping Period of 12 Cultural Types	C-189
168. Relationship between Growing Period and Yield in TARC Experimental Field of Muda Area and MARDI	C-190
169. Maximum Total Product, Double Cropping Area and Variety Used by Cultural Type	C-191
170. Future Irrigation Area in Muda Area	C-192
171. Prospected Annual Schedule of Tertiary Development in Muda Area	C-193
172. Projected Minor Irrigation Area by River Basin in the Region	C-194
173. Annual Development Schedule of Minor Irrigation Schemes	C-195
174. Average Paddy Yield by Locality in Muda Area for 1981-83	C-196
175. Increased Paddy Production by Sufficient Water Supply to the Region	C-197
176. Projected Production of Rubber in Three States	C-198
177. Projected Production of Oil Palm in Three States	C-198
178. Processing Water Requirement by Palm Oil Mill	C-198
179. Processing Water Requirement by Rubber Factory	C-199
180. Derivation of Economic Farm Gate Price of Paddy (1983 Constant Dollar)	C-200

	Page
181. Financial and Economic Paddy Production Cost at 1983 Constant Prices in Muda Area for 1982/83 Main Season	C-201
182. Estimated Average Paddy Yield and Economic Net Production Value	C-202
183. Total Economic Net Production Value in 2003 Onward under With and Without Project Conditions	C-203
184. Economic Cost and Benefit Streams of Muda Irrigation Project	C-204
185. Economic Cost and Benefit Streams of Minor Irrigation Schemes in Fringe Area along MADA Canal	C-205
186. Economic Cost and Benefit Streams of Minor Irrigation Schemes along Main Stream of the Kedah River	C-206
187. Economic Cost and Benefit Streams of Minor Irrigation Schemes along Tributaries of the Kedah River	C-207
188. Economic Cost and Benefit Streams of Minor Irrigation Schemes along Main Stream of the Muda River	C-208
189. Economic Cost and Benefit Streams of Minor Irrigation Schemes along Tributaries of the Muda River	C-209
190. Economic Cost and Benefit Streams of Minor Irrigation Schemes in the Perai River Basin	C-210
191. Economic Net Production Value of Crop for Estimating Production Foregone	C-211
192. Typical Farm Budget of Average Farm Household for One Crop Season	C-212

LIST OF FIGURES

1. Agroclimatic Condition in the Region
2. Location of District and Locality in Muda Scheme
3. Double Cropping Period of 12 Cultural Types
4. Alternative Cropping Schedules by Planting Method
5. Proposed Cropping Pattern

SPECIAL ABBREVIATIONS

BPM	:	Agriculture Bank of Malaysia
DOA	:	Department of Agriculture
DRC	:	Dry Rubber Content
FFB	:	Fresh Fruit Bunch
FOA	:	Farmer's Organization Authority
GRP	:	Gross Regional Product
IADP	:	Integrated Agricultural Development Project
LPN	:	National Paddy and Rice Authority
MARDEC	:	Malaysian Rubber Development Corporation
MARDI	:	Malaysian Agricultural Research Development Institute
NAP	:	National Agricultural Policy
PORIM	:	Palm Oil Research Institute of Malaysia
RRIM	:	Rubber Research Institute of Malaysia
TARC	:	Tropical Agricultural Research Center, Japan

1. INTRODUCTION

This Annex presents the study results on irrigation water supply benefit attributable to implementation of the proposed Beris dam project. The said irrigation benefit is estimated on the basis of the actual farm gate price during the 1982/83 main season of paddy cultivation in the Muda area for the purpose of financial analysis and the average projected price for the period from 1990 to 1995 by IBRD for the economic analysis. These prices are on the same level with those employed in estimating the irrigation benefit allocated to the Reman Project.

In addition to the above, the planning materials which were prepared for the estimate of irrigation water demand in the Perlis - Kedah - Pulau Pinang Regional Water Resources Study are updated and modified to minor extent by referring to data and informations mainly supplemented from the Muda Agricultural Development Authority (MADA) and the Tropical Agricultural Research Center, Japan (TARC) during June and July 1984.

2. AGRICULTURAL BACKGROUND

2.1 Role of Agriculture in National Economy

Agriculture is the single largest sector playing an important role in the national economy. Although the structural change in the Malaysian economy has recently resulted in gradual decrease in the contribution of the agricultural sector to the national economy, this sector in 1983 accounts for M\$7,030 x 10⁶ in 1970 constant prices or 22.4% of GDP, 1.94 x 10⁶ workers or 37.0% of the total employment and M\$10,961 x 10⁶ in 1983 current prices or 33.3% of the gross exports.

Under the Fourth Malaysia Plan (4MP, 1981-1985), the growth rate of GDP in the agricultural sector was targeted to be 3.0% per annum. The actual rate of GDP during the first three years of 4MP attained to 4.0% per annum owing mainly to the notable increase in palm oil production. In the Mid-term Review of 4MP, therefore, the average growth rate of GDP in the agricultural sector is expected to be 4.2% per annum. In Table 1, GDP by industry of origin for the period from 1980 to 1985 is as summarized and its average annual growth rate is as shown in Table 2.

The agricultural sector newly created job opportunities for 30,000 workers during the period between 1980 and 1983 as seen from Table 3. The employment in this sector was 1.94 x 10⁶ as of 1983, corresponding to 37.0% of the total employment. It is estimated to increase to 1.98 x 10⁶ by 1985.

The overall volume of agricultural commodity exports expanded for the first three years of 4MP, while export earnings decreased by 2.1% per annum due to the decline in international market prices of export commodities. Such a tendency was also strongly in evidence in case of trade of forestry products. With the recovery in export prices from 1983 onward, the average growth rate of export value is expected to be 4.1% per annum for agricultural commodities and 3.3% per annum for forestry products in the Mid-Term Review of 4MP, compared with 11.9% per annum and 8.4% per annum, respectively, of the original targets under 4MP. The actual and expected figures in terms of export are as shown in Table 4 for commodity export and Table 5 for gross export by sector for the period from 1980 to 1985.

2.2 Agricultural Production

2.2.1 Land development

According to the study on soil suitability classification, there exist 4.40 x 10⁶ ha of new land available for agriculture in the whole Malaysia as of 1981, comprising 2.38 x 10⁶ ha in Peninsular Malaysia and 2.02 x 10⁶ ha in Sabah and Sarawak. Further, there are 1.55 x 10⁶ ha of in situ land, which refers to land already alienated for agriculture but has not fully utilized or left idle, in the country as of 1981. Out of this, 0.73 x 10⁶ ha of in situ land extend over Peninsular Malaysia and the remaining 0.82 x 10⁶ ha are distributed in Sabah and Sarawak.

The target of new land development under 4MP was set up to be 543,500 ha in the original plan and 529,600 ha in the revised plan. During the period from 1981 to 1983, a total of 303,200 ha of new land were developed in the nation corresponding to 55.8% of the target in the original plan and including 246,600 ha of new land developed in Peninsular Malaysia. About 226,400 ha of new land which corresponds to the remaining target of the revised plan are expected to be developed in 1984 and 1985, out of which 170,800 ha exist in Peninsular Malaysia. Table 6 indicates the progress and target in land development by agency/program.

In addition to the new land development mentioned in the above, the redevelopment of existing idle and under-utilized agricultural land was embarked upon through the implementation of Integrated Agricultural Development Projects (IADPs) and other in situ development programs. During the first three years of 4MP, 7,000 ha of in situ land were redeveloped under in situ development programs and another 247,000 ha of paddy land were developed and improved under the execution of IADPs. The further efforts to utilize idle and under-utilized land are expected to be concentrated into such States having poor land resources as Perlis, Kedah, Pulau Pinang, Selangor, Negeri Sembilan, Melaka and Kelantan with an approximate total of 444,000 ha through the said various measures from 1984 onward.

2.2.2 Cropped area and crop production

The hectarage by major crop including timber area in Malaysia for the period from 1980 to 1985 is as summarized in Table 7. The progress and prospect of agricultural and forestry production in Malaysia for the said period is as shown in Table 8.

Rubber production as a whole has been stagnant in the level of 1.5×10^6 tons annually for the period from 1981 to 1983. This tendency is caused by the continuous decline in the international market price of rubber resulting in the failure in rubber smallholders' will to tap and the self-imposed control on tapping by rubber estates. Statistics indicate that the conversion of rubber to oil palm has also been carried out mainly in private estates, so that the rubber planted area decreased from 510,000 ha in 1980 to 390,000 ha in 1983. On the other hand, the area under smallholders raised from 1.5×10^6 ha in 1980 to 1.6×10^6 ha in 1983 through the implementation of the new land development schemes. As rubber trees replanted and newly planted in smallholders' areas in early years come to maturity, rubber production in the smallholder sector is tending upward.

Oil palm planting area increased from 1.07×10^6 ha in 1980 to 1.23×10^6 ha in 1983 due to new planting and conversion of rubber to oil palm. During this period, the weather condition was favourable for the growth of oil palm trees, the matured area under oil palm plantations also increased by 150,000 ha and the weevil pollination technique introduced in 1981 were broadly applied. As a result, oil palm products increased from 2.6×10^6 tons in 1980 to 3.0×10^6 tons in 1983 for palm oil and from 247,500 tons in 1980 to 403,700 tons in 1983 for palm kernel oil.

Cocoa cultivation area drastically raised from 108,600 ha in 1980 to 205,000 ha in 1983 resulting in sharp increase in the production of dry cocoa beans from 32,900 tons in 1980 to 65,000 tons in 1983. This notable expansion of the area under cocoa cultivation is supported by the high price of cocoa beans in the international market in the late 1970s, encouraging farmers to continue to plant cocoa as a single crop or an intercrop in coconut areas.

Pepper producers, mostly consisting of smallholders, have been affected by the sluggishness in world market prices and compelled to make pepper cultivation unremunerative. The planted area declined from 12,700 ha in 1980 to 11,400 ha in 1983. During this period, the pepper production decreased from 31,700 to 23,500 tons.

Paddy production diminished from 2.0×10^6 tons in 1980 to 1.8×10^6 tons in 1983 caused by unfavourable weather conditions and further by the outbreak of pest and disease. The latter affected seriously the Muda area which was the main rice producing center in the country.

2.3 Supports Services

2.3.1 Institutions

The Federal Government agencies involving in implementation of development and support activities in the agricultural sector are the Ministry of Agriculture, Ministry of Lands and Regional Development and Ministry of Primary Industry. The Ministry of Agriculture, consisting of five divisions and eight Statutory Bodies, is responsible for (1) all crop production except for export crops such as rubber, oil palm, tobacco, sugarcane and pineapples, (2) fish and livestock production, (3) agricultural credit, marketing and research except for rubber and oil palm and (4) farmers' organizations, community and cooperative development. The Ministry of Lands and Regional Development performs the duties of land development and rehabilitation. The Ministry of Primary Industry handles the above-mentioned export crops.

Under the Ministry of Agriculture, the Drainage and Irrigation Department (DID) shares the Ministry's responsibilities in the field of planning, implementation, operation and maintenance of the country's drainage and irrigation schemes. The Department of Agriculture (DOA) is responsible for agricultural extension services especially regarding formulation of nationwide policies and programs for the services. The grassroots extension services to farmers are provided by the State DOAs and the Federal and State Statutory Bodies.

The Ministry of Agriculture has undertaken in situ development comprising IADP approach and normal individual departmental programs under its charge. The main aim of IADP is to enable farmers to obtain maximum benefits from capital investments by providing with the following components in an integrated package: (1) the provision of necessary infrastructure, inputs and services, (2) the development of institutions and (3) the level of technology among the farmers through training and extension. At present, there exist 24 IADPs, among which three were already completed and 14 are being implemented. The remaining seven are at the stage of feasibility study as shown in Table 9.

There are three nationwide authorities established under the Ministry of Lands and Regional Development. These are the Federal Land Development Authority (FELDA), Federal Land Consolidation and Rehabilitation Authority (FELCRA) and Rubber Industry Smallholders Development Authority (RISDA). The main task of FELDA is to develop new land for cultivation of oil palm, rubber, cocoa, sugarcane and coffee and later to distribute newly developed land to eligible persons, the majority of which are landless farmers or smallholders owing from land of less than 1 ha. FELCRA is responsible for rehabilitation of unsuccessful state land schemes and development of new land schemes at a smaller scale than FELDA's scheme. RISDA has the responsibility in encouraging rubber smallholders to replant the existing non-productive trees with high-yielding varieties, to extend rubber planting areas and to obtain shares in RISDA block plantings run on an estate basis.

2.3.2 Training and extension

DOA has intensified its extension program under the National Extension Project financed by the World Bank (IBRD). Farmers learn modern farm management including the application of fertilizer, crop rotation and other aspects of crop husbandry through the training and visit system provided by DOA. Apart from such a formal training program, various agricultural agencies like the Farmer's Organization Authority (FOA) provide training and extension services relevant to their respective target groups.

2.3.3 Credit and subsidies

The Agriculture Bank of Malaysia (BPM) provided 169,000 borrowers with credit amounting to M\$562 x 10⁶ under its various programs for the first three years of 4MP, exceeding the target amount of M\$423 x 10⁶ in 4MP. The breakdown of loans was M\$47 x 10⁶ or 11% for paddy production, M\$63 x 10⁶ or 15% for land development, M\$68 x 10⁶ or 16% for agro-based industry and the rest for fisheries, livestock, farm machinery, tobacco production and others. A total of M\$794 x 10⁶ is expected to be additionally disbursed from BPM to another 129,600 borrowers in 1984 and 1985.

During the period from 1981 to 1983, M\$1,124 x 10⁶ in total had been subsidized to farmers under various schemes. For paddy farmers, a total of M\$798 x 10⁶ was spent through implementation of two subsidy schemes comprising the paddy fertilizer subsidies amounting to M\$273 x 10⁶ and the price support scheme amounting to M\$525 x 10⁶. The former enables the farmers to reduce the financial burden in paddy cultivation, while the latter ensures a stable price for paddy and reasonable income for paddy farmers through the provision of a cashable coupon valued at M\$16.54 for every 100 kg of paddy sold. To develop fruits, vegetable, cocoa and other minor short-term crop production, DOA provided various input subsidies under the Agricultural Input and Diversification Program totalling M\$42 x 10⁶. Through RISDA, rubber smallholders were provided with M\$164 x 10⁶ for input subsidies and infrastructural facilities aimed at encouraging replanting and M\$20 x 10⁶ for launching grant in setting-up of co-operatives. In order to encourage the smallholders having holding of less than 4 ha to participate in replanting programs, another soft loan

service was put in operation under the Replanting Incentive Scheme giving interest-free subsistence loan, ranging from M\$60 to M\$100 per month for six years, to be repaid when replanted holdings matured.

In 1984 and 1985, a total of M\$70 x 10⁶ soft loan is expected to be provided under the Replanting Incentive Scheme in addition to M\$60 x 10⁶ provided for agricultural inputs and infrastructural facilities for encouragement of replanting. The total amount allocated for fertilizer subsidy scheme for paddy farmers is expected to be M\$159 x 10⁶ in 1984 and 1985. The role of agricultural subsidies in agricultural development will be reviewed during the remaining period of 4MP from the viewpoint to make farmers' will more independent and self-reliant, to raise their productivity and income by utilizing their own resources and to lighten a burden in the financial resources of the Government.

2.3.4 Processing and marketing

The National Paddy and Rice Authority (LPN) increased its purchases of paddy from 317,000 tons in 1980 to 397,000 tons in 1983. The share of LPN in the marketing of paddy is about 20% in the country. The total installed capacity of LPN was 470,000 tons for drying and 258,000 tons for milling. Through the new installation of drying and milling facilities, LPN will magnify its share in the marketing of paddy from 1984 onward.

The Malaysian Rubber Development Corporation (MARDEC) and RISDA together handled 172,000 tons or 18% of total rubber produced by smallholders for processing into smoked sheets and technically specified rubber. The role of MARDEC and RISDA will be rationalized to provide better marketing facilities for rubber smallholders.

2.3.5 Research

The Malaysian Agricultural Research Development Institute (MARDI) is undertaking applied research in food technology as well as seasonal and perennial crop husbandry excluding rubber and oil palm. The items given high priority in research by MARDI, the Rubber Research Institute of Malaysia (RRIM) and the Palm Oil Research Institute of Malaysia (PORIM) are (1) developing labour-saving techniques such as mechanization in cultivating paddy, rubber and oil palm, (2) cost minimization in the crop production, (3) improvement of yield and post-harvest losses of important crops and (4) food processing for commercial purposes.

2.3.6 Public development expenditure for agriculture

The public development expenditure allocated for agricultural development amounted to M\$4,938 x 10⁶ for the period from 1981 to 1983, corresponding to 57% of the originally planned target of 4MP as shown in Table 10. The total allocation for agricultural development under the Mid-Term Review of 4MP was revised to be M\$8,014 x 10⁶. The balance to be spent in 1984 and 1985 amounts to M\$3,076 x 10⁶.

2.4 National Agricultural Policy

The agricultural sector in Malaysia has a characteristic structure which is divided into a well-organized estate sub-sector and a non-organized smallholder sub-sector. As indicated in Table 11, smallholders planting rubber and paddy were formed of 544,000 households corresponding to 60% of the total households in the agricultural sector as of 1983. Among these, 323,000 households were identified as a poor household with an income level below the minimum requirement of household. These smallholders share 65% of the sector's poor household and 45% of the total poor households in the country. The smallholder sub-sector is currently faced with several constraints comprising uneconomic-sized holdings, low-return crops, traditional methods of production, restrictive conditions with regard to cropping patterns and inadequate access to assistance and support services. The shortage of labour in the agricultural sector has recently become prominent due to rapid migration of youths from rural areas being harassed by poverty derived from low productivity and income to urban areas having possibilities to get more remunerative employment opportunities as shown in Table 12. This structural problem has led to the underutilization and abandonment of alienated cultivable land and the consignment decline in agricultural output.

The National Agricultural Policy (NAP) had therefore been formulated in the light of the required role of agriculture sector in national development and was published in January 1984. The objective of NAP is to maximize income from agriculture through efficient utilization of the sector's contribution to the overall economic development of the country. The process of maximizing farm income is to be achieved through the expanded production of traditional export crops, the development and expansion of production of food and industrial crops. For these objectives, the current approach in agricultural development through new land development, in situ development, the provision of support services and incentives, and the social and institutional development will be continued with some modifications made for programs and projects.

In addition to the above broad strategies, NAP also sets out guidelines for the development of specific commodities. With respect to industrial crop production, major emphasis will be directed towards increasing the efficiency of rubber production under present hectarage. Efforts to expand production of palm oil will continue through the development of well-managed estates with emphasis on improved technology, while non-organized smallholdings will be discouraged. Cocoa has considerable potential as an export earner and its cultivation on a large scale will be encouraged to ensure efficiency of production and quality of produce. The cultivation of coconut will be aimed at meeting the local demand for fresh nuts and providing shade for cocoa.

2.5 Self-sufficiency of Staple Food

In NAP, it is premised to meet the demand for staple food by rice. The target is set up to achieve a level of domestic production of 80 to 85% of the domestic requirement, based on the consideration that it is not economical to produce 100% of the total requirement of the country in view

of high cost in paddy production. In order to achieve and sustain this level of self-sufficiency, paddy production will be intensified through the provision and improvement of irrigation and drainage facilities in existing paddy cultivation areas for increasing crop intensity, use of high yielding varieties and adoption of modern farming techniques.

The supply and demand situation is as shown in Table 13 under the actual condition in the past and Table 14 under the future condition estimated in NAP. In estimating the future demand, the annual per capita consumption of rice is assumed to be 97.4 kg in 1990 and 88.1 kg in 2000, compared with the present per capita consumption level of 111 kg in 1981. Table 15 shows the breakdown of rice supply by type of irrigation scheme in Peninsular Malaysia for the period from 1981 to 2000.

3. PRESENT SITUATION OF AGRICULTURE IN THE REGION

3.1 Natural Circumstances

3.1.1 Land resources

The Perlis - Kedah - Pulau Pinang Region (the Region) is a group of river basins in the northern part of the west coast of Peninsular Malaysia. The Region comprises the Perlis, Kedah, Merbok, Muda, Perai and Pulau Pinang river basins, including Julu and other southern rivers, with a total coverage of 10,325 km² which correspond to 91.7% of the total land of the States of Perlis, Kedah and Pulau Pinang.

3.1.2 Soils

Soils in the Region are broadly classified into (1) alluvial soils extending over coastal plains, riverine flood plains and riverine terraces, (2) sedentary soils occurring on undulating plains, rolling hills and mountains and (3) soils of urban and mined land as shown in Table 16. In the Region, an areal distribution is 3,138 km² for the alluvial soils, 7,020 km² for the sedentary soils and 167 km² for the soils of urban and mined land.

The alluvial soils, which are derived from marine and riverine sediments, are generally used for paddy cultivation. The marine alluvial soils are predominantly clay with substantial nutrient reserves but are often poorly drained. Some marine alluvial soils have high accumulation of sulphate causing the formation of acid sulphate soils. The riverine alluvial soils tend to be less clayey and more sandy resulting in freer drainage and less nutrient reserves. With respect to such alluvial soils extending over the paddy cultivation areas of the Region, a total of 31 soil series are identified as listed up in Table 17.

3.1.3 Agroclimatic condition

The result of comprehensive study on agroclimatic condition in Peninsular Malaysia was published by MARDI in 1982. In this study, a total of 26 agroclimatic regions is demarcated for selecting the most suitable lowland crops in relation to climatic factors which control crop performances in the respective regions. In delimiting the agroclimatic regions, rainfall is used as the major distinguishing factor and its monthly data are compared to crop water needs. For the comparison purpose in the same units, a basic idea of the agricultural rainfall index is employed, which indicates rainfall in percents of the potential evapotranspiration for the same period and station. In the computation of the said index, probable rainfall figures are computed at 10% intervals.

As illustrated in Fig. 1, the Region corresponds to the agroclimatic regions 1 to 4. The main climatic feature in these four regions is the clear and regular dry season, during the period from December to March,

as summarized in Table 18. The main rainy period in these regions starts from September and ends in November, while the secondary maximum rainy period lasts between April and May.

As shown in Table 19, the average annual rainfall in the Region ranges from 1,948 mm at the Kula Nerang rainfall station being located in the Kedah river basin to 2,947 mm at the Ibu Bekalan rainfall station being operated in the Muda river basin. The average monthly rainfall in the main rainy period indicates a rather wider range between 209 mm in November at the Kuala Nerang rainfall station and 486 mm in October at the Pintuair Bagan rainfall station being located in the Pulau Pinang river basin. Its range in the secondary maximum rainy period is between 174 mm in April at the Keretapi rainfall station in the Kedah river basin and 296 mm in May at the Ibu Bekalan rainfall station. The driest month is January and February with an average monthly rainfall varying from 38 mm in February at the Kuala Nerang rainfall station to 107 mm in January at the Ladang Began Sena rainfall station being situated in the Muda river basin.

Other elements of climate show less variation than rainfall, but the dry season is usually accompanied by more sunshine, higher day and lower night temperatures and a lower relative humidity than those during the rest of year as illustrated in Fig. 1. Among these elements, the mean daily maximum temperature is over 34°C during the period from late January to early April. Such higher day temperature causes an occurrence of sterile grains in paddy cultivation.

3.1.4 Forest cover

In the States of Perlis, Kedah and Pulau Pinang, there exists a forested land of 3,971 km² in total as of 1982 as shown in Table 20. Forest exploitation has been continuously undertaken in productive forests totalling 2,086 km² comprising inland forest of 2,004 km² and mangrove forest of 82 km² as shown in Table 21.

The land covered with natural and artificial forests is 3,103 km² at present, corresponding to 78% of the total forested land, with the distribution of 73 km² in the State of Perlis, 2,973 km² in the State of Kedah and 57 km² in the State of Pulau Pinang. As seen from Table 22, these forests consist of unexploited and regenerated productive forests, unproductive forests, wild life and other reserves, and state forests.

3.2 Role of Agriculture in Regional Economy

3.2.1 Gross regional product by agricultural sector

The agricultural sector in the States of Perlis, Kedah and Pulau Pinang contributes to the regional economy as the largest rice supplier to other rice consuming centers in Malaysia. Another predominant activity contributing to the regional economy is rubber cultivation by smallholders. The actual and estimated values of Gross Regional Product (GRP) in the States of Perlis, Kedah and Pulau Pinang totaled M\$3,514 x 10⁶ in 1970 prices for 1980, M\$4,227 x 10⁶ in 1970 prices for 1983 and M\$4,741 x 10⁶

in 1970 prices for 1985 as shown in Tables 23 thru 25. The agricultural sector accounted for M\$862 x 10⁶ in 1970 prices or 24.5% of GRP for 1980 and M\$887 x 10⁶ in 1970 prices or 21.0% of GRP for 1983 and is expected to account for M\$913 x 10⁶ in 1970 prices or 19.3% of GRP for 1985.

For the period from 1981 to 1983, the sector grew at only 1.0% per annum in the State of Perlis, 1.1% per annum in the State of Kedah and 0.3% per annum in the State of Pulau Pinang as shown in Table 26. Such a little growth rate is mainly due to structural defect in the predominant agricultural activities of the Region. In paddy cultivation, increase in double cropping area and fixing of double cropping schedule are restricted by insufficiency and uncertainty of irrigation water supply system, while no increase in rubber production is caused by low productivity and small-holdings.

Per capita GRP in 1970 prices is estimated to increase from M\$1,336 in 1980 to M\$1,561 in 1985 for the State of Perlis, from M\$1,151 in 1980 to M\$1,325 in 1985 for the State of Kedah and from M\$2,235 in 1980 to M\$2,875 in 1985 for the State of Pulau Pinang as shown in Table 27. Aside from the per capita GRP measure, the living standard of individuals can be more directly gauged by per capita monthly household income. According to the Household Well-Being Survey conducted by the Socio-Economic Research Unit in 1982, the per capita monthly rural household income in 1982 current prices was M\$76 for the State of Perlis, M\$70 for the State of Kedah indicating the lowest household income in Peninsular Malaysia and M\$74 for the State of Pulau Pinang, all of which were below the average of M\$89 in Peninsular Malaysia. On the contrary, there was marked disparity between the urban and rural per capita monthly household incomes. The urban per capita monthly household income in 1982 current prices was M\$143 for the State of Kedah and M\$130 for the State of Pulau Pinang.

3.2.2 Employment by agricultural sector

The total population in 1980 was 2.22 x 10⁶ in the three States, comprising 0.15 x 10⁶ for the State of Perlis, 1.12 x 10⁶ for the State of Kedah and 0.95 x 10⁶ for the State of Pulau Pinang as shown in Table 28. Higher rate of net inter-state migration in the State of Kedah recording the rate of -5.3% between 1970 and 1980 is also expected for the period of 4MP. Thus, the growth rate of population for this period is set up to be 1.3% in the State of Kedah, compared with a slightly higher growth rates of 1.6% and 1.7% for the States of Perlis and Pulau Pinang, respectively. The share of rural population is forecasted to decline from 91.0 to 90.5% in the State of Perlis and increase from 53.1 to 55.4% in the State of Pulau Pinang, while it shows no change in the State of Kedah.

According to the General Report of Population Census, 1980, the labour force aged 10 and over was 110,000 in the State of Perlis, 787,000 in the State of Kedah and 692,000 in the State of Pulau Pinang, totaling 1.59 x 10⁶ in the three States. On an average, males shared 66% of the total labour force in 1980 and about 730,000 or 70% of the male labour force were participating in work activities. On the other hand, participation rate of females was only 35% of the total female labour force of 540,000.

3.3 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 textural descriptions with statistical data and the maps having varied scale of 1 inch to 1 mile to 1 inch 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 as well as data prepared by the State's DOAs are supplementarily used for the review of present land use in the States of Perlis, Kedah and Pulau Pinang as well as the Region.

The present condition of land use in the three States having a total area of 11,254 km² is as tabulated in Table 29. Agricultural land shares 5,428 km², comprising rubber of 2,671 km², paddy of 1,684 km², mixed horticulture of 342 km², coconut of 280 km², oil palm of 189 km², sugarcane of 154 km² and other crops of 108 km². The land use condition by river basin is as shown in Table 30. In the Region, there exist rubber planting area of 2,490 km² and paddy cultivation area of 1,612 km² out of the total agricultural land of 5,088 km².

3.4 Crop Husbandry Outside Muda Area

3.4.1 Major crops

Predominant crops in the Region are paddy, rubber and sugarcane. The annual rice production in the States of Perlis, Kedah and Pualu Pinang has shared about 62%, on an average, of the total rice production of approximately 1.12 x 10⁶ tons in Peninsular Malaysia. The surplus after satisfying local requirements in the Region has met rice demand to large extent in the metropolitan area of Kuala Lumpur. The historical records on paddy cultivation area, yield and production in the three States is as summarized in Table 31.

The annual rubber production has amounted to about 260,000 tons since 1976, sharing 18% of the total rubber production in Peninsular Malaysia. Most of rubber production are derived from smallholders' old rubber trees with a distinguishing feature of very low productivity.

There are two integrated sugar cultivation units each of which is located in the States of Perlis and Kedah, respectively. These units grow sugarcane in approximately 14,000 ha in total and have own sugar factories with a total daily milling capacity of 7,500 tons of cane sugar. Out of 50,000 tons of raw sugar annually produced in Peninsular Malaysia, about 30,000 tons are the production of these two sugar factories. To increase the domestic production of raw sugar, FELDA generates application of more efficient planting techniques in its sugar plantation in the State of Perlis.

3.4.2 Paddy cultivation outside Muda area

Among paddy cultivation areas distributed outside the Muda area, a marked decline in the actually planted area is seen lately in the State of Pulau Pinang. As shown in Table 32, the annually planted area decreased from 31,580 ha in 1974/75 to 15,190 ha in 1981/82. This remarkable increase in idle paddy field is due to the shortage of labour in rural areas where considerable youths can easily get more remunerative employment opportunities in manufactories, hotels and other sectors of tertiary industry within the State. On the contrary, such a structural change in paddy cultivation sub-sector is yet actualized taking the form of occurrence of idle land in the States of Perlis and Kedah.

There are nine typical cropping calendars prevailing in paddy cultivation areas of the three States as shown in Table 33. These mainly depend on the rainfall and the availability of river discharges. The main season cropping starts from June at the earliest case to December at the latest case. Harvesting period varies between November and April. The off season cropping is commenced from January to July and its harvesting time comes to May to November.

For supplemental provision of irrigation water to the paddy cultivation area, a total of 69 minor irrigation schemes are in operation in the Region, covering 26,020 ha at present. In the State of Perlis, the Perlis river and its tributaries supply irrigation water for minor irrigation scheme areas of 3,717 ha. In the State of Kedah excluding the Kerian river basin and Pulau Langkawi, the Muda river and the tributaries of the Kedah river cover minor irrigation scheme areas amounting to 7,175 ha in total. In the State of Pulau Pinang, a total irrigation scheme area of 15,128 ha including the Sungai Muda pumping irrigation scheme with a coverage of 7,115 ha is provided with irrigation water from the Muda and Perai rivers. In addition, there exist nine control drainage schemes in the Region. Out of these, seven schemes are distributed in the State of Perlis and cover 3,637 ha in total, while the rest with a total service area of 2,983 ha are located in the State of Kedah. About 39,200 ha remain as rainfed paddy cultivation area due to insufficiency of natural flows in the river system of the Region.

The traditional farming practices prevailing in the rainfed paddy cultivation area are to grow non-improved rice varieties with photo-sensitive features and long-maturity period varying between 150 and 180 days. In double cropping areas under irrigated condition, improved rice varieties with non-photo-sensitive characteristics and medium-maturity period of 135 days on an average have been grown for both the main and off-seasons. Further, this practice has been common in single cropping areas supplementarily provided with irrigation water for the main season. In Table 34, the characteristics of typical rice varieties released are as summarized and, in Table 35, the hectareage planted with a different rice variety is as shown by the State.

Currently, land preparation works are done using two- or four-wheeled tractors. The land is normally cultivated twice before transplanting. In certain areas where no machinery can be used, buffaloes are used for tillage purpose. Nursery bed is set up on a part of main paddy fields and nursery preparation works are started when water is made available to the field. Seedlings aged 35 days on an average are manually transplanted on main paddy fields either by using hired labour or family labour force. The predominant planting density is 10 hill/m². The average application of nitrogen fertilizer amounts to 67 kg/ha. Basal fertilization is scarcely undertaken prior to transplanting because of less effectiveness under deep water condition on main paddy fields during pre-saturation and transplanting periods. The fertilizer application is done at the first time between 15 and 25 days after transplanting and at the second time ranging from 40 to 60 days after transplanting. Chemical control of pests and diseases is performed only when the symptoms of disease or insect occur, so that there is little performance. Though mechanized harvesting works have become common, to some extent, in the area where shortage of labour force has become more serious, manual harvesting and threshing works are still common.

Poor irrigation water management is common to most of all the minor irrigation schemes, especially in the States of Perlis and Pulau Pinang. This is partly caused by poor operation of the existing irrigation facilities, while shortcomings in the infrastructure mostly make correct operation impossible. Thus, not only rainfed areas but also some of minor irrigation scheme areas have become abandoned land.

Due to irregular rainfall pattern, uncertain irrigation water supply, lack of adequate drainage system and spread of pests and diseases, the harvested area has been unstable as shown in Table 32, resulting in fluctuation of paddy yield as shown in Table 36.

The annual paddy production in the minor irrigation scheme and rainfed areas fluctuated between 202,800 and 280,000 tons during the period from 1973/74 to 1981/82 as shown in Table 36. In the State of Pulau Pinang, the decline in paddy yield and production becomes more conspicuous for the reason described hereinbefore.

3.4.3 Tree crops

In the State of Kedah, FELDA and FELCRA have concentrated their efforts for opening up new lands to plant rubber. It is reported that the total planted area of rubber as of 1982 became 19,200 ha. Beside these new land development schemes, RISDA has involved in replanting schemes of smallholders' old rubber trees through introduction of high-yielding hybrids. By the end of 1982, RISDA carried out such replanting schemes in 49% of the whole smallholders' rubber planting area of 168,900 ha in the States of Kedah and Pulau Pinang. Private rubber estates have a total area of 79,000 ha in the States of Perlis, Kedah and Pulau Pinang as shown in Table 37.

Rubber production in these States shows increasing tendency in small-holders' sector resulting from the RISDA's replanting schemes under which some of high-yielding rubber trees newly introduced have become matured. As shown in Table 38, the total rubber production in 1982 was 261,500 tons in the States of Perlis, Kedah and Pulau Pinang.

In the States of Kedah and Pulau Pinang, oil palm is grown by rubber estates of which owners have tried crop diversification by introducing oil palm at their own risk. As shown in Table 39, a total of 18,900 ha in the States of Kedah and Pulau Pinang is grown with oil palm. As newly planted young trees were reaching to matured level, production has sharply increased from 1976. The total harvest of fresh fruit bunch recorded to be 214,400 tons in 1982 as shown in Table 40.

3.5 Paddy Cultivation in Muda Area

3.5.1 Muda Irrigation Scheme

The Muda Irrigation Scheme stretches over both the States of Perlis and Kedah. The command area occupies a flat alluvial plain, about 20 km wide and 65 km long, between the foothills of the Central Range and the Straits of Malacca. It has fully been operated since 1974. The major infrastructures constructed by the Scheme comprise the Muda and Pedu dams with a total active storage capacity of $1,209 \times 10^6 \text{ m}^3$, the 7-km long Saiong tunnel linking these two reservoirs, headworks, a system of main canals with the total length of 115 km, secondary canals totalling 970 km with a canal density of 10 m/ha, drains and water control structures, and laterite surfaced farm roads of 780 km in total. The command area is 96,000 ha in net. The irrigable area in the off-season is restricted to 89,000 ha due to the existence of isolated high ground where no irrigation water can be provided by the infrastructure.

The present system of irrigation water distribution relies on plot-to-plot flooding from the secondary canals, serving irrigation blocks of about 700 ha each with an average distance of 1,600 m. Under such a prevailing condition of plot-to-plot flooding and a variation of micro-topography, there remain difficulties in ensuring timely and controlled distribution of irrigation water as well as smooth access to farm plots.

In order to overcome these problems, the Muda II Irrigation Project was commenced in 1979 taking the financial assistance from IBRD. The Project aims at augment of canal density to 30 m/ha through the provision of tertiary irrigation facilities, which is regarded as the first phase of the overall and long-term program for tertiary development covering the whole area of the Muda Irrigation Scheme. The Project is currently implemented in 37 irrigation blocks with a total coverage of 25,000 ha out of 110 irrigation blocks. It is expected to be completed by 1987. On the tertiary development in the remaining irrigation blocks, a feasibility study will be carried out soon as the Muda III Irrigation Project.

The co-operation research program between MADA and TARC has been carried out in the Muda area since 1978. The purpose of research is to establish an advanced double cropping system of rice to make paddy yield high and stable in the Muda area. Through the field observation and technical analyses on various aspects, background of problems which the Muda area is currently facing has been definitely shown and a new double cropping system with the purpose of overcoming major problems is going to be proposed.

3.5.2 Changes in paddy production

Before the completion of the Muda Irrigation Scheme, crop intensity was on a level of 95% and annual paddy production was around 305,600 tons as shown in Table 41. After the completion of the Scheme, the crop intensity increased to 193% by 1975 and, since then, has been kept in a relatively constant level. The annual paddy production under the full operation of the Scheme increased to 759,100 tons in 1974/75 as shown in Table 41. Since then, the Muda Irrigation Scheme has contributed to the supply of rice to the domestic markets in the country to large extent. In 1978, the off-season cropping was cancelled due to severe drought and lack of impounded water in the Muda and Pedu reservoirs. As the Government started implementation of the paddy fertilizer subsidies in 1979, the annual paddy production marked the maximum record of 866,200 tons in the crop year of 1979/80 as a result of increase in rates of application of fertilizers. However, due to outbreak of diseases and pests in the whole area of the Muda Irrigation Scheme, paddy production in the off-season of 1982 sharply dropped by about 25% compared with that in 1981.

3.5.3 Present status of farm management

There are 110 irrigation blocks with an approximate coverage between 400 and 1,000 ha. Each of irrigation block lies between a secondary canal and a secondary drain and is divided into about 10 to 20 farm lots, on an average, owned by different farmers. These farm lots are usually demarcated by field ridges with a dual function of helping to retain water in the field and serving as ownership boundary markers. Under plot-to-plot flooding, irrigation water can be directly introduced to far lots adjoining a secondary canal, but after 40 days or sometimes more it can reach to farm lots situated at the drainage end and remote from a secondary canal.

Land preparation is almost entirely mechanized in the whole Muda area except for minor spots in the coastal area. A traditional tool like a scythe is resorted to for the purposes of land preparations in such places where the soil is very soft and its bearing capacity is quite low. Farm machineries commonly used are 2-wheeled pedestrian power tillers and 4-wheeled tractors attached with rotary tillers. After tillage by machines, buffaloes are sometimes used for raking, puddling and levelling the fields.

Nursery preparation normally commences after the farm plot has been entirely presaturated with water. Nursery beds are usually set up in one corner of the farm plot, covering about 4% of the main fields. Under the present irrigation system, separate irrigation of nurseries is impossible, hence continuous irrigation over the entire farm plot has to be practiced. The seeds from the harvest of the previous season are commonly used without proper selection of seeds, resulting in quite a high degree of mixing and off types in the field. Nitrogen fertilizer is applied 10 to 14 days after sowing in a form of urea. Seedlings with a height of 40 to 50 cm are normally transplanted to the main fields 30 to 40 days after sowing.

Manual transplanting is common, using a forked tip planting instrument called as "Kuku Kambing" in the local language, and requires as many as 130 hr/ha. The planting density is 10 hill/m² on an average and three to eight seedlings per hill are used. The transplanting depth ranges from 7 to 10 cm.

After transplanting, water is continuously supplied to the main fields with the standard amount of 0.58 to 1.17 lit/s/ha for the purpose of supplemental irrigation during the paddy growing season until 15 days before harvesting. As it is usual that several parcels of farm plot in different places are operated by one farmer, proper water management on a farm plot level is quite difficult.

Fertilizers are applied at the recommended rate 200 kg/ha for nitrogen, 50 kg/ha for phosphate and 50 kg/ha for potassium by supporting through the paddy fertilizer subsidies. Within one month after transplanting, 50% of the total amount of nitrogen fertilizer is timely applied, while the application of the remaining quantity is done during undesirable period.

For controlling pests, diseases and weeds, agro-chemicals are used by about one-third of the farmers. Weeding is also done manually with the scythe.

Harvesting is carried out by combined harvestors of which service area covers about 80% of the whole Muda area, while, for the remaining area, manual harvesting is still common. Combined harvestors are operated on a commercial basis and all of them consist of European type with a 4-m long cutter and a power of 80 to 92 HP.

Milling is undertaken by LPN and private millers, the both of which install enough milling capacity to meet the local demand at present. There exist 38 large commercial rice mills with an installation of mechanical drying units and about 300 small home consumption mills in the Muda area. In addition, LPN has constructed 17 large drying complexes with mechanical drying capacity of 30 tons each. The milling industry is largely made up of the 38 large commercial mills and LPN's own milling facilities integrated with nine of its drying facilities. According to the LPN Kedah/Perlis Office, the peak time of operation is February and March for the harvest of the main season crop and August to October for the off-season crop.

3.5.4 Performance of field activities and present cropping pattern

In the original plan for double cropping of paddy under the proposed Muda II Project set up in 1977, it was scheduled that the off-season cropping started from January and ended July with a total farm operation period of 179 days including land rest period of 18 days and the main season cropping was done for 186 days, with land rest period of 39 days, between July and January as shown in Table 42. However, such problems as insufficient irrigation water, long time lag in distributing irrigation water to individual farm plots and shortage of farm labour force have caused the remarkable delay of cultural planting schedule and seasonal overlapping of cultural planting schedule every year in the Muda area. Taking into account the actual performance of cultural practices, the revised plan for double cropping of paddy was formulated in 1983 as summarized in Table 42.

To grasp the actual progress of farm operation in the whole Muda area, MADA has recorded the performance of field activities after the cancellation of off-season cropping in 1978. The main items of activities checked are presaturation, land preparation, transplanting and harvesting. The performance is weekly recorded in each phase of the four irrigation districts, I to IV, showing the actual cropping pattern in the Muda area. The data from the off-season cropping in 1979 to that in 1984 are as tabulated detailedly in Tables 43 thru 132.

Though impounded water is released from the existing two reservoirs to meet presaturation water requirement for the off-season crop occurred in dry months, the performance in presaturation is much influenced by rainfall pattern at a time when presaturation is commenced. As shown in Table 133 in which the performance data are summarized, it took 14 to 72 days to presaturate 95% of the irrigation area in each phase of the four irrigation districts. This implies that the present canal system without tertiary development is inadequate to achieve complete presaturation within a period of 30 days as scheduled in the original plan. For completion of land preparation in each phase, 66 days were required for the off-season crop, while 80 days were needed for the wet season crop. In case of transplanting, no farmers prepare their nursery immediately after distribution of water. Therefore it took 35 to 70 days to prepare the nursery for seeding in each phase. Transplanting works were completed between 65 and 80 days in each phase. It took 70 to 85 days on an average to complete harvesting in each phase.

3.5.5 Direct seeding

When the off-season crop in 1978 was cancelled, farmers practiced direct seeding without irrigation water supply in a total area of 17 ha in District IV of the Muda area. Since then, direct seeding practice gradually spread in District IV up to 1980 as shown in Table 134. Under the pressure of rising cost of production, especially increase in labour cost for transplanting from M\$113/ha in the main season of 1976 to M\$200/ha in the off-season of 1980, the hectarage under direct seeding has sharply risen after 1980 in each District. In the off-season of 1984, direct seeding was conducted in 46,456 ha in the whole of Muda area.

According to TARC's study on comparison of water consumption between direct seeding and transplanting system, which was carried out in 1982 based on the unit water consumption, irrigation water requirement for direct seeding system exceeds by 30% compared with that for transplanting system. As shown in Table 135, there is no significant difference in presaturation water supply for both planting methods. The main cause are longer period for supplementary irrigation water supply and occurrence of a substantial wastage of water resulting from such practice that standing water is drained out before direct seeding.

3.5.6 Pests and diseases

The outbreak of pests and diseases has caused sharp drop of paddy production in the Muda area since 1981. The area damaged by brown and white-back planthoppers as well as Tungro is reported to be 6,499 ha in 1981, 13,600 ha in 1982 and 20,529 ha in 1983, as shown in Table 136. The total paddy production in the off-season went down from 460,200 tons in 1979 to 292,500 tons in 1982. It is pointed out that such spread of planthoppers and Tungro in the Muda area arises from year-round planting of rice which is the main host plant feeding not only brown and white-back planthoppers but also green leaf hopper as a transmitter of Tungro virus. Therefore many trials by chemical control has not shown good performance in the Muda area.

At present, it is understood that the most effective countermeasure is to control such pests ecologically instead of using a lot of agro-chemicals. For this purpose, the fallow period of about one month before starting the off-season cropping is required for killing simultaneously all the host plants including rice stubbles, ratoons, volunteer rice plants and weeds with the similar species to rice plant remained or appeared after harvesting the main season cropping in the whole Muda area.

3.6 Farm Economy

3.6.1 Highlights of impact evaluation study on Muda II Irrigation Project

According to the Muda II evaluation survey for the pre-project status regarding the farm household economy, performed in the off-season of 1981, the weighted average of farm family size was 5.1 for the sample farmers in the Muda II Scheme area and 5.3 in the non-Muda II Scheme area, as shown in Table 137. The average age of the farmer was 45.6 years old in the Muda II Scheme area and 47.2 years old in non-Muda II Scheme area.

The historical change in land tenure condition in the whole Muda area is as summarized in Table 138. During 20 years between 1955 and 1975, the share of land owners increased from 37.6% to 56.1%, while the mean farm size of land owners declined from 1.70 ha to 1.30 ha. The farm size distribution by land tenure of sample farmers in the areas of Muda II Scheme and non-Muda II Scheme is as shown in Table 139. The average farm size for both sample farmers was 1.11 ha for land owners, 1.43 ha for tenants and 2.21 ha for owner/tenant, as shown in Table 140.

Generally, the maximum distribution of farm size was below 0.86 ha in case of land owner farms sampled in the both areas of Muda II Scheme and non-Muda II Scheme. On the contrary, tenant farms cultivated farm lands of 0.86 to 1.73 ha in the maximum case for the both sample areas.

As shown in Table 141, one farm in the sample area of Muda II Scheme possessed 2.4 farm plots for farm size of less than 0.86 ha, 3.5 farm plots for farm size of 0.86 to 1.73 ha, 5.2 farm plots for farm size of 1.73 to 2.59 ha, 5.8 farm plots for farm size of 2.59 to 3.45 ha and 11.0 farm plots for farm size of more than 3.45 ha. An overall average area of one farm plot was 0.37 ha with a range of the average area between 0.26 ha for the distribution size of less than 0.86 ha and 0.60 ha for that of 2.59 to 3.45 ha. Such a tendency was also quite similar to the sample farms of non-Muda II Scheme.

Farmers whose farm size was below 0.86 ha met some difficulties to secure enough space for nursery. Thus, 31.5% of them in the sample area of Muda II Scheme and 39.6% in the non-Muda II Scheme area used nurseries made by other farmers to supplement insufficient seedling supply to their own paddy fields.

Labour use condition for paddy cultivation is tabulated in Table 142 indicating man-hour per one farm household and in Table 143 indicating man-hour per hectare. Hired labour utilization per farm household is as shown in Table 144 and labour use pattern by farm size is as summarized in Table 145. The total labour input per hectare was 251 man-hours on an average in the sample area of Muda II Scheme and 246 man-hours on an average in the non-Muda II Scheme area. Out of these average total labour inputs, 133 man-hours were used for transplanting works in the both sample cases. The average sample farmers in the Muda II Scheme area depend 48.6% of total labour input on family labour, while those in the non-Muda Scheme area depend 54.5% on family labour. The rest of labour input was met by hiring labour and by utilizing group labour system. The share of hired labour in the total labour input was 40% in case of sample farms with the farm size of 1.73 to 3.45 ha and exceeded 60% for farms with farm size of more than 3.45 ha in the both areas of Muda II Scheme and non-Muda II Scheme. Farmers of which farm size of less than 0.86 ha earned some cash incomes by working mainly at a transplanting time in other large size farms as shown in Table 146.

3.6.2 Paddy expenditure and income in Muda area

The result of Muda II evaluation survey presented the expenditure and receipt for farm activities by farm size as shown in Table 146, average paddy expenditure and income per farm household as shown in Tables 147 thru 154, and paddy expenditure and income per hectare as shown in Tables 155 thru 162.

The total farm household expenditure averaged M\$1,300 for all the sample farms in the Muda II Scheme area and M\$1,306 for them in the non-Muda II Scheme area. The largest expenditure item was harvesting which accounted for 25% of total expenditure, followed by land rents which was 23%. Transplanting shared 13% of total expenditure though this activity required major labour input.

The constituents of paddy income included sales of paddy, value of the unsold paddy, labour income from working in other paddy farms, land preparation and other miscellaneous income. The average farm household income from paddy sales amounted to M\$1,810 in the Muda II Scheme area and M\$1,762 in the non-Muda II Scheme area. The gross income per farm household was M\$1,883 in the Muda II Scheme area and M\$1,796 in the non-Muda II Scheme area.

According to the paddy production cost survey performed by MADA for every every crop season as shown in Tables 163 and 164, the cost in the whole Muda area averaged M\$956/ha for the 1982/83 off-season crop and M\$935/ha for the 1982/83 main season crop in case of land owner farmers. The average land rental charge was M\$599/ha in the 1982/83 off-season and M\$604/ha in the 1982/83 main season.

The result of comparison of paddy production cost between direct seeding and transplanting systems based on the MADA's paddy production cost survey for 1982 is as shown in Table 165. There is no difference in material input cost, while labour cost was saved by M\$252/ha or 26% by execution of direct seeding system.

3.6.3 Paddy production cost in areas of outside Muda

As indicated in Table 166, labour and contract cost shared 84% of the total paddy production cost in the States of Perlis and Kedah and 88% of that in the State of Pulau Pinang.

3.7 Summary of TARC's Study

Among the various fruits obtained through undertaking of cooperative research program between MADA and TARC, development of a new double cropping system is fully referred to in the Part 2 Study.

A total of 12 cultural types as shown in Table 167 and illustrated in Fig. 3 for double cropping of paddy was reviewed aiming at the following:

- (a) Agronomic control of green leaf hopper, the major vector of rice Tungro virus which is now very prevalent in the area, and brown plant hopper by simultaneous fallow during the dry season,
- (b) Effective use of irrigation water by the systematic staggering of the crop,
- (c) Promotion of mechanization through the increased soil bearing capacity of the paddy fields which is facilitated by the fallow during dry season, and
- (d) Increase in yield by the effect of air-drying of the soils during the fallow period.

On the basis of study results on relationship between growing period and yield by rice variety as shown in Table 168 and comparison of maximum total product, double cropping area and variety used by cultural type as shown in Table 169, a new double cropping system was proposed for the purpose of overcoming major constraints to make paddy yield high and stable. This new system comprises the off-season cropping, the main season cropping, perfect fallow of one month period simultaneously practiced over the whole Muda area during the initial stage of dry season after harvesting the main season crop, and a systematic staggering of cropping in the whole area in the period of two months.

The comparative study on annual irrigation water requirement for the selected four cultural types in the Part 2 Study indicates $10.13 \times 10^3 \text{ m}^3/\text{ha}$ for the type A, $9.62 \times 10^3 \text{ m}^3/\text{ha}$ for the type D, $11.07 \times 10^3 \text{ m}^3/\text{ha}$ for type E and $9.45 \times 10^3 \text{ m}^3/\text{ha}$ for the type K.

4. AGRICULTURAL DEVELOPMENT PLAN

4.1 Constraints in Agriculture of the Region

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 chronically unsteady cropping calendar in double cropping area. The major reasons are as follows:

- (a) inadequate irrigation water supply originated from lack of tertiary canals and on-farm irrigation service facilities,
- (b) deep-water condition during main season which often delays land preparatory work and farmers are unable to follow gazetted dates of operations, and
- (c) 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 fields 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 small-holders sector.

In the Muda area which is the main rice bowl in the Region, furthermore, the consistent occurrence of water shortage problems have continuously had an adverse effect on paddy cultivation from 1977 onwards. Recently, various studies revealed the existence of an overall deficit in water supply system to the Muda Irrigation Scheme. The major factors are as follows:

- (a) Inadequate average annual reservoir inflow to meet 58% to 75% of the annual reservoir demand,
- (b) Uncertain contribution from uncontrolled flow meaning that the period of maximum flow coincides with the period of high plain precipitation,
- (c) Unreliable contribution of rainfall due to its high yearly variation in monthly amount of precipitation, and
- (d) Actual scheme water consumption exceeds the design value.

Excessive water consumption in the Muda Irrigation Scheme area is primarily due to the existing irrigation infrastructure at a canal density of 10 m/ha being grossly inadequate to rationalize any form of on-farm water control. The farmers are unable to exercise effectively in-field water management. Consequently, the overall system efficiency is as low as 50%.

In addition to the above-mentioned water management problem, the Muda Irrigation Scheme has currently faced the following serious constraints in agronomic matters:

- (a) Spread of pests and diseases,
- (b) Delay of cropping schedule, and
- (c) Shortage of labour force.

4.2 Development Policy and Strategy

4.2.1 Policy

The agricultural policy under 4MP 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.

4.2.2 Strategy

In the Muda area, the strategy for reducing water consumption through efficient utilization of available water has been formulated under the Muda II concept. It is envisaged upon completion of the physical tertiary infrastructure, the density of canal/drain will be increased by 2.5 to 3 times compared with the present level, allowing a more efficient irrigation water supply and drainage systems for the Muda Irrigation Scheme. However, the output of the Pedu-Muda dams will be unable to meet the total irrigation water requirement even if tertiary system covers the whole area of Muda Irrigation Scheme. Thus, creation of new water resources is indispensable in collaboration with the rational water management through the provision of tertiary canal system.

To control pest and disease problems ecologically instead of utilization of agro-chemicals to large extent, the fallow period of about one month will be introduced before commencement of the off-season cropping. The introduction of such an agronomic countermeasure is effective for killing simultaneously all the host plants and weeds with the similar species to rice plant in the whole area of Muda Irrigation Scheme.

To utilize available surface water resources in tributaries of the Kedah and Muda rivers, minor irrigation development will be promoted in the existing rainfed and irrigation single cropping areas, if technical feasibility and economic viability is confirmed.

4.3 Projection of Future Irrigation Area

In the area under the Muda Irrigation Scheme, the total net irrigation area will slightly decline from 95,200 ha to 92,000 ha as shown in Table 170, because the implementation of tertiary canal development in the whole Muda area requires allocation of the existing irrigated land to newly constructed tertiary canals and farm roads. The prospected annual development schedule of tertiary canal system is as shown in Table 171. No expansion of irrigation area is expected in the fringe area where irrigation water source depends on the MADA canal, taking into account the condition that the canal water is primarily distributed to the Muda Irrigation Scheme.

In projecting irrigation area in the future, it is considered that the development of newly irrigated paddy field will be mainly concentrated along tributaries of the Kedah and Muda rivers, where runoff can secure irrigation water demand for the dry season cropping with a cropping intensity of 150% at minimum. The projected area of minor irrigation schemes newly developed by river basin in the Region is as shown in Table 172. The prospected annual development schedule of these new minor irrigation schemes is as shown in Table 173. In the Kedah river basin, the projected area is 440 ha along the main stream and 1,330 ha along tributaries. In the Muda river basin, the projected area is 2,157 ha along the main stream and 4,284 ha along tributaries. In addition, another 352 ha will be newly irrigated in the Perai river basin.

4.4 Future Cropping Pattern and Farming Practices

4.4.1 Future cropping pattern outside Muda area

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 September and February, using varieties which require about 110 days on the main field after transplanting. The off-season wet paddy should be grown between March and August, using varieties which require around 120 days after transplanting to the main field. Future cropping patterns established are as shown in Fig. 5.

4.4.2 Future cropping pattern in Muda area

As a result of cooperative research program between MADA and TARC which has been carried out since 1978, a new double cropping system was proposed in 1984 to overcome the current major constraints by introducing agronomic countermeasures under the present field condition. Referring to this new double cropping system and taking into consideration the result of comparative study on alternative cropping patterns, the proposed cropping pattern, as illustrated in Fig. 5, is established under the condition that the tertiary canal system and new water source facilities are provided.

4.4.3 Future farming practices

Land preparation works are done using two- or four-wheeled tractors. The land is normally puddled twice before transplanting. Nursery bed is set up on a part of main paddy fields and nursery preparation works are started when water is made available to the field. Seedlings aged 25 days on an average are manually transplanted on main paddy fields either by using hired labour or family labour force. The recommended planting density is 20 hill/m². The basal application of fertilizer amounts to 45 kg/ha for nitrogen and 23 kg/ha for phosphate and potassium. The fertilizer application is done at the first time between 15 and 25 days after transplanting and at the second time ranging from 40 to 60 days after transplanting. Chemical control of pests and diseases is performed only when the symptoms of diseases or insect occur. Harvesting works are done by renting combine on a commercial basis.

4.5 Anticipated Paddy Yield and Production

4.5.1 Anticipated paddy yield

Through provision for proper irrigation water supply system and improved agricultural supporting services, increase in paddy yield could be expected to large extent. Under the condition that irrigation development will be implemented, average paddy yield per one cropping is anticipated to be 4.0 ton/ha in case of the without tertiary development and 5.0 ton/ha in case of the with tertiary development in the Muda area in due consideration of the average yield for 1981-83 as shown in Table 174. The average yield in newly developed minor irrigation scheme areas is expected to increase from 2.2 ton/ha under the present rainfed condition to 4.5 ton/ha under the future irrigated condition.

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 four years.

4.5.2 Increase in paddy production

The future paddy production increase at the full development stage of the project by sufficient irrigation water supply is estimated on the basis of the projected irrigation development area and the anticipated yield mentioned above.

In the MADA and existing minor irrigation scheme areas of which irrigation water is provided through the MADA canal system and the main stream of Kedah river, the annual paddy production, which is expected to be 659,000 tons under the condition of insufficient water supply, will increase to 940,600 tons with sufficient water supply as shown in Table 175.

In the Kedah river basin, the existing minor irrigation schemes and rainfed paddy cultivation areas will be improved in taking irrigation water for supplemental purpose in the wet season and for irrigating more than 50% of paddy fields in the dry season. As a result, the annual paddy production will increase from 10,500 tons to 19,800 tons in the existing and newly developed minor scheme areas along the tributaries of the Kedah river.

In the Muda river basin, the existing minor irrigation schemes and rainfed paddy cultivation areas will also be able to meet irrigation water requirements fully for the wet season and more than half for the dry season through implementation of the proposed irrigation development plans. The expected increase in annual paddy production is 12,900 tons by the schemes diverting irrigation water from the main stream of the Muda river as shown in Table 175 and 22,300 tons by the schemes of which irrigation water sources are tributaries of the Muda river.

The total output expected by the sufficient irrigation water supply to the Region will increase from 797,700 tons in 1983 to 1,123,800 tons in 2003.

4.6 Tree Crop Development

4.6.1 Future planted area and production of tree crops

To provide basic data in estimating processing water requirement of rubber and oil palm as a component of industrial water demand, future production of rubber and oil palm is projected.

The future production projected by the State is summarized in Table 176 for rubber and Table 177 for oil palm. The projection indicates the increase in rubber production from 213,000 DRC tons in 1982 to 406,000 DRC tons in 2000 in the State of Kedah and from 39,000 DRC tons in 1982 to 223,000 DRC tons in 2000 in the State of Pulau Pinang.

4.6.2 Processing water requirement

The processing water demand is estimated by mill or factory in the respective river basins of the Region based on the forecasted processing amount of oil palm and rubber. The results of estimation are as shown in Table 178 for palm oil mills and Table 179 for rubber factories. The total annual processing water requirement in the Region in 2000 is estimated to be 220,000 m³ for palm oil mills and 10.6 x 10⁶ m³ for rubber factories, respectively.

5. AGRICULTURAL BENEFIT ATTRIBUTABLE TO WATER RESOURCES DEVELOPMENT AND MANAGEMENT

5.1 Economic Benefit in Agricultural Sector

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, to be developed during the periods of 4MP thru 7MP, which will provide irrigation water to wet paddy field fully for the water requirement of wet season cropping and at least more than half of water requirement for the dry season cropping. 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 four years.

5.2 Economic Prices of Farm Input and Output

The economic farm gate prices of rice and other internationally marketable crops are derived from a projection to 1995 at 1983 constant price level. For this, international market prices forecasted by IBRD in its 1983 issue are employed. The projected farm gate prices are M\$548/ton for paddy and M\$2,920/ton for dry rubber. The details for the derivation of economic farm gate price of paddy are as shown in Table 180. This economic farm gate price follows the result of the Feasibility Study on Reman Reservoir Project of which final report was submitted in 1984.

5.3 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. For the cost of fertilizers which are actually supplied to farmers in kind as one of Governmental subsidies, the economic fertilizer costs are estimated taking into account the purchasing prices by the Government. The breakdown of paddy production cost in the Muda area is as shown in Table 181. It is estimated on the basis of actual cost for the main season crop in 1982/83 and further by applying the economic conversion rate and by adjusting to the 1983 constant prices.

The estimated production cost for paddy cultivation in the Region is M\$796/ha for rainfed areas, M\$844/ha for minor irrigation areas and M\$892/ha for the Muda Irrigation Scheme areas under the without project condition as shown in Table 182. Under the with project condition, it is M\$916/ha for newly developed minor irrigation areas and, in the Muda area, M\$892/ha in case of without tertiary development and M\$938/ha in case of with tertiary development.

5.4 Economic Production Value

The economic gross production value is obtained by multiplying the anticipated crop yield by the economic farm gate 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 the both cases of insufficient and sufficient irrigation water supply are as tabulated in Table 182.

The estimated net production value under the without project condition is M\$410/ha for rainfed areas, M\$910/ha for the existing minor irrigation scheme areas and M\$1,300/ha for the Muda area where tertiary development has not been completed. The net value under the with project condition is M\$1,550/ha for the newly developed minor irrigation scheme areas, M\$1,802/ha for the Muda area after completion of tertiary development. There is no increase in the economic net production value in the Muda area under the condition of the without tertiary development and sufficient irrigation water supply.

As shown in Table 183, the total economic net production value in 2003 onward will increase from M\$210.3 x 10⁶ to M\$331.6 x 10⁶ in the Muda area, M\$6.0 x 10⁶ to M\$9.7 x 10⁶ in minor irrigation scheme areas depending irrigation water sources on MADA canal or the main stream of Kedah river. In the Muda river system, it will increase from M\$29.5 x 10⁶ to M\$50.5 x 10⁶ for minor irrigation scheme areas of which irrigation water resources are the main stream of Muda river and the Perai river system, and from M\$3.7 x 10⁶ to M\$13.3 x 10⁶ for minor irrigation scheme areas diverting river discharge from tributaries of the Muda river.

5.5 Economic Irrigation Cost and Benefit

The unit construction cost is assumed to be the same as that for Part 1 Study, or M\$9,000/ha for tertiary development in the Muda area and M\$11,500/ha for newly developed minor irrigation scheme areas in terms of financial cost. Annual operation and maintenance costs are assumed to be 1.5% of the total investment costs. Annual disbursement schedule of financial construction cost is estimated taking into account the annual development schedule of tertiary development in the Muda area and minor irrigation development in the outside of Muda area as shown in Table 171.

The estimated economic cost and benefit streams are as shown in Table 184 for the Muda Irrigation Scheme, Table 185 for minor irrigation schemes in the fringe area along the MADA canal, Table 186 for those along the main stream of Kedah river, Table 187 for those along tributaries of the Kedah river, Table 188 for those along the rain stream of Muda river, Table 189 for those along tributaries of the Muda river and Table 190 for those in the Perai river basin.

5.6 Production Foregone

For economic analysis, the opportunity cost of production foregone in the area affected by constructing the proposed Beris dam instead of compensation cost in financial analysis. The opportunity cost of production foregone is defined to be equivalent to the net production value of crops which are cultivated in the affected area. In the proposed reservoir area of Beris dam, paddy are grown under rainfed condition at the lowest part, and cassava, rubber and horticulture crops are planted around housing areas in upper parts. The average yield is estimated to be 1.5 ton/ha for paddy, 10.0 ton/ha for cassava and 0.7 ton/ha of dry rubber in the affected area. The estimated production foregone is M\$170/ha for rainfed paddy, M\$100/ha for mixed horticulture which is represented by cassava and M\$1,300/ha for rubber as shown in Table 191.

There are forest covers to some extent in the proposed reservoir area. People depend firewood source on these forests. Some forest products such as logs and poles are also harvested from forest reserves. Taking these forest activities into account, production foregone is estimated to be M\$650/ha for alienated forests and M\$1,660/ha for unalienated forests. In this estimate, statistical figures available in the Annual Report on Forestry in Peninsular Malaysia are referred to.

5.7 Financial Farm Budget

In evaluating payment capacity which is defined as the ability of farmers to bear the expenses required for development of irrigation facilities, typical farm budget is estimated for the both cases of with and without project as shown in Table 192. For the purpose of crop budget estimate, financial paddy farm gate price and production cost are set up as shown in Table 181.

In newly developed minor irrigation scheme areas, the gross cash income will increase from M\$1,408/ha to M\$2,469/ha on an average while the paddy expenditure will increase from M\$825/ha to M\$1,028/ha excluding land rent of M\$285/ha. The increase in net cash income by paddy cultivation is, therefore, expected to be M\$784/ha on an average.

As for the Muda area, the gross cash income will increase from M\$2,199/ha to M\$2,739/ha on an average, while the paddy expenditure will also slightly increase from M\$1,031/ha to M\$1,099/ha not including land rent of M\$285/ha. Thus, the net cash income by paddy cultivation is expected to increase by M\$326/ha on an average.

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TABLES

Table 1 GDP BY INDUSTRY OF ORIGIN IN MALAYSIA
FOR 1980-85

Unit: M\$10⁶ in 1970 prices

Sector	1980	1981	1982	1983	1984	1985
Primary						
Agriculture, forestry, livestock & fishing	6,255	6,516	6,995	7,030	7,335	7,673
Mining & quarrying	1,171	1,148	1,180	1,371	1,572	1,696
Sub-total	7,426	7,664	8,175	8,401	8,907	9,369
Secondary						
Manufacturing	4,875	5,115	5,309	5,628	6,022	6,534
Construction	1,209	1,391	1,523	1,751	1,944	2,090
Sub-total	6,084	6,506	6,832	7,379	7,966	8,624
Tertiary						
Electricity, gas & water	605	665	707	771	848	933
Transport, storage & communications	1,803	2,024	2,248	2,509	2,810	3,153
Wholesale & retail trade, hotels & restaurants	3,529	3,772	3,952	4,234	4,488	4,757
Finance, insurance, real estate & business services	2,041	2,199	2,337	2,512	2,726	2,971
Government services	3,202	3,750	4,030	4,191	4,359	4,533
Other services	720	750	774	813	862	914
Sub-total	11,900	13,160	14,048	15,030	16,093	17,261
Less: Imputed bank service charges	-407	-487	-644	-710	-792	-883
Plus: Import duties	1,225	1,249	1,266	1,298	1,336	1,384
GDP at purchasers' value	26,228	28,092	29,677	31,398	33,510	35,755

Source; Ref. C 1

Table 2 AVERAGE ANNUAL GROWTH RATE OF GDP
IN MALAYSIA FOR 1981-85

Unit: %

Sector	1981	1982	1983	1984	1985	1981-83	1981-85	FMP
Primary								
Agriculture, forestry, livestock & fishery	4.2	7.4	0.5	4.3	4.6	4.0	4.2	3.0
Mining & quarrying	-2.0	2.8	16.2	14.7	7.9	5.4	7.7	5.8
Sector	3.2	6.7	2.8	6.0	5.2	4.2	4.8	3.5
Secondary								
Manufacturing	4.9	3.8	6.0	7.0	8.5	4.9	6.0	11.0
Construction	15.1	9.5	15.9	11.0	7.5	13.1	11.6	9.0
Sector	7.0	5.0	8.0	8.0	8.3	6.6	7.2	10.6
Tertiary								
Electricity, gas & water	9.9	6.3	9.0	10.0	10.0	8.4	9.0	10.0
Transport, storage & communications	12.3	11.1	11.6	12.0	12.2	11.6	11.8	8.0
Wholesale & retail trade, hotels & restaurants	6.9	4.8	7.1	6.0	6.0	6.3	6.2	8.0
Finance, insurance, real estate & business services	7.7	6.3	7.5	8.5	9.0	7.2	7.8	7.4
Government services	17.1	7.5	4.0	4.0	4.0	9.4	7.2	9.0
Other services	4.2	3.2	5.0	6.0	6.0	4.1	4.9	7.6
Sector	10.6	6.7	7.0	7.1	7.3	8.1	7.7	8.3
Imputed bank service charges								
Imported duties	19.7	32.2	10.2	11.5	11.5	20.4	16.8	-
	2.9	1.4	2.5	2.9	3.6	1.9	2.5	-
GDP at purchasers' value	7.1	5.6	5.8	6.7	6.7	6.2	6.4	7.6

Source; Ref. C 1

Table 3 EMPLOYMENT ESTIMATE BY SECTOR
FOR 1980-85

Sector	1980		1983		1985	
	(103)	(%)	(103)	(%)	(103)	(%)
Primary						
Agriculture, forestry, livestock & fishing	1,911	39.7	1,941	37.0	1,981	35.5
Mining & quarrying	81	1.7	65	1.2	63	1.1
Sub-total	1,992	41.4	2,006	38.2	2,044	36.6
Secondary						
Manufacturing	750	15.6	800	15.3	876	15.7
Construction	268	5.5	346	6.6	387	6.9
Sub-total	1,018	21.1	1,146	21.9	1,263	22.6
Tertiary						
Electricity, gas & water	51	1.0	57	1.1	59	1.1
Transport, storage & communications	199	4.1	242	4.6	272	4.9
Wholesale and retail trade, hotels & restaurants	598	12.4	662	12.6	719	12.9
Finance, insurance, real estate & business services	46	1.0	51	1.0	55	1.0
Government services	693	14.4	837	16.0	896	16.1
Other services	220	4.6	244	4.6	268	4.8
Sub-total	1,807	37.5	2,093	39.9	2,269	40.8
Whole sectors	4,817		5,245		5,576	
Labour force	5,109		5,580		5,947	
Unemployment	292		335		371	
Unemployment rate (%)	5.7		6.0		6.2	

Source; Ref. C 1

Table 4 COMMODITY EXPORTS OF MALAYSIA FOR 1980-85

Commodity	1980	1981	1982	1983	1984	1985
Rubber						
Volume (10 ³ ton)	1,526	1,483	1,378	1,563	1,560	1,600
Unit value (M\$/ton)	3,026	2,502	1,927	2,344	2,800	2,950
Value (M\$10 ⁶)	4,617	3,712	2,655	3,664	4,368	4,720
Palm oil						
Volume (10 ³ ton)	2,138	2,350	2,700	2,913	2,952	3,347
Unit value (M\$/ton)	1,176	1,153	984	1,022	1,147	1,158
Value (M\$10 ⁶)	2,515	2,710	2,656	2,977	3,386	3,876
Cocoa						
Volume (10 ³ ton)	30.6	41.8	57.6	56.1	69.3	78.5
Unit value (M\$/ton)	5,287	4,088	3,439	4,059	4,400	4,500
Value (M\$10 ⁶)	162	171	198	228	305	353
Pepper						
Volume (10 ³ ton)	31.7	28.8	25.2	23.5	25.0	28.0
Unit value (M\$/ton)	3,395	2,840	2,625	3,332	3,520	3,714
Value (M\$10 ⁶)	108	82	66	78	88	104
Sawlogs						
Volume (10 ³ m ³)	15,152	15,816	19,288	18,752	18,074	17,351
Unit value (M\$/m ³)	173	156	175	149	160	178
Value (M\$10 ⁶)	2,621	2,473	3,378	2,794	2,892	3,088
Sawn timber						
Volume (10 ³ m ³)	3,000	2,698	2,942	3,287	3,253	3,237
Unit value (M\$/m ³)	393	360	351	371	395	425
Value (M\$10 ⁶)	1,179	971	1,035	1,221	1,285	1,376
Tin						
Volume (10 ³ ton)	69.5	66.4	48.6	57.1	47.0	51.0
Unit value (M\$/ton)	36,040	32,180	30,549	30,093	30,090	30,541
Value (M\$10 ⁶)	2,505	2,138	1,484	1,718	1,414	1,558
Copper						
Volume (10 ³ ton)	107	128	124	120	120	120
Unit value (M\$/ton)	1,651	1,355	1,194	1,320	1,393	1,532
Value (M\$10 ⁶)	177	174	149	158	167	184
Crude petroleum						
Volume (10 ³ ton)	11,252	10,143	11,974	14,224	16,748	16,748
Unit value (M\$/ton)	596	682	643	553	524	524
Value (M\$10 ⁶)	6,709	6,918	7,694	7,871	8,776	8,776
LNG						
Volume (10 ³ ton)	-	-	-	1,690	2,990	4,500
Unit value (M\$/ton)	-	-	-	578	410	410
Value (M\$10 ⁶)	-	-	-	977	1,226	1,845
Manufactures						
Value (M\$10 ⁶)	6,107	6,411	7,442	9,797	11,796	14,662
Other commodity exports						
Value (M\$10 ⁶)	1,472	1,340	1,379	1,440	1,664	1,832
Total gross commodity exports						
value (M\$10 ⁶)	28,172	27,100	28,136	32,923	37,367	42,374

Source; Ref. C 1

Table 5 GROSS EXPORT BY SECTOR FOR 1980-85

Sector	1980	1981	1982	1983	1984	1985
Agriculture*						
Volume index (1980=100)	100	102.4	104.4	115.2	116.9	125.5
Unit value index (1980=100)	100	87.8	70.7	81.0	94.3	97.7
Value (M\$10 ⁶)	7,402	6,675	5,576	6,946	8,147	9,053
Share of total (%)	26.3	24.6	19.8	21.1	21.8	21.4
Forestry**						
Volume index (1980=100)	100	99.9	118.2	119.4	115.9	112.4
Unit value index (1980=100)	100	90.6	97.5	88.7	95.0	104.5
Value (M\$10 ⁶)	3,800	3,444	4,413	4,015	4,177	4,464
Share of total (%)	13.5	12.7	15.7	12.2	11.2	10.5
Mining***						
Volume index (1980=100)	100	92.1	96.9	114.3	126.3	127.9
Unit value index (1980=100)	100	107.1	101.0	90.1	86.7	87.2
Value (M\$10 ⁶)	9,391	9,230	9,326	9,747	10,357	10,518
Share of total (%)	33.3	34.1	33.2	29.6	27.7	24.8
LNG						
Value (M\$10 ⁶)	-	-	-	977	1,226	1,845
Share of total (%)	-	-	-	3.0	3.3	4.4
Manufactures						
Value (M\$10 ⁶)	6,107	6,411	7,442	9,797	11,796	14,662
Share of total (%)	21.7	23.7	26.4	29.8	31.6	34.6
Other commodity exports						
Value (M\$10 ⁶)	1,472	1,340	1,379	1,440	1,664	1,832
Share of total (%)	5.2	4.9	4.9	4.4	4.5	4.3
Gross exports						
Value (M\$10 ⁶)	28,172	27,100	28,136	32,922	37,367	42,374

Remarks; *: Including rubber, palm oil, cocoa and pepper.
 **: Including sawlogs and sawn timber.
 ***: Including tin, copper and crude petroleum.

Source; Ref. C 1

Table 6 PROGRESS AND TARGET OF LAND DEVELOPMENT
IN MALAYSIA FOR 1981-85

Unit: ha

Agency/Program	Original	Achievement		Revised
	Target 1981-85	1981-83	(%)	Target 1981-85
Federal programs				
FELDA	149,798	104,184	69.5	161,581
FELCRA*1	32,662	27,450	84.0	41,142
RISDA*2	15,409	9,770	63.4	9,770
Sub-total	197,869	141,404	71.5	212,493
State programs				
Peninsular Malaysia*3	143,872	75,245	52.3	143,872
Sabah*4	56,680	27,660	48.8	56,680
Sarawak*5	16,599	4,980	30.0	16,599
Sub-total	217,151	107,885	49.7	217,151
Joint-venture*6 & private sector	128,441	53,945	42.0	100,000
Total	543,461	303,234	55.8	529,644

- Remarks;
- *1: Excluding rehabilitation and existing village consolidation schemes.
 - *2: Block newplanting only and the program was terminated in August 1982.
 - *3: For programs of regional development authorities, SLDBs, SADCs, SEDCs and DOA.
 - *4: For programs of SLDBs, SRFB and Rural Development Cooperative, Sabah.
 - *5: For programs of SLDBs and DOA (rubber newplanting).
 - *6: For joint-venture projects between public sector agencies and the private sector as well as by private sector alone.

Source; Ref. C 1

Table 7 PROGRESS OF CROPPED HECTARAGE
IN MALAYSIA FOR 1980-85

Unit: 10³ ha

Crop	1980	1981	1982	1983	1984	1985
Rubber	2,010	2,006	1,966	1,990	2,000	2,012
Oil palm	1,070	1,141	1,212	1,227	1,306	1,400
Cocoa	109	150	190	205	211	237
Pepper	12.7	13.4	12.8	11.4	11.0	10.8
Ochard	93.0	87.8	89.0	90.0	92.0	94.0
Pineapple	12.1	11.7	9.7	8.2	7.2	7.0
Vegetables	18.4	15.3	16.1	18.3	20.7	23.5
Paddy	735	768	758	764	770	775
Tobacco	12.5	13.0	13.6	14.2	15.0	15.7
Timber	383	391	487	586	560	560

Source; Ref. C 1

Table 8 PROGRESS OF AGRICULTURAL AND FORESTRY
PRODUCTION IN MALAYSIA FOR 1980-85

Unit: 10³ ton

Production	1980	1981	1982	1983	1984	1985
Rubber	1,530	1,526	1,517	1,530	1,550	1,570
Crude palm oil	2,576	2,825	3,511	3,015	3,473	3,938
Palm kernel oil	248	265	410	404	439	480
Cocoa	32.9	48.0	62.0	65.0	72.3	81.0
Pepper	31.7	28.8	25.2	23.5	25.0	28.0
Pineapple	185	154	153	153	153	153
Paddy	2,053	2,021	1,873	1,818	1,855	1,892
Sawlogs (106 m)	27.9	30.7	32.8	34.2	32.9	31.5
Fisheries	744	767	694	713	741	725
Livestock:						
Beef	13.0	12.1	13.7	14.0	14.4	14.8
Mutton	0.8	0.6	0.6	0.6	0.6	0.6
Poultry	114	115	116	122	128	134
Eggs (106)	2,296	2,308	2,380	2,499	2,623	2,755
Pork	123	131	127	131	135	139
Milk (106 lit)	8.2	14.9	16.7	18.9	24.5	27.3

Source; Ref. C 1

Table 9 PROGRESS OF INTEGRATED AGRICULTURAL
DEVELOPMENT PROJECT IN MALAYSIA

Project already Completed	Project under Implementation	Project under Feasibility Study
Muda I (Perlis & Kedah)	Perlis (Perlis)	Tumboh Block (Perak)
Besut (Trengganu)	Muda II (Perlis & Kedah)	Western Johor II (Johor)
Kemubu (Kelantan)	Kedah Valley (Kedah)	Sungai Sokor/Sungai Nal (Kelantan)
	Balik Pulau/Seberang Prai (P. Pinang)	Sungai Golok (Kelantan & Thailand)
	Krian/Sungai Manik (Perak)	Samarahan (Sarawak)
	Trans-Perak (Perak)	Kalaka-Saribas (Sarawak)
	North West Selangor (Selangor)	
	Negeri Sembilan Timur (N. Sembilan)	
	Melak (Melaka)	
	West Johor I (Johor)	
	Rompin/Endau (Pahang)	
	Pahang Barat (Pahang)	
	Kemasin/Semarak (Kelantan)	
	KADA II (Kelantan)	

Source; Ref. C 1

Table 10 PUBLIC DEVELOPMENT EXPENDITURE FOR
AGRICULTURAL PROGRAMS FOR 1981-85

Unit: M\$10⁶

Program	Original Alloca- tion 1981-85	Estimated Expendi- ture 1981-83	Achieve- ment (%)	Revised* Alloca- tion 1981-85	Balance to be spent 1984-85
IADP	892	191	32.2	450	259
Diversification of crop	65	42	59.5	43	1
Extension and other services	80	33	41.7	74	41
Other programs	189	144	59.8	215	71
Input subsidies for paddy	500	273	58.0	432	159
KADA	28	20	72.4	27	7
MADA	33	13	38.4	21	8
Replanting: Rubber	317	219	69.1	479	260
Pineapple	20	8	40.1	13	5
Coconut	50	27	54.3	54	27
Land and regional develop- ment	3,982	2,250	62.2	3,554	1,304
Drainage and irrigation	860	950	79.4	1,472	522
Forestry	63	24	38.8	33	9
Livestock	241	98	42.1	138	40
Fisheries	435	180	41.5	320	140
Agricultural research	93	64	63.0	78	14
Credit, marketing and processing	782	402	52.9	611	209
Total	8,630	4,938	59.5	8,014	3,076

Remark; *: Revised 4MP allocation during Mid-Term Review.

Source; Ref. C 1

Table 11 INCIDENCE OF POVERTY BY RURAL-URBAN STRATA IN PENINSULAR MALAYSIA IN 1983

Stratum	Total Households (103)	Total Poor Households (10 ³)	Incidence of Poverty (%)	Percentage among Poor (%)
Rural				
Agriculture	906.6	496.6	54.9	69.4
Rubber smallholders	(405.8)	(247.9)	(61.1)	(34.6)
Oil palm smallholders	(23.0)	(1.5)	(6.5)	(0.2)
Coconut smallholders	(31.0)	(10.1)	(32.7)	(1.4)
Paddy farmers	(138.9)	(75.0)	(54.0)	(10.5)
Other agriculture	(161.7)	(87.3)	(54.0)	(12.2)
Fishermen	(40.5)	(18.1)	(44.7)	(2.5)
Estate workers	(105.7)	(57.7)	(54.6)	(8.0)
Other industries	582.9	122.1	20.9	17.0
Sub-total	1,489.5	619.7	41.6	86.4
Urban				
Mining	5.2	2.1	41.0	0.3
Manufacturing	222.2	28.0	12.6	3.9
Construction	38.0	5.2	13.7	0.7
Transport and utilities	92.3	14.4	15.6	2.0
Trade and services	523.3	48.2	9.2	6.7
Sub-total	881.2	97.9	11.1	13.6
Total	2,370.7	717.6	30.3	100.0

Source; Ref. C 1

Table 12 LABOUR FORCE BY AGE AND STRATUM IN PENINSULAR MALAYSIA FOR 1980-85

Age Group	1980		1985		Average Annual Growth Rate for 1981-85 (%)
	(10 ³)	(%)	(103)	(%)	
Rural					
15 - 19	331.8	13.0	311.3	11.4	-1.3
20 - 34	1,137.7	44.5	1,238.8	45.1	1.7
35 - 44	525.4	20.6	576.7	21.0	1.9
45 - 54	365.3	14.3	404.3	14.7	2.1
55 - 64	194.2	7.6	213.8	7.8	1.9
Total	2,554.4	100.0	2,744.9	100.0	1.5
Urban					
15 - 19	225.8	13.2	247.4	11.5	1.8
20 - 34	917.1	53.8	1,156.3	53.4	4.7
35 - 44	306.2	18.0	426.6	19.7	6.9
45 - 54	181.6	10.6	238.5	11.0	5.6
55 - 64	74.7	4.4	95.7	4.4	5.1
Total	1,705.4	100.0	2,164.5	100.0	4.9

Source; Ref. C 1

Table 13 HISTORICAL RECORD ON CONSUMPTION OF
RICE IN PENINSULAR MALAYSIA FOR 1970-81

Year	Production (10 ³ ton)	Net Import (10 ³ ton)	Total Apparent Consumption (10 ³ ton)	Rate of Self- Sufficiency (%)	Apparent per Capita Consumption (kg)
1970	915	262	1,177	78	133
1971	990	143	1,133	87	126
1972	1,002	98	1,100	91	102
1973	1,106	157	1,263	88	134
1974	1,164	205	1,369	85	141
1975	1,099	61	1,160	95	117
1976	1,118	114	1,232	91	121
1977	1,060	163	1,223	87	116
1978	799	287	1,086	74	101
1979	1,170	101	1,271	92	115
1980	1,145	25	1,170	98	105
1981	1,137	125	1,262	90	111

Source; Ref. C 2

Table 14 ESTIMATED SUPPLY AND DEMAND SITUATION
FOR RICE FOR 1984-2000

Year	Net Local Production of Rice (10 ³ ton)	Estimated Demand for Rice based on per Capita Consumption (10 ³ ton)	Level of Self-sufficiency (%)
1984	959	1,501	63.9
1985	1,052	1,515	69.4
1986	1,086	1,524	71.3
1987	1,106	1,534	72.1
1988	1,163	1,545	75.3
1989	1,189	1,556	76.4
1990	1,323	1,568	84.4
1995	1,537	1,665	92.3
2000	1,647	1,857	88.7

Source; Ref. C 3

Table 15 BREAKDOWN OF RICE SUPPLY BY TYPE OF IRRIGATION SCHEME IN PENINSULAR MALAYSIA FOR 1981-2000

Type of Scheme	1981	1985	1990	2000
Major Irrigation Schemes				
Physical area (ha)	210,497	212,235	214,871	221,797
Crop intensity	1.5	1.5	1.7	1.9
Planted area (ha)	305,528	316,858	369,103	411,466
Average yield (ton/ha)	3.8	4.2	4.7	5.6
Paddy production (10 ³ ton)	1,157.1	1,318.4	1,718.4	2,290.2
Rice production (10 ³ ton)	656.2	745.0	968.5	1,287.3
Minor Irrigation Schemes (Double cropping area)				
Physical area (ha)	51,026	60,666	60,666	60,666
Crop intensity	1.3	1.3	1.4	1.5
Planted area (ha)	66,334	78,866	84,932	90,999
Average yield (ton/ha)	2.7	3.3	3.8	3.8
Paddy production (10 ³ ton)	179.1	260.3	322.7	345.8
Rice production (10 ³ ton)	99.7	142.2	176.1	188.7
Minor Irrigation Schemes (Single cropping area)				
Physical area (ha)	23,910	23,910	23,220	21,687
Crop intensity	0.7	0.7	0.7	0.7
Planted area (ha)	16,737	16,737	16,254	15,811
Average yield (ton/ha)	2.7	2.7	2.7	2.7
Paddy production (10 ³ ton)	45.2	45.2	43.9	41.0
Rice production (10 ³ ton)	24.7	24.7	23.9	22.4
Control Drainage Schemes				
Physical area (ha)	18,601	13,951	9,301	0
Crop intensity	0.5	0.5	0.5	0
Planted area (ha)	9,300	6,975	4,650	0
Average yield (ton/ha)	1.7	1.7	1.7	0
Paddy production (10 ³ ton)	15.8	11.9	7.9	0
Rice production (10 ³ ton)	8.6	6.5	4.3	0
Whole Schemes				
Physical area (ha)	304,034	310,762	308,058	304,150
Crop intensity	1.3	1.3	1.5	1.7
Planted area (ha)	397,899	419,436	474,939	518,276
Average yield (ton/ha)	3.5	3.9	4.4	5.2
Paddy production (10 ³ ton)	1,397.2	1,635.8	2,092.9	2,677.0
Rice production (10 ³ ton)	789.2	918.4	1,172.8	1,498.4

Source; Ref. C 4

Table 16 AREAL EXTENT OF SOILS IN THE REGION

Unit: km²

Soils	Perlis	Kedah	P. Pinang	Region
A. Alluvial Soils				
Alluvial soils on coastal plains	184	965	402	1,551
Alluvial soils on coastal and/or riverine	-	-	1	1
Alluvial soils on riverine flood plains or low riverine terraces	148	935	86	1,169
Alluvial soils on intermediate and higher terraces	265	54	98	417
Sub-total	597	1,954	587	3,138
B. Sedentary Soils				
Sedentary soils on undulating plains to rolling land	87	3,573	82	3,742
Sedentary soils on rolling and low hilly land	-	-	-	-
Sedentary soils on hills and mountains	103	2,995	180	3,278
Sub-total	190	6,568	262	7,020
C. Urban and Mined Land				
Soils on urban and mined land	8	75	84	167
Total	795	8,597	933	10,325

Source; Refs. C 5 and C 6

Table 17 SOIL SERIES IDENTIFIED IN PADDY CULTIVATION AREAS
IN THE STATES OF PERLIS, KEDAH AND PULAU PINANG

Soils	Perlis	Kedah	Pulau Pinang
Marine alluvium	Chengai Kundur Rotan Sedaka Kranji Kangkong Telok Kuala Kedah Tebengau	Kranji Kuala Kedah Tebengau Kangkong Kundur Chengai Rotan Sedaka	Sedaka Bakau Serong Kranji K. Kedah Permatang
Riverine alluvium	Tualang Hutan Sembrin	Tualang Idris Hutan Sembrin	Akob Telemong
Mixed riverine & marine alluvium	Kangar	Kangar	Rantau Kundur Tualang
Acid sulphate	Kuala Perlis	Kuala Perlis Telok Guar	
Sub-recent alluvium			Manik Sogomana Lunas Holyrood
Recent alluvium			Local alluvium colluvium
Alluvium on lower terrace	Serok Chuping Kabu Telemong		
Alluvium on middle terrace	Holyrood-Nangka associations		
Alluvium on higher terrace	Harimau-Tampoi associations		

Source; Ref. C 7

Table 18 MAIN CHARACTERISTICS OF THE AGROCLIMATIC REGIONS 1 TO 4

Region	J	F	M	A	M	J	J	A	S	O	N	D	Others
1	D	D	D	d	m	dm	m	m	m	f		D	w
2	D	D	D	d			(d)			Fr		D	
3	D	D	D		m	m	m	m	Fm	F		D	w
4	D	D	d	f						fr	F		

Remarks; D: dry month with the agricultural rainfall index of below 40 during 20% of years on record
d: frequent moisture stress days with a probability of over 40%
m: morning rainfall maximum
F: flash floods likely with a probability of 90% rainfall over 200 mm
f: flash floods probable with a probability of 80% rainfall over 200 mm
r: sunshine less than 40% of possible hours
w: strong wind gusts possible
(): only in some parts of the region

Source; Ref. C 8

Table 19 AVERAGE MONTHLY RAINFALL IN THE REGION

Unit: mm

	Rainfall Station No.								
	6402007	6206035	6204039	6004045	5704057	5807067	5406081	5404041	5302002
J	41	43	44	48	64	62	107	79	78
F	40	38	53	58	65	64	90	74	94
M	107	119	100	86	136	109	192	129	158
A	177	184	187	174	231	205	275	192	225
M	210	223	255	260	296	249	270	199	258
J	171	137	182	214	265	168	184	158	184
J	165	139	187	248	272	202	230	196	210
A	207	176	218	243	277	210	240	209	261
S	273	262	301	370	417	288	341	341	376
O	294	316	321	358	483	381	456	392	486
N	235	209	214	235	294	266	336	280	270
D	92	102	100	95	147	114	219	155	132
Y	2,012	1,948	2,162	2,389	2,947	2,318	2,940	2,404	2,732

Remarks; 6402007: Arau, 6206035: Kuala Nerang,
6204039: Kajicuaca, 6004045: Keretapi,
5704057: Ibu Bekalan Tupah, 5807067: Sik,
5406081: Ladang Bagan Sena,
5404041: Ladang Malakoff and
5302002: Pintuair Bagan

Table 20 AREAL EXTENT OF FORESTED AND NON-FORESTED LAND IN THE STATES OF PERLIS, KEDAH AND PULAU PINANG AS OF 1982

Unit: ha

Category	Perlis	Kedah	Pulau Pinang	Total
1. Forested Land				
1.1 Forest reserve	7,522	338,950	6,030	352,502
1.2 Wild life & other reserves	-	-	803	803
1.3 State forest				
- Uncommitted	4,564	-	-	4,564
- Others	-	38,745	535	39,280
Sub-total	12,086	377,695	7,368	397,149
2. Non-Forested Land				
2.1 Alienated land	40,084	356,450	89,902	486,436
2.2 State land forest	27,345	208,385	6,086	241,816
Sub-total	67,429	564,835	95,988	728,252
3. Total Land	79,515	942,530	103,356	1,125,401

Source; Ref. C 9

Table 21 PRESENT STATUS OF FOREST RESERVE IN THE STATES OF PERLIS, KEDAH AND PULAU PINANG

Unit: ha

Item	Perlis	Kedah	Pulau Pinang	Total
Product Forest				
Inland forest	5,187	192,902	2,271	200,360
Mangrove forest	-	7,749	406	8,155
Total	5,187	200,651	2,677	208,515
Unproductive Forest				
Inland forest	2,335	137,011	3,353	142,699
Mangrove forest	-	1,288	-	1,288
Total	2,335	138,299	3,353	143,987
Forest Reserve	7,522	338,950	6,030	352,502

Source; Ref. C 9

Table 22 EXISTING FOREST COVER IN THE STATES OF
PERLIS, KEDAH AND PULAU PINANG

Unit: ha

Forest Cover	Perlis	Kedah	Pulau Pinang	Total
Unexploited productive inland forest	401	81,018	612	82,031
Regenerated productive inland forest	-	31,527	-	31,527
Unexploited productive mangrove forest	-	7,749	406	8,155
Unproductive inland forest	2,335	137,011	3,353	142,699
Unproductive mangrove forest	-	1,288	-	1,288
Wild life and other reserves	-	-	803	803
State forest	4,564	38,745	535	43,844
Total	7,300	297,338	5,709	310,347
Forested land	12,086	377,695	7,368	397,149
Exploited and untreated land	4,786	80,357	1,659	86,802
Ratio of forest cover (%)	60	79	77	78

Source; Ref. C 9

Table 23 GROSS REGIONAL PRODUCT BY INDUSTRY OF
ORIGIN IN THE STATES OF PERLIS, KEDAH
AND PULAU PINANG FOR 1980

Unit: M\$10⁶ in 1970 prices

Sector	Perlis	Kedah	Pulau Pinang	Total	Contribution to Malaysia
Primary					
Agriculture, forestry, livestock & fishing	87.7	643.2	130.7	861.6	13.8%
Mining & quarrying	1.1	13.5	8.7	23.3	2.0%
Sub-total	88.8	656.7	139.4	884.9	11.9%
Secondary					
Manufacturing	23.1	69.2	709.5	801.8	16.4%
Construction	5.3	29.8	74.6	109.7	9.1%
Sub-total	28.4	99.0	784.1	911.5	15.0%
Tertiary					
Utilities	2.5	25.2	64.9	92.6	15.3%
Transport, storage & communications	6.7	59.4	233.4	299.5	16.6%
Wholesale & retail trade, hotels & restaurants	6.8	61.4	438.5	506.7	14.4%
Finance, insurance, real estate & business services	16.5	110.2	143.3	270.0	13.2%
Government service	37.2	209.0	206.3	452.5	14.1%
Other services	5.6	27.5	63.1	96.2	13.4%
Sub-total	75.3	492.7	1,149.5	1,717.5	14.4%
Total GRP	192.5	1,248.4	2,073.0	3,513.9	13.8%
GRP at purchasers' value	198.1	1,284.7	2,133.13	3,616.1	13.8%

Source; Ref. C 1

Table 24 GROSS REGIONAL PRODUCT BY INDUSTRY OF
ORIGIN IN THE STATES OF PERLIS, KEDAH
AND PULAU PINANG FOR 1983

Unit: M\$10⁶ in 1970 prices

Sector	Perlis	Kedah	Pulau Pinang	Total	Contribution to Malaysia
Primary					
Agriculture, forestry, livestock & fishing	90.4	664.5	131.7	886.6	12.6%
Mining & quarrying	1.2	14.0	10.9	26.1	1.9%
Sub-total	91.6	678.5	142.6	912.7	10.9%
Secondary					
Manufacturing	27.0	79.2	872.4	978.6	17.4%
Construction	7.7	41.4	100.6	149.7	8.5%
Sub-total	34.7	120.6	973.0	1,128.3	15.3%
Tertiary					
Utilities	2.8	27.6	81.9	112.3	14.6%
Transport, storage & communications	10.0	83.6	295.0	388.6	15.5%
Wholesale & retail trade, hotels & restaurants	8.3	75.1	541.2	624.6	14.8%
Finance, insurance, real estate & business services	22.2	141.1	179.4	342.7	13.6%
Government service	49.8	281.9	278.1	609.8	14.6%
Other services	6.6	31.0	70.2	107.8	13.3%
Sub-total	99.7	640.3	1,445.8	2,185.8	14.5%
Total GRP	226.0	1,439.4	2,561.4	4,226.8	13.7%
GRP at purchasers' value	229.8	1,463.9	2,604.9	4,298.6	13.7%

Source; Ref. C 1

Table 25 GROSS REGIONAL PRODUCT BY INDUSTRY OF
ORIGIN IN THE STATES OF PERLIS, KEDAH
AND PULAU PINANG FOR 1985

Unit: M\$10⁶ in 1970 prices

Sector	Perlis	Kedah	Pulau Pinang	Total	Contribution to Malaysia
Primary					
Agricultural, forestry, livestock & fishing	93.5	687.4	131.7	912.6	11.9%
Mining & quarrying	1.3	16.5	14.8	32.6	1.9%
Sub-total	94.8	703.9	146.5	945.2	10.1%
Secondary					
Manufacturing	31.9	99.3	1,010.5	1,141.7	17.5%
Construction	9.0	48.8	116.0	173.8	8.3%
Sub-total	40.9	148.1	1,126.5	1,315.5	15.3%
Tertiary					
Utilities	3.2	30.7	100.9	134.8	14.4%
Transport, storage & communications	12.2	102.1	369.8	484.1	15.4%
Wholesale & retail trade, hotels & restaurants	10.6	87.4	602.2	700.2	14.7%
Finance, insurance, real estate & business services	25.3	160.4	206.9	392.6	13.2%
Government service	54.5	288.1	305.1	647.7	14.3%
Other services	7.5	35.2	78.2	120.9	13.2%
Sub-total	113.3	703.9	1,663.1	2,480.3	14.4%
Total GRP	249.0	1,555.9	2,936.1	4,741.0	13.4%
GRP at purchasers' value	252.1	1,575.0	2,972.1	4,799.2	13.4%

Source; Ref. C 1

Table 26 AVERAGE ANNUAL GROWTH RATE OF GRP BY INDUSTRY OF ORIGIN IN THE STATES OF PERLIS, KEDAH AND PULAU PINANG FOR 1981-83

Sector	Unit: %		
	Perlis	Kedah	Pulau Pinang
Agriculture, forestry & fishing	1.0	1.1	0.3
Mining & quarrying	2.9	1.2	7.8
Manufacturing	5.3	4.6	7.1
Construction	13.3	11.6	10.5
Utilities	3.8	3.1	8.1
Transport, storage & communications	14.3	12.1	8.1
Wholesale & retail trade, hotels & restaurants	6.9	6.9	7.3
Finance, insurance, real estate & business services	10.4	8.6	7.8
Government services	10.2	10.5	10.5
Other services	5.6	4.1	3.6
GRP at purchasers' value	5.1	4.4	6.9

Source; Ref. C 1

Table 27 PER CAPITA GRP IN THE STATES OF PERLIS, KEDAH AND PULAU PINANG IN 1980, 1983 AND 1985

Item	Perlis	Kedah	Pulau Pinang	Malaysia
Per capita GRP (M\$10 ⁶ in 1970 prices)				
1980	1,336	1,151	2,235	1,908
1983	1,470	1,261	2,596	2,120
1985	1,561	1,325	2,875	2,300
Average annual growth rate (%)				
1981 - 83	3.2	3.1	5.1	3.6
1984 - 85	4.7	3.7	6.8	6.7
Ratio to Malaysian average per capita GRP				
1980	0.70	0.60	1.17	1.00
1983	0.69	0.59	1.22	1.00
1985	0.68	0.58	1.25	1.00

Source; Ref. C 1

Table 28 POPULATION AND ITS RELATED INFORMATION IN
THE STATES OF PERLIS, KEDAH AND PULAU PINANG

Item	Perlis	Kedah	Pulau Pinang	Total	Contribution to Malaysia
Population (10 ³)					
1980	148.3	1,116.1	954.6	2,219.0	16.1%
1985	161.5	1,188.6	1,033.9	2,384.0	15.3%
Net inter-state migration rate (%)					
1970-80	-0.1	-5.3	0.3	-	-
Population growth rate (%)					
1981-85	1.7	1.3	1.6	-	-
Age group (10 ³)					
1980					
0 - 14	52.3	441.5	323.9	817.7	15.1%
15 - 64	89.0	630.8	589.3	1,309.1	16.7%
65 & above	7.0	43.8	41.4	92.2	18.4%
1985					
0 - 14	55.2	455.6	327.3	838.1	14.3%
15 - 64	98.5	682.5	660.3	1,441.3	15.8%
65 & above	7.8	50.5	46.3	104.6	18.3%
Proportion by age group (%)					
1980					
0 - 14	35.3	39.6	33.9	36.8	-
15 - 64	60.0	56.5	61.7	59.0	-
65 & above	4.7	3.9	4.4	4.2	-
1985					
0 - 14	34.2	38.3	31.6	35.1	-
15 - 64	61.0	57.4	63.9	60.5	-
65 & above	4.8	4.3	4.5	4.4	-
Urban-rural population (10 ³)					
1980					
Rural	135.0	954.0	507.2	1,596.2	17.7%
Urban	13.3	162.0	447.4	622.7	13.1%
1985					
Rural	146.1	1,016.7	572.9	1,735.7	17.8%
Urban	15.4	171.9	461.0	648.3	11.2%
Proportion by urban-rural strata (%)					
1980					
Rural	91.0	85.5	53.1	71.9	-
Urban	9.0	14.5	46.9	28.1	-
1985					
Rural	90.5	85.5	55.4	72.8	-
Urban	9.5	14.5	44.6	29.2	-

Source; Ref. C 1

Table 29 PRESENT LAND USE IN THE STATES OF
PERLIS, KEDAH AND PULAU PINANG

Unit: km²

Land Use Category	Perlis	Kedah	Pulau Pinang	Total
1. Agricultural Land				
1.1 Paddy	266	1,245	173	1,684
1.2 Rubber	99	2,319	253	2,671
1.3 Oil Palm	-	124	65	189
1.4 Coconut	15	112	153	280
1.5 Cocoa	-	7	6	13
1.6 Orchards	2	22	15	39
1.7 Pineapple	-	0	2	2
1.8 Sugarcane	81	73	-	154
1.9 Mixed Horticulture	79	125	138	342
1.10 Diversified Crops	5	26	9	40
1.11 Miscellaneous	2	6	6	14
Sub-total	549	4,059	820	5,428
2. Non-Agricultural Land				
2.1 Urban	6	52	79	137
2.2 Estate Building	1	11	1	13
2.3 Mining & Quarry	1	11	2	14
2.4 Grassland	27	118	19	164
2.5 Forest	121	3,686	74	3,881
2.6 Swamp	6	90	3	99
2.7 Others	84	1,398	36	1,518
Sub-total	246	5,366	214	5,826
Total	795	9,425	1,034	11,254

Source; Refs. C 10 to C 12, C 17 and C 18

Table 30 PRESENT LAND USE BY RIVER BASIN

Unit: km²

Land Use Category	Basin 1	Basin 3	Basin 4	Basin 5	Basin 6	Basin 7	Region Total
1. Agricultural Land							
1.1 Paddy	147	1,142	31	187	89	16	1,612
1.2 Rubber	99	575	213	1,157	394	52	2,490
1.3 Oil Palm	-	5	1	101	65	-	172
1.4 Coconut	15	60	5	52	100	19	251
1.5 Cocoa	-	7	-	-	6	-	13
1.6 Orchards	2	10	2	9	1	13	37
1.7 Pineapple	-	-	-	-	1	-	1
1.8 Sugarcane	81	73	-	-	-	-	154
1.9 Mixed Horticulture	79	34	19	53	77	45	307
1.10 Diversified Crops	5	9	3	10	8	2	37
1.11 Miscellaneous	2	6	0	2	1	3	14
Sub-total	430	1,921	274	1,571	742	150	5,088
2. Non-Agricultural Land							
2.1 Urban	6	28	4	11	39	42	130
2.2 Estate Building	1	2	2	4	2	-	11
2.3 Mining & Quarry	1	2	4	1	1	1	10
2.4 Grassland	27	56	6	36	19	6	150
2.5 Forest	235	1,164	131	1,994	48	67	3,639
2.6 Swamp	6	4	12	4	25	0	51
2.7 Others	84	518	87	529	4	24	1,246
Sub-total	360	1,774	246	2,579	138	140	5,237
Total	790	3,695	520	4,150	880	290	10,325

Remarks; Basin 1: Perlis Basin 3: Kedah
 Basin 4: Merbok Basin 5: Muda
 Basin 6: Perai Basin 7: Pulau Pinang

Source; Refs. C10 to C 12, C 17 and C 18

Table 31 HISTORICAL RECORDS ON PADDY CULTIVATION
IN THE STATES OF PERLIS, KEDAH AND
PULAU PINANG

Year	Crop Season	Planted Area (ha)	Yield (ton/ha)	Production (ton)	Contribution to Malaysia (%)	
					Planted Area	Production
1973/74	Main	162,630	3.53	574,400		
	Off	114,590	3.76	431,200		
1974/75	Main	160,740	3.45	553,900		
	Off	121,440	3.50	425,000		
1975/76	Main	160,740	3.33	535,100	46.2	55.4
	Off	125,270	4.02	503,200	56.3	65.5
1976/77	Main	158,390	3.13	496,000	45.9	54.8
	Off	125,270	3.49	437,000	59.0	61.1
1977/78	Main	160,520	3.11	498,600	47.9	54.5
	Off	17,180	3.60	61,900	16.6	20.3
1978/79	Main	161,150	3.66	589,600	48.6	57.0
	Off	136,940	3.76	514,500	61.3	68.3
1979/80	Main	160,530	3.71	595,900	50.3	57.9
	Off	118,770	4.26	506,100	58.1	70.0
1980/81	Main	159,220	3.90	620,400	50.4	60.1
	Off	113,850	4.02	458,000	57.2	64.9
1981/82	Main	140,900	3.84	540,800	51.3	59.7
	Off	125,190	3.14	392,900	59.0	57.5

Source; Ref. C 2

Table 32 HISTORICAL RECORDS ON PADDY CULTIVATION AREA OF
 RAINFED AND MINOR IRRIGATION SCHEME AREAS IN
 THE STATES OF PERLIS, KEDAH AND PULAU PINANG

Unit: ha

Year	Crop Season	Perlis		Kedah		Pulau Pinang	
		Planted	Harvested	Planted	Harvested	Planted	Harvested
1973/74	Main	10,300	9,940	39,190	39,010	17,290	17,160
	Off	2,830	2,830	15,390	15,330	13,760	13,480
1974/75	Main	10,300	9,810	39,190	38,720	15,390	14,910
	Off	2,830	2,830	13,800	13,800	16,190	15,930
1975/76	Main	10,300	9,930	39,190	39,050	15,990	15,820
	Off	5,680	5,540	16,050	15,940	14,920	14,790
1976/77	Main	10,300	7,000	38,530	37,130	13,700	13,500
	Off	2,030	1,900	11,810	11,800	13,220	13,040
1977/78	Main	10,300	4,000	40,680	14,880	13,680	13,400
	Off	-	-	7,640	7,640	9,540	9,530
1978/79	Main	10,300	9,490	40,740	40,700	14,250	13,730
	Off	7,800	5,700	27,440	27,430	13,080	13,080
1979/80	Main	10,360	10,040	42,890	41,650	11,420	11,340
	Off	3,380	3,310	14,510	14,470	11,420	10,940
1980/81	Main	10,360	10,000	41,910	41,700	11,090	10,770
	Off	5,250	2,690	12,670	11,840	5,730	5,500
1981/82	Main	10,560	4,700	30,340	21,830	6,760	5,500
	Off	7,960	3,920	19,270	18,760	8,430	8,400

Source; Ref. C 2

Table 33 TYPICAL CROPPING CALENDAR OF PADDY IN THE STATES OF PERLIS, KEDAH AND PULAU PINANG

State	Type	Main Season		Off-Season	
		Sowing	Harvesting	Sowing	Harvesting
Perlis	A	July - Oct.	Nov. - Feb.	Mar.	Aug.
	B	Oct.	Mar.	Apr. - June	Aug. - Oct.
Kedah	C	Aug. - Sept.	Jan. - Feb.	Feb. - Mar.	Aug. - Sept.
	D	Sept.- Dec.	Jan. - Apr.	Mar. - June	July - Oct.
	E	July - Aug.	Jan. - Feb.	Mar. - May	Aug. - Oct.
	F	June	Nov.	Jan. - Feb.	May - June
Pulau Pinang	G	Sept.- Dec.	Jan. - Apr.	Apr. - July	Aug. - Nov.
	H	Aug.	Dec.	Jan. - Feb.	May - June
	I			Apr.	Sept.

Source; Refs. C 2 and C 13 thru C 16

Table 34 CHARACTERISTIC OF TYPICAL RICE VARIETIES

Rice Variety	Maturation		1,000 Grains Weight (g)	Threshing Ability	Milling Recov-ery Rate (%)	Maximum Yield Capacity (ton/ha)	Year Re-leased
	Main Season (day)	Off-Season (day)					
Malinja	135	145	26.5	Easy	76.6	3.92	1964
Mahsuri	132	135	17.1	Easy	69.0	4.26	1965
Ria	125	125	29.0	Mod. easy	71.0	5.60	1966
Bahagia	137	145	25.5	Mod. easy	66.5	5.04	1968
Murni	135	140	24.5	Mod. easy	70.5	4.48	1972
Masria	120	125	26.3	Easy	70.0	5.60	1972
Jaya	123	127	23.5	Easy	70.1	4.45	1973
Sri Malaysia							
I	135	145	26.0	Mod. easy	67.5	5.04	1974
II	128	130	29.0	Easy	66.7	6.50	1974
Pulut							
Malaysia I	135	145	22.0	Mod. easy	69.7	6.16	1974

Remark; Mod. easy: Moderately easy

Source; Ref. C 2

Table 35 AREA PLANTED WITH DIFFERENT RICE VARIETIES IN THE STATES OF PERLIS, KEDAH AND PULAU PINANG IN 1980/81

Unit: ha

Rice Variety	Perlis		Kedah		MADA		Pulau Pinang	
	Main	Off	Main	Off	Main	Off	Main	Off
1,000 Gantang	3,000	1,200	13,510	5,190	37,390	35,960	170	30
Mahsuri	1,450	420	8,710	2,210	1,710	-	1,490	890
Anak Dara	2,500	500	2,790	580	17,460	12,940	1,000	10
Bahagia	20	-	2,210	240	-	-	290	220
MR 1	70	5	-	-	3,600	3,490	2,810	2,220
MR 6	-	-	-	-	8,730	11,300	-	-
MR 7	450	250	1,280	740	2,650	820	-	530
Benua	100	5	-	-	4,180	4,110	-	-
Malaysia Pasir	300	-	-	-	-	-	-	-
Sri Malaysia I	100	-	-	-	-	-	-	-
Sri Malaysia II	120	-	-	-	-	-	-	-
Pulut Malaysia I	-	-	-	-	-	-	-	-
Murni	-	-	-	-	1,140	410	-	-
Madu 3	150	-	-	-	-	-	30	-
Mat Candu	500	20	3,260	1,120	570	-	1,800	260
Lain-lain	1,600	2,850	6,950	2,410	18,410	21,170	830	200
Ketek	-	-	-	-	-	-	2,670	1,320
Jaya	-	-	1,500	-	-	-	-	-
Apollo	-	-	1,700	180	-	-	-	50
Total	10,360	5,250	41,910	12,670	95,840	90,200	11,090	5,730

Source; Ref. C 2

Table 36

HISTORICAL RECORDS ON PADDY YIELD AND PRODUCTION
OF RAINFED AND MINOR IRRIGATION SCHEME AREAS IN
THE STATES OF PERLIS, KEDAH AND PULAU PINANG

Unit: Yield ton/ha
Production ton

Year	Crop Season	Perlis		Kedah		Pulau Pinang	
		Yield	Production	Yield	Production	Yield	Production
1973/74	Main	2.75	28,400	2.90	113,500	3.42	59,100
	Off	1.27	3,600	1.52	23,400	3.67	50,500
1974/75	Main	2.26	23,300	2.32	91,100	3.31	50,900
	Off	0.32	900	0.35	4,800	3.00	48,800
1975/76	Main	2.82	29,100	2.89	113,100	3.34	39,800
	Off	2.78	15,800	2.03	32,600	3.21	37,100
1976/77	Main	2.09	21,500	1.57	60,300	2.91	45,300
	Off	3.65	7,400	3.54	41,800	2.80	31,900
1977/78	Main	0.52	5,400	2.33	94,800	3.31	45,300
	Off	-	-	3.93	30,000	3.34	31,900
1978/79	Main	3.19	32,900	2.57	104,700	2.97	42,300
	Off	2.13	16,600	1.73	47,500	2.75	36,000
1979/80	Main	1.91	19,800	2.05	88,000	2.45	27,900
	Off	3.83	9,300	2.27	39,100	2.41	27,500
1980/81	Main	3.31	34,300	2.56	107,200	2.87	31,900
	Off	2.48	13,000	2.45	31,000	2.96	17,000
1981/82	Main	1.67	17,700	2.29	69,400	2.26	15,300
	Off	3.53	28,100	2.41	46,400	3.07	25,900

Source; Ref. C 2

Table 37 PLANTED AREA OF RUBBER BY PRODUCER
IN THE STATES OF PERLIS, KEDAH AND
PULAU PINANG AS OF 1982.

Unit: ha

Producer	Perlis	Kedah	Pulau Pinang	Total
Estate	475	73,651	4,877	79,003
FELDA	-	12,080	-	12,080
FELCRA	-	7,082	-	7,082
RISDA	-	70,119	12,508	82,627
Smallholder	9,400	69,000	7,900	86,300
Total	9,875	231,932	25,285	267,092

Source; Ref. C 17

Table 38 RUBBER PRODUCTION BY PRODUCER IN
THE STATES OF PERLIS, KEDAH AND
PULAU PINANG IN 1976 AND 1982

Unit: DRC ton

State	1976			1982		
	Estates	Small- holders	Total	Estates	Small- holders	Total
Perlis	600	5,700	6,300	400	14,500	14,900
Kedah	92,300	115,000	207,300	97,300	113,100*	210,400
Pulau Pinang	10,900	37,500	48,400	6,800	29,400	36,200
Total	103,800	158,200	262,000	104,500	157,000	261,500

Remark; *: Including production by FELDA schemes.

Source; Ref. C 17

Table 39 PLANTED AREA OF OIL PALM BY PRODUCER
IN THE STATES OF PERLIS, KEDAH AND
PULAU PINANG AS OF 1983

Unit: ha

Producer	Perlis	Kedah		Pulau Pinang		Total
		Mature	Immature	Mature	Immature	
Estates	-	8,579	3,342	3,689	1,895	17,505
FELDA	-	-	283	-	-	283
RISDA	-	-	-	-	-	-
FELCRA	-	-	-	-	-	-
Smallholders	-	53	114	577	343	1,087
Total	-	8,632	3,739	4,266	2,238	18,875

Source; Ref. C 18

Table 40 OIL PALM PRODUCTION BY PRODUCER IN
THE STATES OF PERLIS, KEDAH AND
PULAU PINANG IN 1976 AND 1982

Unit: FFB ton

State	1976			1982		
	Estates	Public Agencies	Total	Estates	Public Agencies	Total
Perlis	-	-	-	-	-	-
Kedah	77,000	-	77,000	154,265	-	154,265
Pulau Pinang	43,000	-	43,000	60,180	-	60,180
Total	120,000	-	120,000	214,445	-	214,445

Source; Ref. C 18

Table 41 HISTORICAL RECORD ON PADDY CULTIVATION IN MADA

Year	Crop Season	Harvested Area (ha)	Yield (ton/ha)	Production (ton)
1968/69	Main	95,855	3.19	305,590
	Off	-	-	-
1969/70	Main	95,855	3.26	312,200
	Off	30,565	3.77	115,110
1970/71	Main	95,855	3.68	352,750
	Off	42,350	3.94	166,900
1971/72	Main	95,855	3.89	372,850
	Off	62,604	3.99	249,910
1972/73	Main	95,855	3.85	369,330
	Off	78,807	4.02	316,490
1973/74	Main	95,855	3.90	373,360
	Off	85,436	4.14	353,700
1974/75	Main	95,855	4.05	388,600
	Off	88,624	4.18	370,450
1975/76	Main	95,855	3.68	353,130
	Off	88,624	4.71	417,690
1976/77	Main	95,855	3.85	368,850
	Off	88,624	4.02	355,920
1977/78	Main	95,855	3.68	353,130
	Off	-	-	-
1978/79	Main	95,855	4.27	409,690
	Off	88,624	4.68	414,410
1979/80	Main	95,855	4.80	460,200
	Off	89,463	4.54	405,980
1980/81	Main	95,855	4.66	446,970
	Off	90,204	4.40	396,990
1981/82	Main	93,239	4.70	438,410
	Off	89,528	3.27	292,490
1982/83	Main	95,208	4.25	404,640

Source; Refs. C 2 and C 19

Table 42 SPECIFIC CULTURAL PLANTING SCHEDULE IN MADA

Farming Practice	Original Plan	Revised Plan
(1) Off-Season Crop		
Growing period	140 days	125-140 days
Staggering period	15 days	40 days
Commencement of irrigation	Jan. 17	Feb. 1
Calendar of cropping schedule		
- Presaturation & land soaking	7 days	(12 days)
- Nursery bed preparation	14 days	7 days
- Nursery growth	25 days	25 days
- Transplanting	4 days	4 days
- Plant growth	105 days	90-105 days
- Harvesting	6 days	6 days
- Land rest	18 days	25-40 days
Total operation period	179 days	179 days
Fallow period*	14 days	0-11 days
(2) Main Season Crop		
Growing period	135 days	125-140 days
Staggering period	15 days	40 days
Commencement of irrigation	July 15	July 30
Calendar of cropping schedule		
- Presaturation & land soaking	5 days	(12 days)
- Nursery bed preparation	7 days	7 days
- Nursery growth	25 days	25 days
- Transplanting	4 days	4 days
- Plant growth	101 days	91-106 days
- Harvesting	5 days	5 days
- Land rest	39 days	34-49 days
Total operation period	186 days	186 days
Fallow period*	45 days	25-40 days

Remark; *: Period between the last day of harvesting and the first day of sowing.

Source; Refs. C 20 and C 21

Table 43 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT I
OF MUDA AREA FOR CROP SEASON 1979/I (1/2)

Unit: %														
1979/I	Y 1979													
Total Area	M	2	2	2	2	3	3	3	3	3	4	4	4	4
16,139 ha	D	10	17	24	28	3	10	17	24	31	11	21	26	30
Phase 1 : Main field 4,721 ha														
Presaturation		44	61	68	74	85	88	88	93	95	97	97	97	99
Land preparation		8	24	39	45	68	80	82	87	90	97	97	97	99
Transplanting									11	29	74	83	92	
Flowering														
Ripening														
Harvesting														
Phase 2 : Main field 4,469 ha														
Presaturation			11	18	36	54	65	71	76	86	92	95	97	
Land preparation			1	3	8	21	31	45	50	62	85	90	96	
Transplanting									2	14	39	59	80	
Flowering														
Ripening														
Harvesting														
Phase 3 : Main field 3,328 ha														
Presaturation						17	33	49	60	73	90	92	99	
Land preparation						3	7	13	23	36	67	70	76	
Transplanting										4	16	18	41	
Flowering														
Ripening														
Harvesting														
Phase 4 : Main field 3,621 ha														
Presaturation									12	42	59	92	92	98
Land preparation									10	21	64	64	81	
Transplanting												1	4	
Flowering														
Ripening														
Harvesting														

Remarks; Y: Year, M: Month, D: Date

Source; Refs. C 22 and C 23

Table 44 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT I
OF MUDA AREA FOR CROP SEASON 1979/I (2/2)

Unit: %

1979/I	Y 1979												
Total Area	M 5	5	5	7	8	8	9	9	9	9	10	10	10
16,139 ha	D 5	12	19	21	11	23	6	13	20	27	13	18	22

Phase 1 : Main field 4,721 ha

Presaturation	100	100	100	100	100	100	100	100	100	100	100	100	100
Land preparation	100	100	100	100	100	100	100	100	100	100	100	100	100
Transplanting	92	99	100	100	100	100	100	100	100	100	100	100	100
Flowering													2
Ripening													39
Harvesting							86	98	99	99	100	100	100

Phase 2 : Main field 4,469 ha

Presaturation	97	97	98	100	100	100	100	100	100	100	100	100	100
Land preparation	96	96	97	100	100	100	100	100	100	100	100	100	100
Transplanting	80	89	95		100	100	100	100	100	100	100	100	100
Flowering													12
Ripening													45
Harvesting							61	90	95	98	100	100	100

Phase 3 : Main field 3,328 ha

Presaturation	99	99	99	100	100	100	100	100	100	100	100	100	100
Land preparation	86	93	96	99									100
Transplanting	51	74	86		98								100
Flowering					70								
Ripening					20								
Harvesting							36	50	80	90	95	98	100

Phase 4 : Main field 3,621 ha

Presaturation	100	100	100	100	100	100	100	100	100	100	100	100	100
Land preparation	88	93	97	98									100
Transplanting	14	31	52		95								100
Flowering					65								
Ripening					10								
Harvesting							8	40	55	70	87	94	100

Remarks; Y: Year, M: Month, D: Date

Source; Refs. C 22 and C 23

Table 45 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT II OF MUDA AREA FOR CROP SEASON 1979/I (1/2)

		Unit: %												
1979/I	Y 1979													
Total Area	M	2	2	2	2	3	3	3	3	3	4	4	4	4
30,018 ha	D	10	17	24	28	3	10	17	24	31	11	21	26	30
Phase 1 :		Main field 4,204 ha												
Presaturation	21	56	65	76	78	83	85	89	91	92	100	100	100	100
Land preparation			7	8	22	27	65	75	86	88	99	100	100	100
Transplanting									25	44	81	87	92	
Flowering														
Ripening														
Harvesting														
Phase 2 :		Main field 10,603 ha												
Presaturation			11	24	40	56	67	67	69	74	89	93	93	
Land preparation					5	13	27	33	45	56	79	89	89	
Transplanting										4	25	46	62	
Flowering														
Ripening														
Harvesting														
Phase 3 :		Main field 7,742 ha												
Presaturation						3	18	28	48	71	82	86	96	
Land preparation						1	3	14	22	52	69	76	85	
Transplanting										2	10	17	31	
Flowering														
Ripening														
Harvesting														
Phase 4 :		Main field 7,469 ha												
Presaturation							1	11	25	64	86	92	97	
Land preparation								1	3	24	40	48	65	
Transplanting													2	
Flowering														
Ripening														
Harvesting														

Remarks; Y: Year, M: Month, D: Date

Source; Refs. C 22 and C 23

Table 46 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT II OF MUDA AREA FOR CROP SEASON 1979/I (2/2)

												Unit: %	
1979/I	Y 1979												
Total Area	M 5	5	5	7	8	8	9	9	9	9	10	10	10
30,018 ha	D 5	12	19	21	11	23	6	13	20	27	13	18	22
Phase 1 : Main field 4,204 ha													
Presaturation	100	100	100	100	100	100	100	100	100	100	100	100	100
Land preparation	100	100	100	100	100	100	100	100	100	100	100	100	100
Transplanting	99	99	100	100	100	100	100	100	100	100	100	100	100
Flowering						3							
Ripening						19							
Harvesting							93	97	99	99	100		
Phase 2 : Main field 10,603 ha													
Presaturation	96	97	97	100	100	100	100	100	100	100	100	100	100
Land preparation	94	96	97	100	100	100	100	100	100	100	100	100	100
Transplanting	86	91	93		100	100	100	100	100	100	100	100	100
Flowering						28							
Ripening						37							
Harvesting							64	87	94	97	100		
Phase 3 : Main field 7,742 ha													
Presaturation	98	98	98	100	100	100	100	100	100	100	100	100	100
Land preparation	92	97	98	100	100	100	100	100	100	100	100	100	100
Transplanting	56	66	81		100	100	100	100	100	100	100	100	100
Flowering						51							
Ripening						26							
Harvesting							34	56	73	83	93	99	100
Phase 4 : Main field 7,469 ha													
Presaturation	98	99	99	100	100	100	100	100	100	100	100	100	100
Land preparation	78	91	95	100	100	100	100	100	100	100	100	100	100
Transplanting	6	32	54		100	100	100	100	100	100	100	100	100
Flowering						65							
Ripening						13							
Harvesting							9	44	64	78	93	98	100

Remarks; Y: Year, M: Month, D: Date

Source; Refs. C 22 and C 23

Table 47 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT III
OF MUDA AREA FOR CROP SEASON 1979/I (1/2)

		Unit: %											
1979/I	Y 1979												
Total area	M 2	2	2	2	3	3	3	3	3	4	4	4	4
17,946 ha	D 10	17	24	28	3	10	17	24	31	11	21	26	30
Phase 1 :		Main field 4,384 ha											
Presaturation	18	56	70	73	78	87	92	93	95	97	100	100	100
Land preparation		22	30	36	42	62	74	82	88	95	99	100	100
Transplanting								5	17	65	94	95	100
Flowering													
Ripening													
Harvesting													
Phase 2 :		Main field 4,749 ha											
Presaturation		1	18	29	43	66	82	89	90	94	95	95	100
Land preparation			1	2	5	16	48	65	70	89	91	95	96
Transplanting										21	77	78	80
Flowering													
Ripening													
Harvesting													
Phase 3 :		Main field 4,355 ha											
Presaturation					5	17	44	65	72	85	91	91	100
Land preparation						3	13	30	38	69	80	87	90
Transplanting										3	17	30	41
Flowering													
Ripening													
Harvesting													
Phase 4 :		Main field 4,458 ha											
Presaturation							4	16	39	83	99	100	100
Land preparation									5	23	51	56	67
Transplanting												2	6
Flowering													
Ripening													
Harvesting													

Remarks; Y: Year, M: Month, D: Date

Source; Refs. C 22 and C 23

Table 48 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT III
OF MUDA AREA FOR CROP SEASON 1979/I (2/2)

1979/I	Y 1979												Unit: %
	M	5	5	7	8	8	9	9	9	9	10	10	
Total Area	5	5	5	7	8	8	9	9	9	9	10	10	10
17,946 ha	D 5	12	19	21	11	23	6	13	20	27	13	18	22

Phase 1 : Main field 4,384 ha

Presaturation	100	100	100	100	100	100							
Land preparation	100	100	100	100	100	100							
Transplanting	100	100	100	100	100	100							
Flowering							1						
Ripening							4						
Harvesting										100			

Phase 2 : Main field 4,749 ha

Presaturation	100	100	100	100	100	100	100	100					
Land preparation	96	96	96	100	100	100	100	100					
Transplanting	88	91	92		100	100	100	100					
Flowering							20						
Ripening							15						
Harvesting								73	96	100			

Phase 3 : Main field 4,355 ha

Presaturation	100	100	100	100	100	100	100	100	100	100			
Land preparation	91	91	92	100	100	100	100	100	100	100			
Transplanting	61	80	87		100	100	100	100	100	100			
Flowering							70						
Ripening							10						
Harvesting								53	72	81	93	100	

Phase 4 : Main field 4,458 ha

Presaturation	100	100	100	100	100	100	100	100	100	100	100		
Land preparation	83	96	100	100	100	100	100	100	100	100	100		
Transplanting	7	30	65		100	100	100	100	100	100	100		
Flowering							77						
Ripening							2						
Harvesting								4	12	49	72	87	100

Remarks; Y: Year, M: Month, D: Date

Source; Refs. C 22 and C 23

Table 49 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT IV
OF MUDA AREA FOR CROP SEASON 1979/I (1/2)

1979/I	Y 1979													Unit: %
	M	2	2	2	2	3	3	3	3	3	4	4	4	
Total Area	D	10	17	24	28	3	10	17	24	31	11	21	26	30
24,259 ha														
Phase 1 : Main field 6,937 ha														
Presaturation		14	42	64	75	81	87	92	93	96	98	100	100	100
Land preparation			9	32	46	55	65	81	88	93	98	100	100	100
Transplanting									6	24	64	93	97	99
Flowering														
Ripening														
Harvesting														
Phase 2 : Main field 3,671 ha														
Presaturation			4	14	23	35	50	79	90	96	100	100	100	100
Land preparation			1	7	16	25	34	62	75	80	96	100	100	100
Transplanting										5	27	67	82	88
Flowering														
Ripening														
Harvesting														
Phase 3 : Main field 7,788 ha														
Presaturation						1	13	16	48	68	86	96	97	98
Land preparation							1	5	17	33	58	80	87	95
Transplanting												7	15	25
Flowering														
Ripening														
Harvesting														
Phase 4 : Main field 5,863 ha														
Presaturation									3	23	38	64	75	85
Land preparation										10	23	44	55	70
Transplanting														2
Flowering														
Ripening														
Harvesting														

Remarks; Y: Year, M: Month, D: Date

Source; Refs. C 22 and C 23

Table 50 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT IV OF MUDA AREA FOR CROP SEASON 1979/I (2/2)

Unit: %

1979/I	Y 1979												
Total Area	M 5	5	5	7	8	8	9	9	9	9	10	10	10
24,259 ha	D 5	12	19	21	11	23	6	13	20	27	13	18	22
Phase 1 :		Main field 6,937 ha											
Presaturation	100	100	100	100	100	100	100	100	100	100			
Land preparation	100	100	100	100	100	100	100	100	100	100			
Transplanting	100	100	100		100	100	100	100	100	100			
Flowering													
Ripening					18								
Harvesting							92	97	99	100			
Phase 2 :		Main field 3,671 ha											
Presaturation	100	100	100	100	100	100	100	100	100	100			
Land preparation	100	100	100	100	100	100	100	100	100	100			
Transplanting	98	100	100		100	100	100	100	100	100			
Flowering					5								
Ripening					15								
Harvesting							94	97	99	100			
Phase 3 :		Main field 7,788 ha											
Presaturation	99	99	100	100	100	100	100	100	100	100	100	100	100
Land preparation	96	99	100	100	100	100	100	100	100	100	100	100	100
Transplanting	54	69	88		100	100	100	100	100	100	100	100	100
Flowering					65								
Ripening					17								
Harvesting							21	58	62	80	99	100	
Phase 4 :		Main field 5,863 ha											
Presaturation	93	95	95	100	100	100	100	100	100	100	100	100	100
Land preparation	78	89	89	100	100	100	100	100	100	100	100	100	100
Transplanting	14	17	32		100	100	100	100	100	100	100	100	100
Flowering					49								
Ripening					5								
Harvesting							7	26	46	48	68	93	94

Remarks; Y: Year, M : Month, D: Date

Source; Refs. C 22 and C 23

Table 51 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT I
OF MUDA AREA FOR CROP SEASON 1979/II

Unit: %

1979/II	Y 1979										1980											
Total Area	M	8	9	9	9	10	10	10	11	11	11	11	11	12	12	1	1	2	2	3	3	3
18,530 ha	D	16	13	20	29	4	13	25	3	8	10	17	24	1	8	10	19	1	23	15	22	29
Phase 1 : Main field 5,194 ha																						
Presatu- ration																						
Land pre- paration	3	43	50	56	75	84	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Trans- planting			3	5	46	53	60	90	95	95	98	100	100	100	100	100	100	100	100	100	100	100
Flowering																	40	10				
Ripening																	40	15	5			
Harvesting																10	20	75	95	100		
Phase 2 : Main field 5,026 ha																						
Presatu- ration																						
Land pre- paration	22	35	50	60	62	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Trans- planting				11	15	28	70	75	75	95	99	100	100	100	100	100	100	100	100	100	100	100
Flowering																	55	20				
Ripening																	25	40	25			
Harvesting																5	10	40	75	100		
Phase 3 : Main field 8,310 ha																						
Presatu- ration																						
Land pre- paration	3	3	11	15	35	85	85	90	90	99	99	100	100	100	100	100	100	100	100	100	100	100
Trans- planting				2	4	10	40	50	50	65	75	89	96	98	98	98	98	98	98	98	98	98
Flowering																	60	40	23			
Ripening																	10	38	40	23		
Harvesting																1	2	20	35	75	100	

Remarks; Y: Year, M: Month, D: Date

Source; Refs. 22 and 24

Table 52 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT II OF MUDA AREA FOR CROP SEASON 1979/II

Unit: %

1979/II	Y 1979												1980										
Total Area	M	8	9	9	10	10	10	11	11	11	11	11	12	12	1	1	2	2	3	3	3		
31,905 ha	D	16	13	20	29	4	13	25	3	8	10	17	24	1	8	10	19	9	23	15	22	29	
Phase 1 : Main field 6,939 ha																							
Presaturation																							
Land preparation	8	39	54	68	76	91	98	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Trans-planting			4	7	8	31	69	90	94	94	97	100	100	100	100	100	100	100	100	100	100		
Flowering																	43	54					
Ripening																	30	22	29				
Harvesting																9					100		
Phase 2 : Main field 12,328 ha																							
Presaturation																							
Land preparation	2	10	19	34	49	81	94	98	98	100	100	100	100	100	100	100	100	100	100	100	100		
Trans-planting				1	4	24	50	67	67	81	93	100	100	100	100	100	100	100	100	100	100		
Flowering																	58	29	5	2			
Ripening																	17	37	30				
Harvesting																1					98	100	
Phase 3 : Main field 12,638 ha																							
Presaturation																							
Land preparation	2	4	10	23	72	89	93	93	96	98	100	100	100	100	100	100	100	100	100	100	100		
Trans-planting			1	1	7	22	31	31	56	80	95	100	100	100	100	100	100	100	100	100	100		
Flowering																	35	60	18				
Ripening																	4	25	43	5	2		
Harvesting																1					94	97	98

Remarks; Y: Year, M: Month, D: Date

Source; Refs. 22 and 24

Table 53 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT III OF MUDA AREA FOR CROP SEASON 1979/II

Unit: %

1979/II	Y 1979												1980											
	M	8	9	9	9	10	10	10	11	11	11	11	11	12	12	1	1	2	2	3	3	3		
Total Area	D	16	13	20	29	4	13	25	3	8	10	17	24	1	8	10	19	9	23	15	22	29		
Phase 1 : Main field 7,582 ha																								
Presatu- ration																								
Land pre- paration	13	40	42	50	60	75	80	100	100	100	100	100	100	100	100	100	100	100	100	100	100			
Trans- planting			5	14	20	40	55	95	98	98	99	99	100	100	100	100	100	100	100	100	100			
Flowering																					27			
Ripening																					65	9		
Harvesting																					25	100		
Phase 2 : Main field 7,992 ha																								
Presatu- ration																								
Land pre- paration	12	13	22	30	50	65	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100			
Trans- planting			2	7	23	28	47	64	64	70	85	92	98	100	100	100	100	100	100	100	100			
Flowering																					60	41	16	
Ripening																					24	24	28	2
Harvesting																					8	98	100	
Phase 3 : Main field 5,464 ha																								
Presatu- ration																								
Land pre- paration				10	30	35	45	60	60	70	90	100	100	100	100	100	100	100	100	100	100			
Trans- planting																								
Flowering																					15	75	66	10
Ripening																					3	29	15	2
Harvesting																						75	98	100

Remarks; Y: Year, M: Month, D: Date

Source; Refs. 22 and 24

Table 54 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT IV OF MUDA AREA FOR CROP SEASON 1979/II

Unit: %

1979/II	Y 1979												1980												
Total Area	M	8	9	9	9	10	10	10	11	11	11	11	11	12	12	1	1	2	2	3	3	3			
24,534 ha	D	16	13	20	29	4	13	25	3	8	10	17	24	1	8	10	19	9	23	15	22	29			
Phase 1 : Main field 5,933 ha																									
Presatu- ration																									
Land pre- paration																									
	5	37	43	67	87	98	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100				
Trans- planting																									
		8	15	25	48	77	80	100	100	100	100	100	100	100	100	100	100	100	100	100	100				
Flowering																									
Ripening																					27	10			
Harvesting																					50	100			
Phase 2 : Main field 7,658 ha																									
Presatu- ration																									
Land pre- paration																									
		13	19	32	55	60	65	88	90	90	90	93	100	100	100	100	100	100	100	100	100				
Trans- planting																									
				3	18	23	26	53	55	55	67	72	97	99	100	100	100	100	100	100	100				
Flowering																					60	45	30		
Ripening																					10	25	20	5	
Harvesting																						95	100		
Phase 3 : Main field 10,943 ha																									
Presatu- ration																									
Land pre- paration																									
		1	1	4	14	20	32	35	37	37	85	90	94	98	100	100	100	100	100	100	100	100			
Trans- planting																									
					1	2	3	23	25	25	65	68	69	72	100	100	100	100	100	100	100	100			
Flowering																					30	50	37		
Ripening																					3	25	30	10	5
Harvesting																						90	95	97	

Remarks; Y: Year, M: Month, D: Date

Source; Refs. 22 and 24

Table 55 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT I OF MUDA AREA FOR CROP SEASON 1980/I (1/2)

1980/I Total Area 16,222 ha	Y 1980																	Unit: %	
	M	2	3	3	3	3	4	4	4	4	5	5	5	5	5	6	6		7
	D	23	4	15	22	29	5	12	19	26	3	10	17	24	31	7	14		6
Phase 1 :		Nursery 189 ha; Main field 4,721 ha																	
Nursery			20	96	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Presaturation	31	55	88	97	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Land preparation			8	31	50	74	84	95	98	99	100	100	100	100	100	100	100	100	
Transplanting							4	26	53	80	90	98	100	100	100	100	100	100	
Flowering																			
Ripening																			
Harvesting																			
Phase 2 :		Nursery 182 ha; Main field 4,550 ha																	
Nursery			2	25	50	80	83	100	100	100	100	100	100	100	100	100	100	100	
Presaturation			25	55	75	80	86	90	93	100	100	100	100	100	100	100	100	100	
Land preparation			12	16	33	46	54	69	77	86	91	92	93	99	100	100	100	100	
Transplanting							1	2	7	14	33	57	73	85	90	100	100	100	
Flowering																			
Ripening																			
Harvesting																			
Phase 3 :		Nursery 133 ha; Main field 3,329 ha																	
Nursery								24	59	70	90	100	100	100	100	100	100	100	
Presaturation								52	73	94	99	99	99	100	100	100	100	100	
Land preparation								10	30	56	73	87	95	97	98	100	100	100	
Transplanting									1	2	6	13	30	51	71	85	95	100	
Flowering																			
Ripening																			
Harvesting																			
Phase 4 :		Nursery 145 ha; Main field 3,622 ha																	
Nursery										25	68	85	100	100	100	100	100	100	
Presaturation										77	78	87	93	100	100	100	100	100	
Land preparation										1	12	28	48	68	81	94	99	100	
Transplanting													1	1	5	26	38	99	
Flowering																			
Ripening																			
Harvesting																			

Remarks; Y: Year, M: Month, D: Date

Source; Refs. C 22 and C 25

Table 56 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT I
OF MUDA AREA FOR CROP SEASON 1980/I (2/2)

1980/I	Y 1980														Unit: %			
	M	7	7	8	8	8	8	8	9	9	9	9	10	10		10	10	11
Total Area	M	7	7	8	8	8	8	8	9	9	9	9	10	10	10	10	11	11
16,222 ha	D	12	19	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8
<hr/>																		
Phase 1 :	Nursery 189 ha; Main field 4,721 ha																	
Nursery	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Presaturation	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Land preparation	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Transplanting	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Flowering		70	30	20	5	4												
Ripening		28	45	38	31	20	13	3										
Harvesting		2	25	42	64	76	87	97	100									
Phase 2 :	Nursery 182 ha; Main field 4,550 ha																	
Nursery	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Presaturation	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Land preparation	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Transplanting	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Flowering		80	75	70	50	30	20	15										
Ripening		20	21	21	39	42	34	22	25	16	10	1						
Harvesting		4	9	11	28	46	63	75	84	90	99	100						
Phase 3 :	Nursery 133 ha; Main field 3,329 ha																	
Nursery	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Presaturation	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Land preparation	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Transplanting	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Flowering		15	40	60	70	60	50	10										
Ripening					24	27	26	46	36	20	11	1						
Harvesting					6	13	24	44	64	80	89	99	100					
Phase 4 :	Nursery 145 ha; Main field 3,622 ha																	
Nursery	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Presaturation	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Land preparation	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Transplanting	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Flowering				5	20	25	58	78	80	70	50	30	10					
Ripening							1	1	18	26	35	34	27	15	6	2		
Harvesting							1	1	2	4	15	36	63	85	94	98	100	

Remarks; Y: Year, M: Month, D: Date

Source; Refs. C 22 and C 25

Table 57 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT II OF MUDA AREA FOR CROP SEASON 1980/I (1/2)

1980/I	Y 1980																Unit: %		
	M	2	3	3	3	3	4	4	4	4	5	5	5	5	5	6		6	7
	D	23	4	15	22	29	5	12	19	26	3	10	17	24	31	7		14	6
Total Area 30,138 ha																			
Phase 1 :	Nursery 180 ha; Main field 4,330 ha																		
Nursery		22	41	67	86	95	98	100	100	100	100	100	100	100	100	100	100	100	
Presaturation	10	67	88	96	99	99	100	100	100	100	100	100	100	100	100	100	100	100	
Land preparation		8	23	36	48	69	75	92	99	100	100	100	100	100	100	100	100	100	
Transplanting							4	12	30	60	78	92	99	100	100	100	100	100	
Flowering																			
Ripening																			
Harvesting																			
Phase 2 :	Nursery 420 ha; Main field 10,507 ha																		
Nursery			19	53	79	91	95	97	99	99	99	99	99	100	100	100	100	100	
Presaturation		22	65	84	88	91	92	93	95	96	98	99	99	99	100	100	100	100	
Land preparation		1	4	21	30	39	54	71	84	88	96	99	99	99	100	100	100	100	
Transplanting								2	22	42	62	82	92	98	100	100	100	100	
Flowering																			
Ripening																			
Harvesting																			
Phase 3 :	Nursery 313 ha; Main field 7,832 ha																		
Nursery							8	30	59	74	89	93	99	100	100	100	100	100	
Presaturation						10	33	60	74	87	88	95	97	99	100	100	100	100	
Land preparation						1	4	19	34	60	78	83	91	98	100	100	100	100	
Transplanting									2	7	20	32	57	78	93	100	100	100	
Flowering																			
Ripening																			
Harvesting																			
Phase 4 :	Nursery 299 ha; Main field 7,469 ha																		
Nursery								9	39	81	93	98	99	100	100	100	100	100	
Presaturation								42	65	77	85	94	97	100	100	100	100	100	
Land preparation								1	10	15	36	60	69	79	95	100	100	100	
Transplanting											2	2	6	9	32	100	100	100	
Flowering																			
Ripening																			
Harvesting																			

Remarks; Y: Year, M: Month, D: Date

Source; Refs. 22 and 25

Table 58 RECORD ON PROGRESS OF FIELD ACTIVITIES IN DISTRICT II OF MUDA AREA FOR CROP SEASON 1980/I (2/2)

1980/I	Y 1980														Unit: %				
	M	7	7	8	8	8	8	8	9	9	9	9	10	10		10	10	11	11
Total Area	D	12	19	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	
<hr/>																			
Phase 1 :	Nursery 180 ha; Main field 4,330 ha																		
Nursery	100 100 100 100 100 100 100 100 100 100																		
Presaturation	100 100 100 100 100 100 100 100 100 100																		
Land preparation	100 100 100 100 100 100 100 100 100 100																		
Transplanting	100 100 100 100 100 100 100 100 100 100																		
Flowering	57 71 39 28 24 7																		
Ripening	2 40 69 25 28 13 4 2																		
Harvesting	5 18 41 65 87 96 98 100																		
Phase 2 :	Nursery 420 ha; Main field 10,507 ha																		
Nursery	100 100 100 100 100 100 100 100 100 100 100 100 100																		
Presaturation	100 100 100 100 100 100 100 100 100 100 100 100 100																		
Land preparation	100 100 100 100 100 100 100 100 100 100 100 100 100																		
Transplanting	100 100 100 100 100 100 100 100 100 100 100 100 100																		
Flowering	5 29 83 79 60 25 23 17 7 1																		
Ripening	1 16 26 51 38 26 13 3 1 1																		
Harvesting	2 13 23 39 57 80 96 99 99 100																		
Phase 3 :	Nursery 313 ha; Main field 7,832 ha																		
Nursery	100 100 100 100 100 100 100 100 100 100 100 100 100 100																		
Presaturation	100 100 100 100 100 100 100 100 100 100 100 100 100 100																		
Land preparation	100 100 100 100 100 100 100 100 100 100 100 100 100 100																		
Transplanting	100 100 100 100 100 100 100 100 100 100 100 100 100 100																		
Flowering	1 7 25 46 52 49 47 38 15 7 1																		
Ripening	5 10 32 33 37 44 34 19 10 4 1																		
Harvesting	2 8 12 33 41 59 80 90 96 99 100																		
Phase 4 :	Nursery 299 ha; Main field 7,469 ha																		
Nursery	100 100 100 100 100 100 100 100 100 100 100 100 100 100																		
Presaturation	100 100 100 100 100 100 100 100 100 100 100 100 100 100																		
Land preparation	100 100 100 100 100 100 100 100 100 100 100 100 100 100																		
Transplanting	100 100 100 100 100 100 100 100 100 100 100 100 100 100																		
Flowering	4 6 24 41 46 63 69 52 12 3																		
Ripening	1 1 2 4 18 30 52 45 29 12 3																		
Harvesting	2 7 17 33 52 71 88 97 100																		

Remarks; Y: Year, M: Month, D: Date

Source; Refs. 22 and 25