IV-4 Natural Conditions of Swamps

4-1 Location, topography and distribution

148. The swamps for which the master plan study was conducted lie south of the right bank of the Trengganu River. All the swamps lie in flat terrain without exception, but their sizes and shapes are diversified. Those whose area exceeds 100 acres amount to about 50 in number. The largest is Jerangau Swamp which measures 44,500 acres. All the swamps were not formed under the same conditions.

149. What is common to all swamps is that they form inland waters pooling stormwater and river water, because drainage is poor for the river basins where most swamps are located. In the mountains where water drains well, there are no swamps. The swamps ae noticed in the terraces (east of Trengganu Highlands) about 15 miles or less inward from the coastline and in the coastal area including dunes. In the terraces, there are developed inland swamps. In the coastal area, coastal swamps are dominant.

4-2 Formation and characteristics of swamps

150. Although it cannot be said definitely when the swamps were formed, it is sure that they were formed after the formation of land. The terraces on which swamps are distributed are a part of the Trengganu highlands, which is considered to have been formed after the Jurassic period. Namely, the magmatic intrusion into the host rock deposited in the Carboniferous period of the Paleozoic era progressed the land formation in the region, developing the noted granitic belt.

151. The dunes on which coastal swamps are distributed are considered to have been formed in the Pleistocene epoch of the Quaternary period, when transgression and regression were repeated. It is proved that the East Coast of the Peninsular Malaysia has been subjected to transgression and regression at least three times. The dune belt we can see today may well be said to have been developed by the last regression. The inland swamps are formed because of insufficient drainage capacity of the rivers in the region, and are different in formation and characteristics from each other depending on the difference in drainage conditions of related rivers.

152. In the localities where the drainage capacity becomes deficient in the flood period of the rainy season, inland seasonal swamps are formed. The inland seasonal swamps are usually covered with tropical rain forests, and run dry in the dry season. Accordingly, organic matter is easily disintegrated, and there is no fresh organic matter found deposited in a thick bed. Formation of peat and muck is not seen, either. The soil is Gleysols (G) of fine to medium-textured.

153. Where the sites are kept in a submerged or in a quasisubmerged (groundwater level within 30 cm below the surface) state throughout the year, the inland water-logged swamps are formed. Such swamps are classified into three types different in characteristics depending chiefly on the relationships with water. These are as follows:

a. A swamp formed in a plain always susceptible to the flooding of mineral-rich river water. In many cases, this type of swamp is developed in the form of a strip on either side of a river. It is covered with tropical rain forests, constantly fed with fresh fallen leaves and minerals to activate microbes, which decompose organic matter is checked from being accumulated. The soil is mostly Gleysols (G) of fine-textured.

b. A swamp which, in the rainy season, is subjected to the flooding of river, and which, in other time of the year, is fed with stormwater. It is covered with ombrogenous tropical rain forests, and there is seen a sedimentary layer consisting of fresh or incompletely decomposed organic matter. In some cases, peat and muck are observed to a little extent. The soil is humic Gleysols (Gh), which usually is of fine- to medium-textured.

c. A swamp which may have been connected directly to a river in its early stage of development, but which at present is cut off from the river by a fluvial terrace formed in between. Even today, river water occasionally runs into swamp over the terrace at the time of high water in the rainy season. Usually, the water level in the swamp is held above that in the nearby river. The swamp is covered with ombrogenous tropical rain forests. There is a deep layer of peat in the center of the swamps. The formation of a deep peat bed is progressed to a larger degree. The smaller the slope area of the terraces surrounding the swamp is and the less the mineral runs into the swamp. The

water in the swamp has remained almost dead from the early stage of swamp development to now, and this fact may have been effective in creating and conserving the peat. Gleysols (G) is found near the fluvial terraces, and Histosols (O) in the center of the swamps.

154. The process of the formation of the coastal swamps is basically the same as with the inland swamps; namely, they were formed for want of drainage capacity of the region in which they are present, and by the limnogenesis of river water and stormwater. Unlike the inland swamp, however, the coastal swamp is characterized by special conditions inherent in coastal areas. Namely, what makes the coastal swamp different from the inland swamp is the fact that it is formed in a dune belt running along the coastline or in the lower reaches of a river, which are directly influenced by tides.

155. The dune belt is an undulating terrain with a relative height of about 10 feet between the higher plane and the lower plane. In the dune belt, swamps are formed in the lower plane. The dunes which originally were sand banks or sand bars formed under sea water were then developed by emergence, and the formation of coastal swamps must have been subjected to tidal effects. The coastal swamps are divided into two types; freshwater swamp which at present is quite free from tidal effects, and tidal swamp which still is under the influence of tides.

156. The coastal sand-dune swamp referred in this report is a freshwater swamp defined as above. The tidal swamp is called the coastal tide-influenced and the coastal mangrove swamps. The coastal sand-dune swamp is classified into two types; seasonal type in which the swamp is submerged only when flooded in the rainy season, and emerges dry in the dry season, and water-logged type in which the swamp is submerged throughout the year. The former shows coarse-textured Regosols (R), and the latter shows, in not so a few cases, shallow Histosols (O).

157. The lowlands behind the dunes closest to the coastline have a strip-like tidal swamp, which is formed as a result of the blocking of the estuary. Its size is not so large. That part of the lower reaches of the rivers which is influenced by tidal action is usually in the range of 7 to 10 miles up along the stream from the estuary. In the tidal zone, there are formed coastal tidal swamps on both sides of the river. Nippa fruticans Wurmb is an indicator plant. Within the region investigated in the master plan study, there are a very few coastal tidal swamps. They are small in size, and are few and far between.

158. The coastal mangrove swamps cannot be seen in any place other than on either side of the lowest reaches of the river. They are limited to within several miles along the river from the estuary, and are small in size. The coasts in Trengganu are battered by waves and winds from the South China Sea, and lack rivers with large basins. Accordingly, they are destitute of conditions that are necessary for the formation of a large coastal plain, showing a topography quite different from the West Coast. There are no large-scale mangrove type swamps. Seen within the region related to the master plan study are small ones, where Regosols (R) of coarse-textured is found and the mangroves are depauperate.

4-3 Present conditions of forests

159. The survey was conducted to find logs of which the diameter at breast height (DBH) is more than 6 inches. However, 80 to 90% of logs in the surveyed areas were of DBH below 12 inches. Further, some swamps had no logs which could satisfy this standard. On the other hand, some swamps were found to have a net volume of 19 tons per acre. Thus, the size of logs varies significantly from swamp to swamp.

160. In general, the height of logs ranges between 50 to 100 feet. Due to poor environmental conditions for the growth of trees, trunks are short, branching a few feet above the ground and a number of trees have prop aerial roots. Also ground growth such as Menkuang (Pandanus spp.), Kelubi (Zalacca conferta) and stemless palms and respiratory roots are often found. The number of trees decreases as the diameter increases. Logs with DBH of 12 inches or more account for 16% of 102 logs per acre and its 10.5% having commercial values. Logs with DBH of more than 18 inches account for only 2%.

161. In the area of stocks, a net volume of 6.5 tons per acre is found for those logs with DBH of 12 inches or more, and 4.36 tons (67%) are good for lumbering. In the case of Terentang, DBH of 8 inches or more are suitable for matches. 4.69 tons of logs will be available when DBH of 8 inches or more of Terentang is included.

162. The dominant species are Kelat, Jankan Paya, Bintangor, Nyatoh, Terentang, and Gerongang. Thus, Dipterocarps, which are suitable for lumbering and plywood, are very few. Terentang is often found in groups in the form of pure stands. Further, the volume of Terentang is large enough to operate a match factory. The species has an advantage; it grows fast.

163. If a match factory is included in the development plan, Terentang forests must be reserved. A large number of Terentang is found in Swamp Nos. 5, 7-5, 11, 18, 19 and 20-3. Those swamps with more than 10 tons of marketable sizes (DBH of 12 inches or more) are found in Swamp Nos. 4, 9, 10, 11, 12 and 14. More than 8 tons or more per acre are found for Swamp Nos. 8 and 18.

4-4 Flood and drainage

164. Rivers in the State of Trengganu are naturally formed and no improvement has been carried out. Therefore, flooding usually occurs after every heavy rain. Natural levees are found for some rivers. Swamps in general do not have low basins which act as branch rivers and drainage canals. Due to combinations of various

factors above, excessive water in swamps does not easily flow out or drain and, as a result, the sites often change to water-logged swamps. In other words, they remain as swamps since their topography and soils do not allow drainage of flood water.

165. Swamps are left as they are since it has never been considered necessary to develop them into farmlands. In order to utilize them as farmlands, a proper drainage system is essential.

V. SWAMP DEVELOPMENT PLAN

V-1 Acreage of Swamp by Types

166. The swamps in the master plan area are shown by types as below:

Table V-1 Swamp Acreage by Types (Large Swamp)

Swamp number	Name	Acreage	Forest		Field	Farm-land	Soil type	Swamp type
			Medium	Thin				
		(acre)	(acre)	(acre)	(acre)	(acre)		
1	Baging	975			975		Rd	C.S
2	Durian	1,125	120	1,005			Rd	C.S
3	Kubang	2,625	1,800	560	265		Gd	I.S
4	Peng Diman	1,075	100		715	260	Gd	I.S
5	Tok Pakir	1,775	250		1,515	10	Oe.S	C.S
6	Tak Asing	1,575		160		1,415	Rd	C.S
7-1	Jerangau	2,828	1,045	825	630	328	Gd	I.W
7-2	"	11,937	5,900	1,650	2,450	1,937	Od.d	I.W
7-3	"	11,741	7,101	1,540	3,100		Od.d	I.W.
7-4	"	10,176	6,911	725	2,540		Od.d	I.W
7-5	"	7,818	833	2,650	1,180	3,155	Oe.d	I.W
8	Telemboh	1,075	500		355	220	Gd	I.S
9	Perdah	950	650		300		Gd	I.S
10	Lok	1,250	1,250				Ge	I.W
11	Pak Sabah	2,125	400			1,725	Od.s	I.W
(12)	(Bukit Bauk)	7,006	3,300	2,506	1,200		Od.d	I.W
13	Tok Aron	1,675	250			1,425	Od.d	I.W
14	Mengkuang	9,575	3,200	2,295	3,450	630	Od.s	I.W
15	Bungkus	5,125	3,700	1,425			Ge	I.W
16	Jelio	2,100	1,400	700			Ge	I.S
17	Chabang	725	250		405	70	Oe.S	I.W
18	Kemasik	975	190	785			Od.d	I.W
19	Kijal	1,125	260	200	555	110	Oe.d	C.S
20-1	Ibok	4,832	1,130	1,460	2,172	70	Ge	I.W
20-2	"	1,994	470	600	914	10	Ge	I.W
20-3	"	13,362	3,040	3,920	5,852	550	Od.d	I.W
20-4	"	2,421	570	800	1,011	40	Od.d	I.W
20-5	"	5,516	1,300	1,680	2,506	30	Od.d	I.W
21	Pinang Ulu	975				975	Ge	I.W
22	Cherul	3,700				3,700	Ge	I.W
	Total	120,156	45,920	25,486	32,090	16,660		

167. Thin forest is defined as the forest of which logs of more than 6 inches of DBH could not be found, while medium forest has logs of which DBH is more than 6 inches.

Table V-2 Swamp Acreage by Types (Small Swamp)

Swamp number	Acreage	Forest		Field	Farm-land	Soil type	Swamp type
		Medium	Thin				
	(acre)	(acre)	(acre)	(acre)	(acre)		
S1	281		112	169		Rd	C.S
2	234		234			Rd	C.S
3	250	120	130			Gd	I.S
4	328	150		138	40	Gd	I.S
5	171	80		31	60	Gd	I.S
6	125	50		45	30	Gd	I.S
7	313	180	60	73		Gd	I.W
8	313	90	80	143		Gd	I.W
9	453	270		163	20	Gd	I.S
10	109	60		39	10	Gd	I.S
11	484		389		95	Rd	C.S
12	531		531			Gd	I.S
13	531				531	Rd	C.S
14	422				422	Gd	I.S
15	266				266	Gd	I.S
16	625				625	Gd	I.S
17	281	281				Gd	I.W
18	593	413			180	Gd	I.S
19	531	370		161		Gd	I.S
20	234	234				Gd	I.S
21	203				203	Ge	I.W
22	740				740	Ge	I.W
23	453		200	173	80	Ge	I.W
24	313		180	133		Gh	I.W
25	210	150	60			Gd	I.W
Total	8,994	2,448	1,976	1,268	3,302		
Grand-total	*129,150*	*48,368*	*27,462*	*33,358*	*19,962*		

168. Abbreviation of soil units and swamp types are as follows:

Soil units

Abbreviation	Name
Rd	Dystric Regosols
Gd	Gleysols
Gh	Humic Gleysols
Ge	Eutric Gleysols
Od.s	Shallow Dystric Histosols
Oe.s	Shallow Eutric Histosols
Od.d	Deep Dystric Histosols
Oe.d	Deep Eutric Histosols

Swamp types

Abbreviation	Name
C.S.	Coastal sand-dune swamp
I.S.	Inland seasonal swamp
I.W.	Inland water-logged swamp

169. If there are more than one soil type found for a swamp, they will be classified under the most dominant soil type which occupies the largest area currently unused.

V-2 Proposed Land Use

170. Based on the survey results for 47 large and small swamps, the following swamps were excluded from the development plan:

(1) Swamps which require forced drainage by pump in order to use as farmland.

(2) Swamps which are connected to tidal rivers and their lower basins affected by tides.

(3) Swamps with complicated topography which will possibly result in a small development area in consideration of work required for roads and drainage canals. Their development is costly.

(4) Small swamps distant from the existing villages. It is not practical to develop its own communities.

(5) Swamps of which development is already planned or on-going.

(6) Sand-dune swamps which cannot be converted into farmland without irrigation facilities.

171. Even though the development is possible, they are excluded from the plan since development cost per unit is too high to be justified.

Table V-3. Swamps to be Developed

Swamp No.	Name	Farm-land	Usable Land				Unusable land	Total acreage
			Forest		Wilder-ness	Sub-total		
			Medium	Thin				
2	Durian		120	1,005		1,125		1,125
3	Kubang		1,800	560	265	2,625		2,625
4	Penghulu Diman	260	100		715	815		1,075
5	Tok Pakir	10	250		1,515	1,765		1,775
7-1	Jarangau		1,045	825	630	2,500	328	2,828
7-2	"		5,900	1,650	2,450	10,000	1,937	11,937
7-3	"		7,101	1,540	3,100	11,741		11,741
7-4	"		6,911	725	2,540	10,176		10,176
7-5	"	3,155	833	1,180	1,180	3,193	Sand Dune 1,470	7,818
8	Telemboh		500		355	855	220	1,075
9	Perdah		650		300	950		950
11	Pak Sabah	400	400		1,325	1,725		2,125
12	Bukit Bauk	0	3,300	2,506	1,200	7,006		7,006
14	Meng Kuang	630	3,200	2,295	2,535	8,030	915	9,575
15	Bung Kus		3,700	1,425		5,125		5,125
17	Chabang	70	250		405	655		725
18	Kemasik		190	785		975		975
19	Kijal	60	260	200	555	1,015	50	1,125
20-4	Ibok	40	570	800	1,011	2,381		2,421
-5	"	30	1,300	1,680	2,506	5,486		5,516
S.11		95		389		389		484
S.12				531		531		531
S.20			234			234		234
S.24				180	133	313		313
Total		4,750	38,614	18,276	22,720	79,610	4,920	89,280

V-3 Development Plan

3-1 Hydrological analysis, flood and drainage

(1) Flood analysis

172. The following rivers were analyzed in accordance with the DID's data on the water level.

River	Station	Record Period
Sg. Marang	Peng Setor Kanan	1966.10 ∿ 1978.12
Sg. Dungun	Kg Keriyu	1962.9 ∿ 1978.12
Sg. Kijal	Jam Kijal	1971.9 ∿ 1977.12

173. The above observation stations register the water levels twice daily at 6:00 am and 6:00 pm.

Return period:

174. Flood control in the master plan years in study is based on a return period of ten years in consideration of the fact that the developed areas are farmlands.

Probability flood stage:

175. Probability flood stage of each river is obtained as follows on the basis of its annual maximum flood stage:

Table V-4 Probability Flood Stage

(Unit: feet)

Return period (year)	Sg. Marang	Sg. Dungun	Sg. Kijal
2	5.9	20.5	7.5
5	7.2	26.8	9.1
10	8.0	30.3	10.2
20	8.8	33.4	11.2
30	9.3	35.0	11.8
50	9.8	36.9	12.5
100	10.6	39.4	13.5

(2) Flood control countermeasures

176. The explanation by rivers is as follows:

a) Dungun River

Swamp No. 7-5 (Jerangau) is located on the left bank of Dungun river. Approximately 6 miles between Kg. Pdg. Pulut and Kg. Tg. Papan are open to the river. Kg. Tg. Papan is 1.5 miles upstream of Kg. Keliyu where a water observation station is located. One mile between the river and the Jerangau swamp is a natural levee which is relatively high in elevation.

It is 104 feet high at the highest point and 35 feet high at the lowest point averaging in 40 feet. Between Kg. Tg. Papan and Kg. Pdg. Pulut, there are five small rivers flowing into Dungun river from the swamp. On the basis of data from the water observation station in Kg. Keliyu, a probability flood stage of 30.3 feet is obtained for this area for probability years of 10. 10.5 miles up to Kg. Wa has an average river bed gradient of 1/4000.

From the above, the following measures should be provided to protect Jerangau swamp from floods of the Dungun River:

i) A trunk road will be constructed on the natural levee on the left bank of the Dungun River in order to compensate low areas of embankment and to use for transporting.

ii) Gates will be built where the small rivers cross with the trunk road in order to prevent flood water from flowing into the swamp and to serve as bridges.

b) Kerteh River

The Kerteh River has a mild river bed gradient of 1/5000 between its estuary and Kg. Batu Puteh 11 miles upstream of the estuary. The gradient increases to 1/2000 through 1/700 from Kg. Batu Puteh and thereon. The river snakes for six miles between Ladang Kerteh and Kg.

Batu Puteh where it is adjacent to Swamp No.14 (Mengkuang). No flood data are obtainable since the river is not provided with observation stations. The presence of villages in the proximity of the snaking areas, however, indicates that the flood stage is not likely to be so high.

Therefore, a main road with banking of 4 to 5 feet should be built along the Kerteh River at the southern tip of the swamp in order to prevent flooding.

c) Chukai River

The Chukai River snakes for 14 miles from its estuary to Kg. Ibok flowing through the center of Swamp No.20 (Ibok). In consequence, embankments are required on each side of the river, in order to develop Swamp No. 20-3 and they will be costly. Currently, JKR plans to build a 6-mile long road in parallel with the river between Chukai and Kg. Ibok.

The road will pass through the village in Kg. Bukit Takar which are located in the lower areas of, Bukit Takar (395 feet high) on the right bank of the river in the center of the Ibok swamp. The road will cross two miles of hilly area in Bukit Takar and the length of the road in the swamp area will be four miles. This road will prevent the Chukai River from flooding into Swamps Nos. 20-4 and 5.

d) Other rivers

Mountainous swamps divided by rapid rivers are normally rectangular, as in the case of Swamps Nos. 4, 9, and 15. Since swamps incline to rivers, an area distant from the rivers is little affected by flooding. Although it is best to build embankments on each side of such rivers, the advantage is insignificant for the cost.

Since such development work is not efficient, the provision of embankments on each side of rivers is not considered in the plan. However, some parts of the existing rivers will be repaired and upland fields will be planned in higher areas distant from rivers. Paddy can be cultivated in the lower areas near rivers and some flooding will be tolerated.

(3) Drainage

177. In this master plan, those swamps which require pumping facilities for drainage are excluded. Included are improvement of existing rivers and building of major and branch drainage canals.

a) Unit drainage discharge

Rainfall intensity of 17 mm/hr and unit drainage discharge of $q = 0.01889$ $m^3/sec/ha$ were obtained on the basis of the DID's standards for return period of 10 years.

b) Drainage channel cross section

Drainage canals will be of earth and channel sections will be varied in accordance with soil properties. Slope gradient will be 1:3 in peat areas while 1:1 in areas of heavy clay soils. The base width of drainage channels will be minimum 50 cm with no provision of freeboard.

c) Drainage channel intervals

Drainage canals include trunk, main, branch and farm channels. The minimum intervals for farm channels will be as follows in accordance with types of farmlands and soil conditions.

Farmland	Soil property	Interval of drainage channel in farmlands (m)
Paddy field	Peat Soil	100
	Heavy clay soil	100
Upland field	Peat soil	40
	Heavy clay soil	80

3-2 Arterial road

178. Development of swamps into farmlands will require new roads in order to connect new towns and transport agricultural products and laborers.

179. Some large swamps require new roads while some don't. For example, the Jerangau swamp must be provided with a new road which connects the road on the coast with the inland Jerangau road.

180. Attached Land Use Map shows the road network which can be utilized for the development of the swamps.

181. In the figure, new and existing roads, of which repairing is planned by J.K.R., are added to the existing concrete and asphalt roads.

(1) Jerangau area

a) J.K.R. has a plan to build a 13.5 mile-long road between Kg. Bemban, north of Dungun river, and Kg. Bt. Bata. Once the entire area on the left bank of the river is developed into farmlands, it will be necessary to build a road running from the coast through the inland areas on the left bank. The Dungun River might flood into some areas of the swamp since its probability flood stage for return period of 10 years is between 35 and 44 feet while the average elevation of the swamp is MSL 40 feet. Therefore, construction of embankments of 3 to 6 feet high will protect the areas from flooding and solve transportation problems as well. Thus, Road R-11 will be built.

b) Since the area is wide, it is necessary to build Roads R-6, 7, and 9 which run through the area.

c) Roads R-5 and 10 will be built in order to connect the area with the existing major roads.

(2) Ibok area

a) J.K.R. has a plan to build a 6-mile long road on the right bank of Chukai river from Chukai through Kg. Bukit Takar to Kg. Ibok. The road will divide the Ibok swamp into two parts, the east and the west sides.

The Swamps Nos. 2-4 and 5 on the west side will not then be directly affected by flooding of the Chukai River as often as before. While the J.K.R.'s road runs through the swamp from north to south, Inland Roads R-21 and 22 running from east to west will be built in order to connect the new road with the existing one.

b) R-23 will be built in the center of Swamp No. 20-4 in order to connect with the existing road running from Chukai to Pasir Gajah.

(3) Other areas

In other swamps, main roads running through the center of the swamps will be built to connect at least one end with an existing road.

3-3 New town

182. New towns will be developed according to the following standards:

a) A minimum of 75 houses will be built in each town.

b) Each town will be within 2.5 miles approximately from farmland.

c) Each town will be of easy access from a major existing or a new principal road.

d) Each town will stand on a solid foundation free from flooding.

183. Among the 19 new towns developed in accordance with the above-said standards, the smallest one will have 122 houses in N.T.3 of Peng Diman and the largest one 1,607 houses in N.T.8 of Jerangau averaging in 590 houses. These new towns will be provided with the minimum necessities essential to a new community. The following three towns will be provided with agencies capable of providing farming guidances and distributing agricultural products, and workshops for repairing large farm machinery.

i) N.T.8 Jerangau:

The largest among all the towns developed in the master plan area will become the center of Jerangau.

ii) Bukit Bauk:

A town to be developed in the Bukit Bauk Pilot Project is equipped with a demonstration farm. The town will be located near Dungun.

iii) N.T.19 Ibok:

A new town in the Ibok swamp which is located on the southern tip of Trengganu State. The town is located near Kemaman.

184. Number of houses and acreage of each new town are shown in Table V-5.

Table V-5 Number of Houses and Acreage of New Town[1]

New town No.	Related swamps	Number of houses	Area (acre)	Remarks
NT. 1	2, S11	151	45	
2	3	289	87	
3	4	122	37	
4	5	185	56	
5	7-1	460	138	
6	7-2, 7-3	917	275	
7	7-2, 7-3	917	275	
8	7-3, S12	1,607	482	
9	7-3, 7-4	917	275	
10	7-4	807	242	
11	7-5	492	148	
12	8, 9	268	80	
13	11	205	62	
14	14	1,344	403	
15	15	797	239	
16	17, S20	132	40	
17	18, 19, S24	308	92	
18	20-4	375	113	
19	20-5	864	259	
Sub total		11,157	3,348	
(Bukit Bauk)	(12)	705	228	Pilot project
Total		11,862	3,576	

[1] New town acreage = number of households x 0.3 acre/house

3-4 Deforestation

(1) Cutting and clearing

185. To develop jungle area into farmland, useful logs will be cut down and transported before residual ones are cut down, dried, and burnt (should be burnt at the end of the dry season). It is desirable, however, to drain as much as possible before cutting down the logs in order to maximize efficiency. Chain saws will be used to cut with. Skidding methods depend on the size of logs and deforestation acreage and further, the amount of capital invested.

186. In this particular project, the number of logs with a large diameter are extremely a few, almost all forests are level and the acreage of each forest is relatively small. From the above, it would be best to use trolleys and tractors to collect logs. If tractors can not easily be used in swamp areas even after draining, the logs will be hoisted and transported by trolleys to the nearest access where they will be loaded onto trucks.

187. After useful the logs are transported, the remaining small trees and shrubs will be cleared and burned. By this stage, the swamp areas will be drained. Thorough drainage is important to permit building a truck road as close to forests as possible. As roads are built closer to forests, more efficient truck transportation is achieved. For the development of these swamps which are designated as forest reserve by the State Government, it will be necessary to consult with the State Forest Department prior to planning of deforestation.

(2) Utilization and assessment of useful logs

188. Most of useful logs are of medium to small diameters. Dipterocarps is extremely rare in the master plan area. More than 90% of the species found in the area are other than Dipterocarps. Therefore, they are more suitable for sawmills than plywood factory.

189. Logs with DBH of more than 12 inches have commercial values with the exception of Terentang. 8 inches or more are applicable to Terentang for matches. Although cutting and collecting costs depends on skidding method, and tree size and density, logs with DBH of more than 12 inches will cost M$35 per ton while small logs such as Terentang will cost M$20. Respectively M$20 and 15 should be set aside for royalty and cess.

190. The selling price to sawmills is estimated lower than the current price since swamp logs are smaller than those which are currently sold. In consideration of the current price, a loco price at yard of M$90.00 is estimated reasonable and competitive. Terentang will be priced at M$60.00. Earning and expenses for swamp logs are as follows:

Table V-6 Earning and Expenses for Swamp Logs

Item	Kind of Timber	Value (M$)	Remarks
Income	Swantimber	15,754,950	175,055 tons x M$90
	Terentang	1,157,700	19,295 tons x M$60
Sub-total(A)		16,912,650	
Expense	Swantimber	6,126,925	175,055 tons x M$35
	Terentang	385,900	19,295 tons x M$20
Sub-total(B)		6,512,825	
Tax and others	Swantimber	3,501,100	175,055 tons x M$20
	Terentang	289,425	19,295 tons x M$15
Sub-total(C)		3,790,525	
Balance (A-B-C)		6,6093300	

3-5 Soil improvement

191. As seen from the survey results, the majority of soil types found in the master plan area are Gleysols (G) and Histosols (O) in inland swamps and Regosols (H) and Histosols (O) in coastal swamps. In this paragraph, soil improvement is outlined in relation to soil and swamp type. Specific soil improvement procedures should be determined in accordance with basic matters mentioned hereafter and in consideration of the detailed results obtainable from the future feasibility study. Respective soil improvement procedures for inland and coastal swamps are explained as below.

(1) Improvement of inland swamp soils

192. In general, inland swamps are topographically flat and covered with tropical rain forests. Soils in such swamps are often fine-textured, C-SiC-SC and the groundwater level there is high and drainage conditions

are poor. Due to the tropical and climatic conditions characterized by high humidity and heavy rains, soils are strongly acid and rather infertile lacking in bases such as K, Ca and Mg, and inorganic N, available P, etc.

193. In the land development, deforestation and drainage work are initially carried out. During this stage, the ecological systems of the surrounding soils change rapidly and drastically. Therefore, in the soil improvement, it is important to take various countermeasures to prevent the occurrence of unrecoverable deterioration of soil conditions derived from the change of the ecological systems as mentioned above. Usually, soil improvement in inland swamps is carried out in the following three stages:

a. Provision of drainage facilities in the entire swamp areas and control of the groundwater level.

b. Soil dressing, application of organic and inorganic improvement materials of soil.

c. Soil reversing, subsoil breaking, mixed plowing, harrowing, compaction, etc.

194. Details of the above-said countermeasures by soil types are mentioned below.

1) Gleysols (G)

Master horizons of Humic Gleysols (Gh) consist of H, H, A and B in that order. Differentiation of A Horizon is often unclear and Layer (O + H) of organic matter is up to 40 cm thick. Mixing through plowing of both layer of organic matter and one of inorganic matter is possible, and such a mixing pattern is essential in the soil improvement.

Since organic matter in Layer (O) is decomposed to h2 - h3, it can be used as an organic improvement material of soil. In order to satisfy the improvement target of pH 5.5, the layer must be improved to 20 cm thick and 5,400 kg/ha of pulverized Magnesium Lime Stone must be provided in consideration of field factor on the basis of the data of 1,800 kg/ha/cm of lime stone ($CaCO_3$) obtained from laboratory analysis.

Eutric Gleysols (Ge) is found in inland water-logged swamps which are flooded with river water abundant in inorganic matter. Soils in such swamps are normally fine-textured C-SiC. Due to abundant inorganic matter, organic matter decomposes rapidly. As a result, formation of organic layers is not conspicuous.

Master horizons consist of A, B and C in that order. Soils are relatively fertile and they are further improvable by applying soil improvement materials. In addition, soils are fine-textured. From the above, it is necessary to improve physical characteristics of soils by means of soil reversing, subsoil breaking, applying decomposable organic materials and others.

As in the case of Humic Gleysols (Gh), pulverized Magnesium Lime Stone of 5,400 kg/ha/20 cm is required if improvement target is set at pH 5.5. Dystric Gleysols (Gd) is another typical soil type, in along with Histosols (O), found in inland swamps, especially in seasonal swamps. Master horizons consist of A, B and C in that order and contains almost no organic matter. Soil texture varies widely.

Although fine-textured Gd can be improved in the same way as Ge, 6,300 kg/ha/20 cm of pulverized Magnesium Line Stone is required. Improvement of coarse-textured Gd is especially important since it is extremely poor in nutrition as well as in component and its buffering capacity is also small. Improvement procedures are the same as for Regosols.

2) Histosols (O)

This is one of the typical soil units found in inland water-logged swamps. It is classified into two major groups, Eutric Histosols (Oe), and Dystric Histosols (Od). Each of them is further divided into two types, shallow and deep, depending on the thickness of organic layers (histic horizon). Consequently, the soil is classified into four groups, Oe.s, Oe.d, Od.s and Od.d.

Master horizons include O, H and B in that order. O Horizon contains fresh and insufficiently decomposed organic matter of h2 - h3 in decomposition degree. Organic matter in this layer together with soils in lower layers play an important role in the organic improvement materials of soil.

H Horizon contains peat decomposed to h7 - h9, muck decomposed to h8 - h9 or organic clay soils. Two types of peat are woody and grassy. In the soil improvement, consideration should be given to land subsidence, especially differential settlement, as a result of drainage Od.d. and Oe.d, which are found in deep layers of organic matter, require special caution in the improvement. Groundwater level must always be maintained around 60 cm below the ground surface.

Countermeasures should be provided on the assumption that the soil lacks all types of nutritious matters. Especially lacking is Cu in accordance with our experiences. Test data on Cu application are available by crops.

Improvement effect can be enhanced through mixed plowing shallow layers of Od.s and Oe.s with lower inorganic layers. In the above case, it is unlikely that drainage causes differential settlement but care should be taken since excessive drying through drainage deteriorates soils so seriously that their restoration might not be possible.

For an improvement target of pH 5.5, the volume of pulverized Magnesium Lime Stone required is as follows:

Oe.s:	4,500	- 6,300	kg/ha/20 cm
Oe.d:	5,400	- 8,100	kg/ha/20 cm
Od.d:	7,200	- 10,800	kg/ha/20 cm
Od.s:	7,200	- 8,100	kg/ha/20 cm

These figures are obtained on the basis of histic horizon with bulk density of 0.6 g/cm^3 after the land development.

(2) Improvement of coastal swamp soils

195. The majority of coastal swamps in the master plan area are of the sand-dune type. Tide-influenced and mangrove swamps occupy only a small area near the estuary areas. Therefore, in this paragraph, soil improvement on coastal sand-dune swamps is mentioned as below.

196. The main soils in coastal sand-dune swamps are Dystric Regosols (Rd), which is covered with spares grove of Gelam (Melaeuca leucadendron) and Dystric Histosols (Od) which is covered with grass mainly Junco effusus L. Bar decipieno Buchen. The Layer of organic matter of Od is normally found to be around 100 cm. General soil improvement measures required are almost the same as for inland swamps. But, due to soil and locational conditions, irrigation facilities are necessary in addition to drainage facilities. Rapid ecological changes take place during the initial stage as in the case of inland sand-dune swamps are not capable of adjusting well to these rapid changes.

3) Dystric Regosols (Rd)

Master horizons consist of A, B and C in that order, and the entire horizons are coarse-textured sand S. During the dry season, the groundwater level is normally found around 100 cm deep below the surface. Differentiation of the soil layers is not sufficient and the soil is not completely developed yet, lacking in both organic and inorganic matters.

Further, capacity of both water holding and nutritious matter holding is extremely low. Therefore, the application of improvement materials, including quality clay soils, is absolutely necessary in order to achieve and maintain high standard land use.

Without the provision of improvement materials, its buffering capacity is extremely small, therefore the application amount of lime stone for improvement should be restricted. Its excessive application causes severe unrecoverable deterioration of the soil preventing crops from absorbing the necessary amount of nutrients.

4) Dystric Histosols (Od)

Master horizons consist of O, H and B in that order. O Horizon is often about 10 cm thick and the layers of organic matter (O + H) being up to 200 cm thick. O Horizon is decomposed to h2 - h3 and organic matter in H Horizon to h7 - h9. The parent material of H Horizon is grassy peat and muck or organic clay. The soil should be improved in the same way as Histosols (O) in inland water-logged swamps. It should be noted, however, that in the case of Histosols (O) in coastal swamps, the inorganic layer below the organic layers consists of coarse sand.

V-4 Environmental Problems

4-1 General

197. Environmental assessment is one of the newest scientific branches. It is important to give considerations to environment during the planning period of development projects. It should always be remembered that development, which is intended to achieve better living conditions, also has negative effects. They might be found during the implementation of a development project or long after it is completed sometimes even 10 to 20 years later.

198. In recent years, environmental problems are found throughout the world as a result of a failure to consider negative aspects of development in eagerness to pursue positive aspects only. In the development of swamps, the assessment of environmental factors is vital. Swamps do not only have special ecological characteristics but are also vulnerable to environmental changes.

199. Furthermore, there have been very few large-scale developments of tropical swamps. Thus, data readily available are scarce. The purpose of the master plan study is to develop farmland in general. In contrast to urban development, an agricultural development is regarded as land utilization with no environmental disruptions and farmland is said to be a seminature.

200. Certainly, agriculture may protect environment, and farmland may provide greenery if it is used properly. But, even an agricultural development project could cause a rapid change in ecology. As a result, it is not entirely free from environmental problems. Even agriculture might adversely affect environment if it is not seriously taken into consideration.

4-2 Ecological changes and environmental problems

201. It is difficult, however, to foresee ecological changes exactly and in detail since they are normally very diversified in case of a large-scale development of tropical swamps. Consequently, it is important to identify during the feasibility study stage possible ecological changes in order to provide necessary countermeasures. The following ecological changes are expected to take place as a result of the conversion of swamps into farmland.

i. Shift from the natural ecosystem centered around tropical rain forests to agricultural ecosystems centered around cultivation of crops, seen from the vegetation standpoint.

ii. Shift from the swamp soils characterized by recycling of water to dry soils accompanied by oxidation, seen from the soil-water standpoint.

iii. Expulsion of all types of wild animals.

202. The above ecological changes might result in the following environmental problems.

i. Loss of swamp forests resulting in the degeneration of land.

ii. Erosion, land slides and flooding.

iii. Pollution and contamination of both land and water systems.

iv. Loss of valuable nature from the academic standpoint which could be conserved otherwise.

Each point is explained in detail below.

4.3 Environmental problems

(1) Loss of swamp forests

203. In comparison with hillside forests, swamp forests are normally inferior in both volume and quality. Furthermore, cutting down and transporting the logs are not so easy. Therefore, development of swamps into farmland is desirable in terms of efficient utilization of natural resources and conservation of environment.

204. On the other hand, swamp forests are formed over a long period of time. Once they are cleared, it is not easy to restore them in a short period of time. Further, no one has adequate knowledge or the ecological system in tropical swamp forests. Therefore, it is recommended to leave swamps as they are from the environment conservation standpoint, if the swamp development does not offer convincing advantages.

(2) Degeneration of land

205. Land degenerates in the form of land subsidence as a result of drainage of swamps, accumulation of salts on the surface layer, consumption of organic substance, and eluviation of inorganic substance in soils.

206. Subsiding and caving in of ground due to drainage will be especially seen in a large area with Deep Histosols. Special caution will be necessary when non-uniform ground settlement occurs as a result of rapid drainage since it will cause dispersed subsidence. To prevent the problem, it will be necessary to provide facilities to control groundwater level, in addition to drainage.

207. Degeneration of new farmland due to accumulation of salts in the surface layer has already been reported, and how it occurs is also known. As far as the soils in the master plan area is concerned, no possibility of the accumulation of salts in the surface layer rising from the subsoil was recognized in the layer one meter deep.

208. But, its possibility cannot be denied entirely since it could happen when swamp soils change to dried soils. It should also be noted that excessive fertilization and continuous cultivation of crops by means of irrigation will hasten the accumulation of salts.

209. Degeneration of land due to consumption of organic matter and eluviation of inorganic matter will especially be serious in swamps in coastal sand-dunes. It also could happen to inferior swamps where corase soil texture, Dystric Gleysols, is found. Therefore, it will be necessary to carefully select crops and control fertilizing.

(3) Erosion and land slide

210. Since swamps are normally level or only slightly undulating there will be almost no possibility of erosion and land slides except for slopes along roads and waterways. Therefore, adequate protection work will be required for slopes.

(4) Flood

211. Various flood-related problems will be encountered as run-off changes as a result of development. Since no construction of a large-scale embankment is involved in the master plan, major changes in run-off will be due to the construction of roads or the development of farmland.

212. The surface of planned roads will be more than 50 cm high above the current ground level. In other words, it will be lower than the highest river terrace formed between swamps and rivers.

213. Consequently, the construction of roads will not reduce flooding area. Further, the development of swamp forests into farmland will not change direct run-off significantly. In such swamp forests, groundwater level is high up to the surface even under the normal conditions. Thus, the storage capacity for rainwater is small for the entire area during the rainy period and direct run-off is relatively large.

214. On the other hand, systematic drainage facilities provided in the agricultural development will keep the groundwater level low. Consequently, the storage capacity for rainwater will be relatively large even during the rainy period. Thus, direct run-off is controlled.

215. From the above, flood increasing by deforestation is applicable only to the forests in mountains and hilly areas but does not necessarily apply to swamp forests. However, swamps which have a large base flow will be drained during the farmland development.

216. Therefore, the drought water level significantly differes before and after development requiring close examination. Further, villages are found in the surrounding areas of a higher elevation. If they depend on groundwater, it will be important to continuously study possible changes in the groundwater level as a result of the development of farmland, and to provide countermeasures if necessary.

(5) Environmental pollution

217. The source of environmental pollution possibly involved in the master plan area will be livestock excreta, chemicals for soil improvement, fertilizer and agro-chemicals in addition to a match factory, silk mills and settlements. Contaminants from a match factory and silk mills will be discharged in the form of waste water. Therefore, its effects on the water system will be considered prior to building them.

218. Facilities for the processing of waste matters discharged from settlements will also be planned from the beginning of the construction of new towns. Such processing will include incineration, recycling and burrying. Sewage treatment facilities are normally expensive and are sometimes difficult to afford. Special consideration must be given to the end where treated waste water reaches.

219. The livestock industry consists of rearing a large number of animals as on pasture and rearing a small number of animals by individual farmers. Large animals are involved in the former while small ones are involved in the latter. Excreta of livestock, leftover feed and waste water will be recycled and treated within the farm management. The same applies to waste in the sericulture.

220. For the improvement of soil and the fertilization, organic substances will be used as much as possible. The controlling of diseases and insects will start with the cultivation itself although it still will be difficult to avoid chemicals completely. They will be allowed only if toxicity is lower than the permissible value and if they does not remain behind. Furthermore, the quality applied at one time and the number of applications will be controlled. Special considerations must also be given to when and how they should be applied.

(6) Preservation of nature

221. If an area, which is valuable and should be preserved from the academic standpoint, is found in the master plan area, it will be designated as a nature preserve including a swamp concerned, and its development will be prohibited.

222. The survey has been carried out on the basis of the concepts. As indicated before, each of the swamps in the master plan area has its own characteristics and their ecology has not been identified exactly. Therefore, it is very likely there may be some swamps which are valuable from the academic standpoint and their study may provide important information.

223. But, no such a swamp that should be designated as a nature preserve to prohibit its development has been confirmed by the master plan study. It has been mentioned already that development will significantly affected the ecology of swamps including wild life. If the ecology of swamps should be preserved, not only the swamps but also the surrounding hilly areas and water systems connected to the swamps should be designated as a nature preserve. However, the study did not find such an area. It will be necessary to review during the feasibility study phase in order to achieve a definite conclusion.

4-4 Advantages of new ecological systems

224. Negative environmental aspects alone have been pointed out in relation to the development of swamps. In reality, the development will offer a number of positive ecological aspects. Although each specific example is not sited here, rich ecological systems will be achieved as a result of the improvement in water quality and systems, and soils.

225. For instance, the current quality of water in the swamps is strongly acid and poor in nutrition. In addition, water in peat swamps is clouded with dark brown substances. Such a quality cannot possibly support animals and plants adequately. As a result, what is found today is poor from the ecological standpoint.

226. Development of the swamps will improve both water quality and systems in the area and will sustain a variety of animals and plants. Swamps in sand-dunes, which are extremely poor at present in terms of ecology can be converted into very productive farmlands. Such an ecological shift will also be meaningful from the environmental protection standpoint.

VI. PLAN OF AGRICULTURAL PRODUCTION

VI-1 General

1-1 Types of proposed agriculture

The following five types of agriculture will be introduced in the proposed farmland to be newly developed.

(1) Paddy farming

228. Paddy fields will be provided with an irrigation system to allow double c ropping and will be located in lower areas in the proximity of rivers where they might be affected by flooding.

(2) Freshwater pisciculture

229. Low areas close to rivers will be selected for fishing to allow easy supply of water. However, low areas which might be affected by flooding will be avoided to prevent the escaping of fish. Selection of low areas near the housing site of settlers is recommended so that daily work and management will be made easy. In order to consalidate water supply systems, fish pounds will be grouped as much as possible.

(3) Sericulture

230. Sericulture is one of the important sectors emphasized by the Government. It is recommended to avoid a large-scale introduction, since it still will be in the testing stage. Introduction will be carried out in parallel with testing of mulberry cultivation and silkworm rearing. Mulberry trees are able to withstand flooding for a limited number of days and watering is essential for harvesting of quality leaves. Consequently, mulberry fields will be located in level areas where the groundwater level is relatively high.

231. Mulberry fields will not be concentrated in one location. Instead, they should be distributed throughout the development period since mulberry tree and silkworm both are vulnerable to diseases and insects.

(4) Livestock industry

232. Livestock consists of beef and dairy cattle, water buffaloes and others such as sheep, swine, chickens, etc.

233. In this particular development plan, livestock will be limited to mature beef cattle and young dairy cattle up to the first delivery. Rearing of dairy cattle is one of the important policies emphasized by the Government. Furthermore, it will bring a higher income to settlers than beef cattle.

234. At the same time, rearing of dairy cattle and storage and delivery of milk require advanced skills. The majority of settlers, however, will have no previous agricultural experience. Therefore, dairy cattle will be raised until one month before the first delivery and then be sold to dairy farms in suburbs in order to assure safe operations. In the future, the complete process of rearing dairy cattle through milk production can be implemented when settlers acquire the necessary skills.

235. The local species of beef cattle will be improved in order to increase meat production. They will be reared until they are fully grown and then be sold to the market. Currently, water buffaloes are reared for farming purposes and their meat is sold when they grow old. In the development plan, rearing of a large number of water buffaloes is not recommended for the production of meat from the following reasons:

a) Data on buffaloes are inadequate and their rearing is not systematic.

b) It is difficult to raise them in grassland since they require bathing.

236. No large-scale rearing of small animals is planned since their demand and supply is in balance today and their rearing in the proposed farmland is expected not to be so productive. Consequently, they will be reared by individual farmers for their own consumption.

237. Thus, the livestock industry will be centered around the raising of beef cattle in a proposed grassland to be newly developed and dairy cattle up to their first delivery. In comparison with other types of agriculture, productivity of farmland is lowest for the livestock industry. Further, the ultimate goal of the development is to settle people below the poverty line in the state in order to raise their living standard. Therefore, the livestock industry will be confined to those areas which are not suitable for other types of agriculture, for instances, those areas which are distant from new towns, which do not permit the use of farm machinery, and which are steep hills.

(5) Upland farming

238. In comparison with other types of agriculture, upland farming permits flexible allocation of fields. A number of crop combinations are obtainable in consideration of natural conditions such as soil and land shape, distribution of labor and managerial conditions such as distribution of labor and crop rotation in order to suit the characteristics of each combination. Upland crops are classified into grains, spices, vegetables, and fruits, each having its own characteristics. Therefore, more than one cropping patterns will be considered taking soils and rotation into account so that land can be allocated properly.

1-2 Management scale

(1) Anticipated income

239. The prime objective of the social and economic policies of the Malaysian Government is to eradicate poverty. Presently, poverty line is drawn at around M$300.00/household/month although the figure differs from year to year and from state to state. The development plan sets the annual net income per household at around M$6,000 per year.

(2) Projected unit yield of various crops and estimated unit wholesale price

240. Based on the results of researches and experiments conducted by MARDI, and of field investigations on crop yield at various sites of Peninsular Malaysia, the projected unit yields were estimated in consideration of those in the southeastern Asian countries of which the environmental conditions on crop growing are similar to that of Peninsular Malaysia as follows. Also unit wholesale prices of various crops are estimated based on the results of the field survey as follows.

Table VI-1 Projected Unit Yield and Unit Wholesale Price of Various Crops

Crop	Unit Yield (ton/acre)	Unit Price (M$/ton)
Cassava	13	70
Maize	1.4	450
Soybean	0.7	800
Groundnut	0.9	990
Onion	8.0	1,200
Chilli	4.2	1,600
Coffee	2.0	578
Ginger	5.4	1,100
Sorghum	1.8	550
Pineapple	1.0	-
Sweet potato	4.0	700
Watermelon	4.0	250
Lowland cabbage	10	500
Paddy (improved; main season)	1.44	520
Paddy (improved; off-season)	1.52	520

VI-2 Paddy and Upland Crop Farming

2-1 General

241. Farmers who are engaged in the cultivation of paddy and upland crops in the State of Trengganu are, in general, poorer than in other states. Major causes are inadequate irrigation and drainage facilities, small farm management, outdated farming techniques, etc. Another major cause is found to be the lack of distribution. This development plan attempts to increase income through the introduction of advanced agricultural techniques, full utilization of family labor for a higher production, together with the improvement of the distribution system.

2-2 Selection of proposed crops

242. Soil and water are important factors to be considered in the selection of crops. Types of crops to be introduced significantly differ depending on whether self-sufficiency or exporting be emphasized. In the case of this particular development project, the kinds of crops should be proposed from the international and domestic standpoints. As far as paddy is concerned, the self-sufficiency rate had been significantly improved since 1970 and it reached 85% in 1972.

243. The Government then changed the policy to control the rate at around 90% and further production. But, the policy was changed again due to worldwide food shortage and set up to become self-sufficient between 1975 and further 1977. As a result, its rate significantly rose in 1975. But, drought in the next few years dropped the figure down to 73% in 1977 and 58% between 1977 and 1978. Since rich harvest years are compensated by bad years, and the population is expected to grow, demand for rice is expected to grow continuously.

244. Lower areas still swampy even after the implementation of the project should be utilized solely for cultivation of paddy since no other crops will be suitable. Besides, it will be in line with the government policy. On the other hand, it might be a good idea that existing paddy fields which can be easily drained are converted into upland fields. Thus, supply of rice can be controlled in the State of Trengganu as a whole.

245. Upland crops will be selected from various points of view including possibility, relationship between demand and supply, and profitability. Also, each farmer will be required to make efforts to maximize productivity of crops, the number of working days, and the relationship between demand and supply into consideration. Since the groundwater table will still be relatively high even after the implementation of the project, short-term crops with shallow root must be introduced in low areas.

246. In accordance with considerations above, crops to be introduced are tablulated by soil types. The table contains some crops of which productivity is obviously low and are not desirable from the profit-making point of view. They are included, however, to allow rotation of crops, which is essential to upland cropping.

Table VI-2 Upland Crops and Suitable Soils

Crops	Histosols	Gleysols (Fine textured)	Gleysols (Coarse textured)
Short-term crops			
Maize	O	O	O
Sorghum	O	O	O
Cassava	O	O	O
Groundnut	O	O	O
Soybean	O	O	O
Mung bean	O	O	O
Tobacco	O	O	O
Chilli	O	O	O
Leaf vegetables	O	O	O
Fruit vegetables	O	O	O
Root vegetables	X	X	O
Ginger	O	O	X
Long-term crops			
Pineapple	O	O	O
Coffee	O	O	O
Ranbutan	O	O	O

Note: (1) O : Good
X : Difficult

(2) Crops which grow tall will be confined to high areas where groundwater table is low.

(3) Coffee will be provided with shading trees.

(4) The above crops are based on well improved soils with pH 6.

247. For reference, cautions required for the short term crops are shown in Table VI-3.

Table VI-3 Cautions Required for Short-Term Crops

Crop	Variety	Soil management	Planting density	Chemical control	Rotation
Paddy	Improved variety O	More application of fertilizer	O	O	
Maize	Composite O	O $_{p}H$ 5.3∿7.3			O
Sorghum	F_1 hybrid				O
Cassava	O	O $_{p}H$ 5.5∿6.5 O			O
Groundnuts	O	O $_{p}H$ 5.5∿6.5		O	O
Soybeans		Inoculation of root nodule bacteria O		O	O
Green bean				O	O
Tobacco		No successive cropping O		O	O
Chilli				O	O
Ginger		No successive cropping O		O O	

2-3 Planting system

248. Double cropping will be applied to paddy field. Short-term crops will be rotated in accordance with a certain planting system. The scope of a farm differs depending on the acreage and the labor force, and machinery depending on the conditions of each farm and type of crops. The above-said short-term crops are classified into the following groups:

a. Feed including maize, cassava, etc.

b. The pulse family including groundnut, soybean, green bean, etc.

c. Cash crops including chilli, tobacco, ginger, etc.

249. Among them, ginger should be kept away from the direct sunlight and cultivated once every three years or so. For other crops, combinations of a, b, and c should be rotated. Although unit profit per acre is low, feed does not require much labor excluding seeding and harvesting seasons. In contrast, cash crops require intensive management although they are profitable. Pulse family does not require so much labor as cash crops and the marketability is high but its profitability is low. Combinations of pulse family and feed cultivated in rotation prevent adverse effects due to continuous cropping, and increase productivity for soils. Therefore, combination of cash and forage crops, and leguminous crops will result in full utilization of farm labor and efficient production of highly marketable grains, beans and cash crops. Further, a higher production in the future can be expected.

2-4 Farm management plan

250. Proposed settlers will be individual farmers and fishermen and the majority of them will be poor. Normally, each farmer owns less than two acres at present. Consequently, it may be suggested that their agricultural knowledge is limited. Therefore, it will be important to provide them with opportunities to earn funds necessary for agricultural production and to study farming techniques.

(1) Paddy farming

251. Although each farm will be provided with five acres, it will be necessary to plan paddy in such a unit of blocks that will allow cultivation by means of farm machinery which will be shared. For that purpose farms

will be grouped in units of 30 and they will work in cooperation. Current unit yield per acre in the State of Trengganu is 0.74 ton (0.63-0.88 ton) during the rainy season and 1.0 ton (0.88-0.125 ton) during the dry season. These figures are significantly lower than those in the West Coast.

252. According to MARDI, yield can be doubled if farming techniques are improved in such areas as irrigation, drainage, and fertilization. The difficulty in achieving a higher yield at present is due to the fact that individual farmers are not capable of financing such facilities and purchasing fertilizer. To solve the problem, it will be necessary to provide irrigation and drainage facilities in addition to the introduction of high yielding varieties, improvement in fertilization, and employment of close planting and disease and pest control.

253. However, even such measures will not increase production immediately. In the master plan, the unit yield per acre is projected at 1.44 tons for the rainy season and 1.52 tons for the dry season. These figures are attainable when soils are improved after implementation of the development plan. On the basis of the figures above, five acres are estimated to yield 14.80 tons. If one ton is priced at M$480, each farm will be able to earn a gross return of about $7,000.

254. After deduction of production costs, a farmer will earn a net income of M$4,000 or less. Meanwhile, labor is normally concentrated twice a year, during the transplanting and the harvesting seasons. In other seasons, farmers will be able to work for other jobs if employment opportunities are available in surrounding areas. Where after jobs are not available, paddy fields will be reduced and converted into upland fields in order to cultivate highly productive cash crops to increase profit.

255. For instance, five acres can be divided into 3.5 acres for paddy fields and 1.5 acres for upland fields. Paddy is cultivated twice a year in paddy fields while chilli, maize and groundnuts are rotated in upland fields. Since such a cropping pattern will distribute farm labor evenly throughout the year, each farm will be able to earn an annual net income of M$6,500 or more including living expenses.

256. In the initial stage, paddy will be cultivated manually and by means of animal power. However, farm machinery will be introduced in the future and introduction should be planned from the beginning. Farm machinery will be the properties of farmers' cooperatives and the cooperatives will provide machinery and labor in accordance with the request of each farmer.

257. Threshing and subsequent work of each farmer will be entrusted to the association and expenses will be charged to farmers. The area of the seed beds will be 1/25 of paddy fields and seeding period will be set at around 20 days. 14 kg of seeds will be sown per acre. It will be desirable to apply agro-chemicals as well as fertilizer as wide an area as possible at a time. Cropping pattern for paddy is illustrated in Fig. VI-1,2.

Fig. VI-I Cropping Pattern I

(Paddy farming)

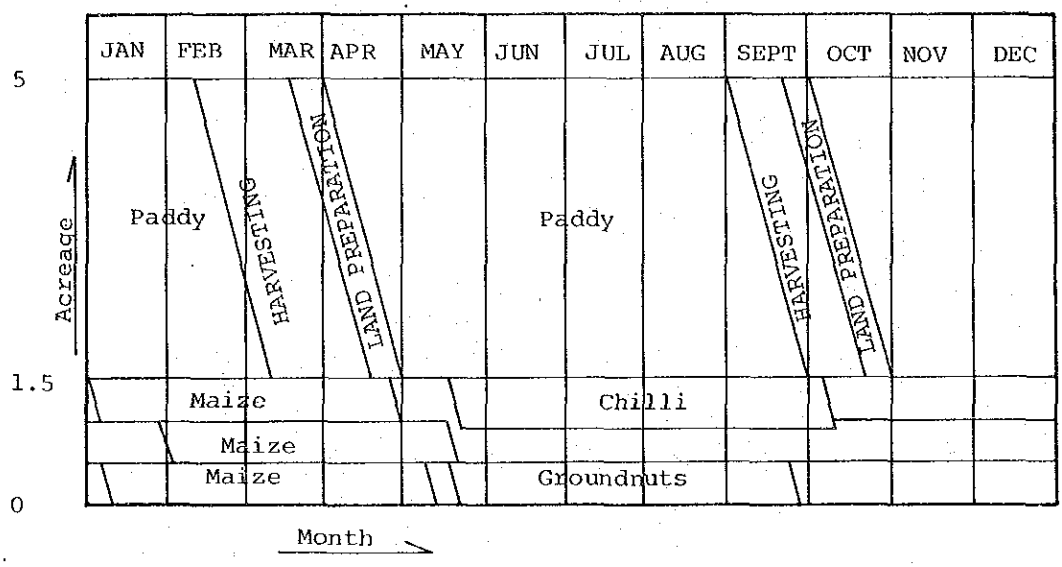
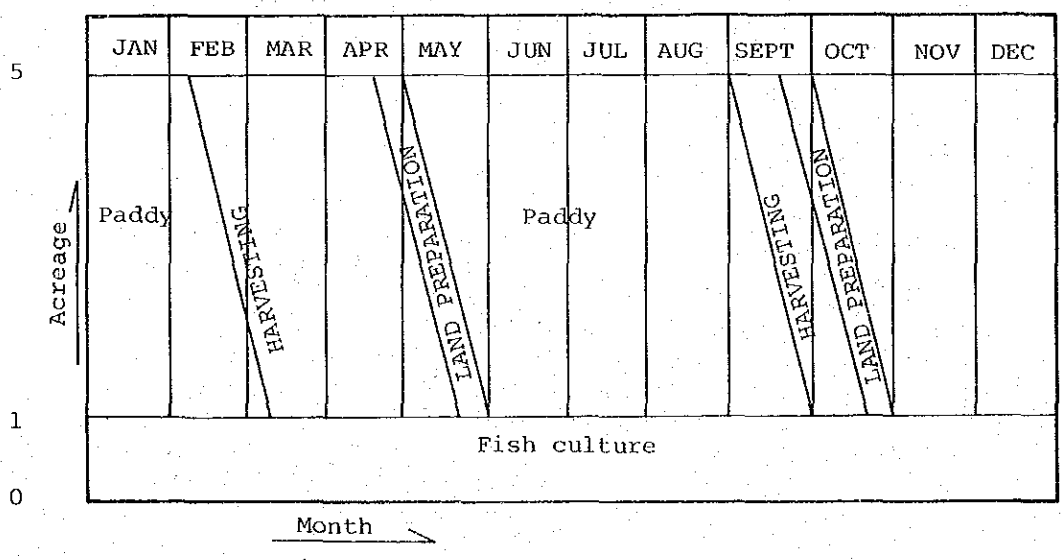


Fig. VI-2 Cropping Pattern II

(Paddy farming
with pisciculture)



(2) Upland farming

The unit size of operational holdings will be set at 6 acres, and 30 farmers, namely 180 acres, will be designated as one working unit. If one tractor of 50 HP is available, tilling for 180 acres of farmland can be done easily.

259. Upland farming faces various problems relating to the maintenance of the land productivity, drought during the dry season, flooding during the rainy season and damages by disease and insects due to high temperature and humidity. Flooding and excessive dryness must be solved through a drastic land improvement. But, they should be coped with in the farming process as well. Normally, soils deteriorate due to climatic changes, especially in the tropical and subtropical zones. Therefore, special efforts will be made to maintain land productivity as high as possible.

260. Although general control including spraying of chemicals is essential to prevent damages by disease and insect, keeping crops healthy is also important in preventing such damages. Therefore, organic substances available for plants in the soils will be increased, and deep tilling will be carried out to widen root zones. Further, nutrients including minor elements will be applied. It is a well known fact that rotation prevents soils from deteriorating caused by succession cropping and improves land productivity. In the development plan, cropping patterns in combination of major short-term upland crops, cash crops and leguminous crops are introduced.

261. Examples of cropping patterns for upland crops are illustrated in Figs. VI-3.1 ~ 3.6.

Fig. VI-3.1 Cropping Pattern III

(Upland farming; Type 1)

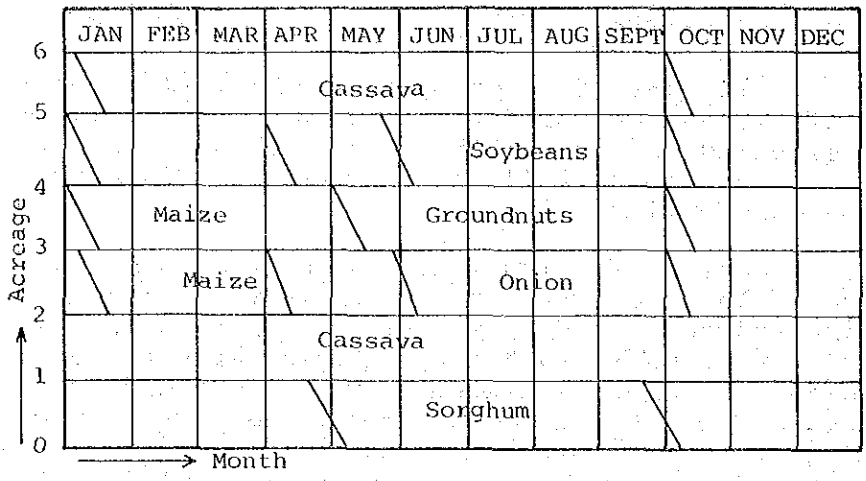


Fig. VI-3.2 Cropping Pattern IV

(Upland farming; Type 2)

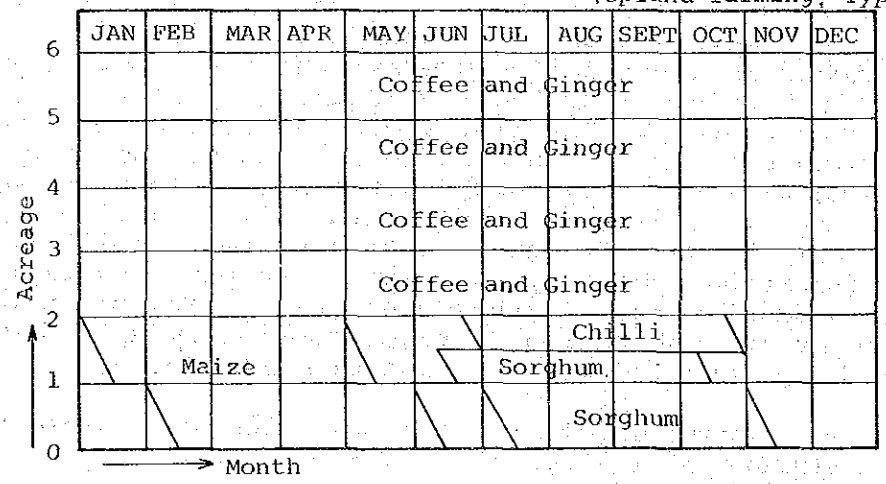
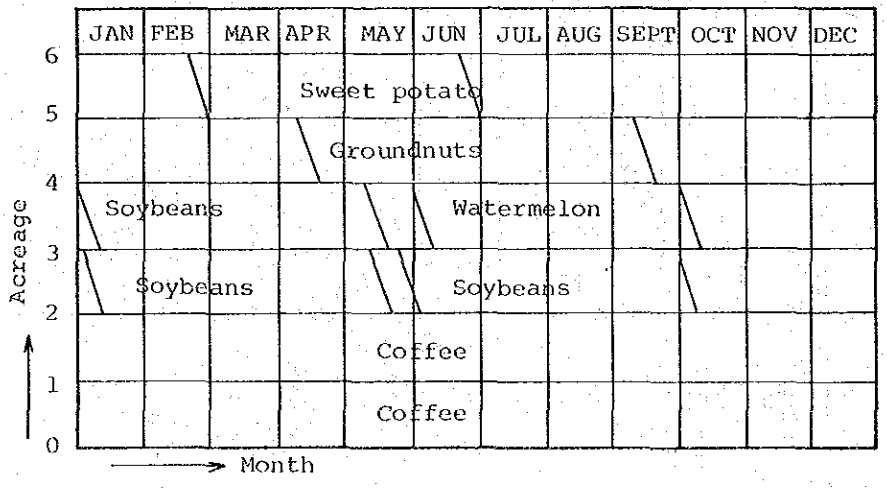


Fig. VI-3.3 Cropping Pattern V

(Upland farming; Type 3)



2-5 Application of cropping patterns[1/] and anticipated production

262. According to the master plan, eight (8) kinds of cropping patterns will be applied in the area. Out of eight kinds of cropping pattern, one (1), i.e., Cropping Pattern I, will be provided for paddy farming, one (1), i.e., Cropping Pattern II, for freshwater pisciculture including paddy farming, and six (6), i.e., Cropping Patterns III, IV, V, VI, VII and VIII, for upland crop farming.

Meantime, soil conditions in respective work units are briefly explained as below.

Work Unit	Soil Conditions
1	Peat contents are about 3/4; sand is not contained.
2	Sand contents are 1/5.
3	Peat contents are about 2/3; sand is contained slightly.

264. Cropping Patterns III, IV, V, VI, VII and VIII for upland crop farming will be applied at a series of certain ratios allotted previously by respective work units taking into account soil conditions mentioned above. Such ratios are shown in the following table.

Work Unit	Cropping Patterns					
	III	IV	V	VI	VII	VIII
	(%)	(%)	(%)	(%)	(%)	(%)
1	20	20	0	0	50	10
2	10	40	30	10	10	0
3	10	50	10	0	10	20

265. The anticipated annual production by crops in the master plan area is calculated on the assumptions that cropping patterns mentioned above are fully utilized. The summary is shown in Table VI-4.

1/: Refer to Figs. VI-3.4 - 3.6.

Fig. VI-3.4 Cropping Pattern VI
(Upland farming: Type 4)

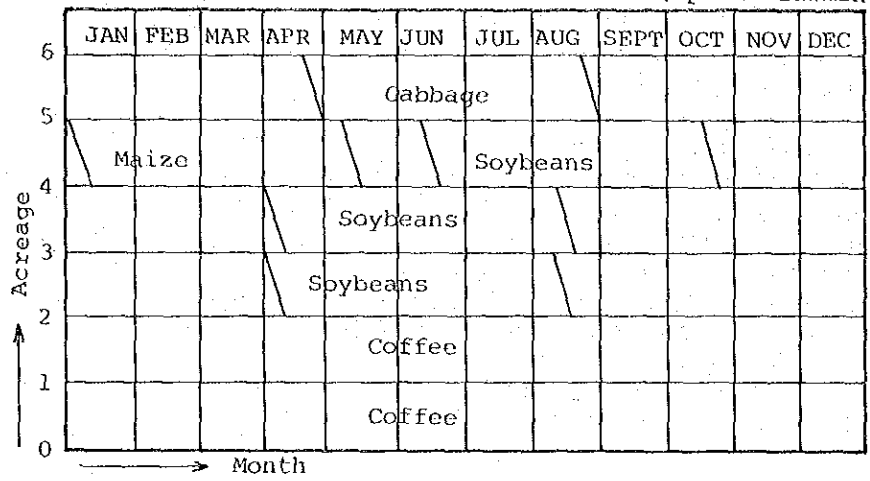


Fig. VI-3.5 Cropping Pattern VII
(Upland farming: Type 5)

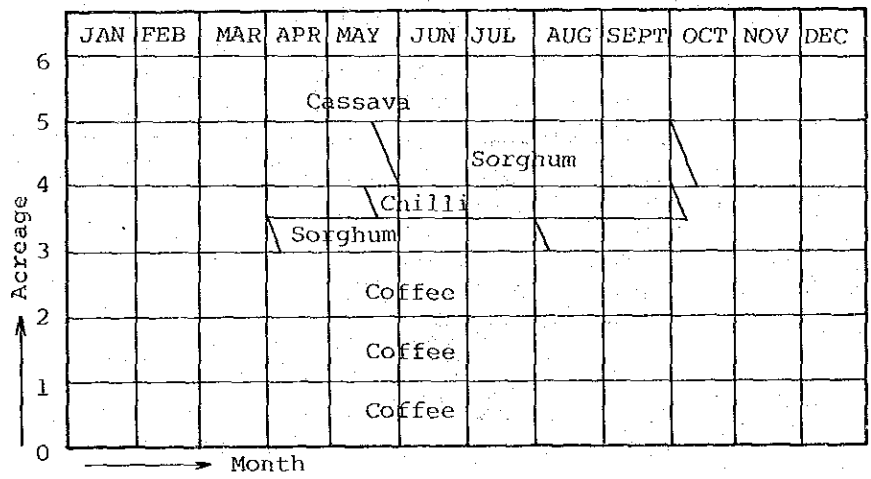


Fig. VI-3.6 Cropping Pattern VIII
(Upland farming: Type 6)

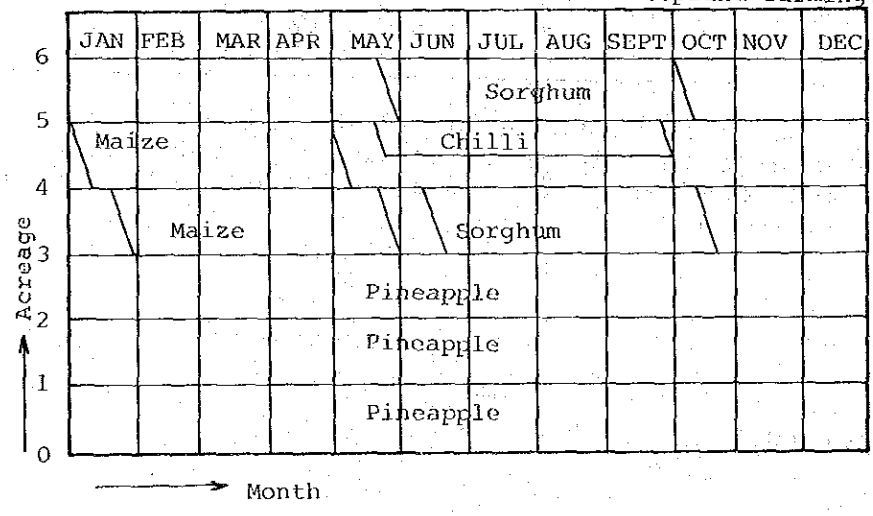


Table VI-4 Anticipated Crop Production in the Master Plan Area

No.	Year	Cassava	Maize	Soybean	Ground-nut	Onion	Chilli	Coffee	Ginger	Sweet Potato	Water-melon	Cabbage	Sorghum	Pine-apple	Paddy
1	1981/82	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1982/83	196	14	8	5	27	28	77	19	0	0	0	0	28	0
3	1983/84	812	62	163	48	118	252	340	40	0	0	0	0	120	928
4	1984/85	1,112	80	224	65	153	341	442	52	0	0	0	0	155	1,299
5	1985/86	1,228	88	243	71	168	371	484	56	0	0	0	0	170	1,411
6	1986/87	10,157	727	1,916	561	1,386	3,240	3,995	468	0	0	0	0	516	8,397
7	1987/88	15,216	1,089	2,713	807	2,074	4,684	5,986	1,287	0	0	0	0	865	10,735
8	1988/89	25,442	1,831	3,388	1,108	3,461	6,623	10,094	2,045	10	10	10	0	2,215	12,843
9	1989/90	31,424	2,320	3,950	1,362	4,295	8,246	12,771	2,467	48	48	48	0	2,930	16,115
10	1990/91	34,311	2,562	4,361	1,542	4,700	9,167	14,086	2,764	67	67	67	0	3,230	18,502
11	1991/92	39,390	3,273	5,498	1,922	5,521	10,594	18,141	3,570	729	863	863	334	3,755	22,981
12	1992/93	42,014	3,664	6,284	2,196	5,956	11,642	20,321	4,150	1,032	1,219	1,219	467	4,149	26,925
13	1993/94	43,848	3,868	6,743	2,358	6,232	12,233	21,456	4,288	1,131	1,334	1,334	507	4,413	28,564
14	1994/95	44,354	3,982	7,451	2,448	6,530	12,496	22,101	4,425	1,258	1,485	1,485	567	4,483	29,720
15	1995/96	44,675	4,064	7,637	2,513	6,396	12,687	22,564	4,525	1,356	1,602	1,602	614	4,527	30,545
16	1996/97	45,012	4,149	7,810	2,573	6,565	12,852	23,054	4,629	1,466	1,733	1,733	667	4,570	31,320
17	1997/98	45,064	4,162	7,871	2,598	6,476	12,934	23,120	4,647	1,471	1,738	1,738	667	4,582	31,664
18	1998/99	45,064	4,162	7,871	2,598	6,476	12,934	23,120	4,647	1,471	1,738	1,738	667	4,582	31,664
19	1999/100	45,064	4,162	7,871	2,598	6,476	12,934	23,120	4,647	1,471	1,738	1,738	667	4,582	31,664
20	2000/01	45,064	4,162	7,871	2,598	6,476	12,923	23,120	4,647	1,471	1,738	1,738	667	4,583	31,664

2-6 Supporting services

(1) Extension services

266. Although the speed of land productivity depends mainly on types of soils, it normally stabilizes in a few years after soils are improved. It is necessary to find soil conditions in advance and then plan for cultivation according to findings since soils change continuously. In consequence, soil surveys, planning of crop cultivation accordingly, and provision of instructions will be necessary. For that purpose, the following personnel will be required:

i) Experts for the study of soil and cropping

ii) Extension workers

267. Since experts mentioned above will be responsible for a large area and their workload will be heavy, more than three will be necessary even if they are assisted by extension workers. In relation with the above, it will be necessary to strengthen existing extension offices in both number of personnel and quality through training.

(2) Extension farm

268. Establishment of an extension farm will be necessary to introduce basic and new farming techniques to settlers periodically or according to necessity. For that purpose, provision of both facilities and personnel will be required. As implementation of the development plan progresses, farm mechanization will be necessitated. The extension farm will also be responsible for training operators of farm machinery.

(3) Farming materials

269. Each farmer is responsible for the procurement of his own fertilizer, chemicals, and seeds. These materials should be prepared by the government in terms of subsidy in consideration of shortage of funds. Since farmers themselves will not be able to obtain seeds for composite corn and hybrid sorghum in their farms and since the germination capacity of soybean does not continue for one year, from the extension farm such seeds must be supplied. The Government should also plan the introduction of farming and processing machinery and equipment, and the fostering of a proper organization which actually carries out the plan. Agricultural cooperatives may be proper for that purpose.

VI-3 Livestock Industry

3-1 Projected demand and supply

270. The Malaysian Government has made a study on demand for livestock products up to 1990 on the basis of actual consumption in 1975. The projected demand is shown in Table VI-5.

Table VI - 5 Projected Demand for Livestock Products, Peninsular Malaysia, 1975 - 90

Products	1975			1980			1985			1990		
	Total Consumption (million lbs)	Ration (%)	Per Capita Consumption (lb)	Total Consumption (million lbs)	Ration (%)	Per Capita Consumption (lb)	Total Consumption (million lbs)	Ration (%)	Per Capita Consumption (lb)	Total Consumption (million lbs)	Ration (%)	Per Capita Consumption (lb)
Poultry Meat	183	49	18.2	273	55	23.7	406	60	30.9	615	66	40.2
Pork	135	37	33.2	162	32	35.4	195	29	37.0	234	25	39.0
Mutton	11	3	7.2	13	3	7.5	15	2	7.8	18	2	8.2
Beef	41	11	6.8	49	10	7.0	58	9	7.3	69	7	7.6
Total	370	100	35.3	497	100	58.1	674	100	49.0	936	100	59.9
Poultry Eggs 1/	1,727	-	171	2,411	-	210	3,366	-	256	4,699	-	313
Milk 2/	78	-	7.7	90	-	7.8	103	-	7.8	118	-	7.9

1/: Total consumption and per capita consumption of eggs are given in millions and number of eggs respectively.

2/: Total consumption and per capita consumption of milk are given in million gallons and gallons respectively.

271. According to the table, meat production is expected to grow by 88% in 10 years from 497 million lbs in 1980 to 936 million lbs in 1990. The growth is not surprosing in consideration of the current growth of the Malaysian economy and society. However, the figure indicates an annual growth rate of 6.5%. According to the current livestock conditions, supply does not seem the growth rate without aggressive efforts. Therefore, it is proper for the State of Trengganu to include the livestock industry in the development project.

3-2 Promotion of livestock industry

272. The livestock industry consists of beef and dairy cattle, water buffaloes, and other domestic animals such as goat, sheep, swine, chicken, etc. In this particular project, the following two objectives will be achieved:

a. Rearing of young pregnant dairy cattle for sales to dairy farms.

b. Rearing of grown beef cattle for sales to the markets.

273. Production of milk is one of the important policies of the Malaysian Government. In addition, it brings a relatively high income to farmers. On the other hand, rearing of dairy cattle and stocking and delivery of milk require special skills. It should be noted, here, that a majority of the settlers will have no previous agricultural experience. From the above reason, and possible transportation and storing problems to ship to the West Coast, milk production are not be pursued initially.

274. The following conditions are essential for a successful production of milk:

a. Enlargement of demand

Market must be in the proximity of production.

b. Road improvement

A good network of roads is essential for delivery of dairy products.

c. Establishment of processing factory

Fresh milk will be pasteurized, packed, and refrigerated.

d. Securing adaptable species of milk cow

Normally, an annual production per head of 3,000 kg or 1,500 kg at minimum must be met in order to be profitable. The minimum standard is set at 4,200 kg in Japan and 5,200 kg (6,000 kg for a dairy farm) in the U.S.A.

e. Preservation of milk

Raw milk is as warm as around 35°C immediately after milking. Milk spoils in four hours or so if it is left in a room warmer than 27°C. Therefore, refrigeration is essential for cooling-down to 5°C or less immediately after milking.

f. Establishment of facilities for refrigeration

Refrigeration is also required during shipping to collection centers and processing plants.

g. Necessity for conservative price estimation of milk

The producers' price is estimated 30% lower than that in the West Coast. When demand is not found in the surrounding areas milk must be shipped to the West Coast. In that case, a lower price is unavoidable due to a higher shipping cost and a lower grade in terms of bacteria, pH, etc. Vibration during longer shipping hours causes churning due to formation of cream, accordingly lowering the grade of fresh milk.

Current producers' price in the West Coast is approximately M$0.60/liter when collected by general collecting operations. The figure can be improved only to around M$0.70/liter even if the collection system is streamlined.

h. Purchasing of better feed stuff

Even the cross bred between Zebu and Friesian, which is considered most suitable, will not be able to produce 3,212 lbs (1,445 kg) if only grass is fed. As a result, feed with a higher T.D.N. must be fed. Refuse is currently fed in the West Coast but if it is obtainable, its purchase will increase the price and will not be competitive against the production cost in the West Coast.

i. Technical training

Since the dairy production requires more advanced skills than other types of agriculture, one to a few years of training will be necessary for the feeding, breeding, milking, health control, and handling of milk.

From the above, production of milk should not be introduced from the beginning of the development. Rather, dairy calves should be reared (more advantageous than rearing of beef cattle) until requirements are met for the dairy production.

Dairy calfs after weaned will be introduced to rear for two and a half to three years. They are bred and sold to dairy farmers in suburbs of consuming cities about one month before delivery. Water buffaloes are reared widely for the agricultural purpose and sold for beef when they grow old or their requirement for draft work is not necessary, for instance, due to double cropping of paddy.

Due to their late maturity and low fertility, water buffaloes are not suitable for rearing in a large number. Therefore, they are not included in the development plan. In the State of Trengganu, productivity for small livestock is low. Intensive poultry farming is especially unsuitable due to feed conditions. Consequently, small livestock are not included in the plan except for a small-scale rearing near housing areas for their own consumption.

3-3 Cattle rearing methods

(1) Grazing

275. Rotational grazing: Cattle will be grouped to three to four heads as follows to allow an easy management:

a. Cattle of 6 to 11 months old will be separated from those of 11 months old or more before breeding.

b. Cattle of 16 to 18 months old or more will be grouped into ones ready for breeding and pregnant ones.

276. One group will be kept in three to five pasture sections which are rotated in three- to seven-day intervals according to the growth of grass. The number of pasture sections is calculated as follows:

$$\text{Number of sections} = \frac{\text{Number of days without grazing}}{\text{Number of grazing days}} + 1 \times \text{Number of heads}$$

277. Number of heads in a herd will be kept as large as possible in order to minimize labor although it depends on how experienced the herdman is. One experienced herdman is normally able to tend 300 to 400 heads with two to three assistants.

278. Advantage and disadvantage of grazing: Advantage and disadvantage of grazing are explained as below.

Advantage of grazing on pasture

a. Grazing is best suited to a large-scale operation of cutting and feeding, and labor is not necessary.

b. In general, grass utilization efficiency is set at around 50 to 70%. The figure could be increased to 70 to 80% if maintenance of grass, the size of herds and paddock, and rotation schedule are set properly once the advanced grazing system is achieved.

c. Once grassland is developed, steep hills and other areas can also be utilized as pasture since daily mechanical work will not be required then.

d. Excreta treatment facilities are not required.

e. No feed storage is required (Necessary in case of a high density).

Disadvantage

a. A large area of grassland is required calling for reclamation and development expenses.

b. Dispersed water and salt places are expensive.

c. A large area requires heavier herding work.

d. Cutting of residual grass will be necessary.

e. Damages due to parasites must be taken into consideration.

(2) Feeding of cut grass

Cut grass feeding procedure: While cattle is brought to a pasture in the pasture grazing system, cattle is kept in pens and fed with cut grass. Consequently, this system can be regarded as feedlot in a broad sense. Although the area of pen per head differs according to climatic conditions, quality of drainage, the area available for exercising, and the excreta disposal method, 10 m^2 to 35 m^2 are normally required. On the other hand, this system does not require grassland as large as the other system, since high yielding Napier grass can be cultivated. An average of 150 to 200 tons of fresh grass can be expected per hectare.

280. Meanwhile, this system requires a considerable amount of mechanical and human work daily for cutting and transporting grass. Also, silage will be called for in preparation for rainy days and days off. Consequently, silos should be provided. Furthermore, equipment and labor will be necessary for the disposal of excreta.

281. Advantage and disadvantage of feeding cut grass: Advantage and disadvantage of feeding cut grass are explained below:

Advantage

a. High yielding Napier grass suitable for cutting can be grown intensively, and requires a small area. Therefore, reclamation and grassland development costs will be lower than for the other system.

b. Grassland can be utilized efficiently. An utilization rate of 80% can be expected.

c. Expenses for water and salt places can be reduced.

d. Less herding work is required since cattle are kept in pens, which are much smaller in area in comparison with the other system. As a result, disease can be controlled more efficiently.

Disadvantage

a. Equipment and labor are required for daily cutting and transporting of grass.

b. Mechanized work requires levelling of land.

c. Feed storage is necessary.

d. Equipment and labor are required for the disposal of excreta.

3-4 Development of pasture land

(1) Development method

282. In Malaysia, domestic animals have been kept loose in vacant land and paddy field after harvesting. In order to develop a modern livestock industry a large investment will be made for the development of sufficient grassland. Pastures can be developed in two methods, namely plowing and non-plowing. The former involves a series of work such as uprooting and the removal of rocks with rakedozer, plowing with a brush breaker or plow, pulverizing and smoothing soils with a disk harrow, tamping with a cultipacker, fertilizing, sowing and covering with a broadcaster, a drill, etc.

283. On the other hand, mechanization is not feasible in the latter which is characterized by steep hills, rocks and trees. In the latter case, hoof cultivation is employed to suppress vegetation prior to growing of grass and to sow grass seeds by means of hoof. Burning and herbicide are sometimes used to control vegetation.

(2) Kinds of grass

284. It is no exaggeration to say that the successful rearing of cattle depends on the introduction of a proper grass and its harvesting volume. A number of studies have been made on grasses while leguminous grass still have to be studied further. Kinds of grass available for feed are as follows:

English name	Scientific name
Grass suitable for grazing on pasture	
Para grass	Brachiaria mutica
Signal grass	Brachiaria decumbens
Palisade grass	Brachiaria brizantha
Pangola grass	Digitaria decumbens
African Star grass	Cynodon plectostachyus
Guinea grass	Panicum meximum
Guatemala grass	Tripsacum luxum
Leguminous grass suitable for grazing on pasture	
Centro	Centrosema pubesens
Stylo (Brazilian Lucern)	Stylosanthes guianensis
Grass suitable for cutting	
Napier grass (Elephant grass)	Setaria (anceps) Sphacelata

285. African Star grass can grow in damp ground of a variety of soils. Signal and Para grass also withstand damp ground. Since Pangola grass endures ill conditions and dry land, it will be suitable for high lands. Guinea grass is good for both grazing on pasture and cutting while Napier grass grows too tall for grazing on pasture. It should be grown for cutting only.

3-5 Plan of livestock industry

286. The plan is as follows:

(1) Fundamental conditions for planning

a) The following four types of cattle will be reared:

i) Six to eight months old dairy calves will be purchased, and artificial insemination be performed approximately 20 months later (26 to 28 months old). After rearing for about 30 months, (36 to 38 months old and one to two months prior to delivery). They are sold to dairy farmers nearby consumers.

ii) Castrated dairy male calves (6 to 8 months old) will be purchased and reared for 18 to 20 months (24 to 26 months old) to sell beef to the market.

iii) Male beef calves born in the master plan area will be castrated and sold for beef after they are reared for 24 to 26 months.

iv) Female calves born in the master plan area will be reared for the breeding purpose.

Production of milk is not included in the project.

b) A live weight of 350 kg is expected for a grown cattle of 24 to 26 months old for both dairy and beef cattle. The weight of grown cattle is shown below according to age:

Male and female calf (0 to 12 months old)	0.25 L.U.
One to two years old (12 to 24 months old)	0.50 L.U.
Two to three years old (24 to 36 months old)	1.00 L.U.

Projected annual mortality rate is 5.0%.

c) Cattle are fed only grass in principle. Concentrated feed or waste matters of sericulture will be limited to sick and pregnant cattle. K.R. Pillar made known in 1976 that 15 lbs of palm oil sludge reduced the volume of grass by 25% without any adverse effect on growth. But, it has not been tested on general farms yet and requires the cooperation of a palm oil plant. Therefore, the possibility will be discussed in the future.

d) The volume of grass fed daily to a grown cattle will be 12.5% of the live weight.

Daily feeding of grass:
350 kg x 0.125 = 43.8 kg/day/head

Daily and beef cattle will be in the ratio of 50% each in order to achieve a healthy

e) Grass yield and utilization rate are as follows:

Type	Variety	Unit yield (ton/acre)	Utilization rate
Cutting	Napier grass	71	0.8
Pasture grazing	Guinea grass	35	0.6

f) Dairy and beef cattle will be in the ratio of 50% each in order to achieve a healthy management and to prevent risks due to diseases. The standard number of heads per farmer is 20, consisting of 10 dairy and 10 beef cattle in livestock unit.

g) Both feeding of cut grass and grazing on pasture will be employed by each farmer. The total area will consist of 65% of grassland for cutting and 35% for grazing.

Several farmers will share forage harvesters jointly to cut grass, and each farmer will cut eight times one year.

h) Large farm machinery will be shared under a group management system. In the system, the development project office will be provided with one to two operators, farm machinery, seeds and fertilizer. They will be available in accordance with the request of farmers and their expenses will be charged to farmers. This system will be able to reduce the cost of farm machinery for each farmer.

(2) Detailed plan

a) Annual grass requirement per farmer

Daily volume per head:
350 kg x 0.125 = 43.8 kg

Daily volume per household:
43.8 kg x 20 heads = 876 kg

Annual volume per household:
0.876 ton x 365 days = 320 tons

b) Average of grassland and cutting volume per household

Grassland for cutting:
320 x 0.65/(71 x 0.8) = 3.66 acres

Pasture:
320 x 0.35/(35 x 0.6) = 5.33

Total = 9.0 acres

Annual cutting volume:
3.66 x 71 x 0.8 = 208 tons

Daily cutting volume:
208,000/365 = 570 kg

Cutting volume per time per acre:
71/8 = 8.88 tons

Cutting acreage per time:
0.57/(8.88 x 0.8) = 0.08 acre

c) Rearing plan for each farmer

An average of 33 to 34 heads will be reared by each farmer (livestock unit of 19 to 20 heads). A farmer will be able to sell annually five dairy and five beef cattle after the third year, if six heads of dairy and six heads of beef calves are introduced every year with an estimated annual loss of five percent.

d) Annual income and expense per farmer

Estimated selling prices are M$1,000 for a pregnant dairy cattle and M$770 for a beef cattle. The purchase price or production cost of a calf is estimated at M$100. The total operation cost of each farmer is estimated at M$200 per head. Therefore, income and expenses of each farmer are as follows:

Income:

Sales of dairy cattle	1,000 x 5 = M$5,000
Sales of beef cattle	770 x 5 = M$3,850
Total	M$8,850

Expenses:

Expenses	(100 + 200[1/]) x 10 = M$3,000
Net profit	8,850 - 3,000 = M$5,850

e) Development unit

The operation of one farmer consists of 9.0 acres of grassland, and 20 heads cattle of livestock unit. If farm machinery is shared among farmers, the scale of the development unit will be as follows:

The capacity of a harvester is estimated at one acre per hour and its standard operating hours are estimated at four hours. Therefore, the harvester can finish four acres per day. Since daily cutting area per farmer is 0.08 acre, 50 farmers (4/0.08) can share the machinery unit. Therefore, one development unit is estimated at 500 acres i.e., 9 acres x 50 farms plus 50 acres for roads and housing sites.

f) Occupancy expenses per farmer

In the plan, there is rearing of beef and daily cattle, the latter until they are ready for milking (approximately one month before delivery). Therefore, facilities can be kept as simple as possible to maximize efficiency and to minimize their cost.

1/: Cultivation, fertilizer, seed, and sanitary expenses (during pregnancy period and the cost of concentrated feed) and others.

Barns: For calfs: $4m^2$ x 23 heads = 92 m^2

For grown cattle:

8 x 10 = 80

Total =170 m^2

Construction cost:

170m^2 x 20 = M$3,400

Fence: 1,500m x 0.9 = M$1,350

Water supply system: One location M$1,000

Dipping facilities : One location M$1,000

Development of grassland:

9 acres x 140 = M$1,260

Total M$8,010

g) Cost of machinery per development unit

Tractor (70 to 80 PS)	One	M$40,000
Forage harvester	One	M$70,000
(Automatic mower (7PS)	One	M$3,000)
Attachment (Large)	One set	M$6,800
Attachment (Small)	One set	M$4,500
Total		M$124,300

3-6 Problems on livestock development plan

(1) 287. The livestock industry in the State of Trengganu has shifted toward grazing on pastures in the past few years. But the total area of grassland developed is only 1,200 acres. The majority of livestock is still reared on weeds in vacant land or kept loose in paddy fields after harvesting.

High yielding grassland is essential to modernization of the livestock industry. Although a modern livestock industry might be expensive, it will be profitable in the long run. Furthermore, various difficulties must be solved in order to be competitive in the international market.

(2) 288. The Malaysian Government is promoting the proliferation of dairy cattle in order to meet rising consumptio of dairy and meat products as the standard of living in the country becomes higher.

Although the rearing of dairy cattle and the production and processing of milk might be more profitable than the rearing of beef cattle, this project does not go as far as the production of milk and is concerned with only the rearing the sales of daily cattle. The production of milk is excluded since settlers will have no previous agricultural experience and funds.

It should be remembered, however, that dairy production should be introduced to the State in the future when settlers gain both skill and funds. For that purpose the State of Trengganu will develop a long range livestock production plan to be ready for testing and extension.

(3) 289. Local varieties of grass will be studied for cultivation in the future.

VI-4 Freshwater Pisciculture

4-1 Water quality

290. Water in swamps with thick peat deposits normally registers strong acidity due to organic acid. The swamps in the master plan area are classified into the groups as already mentioned. Many of them have a pH value of 5.5 or more but it can often be improved by the provision of lime. For example, a fishpond in the rubber plantation of FELDA in Belara was found to have a pH value of 6.3 to 6.5 after the application of lime. Acid water with a pH value of 5 or less is generally considered unsuitable for fish cluture.

291. On the other hand, improvement of soils is indispensable to the development of swamps into farmland. Pisciculture in such farmlands can only be planned in anticipation of improved water quality as a result of the improvement of soils. It is also known that the acidity of pond water can be reduced by the propagation of phyto-plankton. It will be necessary to study on the swamps acid water. The results of the study on the swamps along the upper stream of Bera river, which is a branch of Pahang river, indicate that 45 genera and 70 species were found despite a pH value of around 5 all the year around.

4-2 Species suitable for cultivation

292. At present, seedling is carried out for fresh-water fish in five hatcheries and four public organizations in Peninsular Malaysia. In 1977 alone, more than 250,000 seeds were produced but they were of only three species namely, common carp, Lampan Jawa and freshwater shrimp (Macrobrachium rosenbergi).

293. The production is not adequate in both quantity and number of species. In consequence, the shortage is compensated by imports and farmers' own supplies although it should be solved by improving hatching techniques and the reinforcement of existing facilities. Cultivation of common carp and Lampan Jawa can be immediately started since they have long been cultured in the country. Further, they are either omnivorous or hervivorous, and can be priced favorably. Silver Carp and Bighead Carp are cultured on plankton and suitable for cultivation by fertilizers. They are cultured extensively in the West Coast states, especially in Perak. They are also re-commended by the State of Trengganu. It is urgently required to set up a system to supply their fry through-out Malaysia.

294. Grass Carp is one of a few species which can digest a large volume of carbohydrates. Therefore, it can be cultured together with common carp, Silver Carp and Bighead Carp. Seed production for grass carp should also be studied.

295. Introdution of Tilapia must be considered since it is omnivorous and grows rather rapidly. Further, it can endure acid water well although its market price is not so high in comparison with other above-said species. To compensate the problem of low price, its value added must be improved by means of various processing methods mentioned hereafter. Another species to be considered is Tilapia nilotica. The species is cultured very successfully in Taiwan. The red fish is distinguished from Tilapia mossanbica mainly due to differences in appearance and priced more favorably than the latter.

296. The cultivation of freshwater shrimp (Macrobrachium rosenbergi) has bright prospects since it can be priced high in the market. It should be noted here that the cultivation of crustacean requires much more advanced management than fish. If the State of Trengganu is to expand the cultivation of crustacean, the State Fisheries Department must conduct various tests to identify possible technical problems experienced in cultivation.

297. Catfish of Clarias batrachus is widely cultured in Thailand. The same species is found throughout Malaysia and a large quantity is sold today in the western states. But, none is found in the State of Trengganu. 50 to 55% of its total weight are edible. In the State of Trengganu, introduction of channel catfish (Ictalurus Panctatus) should be considered. The species is omnivorous, but its edible portion reaches 65 to 70% of the total weight. One more advantage of the introduction of such species is that its ecology has already been studied by some countries. The State Fisheries Department should evaluate in detail the economy and technique of various plans to commercially cultivate channel catfish. It will be important for Trengganu to offer a better species which can be priced higher than the one currently distributed in the West Coast.

4-3 Cultivation methods

298. A few methods are available including the cultivation in ponds, the most popular method, which is also found in Trengganu. Since the physical size of a pond is limited, the production is also limited unless synthetic food is fed. A constant flow of water, if it is

available in abundance, permits rearing in a high density. But in this method, the constant flow of water flushes not only animal and plant planktons but also nutrient substances. Therefore, it is recommended to start with the stagnant water system to grow and fertilize natural feed to culture fish.

299. Fishponds allow for easy maintenance and high production since it is possible for settlers to own. If a reservoir of a reasonable size is available for irrigation and drainage purposes, it can be utilized for crawls. In the case of crawls, water is freely replaced with surrounding water, and cultivation in relatively high density is possible. Except for freshwater shrimp (Macrobrachium rosenbergi), all of those aforementioned species can be cultured in crawls. If fishponds or crawls are not available, paddy fields can be utilized as currently practiced in other Southeast Asian countries.

300. In utilizing paddy fields, cultivation can be carried out in two ways. In one method, both paddy and fish are cultivated simultaneously while on the other, fish is cultivated after the harvesting of paddy. Unfortunately, many varieties of paddy grown today normally require a large amount of fertilizer and chemicals. As a result, damages to fish by chemicals and herbicide, damages to paddy by fish and many other problems must be solved. From the above, the best method to be adopted in the master plan area must be determined when land utilization and related irrigation systems are finalized for the entire area.

4-4 Management scale

301. In the case of existing cultivation in ponds, daily work such as fertilizing, cutting of grass for feed, and feeding of remains of a meal can be adequately taken care by family members except for liberation of seeds and catching of fish. Further, even unexperienced settlers will have little difficulty if they are properly instructed by travelling state government workers as in the case of FELDA fishponds in Belara. Productivity and a proper management size will be calculated on the basis of productivity of FELDA in Belara.

Productivity for current fishponds

Number of fry liberated:	approx. 500
Species:	Lampan Jawa
	Chinese carp
	common carp

Area of one pond:	0.25 acre
Catch:	500 to 600 lbs.
Cultivation period:	6 to 8 months

i) Annual production in volume

Catch is given on the annual basis.

550 lbs/7 months x 12 months = 943 lbs

ii) Annual production in value

Average wholesale price of common carp, Chinese carp and Lampan Jawa in 1977 is as follows:

	(M$/kt)
Common Carp	1.12
Grass Carp	1.25
Silver Carp	1.27
Bighead Carp	1.06
Lampan Jawa	1.08

The average wholesale price per pond is M$1.16/kt If producers' price is estimated at 85% of the figure, the output would be:

M$1.16/kt x 0.85 = M$0.97/kt = M$1.6/kt

In consequence, annual production per pond is estimated as follows:

M$1.6 x 424 kg = M$678/year = M$2,712/acre/year

iii) Annual gross income

On the assumption that the Malaysian Government provides seeds and fertilizer as today in order to start freshwater pisciculture, almost no expenses will be incurred. Thus, the gross income will be the next income itself.

iv) Anticipated annual profit

As previously mentioned, the annual income under the current cultivation method and management techniques are estimated at around M$2,712/acre. The figure will be increased by 50% by achieving the following two objectives:

a. Increased production by increasing density--25%

Current stocking density at the time of harvesting is 0.424 kg/m^2. The figure will be improved easily by 25% to 0.53 kg/m^2 under the current stagnant water system. For reference, common carp is cultured at density of 1 kg/m^2 under complete stagnant water in Japan.

b. Increased producers' price as a result of selection of species and streamlining of distribution system--20%

The mixing ratio of grass carp and Silver Carp of which seeds are not adequately supplied at present will be raised since their wholesale prices are relatively higher than others. Fish will be sold to individual consumers directly, as in the case of Belara, or to large users on contract basis. Thus, streamlining of the distribution system will raise the current producers' unit price of M$0.97/kt by 20% to M$1.16/kt.

On the assumption that the above goals are achieved and one family owns six fishponds of 1,000 m^2 each, the family will be able to earn about M$6,000 annually. The calculation is shown as below:

M$2,712/acre/year (Current productivity)

x 1.5 (Improved productivity) x 1.5 acres

(six fish ponds) = M$6,102

4-5 Extension work

302. If fish culture is to be based on fishponds of private ownership, the periodic provision of instructions by extension workers will be essential. Further, any inquiry or request for assistance must be answered promptly. It is also important to produce adequate seeds. For instance, more than 2 million seeds will be required annually if fishponds with a total area of 500 acres are developed and 2,400 seeds are consumed per hectare in seven months. In order to meet all those requirements including management of transporting seeds and provision of necessary instructions, an extension centre will be established in the master plan area. The center will be required of such departments as civil engineering, water control, cultivation, disease control and processing.

4-6 Processing

303. Processing will be required in order to raise value added or to sell directly to big users. In general, people are very conservative as far as taste is concerned. Therefore, it is difficult to foresee whether a new product will be well received by consumers. One way to increase the demand of freshwater fish is to use for fish crackers and balls which have been exported to Thailand and Singapore extensively. To expand demand, development of highly processed and standardized products which can last long will also be important.

304. Processing of fish includes drying, salting, kneading and canning. A canning factory has already been completed in Kuala Ibai under the management of SEDC and MAJUIKAN. Fish paste which is popular in Japan requires a rather complicated processing. Besides, water soluble protein is lost during processing, and demand for fish paste in Malaysia is still an unknown quantity. Salted products require simple processing but their value added is minor. From the above, drying in the smoke will be adopted first since smoked products require relatively simple facilities and their value added is high. Furthermore, their demand is steady. Manufacturing problems in smoking freshwater fish are known. But seasoning which suits the taste of the Malaysians must be studied and developed by the extension centre.

VI-5 Sericulture

5-1 Background

305. The purpose of the Trengganu Swamp Area Integrated Agricultural Development is to convert swamps into farmland to raise the standard of living for those farmers, agricultural laborers and fishermen in the State of Trengganu who, at present, live below the poverty line. Sericulture is recommended as a part of the master plan since it is characterized by a relatively high productivity of land and intensive labor. The state is favored in these two aspects. It offers an abundant supply of labor and favorite climate.

306. On the other hand, Malaysia is not experienced in commercial sericulture. Therefore, it is essential for the government to provide proper guidance and assistance for a successful introduction of sericulture. It is also important to conduct researches in order to introduce sericulture in the most effective manner.

5-2 Worldwide supply and demand of raw silk and silk yarn

307. World's supply and demand of cocoons and silk yarn are summarized hereafter. Production of textile fabrics in the world increased 40% during the period between 1965 and 1976. Demand for silk fabrics also grew at a similar rate for the same period. Production of silk yarn, on the other hand, has remained around 48,000 tons since 1974. Japan, who had been the leading silk yarn producer for some time, was replaced by the People's Republic of China in 1977. The two countries together produce about 70% of the total world's supply.

Table VI-6 World Production of Cocoon and Silk Yarn, 1977

Country	Production			
	Cocoon		Silk Yarn	
	(ton)	(%)	(ton)	(%)
People's Republic of China	166,000	42.3	17,760	36.3
Japan	79,300	20.2	16,080	33.1
India	43,000	11.0	3,090	6.4
USSR	41,000	10.5	3,240	6.7
Korea (South)	31,900	8.1	5,004	10.3
Korea (North)	6,800	1.7	648	1.3
Brazil	6,500	1.7	978	2.0
Iran	3,500	0.9	432	0.9
Bulgaria	2,200	0.6	240	0.5
Turkey	1,300	0.3	126	0.3
Others	10,700	2.7	876	1.8
Total	392,200	(100.0)	48,534	(100.0)

308. They are followed by India, USSR, South Korea and Brazil. Those six countries account for 95% of the world's production. The People's Republic of China, the leading exporter, supplies nearly 75% of the world's exports. Other major exporters are South Korea and Brazil. Meanwhile, Japan, the biggest importer, imports nearly 50% of the silk yarn exported in the world. Other major importers are Italy, France, and USA. Thus, Japan is the second largest producer and the leading importer at the same time.

309. In the past, consumption of silk yarn exceeded production. But this pattern was reversed in 1974. This was in part due to a significant decrease in demand for "Kimono", the traditional Japanese dress, which accounts for 95% of silk yarn consumed. As a result, the Government of Japan has started regulating the imports.

310. The major supplier of cocoons and silk yarn to European countries is the People's Republic of China. Major importers are Italy, France, Switzerland and West Germany. It should be noted that the importing of silk yarn by European countries is steadily increasing, probably due to a stable supply and a relatively low cost of Chinese silk yarn. Consumption in U. S. A., the former leading consuming country, on the other hand, dropped drastically as the number of silk mills decreased and due to a prolonged recession.

311. Consequently, Japan is the current leading consumer and her demand significantly influences the world's market. It is not realistic, however, to expect an improvement in her demand. Some developing countries started a few years ago promoting sericulture to compensate for the decrease of production in Japan. Such decisions could be risky since the Japanese demand is not likely to increase.

5-3 Requirements for sericultural development

312. In view of the demand and supply conditions above and the current social and economic conditions of Malaysia, the following conditions must be met in order to introduce the sericulture successfully:

(1) It is difficult for a new producer to break into the exporting market under the current conditions of the world's market. In consequence, silk yarn and fabrics produced must be aimed at the domestic market.

(2) It will be possible to export cocoons when production grows satisfactorily in the future.

(3) It will be essential to win the reputation for good quality from clients. For that purpose, homogeneous silk yarn must be made available constantly.

(4) Export of cocoons is easier than silk yarns as long as homogeneous quality cocoons are constantly available in quantity.

(5) It is desirable to establish a continuous production system from cocoons to raw silk and silk fabrics.

(6) Handicrafts are now popular worldwide. Articles of folk art with full of local color are highly appreciated. Folk costumes indigenous to Malaysia such as Songket and Batik could be made of silk for exports as well as for the domestic market to expand the market.

(7) Sericulture consists of two parts, cultivation of mulberry and rearing of silkworm. Most of the work are done by hand requiring experience and expertness. Mechanization is under way in Japan, where experienced labor is short. Sericulture in Malaysia, where labor is abundant, should be based on a working system centered around family work force. Mechanization confined to certain types of work could be pursued in the future when such need arises as a result of expansion.

(8) Automatic reeling machines which are now widely available will be adopted to achieve efficient reeling when satisfactory results are guaranteed in the future. Training of operators is relatively easy.

(9) Land is the foundation of cocoon production. Quality as well as quantity of mulberry leaves harvested significantly influence the production of cocoons. Therefore, the selection of suitable land is extremely important. Once the land is selected, soil must be studied and improved on the basis of findings before planting takes place.

(10) Scattered farms are destructive to the provision of technical assistance. Therefore, certain areas will be designated for sericulture to consolidate mulberry fields and sericulture developments.

(11) To develop and standardize techniques for rearing of silkworms and cultivation of mulberry, establishment of the research organizations are recommended in parallel with the training of technical staff.

5-4 *Technical characteristics of sericulture*

313. Harvesting of leaves several times a year deteriorates the vitality of mulberry. Thus, mulberry requires more attention than other perennial fruit trees. The following poiits are important in the are cultivation of mulberry:

a) Sufficient fertilizer should be applied. Normally fertilizer is required as much as the weightof mulberry leaves harvested.

b) Mulberry requires a large quantity of water equivalent to 5 to 6 mm per day.

d) Mulberry becomes vulnerable to disease and harmful insects as its vitality weakness. Constant control is essential.

e) There are many varieties of mulberry differing in characteristics. It is essential to select the best suited variety among a number of available ones. A further research is required to determine whether a local or a foreign variety be chosen.

314. Rearing of silkworms requires attention and care since they grow rapidly. They shed four times during one generation which consists of four weeks. They weigh approximately 0.4 mg immediately after hatching while they increase to about 4 g at the end of fifth stage. Thus, they grow 10,000 times in four weeks. Rearing temperature and humidity, and feeding amount vary according to each stage. Healthiness of grown silkworms (4th-5th stage) and the yield of cocoons depend on how well they are cared when young (1st-3rd stage). In Japan, young silkworms are reared in a cooperative rearing house, where temperature and humidity are controlled, under the supervision of a professional staff, and after 2nd or 3rd molting silkworms are distributed to each farmer. They are vulnerable to a variety of diseases. As a result, a thorough control is essential. Checking for pebrine is one of the important check-ups to prevent total destruction.

5-5 Policies for sericultural development

(1) Government workers in charge of sericulture

315. The government will either establish a new office or designate an existing one in charge of sericulture to provide proper technical guidance and financial assistance. Government workers in charge of sericulture will be fully knowledgeable and their responsibilities will not be changed while they are in office. They will be required to work in relays on Sundays and holidays during the season.

(2) Management system

316. Sericulture directly conducted by government has almost never been successful since it is difficult to require of salaried workers a strong sense of responsibility and delicate skills.

317. Land and other sericultural facilities will be leased to farmers either on a tenant or contract basis. Either case will be based on individual management with a cooperative association.

318. The government will be responsible for the stabilization of the cocoon price and provision of marketing outlet and guidance.

(3) Setting of cocoon price

319. Although the price of cocoon fluctuates according to the social and economic conditions of the producing countries, it should be set in favor of the farmers as much as possible. Government purchase price will be set according to qualities and farmers will be informed in advance of the standard minimum price. Although the price of cocoon is normally set on the basis of that of raw silk, more than 60% of raw silk price must be returned to the farmers.

(4) Criteria for the selection of sericulture farmers

320. Sericultural farmers must be industrious, observing and attentive. In addition, they must be able to work in harmony with one another since they should be working as a group.

5-6 Planning for sericultural development

(1) Selection of mulberry fields

321. Mulberry fields will be selected according to the following criteria in order to assure maximum cultivation:

a) Land must be flat or its grade must not exceed 10 degrees.

b) Land must have good drainage. Swamp areas must be avoided.

c) Deep layer for plowing and fertility are essential.

d) Fields must be near to villages and must be easily accessible.

(2) Unit size for sericultural development

322. Although the unit size varies according to environmental and social conditions, a minimum of 50 acres is desired in view of a joint rearing station.

(3) Size of sericultural farmer

323. A standard sericultural farmer consists of two workers, and a mulberry field of 0.7 acres in the first year which is gradually increased to 2.5 acres in the fourth year. That is, a farmer rears a total of 25 boxes of silkworm eggs annually, divided into eight times with 3 to 4 boxes at a time. As a result, approximately 700 kg of cocoons are expected annually.

(4) Establishment of cooperative rearing house for young silkworms

324. One rearing house will be established for every 20 to 25 households with 50 to 62.5 acres of mulberry fields. In addition to the rearing of young silkworms, the house will act as the center of extension activities to provide technical assistance to the workers.
The house will be capable of rearing 100 boxes of young silkworms (1 to 3) at a time and is provided with rearing, leaf storage, study and rest rooms.

(5) Handling of cocoons produced

325. Cocoons are collected from farmers and ranked before they are delivered to the government raw silk reeling mill.

(6) Yearly program

326. Sericulture will start with 150 farmers and the number will be increased every year to 2,500 farmers in the fourth year. The total area of mulberry fields will be 6,250 acres producing 1,780 tons of cocoon in the fourth year. The number of farmers, the total area of mulberry fields and the production of cocoons are shown in the following Table VI-7:

Table VI-7 Sericultural Plan

	First year	Second year	Third year	Fourth year	Fifth year	Sixth year	Seventh year	Eighth year	Ninth year
Number of settlers	500	1,000	500	500	(2,500)				
Acreage reclaimed	350	1,050	1,400	1,600	1,100	550	200	(6,250)	
Acreage planted									
First year	350	1,050	1,400	1,600	1,100	550	200		
Second year	-	350	1,050	1,400	1,600	1,100	550	200	
Third year	-	-	350	1,050	1,400	1,600	1,100	550	200
Total	350	1,400	2,800	4,050	4,100	3,250	1,850	750	200
Quantity of cocoons harvested									
First year	35	105	140	160	110	55	20		
Second year		70	210	240	320	220	110	40	
Third year			100	400	700	1,255	1,565	1,725	1,780
Total	35	175	450	800	1,230	1,530	1,695	1,765	1,780
Number of silkworm egg boxes	1,400	7,000	18,000	32,000	49,200	61,200	67,800	70,600	(71,200)
Raw silk produced	6.0	30.0	76.5	20.5	209.0	260.0	288.0	300.0	(302.5)

Note: 1) The area of mulberry field of each farmer will be increased every year by 0.7 acre between the first and the third year, and by 0.4 acre in the fourth year. The total area will be 2.5 acres.

2) Target quantities of cocoons harvested are as follows:

First year : 100 kg
Second year : 200 kg
Third year and thereafter: 285 kg

3) The average cocoons of 25 kg will be harvested per a box, of silkworm eggs.

4) The ratio in volume of raw silk to cocoons is 17%.

5-7 Technical aspects of sericulture

327. The technical aspects are as follows:

(1) Points of mulberry cultivation

a) Cultivation of mulberry is the foundation of sericulture. A large volume of quality leaves is the key to the success of sericulture.

b) A good variety will be selected among existing ones and multiplied by means of cuttage.

c) Mulberry is planted two meters between furrows with a root spacing of 0.7 to 1.0 m.

d) Low cut mulberry training is available, and leaves are harvested two to three times one year.

e) The standard quantity of fertilizer applied per acre will consist of 40 kg of nitrogen, 20 kg of phosphate and 20 kg of potash. Furthermore, a generous amount of compost and other organic matters will be applied to enrich the soil.

f) Weeding and intertillage will be done by human. labor. Excessive weeds hamper the growth of mulberry and aggragates damage by blight and harmful insects.

g) Control of damage by blight and harmful insects is essential. Snails and slugs are often seen during the rainy season. Prevention is the best policy.

(2) Points of silkworm rearing

a) Rearing rooms will not be exposed to direct sunlight and will be provided with long eaves and side walls in addition to the roof to prevent seepage of rainfall.

b) A total area of 96 m^2 is required for rearing of maximum five boxes at a time. Trees will be planted around the building in order to provide shade.

c) Flat silkworm rearing will be employed feeding mulberry shoots. Suitable leaves will be fed at the time of ecdysis and mounting.

d) Silkworms will be fed three times a day, in the morning, noon and in the evening or more than three times.

e) It is advisable that the rotary cocooning frame will be used for mounting.

5-8 Sericultural center

328. The sericultural center is explained as follows:

(1) A sericultural center will be established to conduct researchs and to train technical staff. In the initial stage, the sericultural department can be added to the existing Agricultural Experiment Station. It is desirable, however, to establish a center in the proximity of the main sericultural areas in a later stage. The center will consist of various departments such as mulberry cultivation, silkworm rearing, disease control, and training.

a) Mulberry cultivation department:

Soil survey for mulberry fields.

Selection and rearing of a superior variety.

Establishment of standard rearing techniques.

Production and distribution of graft.

b) Silkworm rearing:

Selection and raising of a superior variety.

Establishment of rearing methods.

Production and distribution of silkworm eggs.

c) Disease control:

Control of blight and harmful insects for both silkworm and mulberry.

d) Training:

Training of extension workers under specialists.

(2) Sub-centers

329. Sub-centers will be established in major sericultural developments to conduct researches in order to establish silkworm rearing and mulberry cultivation

techniques suitable for each area, to establish a demonstration farm, and to train farmers.
A sub-center will test mulberry and sulkworm distributed by the Sericulture Center for adaptability, and produce and distribute graft and silkworm eggs to farmers.

(3) Distribution of graft and silkworm eggs

330. The major responsibilities of the Sericultural Center are the production and distribution of graft necessary for the development of mulberry fields and silkworm eggs. Different varieties of mulberry will be imported from Japan, India and Thailand to select the best suited variety.

331. In addition to the consideration of local varieties, parent silkworm eggs of F1 hybrid will be imported from Japan and distributed until the Sericultural Center starts functioning.

332. Silkworm eggs of F2 will be produced by means of multiplication of F1 hybrid for distribution. In the future, the original strain will be imported from overseas to develop a superior variety suitable for local conditions.

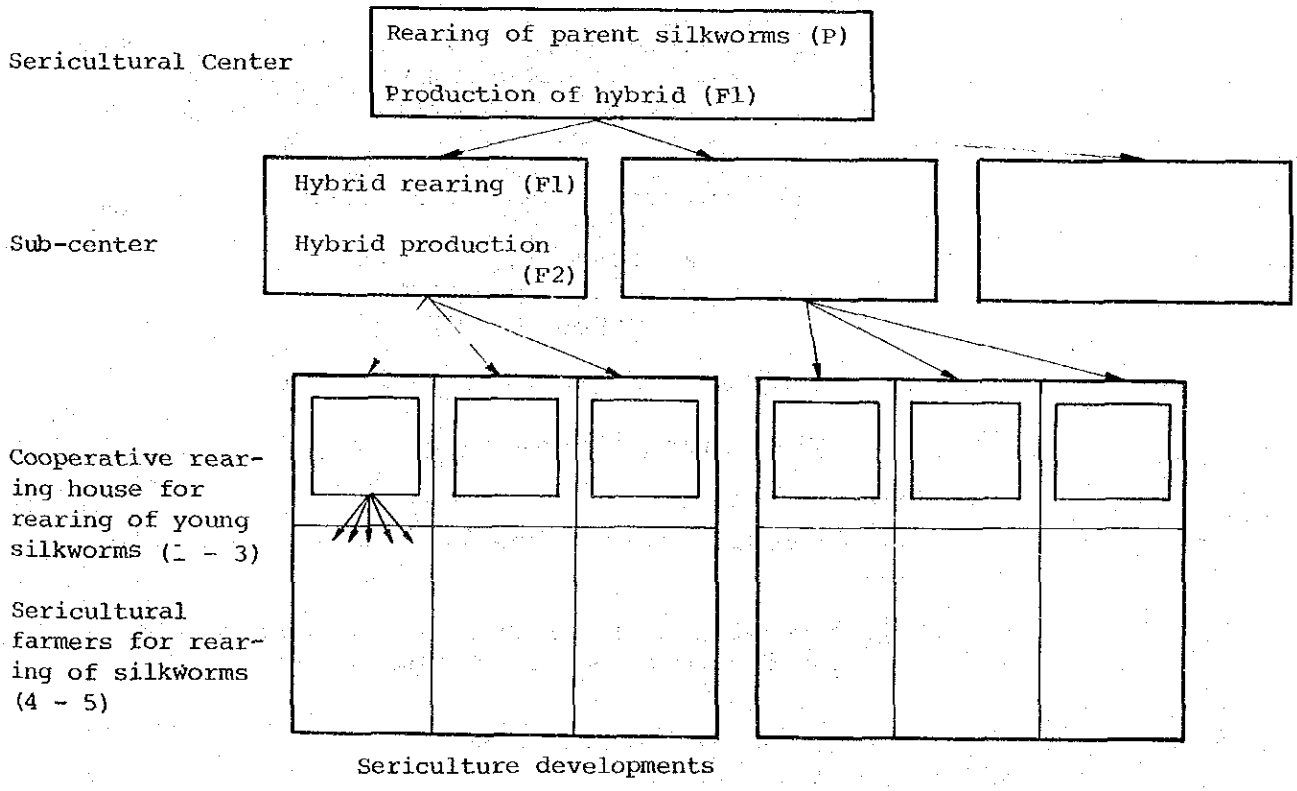


Fig. VI-4 Basic Silkworm Egg Production and Distribution Policy

(4) Major facilities

a) Sericultural center

i) Main building:

Rooms for research, disease control and soil test, training and exhibition

ii) Rearing rooms: Three buildings

iii) Refrigerators for silkworm eggs, artificial hatcheries, mulberry leaf storage room, administration office for mulberry cultivation, compost shed, equipment room and water pool for cleaning of rearing tools

iv) Others: (garage and others)

v) Mulberry field (15 acres):

5 acres for research purpose,
7.5 acres for rearing of silkworms, and
2.5 acres for graft

b) Sub-center

i) Rearing rooms: Two buildings

ii) Refrigerators for silkworm eggs, water pool for cleaning of rearing tools, artificial hatcheries, mulberry leaf storage room

iii) Mulberry field (14 acres):

2 acres for exhibition
5 acres for graft
7 acres for rearing

5-9 Establishment of raw silk reeling mill

333. The establishment is as follows:

(1) Requirements

The following conditions should be taken into account:

a) The site of mill will be as near to cocoon producing areas as possible.

b) Proper quality of water will be made available in volume.
Approximately one ton of water is required to produce 1 kg of raw silk. Water quality of pH 7.0 and hardness of 3 to 5 degrees is ideal. Water quality control equipment is required if proper quality is not readily available.

(2) Selection of reeling machine

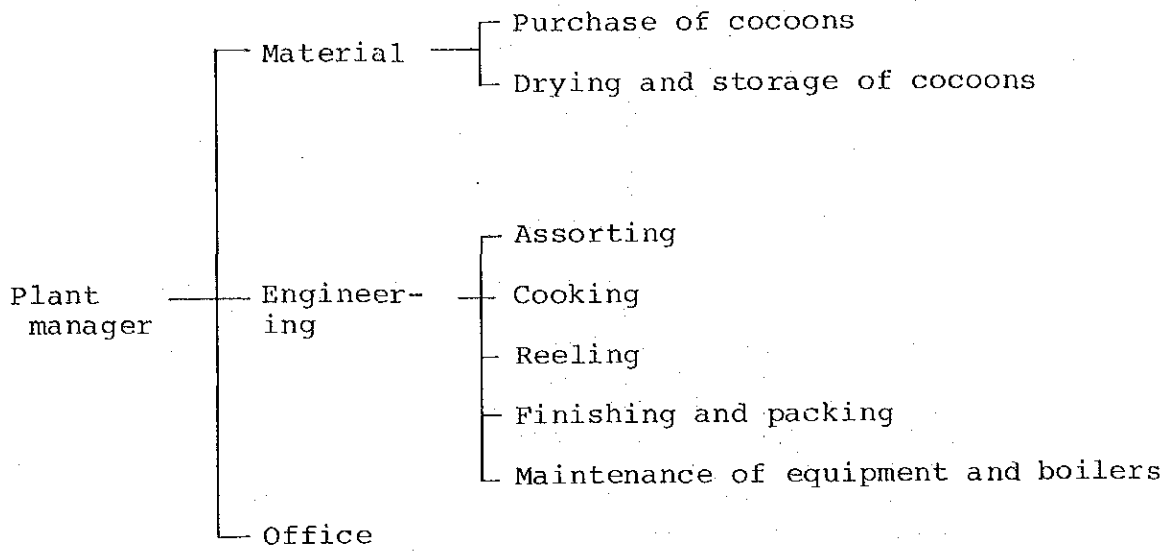
334. Quantity and quality of cocoons and finished products will be taken into account in the selection of a proper reeling machine. Quality cocoons are essential in order to produce quality raw silk. Reeling machines are available in two types, one using mechanical power and the other using human power. In the latter case, a sitting reeling system is used. To produce quality silk yarn, automatic reeling machines are preferred although they are more costly.

335. A set of automatic reeling machines (12 units for 240 reeling ends) is capable of producing approximately 20 to 25 kg of standard yarn on an average. To produce that volume, 40 to 50 tons of cocoons are annually required on the basis of 300 operation days and a ratio of 17% between cocoons and yarn.

336. Reeling machines will be added in units of set as the production of cocoons increases. For that purpose, the site will be large enough from the beginning to accommodate future expansion and the design and structure of buildings will be such that permits easy expansion in the future. The mill will be equipped with 33 sets of reeling machines when completed.

(3) Organization of mill

337. The following organization is recommended for the mill:



The number of personnel required is 16 per set of reeling machines excluding office staff.

(4) Equipment required

a) Cocoon dryer:

One unit of low temperature wind force type

Drying capacity: 3,000 kg

b) Automatic reeling machine:

One set (12 units for 240 reeling ends)

Daily reeling capacity: 180 kg
(in terms of fresh cocoons)

Daily raw silk production capacity: 25 to 30 kg
(17% of fresh cocoons)

c) Cooker: One unit

Daily capacity: 800 to 1,000 kg (in terms of fresh cocoons)

d) Rewinder:

24 windows type

Daily capacity: 20 to 25 kg

e) Other equipment:

Cocoon assorting machine, skeining machine, booking machine, measuring equipment, boiler, etc.

f) Cocoon storage

g) Silk yarn storage

h) Others

VI-6 Management System

6-1 Kinds of management system

338. There are three management systems as shown below:

Direct management under public cooperation:

339. This system should be applied to such agricultural activities which are diversified and complicated, which should be grouped to improve productivity of labor, and which require sophisticated skills and instruction by experts. Farmers are placed under the direct management of the public cooperation to work as wageworkers. Although it is difficult to expect improvement in morale, this system is considered desirable in the initial stage since Malaysian farmers are used to working for estates and FELDA.

Joint management system:

340. Although technical and managerial instructions are provided by the public cooperation, a group of farmers manages for themselves as a unit. However, those farmers who are capable of managing themselves jointly will likely prefer individual management. Therefore, this system should be applied to such joint work that improves profitability. For examples, joint use of large farm machinery, joint procurement of agricultural materials, and joint shipment of agricultural products.

Individual management system:

341. Farmlands are allocated to individuals and they are responsible for management. Since individuals can earn more in accordance with their efforts and ideas, this system will be suitable for experienced and capable settlers.

6-2 Management pattern by agricultural types

342. Management patterns are described by agricultural types as follows:

Paddy farming:

343. In principle, paddy field should be cultivated by experienced individual farmers. While such work that requires a large tractor should be shared, ordinary work will be done under individual management. Because the joint management might be not so efficient in such cases. Since profitability is low for paddy farming, it should be combined with upland farming or freshwater fisheries.

Freshwater pisciculture:

344. Freshwater pisciculture alone are questionable if seen from the daily distribution of labor and marketability standpoint. They should be combined with paddy farming.

Sericulture:

345. Procurement of silkworm eggs, incubation and rearing of young silkworm should be carried out jointly. Meanwhile, individual management is preferable as far as the management of mulberry fields and rearing of grown silkworm are concerned. Individual management offers more detailed work and improves productivity. Production of silkworm eggs and the silk yarn factory should be managed by the public cooperation.

Livestock rearing:

346. Grazing a large number of beef cattle often improves productivity of labor. Therefore, joint management should be allowed to a certain extent. In principle, however, livestock rearing should be managed by individuals since each of them may have their own preference in selecting dairy and beef cattle.

Upland farming:

347. Since the number of crops and their combinations are large, upland farming offers many choices to individual farmers. It is important, however, to provide sufficient training before farmers start their own operations. Large farm machinery should be shared.

VI-7 Acreage and Number of Households by Farming Types

348. The acreage and the number of farms are determined in accordance with topographic, geographic, and soil conditions of the area and the management size per household of each type. They are as follows:

Table VI-8 Management Size

Type	Acreage per household	Acreage	Number of households	Remarks
Paddy farming (with upland farming)	5.0	10,700	2,140	Paddy field 3.5 acres + Upland field 1.5 acres
Paddy farming (with freshwater pisciculture)	5.0	4,000	800	Paddy field 4.0 acres + freshwater pisciculture 1.0 acres
Upland farming	6.0	28,533	4,747	
Sericulture	2.5	6,300	2,520	
Livestock rearing	9.0	8,550	950	
Total		58,083	11,157	

7-1 Grouping into units

349. Each swamp offers a potential farmland area of 2,600 acres on an average. The Jerangau swamp, the largest among all, has a potential area of 9,000 acres or more. Under such a large development, the size of farmlands for each type ranges from a few hundreds to a few thousands of acres. In order to utilize such large farmlands efficiently, the introduction of large farm machinery is essential. Further, it will be more efficient if machinery is shared by several farmers. Therefore, farms should be grouped into units by agricultural types. The scope of each unit is as follows:

Paddy farming: Paddy field will be developed in units of 150 acres which one tractor of 50 PS can plow and in 30 days.

Upland farming: Upland field will be developed in units of 180 acres which one tractor of 50 PS can plow in 30 days.

Sericulture: Silkworm rearing rooms will be provided in units of 180 m^2 while mulberry fields are be developed in units of 50 acres.

Livestock rearing: Liverstock rearing area will be developed in units of 110 acres including 72 acres of pasture land which a harvestor of 30 PS can harvest within 20 days.

Table VI-9 Unit Acreage by Sectors and Number of Farms

Type	Unit acreage (acre)	Acreage per farm (acre)	Number of farms per unit
Paddy farming	150	4.0 (3.5)	37
Upland farming	180	6.0	30
Sericulture	50	2.5	20
Livestock rearing	110	9.0	12

Table VI-10 Acreage of Proposed Swamps

(Unit: acre)

Swamp No.	Planned acreage	Public area	Farmland	Number of households
2	1,125	225	900	112
3	2,625	525	2,100	289
S-11	389	78	311	39
4	815	163	652	122
5	1,765	353	1,412	185
7-1	2,500	500	2,000	460
7-2	10,000	2,000	8,000	1,566
7-3	11,741	2,348	9,393	1,951
7-4	10,176	2,035	8,141	1,590
7-5	3,193	639	2,554	492
S-12	531	106	425	58
8	855	171	684	128
9	950	190	760	140
11	1,725	345	1,380	205
14	8,030	1,606	6,424	1,344
15	5,125	1,025	4,100	797
17	655	131	524	101
S-20	234	47	187	31
18	975	195	780	130
19	1,015	203	812	137
S-24	313	63	250	41
20-4	2,381	476	1,905	375
20-5	5,486	1,097	4,389	864
Total	72,604	14,521	58,083	11,157
(Bukit Bauk)	7,006	1,318	5,337	705
Grand-total	79,610	15,839	63,417	11,862

Table VI-11 Proposed Land Use

Swamp No.	Farmland acreage	Number of households	Paddy field					Upland field				Mulberry field		Grass land		Fish pond	
			Total acreage	With upland farming	Number of households	With fisheries	Number of households	Total acreage	Acreage for paddy farmers	Acreage for full-time farmers	Number of households	Acreage	Number of households	Acreage	Number of households	Acreage	Number of household
	(acre)		(acre)	(acre)		(acre)		(acre)	(acre)	(acre)		(acre)		(acre)		(acre)	
2	900	112						225		225	37			675	75		
3	2,100	280	310	210	60	100	25	415	90	325	54			1,350	150	25	25
S-11	311	39						86		86	14			225	25		
4	652	122	310	210	60	100	25	317	90	227	37					25	25
5	1,412	185						512		512	85			900	100		
7-1	2,000	460	1,240	840	240	400	100	360	360	0	0	300	120			100	100
7-2	8,000	1,566						7,000		7,000	1,166	1,000	400				
7-3	9,303	1,951	4,135	2,975	850	1,160	290	3,203	1,275	2,018	336	1,000	400	675	75	290	290
7-4	8,441	1,590						7,141		7,141	1,190	1,000	400				
7-5	2,554	402						1,154		1,154	192	500	200	900	100		
S-12	425	58						200		200	33			225	25		
8	684	128	310	210	60	100	25	349	90	259	43					25	25
9	760	140	310	210	60	100	25	425	90	335	55					25	25
11	1,389	205						930		930	155			450	50		
14	6,424	1,304	1,240	840	240	400	100	2,484	360	2,124	354	1,250	500	1,350	150	100	100
15	4,100	707	765	525	150	240	60	2,100	225	1,875	312	500	200	675	75	60	60
17	524	101	310	210	60	100	25	189	90	99	16					25	25
S-20	187	31						187		187	31						
18	780	130						780		780	130						
19	812	137	310	210	60	100	25	252	90	162	27			225	25	25	25
S-24	250	41						250		250	41						
20-4	1,905	375						1,655		1,655	275	250	100				
20-5	4,389	864	1,450	1,050	300	400	100	1,439	450	989	164	500	200	900	100	100	100
Total	58,083	11,157	10,690	7,400	2,140	3,200	800	31,743	3,210	28,533	4,747	6,300	2,520	8,550	950	800	800

Table VI-12 Farmland Acreage and Number of Units

Swamp No.	Farmland acreage	Number of households	Paddy field			Upland field			Mulberry field			Grass land		
			Acreage	Number of households	Number of Units	Acreage	Number of households	Number of Units	Acreage	Number of households	Number of Units	Acreage	Number of households	Number of Units
	(acre)		(acre)			(acre)			(acre)			Acre		
2	900	112				225	37	1				675	75	6
3	2,100	280	310	85	2	415	144	2				1,350	150	12
S-11	311	39				86	14	-				225	25	2
4	652	122	310	85	2	317	37	2						
5	1,412	185				512	85	3				900	100	8
7-1	2,000	460	1,240	340	8	360	0	2	300	120	6			
7-2	8,000	1,566				7,000	1,166	39	1,000	400	20			
7-3	9,313	1,951	4,135	1,140	28	3,293	336	18	1,000	400	20	675	75	6
7-4	8,141	1,500				7,141	1,100	40	1,000	400	20			
7-5	2,554	492				1,154	192	6	500	200	10	900	100	8
S-12	425	58				200	33	1				225	25	2
8	684	128	310	85	2	429	43	2						
9	760	140	310	85	2	425	55	2						
11	1,380	205				930	155	5				450	50	4
14	6,424	1,344	1,240	340	8	2,484	354	14	1,250	500	25	1,350	150	12
15	4,100	707	765	210	5	2,100	312	12	500	200	10	675	75	6
17	524	101	310	85	2	189	16	1						
S-20	187	31				187	31	1						
18	780	130				780	130	4						
19	812	137	310	85	2	252	27	1				225	25	2
S-24	250	41				250	41	1						
20-4	1,905	375				1,655	275	9	250	100	5			
20-5	4,389	864	1,450	400	10	1,439	164	8	500	200	10	900	100	8
Total	58,083	11,157	10,690	2,940	71	31,743	4,747	174	6,300	2,520	126	8,550	950	76

VII. PLAN FOR COMMUNITY DEVELOPMENT

VII-1 General

350. New large-scale development projects implemented in the East Coast by the Government are almost always based on the new town systems. The system is effective in achieving efficient production as a whole even if the management of each individual farmer is small, and in providing settlers with a modern rural life style.

351. This particular master plan study also applies the new town system to achieve the same objectives. However, it will be necessary to start with rather modest facilities since costly ones are not economically feasible in the initial stage, and besides, they may be improved later.

VII-2 Settlement

352. The economy of Malaysia heavily depends on agriculture both domestically and internationally. Therefore, it is correct for the Malaysian Government to promote agricultural products such as rubber and palm oil, which are highly competitive internationally.

353. Malaysia faces a serious problem of chronic unemployment. It is urgently required to improve the situation by increasing the size of farm management, and to create more jobs through the development of land. The number of the people below the poverty line is estimated at more than 40,000 in the State of Trengganu alone.

354. It is expected that the consumption of middle to high quality vegetables, meat and fruit grow much faster than that of paddy, 80 to 90% of which are self-sufficient in Malaysia although the figure differs from year to year. The master plan study aims at the agricultural development in general by developing swamps into farmland.

355. As mentioned repeatedly, improvement of soil, irrigation and drainage are essential in addition to the introduction of advanced farming techniques in order to achieve successful agriculture in the proposed farmlands. Settlement must be planned by taking the above matters into account. Planning includes selection of settlers, determining the number of settlers and the size of farmland per household and housing sites, a community center and a demonstration farm. Each item is outlined hereafter.

(1) Basic problems in selecting settlers

356. It will be important to introduce two types of settlers in a proper ratio. One type consists of those who have agricultural experiences and skills. Meanwhile, settlers of the other type have no previous agricultural experience and they are poor. Only the poor with no skills or a large proportion of them does not help to solve the various problems previously mentioned.

357. Settlers will become individual management households ultimately. Mastering of farming techniques will not be the same between paddy growing farmers, and those who engage in sericulture, livestock rearing and upland farming. Therefore, those settlers should be able to work from a few to ten years as members of an agricultural cooperative to be established by KETENGAH for a limited period of time. They should become individual management households as soon as they become capable of supporting themselves. Paddy growing farmers with experience or skills should be individual management households from the beginning.

(2) Criteria for selecting settlers

358. Principally, settler applicants should be resident of the State of Trengganu, and satisfy the following conditions.

a. Married male between 18 and 35 years of age and of Malaysian nationality.

b. Applicants should not own land at all or no more than two acres if owned.

c. Applicants should satisfy criteria set for health, education, skill, home circumstances, presence of children, etc.

VII-3 Plan for New Town Establishment

3-1 Community centers

359. New communities will be established in new settlements independent of those in existing communities. A community includes not only the center of community life but also of production, sales, and distribution. A central community center will be established in the Jerangau which will be the center of the master plan area, and branch centers in two major sub-areas, such as Bukit Bauk and Ibok.

360. The community center will occupy 25 acres with the following facilities.

Clinic	One building	10m x 10m
Meeting room	Two buildings	15m x 20m
Kindergarten	Two buildings	15m x 20m
Primary school	Two buildings	15m x 20m
Water supply and sewerage systems:		
Mosque	One building	

3-2 Demonstration farm

361. Malaysia has not yet experienced such a large-scale swamp development as planned in the master plan study. In consequence, much of farming techniques and improvement of soil depend on the findings of further studies. In addition to technical assistance, the demonstration farm will test crops, fertilizer, and water management which will be done with MARDI's cooperation.

362. The demonstration farm does not only handle crops but also conducts tests related to sericulture, livestock rearing and freshwater pisciculture, and extension work. To meet these requirements, it will be necessary to provide the farm with an office, training center and dormitory in addition to such facilities as a godown, farm machinery experimental rooms, workshop for farm machinery, fish ponds, veterinary hospital and a rice mill. Related facilities will be consolidated into one section.

3-3 New towns

(1) Housing

363. Wooden one-story houses will be built for settlers as in existing new towns.

(2) Water supply and sewage treatment

364. A simple water supply system will be provided in accordance with the following criteria:

i) The system will be based on the supply required in the years after completion of settlement.

ii) The volume of water supply will be based on the population at the time of settlement and the estimated population in the final year of the plan.

iii) The volume of water supply will be calculated by multiplying the number of settlers by daily maximum supply per person.

iv) The daily maximum supply per person will be set at 150ℓ.

v) The source of water supply will be ground-water in the new town area.

365. Sewage includes waste liquids from homes, plants and rainwater. Since there will be no plant involved in the plan, only waste liquids from homes and rainwater need to be concerned with. In general sewage water can be treated in the following three methods:

i) Irrigation method in which sewage water is guided to farmland and used as fertilizer.

ii) Dilution method in which sewage water is diluted with fresh water prior to discharge, or discharged directly into rivers or seas where it is diluted with water itself.

iii) Sewage treatment method in which sewage water is treated at a treatment plant prior to discharge.

366. Among the three methods above, the third one is most advanced scientifically and essential to waste water from factories. This method requires, however, a large expense. The dilution method, which is frequently applied at present, creates environmental problems. At the same time, the irrigation method is suitable for the treatment of waste water from farmhouses but not from factories. Also, returning human waste to farmland is desirable from the standpoint of agriculture in which organic matters are mainly applied instead of chemical fertilizers.

Therefore, the irrigation method should be applied to the treatment of sewage water in the new town.

(3) Electricity

367. The proposed power available for farmers' lightning, public facilities and manufacturing factories will be supplied through an integrated electric network to be established in the near future. It is expected that after completion of Kenyir Dam in the upper reach of Trengganu river, sufficient electricity could be supplied to all important areas of the project.