III. THE PILOT PROJECT AREA

III. THE PILOT PROJECT AREA

A. Location and Natural Features

1. General

25. Malaysia comprises a total of 13 states, 11 in Peninsular Malaysia and 2 in Borneo, and covers an area of 127,581 square miles. The west coast of Peninsular Malaysia is fairly well developed, but the east coast and Borneo are still underdeveloped, the greater part of these being covered with virgin forest. The Government of Malaysia is making efforts to develop these areas, with specific emphasis placed on agricultural development which is being promoted as one of its top priority economic policies.

26. The preliminary survey covered the swamp areas located intermittently in the Trengganu Tengah Development Region which is situated in the southern part of Trengganu State on the east coast of the peninsula and accounts for about one-third of the total area of the state. The objective was formulation of a swamp utilization plan which could be implemented in harmony with the development of the surrounding hilly areas.

27. The state has a relatively mild topography. Mountainous areas have an elevation of 2,500 - 5,000 ft., but they are undulating and covered with jungle. In addition, plateaus and flat plains extend over a comparatively long distance. Hence, the ratio of storm-run-off is not very large relative to the heavy rainfall. However, as rivers are still in the natural state without training or improvement work, flood waters collect in flat plains during the monsoon season, occasionally bringing the traffic to a standstill on even national highways.

28. From the viewpoint of soil, hilly areas are composed of reddish brown laterite and reddish yellow or yellowish gray podozolic soils for the most part. The laterite overlies the parent metal derived from acidic rocks including granite. Lowland areas are composed of coastal sand and alluvial soil.

29. The swamp soils can be broadly classified into the following three groups:

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

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

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

30. Development of such swamp areas has not been undertaken to date with the exception of paddy cultivation in the dry season in part of the peripheral areas but this is only to the extent that no development has been needed. A master plan for development of Trengganu Tengah was presented in 1974 by Hunting Technical Services Limited with the Shankland Cox Partnership, England, but it excluded the swamp areas. Planning of a swamp development project is now urgently called for as development based on this master plan has already made considerable progress.

31. As mentioned previously, the Bukit Bauk Pilot Project has been selected as a part of the Trengganu Tengah Swamp Area Agricultural Development Programme as well as a part of the Trengganu Tengah Regional Development Programme. In the feasibility study on the Bukit Bauk Swamp Area Agricultural Development, a more detailed and concrete plan for management and development is formulated and its economic viability is carefully reviewed.

2. Location

32. The Pilot Project area is a swamp area surrounded by hills between the Dungun river and the Paka river. The linear distance between the two rivers is about 9 miles. The Pilot Project area is about 5 miles upstream of the estuary of the Dungun river and about 12 miles upstream of the estuary of the Paka river. The location and catchment area is illustrated in Fig. III-1.

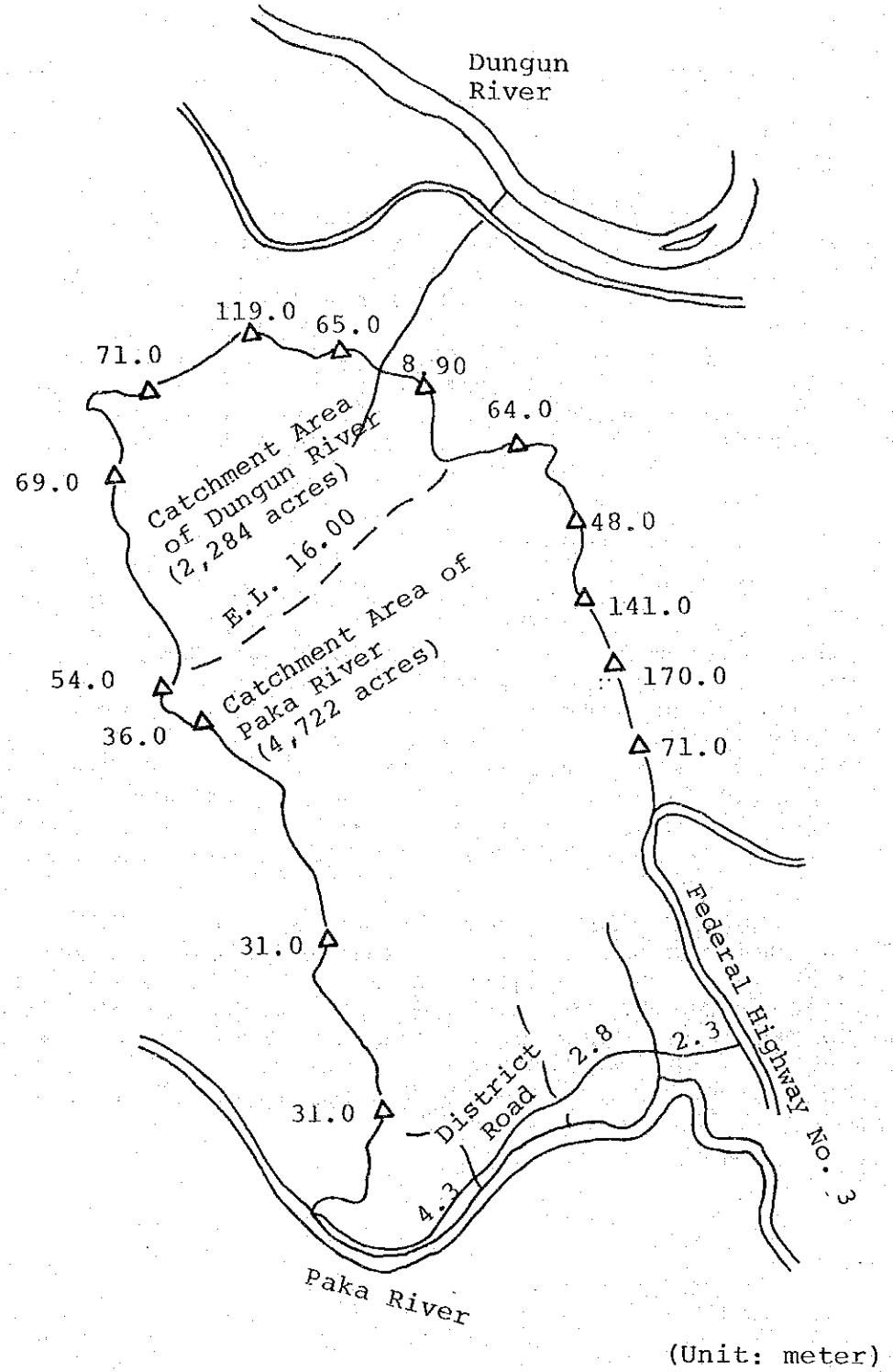


Fig. III-1 Map of Location of Pilot Project Area and Catchment Area

33. The Pilot Project area is nearly rectangular measuring about 5 miles from north to south and about 2.5 miles from east to west. Its area is 7,006 acres (2,835 ha). The land is surrounded by hills of less than 500 feet in height on three sides (north, east and west), and is open to the Paka river on the south with the elevation of about 10 - 15 feet. Two-thirds of the total area (or 4,722 acres) drains to the Paka river through several streams, but most of the area are flooded with water from the Paka river in the monsoon season. The remaining one-third (2,284 acres) is along the Dungun river and is connected to the Dungun river through two valleys between hills, but is not affected by the flooding of the Dungun river because of its high elevation. The Pilot Project area is about 240 miles from Kuala Lumpur, and about 6 miles from Kuala Dungun, the third largest town in Trengganu State. The Pilot Project area adjoins Federal Highway No. 3 which links Kuala Trengganu and Kuantan, and has a district road which runs through it parallel with the Paka river.

3. Topography

34. The topography of the Pilot Project area varies with gentle slopes along the Paka river, 1/500 for about 1.6 miles from the district road along the Paka river to northwest, and 1/300 for about 1.4 miles from there to the watershed in the area with an elevation of 52 feet. For about 0.9 miles the slope is 1/400. Its catchment area is about 11.9 square miles (28.4 square kilometers). The Paka river originates from Mt. Patang (elevation: 2,064 feet) flows down along the western side of the Pilot Project area and turns to the east at Kg. Durian Jeranga and runs into the South-China Sea.

35. On the other hand, the Dungun river originates from Mt. Ulu Perus (elevation: 4,702 feet) and runs eastward to the South-China Sea along the north side of the Pilot Project area. Its distance from the site is only 1.8 miles, but the flooding of the Dungun river does not affect the Pilot Project area because of the elevation difference of about 30 feet. Table III-1 shows the area-elevation range as based on a topographic map prepared by JICA in 1978.

Table III-1 Area-Elevation Range

Contour Interval	Area (acre)	% of Total
Below 5 meters 1/	785	11.2
5-10 meters	1,668	23.8
10-15 meters	1,526	21.8
15-20 meters	1,832	26.1
above 20 meters	1,195	17.1
Total	7,006	100

1/ Elevation based on mean sea level.

36. As shown in the table, the difference between the maximum and the minimum elevation is so small that the Pilot Project area appears to have basically a flat terrain at a mean elevation of about 10 meters. In microscale, however, many undulations can be seen making it difficult terrain from the viewpoint of irrigation design. In general terms, the topography may be described as follows:

a. The northern half of the Pilot Project area is undulating terrain having a ridgeline running from north-west to south-east.

b. The expanse from the central part to the south-western part forms natural levees of complex terrain.

c. The south-eastern part comprises of lowlands.

4. Climate

37. The climate is of the tropical monsoon type and is characterized by a distinct wet period at the end of the year, when the north-east monsoon prevails. Annual average temperature and rainfall are about 78°F and 100 inches respectively. The warmest months are April, May and June when the average temperature is about 80°F.

38. Temperatures during the north-east monsoon are lower and drop to about 77°F. The mean daily maximum ranges from 84.9°F and the mean daily minimum from 69.9°F to 72.8°F. On the other hand, most of the rain come with the north-east monsoon in November, December and January. The mean rainfall for this period ranges from 20 - 35 inches. The other months of the year have much less rainfall than the mean monthly rainfall of 2 - 10 inches. Location of rainfall stations, rainfall data obtained from those stations and others are shown in the Appendix I. The monthly average values of climatic data are shown in the following Table III-2.

Table III-2 Climatic Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Year
Monthly rainfall (mm), 1957-1978	283	115	148	120	143	144	128	169	163	245	537	639	2,834
Monthly average temperature (°F)	78.3	79.9	79.5	81.7	81.1	81.2	80.2	79.9	79.2	78.7	78.0	75.9	79.
Monthly rainy days (day)	14	7	15	4	7	14	12	15	20	23	20	27	178
Monthly average humidity (%)	85	84	86	85	87	86	87	86	87	89	91	91	87

5. Hydrology

39. The rivers related to the Pilot Project area are the Dungun river and the Paka river. The Dungun river runs along the southern side of the area and the Paka river along the northern side, and both rivers flow into the South-China Sea.

40. About one-third of the northern side of the Pilot Project area lies along the Dungun river. Flooding of the Dungun river does not affect the area because the elevation of this portion is over about 40 feet. The water levels of the Dungun river are shown in Table III-3.

Table III-3 Water Levels of Dungun River at Keliyu

Name of River	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Dungun												
Min.	1.5	0.9	0.8	0.7	1.0	1.0	0.8	0.6	0.9	0.9	1.0	1.7
Mean	2.3	1.6	1.3	1.2	1.4	1.2	1.2	0.9	1.2	1.3	1.6	2.0
Max.	3.6	3.6	1.9	2.2	1.8	1.6	2.4	1.3	1.6	2.0	3.4	3.7

41. The Paka river flows across the southern part of the Pilot Project area and into the South-China Sea. The water levels of the Paka river during the dry season are as shown in Table III-4. Details of daily water levels of the river are shown in the Appendix I.

Table III-4 Water Levels of Paka River at Kg Luit (No. 4732461) in 1977

Name of River	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Paka										1/		
Min.	1.21	1.21	0.99	0.76	0.78	0.76	0.90	0.90	1.30	-	2.10	
Mean	1.35	1.72	1.23	0.89	0.91	0.97	1.57	1.81	1.75	-	2.74	
Max.	1.41	2.99	2.00	1.10	1.16	1.20	2.92	3.12	2.00	-	3.48	

1/ No data was available

42. The gauging station relevant to the Pilot Project area is at Durian Mentangau which is about 12 miles upstream from the river mouth. Under the influence of the monsoon, the hydrograph nearly follows the annual rainfall pattern.

43. Taking the mean elevation of the Pilot Project area as 32.8 feet (10 meters), the following may be derived from the figures:

a. On the average, the lowest low water mark of about 1 foot continues during the dry season from mid-April to mid-September.

b. From mid-October, the water level rises at a fast pace. The Pilot Project area becomes subject to flooding from early November to mid-February.

c. The river water level is at its highest in late December, registering 13.6 feet on the average. The highest water level reached in the past several years was 17 feet. The water level begins to decline in March.

44. Based on measurements using an electrical conductometer at Durian Mentangau, salinity was found to be in the range of 20 ppm to 30 ppm indicating that the measured water was pure fresh water. Since measurement was done only at the end of last October, it should be noted that the measurements do not represent drought conditions. Data obtained from the field survey are shown in the Appendix I.

6. Geology and Soil

6.1 Geology

45. Most of the Pilot Project area (67.1%) are covered with alluvial deposits of the Quaternary Era. These alluvial deposits are chiefly composed of recent riverine alluvial (14.1%) and woody peat (53.0%).

46. The peripheral hilly areas that surround the swamp of the Quaternary Era occupy 32.9% of the total area. The geology of the hilly areas is arenaceous rocks and argillaceous beds of Carboniferous rocks on the west, and Jurassic-Triassic sedimentary rocks on the east and north.

6.2 Soil

Soil units

47. When the main soils found in the Pilot Project area are expressed in the soil terms adopted by FAO/UNESCO in its "Soil Map of the World", they can be classified as Histosols(O), Gleysols(G) and Acrisols(A). Histosols forms the majority of the swamp and is also found under the swamp forest and Belukar (a denuded cut-open land). Gleysols found in the southern part of the swamp serves as the flood periphery of the Paka river. The neighbouring farmers are forging ahead with a scheme to convert part of the area into paddy fields. Acrisols is found on the east, north and west, surrounding the swamp, and also in the hilly areas.

48. Histosols occupies an area of about 1,500 ha, the main organic matter being woody peat. The thickness of the peat layer ranges between 50 and 500 centimeters. Gleysols occupies an area of about 400 ha which is mostly Humic Gleysols (Gh) composed of surface layer soils which contain large quantities of organic matter.

The rest is Dystric Histosols(Gd). Both belong to the fine textured class. Acrisols occupies an area of about 930 ha being mostly Orthic Acrisols(Ao) referred to as 'Red-Yellow Podozolic Soils' in the Generalized Soil Map of West Malaysia (1970)". They also partly comprise Ferric Acrisols(Af) containing ferruginous mottles that developed in these lower layer soil. Acrisols in the Pilot Project area ranges from 'fine textured' to 'medium textured' in textural class.

Physical properties of the main soils

49. The majority of the Histosols is woody peat permanently in a water-logged condition and most disintegrated to a certain degree. The solid ratio was in the 2.3 - 12.3% range. There was no example of woody peat in a wet condition of over 10%. The volume weights are 3.5 - 17.8 g/100cc (air dried matter); and true density 1.46 - 1.52 g/cm^3. As both porosity and water holding capacity are large, the dehydration percentage and the shrinkage percentage measured under air-dried conditions were 75.3 - 94.2% and 37.5 - 75.6%, respectively, therefore permeability is large.

50. Virtually all Gleysols soils belong to the fine textured class. The solid ratio is 28.9 - 46.4% and volume weights between 51.6 and 116.5 g/100cc (oven dried matters). The true density is in the range of 2.16 and 2.57. As the clay content is high, the dehydration percentage and the shrinkage percentage measured under air-dried conditions were 31.8 - 43.0 % and 14.1 - 48.6%, respectively, thus a large value. The permeability is low.

51. Acrisols is found with a wide range from the 'fine textured class' to the 'medium textured class'. This is due to the properties of the main substances. The solid ratio is 39.0 - 52.1%; porosity 47.9 - 61.0%; volume weights 103.0 - 130.7 g/100cc (oven dried) and true density 2.47 - 2.65 g/cm^3. Permeability is medium.

Chemical properties of main soils

52. Samples of Histosols were collected from underneath swamp forest which remains in a permanent water-logged condition and also from under the Belukar under the drainage conditions during the dry season. The pH(KCl) value of these soils is 3.8 - 3.9 (air dried soil), and the humus content 64.5 - 91.4%. Total nitrogen was found over a comparatively wide range between 0.38 and 1.87%. The cation-exchange capacity (C.E.C.) was 17.5 - 55.1 m.e.%, but in the case of woody peat under the swamp forest, it was 17.5 - 21.8 m.e.%, a comparatively narrow range. The base saturation percentage is, in general, 4.95 - 29.5%, but for woody peat from under the swamp forest was 26.2 - 29.5%.

Total sulphur as SO_4 is 0.02 - 0.73%, this is not considered to be an 'acid suphate' soil. The pH(KCl) value of the Gleysols is 4.0 - 4.7 (air dried soil). However, this value excludes those found in paddy fields of neighbouring farms (pH value 6.9 - 7.1). As these paddy soils are subject to the influence of irrigation water from the Paka river and farm management, chiefly liming, the pH value is considered to have been elevated. The humus content is 2.64 - 6.24%, total nitrogen 0.37 - 1.23%, cation exchange capacity 13.2 - 24.4% and base saturation percentage 7.82 - 7.96%. Total sulphur as SO_4 is 0.16 - 0.22%. Although this is not considered an 'acid sulphate' soil, the fertility rate is considered to be not very high. There was no chemical analysis conducted on the Acrisols.

7. Flood and Drainage Conditions

53. The elevation of the catchment area (4,722 acres) of the Paka river out of the total Pilot Project area (7,006 acres) ranges between 8 and 52 feet. Since the water level of the Paka river reaches 14 - 17 feet in the monsoon season, about 1,200 acres of the Pilot Project area along the Paka river are considered to be submerged under water every year.

54. Accordingly to the records obtained from DID, Kuala Trengganu, the flood water level of the river reaches about 18 feet on a 10-years-return period. The Paka river has no embankment, consequently flooding inundates many places in the Pilot Project area. Flood water in the area does not run off easily because of the topographic conditions.

55. The Pilot Project area is nearly rectangular and of about 7,006 acres. The most inner part is about 5 miles from the left bank of the Paka river. There are no streams to provide drainage channels in the area. In addition, run-off of rainfall within the area is very slow, therefore the whole area remains a water-logged swamp area even during the dry season.

56. For reference, the annual peak record of water level of the Paka river at Durian Mentangau Gauging Station is as follows:

Table III-5 Annual Peak Record of Water Level of Paka River at Durian Mentangau

Date	Water Level (feet)	Water Level (meters)
December 12, 1973	17.80	5.42
December 3, 1974	17.80	3.51
November 28, 1975	15.40	4.70
December 30, 1976	15.50	4.73

8. Water Quality

57. Paddy cultivation during the main season can depend mainly upon rainfall, but for the paddy and upland crop cultivation during the off-season, planned irrigation is needed. Although groundwater, pond water and river water are available, in this plan, water will be taken principally, from the Paka river. According to the field survey on salinity determined using a pH meter and an electrical conductometer, the quality of the water of the Paka river at the proposed pumping station site is below the tolerance limit necessary for irrigation. For reference, the tolerance limit of paddy of salinity in terms of Cl' content in irrigation water, and the relation between salinity and paddy growing are shown in VIII-23 of 24, 25, 26 and 27 of the STUDY REPORT.

B. Existing and Planning Infrastructure

1. Irrigation Systems

58. In most of the Pilot Project area, any irrigation system has been not developed yet. In the southernmoat part of the area, an area of about 400 acres (160 ha) has an irrigation system which extends the west to east along the district road. In this irrigated area, the irrigation system is supplied with water pumped up from the Paka river, and double cropping of paddy is planned there.

2. Drainage Systems

59. As with the irrigation systems, in most of the Pilot Project area, the existing drainage system has not been developed yet. However, in the above-said irrigated area, some small-scale drainage canals exist. According to the field survey, during the monsoon season about one half of the area as well as the drainage canals are considered to be submerged in water.

3. Transportation

60. District road transport is the only means of transportation available for the Pilot Project area. This trunk road connects Kuala Dungun in the east and Kg. Durian Jeranga in the west. However, the road width is rather too narrow to allow large vehicles to pass, and during the monsoon season, the road is covered with flood water.

C. Present Agriculture

1. General

61. Trengganu State is not favourably situated and its economy is still at the initial stage of development. Although it covers an extensive area, it has a population of only 495,000 (as of 1977) which accounts for only 4% of the country's total population. Its population density of 37 persons per square kilometers is therefore far below the average of Peninsular Malaysia which is 72 persons per square kilometre.

62. The key industry in Trengganu State is agriculture, there being no other industries worthy of mention. Agricultural sectors therefore account for as much as 44% of GDP as against the country's average of 30%. Agricultural productivity is extremely low compared to other industries on a per capita GDP basis.

63. This is clearly reflected in the employment pattern, the State's agriculture, forestry and fisheries provide 68% of employment compared to the country's average of 54%, then come public service and service industries. Manufacturing industries capable of employing a labor force are operated on a subsistence-level and they are very few in number. Hence, the agricultural employment ratio is higher than the country's average.

64. The accurate number of households is not known due to the lack of relevant data. Judging from the total population, it is estimated at about 90 thousand, of which nearly 80% are considered to be accounted for by farm and fisheries households. Most farmers are Malays who are operating rubber plantations or paddy fields on a small scale or working as farm laborers of estate, and a great many of these are classified as in "poverty".

65. The term "poverty" is used to indicate those households whose income is lower than that required for provision of foods and daily necessities at the lowest level.

In Peninsular Malaysia, poverty class households account for 44% of all households, 63% of farm and fisheries households, 77% of paddy farm households. It is likely that these ratios are higher in Trengganu State. As a consequence, farmers in the state are forced to engage in other jobs, working at rubber plantations or offering their labor services in some other way. However, as there are few job opportunities and the wages paid are low, quite a few farmers are unable to earn an income of M$250 a month per household of five people which is the poverty line income specified for provision of the lowest level of livelihood.

66. Trengganu State is divided into six administrative districts. The Bukit Bauk Pilot Project area is located in the eastern part of Dungun District. Dungun District covers 675,840 acres in total, with a population of 56,000 in 1977. In Kuala Dungun, agriculture plays an important role in the economy.

67. Towns having a population of more than 1,000 persons are Kuala Dungun, Jerangau, Kuala Paka and Bukit Besi, with populations of 13,300, 7,700, 6,700 and 1,300 respectively. Kuala Dungun, the largest town in the district, is located near the river mouth of the Dungun river, and plays an important role in the economy as well as in the administration.

68. Two rivers, the Dungun and the Paka, run across the region from the North to the Southeast and then turn to the West, finally entering into the South-China Sea. Their tributaries spread in a mesh form in the western and southern parts of the district. Cultivated land is located intermittents in the mesh. During the monsoon season most of these areas often get flooded.

2. Land Use

69. As mentioned previously, the proposed Pilot Project area is situated on the left bank of the Paka river. It is nearly rectangular and surrounded by hills less than 500 feet in height on three sides and open to the Paka river only on the southern side. This area covers about 7,000 acres (2,835 ha), of which about 500 acres of land are extend along the Paka river, and are utilized as paddy field. Of the 500 acres mentioned above, 100 acres are private land, and 400 acres are T.O.L. land. 400 acres of the above area are in the existing irrigation scheme area. In 1975 the irrigation facilities including one pumping station were installed. Irrigation water is pumped from the Paka river, and conveyed to each paddy field. Although double cropping is planned, during the off-season most of the fields are not fully utilized.

The remaining 6,000 acres of the Pilot Project area are water-logged swamps and hilly land of which almost all are covered by natural forest comprising large trees of 4 - 16 inches in diameter and 33 - 130 feet in height.

3. Cropping Patterns

70. The cropping pattern adopted by the farmers of the existing fields within the Pilot Project area is just single cropping of padddy during the monsoon season. Although the irrigation scheme has been implemented for double cropping, in practice double cropping is not always done by the farmers.

71. Generally, cropping patterns vary depending on climate, soil, flood and drainage conditions, labor availability, etc. On the lower lying terraces and flood plains of Trengganu State, a long-duration long-strawed paddy is grown within the period of August to March. Where irrigation water is available a second paddy is grown in the March to November period with rainfed tobacco being grown in some of the elevated, better drained areas.

72. On the higher river terraces and sedimentary soils where extensive areas are under rubber, the basic cropping pattern is one main monsoon season paddy followed by one, sometimes two, crops of groundnut or tobacco. There are quite extensive plantings of rambutan which together with other fruits provide a useful supplementary cash income. Nevertheless, there are appreciable areas of uncultivated land and the bulk of the rain-fed lands lie idle during the off-season.

4. Flood and Pest Damage

73. Table III-6 shows the degree of damage caused to the rice crop in Trengganu State by drought, flood and insects. The demaged area extended to 22,126 acres afflicting 10,068 acres of planted area. The worth of the damaged amount of 580,000 gantang was estimated at M$1,704,178. The breakdown shows that 5,420 acres were damaged by drought while 626 acres by flood or 6% and 0.7% respectively of the total acreage. Rice blight was the major cause of damage by disease with the afflicted areas totalling 102 acres. Insects causing damage to the rice crop were white-backed planthoppers (Sogatella furcifera HORVATH) (350 acres), brown planthoppers (Nilaparvata lugens stal) (12 acres), rice bugs (214 acres) and rice bugs of other species (1.38 acres). Also striped rice borers (Chilo suppressalis WALKER) and yellow stem borers (Tryporyza incertulas WALKER) have caused damage to 726 acres. In short, a total of 2,682 acres of crops worthy to M$434,000 were damaged by insects, representing nearly 25% of the total damage amount. A considerable part of the rice crop was also damaged by wood mice (325 acres) and monkeys (413 acres.)

Table III-7 shows the amount of rice crop damage in Dungun District in 1977. The table clearly indicates that drought accounted for nearly 32% of the total rice crop damage equivalent to M$18,000. This was mainly due to an acute water shortage during the heading time of the upland rice. Wood mice and monkeys were responsible for nearly 40% of the total damage. The majority of the damage was to upland rice cultivated near the jungles.

74. Although free agricultural chemicals were distributed to each local project office, satisfactory results have hitherto not been obtained. The agricultural chemicals were DP26, Roger 40, Dol G and Gamma BHC. Zinc phosphide was used against wood mice while chemicals regarded effective against monkey and quail were administered although favorable results were not obtained.

Table III-6 Estimated Damage to Paddy in Trengganu State (1977)

	Acreage		Damage	
	Area Involved (acre)	Area Damaged (acre)	Amount (gantang)	Value (M$)
Drought	6,260	5,420	813,000	1,056,900
Flood	5,729	626	35,495	46,143
Sogatella Furcifera	1,900	350	87,600	113,880
Nilaparvata Lugens	27	12	2,500	3,250
Leptocorisa Oratorius	900	214	41,075	53,397
Scotinophara Coarctata	3,225	1,380	70,410	81,865
Chilo Suppressalis Tryporyza Incertulas	1,831	726	161,980	181,420
Blast	742	102	26,450	32,550
Rat	762	825	108,000	140,408
Wild Pigs	750	413	48,010	54,365
Total	22,126	10,068	582,333	1,764,178

Source: Annual Report, 1977, Jabatan Pertanian Negeri, Trengganu

Table III-7 Estimated Damage to Paddy in Dungun District (1977)

Type of Damage	Acreage: Area Involved (acre)	Acreage: Area Damaged (acre)	Value of Estimated Damage (M$)
Drought	150	80	18,000
Red Spot	35	20	4,700
Leptorisa Spp.	20	10	2,200
Scotinophara Coarctata	56	33	5,490
Stem Borer	30	20	3,600
Rat	178	120	14,600
Wild Pig	70	223	7,760
Total	539	506	56,350

Source: Survey of Department of Agriculture, Dungun

5. Yield and Production

75. Various data and information on yield and production were obtained through our field survey. In this case, studies were made on five kinds of crops in Trengganu State, namely rubber, oil palm, coconut palm, wet season paddy and dry season paddy. Also investigations were made on maize, groundnut, beans, sugarcane, tapioca, water melon and vegetables in Dungun District.

76. Table III-8 shows the cultivated area, average unit yield and the total yearly production of each major crop in Trengganu State for 1974 and 1977. Rubber plantations had increased about 50% in 1977 over 1974 while the total rubber production was boosted two-fold from 1,461 tons in 1974 to 3,038 tons in 1977. The planted area of oil palm too, increased about 50% in the three years up to 1977, showing a similar remarkable trend as rubber.

77. With regard to coconut palm, the planted area of 31,667 acres in 1974 had dropped to 29,441 acres in 1977, a decrease of about 7%. This was because conversions were made from coconut palm to the more profitable oil palm. Concerning rice crops, the planted area of lowland main monsoon season varieties had decreased about 8% in 1977 from 1974 to 65,564 acres, and also the total production had dropped about 8,500 tons.

78. However, with regard to the dry season varieties, the total acreage had showed a four-fold increase of 15,071 acres in 1977 over 1974 with a total yearly output of 6,036 tons in 1977, 5.6 times that of 1974. The unit yield per acre of 0.29 tons in 1974 was drastically improved to 0.47 tons in 1977. On the other hand, concerning rice crop yielded during the dry season, despite the crop acreage of 9,675 acres in 1977 being 20% less than that in 1974, the unit yield per acre increase of 7% boosted drastically total annual production to 9,990 tons.

79. Tables III-9 and 10 show the cultivated area, average unit yield and the total annual production of each major crop in Dungun District. With regard to rice crops, the acreage of the lowland monsoon season varieties accounted for 65% of the total with aggregated production registering 76% of the total yearly rice production in 1977, or 618,750 gantang. The unit yield per acre of 250 gantang proved outstanding when compared to yields of dry field varieties and highland varieties.

80. On the other hand, the planted areas for water melon and groundnut occupied a larger acreage. However, the unit yield per acre of both varieties were below the state level indicating the backwardness of agriculture in this district. Most noteworthy was the production of groundnut which was considerably below the average level as a result of irregular germination, vacant hills and abundant rainfall in the seedling stage.

Table III-8 Cultivated Acreage, Yields of Main Crops in Trengganu State in 1974 and 1977

Kind of Crops	Total Average		Average Yield		Total Production	
	1974 (acre)	1977 (acre)	1974 (ton /acre)	1977 (ton /acre)	1974 (ton)	1977 (ton)
Rubber	150,300	232,039	0.35	0.57	1,461	3,083
Oil Palm	73,828	113,652	0.68	0.67	927	na
Coconut Palm	31,667	29,461	na 1/	na	na	na
Wet Season Paddy						
Lowland paddy	71,200	65,564	0.50	0.65	34,390	25,895
Dry land paddy	3,690	15,071	0.29	0.47	1,070	6,036
Hill paddy	na	na	na	na	na	na
Dry Season Paddy						
	12,100	9,675	0.56	0.96	6,690	9,990

Source: Preliminary Survey Report on Trengganu Tengah Swamp Area Agricultural Development prepared by JICA, 1978;
Annual Report, Jabatan Pertanian Negri, Trengganu, 1977

1/: Not available

Table III-9 Cultivated Acreage, Yields of Main Crops in Dungun District, 1977

Kind of Crops	Total Average (acre)	Average Yield (kg/acre)	Total Production (ton)
Rubber	16,500	1,475 1/	2,433.8 1/
Oil Palm	6,000	6,700 2/	40,200 1)
Coconut Palm	1,700	na 2)	na
Wet season paddy			
Lowland paddy	2,729	635	1,733
Dryland paddy	1,335	483	644
Hill paddy	120	356	17

Source: Annual Report, Jabatan Pertanian Negeri, Trengganu

1/ : State total

2/ : Not available

Table III-10 Cultivated Acreage, Yields of Upland Crops in Dungun District, 1977

Kind of Crops	Total Average (acre)		Average Yield (kg/acre)	Total Proeuction (kg)
		1/		
Maize	62	(57)	175	9,975
Groundnut	100	(95)	182	12,790
Pulses	30	(na)	545	na
Sweet potato	30	(17)	748	12,716
Water melon	132	(112)	2,162	242,144
Vegetables				
leaf	75	(70)	545	38,150
fruits	57	(52)	349	18,148
Tapioca	22	(15)	1,227	18,405

Source: Annual Report, Jabatan Pertanian Negeri, Trengganu

1/ : Harvested acreage

6. Farm Mechanization

81. In Trengganu State, farm work including land tilling hitherto relied on animal tillage by chiefly buffalo or by man, and the use of agricultural machinery was rare. Shutting was conducted by the primitive method of simply threshing on a thresher.

82. Comparing the average ploughing capacity of a buffalo and a tractor (0.5 horsepower), the former is 0.25 - 0.5 acre/day while the latter is 4 - 5 acre/day. In double cropping, as the time between the first and second croppings is short, ample tillage and land preparation time is almost impossible when all work depends on buffalo and man. Therefore, without hesitation, we can say that the key to successful double cropping lies in the introduction of agricultural machinery in the future.

83. Table III-11 shows the actual number of pieces of agricultural machinery owned by the people in Trengganu State. That owned by the Department of Agriculture and the Farmers' Associations, is rented to local farmers on an application basis. Although agricultural machinery owned by small holders and contractors is loaned out to farmers, the rental fee is naturally more expensive than that of the Department of Agriculture and the Farmers' Associations.

84. Table III-12 shows the actual number of pieces of agricultural machinery owned by the people in the Dungun District. Owners of expensive tractor are: Department of Agriculture 3, Farmers' Associations 2, and Contractor 1. Small holders own no tractors. However, with regard to power tillers, pumping machines and knapsacks, a large number of these are owned by small holders.

85. The majority of small holders rely on animal tillage. But farm households which have capital equipment and with a large area of cultivated land under management employ power tillers to cultivate cash crops such as tobacco, groundnut, etc. As mentioned previously, the agricultural machinery owned by the Department of Agriculture and the Farmers' Associations is rented out to the local farmers. The Farmers' Associations, which employ two operators, rental fee for a rotavator and a disk plough combined is M$52/acre. On the other hand, the Department of Agriculture's rental fee for a disk plough is M$8/hour while the rotavator is M$12/hour. However, the average rental fee of tractors owned by private individuals is said to be between M$60/acre and M$80/acre.

86. Problems that will inevitably occur with the introduction of agricultural machinery in the future are, firstly, the extremly small acreage of cultivated land under management by small holders, and secondly, lack of backing of financial support to local farmers in purchasing such machinery.

87. However, these problems can be solved by encouraging a number of small holder households to organize an agricultural machinery cooperative to jointly purchase such machines with loans from the Farmers' Associations. In this case, the training of operators and maintenance-people will become necessary. However, another problem to be solved in the future is the conservation of the soil condition when farming is changed from animal tilling to machine tilling.
Straw and animal manure have hitherto provided a great portion of the organic supply source.

Table III-11 Farm Machinery in Dungun District

Owner	Tractor (4 wheels)	Tractor (Tiller)	Pump	Sprayer
Department of Agriculture	3	3	-	-
Small Holder	-	5	4	15
Contractor	1	-	-	-
Farmers' Associations	2	-	2	3
Total	6	8	6	18

Source: Annual Report 1977; Department of Agriculture, Dungun

Table III-12 Farm Machinery in Trengganu State

Owner	Tractor (4 wheels)	Tractor (Tiller)	Pump	Sprayer
Department of Agriculture	44	9	13	52
Small Holder	60	84	6	-
Contractor	43	15	7	-
Farmer's Associations	14	12	2	4
Total	161	120	28	56

Source: Annual Report 1977, Department of Agriculture, Trengganu

7. Rural Organization and Extension Services

88. There are 16 farmers' associations in Trengganu State of which two are located in the Dungun District, i.e. Farmers' Association, Dunqun and Farmers' Association, Jeranqau. The former was established in July, 1972 and the latter in September, 1975, with memberships of 1,185 and 781 persons, respectively.

89. Also in this district is an organization called the Youth Club with a membership of 1,800 young persons (male 1,300 and female 500) of which 80% are engaged in farming. One of the main activities of this club is the holding of many entertainment programmes to promote the feeling of social solidarity among the young people who tend to become rather shut-in in their rural life and to foster mutual friendship and understanding. Various sports programmes are also popularly held. However, of the various activities organized by the club, the following list gives five groups who have been formed by members to engage in various agricultural projects that are supported by government subsidy through the local Extension Service Station.

Table III-13 Agricultural Projects

Name of Project	Number of Members	Cultivated Area
1. Vegetable project	3	3 acres
2. Pineapple project	9	9 acres
3. Banana project	4	6 acres
4. Poultry (broiler) project	1	200 birds
5. Poultry (layer) project	2	500 birds

90. For reference, the government issues temporary occupancy licenses for land on which such projects are conducted. Also, although not limited to this district alone, there is the traditional mutual assistance system called the Goton-Royong. The Goton-Royong is not limited to the rural areas, but in the farms it functions to provide mutual help between workers during the busy harvest season and at times when extra hands are needed for house building, fence erecting, etc.

91. There are two local extension service stations in the district - the Unit Extension Office, Kuala Dungun and the Unit Extension Office, Jerangau which is located in the north-western part of the district. Each unit extension office is directed by a Unit Extension Chief who heads staff of 4 to 5 Agricultural Technicians. The Unit Extension Chief must be a holder of a Diploma of Agriculture while on Agricultural Technician must possess a Certificate of Agriculture. Each Extension Worker looks after 14 or 15 groups of farmers visiting each group once every two weeks. The Unit Extension Offices also distribute seed and stocks, fertilizer and agricultural chemicals free of charge and offer instructions on their use to the farmers.

8. Cooperatives and Credit

8.1 Cooperatives

92. The first Farmers' Organization in Malaysia was organized in 1968 in the MUDA area after the Farmers' Association Act was inaugurated in 1967. The nation's Farmers' Associations were then regarded as belonging to the Taiwan Type in character and were semi-governmental organizations.

93. However, the enactment of the Farmers' Organization Act gave birth to the Farmers' Organization Corporation with the National Farmers' Organization formed by 13 State Farmers' Organizations as its subsidiary organ. Each State Farmers' Organization further consists of a number of Area Farmers' Organizations which all have a staff of at least 5 members: a director, a person in charge of organization and a treasurer.

94. The purpose of the Area Farmers' Organizations as stipulated in law is as follows:

1. Promotion of activities to popularies farming.
2. Procurement of farming materials.
3. Promotion of market facilities.
4. Promotion of credit facilities.
5. Streamlining of farm management efficiency.

95. In this connection, a person engaged in farming is one who depends for more than 50% of his total annual income on farming. Only one such person from a farm household is allowed to become a member. Each person must pay a M$1 admission fee and a M$1 yearly membership fee and must be a stockbearer of more than one share (M$5 per share) to become a member.

96. In Trengganu State alone, there are 16 such Farmers' Organizations of which two of them are found in Dungun District. One is the Farmers' Association Dungun formed by farmers residing in Kuala Dungun while the other is the Farmers' Association Jerangau organized by members living in Jerangau, the second largest town in the area.

97. With regard to the date of establishment and the number of members presently registered, the former was founded in July, 1972, with a membership of 1,185 while the latter was formed in September, 1975, with 781 registered members.

98. The activities of these associations can be roughly divided into the following four classes:
(1) service, (2) purchase, (3) farm produce shipment and (4) finance. Pertaining to (1), a number of technical instructors assigned to the association offer technical advice and guidance to the members and the two tractors owned by the Association are rented out to the member farmers. With regard to (2), the Association purchases fertilizers, agricultural chemicals and seedlings in bulk for distribution to member farmers. As regards (3), the Association purchases farm products harvested by the member farmers, and ships them out. In this case, the produce is purchased at a higher price by the Association than by brokers.

8.2 Credit

99. Large farm households possessing large land areas can easily borrow money from commercial banks at an interest rate of between 9 - 10% per annum. However, small farm households could hitherto borrow funds only from brokers. Therefore, it is an important function of the Farmers' Association to furnish funds to such farmers.

100. According to the financing of major crops provided to member farmers of the Association in the Dungun District, to prevent loans being spent for other purposes than farming, the loans are all furnished in the form of farming materials such as seed, fertilizer, machine for ploughing and others. All credits are basically short-term loans repayable in one season and carry an interest of 7% per season.

9. Marketing

101. Although in the Pilot Project area any marketing systems have not yet developed, presently, in the whole area of Trengganu State, marketing systems are available for rice, groundnut and tobacco. In Dungun District similar to other areas of Trengganu State, most of the rice produced are retained for domestic consumption. Surplus amount of rice is mainly dealt as paddy among farmers. These paddy is milled in private or cooperatively owned mills provided in most villages.

102. According to the socio-economic study, usually the price of the paddy is of the order of M$450/ton.

103. For reference, in Malaysia, the Lembaga Padi dan Beras Negara (LPN) is responsible for the national rice stockpile and controls of all imports and sales of rice.

D. Present Livestock Industry

1. General

104. The inventory of livestock in Trengganu State is as shown in Table III-14. It is found that the livestock industry has been growing yearly. Water buffaloes and cattle are important not only for draught, but also as meat. The goats and sheep are easy to ready, and are important domestic animals that offer a protein source and that realize well.
The pigs account for a small proportion of total livestock, though their number has been increasing. This is because most of the inhabitants are Malays who hold the Islamic faith and abstain from eating pork. In recent years, however, efforts have been made to import pork from both Pahang and Selangor States in order to meet the growing demand.

105. The livestock in Dungun District is as shown in Table III-15. The water buffalo population in 1977 got smaller compared with the two preceding years. On the other hand, the numbers of goats, pigs and poultry have been increasing at a rapid rate. The number of pigs in 1977 was 2.8 times that in 1975. Ten or so poultry are kept free range in and around every homestead. Lately, some farmers have been engaged in livestock farming with a focus on poultry. It is noteworthy that in an area neibhouring the Bukit Bauk area there is a poultry farm raising approx. 11,000 fowls (4,000 egg-laying hens with a laying rate of 65%, and 7,000 chickens).

106. The breeds are as listed in Table III-16. The majority of buffaloes are of the swamp type. The greater part of the cattle are Kedah-Kelantan which are small in size and yellowish brown in color. Almost all goats are indigenous, and are black, brown or white, or dappled with these colors. They are small and are reared for meat.

2. Meat Production

107. Little is known about the meat production in Trengganu State due to the lack of available data. According to the data obtained from the Department of Veterinary Services, Trengganu State, the number of livestock slaughtered in 1977 is as shown in Table III-17, suggesting that beef would have amounted to about 1,100 tons, mutton to 7 tons and pork to 280 tons. In Dungun District, the livestock being slaughtered has been increasing in number as shown in Table III-18.
From the table, the beef production in 1977 is estimated at 130 tons. Since the region has an active livestock industry rearing great numbers of goats, sheep, pigs and poultry, it is surmised that great numbers have been slaughtered there, though no information was available to the survey team.

More than half the slaughtered animals are expected to have been served on the tables of the livestock farmers themselves.

3. Animal Husbandry

108. Meat consumption in Trengganu State is about 10 kg per person per year compared with the national average of 15.2 kg. As represented by the growing activity in livestock farming, the demand for livestock products will rise in keeping with the increase in population and improvements in diet. In recent years, a programme for the improvement of beef has been implemented. During the period 1976 to 1977, 1,000 heads of Drought-Master were imported from Australia, and breeding is now under way. In Malaysia, Kelantan State, training and guidance in poultry farming, and distribution of pullets have been pushed forward under a poultry promotion programme. Many farmers range animals free, and the forage is mostly wild grasses and what is left of rice straw after threshing. The Pilot Project area has great potential for the development of a livestock industry because it neibhours Singapore, a large consummer-market. In order to make the project efforts rewarding, it will be necessary to improve grasses and utilize state land for livestock farming. The development of a livestock industry is significant in that the fertility of the soils can be enhanced by the manure available from the livestock to assist agriculture.

4. Processing and Markets

109. In Trengganu State, the processing of livestock into the form of canned foods is not carried out. Butter and canned foods found there are all from other states and overseas. Farmers buy and sell animals at markets. Animals are taken to the slaughterhouse and slaughtering performed by a butcher if the animals are large. Small animals are normally slaughtered by the farmers themselves.

Table III-14 Livestock Population in Trengganu State

(head)

Year	Buffalo	Cattle	Goat	Sheep	Swine
1973	21,358	44,805	8,893	2,355	2,568
1974	22,922	47,509	10,720	1,674	756
1975	25,768	51,255	11,057	2,430	872
1976	27,054	55,668	12,262	3,247	961
1977	29,137	60,057	12,876	4,558	1,746

Source: Department of Veterinary Services, Trengganu

Table III-15 Livestock Population in Dungun District

(head)

Kind of Livestock	1975	1976	1977
Buffalo	2,544	3,700	2,323
Cattle	3,598	4,578	4,020
Goat	1,681	1,895	1,928
Sheep	-	-	-
Swine	131	143	361
Poultry	83,950	90,476	128,000

Source: Department of Veterinary Services, Dungun

Table III-16 Main Breeds of Livestock

(head)

Livestock	Varieties
Baffalo	Swamp Buffalo
Cattle	Kedah-Kelantan
Goat	Local breed
Sheep	-
Swine	Local breed
Poultry	Local, white rock, white Rhode Island Red

Source: Department of Veterinary Services, Dungun

Table III-17 Number of Livestocks Slaughtered for Last 5 Years in Trengganu State

(head)

Year	Buffalo	Cattle	Goat	Sheep	Pig
1973	2,281	3,831	564	760	6,996
1974	2,083	3,321	602	238	5,932
1975	1,549	3,412	593	248	5,781
1976	2,041	4,384	615	223	6,535
1977	2,338	3,867	568	243	6,860

Source: Department of Veterinary and Services, Ministry of Agriculture, Kuala Trengganu

Table III-18 Number of Livestocks Slaughtered for Last 3 Years in Dungun District

(head)

Year	Buffalo	Cattle
1975	75	350
1976	120	420
1977	200	550

Source: Department of Veterinary and Services, Dungun

E. Present Fisheries

110. Inland fisheries in Trengganu Tengah are in general, still at the stage of primary development and is not practiced at a commercial level. According to the Annual Fisheries Statistics, Malaysia, 1976, the number of fish ponds in Trengganu is 310 with the total acreage of 54.23. The average acreage per pond is thus 0.37 and average acreage per farmer is 0.47. The number of farmers is 110, of which about 95% are Malays. Besides these pond fisheries, inland fish culture is practiced in rivers, paddy fields, reservoirs and in canals both by fry stocking and on a capturing basis. Although official statistics are not available the number of full-time inland fishermen is estimated as being almost negligible and most of the fish pond owners are engaged in other type of agricultural production, i.e. paddy, livestock and poultry farming, rubber and oil palm plantation. Present freshwater fish culture activities in Trengganu are mostly on an artisan or subsistence scale.

111. The Government of Malaysia provides various support measures for the development of freshwater fish culture both on the Federal and State level, and one such activity includes a free supply of fry to the farmers. However, further efforts should be made to increase fry production and to expand the variety of species. The following Table III-19 shows species and the number of fish fry distributed in Trengganu to farmers and into public waters in 1976.

Cable III-19 Distribution of Freshwater Fish Fry in Trengganu State, 1976

Common Name	Scientific Name	Number
Lampan Jawa	Puntius gonionotus	22,775
Lee Koh	Cyprinus carpio	10,925
Tilapia	Tilapia mossambica	1,275
Kap Kepala Besar	Aristichtys nobilis	42
Kap Rumput	Ctenopharyngodon idellus	125
Total		35,142

Source: Annual Fisheries Statistics, Malaysia, 1976

112. The wholesale price of freshwater fish in main market remains stable and relatively favourable for suppliers in spite of large volumes of landings of marine fish and the general preference of people for sea fish. The present wholesale price as of October, 1978 of Lampan Jawa in Trengganu was M$1.1 - 1.3 per kati, which may explain the above-mentioned trend. The wholesale price of selected freshwater species in main markets is shown in Table III-20.

Table III-20 Average Wholesale Price of Fresh-Water Fish in Main Markets, 1976

Common Name	Scientific Name	Average Price (over 12 months) (M$/kati)
Baung	Mystus nemurus	1.53
Kap Perak	Hypohthalmichthys molitrix	1.45
Kap Rumput	Stenopharyngodon idellus	1.16
Kap Kepala Besar	Aristichthys nobilis	1.24
Lampan Jawa	Puntius gonionotus	0.98
Lee Koh	Cyprinus carpio	1.09
Sebarau	Hampala macrolepidota	2.05

Source: Annual Fisheries Statistics, Malaysia, 1976

113. As already described, various financial assistance is provided by the Government as an incentive for the promotion of freshwater fish culture. However, resolution of the following constraints it to be recommended to allow acceleration of the development of inland fisheries in Trengganu.

(1) More technical assistance to the farmers will be necessary rather than strengthening financial back-up. Training and assignment of more technical personnel is required to give regular on-site guidance to farmers.

(2) In order to meet the demand of the farmers seed production of higher priced species must be accomplished.

(3) The supply of cheap, abundant marine fish will be one of the factors limiting freshwater fisheries development. Therefore, research must be made into the primary processing of freshwater fish to obtain achieve better acceptance of these fish as well as the additional value of products.

(4) More basic data and information are necessary on the distribution, life cycle, feeding habits, reproduction and migration of existing species including blackish water areas. Well-staffed institution facilities with fry production capacity must be established on the east coast of Peninsular Malaysia, preferably in Trengganu.

F. Present Forestry

1. Forests in the Bukit Bauk Area

114. The forested land in the Bukit Bauk area is found between the Paka river and the Dungun river. This area is composed of a swamp forest of 3,907 acres and the surrounding hill forests of about 3,000 acres, totaling about 7,000 acres in all. The swamp forests are bordered by paddy fields, Belukar (a debuded cut-over land) and rubber plantations to the south and by the hill forests to the east, west and north. The swamp forest is of the 'fresh water inland swamp forest type' while the hill forest are of the 'lowland Diptero forest type'. The lowland Diptero forest type belongs to the Kanpur forest category chiefly growing Kanpur mixed with Balan, Keruing, etc. of the Meranti species.

2. Swamp forest in the Bukit Bauk Area

115. As mentioned above, the swamp forest in the Bukit Bauk area belongs to the Fresh Water Inland Swamp Forest type. And depending on the thickness of the swamp, the swamp forest can be classified as 'shallow' swamp forest or 'deep' swamp forest. The former is a swamp forest with peat soil of less than 2 feet while the latter is over 2 feet deep.

116. Trees that are frequently found in shallow swamp forests are Bintangar, Telentang, Geronggang, Merantipaya, etc. And species normally found in deep swamp forests are Bintangar, Keruing, Kempas, Meranti bakan, Punak, Mattens (Calamus SP), Stemless Palms, etc.

117. The peat soil of the Bukit Bauk swamp forest is about 1 meter deep at the forest edge and becomes thicker forwards the center of the forest reaching a maximum of 4 meters. Therefore, the majority of the swamp forest is of the 'deep swamp forest type' with Terentag and Geronggant near the forest edge and Keruing, Meranti, Langgong, etc. in the inner forest.

3. Survey Result

118. Tree species that compose the swamp forest are:

Meranti	paya	(Shorea rugasa)
"	white	(Shorea SPP)
"	rambai daun	(Shorea accuminate)
"	langgong	(Shorea eepidata)
Balan	red	(Shorea guiso)
Keruing	(Dipterocarpus SPP)	
Kelet	(Eugeraa SPP)	
Alan batu	(Shorea albida)	
Kempaso	(Koompassia malaccensis)	
Simpoh	(Dillenia SPP)	
Terentang	(Campnosporma SPP)	

The Meranti species comprise about 35% while Dipterocarp species comprise about 20% and Dipterocarpus species 55%.
In Belukar, Terentang species were found growing in profusion while Keruing seedlings were seen occassionally between fun palm. Near the edge of the forest, Terentang, Keruing, Red Balau, Kalat, Kempasi, and Simpoh were observed. From about 500 meters inside the swamp forest, Meranti species began to appear in abundance. The largest tree measured 30 inches.

119. With regard to volume of trees of over 10 centimeters in bust height diameter for each 2 acre-unit, every tree timber survey registered that 3,532 ft^3 per acre or 250 m^3 per ha. The results of every tree survey of upper layer trees covering 1.75 acres gave a stand density for +8 inch trees of 27.4 trees per acre and volume of 1,825 ft^3 per acre.

120. Also by inspecting +12 inch trees that were considered to have market value, 1,511 ft^3 per acre of material wood volume which in terms of lumber is 876.4 ft^3 (13.7 m^3) was found. Also by measuring diameters of every tree out of trees of over 10 centimeters in main trunk diameter for 2 acres, stand density was found to be 227.5 trees per acre with a volume 3,532 ft^3 per acre. The stand density of trees with main trunk diameter of +31 centimeters (+12 inches) was 22 trees per acre, the volume 1,698 ft^3 per acre (=48.08 m^3 per acre) or 26.5 m^3 per acre. And marketable trees were computed at 14.2 m^3 per acre.

121. The total volume of swamp forest in the Bukit Bauk area of +12 inch trees of (c.f. the Dungun District) was:

Superior Forest ..... 2,371 ft^3
Good Forest ..... 1,883 ft^3
Moderate Forest ..... 1,526 ft^3

122. Our survey findings revealed that +12 inch trees represented 1,698 ft^3 per acre and 1,825 ft^3 per acre which meant they did not reach the level of 'Good' class hill forest but were better than the 'Moderate' class. Meranti species occupied 36 - 39%, and if trees belonging to the Dipterocarpus species were included, the total was about 60% indicating that the utility value of the forest was high.

4. Survey of Hill Forest around the Bukit Bauk Area

123. Selective cutting has been conducted twice to date of the hill forests (lowland forest) in this area. We have conducted every tree timber cruising in the cut-over land (conducted in 1977) on the state-run Bukit Bauk lignosa farm situated at the southern extremity of the swamp area. The trees were Meranti species, Kapur, Kerving, Nyatoh, Kelat, Bintangor, Berangan, etc. Meranti species occured in abundance constituting about 45% of the total while Dipterocarpus species constituted 25%. In short, this is a superior forest with Dipterocarpus comprising about 70%. Although the volume of 3,400 ft^3 per acre is comparable to the "Superior" class hill forest (lowland forest) in the Dungun District, it is hard to make an evaluation because of the small size of the standard area.

IV. THE PROJECT

IV THE PROJECT

A. Objectives and Scope

1. General

124. The objectives of the agricultural development of Trengganu State can be summarized as follows:

a. to provide employment opportunities for the working population

b. to increase the income of those engaged in agriculture

c. to modernize agriculture in Trengganu State

d. to raise the rate of self-sufficiency in foods of the state

125. While these objectives presuppose land development as an essential prerequisite, their attainment can be certainly accelerated if the inland swamps distributed in the densely populated flatland are utilized because there is no need to construct new roads which are an absolute must in the development of mountainous jungle areas and also because the swamps are in the proximity of existing rural communities and consequently convenient for settlers. Nevertheless, non of these swamps have actually been utilized on any substantially large scale in the past, and this is the main reason for conducting a master plan study as well as a feasibility survey.

126. Compared with mountainous areas, the swamps are less favourable for development and would incur a higher development cost. Considered only from the economic point of view, therefore, their development effect would not be so high. However, the significance of swamp utilization should be evaluated from a broader and more comprehensive aspect in recognition of the pressing national requirements for a stable supply of food, the extermination of poverty, efficient national land use and so forth. Although the planned swamp utilization is difficult and involves many unsolved problems, it is "not impossible". From these crucial findings, the study on the Trengganu Tengah Swamp Area Agricultural Development was started.

127. 1978 is the year for the mid-term review of the Third Malaysia Plan. The mid-term review is an important task in which achievements of the first half (2.5 years) of the project period are subjected to a rigid examination in order to make necessary corrections and improvements to the implementation plan for the latter half (2.5 years) of the project period. The Government of Malaysia intends to take advantage of this

mid-term review to incorporate the survey plan of the swamp utilization in the Trengganu Tengah Development Programme, and to put the swamp utilization plan into full-scale execution under the Fourth Malaysia Plan which will start in 1981. To conform to this schedule, it is necessary to complete the feasibility study for the Pilot Project in 1978 before completion of the master plan.

2. Objectives and Scope

128. The Bukit Bauk Pilot Project for swamp area agricultural development which forms the Trengganu Tengah Regional Development Programme as well as the Trengganu Tengah Swamp Area Agricultural Development Programme has been given high priority by the Government since it aims to create both agricultural production and employment opportunities through the provision of irrigation and drainage facilities with a pumping station to examine ways in which the multifarious development plan is needed.

129. The Pilot Project is divided into two phases. The First Phase will take 10 years from project commencement. In this period man and animal power will be used for farming. In the Second Phase (the period following the First Phase) mechanized farming will be incorporated into the Pilot Project. The major components of there two phases will be as follows:

First Phase

(i) Irrigation and drainage facilities for 5,542 acres (2,243 ha) of arable land including on-farm facilities will be established. The total length of the main and secondary irrigation canals will be 10.2 miles (16.5 kilometers) and main drainage canals about 3.7 miles (5.9 kilometers), with provision for driving channel lines of 0.143 miles (0.23 kilometers).

(ii) Agricultural development will be promoted through the setting up of a demonstration farm, marketing facilities, and other agricultural support services.

(iii) Inland fisheries development to ensure a supply protein in the diet of the settlers will be achieved through provision of extension services.

(iv) Pumping station will be provided for irrigation

Second Phase

(v) A flood protection embankment of 3.04 miles (4,898 meters) in length running on and along the district road will be built. It will be high enough to protect a gross area of 1,616 acres (654 ha) of land against flooding throughout the year.

(vi) One pumping station for irrigation and drainage will be installed.

B. Irrigable Area, Water Supply and Demand

1. Irrigable Area

130. The irrigable area of the proposed Pilot Project has been estimated with the use of a planimeter and a topographic map with one-meter contours prepared by JICA in 1978 (Scale, 1:5,000). The Pilot Project area within the proposed embankment line and the surrounding hill line is calculated at 7,006 acres (2,835 ha) of which 1,318 acres (533 ha) are noncultivable, i.e., homesteads, roads, steep slope lands, marshes, etc. The remaining arable land covers 5,688 acres (2,302 ha). Irrigable area is calculated at 1,816 acres (735 ha) multiplying 31.9% by the arable land area. The remainder would be a provision for land to be occupied in building the irrigation and drainage canals. The above data are shown in Table IV-1.

Table IV-1 Acreage of Pilot Project Area

Item	Acreage (acre)	Acreage (ha)
a. Total Area of Pilot Project	7,006	2,835.4
b. Arable Land		
(1) Ordinary Farms of Pilot Project	4,867	1,969.7
Paddy field	835	337.8
Upland crop field	1,874	758.5
Long-term crop field	255	103.4
Grassland for cattle	1,483	600.0
Grassland for buffalo	420	170.0
(2) Demonstration Farm of Pilot Project	467	189.1
Paddy field	59	24.0
Upland crop field	74	30.0
Long-term crop field	13	5.1
Grassland for cattle	247	100.0
Grassland for buffalo	74	30.0
(3) Paddy Field of DID Scheme	354	143.2
Total	5,688	2,302.0

Item		Acreage (acre)	Acreage (ha)
c. Non-cultivable Land			
	Homesteads for settlers	203	82.1
	Facilities for demonstration farm	97	39.3
	Lots for roads and canals	412	166.8
	Public area	25	10.0
	Control reservoir	5	2.0
	Pumping station and embankment sites	49	20.0
	Remaining area (steep slopes)	320	129.5
	Remaining area (marsh)	207	83.7
	Total	1,318	533.4
d. Irrigable Land (parts in arable land)			
	Paddy: Ordinary farm	835	337.8
	Demonstration farm	59	24.0
	Upland crops: Ordinary farm	848	343.2
	Demonstration farm	74	30.0
	Total	1,816	735.0

2. Water Supply

131. Supply of irrigation water from the Paka river is possible throughout the year. As mentioned previously, the drought discharge of the river is estimated at about 2.8 m^3/sec to the maximum water requirement of 0.82 m^3/sec for the Pilot Project. The river bank of the site selected for an irrigation water intake is stable against erosion by silting; thus, the particular site is ideal for continuous pumping.

3. Water Requirement

132. In general, there is insufficient rainfall from April through September in the Pilot Project area. During these months and even during other dry periods when evapotranspiration exceeds the available rainfall, irrigation water is necessary for crop production purposes.

133. In estimating total water requirements it is necessary to use long-term historical data on the water requirement of various crops in the Pilot Project area. Unfortunately,

such data were not obtainable. In this study, therefore, the data derived from limited experiments on water requirements carried out in tropical countries like Sri Lanka as well as Malaysia were utilized.

134. Water requirements for lowland rice and upland crops are as follows:

Water requirement

i. Lowland rice

135. In the Dewan Salor Irrigation (DSI) Scheme located near Kota Bahru the following data are as in the reference materials prepared by FAO[1/].

Off-season (dry season)

Month	DSI Scheme (mm/day)	Dungun Area (May 10 - Aug. 23)
May	4.8	(5.9)
June	4.8	(5.9)
July	5.8	(6.2)
August	5.1	(5.1)

Main season (wet season)

Month	DSI Scheme (mm/day)	Dungun Area (May 10 - Aug. 23)
October	4.3	(5.0)
November	4.6	(4.8)
December	3.6	(5.4)
January	4.1	(6.0)
February		(5.4)

Remarks: Figures in parentheses are ET. values prepared using the crop factor obtained from Sri Lanka (Refer to VIII. of the STUDY REPORT). One of the 105-day-growing types (May 10 - August 23), and for the wet season. One of the 115-day-growing types (October 20 - February 12) were utilized.

1/: Refer to No. 14; Irrigation Requirement for Double Cropping of Lowland Rice in Malaysia.

ii. Upland crops

136. Using the ET. value at Dungun and a Crop factor (obtained from Sri Lanka for upland crops) the consumption necessary for irrigation of upland crops to be introduced after completion of the Pilot Project, was calculated. The figures will be utilized in irrigation planning as well as in the hydrological analysis.

137. In this study, the calculated seasonal consumption is relatively high compared to that for Kelantan. It is considered to depend mainly upon the difference of respective climatic conditions.

138. The water requirement for this plan was determined using the assumptions of the cropping plan shown in VIII. of the STUDY REPORT. When the cropping plan changes with farming development in the future, the water requirement per period may be determined based on the crop factors and pan evaporation (ETO) in VIII. of the STUDY REPORT. The study report shows a claculation example.

3.2 Irrigation requirement and water requirement for puddling

139. The following data on six sites during the period 1961 to 1963 were published by FAO.

i) Double cropping

Off-season (dry season)

	Inch / month	L/sec/ha	mm/day
a. Presaturation period (40 days)	15	1.5	12.7
b. Normal irrigation period	10	1.0	8.5
Main season (wet season)			
a. Presaturation period (40 days)	13	1.3	11.0
b. Normal irrigation period	9	0.9	7.6

ii) Single cropping

a. Presaturation period (40 days)	12	1.2	10.2
b. Normal irrigation period	9	0.9	7.6

140. For reference, evaporation at Dungun and crop factors are shown in VIII. of the STUDY REPORT.

Cropping Schedule

141. The proposed cropping schedule might be amended to take into account the change in soil conditions resulting from drainage after completion of farmland reclamation. At the initial stage, the followings are to be studies:

		Necessity of Irrigation
Lowland:	Paddy (115 days) + Paddy (105 days)	with irrigation
Lowland:	Paddy (115 days) + Upland crops	with irrigation
Upland:	Vegetables or Pulses	with irrigation
Hilly area:	Pasture or Pepper	without irrigation

142. As for paddy, about 150 mm of irrigation water including losses for land preparation, and puddling will be used.

(Source: Reports prepared by DID for the years 1961, 1962 and 1963)

3.3 Design irrigation requirements

Lowland rice

a. Irrigation requirement for land preparation

143. 150 mm of irrigation water are calculated as the water required for land preparation and puddling including conveyance losses. The period is taken as 30 days.

144. The land preparation period should be shortened to 10-20 days depending on the degree of farm mechanization in consideration of machine operating efficiency. However, it is assumed as 30 dyas considering current farming operation status.

b. Normal irrigation period

145. The irrigation requirement for this period (dry season) is calculated using consumptive use and deep percolation loss. Deep percolation loss is estimated at 1.0-3.0 mm/day because the soil is a heavy clay soil containing more than 50% clay. But a design figure is taken as 2.0 mm/day.

(mm)

Month	Consumptive use	Percolation	Total	Irrigation Requirement
1st month (May)	5.9	2.0	7.9	8.7
2nd month (June)	5.9	2.0	7.9	8.7
3rd month (July)	6.2	2.0	8.2	9.1
4th month (August)	5.1	2.0	7.1	7.9

3.4 Irrigation method

i. Lowland rice

146. In an effectively managed paddy field, 20 - 30% of irrigation water can be saved by using the rotational irrigation method, and furthermore the scale of the main canal and the capacity of the pumps can be reduced. Due to the difficult management of irrigation water, however, the traditional continuous irrigation method will be applied.

ii. Upland crops

147. Taking into account water holding capacity, basic intake rate, topographic conditions, kinds of crops, etc., the proposed irrigation methods are mainly as follows:

Irrigation Method	Allowable Range of Gradient	Range of Basic Intake Rate	Kinds of Crops
Furrow irrigation	Less than 5%	5-100 mm/hr	General row crops and fruit trees
Contour furrow irrigation	5 - 27%	Less than 100 mm/hr	- do -
Border irrigation	Less than 5%	Less than 75 mm/hr	Mainly, pasture grasses.
Contour ditch irrigation	14 - 50%	As above intake rate	Mainly, pasture grasses.
Basin irrigation	Less than 2%	Less than 75 mm/hr	Fruit trees and pasture grasses
Sprinkler irrigation	As above	More than 5 mm/hr	Various crops and fruit trees
Drip irrigation	- do -	As above	Vegetables and fruit trees

148. In the plan, the relatively gently sloping uplands are considered as irrigation areas. Most of the farm fields are considered almost flat. The irrigation methods in such areas, principally, are classified based on the kind of crops and the physical conditions of soils, especially the basic intake rate. However, for the time being, surface irrigation like furrow irrigation and border irrigation will be mainly considered for certain economical and technical reasons. In some parts of the Pilot Project area, drip irrigation might be used for soil management reasons such as prevention of nutrient leaching and water economy, because the value of the basic intake rate is over 1,000 mm/hr in places where a thick peat layer is found just below the ground surface. For reference, accumulated intake curves and physical properties of soils are given in VIII. of the STUDY REPORT.

149. The proposed irrigation methods in the Pilot Project area are tentatively classified based on the soil and proposed crops as follows:

	Soil Textute	Kinds of Crops	Irrigation Method
E I	HC	Vegetables or pasture	Furrow or sprinkler irrigation
E II	0-35 peat below 35 cm HC	Vegetables or fruit trees	Drip irrigation
E III	0-40 Sic	Vegetables or fruit trees	Furrow irrigation
W I	0-15 Lic 15-65 SC	Fruit trees, vegetables or pasture	Furrow irrigation, contour ditch irrigation or sprinkler irrigation
W II	0-20 SCL below 20 cm SL	Fruit trees, vegetables or pasture	Sprinkler irrigation, furrow irrigation, or contour ditch irrigation.

150. The classification of the proposed irrigation methods assumes concentrated cropping in the future. Except for some vegetables, conventional dispersed cropping is to be the main method at the initial stage. In the plan, furrow irrigation and contour ditch irrigation are specified. As farming methods develop, the target facilities are to be implemented.

4. Water Quality

151. It is considered that the water of the Paka river is suitable for irrigation because it is free from salinity. Result of water quality analysis gave salinity as 20-

30 ppm. According to calculations, the salt wedge extends 7 km upstream from the estuary, no affect from the salt wedge is anticipated, as the Pilot Project area is 15 km from the estuary. The back water caused by high/low tide affects the Pilot Project area, and the water level change occurs at the water intake site. According to the plan, therefore, water is to be principally take from the Paka river.

C. Flood Protection, Drainage and Irrigation

1. Flood Protection

152. Civil works for flood protection are to comprise construction of an embankment along the Paka river, a pumping station and a control reservoir. These three civil works are to be completed in the Second Phase of the Pilot Project, since these are prerequisites for mechanized farming.

153. The southern part of the Pilot Project area extends eastwards and westwards along the Paka river. This area is subjected to a complicated current action during the monsoon season. In view of this, the proposed embankment should be built on and along the district road which extends along the Paka river a distance of 50 - 500 yards.

154. In order to determine the hydrological design criteria for the embankment, records obtained from the Duarian Mentangau Gauging Station were reviewed. Observation of water level was commenced in 1973, and the recorded high water level at the station was 17.80 feet.

155. The planned embankment height will be determined by correlating the peak water level at flood time and daily precipitation as flood records are scarce. The 1/10th probability daily precipitation and the 1/10th probability peak water level will then be estimated. According to calculations (Refer to VIII. in the STUDY REPORT) the 1/10 probability water level of the Paka River is 16 feet. Therefore, the height of the planned embankment is 17 feet giving one foot allowance over the probability peak water level.

Design of pumping station

156. Pump water delivery must be able to remove in 3 days the 1/10th probability daily precipitation volume of rainfall in the area.

$$Q = \frac{A \times R \times 10 \times f}{86{,}400 \times m} = 15.2 \text{ m}^3/\text{sec}$$

Where; Q: Pump water delivery (m^3/sec)

A: Catchment area (ha) A = 1,911 ha

R: 1/10th probability daily precipitation R = 293.7 mm/day

f: Outflow rate f = 0.7

m: Days for water removal m = 3

157. The catchment area of the river within the Pilot Project area is 19.1 km^2, the water course 4.8 km and the flood

arrival time according to the Rziha equation about 2 hours. As there is a difference in arrival time at the Paka river and at the Pilot Project area, 70% of the pump water delivery obtained from the above equation should be considered as natural outflow. Therefore, if the pump is to deliver the remianing 30%:

$$Q = 15.2 \times 0.3 = 4.6 \text{ m}^3/\text{sec} = 276 \text{ m}^3/\text{min}.$$

158. With regard to the number of pumps, two pumps of the same capacity are to be used; the amount of water delivery of each pump being qp = 276/2 = 138 m^3/min. The pumps are to be longitudinal axial diagonal flow types, ϕ 1,000 m/m.

159. The output of the prime mover is to be as follows: lows:

In case of diesel engine

P = 250 PS

In case of motor

P = 180 kw

Planning of control reservoir

160. A control reservoir has the dual purpose of controlling irrigation water and pump discharge water. During flood time, the water peak level, here, can reach 16 feet (E.L. 4.88 meters) within the Pilot Project area. The control reservoir must regulate the remaining area (below E.L. 2.00 meters) of low marsh land 835 acres of paddy fields. Therefore, it is not necessary to newly construct a control reservoir for flooding.

161. On the other hand, when planning the irrigation water systems, before conducting the survey it was considered that the salt wedge would reach the intake point to make water intake impossible at full tide during the dry season. However, the survey results revealed that nothing would be affected by the salt wedge, and therefore there would be no need to build a large scale control reservoir.

162. For the above reasons, the control reservoir is to be prepared as a part of the pumping station facility with an area of 80 m x 80 m and bottom reaching E.L. - 150 meters. This reservoir would hold 100 x 100 x 2.0 (20,000 m^3) of water facilitating smooth pumping operations. This volume is equal to one-hour's water delivery capacity of the pumps.

2. Drainage

163. The Bukit Bauk total catchment area is 7,006 acres (2,835 ha), and this discharges into the Paka river and the Dungun river. The catchment area which discharges into the Paka river is 1,911 ha, while the area which discharges into the Dungun river is 924 ha.

164. The discharge flow into the Dungun river is to continue as natural drainage, while the flow into the Paka river will be planned as natural drainage during the First Phase, but from the Second Phase, the discharge flow will be forced drainage using pumps. The pumped drainage in the Second Phase, is necessary if mechanized farming is to be introduced into the whole Pilot Project area for agricultural modernization.

Drainage canals

165. The main canal is to run more or less north-south through the center of the area and discharge into the Paka river. The canal is to be constructed as an earthen waterway with an embankment of a 1:3 side slope (because of the rather soft ground). Discharge rates calculated by rational methods are estimated to be 43 to 157 cub.m/sec. There will be 5,885 m of canal extensions.

166. Secondary canals will meet the main canal almost at right angles. Like the main canal, these canals will also be constructed as earhten waterway, but with a 1:2 side slope. According to rational method calculations, discharge rates will be from 5 to 31 cub.m/sec. There will be 23,250 m of canal extensions.

Driving canal

167. A driving canal between the proposed pump site and the Paka river of L = 250 meters will convey water for irrigation and flood drainage. The bed slope of the channel will be level. As the control reservoir, to be built in the Second Phase, and its surrounding lowlands are to serve as a flood regulator, the estimated rate of discharge of the driving canal has been computed on a daily rainfall daily discharge basis.

3. Irrigation

168. In the Pilot Project area, a combination irrigation system of pipelines and open canals is planned for the paddy field, pipelines for rising gradient lines, and open canals for falling gradient main and secondary canals.

169. In the upland farms, a pipeline is to provide a main canal. This is to be fitted with water-intake valves in necessary numbers, for disinfection and various water feeds. But an irrigation system for upland crops is not to be installed in the First Phase.

170. All terminal small canals are to be formed open earth canal.

Layout of irrigation canals

171. One pumping station is planned at site P. near the district road in the southernmost part of the area. The pumping station is to serve the purpose of irrigation only, in the First Phase. The main and secondary irrigation canals will be located on higher land.

172. The top of the irrigation canals should be a minimum width of 3 feet. The longitudinal slopes of the canal are to be set at about 1:1,000. The water-carrying capacity underlying the design of the cross section of each canal is determined by multiplying the command area to be covered by 1.8 lit/sec/ha. At the intermediate section of the canal, check gates will be set up at intervals for 0.5 to 1 mile in order to maintain the water level necessary for diversion.

173. Small gates are to be installed to divert water from the main canal into the secondary canals, and from the secondary canal into the tertiary canals. To divert the water from the tertiary canals to each farm, weirs will be used.

174. The prohibitive costs of repairs and operating this equipment will become an additional burden to settlers.

D. Land Reclamation

1. Land Clearing

175. Principally, land reclamation in the Pilot Project area will be conducted by using construction machinery. However, in any place in which machinery can not be efficiently operated due to factors like topographic conditions, reclamation work will be done using manpower. Reclamation must be completed as soon as possible taking into consideration future management, because the results of reclamation might have a large affect on the management to be expected by settlers.

Deforestation

176. Immediately after the commencement of the Pilot Project, the work should be commenced.

177. On land intended for grassland, large trees (more than 40 centimeters in diameter) will be left as shade trees for livestock. All trees on land not to become grassland, and small trees (less than 40 centimeters in diameter) on grassland will be felled at the beginning of the First Phase.

Uprooting and removal

178. In lands extending along hilly areas uprooting and removal by a rakedozer for dry land are planned, but on wet land rakedozer specially equipped for wet land is to be utilized. During the First Phase, large stocks will be left as they are, on land for paddy fields and upland fields. The number of such large stocks (more than 40 centimeters in diameter) is estimated about 30 per ha. At the beginning of the Second Phase, these large stocks are to be taken out by ripper and removed by rakedozer. In all areas, all small stocks (less than 40 centimeters) and bushes are to be uprooted at the beginning of the First Phase. Stocks are to be collected in some specified places, and later burned or buried.

Digging of small scale ditches

179. Small scale ditches are to be dug along the boundaries of farm land by excavator. Plowing is to be done by brush braker after the digging of ditches to a depth of about 40 cm.

Application of soil improvement materials

180. Soil improvement materials like calcium precipitate are to be applied by lime sower after plowing.

Stumping

181. Stumping is to be done by disk hallow pulled by tractor. Stumping will allow easy mixing of soil with soil improvement materials.

Compaction

182. Compaction is to be done by cambridge roller pulled by tractor. Clods remaining on the surface are to be crushed, and the soft surface compacted.

Time schedule for farmland reclamation

183. Farmland reclamation is scheduled for completion within three years after the third year of the construction period. For smooth reclamation, at least five sets of machinery should be provided.

Remarks:

Acreages of proposed reclamation 5,900 acres

1st year ------- Detailed design

2nd year ------- Commencement of construction work

3rd year ------- The first year of reclamation work (Target: 1,153 acres)

4th year ------- The 2nd year of reclamation work (Target: 1,977 acres)

5th year ------- The 3rd year of reclamation work (Target: 2,394 acres)

6th year ------- The 4th year of reclamation work (Target: 376 acres)

2. Soil Improvement

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

a. Completion of drainage facilities for drainage of all swamps

b. Addition of soil improvement materials, appropriate for the proposed crops, such as carbonate precipitate, phosphate, etc.

c. Soil reversing and dressing, or soil dressing after draining and drying where necessary

185. The depth of drainage canals in peat soil areas should be determined in due consideration of the possible settlement of ground surface due to soil shrinkage which could occur with the drainage, drying up, and decomposition of organic substances. When mechanized farming is to be introduced, the bearing capacity of ground surfaces should be examined carefully and stumps and other obstacles should be removed to permit smooth operation of farm machinery.

186. Countermeasures for the soil improvement of the soil series classified in the Pilot Project area are as below. These measures were prepared on the basis of our field survey.

i. Soils belonging to the Acrisols which occupies the western hilly area, and the eastern and northern area have gentle slopes and are the most suitable for farm land in their original condition. However, attention must be paid to the erosion which will be caused by the deforestation of the tropical forest. If facilities like drainage ditches are employed, and/or contour strip cultivation is done, even land with slopes of 8° - 12°, and 12° - 15° can be expected to be utilized effectively as better grass land. Also in utilizing such land for fruit trees, rubber, and oil palm plantations; a covering grass crop like pasture will be necessary.

ii. Heavy clay soils derived from recent riverine alluvium have the characteristics that values of both soild ratio and volume weight increase in parallel with drying by drainage through drainage networks. Therefore, softening and porosity of the soil must be controlled by reversing with organic substances. Lowering the soil solids to 35 - 40% of the ratio will be achieved the easiest by such reversing. As one effective way, utilization of farm machinery or plowing by buffaloes for grass cultivation is considered. This type of soil is severely leached, therefore plant nutrient elements including both N, P and K, and minor elements are lacking. The pH value (KCl) of the soil is 4.0 - 4.7, and both the exchangeable calcium and the effective phosphate contents are low. Furthermore, the phosphate absorption coefficient is normal to slightly high. In view of this situation, it is judged that as soil improvement materials, besides calcium and phosphate compounds, various compounds containing minor elements like Cu, Mg, Zn, Mo, B, etc. should be applied. After such improvement, adequate conditions for upland crop cultivation will be achieved.

iii. On land where the layer of peat extends below 1.0 m, when the heavy clay of the lower layers is reversed with peat immediately after the initial subsidence, and the soil improvement measures mentioned in (ii) are effectively promoted, utilization as upland will become possible.

iv. On land where the layer of peat reaches 1.0 - 2.0 m below the ground surface, when deep plowing immediately after the initial subsidence or in 1 - 2 years after the first deep plowing, reversing with heavy clay taken from the deep layer by deep plowing during the early draining stage and further the soil improvement described in (ii) are effectively conducted, the soil will become suitable for upland crop cultivation. However, for deep plowing large and medium types of farm machinery would be needed. Even without deep plowing or reversing, peat soil might be useful for upland crop cultivation as arable soil. However, higher yields are not to be expected.

v. On land where the layer of peat reaches more than 2 m, even immediately after initial subsidence of peat, the effect obtainable from reversing with heavy clay is not expected to be adequate. In this case, subsidence might reach 1 m per year. Dressing with mineral soils obtainable from outside of the Pilot Project area would be costly. In constructing drainage canals and irrigation canals, a large amount of heavy clay soil would be excavated from the lower layers but this amount would not be enough for land dressing.

187. On this land, therefore, peat soils will be utilized as they are. The porosity value of the soil is very high at about 93%, its water holding capacity is also higher. Even if a quantity equal to the gravitational water were drained, the soil would hold water of 12 - 15 times its weight. Since the speed of drainage from the peat layer is not so high in spite of the high porosity value, the spacing of open ditches should be not widened so much. It is reported that a spacing of 30 - 40 m would be suitable.

188. According to our field chemical analysis, the pH value (KCl) of this soil is 3.8 under air-dried conditions, and that of water taken in the field is around 4.0. Given the not particularly good analytical results of the soil analysis, application of calcium and phosphate materials including minor nutrient elements is needed.

3. Road Construction

3.1 Main roads

189. Main roads connect villages and settlements to industrial areas, and to production and transportation facilities. The main road for this area is to run through the settlement planned for the east side of the area and connect with Federal Highway No. 3 and the Dungun to Bukit Besi road. It is being planned essentially for the transportion of agricultural products. The total length of the main road extensions is to be 6.91 km. The road surface is to be gravel, the effective width 6.0 m, and the full width 8.0 m.

3.2 Branch roads

190. Branch roads are to connect farm roads to main roads. There are to be a total of 19.83 km of branch road extensions. Road surfaces will be gravel, the effective width 4.5 m, and the full width 6.5 m.

3.3 Farm roads

191. Farm roads will connect to the near side of each farm zone. These roads will consist of vertical farm roads connecting farm zones to the branch and main roads, and lateral farm roads linking up with the vertical farm roads. Vertical farm roads will be portioned 200 m apart, and lateral farm roads 400 m apart. Road surfaces will be dirt, and the total width 2.0 m.

3.4 Road material

192. The mineral soil of the eastern and western hill sides of the Pilot Project area are to be used for banking material for main and branch roads. During the First Phase, peat soil would be used for banking material of farm roads only, but in the Second Phase, gravel is to be used to surface farm roads to allow introduction of mechanized farming.

E. Agricultural Development

1. General

193. Malaysian agriculture plays an important role in its economic and social development. The agricultural sector provides employment for about one-half of the working population. 50% of total exports and 30% of the gross domestic product are derived from the agricultural sector. However, high population growth coupled with the not-so-advanced institutional development support facilities results in under-utilization of existing human and physical resources. Rural development, therefore, provides the key towards developing the Malaysian economy. This means emphasis on increased agricultural productivity, creation of employment opportunities, strengthening of rural institutions for effective delivery of development services to all, and a broad distribution of incremental benefits.

194. The Pilot Project, which will ensure the availability of water in the right quantity at the right time, thus improving the swamp area, will also bring under control the flooding; it will provide roads and power; it will allow cropping flexibility and intensity with more farm lands utilized. In short, it is an attempt to introduce a rural development programme.

195. Judging from the expansion in rice acreage and yield increases in Trengganu State in recent years, it is anticipated that paddy self-sufficiency will be realized in the near future not only in Dungun District but also in other districts of Trengganu State. Accordingly, preparations must be made for this anticipated development in terms of crop diversification, post-harvest facilities, marketing and distribution.

196. Taking the above-mentioned facts into consideration, agricultural development in the Bukit Bauk area should be based on small-scale farms principally cultivating paddy and by establishing two estate farms, one principally rearing cattle and the other principally cultivating upland crops. The small-scale farms should be operated by individual farmers. On the other hand, the estate farms should be operated by KETENGAH itself or an enterprise specified by KETENGAH.

2. Proposed Land Use

197. Production can be increased in the following manner:

a. By increasing acreage

b. By increasing yield per unit area

In existing fields, acreage can be increased not so much by acquiring new land but by introducing a new cropping patterns. With this, plus year-round irrigation and flood control, the use of land can be doubled even tripled. Increasing yield per unit area should be done through infusion of new technologies and management systems which are already well known and being utilized in places with improved agricultural production practices.

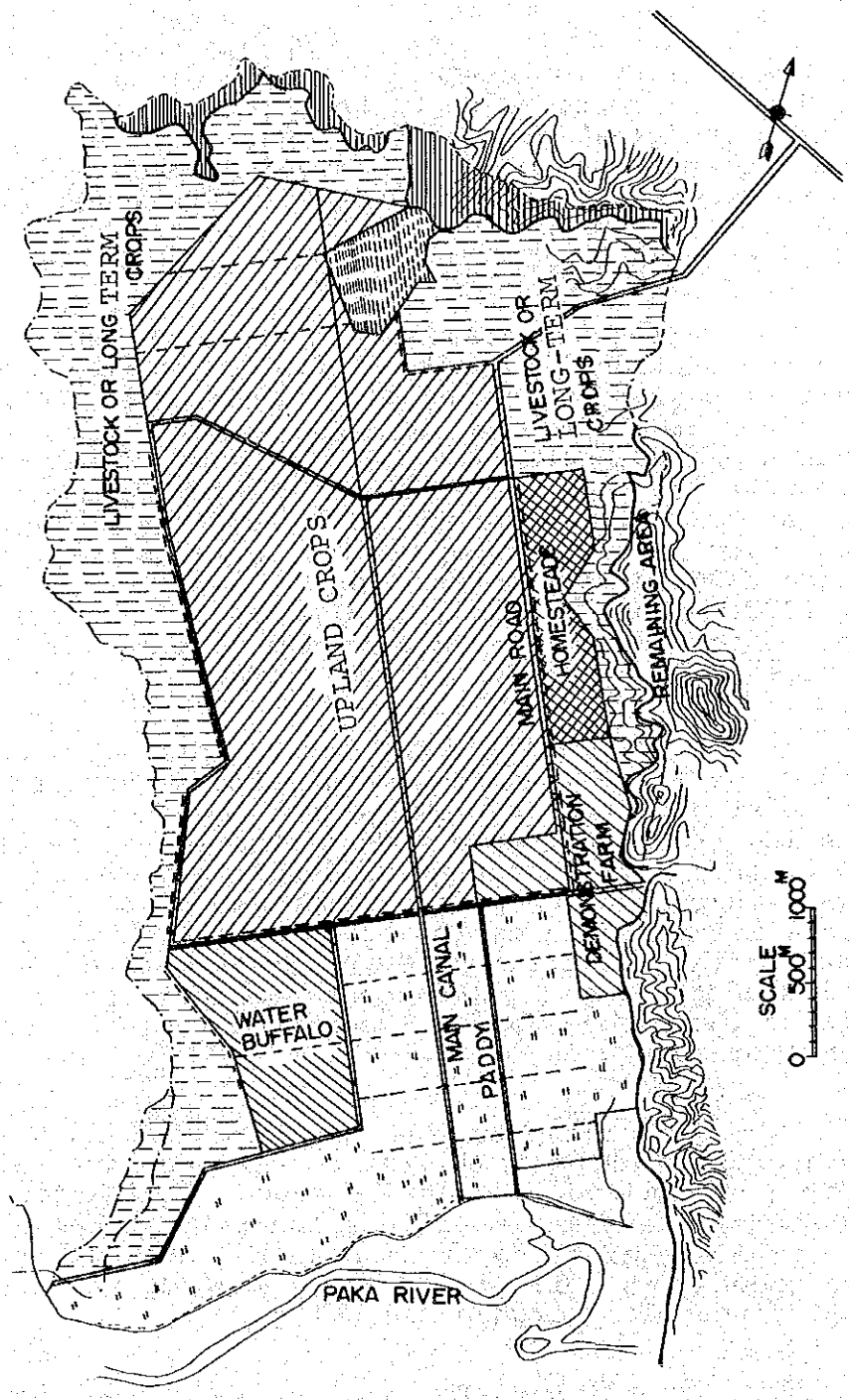
198. In the meantime, swamp utilization will require a huge amount of capital investment because of the natural characteristics, conditions of the swamp areas and their locations. In order to enhance national land use through swamp utilization, it is necessary to study the various swamp conditions including soils, irrigation and drainage, and to make a careful review of the necessity, urgency and justifiability of development from the socio-economic standpoint.

199. Most of forests and swamps in the Bukit Bauk area are to be reclaimed, resulting in the development of farm land of 5,334 acres corresponding to about 76% of the total planned area. On the farm land, paddy is to be cultivated in paddy fields of 894 acres. Upland crops are to be cultivated on 2,216 acres of the estate farm for this purpose, and forage crops on most of the 2,224 acres of the estate farm for livestock rearing. Fig. IV-1 illustrates the proposed land use in the Pilot Project area.

3. Proposed Suitable Crops

200. Success of farm management in swamp areas depends, above all other things, on the selection of suitable crops. While soil and irrigation conditions will set rigid and inevitable limits on the choice of crops, careful consideration should also be given to the marketability of each crop. Criteria for selection in particular, will have to be modified depending on whether priority should be given to improving nation-wide self-sufficiency in foods or to the export of commercial crops. If commercial crops are to be introduced, the future prospects of their demand on the world market will have to be studied in advance.

Fig. IV-1 PLAN OF LAND USE



201. On the other hand, if priority is to be given to augmented self-sufficiency in foods, then no particular difficulty will be entailed in the selection of crops but there will arise the problem of low profitability and anxiety in the possible reduction in market price in the case of over-production. So far as self-sufficiency in rice is concerned, Malaysia attained a high rate of 95% in 1975. If double cropping is promoted with progress of land improvement of paddy fields and if cultural practices are improved with the introduction of breeding, fertilization and plant protection technology, paddy production will perhaps increase beyond the nation's demand very soon. Even then, however, it will not very difficult to convert paddy fields to other crops because they are favoured with better soil conditions than swamp areas.

202. If swamp areas are found to be suitable for paddy field reclamation, it may be viable to content the entire swamp area into paddy fields and convert the existing paddy fields into other crop areas to achieve efficent national land use. Although Malaysia attained 95% self-sufficiency in rice in 1975, the population increase envisaged in the Perspective Plan for 1990 is 18.1 million for the whole country which is an increase of 45% over 1975. The population increase envisaged for Trengganu State is also as high as 7 million or a 44% increase over 1975. Thus, the anticipated population increase may make it necessary to promote paddy field reclamation to a substantial extent even if double cropping is practiced widely in future.

203. As mentioned previously, introduction of crops in the Pilot Project area should be done after a careful and comprehensive study of the various aspects of each crop such as future marketing prospects, crop diversification, balance of demand and supply, and profitability. However, the farmers themselves will actually hope for the introduction and combination of crops which will promise a maximization of income within the limits of their family labor force. It is therefore important to make studies on the most advantageous combinations of crops on the basis of the productivity, labor requirements and demand-supply balance of each crop.

204. According to the report obtained from MARDI, pepper recorded the highest soil productivity per acre at M$6,563 followed by chillies, tomato, tobacco, Sawi Hijau (a kind of vegetables), Markisa (a kind of fruits), and peas in that order, all of which registered a value at the M$1,000 level. Crops which showed low soil productivity were maize, coconut, citrus, paddy, pineapple, sorghum and coffee.

205. With regard to labor productivity, oil palm and cashew hold the top place at M$40 per day, then come pepper at M$38.2. Thus, pepper is the highest in both land productivity and labor productivity. Crops with low labor productivity are coffee, peas, Komatsuna (a kind of Chinese cabbage), maize,

Chinese cabbage, pineapple and leaf mustard. In general, vegetables register low productivity because they call for intensive farm work. Paddy is slightly higher than vegetables in labor productivity, but its land productivity is notably low. From the viewpoint of profitability alone, therefore, it may be said that paddy is not a very advantageous crop.

206. Regarding the number of working days, which affects labor productivity to a great extent, crops calling for more than 200 working days per acre are peas (225 days), chillies (240 days) and Sawi Hijau (220 days). These crops are not very high in labor productivity, although their land productivity is fairly high. There is active demand for some vegetables such as leaf mustard, Komatsuna (a kind of Chinese cabbage) and Chinese cabbage. However, these crops call for 120-165 working days and are low in both land productivity and labor productivity, so that an increase in their market price or a reduction of their distribution cost is necessary.

207. Crop applicable with a smaller number of working days are cashew, cocount, citrus, maize, sorghum and cocoa. All these are fairly high in labour productivity with the exception of maize, but they are low in land productivity. If any sizable amount of income is to be earned by growing these crops, they should be planted over quite an extensive area.

208. An overall review of land productivity, labor productivity and number of working days indicates that the most advantageous crops are pepper, oil palm, tomato and tobacco. Vegetables and fruits consumed in daily life are relatively low in profitability with the exception of tomato. It may be said that these crops do not stimulate the farmers' willingness to produce, although self-sufficiency in their supply is called for.

209. Self-sufficienty in rice should also be improved. Although its profitability is low as mentioned above, care must be exerted to prevent a production decrease because it is the staple food in Malaysia and its stable supply is one of the essential pre-requisites to the nation's development.

4. Proposed Cropping Patterns

210. Swamps are poorly drained being submerged constantly in many places, thus are not favourable for crop cultivation. Of the various crops paddy is the most suitable for cultivation under the existing poor conditions, but if suitable irrigation and drainage facilities are provided, other crops also can be grown. It is to be noted, however, that the soil conditions in the swamp areas are essentially unfavourable for cultivation of deep root crops and will remain so for some time after completion of the Pilot Project.

211. Double cropping of paddy will not involve any particular problems as it is already practiced in a number of project areas in Trengganu State as well as in other states, and its farm management system has already established, though not to a fully workable extent. Since paddy can be grown under poor drainage conditions, its double cropping would be most compatible with the natural conditions in the swamp areas.

212. For the purpose of effective utilization of land and profitability of paddy cultivation, it is desirable that the paddy fields be so improved that water management can be controlled to the extent needed to regulate water supply sufficient for the growing stage.

213. Paddy plus short-term crops is one of the proposed cropping patterns in which short-term crops are to be planted during the dry season (off-season) lasting from April to September after harvesting the paddy during the monsoon (main season). Chillies, soybeans, groundnut, vegetables, tobacco and maize may be cited as suitable short-term crops for adoption under this cropping pattern as their planted areas are expanding rapidly in the whole of Peninsular Malaysia, and are also relatively large in Trengganu State. It must be noted, however, that the introduction of such short-term crops presupposes completion of satisfactory drainage works and improvement of soil conditions.

214. Regarding long-term crops, the introduction of deep root crops should be avoided, because their roots extend down to lower layers which could not be drained perfectly even if drainage canals were cut to a substantial depth. Long-term crops suitable for cultivation in swamp areas are those which are shallow root and exhibit a high growth rate. These will include pineapple, cashew nut, pepper and sago palm. Needless to say, these crops also call for the improvement of drainage and soil conditions, and because of their long growing period, also for exertion of constant care to prevent the fields from being submerged during the monsoon season.

215. Deep root crops such as oil palm and rubber are not suitable for introduction because of topographic and soil conditions in the swamp areas. It is therefore likely that the crops to be grown in swamp areas will be paddy, vegetables, commercial crops and shallow root perennial crops. In order to maximize the profit from minimum land, multiple management by rotation rather than management for single crop is advantageous as it will make it possible for farmers to distribute their family labor force efficiently throughout the year and realize more intensive land use. Especially in paddy field reclaimed areas, such combinations as paddy + vegetables, paddy + commercial crops and paddy + vegetables + commercial crops will yield a greater income than double cropping of paddy which has a rather low profitability. In due consideration of the peat soil in the Pilot Project area, however, for a certain period of time

after completion of the Pilot Project, the emphasis will be placed on double cropping of paddy. The proposed cropping patterns are illustrated in Fig. IV-2.

5. Proposed Farm Management

216. Swamp utilization will require a huge amount of capital investment because of the natural characteristics, conditions of the swamp areas and their locations. In order to enhance national land use through swamp utilization, it is necessary to study the various swamp conditions including soil, irrigation and drainage, and to make a careful review of the necessity, urgency and justifiability of development from the socio-economic point of view.

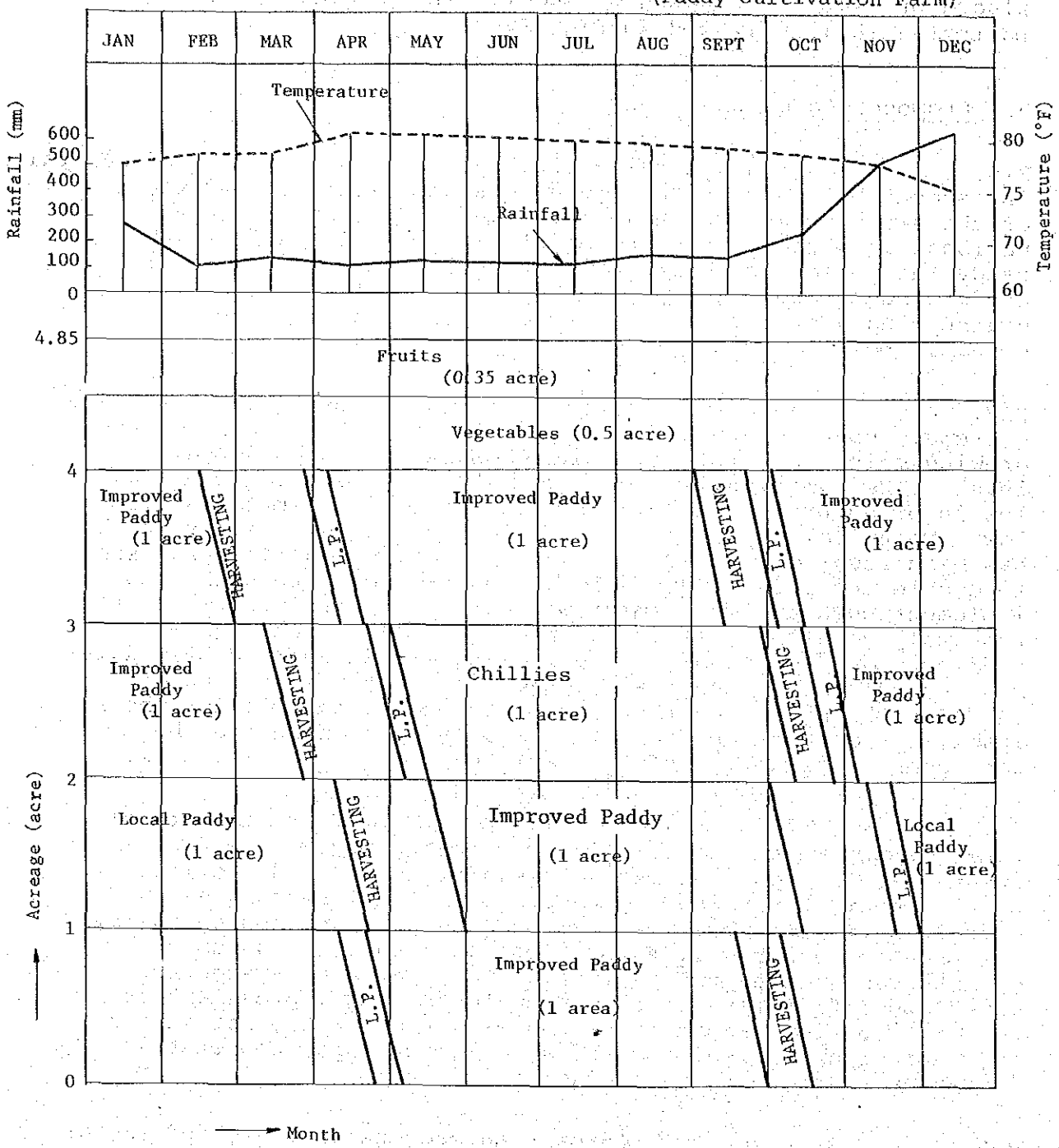
217. As already mentioned, farmers in Trengganu State are extremely poor relative to those in other parts of the country growing mainly rubber, paddy and coconut on a substantial level. The existing land infrastructure is just too poor and low in productivity, and the farmers' technical level is also low. Technical improvement including use of fertilizers which has been studied by MARDI to enhance paddy production promises to double the present yield level, but farmers are unable to implement such an improvement because their not income is just too small to allow them to purchase fertilizers and agro-chemicals due to the high intermediate margin charged by middle-men and brokers in the distribution of paddy. This lack of funds on the part of farmers seems to be responsible for their inability to purchase facilities for paddy milling and the consequent degradation of the marketed paddy.

218. Such being the situation, expansion of management alone is not likely to assist sound farm management and ensure satisfactory incomes unless efforts are made to introduce mechanized farming, to renevate cultural techniques and practices, and improve the farm produce distribution channels. Solution of the prevailing problems will call for a number of measures such as improvement of the guarantee system for vegetables, fruit and livestock products, and improvement of the distribution channels through expansion of the activities and agricultural credit services of agricultural cooperative societies and farmers' associations.

219. Settlement of farmers in such swamp areas and expanstion of their management activities through the swamp development project will not provide a solution to the existing poverty problems. The success of the Pilot Project depends on whether adequate measures are taken to improve management and distribution channels after settlement. It will only be when such measures are enforced successfully that settlers will be enabled to establish sound management, and this will lead to the solution

Fig. IV-2-1 Proposed Cropping Pattern - Type 1 -

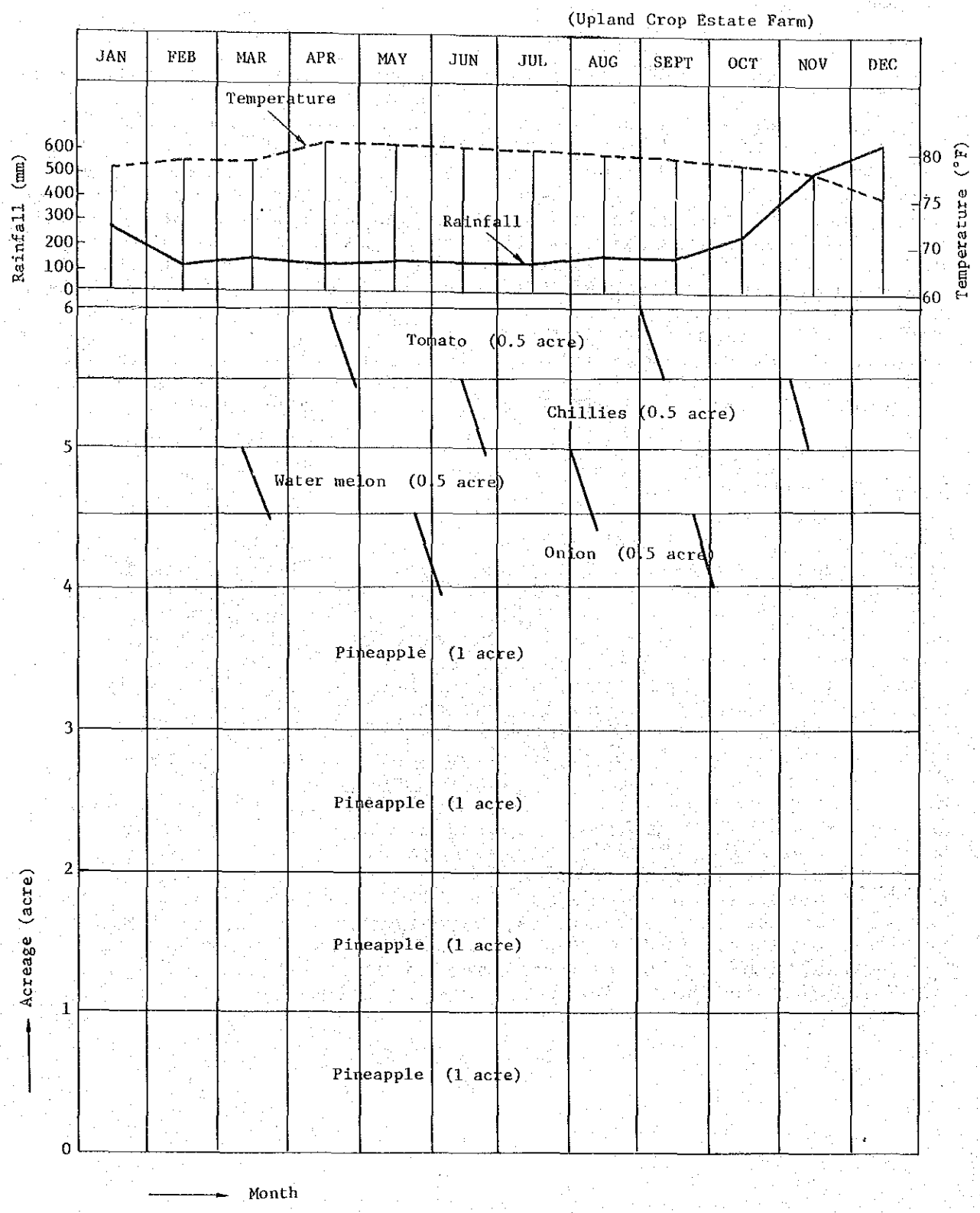
(Paddy Cultivation Farm)



Remarks: (1) L.P.: Land Preparation

(2) Chillies are selected as one of the representatives among various crops.

Fig. IV-2-2 Proposed Cropping Pattern - Type 2 -



of the poverty problems and at the same time make the Pilot Project fully justifiable from the viewpoint of the national economy.

220. In this Pilot Project, the area of a small-scale farms would be 835 acres, and that of two estate farms 4,032 acres in total. The area of a demonstration farm would be 467 acres. This Paddy fields of the Pilot Project are to be managed through the small-scale farms. The units of operational area on an estate farm for livestock rearing is to be 15 acres and upland crops 6 acres, taking the optimal scale of operation and utilization of available labor into consideration. On the small-scale farms, the area of paddy and upland crops per farmer is to be 4.85 acres. On the small-scale farms, each farmer will use water buffalo as his usable labor. At this stage, only part of agricultural operations such as threshing and rice milling are to be mechanized. In the estate farm for livestock rearing, operations are to be mechanized as far as possible. An outline of planned cultivation and livestock rearing on the estate farms and on small-scale farms is given below.

Small-scale farms

221. On small-scale farms, each farmer is to use his labor and the water buffaloes. Threshing and rice milling is to be done by agricultural machine in the agricultural cooperative. Each farm is to be prepare a beds for rice seedlings before cultivating their paddy field. The area of the bed for rice seedlings is to be about 1/25 that of the paddy field. Rice seedlings are to be cultivated in the bed for about 20 days, and rice seeds are to be sown at a rate of 14 kg per acre. Rice seedlings are to be planted manually. It is estimated that 20 farmers would be required per day one acre. Rice seedlings are to be transplanted into paddy fields after the tilling of the paddy with water to a shallow depth. Fertilizer and agro-chemicals should be applied and sprayed at the same time, if possible. Fertilizer would be applied manually in most cases. Irrigation water is to be controlled through a farmers' association throughout the Pilot Project area. However, at the tertiary canals, each farmer will control his irrigation water. Each farmer is to harvest his crops. The harvested paddy is to be threshed and milled by agricultural machine in the agricultural cooperative.

Estate Farm

Estate farm for livestock rearing

222. In the estate farm for livestock rearing, cattle and water buffaloes are to be reared. Cattle are to be reared in areas relatively higher above sea level and on the edge of the Pilot Project area. On the other hand, water buffaloes are to be reared on lowland areas.

223. The cultivation of forage crops should be mechanized as far as possible. However, forage crops for water buffaloes (including paddy as forage) are to be cultivated by water buffaloes and the farmer's workers.

Estate farm for upland crops

224. On the estate farm for upland crops, pineapple, groundnut, cabbage, water melon, etc. are to be cultivated. Although farm machinery are to be used for cultivation, these crops should be principally cultivated manually.

6. Production and Yield Projection

225. There are few statistical data available to project a realistic and comprehensive yield of all crops. Presented in Table IV-1 is the 10-year projected yield made for paddy, one of the main crops of the Pilot Project.

Table IV-2 Projected Yield and Production

No.	Year	Improved Paddy (main season) Projected Yield (ton/acre)	Improved Paddy (main season) Production (10^3 ton)	Improved Paddy (off-season) Projected Yield (ton/acre)	Improved Paddy (off-season) Production (10^3 ton)
1.	1980/81	0	0	0	0
2.	1981/82	0	0	0	0
3.	1982/83	0	0	0	0
4.	1983/84	0.72	265	0	0
5.	1984/85	0.76	280	0.81	448
6.	1985/86	0.94	346	0.99	457
7.	1986/87	1.02	376	1.03	597
8.	1987/88	1.21	446	1.28	708
9.	1988/89	1.25	461	1.32	730
10.	1989/90	1.30	479	1.37	757
11.	1990/91	1.37	505	1.44	796
12.	1991/92	1.44	531	1.52	840

No.	Year	Local Paddy (main season) Projected Yield (ton/acre)	Local Paddy (main season) Production (10^3 ton)	Total Production (10^3 ton)
1.	1980/81	0	0	0
2.	1981/82	0	0	0
3.	1982/83	0	0	0
4.	1983/84	0.7	129	394
5.	1984/85	0.72	133	861
6.	1985/86	0.75	138	1,031
7.	1986/87	0.78	144	1,117
8.	1987/88	0.81	149	1,303
9.	1988/89	0.85	157	1,348
10.	1989/90	0.89	164	1,400
11.	1990/91	0.96	177	1,478
12.	1991/92	1.00	184	1,554

7. Proposed Supporting Services

7.1 Agricultural extension programme

226. Irrigation development must be matched by new technologies to maximize return on investment. Since many of the new technologies will be unknown to farmers (settlers) as well as extension agents, a vigorous programme should be launched by the Ministry of Agriculture to introduce these technologies. Extension agents should undergo rigid preparation and training prior to the completion of the Pilot Project. Since the Sub-district Extension Workers available in the Dungun District are diploma holders, they will need further training. To ensure higher technical competence, Field Extension Workers who have certificate of agriculture will have to be dispatched into the field prior to the completion of the Pilot Project. Regular in-service training programmes should be established by the State Department of Agriculture, Trengganu.

227. For village farmers (settlers), a demonstration farm would be most appropriate. A demonstration farm should be situated at a strategic place to have a fast effect on neibouring farms and should be properly provided with personnel, facilities and other requirements to ensure success.

228. An information campaign with the use of mass media should be pursued. Radio programmes and information systems should be placed within the reach of the farmers (settlers) and their families. Housewives should also have their own special programmes. The information campaign should extend to the youth and school children.

7.2 Support services and programmes

229. Since agricultural improvement or rural development is the main target of the Pilot Project, a whole integrated rural development programme should be pursued. The Ministry of Agriculture, the Ministry of Land and Regional Development, the Ministry of Science, Technology and Environment as well as other government agencies to which are assigned the tasks of financing, technological development and transfer, marketing facilities development, rural organizational development, infrastructural development and maintenance, and others, should be coordinated through a special programme for the area. The State Department of Agriculture, other agencies concerned who have field men in the Dungun area should also coordinate their efforts to minimize duplication of functions and activities as well as integrate their activities under one organizational umbrella for the Pilot Project area.

7.3 Agricultural supplies and equipment

230. Good production can be attained only with the timely availability of materials in sufficient quantities. Thus, the Government should be prepared to support programmes for fertilizers and agro-chemicals procurement. There should also be a programme to make available high quality seed, tools and grain processing equipment. Initially, importation may have to be resorted to, but eventually, the Government and private enterprise should develop the capability to support agricultural needs. The Pertainan Malaysia Bank can help local investors build up these capabilities through special financing programmes. Incentives can also be given these investors to sustain their interest.

7.4 Credit facilities

231. Farmers may not be able to afford the inputs necessary for production and therefore liberal credit facilities must be made available on a package basis to ensure that all production inputs are provided for. The Pertanian Malaysia Bank can service the Pilot Project area. Credit may given on an individual basis or on a cooperative basis depending on the credit rating of these entities. A local bank can also play a role in servicing the needs of agricultural production in the Pilot Project area. This bank should be flexible enough deal both in cash and kind for both issuing and collecting.

7.5 Marketing and Processing

The marketing infrastructure will be bolstered under the Pilot Project by the implementation of the two market sheds and the construction of a 300-ton capacity central paddy godown and seven feeder godowns for upland crops as well as paddy located at strategic positions to accommodate the anticipated increases of crop production.

Apart from the above-said godowns, storages for oxen and buffalo beef, and aquafishes will be established in the Pilot Project area. These storages will be air-conditioned, and some of them are equipped with refrigerators.

For the beef production, a slaughterhouse will be established at a strategic position of the Pilot Project. The facilities are managed by the livestock estate farm, and the capacity will be 15 heads per day.

F. Proposed Livestock Industry

1. Beef Cattle

1.1 General

232. Of the downs and hills extending to the north-east of the Pilot Project area, slopes not steeper than 15° and part of the low land areas are to be used for the rearing of beef cattle. Stock rearing on the slopes will at once harden the land which is left uncared for as it is not suitable for cropping and can answer the growing need for beef. At the same time, it is expected to supply organic manure indispensable for increasing the fertility of the farmland within the Pilot Project area. It is planned to rear up to 1,100 heads in terms of mature cattle. For the purpose of efficient use of land and labor, an estate management system by KETENGAH should be adopted.

1.2 Proposed breeds

233. On account of the tropical climate, the breeds should preferably be resistant to heat and pests and feed on roughage. Given the present state of the art of animal husbandry and the methods of extensive grazing which will be detailed later on, the breeds should be ones that will meet the requirements specified above even if their yield is sacrificed a little, rather than the breeds which are easy to fasten, but which are delicate in breeding.

234. The Kedah-Kelantans are not so fertile; the adult cow weighs 270 kg, the daily average live weight gain is 250 g from ablactation to 2 years of age when the weight is 200 kg, and the nubility is as late as 44 months. As a compromise, it is recommended that Drought-Masters of a Cebu strain are selected, the adult cows of which weigh 400 kg and can be caived at the age of about 34 months, and which are highly tolerant to ticks and mites, or hybrids of Kedah-Kelantans and Drought-Masters.

1.3 Animal husbandry

235. Since the slopes and part of the lowland areas are grazing land, it is not logical to expect much grass product from there. Given available resources in terms of technology and labor, etc., low-density rotational grazing will be appropriate. For this system, the areas necessary per head can be calculated as follows:

Grass yield/head/day = 52.5 kg

236. Namely, the yearly amount of grass required is about 19.16 tons. In the case of grazing, all the grasses can not be turned to good account.

237. Partly because of hoof disease and partly because of excrement, pastures become infected, and availability will probably fall to 65 - 75%. Supposing that the grass availability is 70% and that the grass yield is 50 tons per ha per year, the number of heads which can graze per ha are as follows:

50 tons x 0.7 / 19.16 = 1.8 heads

238. Namely, the area required per head is calculated at 0.54 ha (= 1.4 acre).

239. For the purpose of rotational grazing, the cattle will be divided into 7 groups:

i) Nursing cows and sucklings;

ii) Calves of 6 to 10 months old;

iii) Heifers of 11 months old to before service;

iv) Heifers of suitable age of service, 16 to 18 months old;

v) Pregnant cows;

vi) Steers of 1 to 2 years old; and

vii) Steers of 2 to 3 years old.

240. Since the growth of grass differs between dry and rainy seasons, the grazing areas will be divided into 3 in the rainy season and into 7 in the dry season lots per group. Each group will move from one lot to another every 5 to 10 days. The number of lots is determined according to the following formula.

Number of lots = ((Number of fallow days)/(number of grazing days) + 1)) x (Number of groups)

241. When the grass is 20 to 30 cm high with much foliage and less stalk, it is the most suitable for grazing.

242. Herdsmen will be assigned to cattle groups. Each of them will care for 100 to 150 heads, though his coverage should depend upon his experience. The duties and responsibilities of the herdsman include moving the herd from one feeding ground to another, inventory-taking, inspection of pens and fences, checking anomalous cattle and control and management of watering places and licks.

1.4 Production plan

243. An area of 1,730 acres is to be assigned to the cattle breeding sector. Of it, 130 acres is to accommodate roads and control facilities. The remainder (1,600 acres) is for grazing. Since the area required per head per year is 1.4 acre, it will be possible to rear about 1,140 heads of adult cattle. It is therefore planned to graze 1,060 to 1,100 heads (in terms of adults) continuously.

244. The breeding stock (heifers, 600 heads; seed bulls, 40 head) will be imported from Australia. Healthy heifers of 13 to 15 months old or over will be singled out. Seed bulls should also be healthy and stark. They should weigh more than 320 kg and be over 20 months.

245. In each year from the start of breeding, the number of heads and total weight of shipments are to be as follows:

	Year						
	1st	2nd	3rd	4th	5th	6th	7th
Total number of heads	640	920	1,224	1,502	1,654	1,636	1,634
Livestock units	500	680	778	976	1,066	1,062	1,090
Total weight of shipments (ton)	-	9.90	20.70	29.00	97.82	133.72	122.58

2. Water Buffalo

2.1 General

246. The husbandry of water buffalo in Malaysia is outlined below.

(i) The number of water buffaloes has been decreasing for various reasons; a feed shortage, the widespread growth of double cropping of paddy which has caused a labor shortage for breeding and the lack of reed for draft animals (more rental tractors are being used for farming than previously).

(ii) A greater decrease in the number of male buffalo than female has changed the structure of breeding. Since it is difficult to determine the estrus and the suitable service period of water buffalo, a certain number of male buffaloes must be maintained for well-balanced open cross-breeding. However, this does not seen possible at present.

(iii) The number of who rears more buffaloes than cattle has decreased.

(iv) In the past, buffaloes were used for farming while they were young, and slaughtered when they became old. On the other hand, there is no need to use them for farming purposes at present, nor ever, rearing a small number of beef buffaloes are not profitable since their growth is slow as shown in the table below.

(v) Many farmers rear water buffaloes normally for their own consumption. Therefore, marketability is rather low.

(vi) Water buffaloes are mostly of local varieties with no improvement by breeding. It is the usual practice to rear several in a garden or on the vacant ground of a farm, rather than graze them on grassland.

Comparison of Cattle Types

	Kedah-Kelantan	Drought-master	Water buffalo
Adult weight (kg)	270 ∿ 350	400	450
24-month weight (kg)	200	350	350
First calving age (months)	44	34	48
Calving interval (months)	15	12	18 ∿ 21
Conception rates (%)	60	80	60
Replacement (years)	6	6	8 ∿ 10
Grass yield (kg/head/day)	30	52.5	52.5
Grass yield (ton/head/year)	11.0	19.2	19.2
Head per ha	3.2	1.8	1.8
Acreage per head	0.8	1.4	1.4

2.2 Animal husbandry

247. Water buffaloes are of local varieties. 494 acres (200 ha) of swamp areas at an elevation below 6.0 m are used for grazing water buffaloes. The total number of buffaloes that can be grazed in the area would be 310 heads in livestock units.

248. The number of heads per unit area is the same as that of cattle. Meat yield for buffaloes is, however, lower than

that for beef cattle since buffaloes are not so fertile as cattle. The meat yield ratio for buffaloes is given below together with that for beef cattle:

No. of cattle calvings: $\frac{(6x12)-(34-12)}{12} = 4.2$

Meat yield: $\frac{(1+4.2)x400}{6} = 347$ kg/year/head

No. of buffalo calvings: $\frac{(8x12)-(48-18)}{18} = 3.7$

Meat yield: $\frac{(1+3.7)x450}{8} = 264$ kg/year/head

Meat yield ratio: $\frac{\text{buffalo}}{\text{cattle}} = \frac{264}{347} = 0.76$

249. The number of heads and the total weight of meat for each year are as follows:

	Year						
	1st	2nd	3rd	4th	5th	6th	7th
Livestock units (head)	143	194	222	279	305	303	311
Total weight (ton)	-	2.41	4.39	5.99	21.14	29.17	26.61

2.3 Grassland

250. The same standards as for cattle should be applied to the development of grasslands. A variety of grasses which can grow in marshy areas and adapt to various soils, such as African Star, Para and other similar types should be introduced together with local varities of rice.