MALAYSIA

1. PHYSIOGRAPHY

Malaysia covers an area of about 329,758 km^2 occupying the Malay Peninsula, which lies on the southern shores of the Asian land mass, and the States of Sabah and Sarawak in the north-western coastal of Borneo Island. The two regions are separated by about 531 km of the South China Sea. Peninsular Malaysia, covering 131,598 km^2, has its land frontier with Thailand to the north, and is connected to Singapore by a causeway in the south. The State of Sabah covering 73,856 km^2 and the State of Sarawak covering 124,989 km^2 border the territory of Indonesia's Kalimantan and has land frontiers with the two enclaves which make up Brunei.

Peninsular Malaysia consists of steep hills and mountain ranges, rolling to undulating land the coastal and riverine flood plains. The hill and mountain ranges cover about one-third of the plain surface of the Peninsula and run more or less parallel to the long axis of the country. The rolling to undulating land is found generally an the seaward flanks and the intervening areas between the mountain ranges. Although not very extensive coastal plains and alluvial terraces are found from 15 to 65 km inland from the coast with levels rising to 75 m above mean sea level. The riverine flood plains are found as narrow belts of alluvium gently sloping away from the major rivers. Towards the coast they merge with the marine alluvium of the coastal plains.

Sabah is surrounded on three sides by seas. The physical pattern consists of narrow alluvial coastal plains backed by hilly, forested areas. The mountain of the interior have acted as barriers to inland penetration. The coastal plains and river valleys consist of marine and fluvial alluvium. Although the coastal plains form a small proportion of the total area they are the most important parts of the State in terms of settlement and agricultural and economic development.

Sarawak consists of a flat and swampy coastal area and steepy undulating hills in the interior. The coastal plains comprise deep peat and muck soils, and at various points along the coast "raised beaches" occur some distance inland from the coastline.

2. CLIMATE AND RAINFALL

Malaysia lies near the Equator between latitude 1° and 7° North and between longitude 100° and 119° East. The country is subject to maritime influence and the interplay of wind systems, which originate in the Indian Ocean and South China Sea. The year is commonly divided into the south-west and north-east monsoon seasons.

The climate of Malysia is hot wet equatorial. The important features of the climate are the continuous warm temperatures and the seasonal distribution of rainfall. Mean daily temperatures range from 21°C to 32°C in the lowlands throughout the year. Cooler temperatures prevail at the higher altitudes. Variation in rainfall distribution is the most significant environmental variable. Generally, most if not all parts of Malaysia experience moisture deficits during one or more periods of the year. Conversely, excessive rainfall could occur, and this may physically restrict agricultural activities.

There is considerable variation in the averages of annual and monthly distribution of rainfall by location. The average annual rainfall ranges from 1,500 mm to 4,000 mm with the states of Sabah and Sarawak about 20 % to 40 % more rainfall than Peninsular Malaysia.

3. POPULATION AND SIZE OF HOLDINGS

The total population of Malaysia was 23,266,000 in 2000. Of this, 18,537,800 people were in Peninsular Malaysia, 2,656,400 in Sabah and 2,071,800 in Sarawak. At present rates of growth the population is estimated to be 28,142,000 in the year 2010.

The manufacturing sector holds an important position in the Malaysian economy. It provides employment for nearly 46.9 % of the working population, generates approximately 8.5 % of the gross domestic product.. The population actually engaged in agriculture in 2000 was about 1,060,676.

The size of land holdings in Malaysia is small. The average sizes of farms are about 2 ha in Peninsular Malaysia, 3.5 ha in Sabah, and 8 ha in Sarawak. In Peninsular Malaysia one-third of the farms are below 1.5 ha, whereas in Sabah and Sarawak one-half and one-third of all farms, respectively, are below 2 ha.

4. LAND RESOURCES

Tropical Rain Forest occupies less than 60 % of Malaysia's land area and these are found mainly in the hills and mountains. The potential areas suitable for crop development based on schematic reconnaissance soil surveys total 4,010,933 ha are under cultivation. The major crops under cultivation are rubber, oil palm, paddy and coconut which cover 1,432,567 ha, 2,039,513 ha, 357,734 ha and 115,717 ha respectively.

The major soils of Malaysia include acrisols, ferralsols, fluvisols, gleysols, luvisols, nitosols, lithosols, regosols, combisols and histosols. The most extensive are lithosols, regosols and combisols which occupy 58 % of the land area. These include the shallow soils of the highlands, most of which are not utilised for agriculture, and the regosols of the alluvial plains. The acrisols and the ferralsols make up the major agricultural soils of the country. The fluvisols and gleysols are important in that they are being extensively cultivated with rice. Most of the sedentary soils with topography up to 20° slopes are cultivated with perennial crops such as rubber, oil palm, cocoa, spices and fruit tree. Peat and organic soils cover approximately 2,700,000 ha. Only a small proportion has been developed for agriculture due to several serious physical and chemical limitations of the soils. Presently, pineapple is the only crop which is recommended for extensive cultivation on peat, although rubber, oil palm, coconut and coffee have also been planted on peat soils but yields of these crops are often poor. Peat with depth greater than 1.5 m is considered unsuitable for tree crops. Part of the country is covered by 'bris' soils. These soils are derived from marine sands and have extremely low inherent soil fertility. Coconut, cashew and fruits are grown on the soils, and with some supplementary irrigation tobacco, groundnut, vegetables and watermelon are also cultivated. When economical methods to ameliorate the soils are available they could become potential areas for future agricultural development.

5. WATER RESOURCES

Rainfall generally occurs throughout the year, but there is some concentration due to the North-East and South-West monsoons. The mean annual rainfall averages about 2,300 mm, while the annual potential evaporation averages about 1,500 mm.

The total annual surface water resource is estimated to be 566,000 million m^3 per year and of this 26 % is in Peninsular Malaysia, 54 % in Sarawak, and the remaining 20 % in Sabah. Groundwater resource is estimated to have a safe yield of 14,700 million m^3 per year in Peninsular Malaysia, 5,500 million m^3 per year in Sarawak, and 3,300 million m^3 per year in Sabah.

The present annual total consumptive use of water is estimated to total 10,400 million m^3 for irrigation. 4,900 million m^3 for domestic and industrial water supply. On the whole, Malaysia has sufficient water resources for development to meet all the demand provided there is proper water resources development, conservation and management.

6. BRIEF HISTORY OF IRRIGATION AND DRAINAGE

6.1 Irrigation

Rice is believed to have originated in South-East Asia. It is said to have spread northwards and westwards through Asia and southwards through the Malay Archipelago. There is little evidence of the date of introduction into Malaysia, but it seems likely that is was grown near the settlements along the trade waterways of Malaya at least two thousand years ago. Some form of water conservation for irrigation purposes was practiced from the earliest times and there is some evidence of use of brushwood dams as far as two hundred years. The Wan Mat Saman Canal, which was built in 1888 was perhaps the first well planned attempt to provide effective controlled drainage for the fertile plains in the North. In the riverine areas, brushwood dams were entensively used for harnessing water for irrigation purposes. The water wheels, ingeniously contrived by attached bamboo pipes to the periphery of wheels, were used to lift water to higher areas which could not be irrigated by gravity.

In Sabah and Sarawak, hilly paddy has been cultivated using the traditional "shifting, slash and burn" method from the 18th century.

In 1889, the first suggestion were made for irrigation works on a large scale at Krian in the state of Perak. Further investigation followed and in 1889 work commenced on the Bukit Merah Scheme. This scheme comprising a dam utilizing the flow of two rivers, the Sungai Merah and the Sungai Kurau, together with 26.5 km of main and 66.5 km of branch canals was completed in1906. With the formation of the Drainage and Irrigation Department in1932, it was realized that in order to ensure against frequent crop failures and in order to further promote rice cultivation, some effective form of water control was necessary. Irrigation schemes were constructed to serve both existing and new areas and the technical requirements for such schemes went through several stages of development. The initial stage of irrigation development was to provide a system of controlled drainage in existing cultivated paddy land. Whereas the abundant and well distributed rainfall in the country normally provides sufficient water for plant growth if fields ridges *(batas)* are constructed to retain it on the land, the difficulty encountered was to drain off excess water at the time of harvest. Controlled drainage systems provide some level of water control especially for the coastal areas, where the slope of the land is normally flat. Along Sg. Pahang, many *"paya"* were formed by the silting of the river and the building up of its banks to a level higher than the country inland.

These *"paya"* are usually depressions lying between the foothills and the river banks and having such small catchments that water for irrigation is scarce. For such areas, an "inundation" system of water control was introduced for paddy cultivation. Low earth embankments together with control gates and flood spillways were constructed across the valley and thereby inundate the *"paya"*.

Whilst the controlled drainage and inundation systems provided some means of water contol, these were at best rudimentary. Gradually, such schemes were improved with the provision of "positive" irrigation facilities whereby water is diverted from a river into a system of canals commanding the paddy lands. During this period up to the mid fifties, new areas, such the Krian, Sg. Manik, Tg. Karang and Kubang Pasu Schemes, were reclaimed and provided with irrigation facilities for paddy cultivation.

After the Independence in 1957, the emphasis in irrigation development shifted to increase the income and employment opportunities of the rural poor. One positive method was by increasing the production of rice and hence income with the planting of two crops of paddy where only a single crop had been planted before. With the advent of double cropping, the main task for the Department was the development of a reliable water supply for the second crop, which must of necessity be planted during the period in the year when rainfall is low and riverflows are correspondingly less. This involved the construction of storage reservoirs, river barrages, pumping stations and the upgrading of existing irrigation systems. By 1975 all major rice growing areas were equipped with irrigation facilities to enable double cropping to be carried out. These included the Muda, Krian, Sg. Manik, Tg. Karang, Besut and Kemubu areas, totaling some 190,000 ha. New areas, such as, the Trans-Perak Stage I and parts of Stage IV, were also reclaimed for double cropping of paddy.

Presently, agricultural development in the country emphasis an integrated approach involving consideration of engineering, social, agronomic, cultural and economic factors. Irrigation provides the basic favourable environment for the other components to be successfully introduced. The physical irrigation infrastructure to be provided includes the tertiary irrigation and drainage systems and farm roads. Since the Third Malaysian Plan (1976-1980) large irrigation projects, such as, Muda, Krian/Sg. Manik, Barat Laut Selangor and Kelantan Utara, and planned and implemented based on this integrated approach.

6.2 Drainage

Prior to the twentieth century, very little was done in respect of agricultural drainage except for the cultivation of paddy. Land drainage for agricultural crops other than paddy was carried out independently by estate owners and small holders of coconut, rubber and other crops, to serve their limited purpose and, consequently, there was little or no co-ordination effort. These early reclamation works were constructed through communal effort whereby the land was protected from tidal inundation by an earth bund constructed along the coast. However, these were rudimentary and inadequate, and together with the lack of proper maintenance they failed in time. Destruction of inland cultivation thus occurred and large areas of coconut, rubber and small-holder crops were adversely affected.

With the formation of the Drainage and Irrigation Department in1932, planned drainage works to rehabilitate and consolidate the early reclamation works were intensified. The Department took over the maintenance of drainage works on an estate of 40,000 ha and small-holder lands in Selangor and Perak. Reconstruction of these works and their extension raised the total area to about 80,000 ha in 1942. Large tracts of inland swamps were reclaimed for agricultural

development; and by 1957 the total drained area was 140,000 ha. Greater progress was made after Independence, and by 1975 the total drainage area reached 350,000 ha. This is expected to increase to 476,000 ha by 1982. Drainage schemes protect and prevent damage or destruction to agricultural crops such as, coconut, rubber, oil palm, cocoa and coffee which are widely cultivated in reclaimed lands. However, the provision of drainage facilities alone would not be sufficient to improve production and consequently yield incomes to the desired extent. To achieve this, agricultural support measures – such as, replanting with high yielding variety and intercropping as in the case of small coconut holdings – are required to be implemented at the same time. The present development of large drainage areas proceeds along an integrated approach, involving various agencies. Projects planned and implemented like the West Johore, Nonok, North-West Selangor, and Bagan Datoh, are notable examples of integrated projects currently being undertaken.

7. IRRIGATION AND DRAINAGE METHODS USED

Paddy is the only crop for which extensive irrigation facilities are provided. The method of irrigation is basically basin irrigation where small ridges surround individual lots in which paddy is grown in a depth of standing water. The total area covered by irrigation is currently 660,000 ha out of which 609,000 ha are double cropped. A number of small farms use furrow and sprinkler irrigation vegetables and tobacco, but these areas are too small. Figure 1 shows a water wheel used for irrigating small paddy fields.

Figure 1. Showing a water wheel – An indigenous method of raising water from streams for irrigation of small paddy areas.

Early drainage works involved the construction of coastal embankments to prevent saline water intrusion and the provision of facilities to allow removal of excess rainfall and runoff. Later, works in addition to reclamation were directed towards drainage improvement to permit intercropping. Presently, about 600,000 ha are provided with drainage facilities, based generally on a composite system. The major crops cultivated in these areas are coconut, rubber, oil palm, spices, pineapple and other cash crop.

Figure 2 shows the major drainage and irrigation areas.

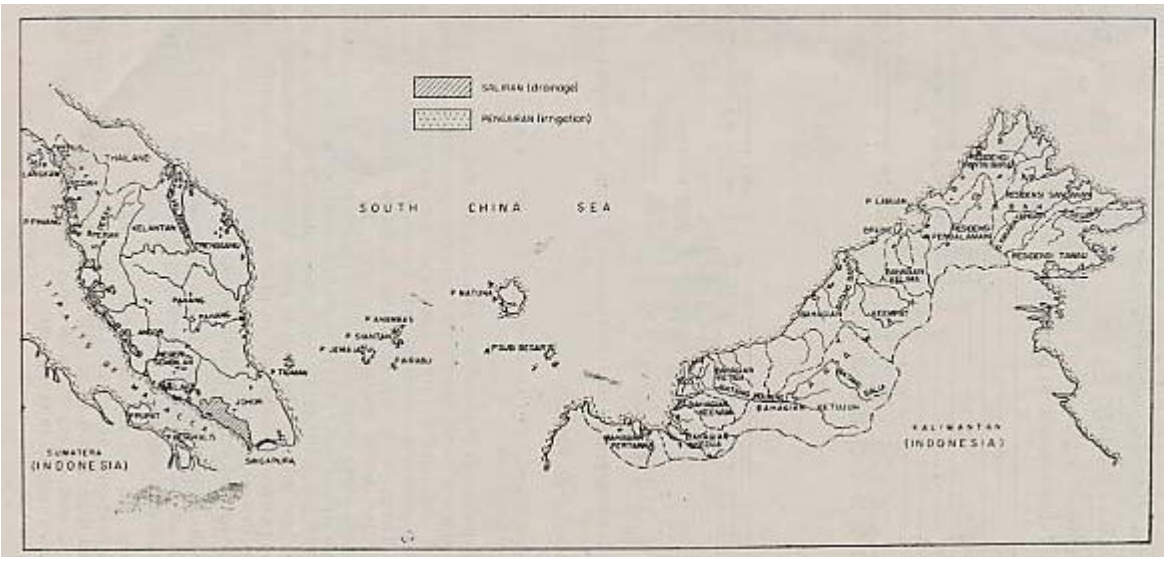

Figure 2. Showing major drainage and irrigation areas (1999)