CHAPTER THREE THE PHYSICAL ENVIRONMENT OF THE STUDY AREA

3.1 Introduction

The nature and efficiency of multi-layer tropical rain forest canopy in intercepting the direct splash of raindrops and reducing its kinetic energy, before hitting the forest floor, has been noted in several studies. (Peh,1976; Morgan,1974;Lal,1977). With nearly no direct impact of rainfall onto the forest floor, except for the drops generated within the forest canopy itself that subsequently hit directly onto the thick layer of litter and humus, soil compaction under the forest is expectedly a very slow process (Greenland,1977). In plantations, such as those cultivated with rubber and oil palm, the same condition is hardly detected, especially in the case of young plantations. Areas consisting of bare soils are expectedly the ones in the most unstable condition. Variations in their physical appearance would be especially evident during the wet season when the process of erosion, compaction, channelisation etc occurs at markedly higher rates.

In this study, it is envisaged that micro environmental differences, both between and within study areas, would be of considerable significance in affecting the nature of the infiltration process. For this reason, the physical characteristics of the study areas are investigated in some detail in this chapter.

3.2 Location of the Study Areas

The Felda Gedangsa and Bukit Belata Forest Reserves study areas are located at latitude and longitude of L 03 43'N, Lg 101 24'E and L 03 43'N, Lg 101 25'E, respectively. These study areas are located in the District of Hulu Selangor, in the State of Selangor, West Malaysia.

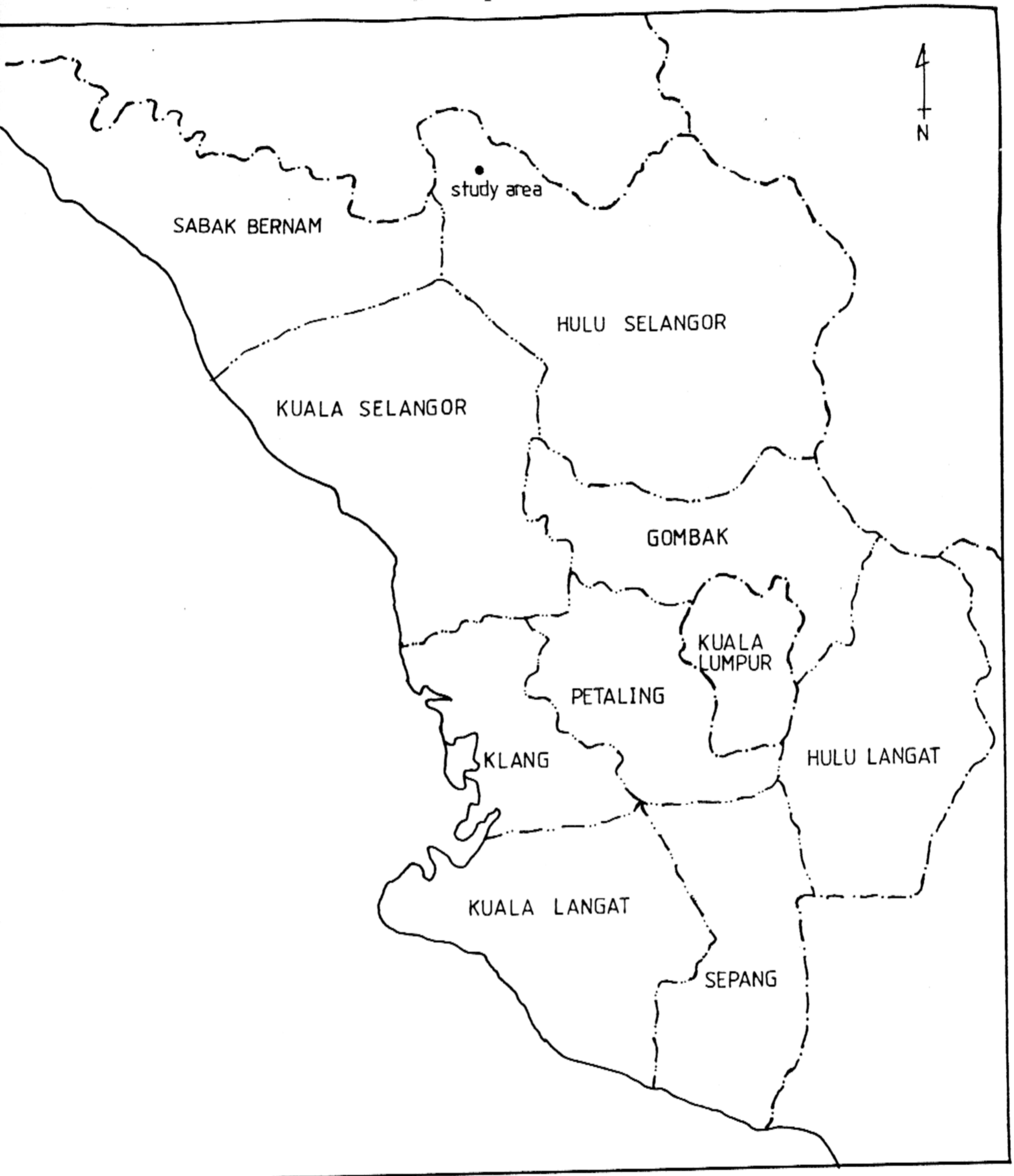
A map showing the position of the District of Hulu Selangor and the detail locations of the study areas are given in Map 3.1, Map 3.2 and Map 3.3, respectively.

In general, the areas are situated at about 120 km to the North of Kuala Lumpur, and the nearest towns by road are Behrang Stesen (5 km), Tanjung Malim (15 Km) and Kuala Kubu Bharu (28 Km).

3.3 The Climate of the Study Areas

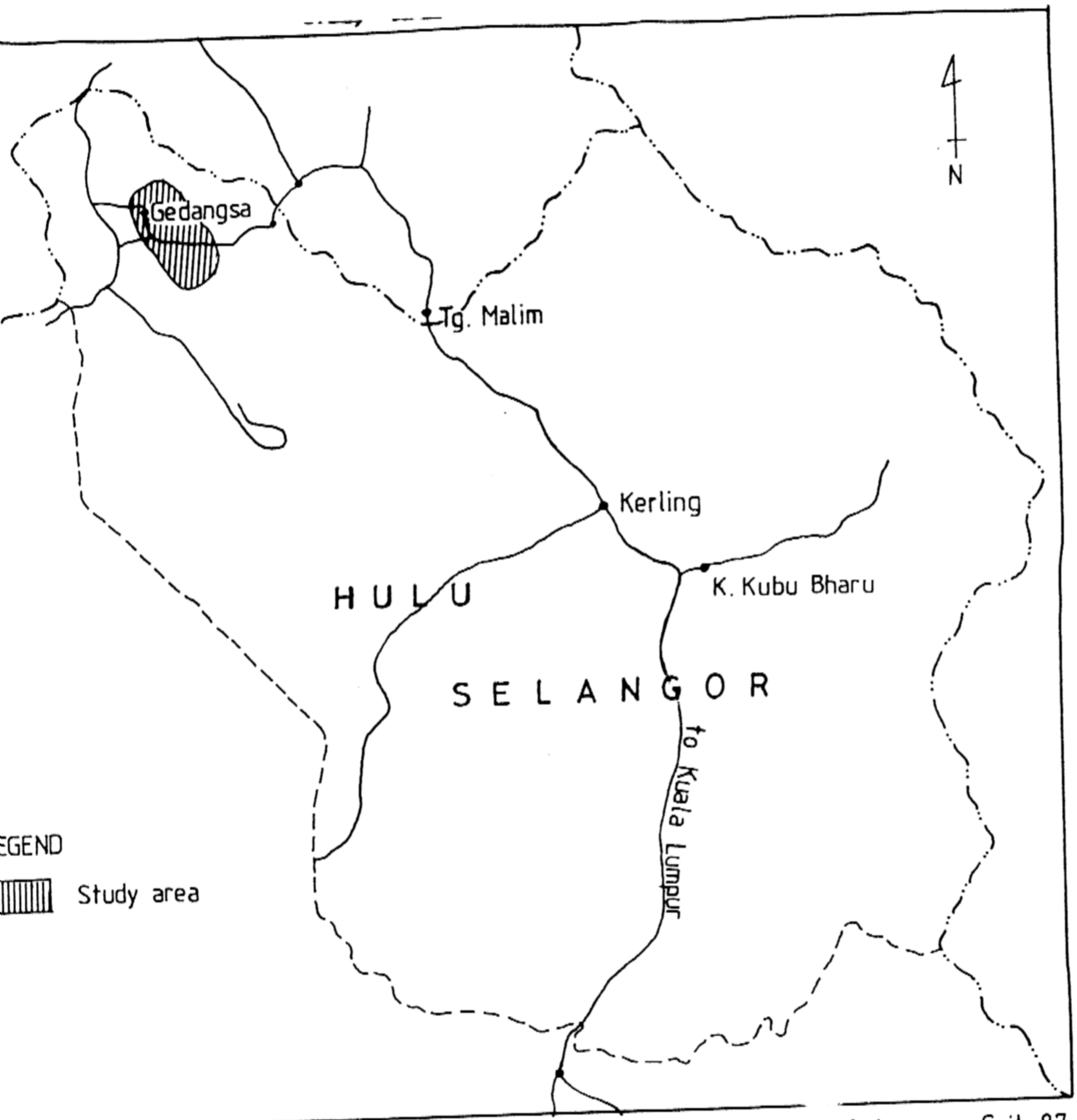
The climate of the study areas reflects in general the climate of Peninsular Malaysia. The climate of Peninsular Malaysia has been described as equatorial and is characterized by high average annual rainfall, temperature and humidity (Dobby,1953;Ooi,1964). The climate is affected by the movements of the South-east Asian monsoon system and moves locally through marine influences and physiography (Dale,1960).

Map 3.1 : The Location of Hulu Selangor and the Study Area

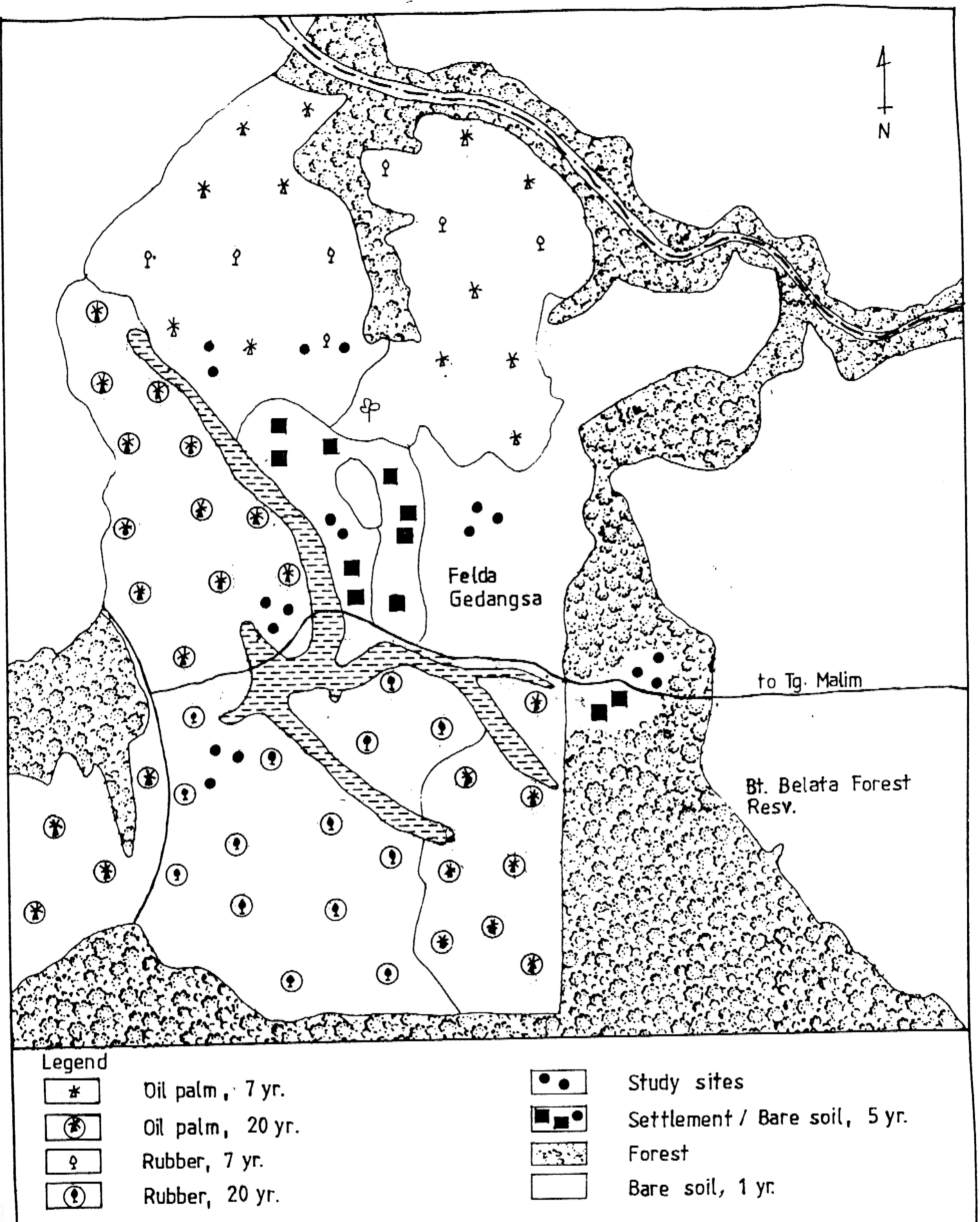


Source : soil Map of Malaysia, 1976

Map 3.2 : A Map of Hulu Selangor Showing the Location of the Study Area



Map 3.3 : Various Landuses of the Study Area



Source : This study / 1993.

3.3.1 Rainfall

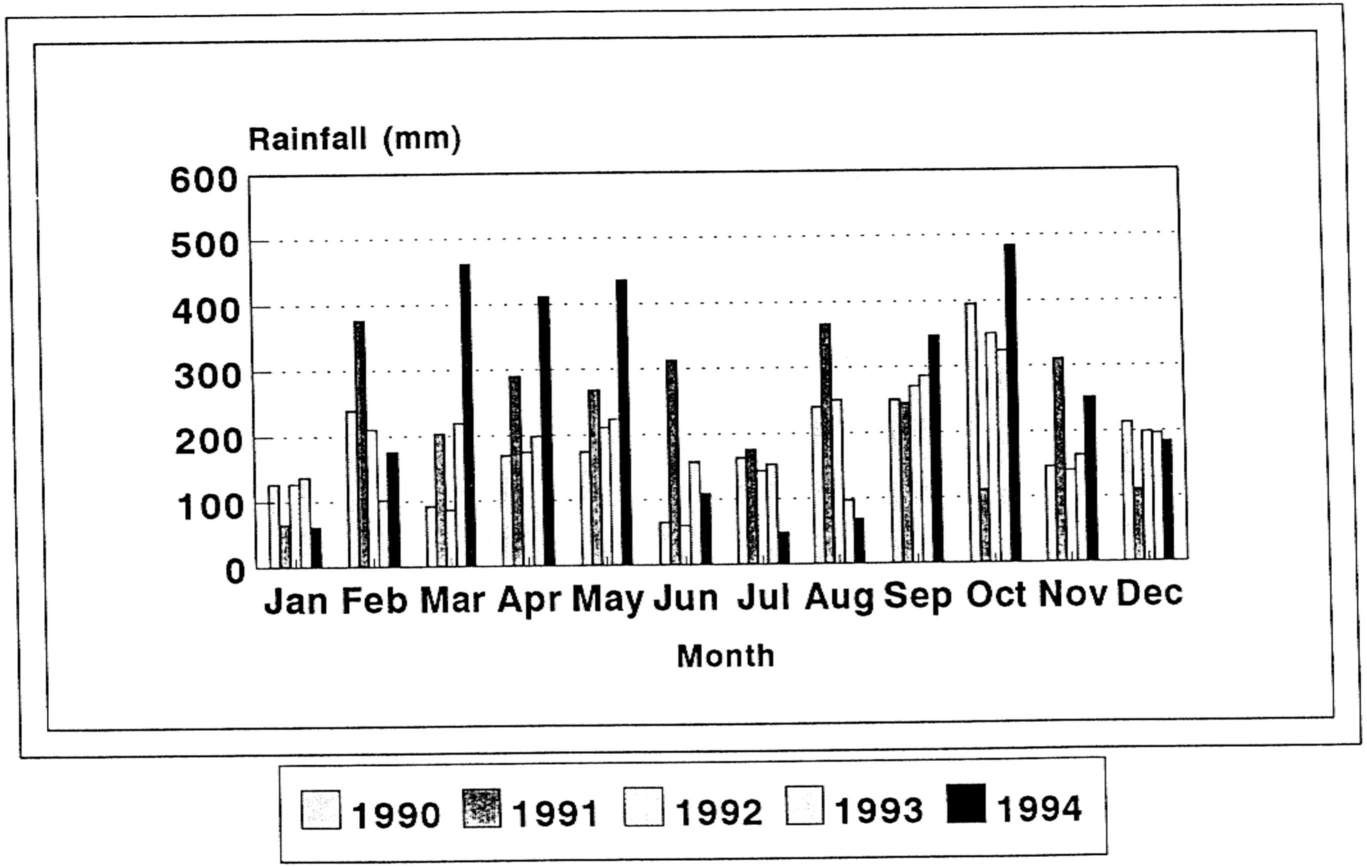
In contrast to the lack of seasonality in temperature, the incidence of rainfall in Peninsular Malaysia follows the pattern of distribution which corresponds to the seasonal reversals of the South-East Asian monsoon system (Dale,1960). The South-East Asian monsoon consists of two monsoonal and inter-monsoonal periods. From November to early March, North Easterly winds prevails over the peninsula. This period is locally referred to as the North-East Monsoon.

At the end of the North East-Monsoon, there is a transitional or inter-monsoonal period of weak and variable winds which coincide approximately with the month of April or early May. This is followed by South-Westerly winds from May to early October which constitute the South-West Monsoon.

An inter-monsoonal period of weak and variable winds occur at the end of the South-West Monsoon which coincide approximately with the month of October and early November (Dale,1959)

The average annual rainfall at study areas for a period of 20 years (1971-90)is 2698 mm. Figure 3.1 show the rainfall pattern of the study areas, based on the rainfall data collected at Tanjung Malim Meteorological Station, which is located about 15 km from the study areas.

Figure 3.1: Monthly Rainfall of the Study Areas (1990 - 1994)



Source: Tg.Malim Meteorological Station

Map 3.4 shows in general the pattern of distribution of annual rainfall of Selangor for a period of 35 years (1950-85).

3.3.2 Temperature

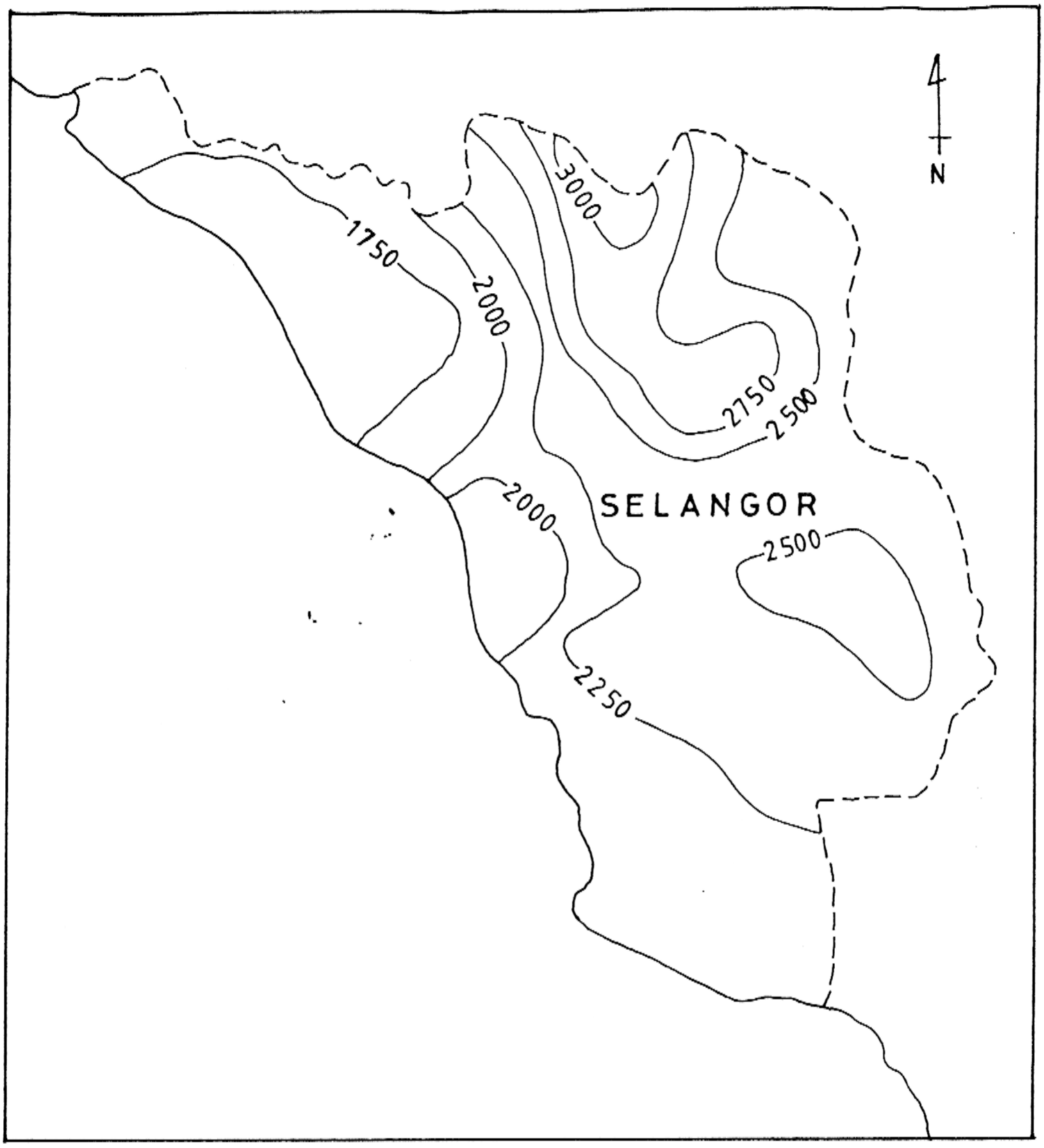
In general, temperatures are high. At Tanjung Malim, which is the nearest meteorological station to the study areas, mean monthly temperatures range from 26.1°C to 28.8°C. Figure 3.2 shows graphically the pattern of monthly temperature of the study areas in the period between 1990 to 1994.

The annual range of temperature is very small because there is no seasonal difference in temperature in the equatorial region (Dale,1963). Maximum daily temperatures in the lowland regions of Selangor are often above 27.5 °C while minimum temperatures are close to 26 °C, giving a mean annual temperature of about 27 °C. The foothill region is cooler, with the mean annual temperatures approaching 26 °C.

3.3.3 Relative Humidity

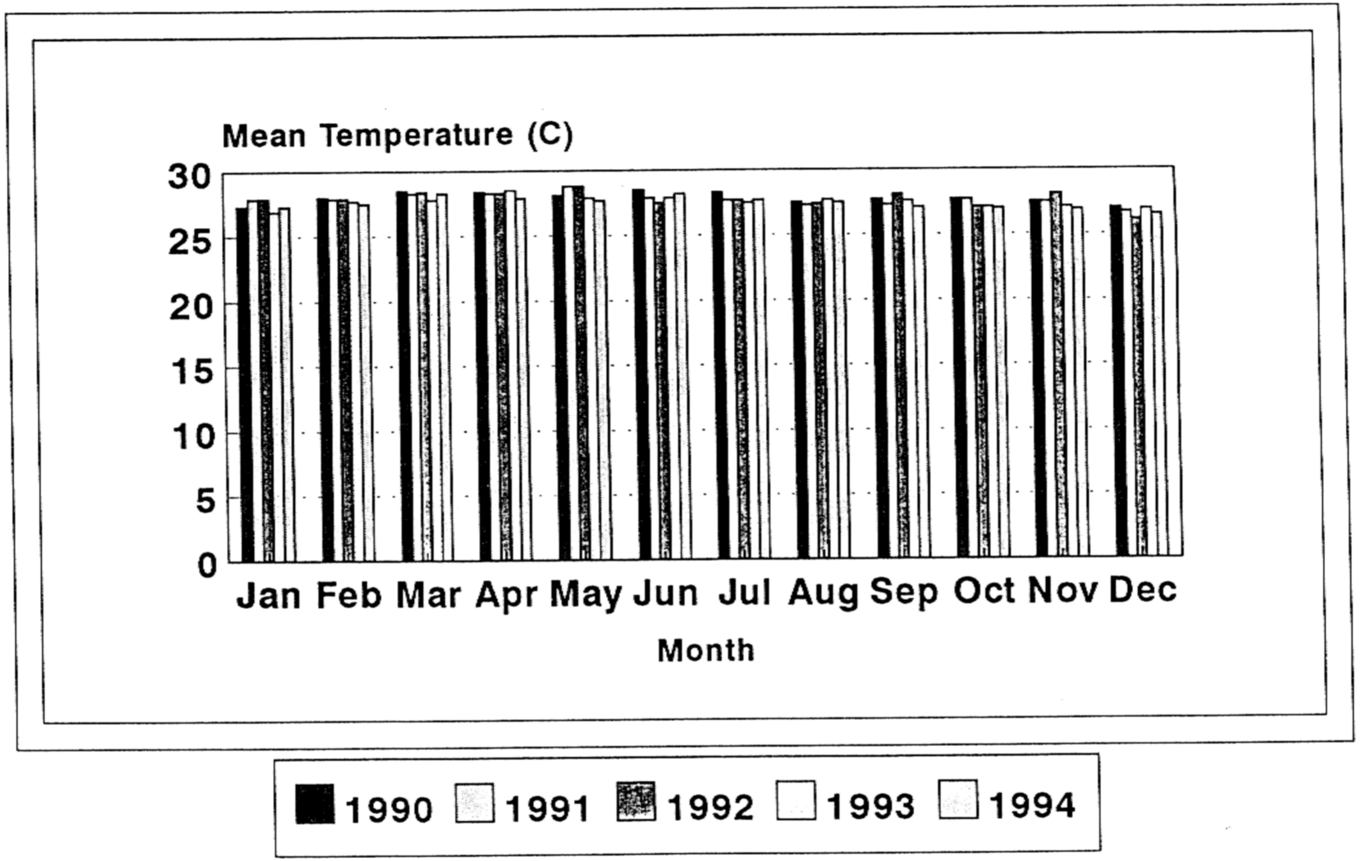
According to Wong (1966), the daily humidity of Selangor is high and often reaches 100%. But, as shown in Figure 3.3, the mean relative humidity (%) of the study areas at 0700 ST often reaches 95%.

Map 3.4 : Annual Rainfall Pattern of Selangor (1950-85) - mm.



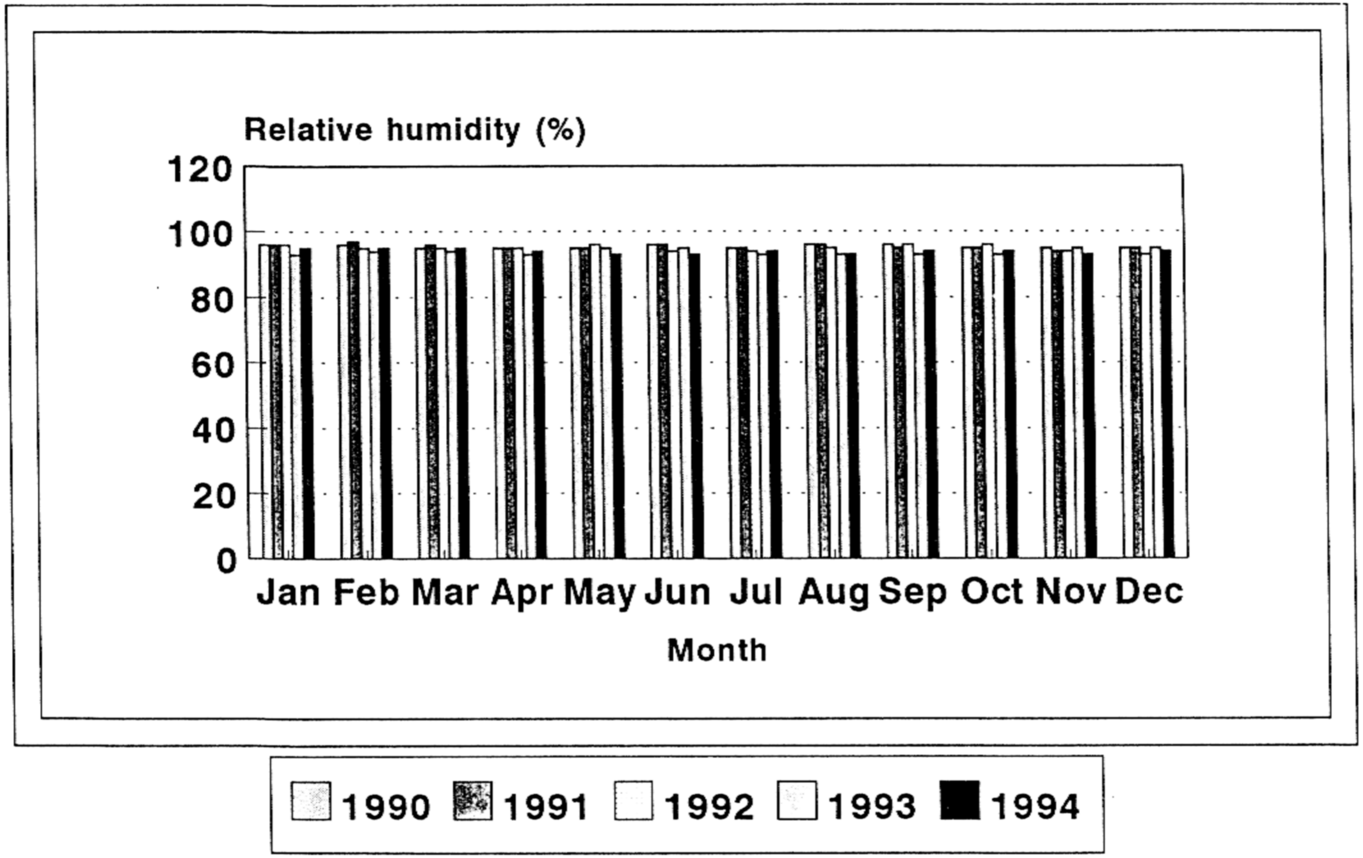
Source : D.I.D , No. 142/88

Figure 3.2: Monthly Temperatures of the Study Areas (1990 - 1994)



Source: Tg. Malim Meteorological Station

Figure 3.3: Monthly Relative Humidity at 0700ST of the Study Areas (1990-1994)



Source: Tg. Malim Meteorological Station

3.4 Geology of the Study Area

The geology as shown by Map 3.5 indicate that the study areas are composed of rocks of the Devonian era, in which phyllite, slate, shale, limestone and sandstone are locally prominent. There are also some inter-beds of conglomerates, chert and rare volcanics.

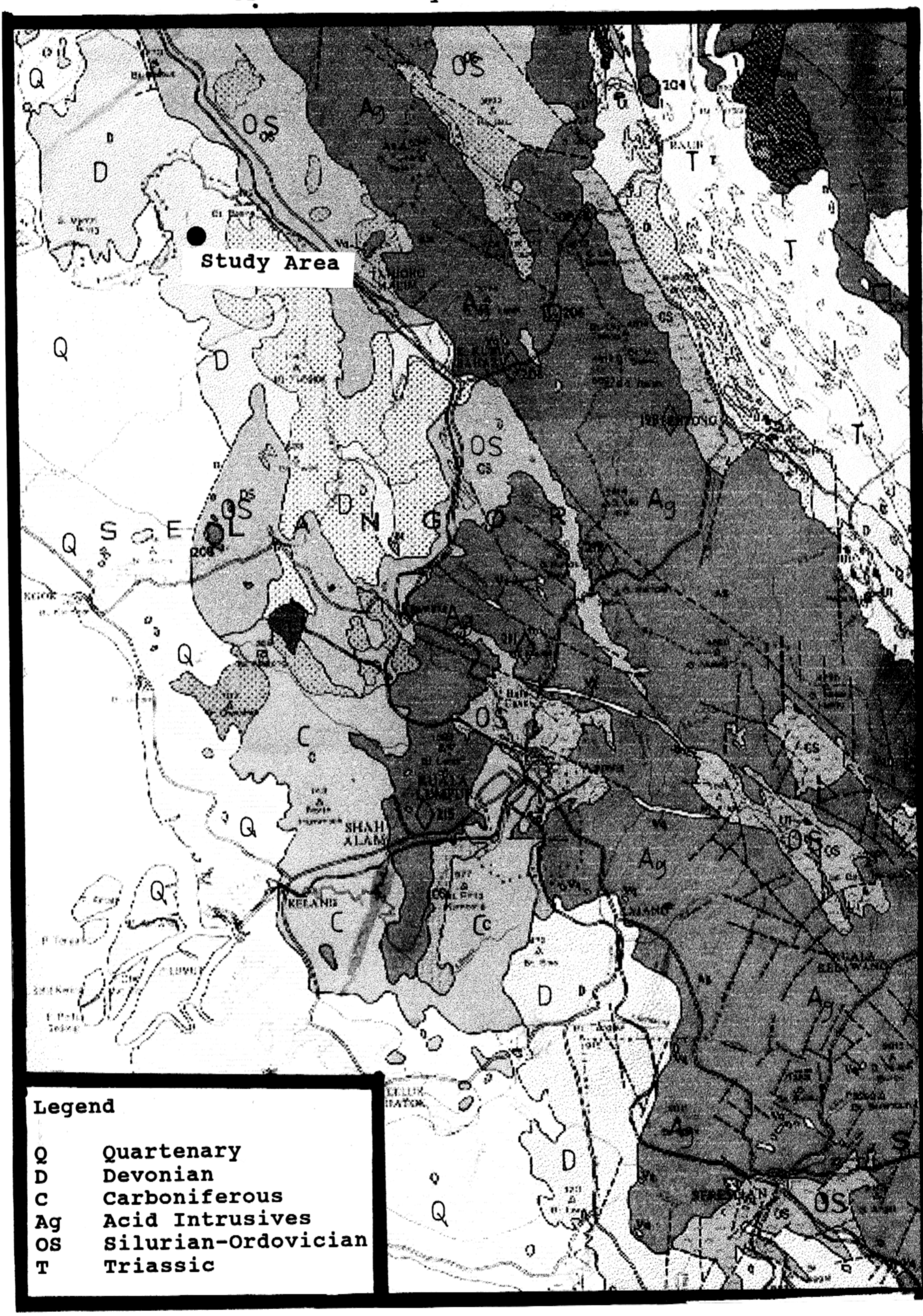
3.5 Soils of the Study Areas

Based on the soil type distribution shown in Map 3.6, the study areas mainly consist of red and yellow latosols and red and yellow podzolic soils. They are found on gently to strongly sloping lands of variable fertility derived from a variety of sedimentary rocks.

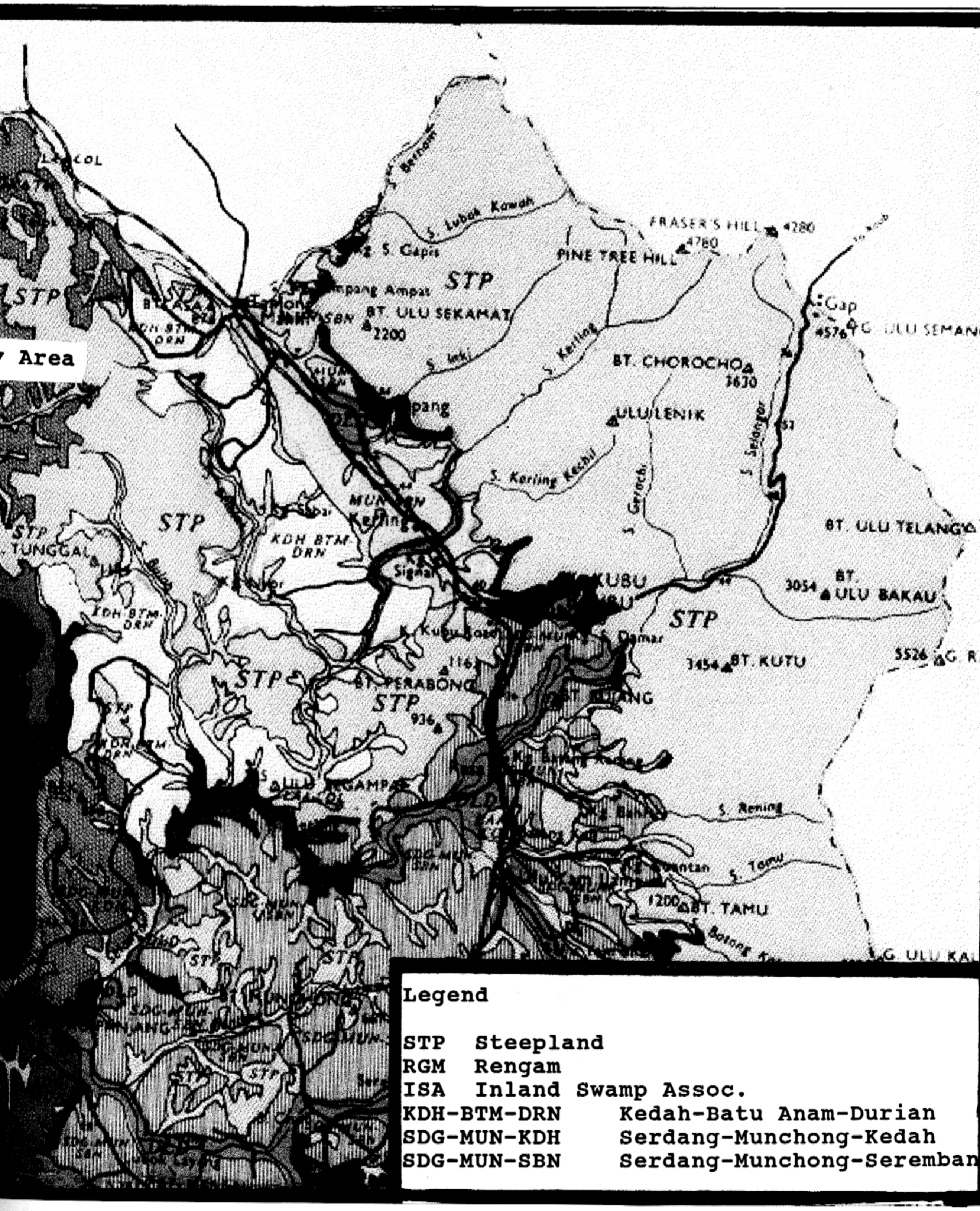
Fine to coarse-grained granites underlies the foothills and mountainous country. The majority of the area has a granitic soil cover consisting of fine to coarse sand and clay. The depth of the soil cover is generally only a few metres but greater depth may be encountered in areas of intense weathering.

In term of soil series, the study areas consist of soils of Serdang-Munchong-Kedah Association (Map 3.6). A larger unit of soil classification was found necessary for the study areas (i.e the soil association, rather than soil series) due to the difficulties encountered in mapping separate series

Map 3.5 Geology of the Study Area



Map 3.6 Soil Types of the Study Area



of soil at reconnaissance level.

A soil association consists of a group of two or three series of soils geographically associated in a defined proportional pattern. Description on soil series which make up the Serdang-Munchong-Kedah Association is discussed separately in this chapter.

3.5.1 The Serdang Series

This is the most extensive soil series in Selangor. It is developed on quartzites, sandstones and sandy shales; often the underlying rock has intercalations of silty and micaceous shales and phyllites. The soil of this series occurs on undulating and rolling to hilly land (4^0-20^0) but mainly on rolling terrain (6^0-12^0); as the terrain becomes steeper the Serdang series soils grade into the shallower soils of the Kedah series.

The top soil is 2.5 - 5 cm thick under jungle conditions; it is dark greyish brown (10YR 4/4) to dark brown (10YR 4/3) in colour, sandy loam to sandy clay loam in texture with friable consistence and moderately developed medium crumb and weakly developed fine subangular blocky structure.

The subsoil, which is more than 1.5 metres thick, is yellowish brown (10YR 5/6) to brownish yellow (10YR 6/8) in colour at times grading to a strong brown (7.5YR 5/8) with depth; texture in the subsoil is sandy clay loam to sandy clay with a consistence that changes from friable to firm with depth and a moderately developed medium subangular blocky structure (Wong,1970).

3.5.2 The Munchong Series

Closely associated with the Serdang series are soils of the Munchong series. The soils are derived from ferrugenous silty and clayey shales, phyllites, and low grade schists with occasional bands of quartzite and vein quartz.

Because of variability in the minerological composition of the parent materials of this series, the variation in the potassium content in these soils is as great as that between different soil series.

High K values, however, has been obtained in soils derived from phyllites and low grade mica schists which are highly probable sources of a greater quantity of K fixing micaceous minerals. The Munchong series soils occur in undulating and rolling to hilly (4^0-20^0) terrain with most of the soils in the 4^0-12^0 slope range. They are differentiated from the Serdang series by their heavier texture and redder colour.

The surface which is 12 to 17 cm thick is a dark yellowish brown (10YR 4/4) to brown (10YR 4/3) fine sandy clay with a friable consistence and weakly to moderately developed medium crumb and granular, fine and subangular blocky structures.

The subsoil of more than 1.3 metres thickness is usually strong brown (7.5YR 5/8) in colour with a fine sandy clay texture, friable to consistence, and moderately developed medium subangular blocky structure with distinct clay skins along root channels and structure faces.

3.5.3 The Kedah Series

A distinctive feature of the soils of the Kedah series is that they are shallow soils developed on hilly to steep (12^0-15^0) terrain. They usually occur in association with the Serdang series which occur downslope, both soils being derived from similar parent materials, namely quartzites, sandstones and sandy shales with minor intercalations of silty and micaceous shales and phyllites.

The top soil of 2.5 to 5 cm thickness is normally dark yellowish brown (10YR 3/5) to greyish brown (10YR 5/2) in colour with a fine sandy loam to sandy loam texture, friable consistence and weakly to moderately developed medium subangular blocky structure. The subsoil which is rarely thicker than 52 cm is yellowish brown (10YR 5/5) grading to strong brown (7.5YR 5/8) or reddish yellow (10YR 6/6) with depth. The parent material is usually encountered at about 50 - 60 cm depth.

3.6 Soil Texture of the Study Areas

Textural analysis of soils of various landuses in the study areas reveal in general the properties of soil of Serdang-Munchong-Kedah Association. From Table 3.1, it is shown that the class name of the soils are closely related to those of the Serdang-Munchong-Kedah Association, namely the sandy clay loam and sandy clay.

In Table 3.1, the percentage of clay, silt, fine sand and coarse sand of soils of various landuses in the study areas are comparable to those of Serdang-Munchong-Kedah Association, as shown in Table 3.2.

Table 3.1: Class Name of a Soil and Its Textural Composition

Type of landuse	Textural Composition,% Clay	Silt	Sand	Class name
Forest	17	19	64	sandy clay loam
Rubber,20yr	32	5	62	sandy clay loam
Oil palm,20yr	38	17	45	sandy clay
Rubber,7yr	21	12	67	sandy clay loam
Oil palm,7yr	26	16	58	sandy clay loam
Bare,5yr	27	22	51	sandy clay loam
Bare,1yr	41	5	54	sandy clay

Table 3.2: Soil Texture of Serdang-Munchong-Kedah Association

Soil series	sampling depth,cm	soil texture, % clay	silt	fine sand	coarse sand
Serdang	5	28	4	45	25
Munchong	5	33	24	33	12
Kedah	5	47	14	19	12

A detailed analysis on soil textures of the study areas are shown in Table 3.3, which emphasized the soil size distribution in accordance to their size class (micron). Meanwhile, Table 3.4 shows the moisture retention characteristics of soils of various landuses, which emphasized the soil moisture content at different level of pF.

Table 3.3: Soil Particle Size Distribution of the Study Area

Type of landuse	soil size distribution,% (micron) 0-2	2-20	20-50	50-100	100-250	250-500
Forest	17.3	7.82	10.87	8.95	28.18	17.11
Rubber,20yr	32.2	1.55	3.65	9.12	31.83	55.75
Palm oil,20yr	38.4	7.68	9.36	9.00	21.11	10.17
Rubber,7yr	20.8	5.06	7.18	13.5	32.89	13.26
Oil palm,7yr	25.6	7.57	8.58	11.3	25.45	13.55
Bare,5yr	27.2	16.0	6.17	15.9	21.98	10.98
Bare,1yr	41.0	2.6	2.39	7.22	28.61	12.61

Table 3.4: Water Retention Characteristics of Soils of the Various Landuses at Different pF Level

Type of landuse	Moisture content (%,w/w) at pF 0	1	2	2.54	4.19
Forest	43	32.2	24.2	17.9	11.3
Rubber,20yr	39	37.2	28.1	22.3	16.6
Oil palm,20yr	44	33.2	26.9	22.0	15.9
Rubber,7yr	34	26.7	19.0	15.8	9.5
Oil palm,7yr	34	26.6	19.4	18.5	11.0
Bare,5yr	33	31.0	24.1	20.0	14.1
Bare,1yr	38	28.5	21.9	12.3	10.5

Table 3.4 above indicates that in a saturated condition, the soils of forest, 20 year-old rubber and oil palm and one year-old bare soil have higher moisture content (at pF 0). At pF 1 and pF2.54 (available water stage), and pF 4.19 (wilting point stage) the amount of water retented is also higher in these four landuses.

3.7 Vegetation of the Study Areas

In the early 1960's, Felda Gedangsa Resettlement Scheme was officially settled by the first group of settlers whose primary occupations were in the rubber and oil palm plantations. Until the early 1970's, the population of the settlement progressively increased and as a result areas of cultivated land also expanded.

Resettlement in the scheme took place in four phases, namely the Peringkat 1 (Phase 1), started in the early 1960's; Peringkat 2 (Phase 2), the middle of 1960's; Peringkat 3

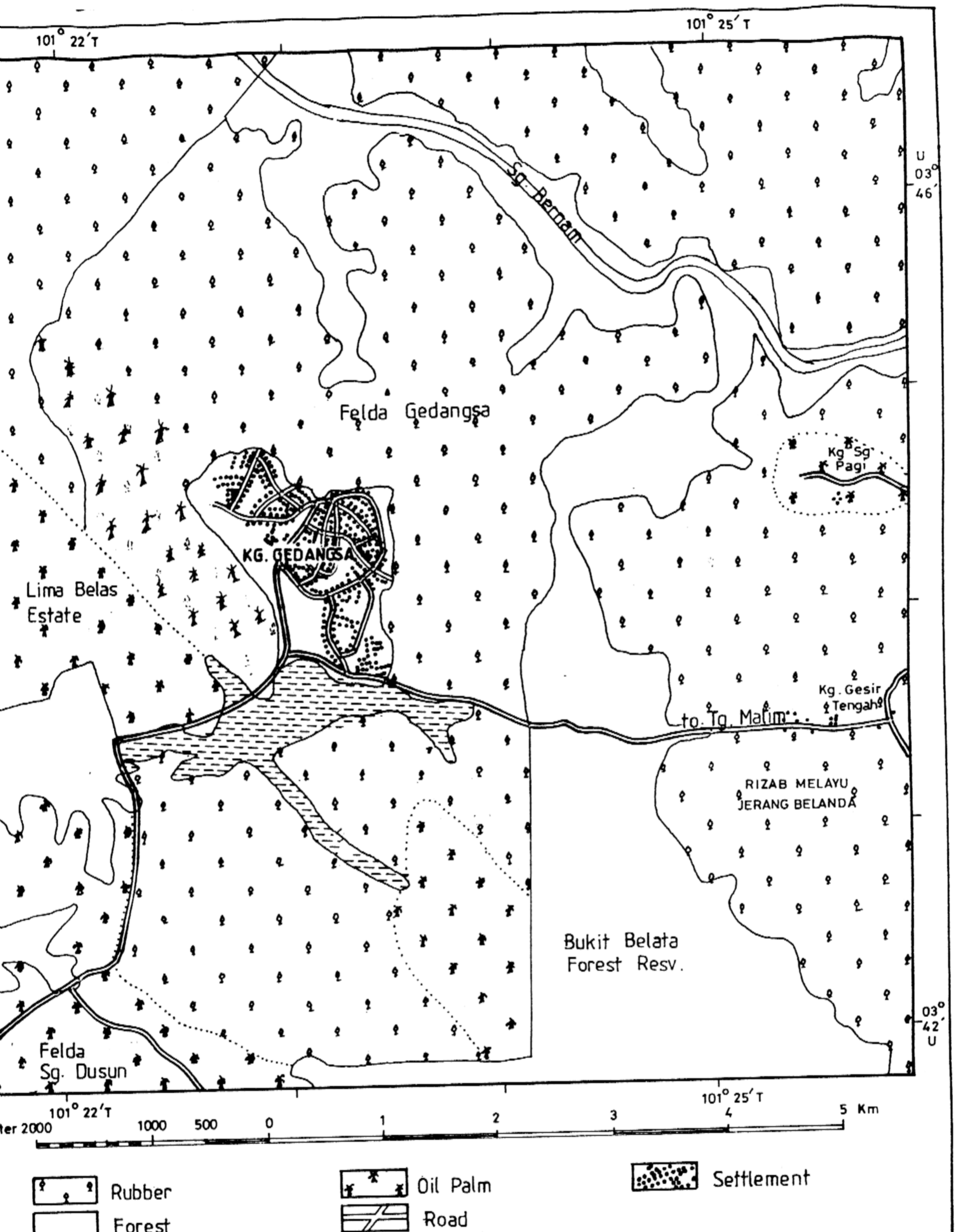
(Phase 3), the late 1960's and Peringkat 4 (Phase 4), the early 1970's (Map 3.7). Since the progress of settlement in each phase was governed primarily by the completion status of the cultivation of rubber (which comprised 90% of planted crops), and oil palm (about 10% of planted crops), variability of age of the plantations were therefore pronounced.

By the early 1980's (i.e when the plantation in Phase 1 had gained its maximum productivity after 25 years of cultivation), replanting of new rubber trees began. It was soon followed by Phase 2 and Phase 3 in the middle and late 1980's, respectively. Replanting of rubber and oil palms in Phase 4 is scheduled in early 1997.

In this replanting process, the settlers were given the choice of whether to plant rubber or oil palms, resulting in a mixture of both crops in plantations in the study areas (refer to Map 3.3).

It is clear then that by the time the study was conducted in early 1991, variability in age of various landuses had already existed. The Bukit Belata Forest Reserve study area is located on the eastern side of the Felda Gedangsa study area, which is shown in detail in Map 3.3.

Map 3.7 : Landuses in the Early 1970's of the Study Study Area



Source : Behrang , Syit 3659 / 1988.

3.7.1 Vegetation Under 20 Year-old Rubber and Oil Palm

The nature of plantations under rubber and oil palm which are 20 years old has been characterized by poor management, especially in terms of weed control. The poor management of the crops was mainly due to the attitude of the owners and the fact that the crops were no longer productive.

Thick undergrowth, sometimes reaching a height of two meters widely covers the soil surface. This underlayer vegetation that dominates the plantations consist mainly of thick shrubs such as *Stenochlaena palostris* (Paku rawan), *Melastoma malabathricum* (Senduduk), *Clidemia hirta* (Senduduk bulu), *Dicranopteris linearis* (Paku resam), *Ischaemum muticum* (Tembaga jantan), and *Chromolaena odorata*; alongside with wild rubber and oil palm seedlings that germinated from the respective plantation trees.

This thick underlayer vegetation is commonly found in the 20 year-old rubber and oil palm plantations, as shown in Appendix 1.

3.7.2 Vegetation Under 7 Year-old Rubber and Oil Palm

For rubber and oil palm plantations which are 7 years old, the underlayer vegetation are hardly found, in contrast with 20 year-old rubber and oil palm. This is mainly due to proper management by the owners.

In these plantations, there are thin groups of vegetation scattered here and there consisting mainly the species of *Asystasia intrusa* (Herba jejentik), *Imperata cylindrica* (lalang), *Cyperus compressus* (Siperus pepat) and *Ischaemum muticum* (see Appendix 2).

3.7.3 Vegetation Under Bare Soil Condition

For 1 year-old bare soil (1 year after land clearing for rubber replanting), the main types of vegetation that randomly cover the area are species of wild *Centresoma pubiscens* (Kekacang tutup bumi), *Peuraria phasioloides* (Kekacang tutup bumi), *Eleusina indica* (Rumput sambau), *Pennisetum polystachyon* (Ekor kuda) and *Mimosa indica* (Semalu besar). (Although a bare soil condition should devoid of vegetation, however, a small patches of vegetation are seen to be growing. In a 1 year-old bare soil, the lands were still favourable for plant growth. This is because the lands were just newly exposed due to the felling of old rubber and oil palm. On 5 year-old bare soil, however, there is no clear indication of any dominant vegetation. This is because the lands were heavily exposed and deeply excavated).

On 5 year-old bare soil, there were some spots of grass such as *Imperata cylindrica* (Lalang) and *Mimosa spp.* (species of Semalu) scattered randomly over the barren soil surface (See Appandix 3).

3.7.4 Vegetation Under Forest Condition

In the forested sites, the vegetation is virgin lowland dipterocarp. Typical of this forest is a feature in which there are more than three-layered structure of tree canopy. The upper layer or emergent storey stands at about 30-40 meters and is discontinuous. The middle layer of the main storey is 21-30 meters above the ground and forms a continuous canopy. The third layer or under storey consists of saplings of the upper two storeys and shrubs. The litter layer on the forest floor consists mainly of a single layer of freely fallen leaves and twigs (see Appendix 4).

3.8 Surface Configuration of the Study Areas

The landform region within which the Felda Gedangsa and Bukit Belata Forest Reserves areas are located had been described as consisting of low, convex hills. Wong (1970), stated that due to its location (i.e being away from the Main Range where the sedimentary structures have been less altered by the granite intrusion) the study areas are more undulating.

The slope characteristics of the study areas are between 4^0-20^0 on undulating and rolling to hilly lands, but as the terain becomes steeper, especially on hilly to steep terrain, slopes of more than 25^0 are encountered.

The elevation of Felda Gedangsa and Bukit Belata Forest Reserves areas are at approximately above 20-60m and 100-350m above mean sea level, respectively.

The highest peak in the study areas is the Bukit Belata itself, i.e circa 416m above mean sea level. A topographic map of the study areas is presented in Map 3.8 in this chapter.

3.9 Drainage Pattern of the Study Areas

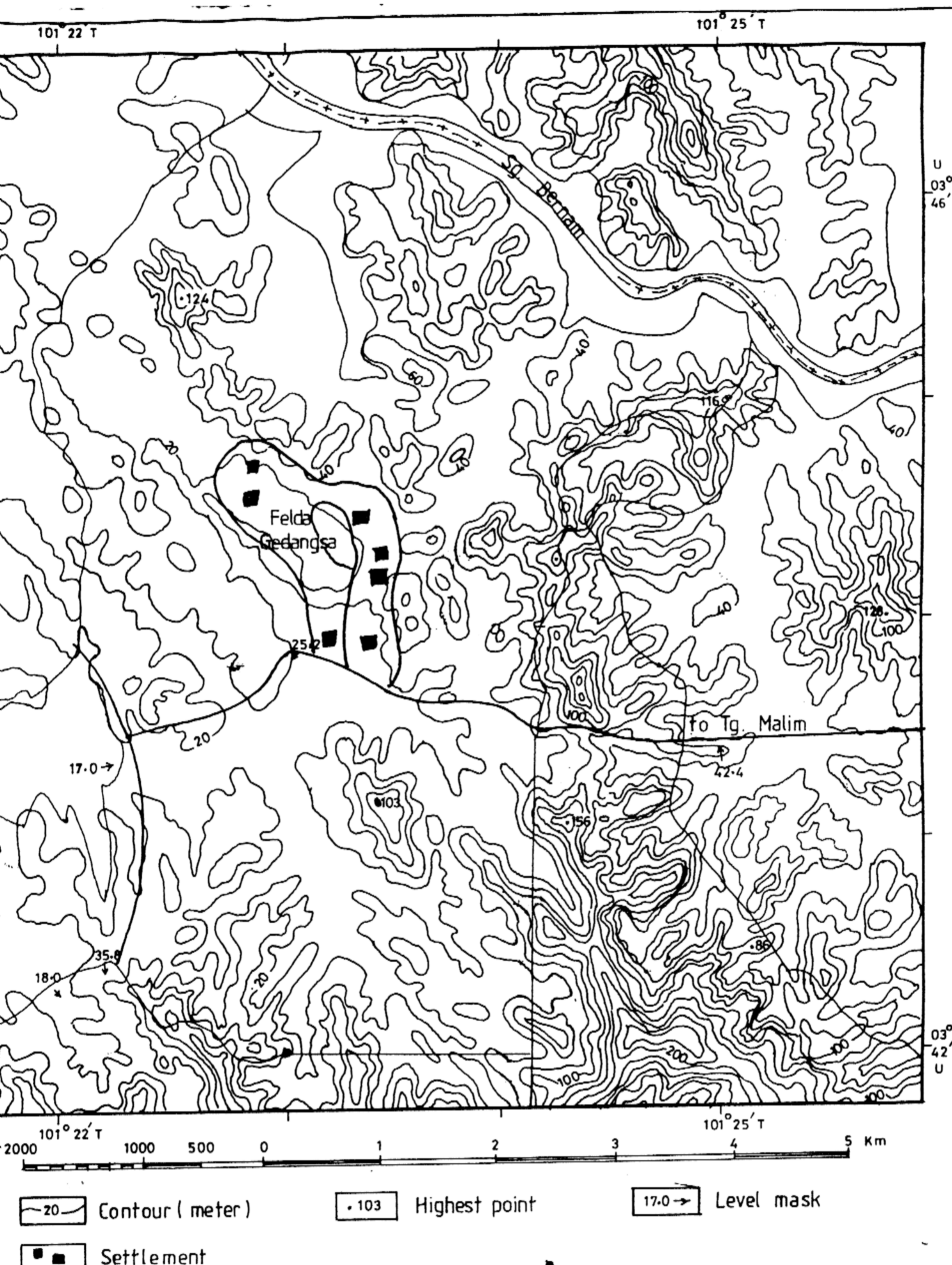
The area of Felda Gedangsa is drained by the Sungai Gedangsa which flows toward the West before merging with the main river, Sungai Bernam, which also serves as a border between the State of Selangor and Perak. Meanwhile, the Bukit Belata Forest Reserve study area is drained partly by Sungai Gesir, which flows toward the North before merging with Sungai Bernam at the Northern most-point of Selangor (Map 3.9).

In general, the drainage pattern of the study areas conforms to the dendritic pattern which ranks at the highest order of 3, according to the river classification by Strahler.

3.10 Conclusion

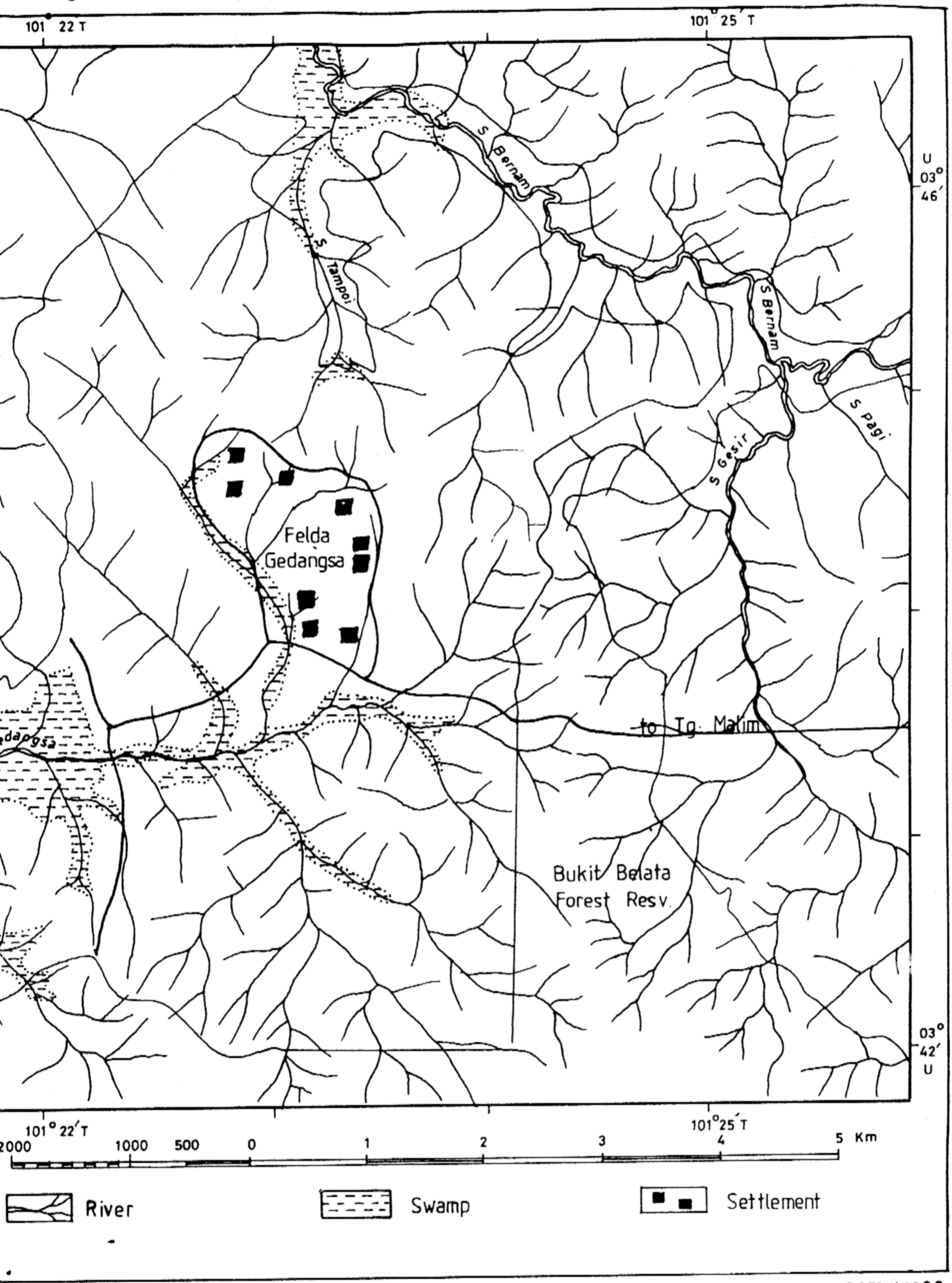
The physical environment of the study areas has a direct bearing on the determination of infiltration rates. The

Map 3.8 : Topography of the Study Area



Source . Behrang , Syit 3659 / 1988

Map 3.9 : Drainage Systems of the Study Area



Source : Behrang , Syit 3659 / 1988

study areas chosen have advantages in terms of variabilty of landuses , accessibility, safety and lodging. Beside its climate which is representative to that of Peninsular Malaysia, the study areas also possess a mixture of soil series consisting of Serdang-Munchong-Kedah Association.

There are many varieties of vegetation which characterised the different types of landuses. In old plantations, it was observed that a great variation of vegetative cover exists, which was mainly due to improper management practice, while in young plantations, regular weed control measures resulted in thinner vegetative cover over the soil surface. This in turn added to the variability of landuses in the study areas. The topography of the study areas is undulating and rolling to hilly land, and the drainage system is considered good.