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A COMPARATIVE STUDY OF SOILS FORMED ON T2 TERRACE IN PENINSULAR MALAYSIA

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EEN VERGELIJKENDE STUDIE VAN BODEMS GEVORMD OP HET T_2 TERRAS IN HET SCHIEREILAND MALEISIE

A COMPARATIVE STUDY OF SOILS FORMED ON T_2 TERRACE IN PENINSULAR MALAYSIA

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Shamshuddin, J(I982). Een vergelijkende studie van bodems gevormd op het T2 terras in het schiereiland Maleisië.

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SAMENVATTING

Er werden eenentwintig profielen gekozen van vijf gebieden in het schiereiland Maleisië. De eenentwintig profielen behoren tot veertien bodemseries, gevormd op het T2 terras dat zijn oorsprong vindt in het Holoceen. De vijf gebieden vertonen een lichte variatie in het klimaat; het noorden is wat droger dan het zuiden van het schiereiland.

Het effect van het moedermateriaal, het klimaat en de topografie komt tot uiting in de natuur van de bodems. De zandige bodems zijn in de uiterst sterk gedraineerde gebieden, gedomineerd door gibbsiet. In de onvoldoende of zwak gedraineerde gebieden bevatten de bodems kaoliniet en gibbsiet, met enige primaire mineralen en/of "mixed layers" mineralen. Anataas accumuleert in de silt fractie van de goed gedraineerde bodems.

De bodems zijn voornamelijk Inceptisols, ze bevatten enkele kleihuidjes maar het gehalte bedraagt minder dan I%. Het stijgen van het kleigehalte met de diepte in sommige bodems lijkt daarom meer geassocieerd te zijn met de sedimentatie voorwaarden dan met klei illviatie. De verandering van de zeer fijne zandfractie/zandfractie % met de diepte duidt op de aanwezigheid van lithologische discontinuiteit binnen de profielen.

Waterdispergeerbare klei(WDK) is in de meeste bodems eerder laag, aangezien deze bodems enige "oxic" eigenschappen hebben. WDK/klei % lijkt te verminderen wanneer Al en/of organisch materiaal vermeerdert. De hoogste waarde(WDK/klei%) wordt gewoonlijk gevonden in de horizont onmiddellijk onder Ap/Al.

Al is de belangrijkste component van aciditeit onder pH 5.5. Boven deze pH lijken de kleien een sterke buffer te vormen in de bodems. He belangrijkste kleimineraal dat deel neemt bij de buffering is kaoliniet, dat een pH_o van 7.3 heeft aan de gebroken vlakken. Deze bodems moeten bekalkt worden om de Al toxiciteit te elimineren. De kalkvereisten van deze bodems kunnen geschat worden door de base nodig om de pH tot 5.5 te brengen, te vermenigvuldigen met I.3. Het base gehalte kan afgeleid worden van de bufferkrommen.

De negatieve ladingen op de klei oppervlaklen overtreffen de positieve ladingen binnen de pH band van 3 tot 6, wanneer de nettolading(PZNC) buiten deze pH waarden valt. De pH_o van deze bodems fluctueert rond 4. De verweringsindex varieert van 60% tot 80%. De silt/klei verhouding op 50 cm diepte is nogal hoog. Dit alles wijst erop dat de bestudeerde bodems eerder in het recente of het intermediaire stadium van verwering zijn.

De textuur van de bodems varieert van zandig tot kleiig, maar is voornamelijk zandig met belangrijke gehalten aan grof zand. In de meeste bodems domineren toermalijn en zirkoon in de zeer fijne zandfractie. Dit duidt erop dat het moedermateriaal van deze bodems hoofdzakelijk granitisch is van oorsprong. De baseverzadiging is laag evenals de sorptie capaciteit en het stikstofgehalte, maar de Al verzadiging is hoog. Samen vormen deze kenmerken belangrijke beperkende factoren voor de planttegroei.

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CHAPTER I

Introduction

I.I General Background

Attempts have been made to classify taxonomically most of the major soil types in Peninsular Malaysia. However, this was not always fully successful particularly due to lack of adequate mineralogical and micromorphological data. Mineralogical data as such are also useful in other cases and may contribute to a better understanding of the fertility status of the soils and hence help to promote right management practices.

In order to support the soil classification and to stimulate soil pedogenetic research work, the Belgian Government has provided equipment(X-ray, DTA-TGA and thin-section equipment) and training facilities to the Soil Science Department of the Agricultural University in Serdang.

A research programme was initiated within the frame-work of the Malaysia-Belgium Technical Cooperation Project. It was designed to train and help members of the academic staff of the Department of Soil Science, Universiti Pertanian Malaysia, to get higher qualification in the field of soil science. Our duty has been set up in the frame of this aid-project and aims to supply the mineralogical and micro-morphological data necessary for a better understanding and classification of the T2 terrace soils representing a widely extended geomorphic unit in Malaysia.

The research was partly carried out in the Department of Soil Science, UPM and partly at RUG, Belgium. At UPM, it was financed by the Faculty of Agriculture, under research project code UPM: I802/I/022; while ABOS supported research carried out at RUG.

This thesis contains a review of work done on the T2 terrace soils, a discussion of their characteristics and finally a morphological and mineralogical study.

I.2 Selection of Soils and Areas

Soils selected for the study are situated on the very extensive T2 terrace. Five areas, where T2 terrace soils are known to be widespread, were sampled. They include the Kelantan plains, the Trengganu plains, the Selangor-Johor plains, Perak plains and the Kedah-Perlis T2 terrace area. The selection of the profiles was done on the following basis:

1. Extensivity of T2 terrace soils in Peninsular Malaysia.
2. Importance of these soils for agriculture.
3. The fertility of these soils differ from area to area.
4. The findings of this study can in some way help in the management practice of the soils.

I.3 Objectives of the Study

The study was carried out with the following objectives:

1. Characterization of T2 terrace soils in Peninsular Malaysia with particular reference to fertility.
2. Characterization of the minerals in the soils.
3. Investigation to their genesis and classification.
4. Characterization of charges on the clay surfaces.

CHAPTER 2

Geography, Geology And Soils In General

2.I Introduction

Geographically, Malaysia occupies two regions; Peninsular Malaysia, which extends from the Thailand border to Singapore, and the states of Sabah and Sarawak in the northwestern part of the Island of Borneo.

Peninsular Malaysia, where the soils for this study were taken, is situated near the Equator between latitudes I° I5'N and 6° 45'N, and longitudes 99°E-I04° 20'E. To the east of the peninsula lies the South China Sea, while the Straits of Melaka constitutes the western border. Peninsular Malaysia covers an area of approximately I2.8 million ha (50,096 square miles). Its greatest length is about 736 km, while its maximum width is around 320 km.

From the latest survey, it is known that about 2.8 million ha of the 6 to 6.4 million ha of agriculturally suitable land have been cultivated(Law and Wong, I975). By I974, about 26% of the total land area was under cultivation of some sort. Most of the cultivated land is under rubber, oil palm and padi, listed in order of decreasing importance(Table 2.I). Recent advance in agricultural development made possible the introduction of cocoa.

About 40% of the land area is hilly or mountainous In the case of the states of Kelantan and Trengganu, steepland(>20°) accounts for about 76% and 72% of the total area of the respective states(Gopinathan and Paramananthan, I979). A large section of the lowland areas is, however, unsuitable for agriculture, either due to acidity, peat or too sandy.

About III,950 ha are covered with mangrove and hence the soils are either acid or potential acid sulphate soils; 90% of which are situated in the west coast(Srivastava et al, I979). On the other hand, on the east coast, especially along the coastal line, the soils are sandy in nature.

Table 2.I Present landuse in Peninsular Malaysia according to the survey made in I974

TYPE	SIZE(hectare)
padi	423,200
rubber	I,9I7,600
oil palm	799,600
coconut	I94,400
misc. crops	4I6,000
urban	II0,000
mining	88,000
forest	7,656,400
swamp	I,055,200
others	733,200

Source: Gopinathan and Paramananthan(I979)

These soils, which are known locally as 'bris soils', cover an area of approximately I60,000 ha(Joseph, I975). Peat is found throughout the country, but particularly well represented in the lowland coastal plains. Joseph et al(I974) estimated that peat covers an area of approximately 0.833 million ha.

2.2 Climate

Peninsular Malaysia lies close to the Equator; the climate is characterized by high humidity and uniformly high temperature with high rainfall(Dale, I959; I960; I963;I964). It can be summarized as follows. The southwest monsoon, which blows into the west coast, starts in mid-April or May and ends in September or mid-October. On the other hand, the northeast monsoon, which brings rainfall to the east coast, begins in October or November and last until

February or March. Floods normally occur during the height of the season. Average annual rainfall is approximately 2,500 mm. Figure 2.I summarizes the rainfall distribution in Peninsular Malaysia.

The plains of the east coast have an annual rainfall of about 3,000 mm. Maxwell hills in Taiping, Perak, experience the highest rainfall in the peninsula(4,594 mm), while Kuala Pilah in Negri Sembilan has the lowest rainfall(about I,660 mm). In Kelantan and Trengganu, the maximum rainfall occurs in November and December, at the beginning of the northeast monsoon. At Kota Bharu, for instance, no less than 42% of the annual rainfall is received during these two months(Table 2.2).

The moisture regime of Peninsular Malaysia is either udic or perudic; perudic is confined to areas more than 300 m above sea-level, while udic charaterizes areas lower than 300 m(Paramananthan, I977). It is also noted that rainfall is relatively higher in the south than in the north of the peninsula, where most of south Johor has a perudic moisture regime. The towns of Batu Pahat and Johor Bharu belong to this moisture regime(Table 2.3).

The northern states of Perlis and Kedah sometimes suffer from a long period of dryness; some places may even approach the ustic moisture regime. Table 2.2 summarizes precipitation, temperature and evapo-transpiration data of Sitiawan, Alor Star, Johor Bharu, Kuala Trengganu and Kota Bharu. Soils for this study were respectively taken from these areas.

Soil temperature can roughly be estimated by adding 2.5°C to the air temperature. Using this assumption, it is found that the MAST at 50 cm depth in the areas under study varies from 28°C to 30°C(Table 2.3). In the lowland, the MAST is above 22°C. The difference between the MSST and MWST is less than 5°C. Therefore the soils of Peninsular Malaysia are isohyperthermic(Table 2.3). It is also noted that the average minimum air temperature in Peninsular Malaysia is 23.3°C and the average maximum air temperature is 32.8°C.

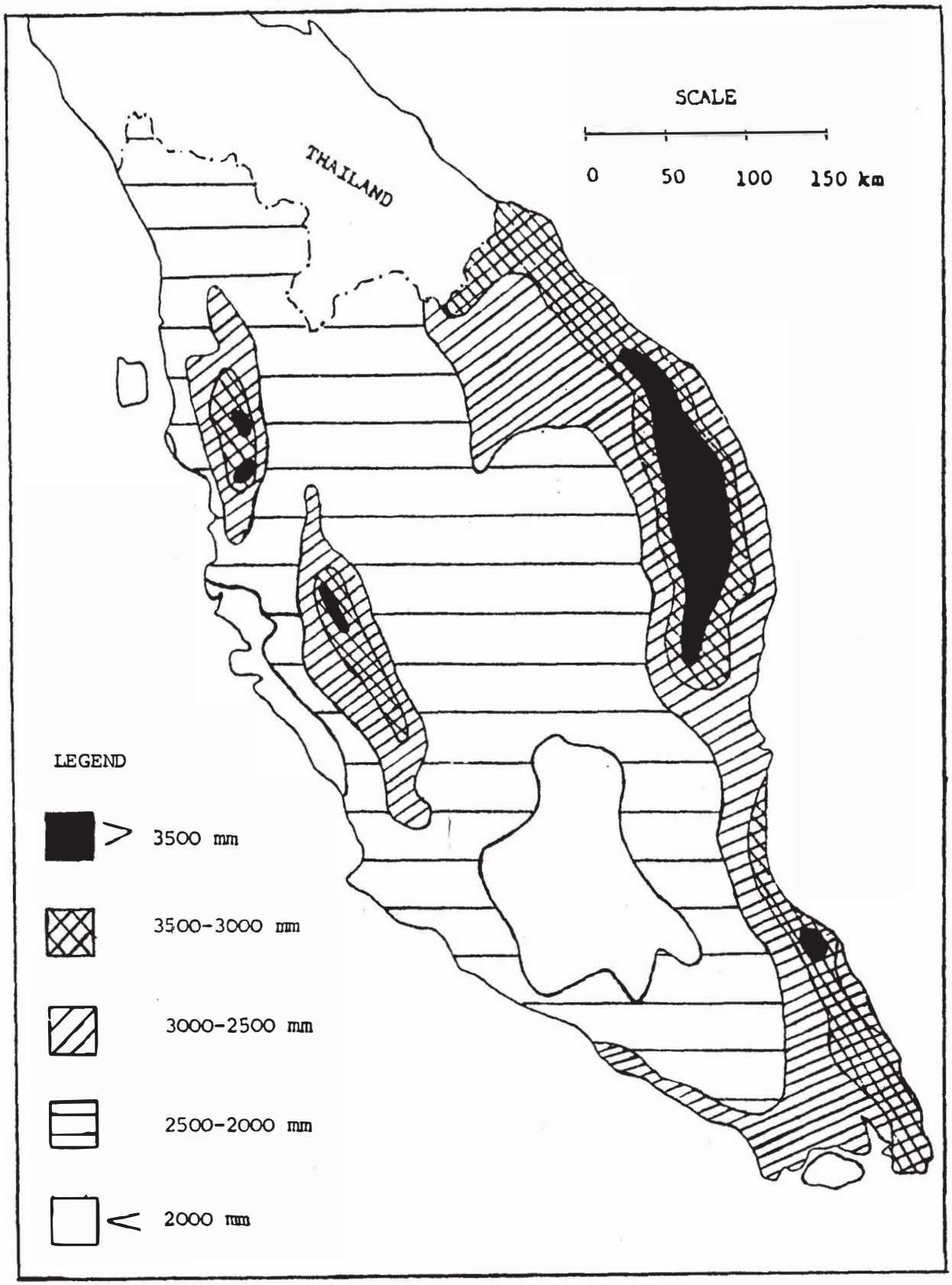

Figure 2.I Mean annual rainfall distribution in Peninsular Malaysia(Law, I970; Oxford University Press, I977)

Table 2.2 Precipitation, temperature and evapo-transpiration data of five selected areas in Peninsular Malaysia

	STA	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
PREC	Sitiawan	188.0	142.2	152.4	177.8	119.4	78.7	83.8	104.1	165.1	205.7	238.8	205.7	1861.7
TEMP		25.8	26.3	26.7	26.9	27.0	29.6	26.6	26.5	26.3	26.1	25.8	25.8	
PET		125.7	122.0	140.4	136.4	145.1	136.4	140.4	140.4	131.1	131.2	122.1	125.7	1596.9
PREC	Alor Star	53.3	50.8	139.7	223.5	254.0	182.9	200.7	246.4	304.8	309.9	218.4	109.2	2293.6
TEMP		26.0	26.8	27.2	27.3	27.3	27.0	26.7	26.6	26.3	26.1	25.8	25.2	
PET		126.4	125.5	143.7	142.3	147.9	143.7	143.1	141.8	130.6	129.5	119.2	121.0	1614.6
PREC	Johor	292.1	200.7	276.9	279.4	218.4	175.3	157.5	200.7	208.3	221.0	274.3	276.9	2781.5
TEMP	Bharu	26.4	26.9	27.4	27.6	27.7	27.4	27.2	27.0	27.2	27.1	26.9	26.4	
PET		135.0	126.9	145.1	145.1	149.4	140.9	145.1	145.1	140.9	145.1	136.4	135.0	1689.9
PREC	Kuala	218.4	127.0	157.5	134.6	114.3	111.8	121.9	152.4	177.8	299.7	640.1	551.2	2806.7
TEMP	Trengganu	25.2	25.5	26.3	26.9	27.0	26.7	26.4	26.2	26.1	25.8	25.4	25.2	
PET		114.2	108.7	134.4	137.7	147.9	139.0	140.2	135.1	128.2	125.2	114.1	114.2	1539.2
PREC	Kota	228.6	121.9	152.4	106.7	149.9	147.3	142.2	162.6	205.7	299.7	622.3	622.3	2961.6
TEMP	Bharu	25.3	25.5	26.4	27.3	27.3	27.0	26.7	26.6	26.4	26.1	25.6	25.2	
PET		115.1	108.0	135.8	142.3	147.9	143.7	143.1	141.8	133.1	130.2	116.6	113.5	1571.1

Source: Tavernier(unpublished data)