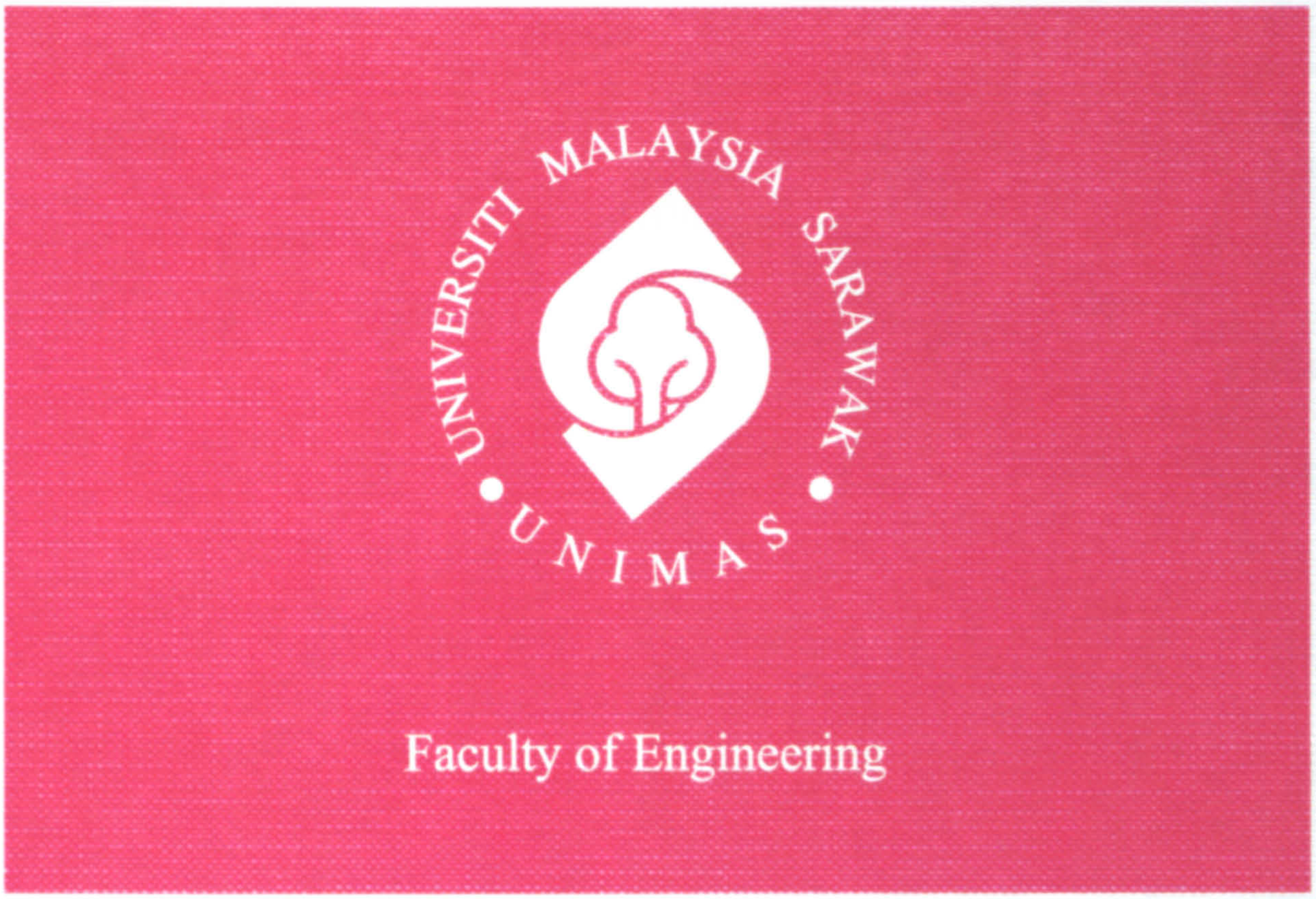

COMPRESSIBILITY BEHAVIOUR OF PEAT SOIL

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Bachelor of Engineering with Honours
(Civil Engineering)
2009

UNIVERSITI MALAYSIA SARAWAK

BORANG PENGESAHAN

JUDUL: COMPRESSIBILITY BEHAVIOUR OF PEAT SOIL

SESI PENGAJIAN: 2008-2009

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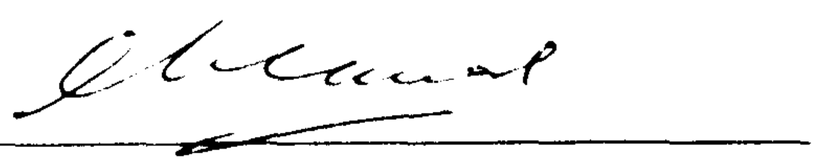

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COMPRESSIBILITY BEHAVIOUR OF PEAT SOIL

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A thesis submitted to

Faculty of Engineering, Universiti Malaysia Sarawak

In fulfillment of the requirements for the award of the degree of

Barchelor of Engineering with Honours

(Civil Enginering)

2009

To my beloved mother and father

My lovely siblings and friends

There's nothing in life that makes me happier than loving all of you

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I would like to deeply praise the ALLAH SWT for allowing me passing all of this moment. I also would like to take this opportunity to express my sincere gratitude to all those who have contributed in completing this project.

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ABSTRACT

Peat has been identified as one of the major group of soil in Malaysia. Peat deposit covers large area of Sarawak. This soil is very useful in horticulture and agriculture but from the engineering aspect is considered as problematic soils. Actually, peat has high water content and organic content which result in low shear strength and large compressibility. In Malaysia, peats cover up to 3 million hectare which represent 8% of the land area of the country and Sarawak has largest area of peat with 1.65 million hectare or 13% of the state land area. Despite of this fact, not much research has been focused on the compression behavior of peat. This study is focused on the compressibility characteristics of peat based on time-compression curves derived from consolidation tests. The peat samples were collected in Kota Samarahan district. The results indicated the physical and chemical properties of peat soil. The compressibility of peat was done by Standard One-Dimension Consolidation test. The experimental results obtained the physical and chemical properties such as loss on ignition and organic content, moisture content, specific gravity test, fiber content test, pH test, sieve analysis test, Atterberg limits test, standard Proctor compaction test and direct shear test. The Oedometer test showed the parameter such as coefficient value of consolidation, C_v, compression index, C_c, and the coefficient of volume compressibility, m_v.

ABSTRAK

Tanah gambut dikenalpasti sebagai salah satu kumpulan utama tanah di Malaysia. Kawasan tanah gambut menyeliputi sebahagian besar Sarawak. Tanah lembut ini sangat berguna dalam bidang perkebunan dan pertanian tetapi dari aspek kejuruteraan ia tergolong sebagai tanah yang bermasalah. Sebenarnya, tanah gambut mempunyai kandungan air dan organic yang tinggi yang mana menyebabkan kekuatan ricih yang rendah dan kebolehmampatan yang besar. Di Malaysia, kawasan tanah gambut adalah meliputi 3 juta hektar, iaitu 8% daripada jumlah keluasan tanah negara ini dan Sarawak mempunyai kawasan tanah gambut yang paling luas iaitu 1.65 juta hektar atau 13% daripada jumlah keluasan tanah negeri itu. Walaupun demikian, tidak banyak penyelidikan tertumpu pada kelakuan pemampatan tanah gambut. Kajian ini tertumpu pada analisis sifat kebolehmampatan tanah gambut berdasarkan lengkung masa-pemampatan yang diperoleh daripada ujian pengukuhan. Sampel tanah gambut telah di ambil di kawasan Kota Samarahan. Keputusan kajian merangkumi sifat fizik dan kimia tanah gambut. Kebolehmampatan tanah gambut telah diperoleh daripada Ujian Piawai Konsolidasi iaitu Ujian Oedometer. Keputusan eksperimen menunjukkan sifat fizik dan kimia tanah gambut seperti kehilangan pembakaran dan kandungan organik, kandungan kelembapan, kegravitian khusus, kandungan gentian, ujian pH, analisis penapisan, atterberg limit, kepadatan dan ujian rincih. Ujian Oedometer menunjukkan parameter seperti nilai kebolehmampatan, C_c, index kebolehmampatan, C_v, dan nilai isipadu kebolehmampatan, m_v.

TABLE OF CONTENTS

CONTENT	PAGE
DEDICATION	i
ACKNOWLEDGE	ii
ABSTRACT	iii
ABSTRAK	iv
TABLE OF CONTENTS	v
LIST OF TABLES	viii
LIST OF FIGURES	x
LIST OF SYMBOLS	xi
CHAPTER 1 INTRODUCTION	
1.1 General	1
1.2 Problem Statement	3
1.3 Objectives of Study	3
1.4 Scope of study	4
1.5 Thesis Structure	5
CHAPTER 2 LITERATURE REVIEW	
2.1 Overview	7
2.2 Peat Soil in Sarawak	8
2.3 Definition of Peat Soil	12
2.4 Physical Properties of Peat Soil	13
2.5 Classification of Peat Soil	16
2.6 Compressibility of Peat Soil	21
2.7 Consolidation using Oedometer Test	21
2.8 Time-Compression Curve	22

2.9 The e-log p' Curve 23

CHAPTER 3 METHODOLOGY

3.1 General 24

3.2 Sampling of Peat 25

3.3 Laboratory Test 25

3.3.1 Preliminary Tests 25

3.3.2 Consolidation Test (Oedometer Test) 26

3.4 Data Analysis 30

3.4.1 Time-Compression Curve 30

3.4.2 The e-log p' Curve 31

3.4.3 Procedures of Data Analysis for Oedometer Test 32

CHAPTER 4 RESULTS AND ANALYSIS

4.1 General 37

4.2 Geotechnical Properties 38

4.2.1 Degree of Humification 38

4.2.2 Loss on Ignition and Organic Content 39

4.2.3 Moisture Content 40

4.2.4 Specific Gravity 41

4.2.5 Fiber Content 42

4.2.6 pH value 43

4.2.7 Sieve Analysis 44

4.2.8 Liquid Limit 46

4.3 Engineering Properties 48

4.3.1 Compaction Test 48

4.3.2 Shear Strength Characteristics 49

4.3.3 Coefficient of Consolidation, C_v 51

4.3.4 Compression Index, C_c 53

4.3.5 Coefficient of Volume Compressibility, M_v 55
4.4 Comparison with Published Data 59

CHAPTER 5 CONCLUSION AND RECOMMENDATION

5.1 Conclusion 62
5.2 Recommendation for Further Works 66

REFERENCES 67

APPENDIX

LIST OF TABLES

TABLES	TITLES	PAGES
2.1	Area of peat in Sarawak	11
2.2	Important physical and chemical properties for some peat deposits	14
2.3	Classification of peat based on degree of decomposition	18
2.4	Classification of peat based on organic and fiber content	19
4.1	Degree of Humification of peat soil in Kota Samarahan	38
4.2	Loss on Ignition and Organic Content	39
4.3	Moisture Content	41
4.4	Specific Gravity	42
4.5	Fiber Content	43
4.6	pH Value	44
4.7	Sieve Analysis	45
4.8	Liquid Limit	47
4.9	Optimum Moisture Content and Dry Density	48
4.10	Shear Strength, τ_v of peat soil in Kota Samarahan	50
4.11	Coefficient of Consolidation, C_v	51

4.12	Compression Index, C_c and void ratio for Kota Samarahan peat soil	54
4.13	Coefficient of Volume Compressibility, m_v	55
4.14	Summary of Peat Properties for Kota Samarahan Area	57
4.15	Parameter of Consolidation (Oedometer test)	58
4.16	Comparison Peat Soil Properties with Published Data	59
4.17	Comparison Consolidation Parameter with Published Data	60

LIST OF FIGURES

FIGURES	TITLE	PAGES
2.1	Distribution of Peat in Sarawak	9
3.1	Isochrones showing the variation of pore pressure with time factor, T_v	29
3.2	Standard Consolidation test (Oedometer test)	29
3.3	Procedure for determining the pre-consolidation pressure	34
3.4	Settlement versus square root of time plot	35
4.1	Percent Finer versus Particles Size	46
4.2	Cone Penetration versus Moisture Conten	47
4.3	Dry Density versus Moisture Content	49
4.4	Coefficient of Consolidation, C_v versus Log P	52
4.5	Deformation versus Square Root of Peat in Kota Samarahan	53
4.6	Void Ratio versus Log Pressure for peat soil in Kota Samarahan	54
4.7	Coefficient of Volume Compressibility versus Log P	56

LIST OF SYMBOLS

w	-	Water content
W_w	-	Weight of water
W_s	-	Weight of dry soil
L_L	-	Liquid Limit
γ_d	-	Dry unit weight
G_s	-	Specific Gravity
N	-	Ignition loss
ρ_w	-	Water density
ρ_s	-	Particles density
H	-	Organic content
FC	-	Fiber content
ρ_d	-	Dry density
C_c	-	Compression Index
C_v	-	Coefficient of Consolidation
m_v	-	Coefficient of volume compressibility
τ_v	-	Shear strength
D	-	Diameter of sample
e	-	Void ratio
e_o	-	Initial void ratio

CHAPTER 1

INTRODUCTION

1.1 General

Geotechnical engineering is one of the civil engineering field that study of earth. It is the sub-discipline of civil engineering that involves natural materials found close to the surface of the earth. It is mostly focus on composition of ground like soils, rocks and etc. The geotechnical engineering contains Soil Mechanics (Soil Properties and Behaviours) , Soil Dynamics (Dynamic Properties of Soils, Earthquake Engineering, Machine Foundation) Foundation Engineering (Deep & Shallow Foundation) ,Pavement Engineering (Flexible & Rigid Pavement) ,Rock Mechanics (Rock Stability and Tunnelling) and Geosynthetics (Soil Improvement).In geotechnical engineering we can classify the properties and characteristic of soils, the method due to foundation, the stability, consolidation, permeability and compaction of soils and all about natural materials found close to the surface of the earth. But some of them are in progress of research by the geotechnical engineering because there have some different result or conclusion of the research.

Peat soils commonly occur as extremely soft, wet, unconsolidated superficial deposits normally as an integral part of wetland systems. They may also occur as strata beneath other superficial deposits. The term peat is described as a naturally occurring highly organic substance derived primarily from plant materials. Malaysia is one of the countries that have a large distribution of peat soils. Peat is an organic soil which consists more than 70% of organic matters. Peat deposits are found where conditions are favorable for their formation. In Malaysia, some 3 million hectares of land is covered with peat. Peat poses serious problems in construction due to its long-term consolidation settlements even when subjected to a moderate load. Hence, peat is considered unsuitable for supporting foundations in its natural state. Various construction techniques have been carried out to support embankments over peat deposits without risking bearing failures but settlement of these embankments remains excessively large and continues for many years. Besides settlement, stability problems during construction such as localized bearing failures and slip failures need to be considered (Tay, 1969)

The compression behavior of fibrous peat consists of two phases i.e.: primary consolidation and secondary compression. The primary consolidation of fibrous peat is much larger than that of other soils due to high initial water content, while the secondary compression occurs due to not only compression of solid particles, but also the plastic yielding (buckling, bending, and squeezing) of the particles (Samson and La Rochelle, 1972). Most of the methods to predict compressibility characteristics of soil are developed based on the results of laboratory consolidation test. Several test methods have been used to study the compressibility of different type of soil including peat. The oldest and the most popular one is the conventional Oedometer

test. This test is still used as a standard consolidation test method in Malaysia as well as in many parts of the world.

1.2 Problem Statement

The compressibility behavior of fibrous peat is different from that of clay soil. The behavior is controlled by several factors including the initial water content, fiber arrangement, and fiber content. The condition in which the fibrous peat is deposited is also an important factor to be considered. The large compressibility of peat results in a large deformations and strains. Accordingly, equipment capable of measuring large strain consolidometer is needed to study the compressibility characteristics of peat. Several consolidation parameters of the peat under study will be determined. The results are useful for identification of the compressibility characteristics and predicting the compression behavior of fibrous peat.

1.3 Objective of Study

Based on the uniqueness of the properties of peat and the importance of compressibility of the peat in the evaluation of its response to loading, the following objectives were set forth:

1. To identify the type and engineering properties of peat found in specific place in Kota Samarahan, Sarawak.

2. To study the compressibility characteristics of the fibrous peat based on the results of consolidation test using Oedometer test.
3. Comparison the compressibility result with the existing published results of the peat soil from the other area and determine the position of peat soil at Sarawak varied with the other area.

1.4 Scopes of Study

The study focuses on the compressibility characteristics of peat soil found in Sarawak. Therefore, the interpretation of the results of the study was limited as indicated in the followings:

1. Peat soil found in Kota Samarahan, Sarawak.
2. Samples were obtained in Kota Samarahan area.
3. Identification of index properties of soil includes: water content, specific gravity, sieve analysis, and acidity.
4. Evaluation of shear strength of the peat was made by laboratory shear box tests.
5. The use of the standard consolidation test (Oedometer) data to determine the range of pressure.
6. Comparison the result with the existing published results and gets the position of peat soil of Kota Samarahan, Sarawak according to existing published result of peat soil at the other area.

1.5 Thesis Structure

The thesis is composed of six chapters. Chapter 1 presents general information regarding background, problem statement, objectives, scope, and significance of the study, and thesis structure. Chapter 2 provides the background of the study on different topics related to the research. This chapter outlines information on the general characteristics of peat soil, the theory of consolidation, the compressibility of peat, and the theories developed by researchers for the study of the compressibility of peat. Chapter 2 also covers review on the standard consolidation test, Oedometer Test.

Chapter 3 provides the overall experimental program including laboratory tests and data analysis. The experimental program includes laboratory soil tests performed to classify the soil and to determine the engineering properties of peats. This chapter also discusses the detail set up and procedures of Oedometer Test and analysis of the data obtained from the test.

Chapter 4 presents the results, analysis and discussion of the thesis. It include the general characteristics of the peat derived from the results of preliminary test. These include soil identification, soil classification, shear strength, and compressibility data obtained from the standard consolidation test on Oedometer cell. Analysis of the test data for determining the compressibility parameters are presented and discussed in detail in this chapter. The compression behavior obtained from Oedometer consolidation test were compared to published data in terms of time-compression curve, consolidation curve, and the range of compressibility parameters.

Chapter 5 presents the conclusions of major findings of this research and recommendation for future work on the topic related to the present study.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

According to Mustaqqim (2006), peat lands cover half of the world's wetland area with total of 3% of global land mass or 150 million hectares and 7% of this total area has been exploited for agriculture and forestry. Approximately 60% of the world's wetland is peat.

Peat has been identified as one of the major groups of soils found in Malaysia. 3 million hectares or 8 % of the area is covered with peat (Huat, 2004). Most type of peat in Malaysia is amorphous peat and fibrous peat. Amorphous peat has a high colloidal fraction and fibrous peat is usually being woody (Bell, 1993).

2.2 Peat Soil in Sarawak

Sarawak as the largest state in Malaysia has the biggest reserve of peat land. There are about 1.5 million hectares of peat land in Sarawak, which are relatively under developed. They are located in low-lying coastal depressing areas. In their natural state, peat soils have generally been recognised as a problem soil with marginal agricultural capability. Poorly drained and waterlogged for most part of the year. Early attempts to farm the peat land, especially those undertaken by smallholders, had been disappointing, often ending in abandonment of the farms. The multitudes of problems encountered were far too enormous and complicated to be overcome by individual efforts of the smallholders. However, as a result of government involvement by way of providing financial and technical support, this scenario has changed to one of optimism as evidenced by successes in the cultivation of a number of crops and the management of the problems posed by the peat soils. Nevertheless, extensive exploitation of the peat land is not encouraged and where such land is being developed for agriculture, a high level of management is emphasized to minimise the occurrence of undesirable consequences, which can lead to the drastic subsidence, and rapid disappearance of the peat. (Jamaludin,2002)

.

At present, an increasing area of this peat land in Sarawak is being converted and developed into agricultural land. In order to further promote agriculture activities in newly opened peat areas, technological packages that were developed thus far need to be tested and upgraded in newly developed areas. These technological developments are mainly confined to base and key

agriculture activities in newly opened peat areas, technological packages that were developed thus far need to be tested and upgraded in newly developed areas. These technological developments are mainly confined to base and key technological packages, which are only sufficient to cater for existing and immediate future needs. To cater for future development requirements on peat, pacing and emerging technological packages will have to be generated. These should cover strategic studies and intensive cultivation of high-value crops.

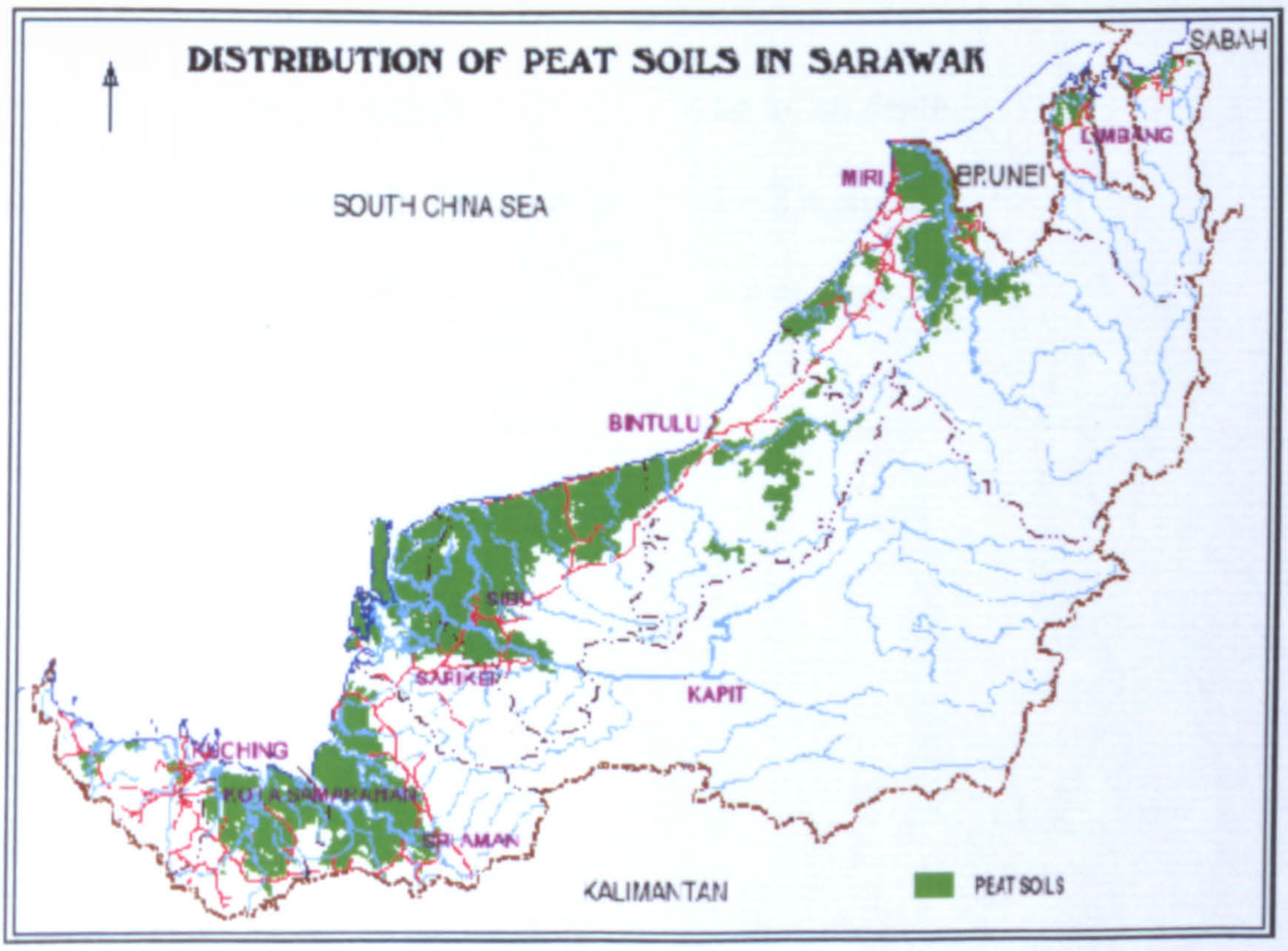

Fig 2.1: Distribution of peat in Sarawak ***(Source: Jabatan Pertanian Sarawak 2001)***