UNIVERSITI PUTRA MALAYSIA

GROWTH AND FINANCIAL APPRAISAL OF INTERCROPPING RATTAN (CALAMUS MANAN MIQ) WITH RUBBER (HEVEA BRASILIENSIS WILLD)

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GROWTH AND FINANCIAL APPRAISAL OF INTERCROPPING RATTAN (*Calamus manan* Miq.) WITH RUBBER (*Hevea brasiliensis* Willd.)

By

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Thesis submitted in fulfilment of the requirements for the degree of Master of Science in Forestry in the Faculty of Forestry, Universiti Pertanian Malaysia

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Abstract of thesis submitted to the Senate of Universiti Pertanian Malaysia in fullfilment of the requirements for the degree of Master of Science

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Chairman: Professor Dr. Nik Muhamad Majid
Faculty : Forestry

Integrated farming under rubber plantation is a new agroforestry practice in Malaysia. It has lately become more important due to the increasing demand for food and raw materials as a result of increasing population and scarcity of land. Interplanting of rattan under rubber can be one of the systems which can solve the problem of insufficient supply of rattan. The system has been introduced in the 1980s with the aim of maximising land use as well as to ensure sufficient rattan supply to the industry. Although the system is now widely accepted by smallholders and rubber plantation owners, there are still many problems related to the cultivation and management aspects such as the impacts of intercropping and the optimal fertilizer regimes.

A greenhouse experiment on 90 potted rattan seedlings (*Calamus manan* Miq.) was carried out in the nursery of the Faculty of Forestry, Universiti Pertanian Malaysia. Eight levels of NPK fertilizer and a control (10, 20, 30, 40, 50, 60, 70, 80 g NPK and control) were given to each seedling with 10 replications for each level. Measurements and observations were made for 12 months. At the end of the study, the rattan seedlings were harvested to determine their root and shoot dry weights.

Four field experiments were conducted at Bukit Ibol RISDA's mini estate, Dengkil, Selangor. A total of 2,500 rattan seedlings were planted at a spacing of 3 x 6 m between six-year old RRIM 600 rubber plantation. The experiments conducted are: (i) monitoring of the growth performance of 500 rattan seedlings for a period of 2 years; (ii) monitoring of the impacts of intercropping on latex production, growth of rubber trees and soil properties; (iii) determining the effects of nine levels (0, 50, 100, 150, 200, 250, 300, 350 and 400 g) of NPK (12:12:17 + TE) fertilizer on the growth of rattan seedlings, and (iv) financial appraisal of the project.

The results of the greenhouse trial indicated that NPK fertilizer applied at 30 g per rattan seedling produced the best height growth of 52.2 cm and the shoot-root ratio of 2.012. In the field, the optimum level was 150 g NPK per seedling. The growth of rattans was 2.08 cm/year and survival after two years was 93.6 percent. In the case of the effects of intercropping on growth of rubber trees, soil properties and latex production, it was found that there was no significant effect for all parameters studied. The financial analysis indicated that planting of rattan under six-year old rubber trees and harvesting after 12 years provide the highest return with IRR, NPV and B/C ratio of 20.68 percent, RM 3,497.44 and 1.64, respectively.

Abstrak tesis yang dikemukakan kepada Senat
Universiti Pertanian Malaysia untuk memenuhi syarat
Ijazah Master Sains

PENILAIAN PERTUMBUHAN DAN KEWANGAN KE ATAS PENANAMAN ROTAN (*Calamus manan* Miq.) DI DALAM LADANG GETAH (*Hevea brasiliensis* Willd.)

Oleh

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Perkebunan campuran di dalam ladang getah adalah satu sistem perhutanantani yang baru. Akhir-akhir ini ianya menjadi penting kerana peningkatan permintaan terhadap bahan mentah akibat dari pertumbuhan populasi dan kekurangan tanah. Penanaman rotan dalam ladang getah dipercayai boleh menjadi salah satu penyelesaian untuk mengatasi masalah kekurangan bekalan rotan di pasaran. Sistem ini diperkenalkan pada tahun 1980an dengan matlamat menggunakan tanah secara maksimum disamping boleh menjamin cukup bekalan rotan untuk industri. Walaupun sistem ini telah dapat diterima oleh banyak pekebun kecil dan pemilik ladang getah, masih terdapat banyak lagi masalah berkaitan penanaman dan pengurusan seperti kesan penanaman dan had pembajaan yang optimum.

Satu kajian rumah kaca ke atas sejumlah 90 anak benih rotan manau (*Calamus manan* Miq.) telah dijalankan di tapak semaian, Fakulti Perhutanan, Universiti Pertanian Malaysia. Satu kawalan dan lapan had pembajaan (10, 20, 30, 40, 50, 60, 70, 80 g baja NPK) telah diberikan kepada setiap anak benih rotan dengan ulangan sebanyak 10 anak benih. Pengukuran dan pemerhatian dibuat selama 12 bulan dan di akhir kajian, anak benih dituai untuk mengukur berat kering pucuk dan akar.

Empat kajian lain telah dijalankan di estet mini kepunyaan RISDA di Bukit Ibol, Dengkil, Selangor. Sejumlah 2,500 anak rotan telah ditanam dengan jarak 3 x 6 m di antara pokok getah kelon RRIM 600. Percubaan yang telah dijalankan adalah: (i) penelitian terhadap kadar pertumbuhan sebanyak 500 anak benih rotan selama 2 tahun; (ii) penelitian terhadap kesan penanaman campuran kepada pertumbuhan dan pengeluaran getah serta tanah; (iii) penentuan kesan 9 had pembajaan (0, 50, 100, 150, 200, 250, 300, 350 dan 400 g) baja NPK (12:12:17 + TE) ke atas pertumbuhan rotan, dan (iv) penilaian kewangan dengan menggunakan data asal dan sekundar projek ini.

Keputusan menunjukkan yang pembajaan anak benih rotan dengan 30 g baja NPK memberikan pertumbuhan yang terbaik dengan kadar pertumbuhan 52.2 cm dan nisbah pucuk dan akar sebanyak 2.012. manakala di lapangan, didapati kadar pembajaan sebanyak 150 g pula adalah yang terbaik. Adalah didapati, rotan tumbuh pada kadar 2.08 sm/tahun dan peratus kehidupan sebanyak 93.6 peratus. Untuk kesan penanaman terhadap pertumbuhan pokok getah, pengeluaran getah dan sifat tanah didapati tiada kesan yang signifikan. Analisis kewangan pula menunjukkan yang penanaman rotan di bawah getah yang berusia 6 tahun dan dituai selepas 12 tahun memberikan pulangan yang terbaik pada kadar IRR, NPV, B/C ratio sebanyak 20.68 peratus, RM´ 3,497.44 dan 1.64.

CHAPTER 1

INTRODUCTION

Malaysia is one of the leading producers of natural rubber in the world. As of 1993, 1.78 million hectares of the total land area in the country are under rubber trees (Malaysia, Ministry of Primary Industries, 1994). This represents 5.4 percent of the total land area in the country. Out of this, about 1.5 million hectares are located in Peninsular Malaysia and the remaining 0.28 million hectares in East Malaysia. About 81 percent of the 1.5 million hectares are managed by 500,000 smallholders whereas the rest are owned by larger corporations such as Guthrie, Sime Darby, Federal Land Development Authority (FELDA), Rubber Industry and Smallholders Development Authority (RISDA) and Federal Land Consolidation and Rehabilitation Authority (FELCRA).

The rubber industry plays a very important role in the socio-economic development of Malaysia. In 1993, the total production of natural rubber was 1.074 million tonnes (Malaysia, Ministry of Primary Industries, 1994), of which, 0.937 million tonnes were exported with a value of RM 2,132.5 million which is equivalent to about 3.98 percent of the total export value of

primary commodities of the country. Rubber industry has also provided job opportunities to the local community. A total of 116,000 workers were employed in the rubber estates and about half a million people in rubber smallholdings. In addition, rubber plantations also produce more than RM 30 million of rubberwood sawntimber and furniture every year. Since 1991, rubberwood timber has made a major contribution to the furniture industry and the demand is expected to increase due to the diminishing supply of logs from the natural forests.

Although the rubber industry has contributed substantially to the national economy, the land under rubber plantation can still be utilized in order to maximize land productivity. In actual practice, only about 25 percent of the area in the rubber plantations is occupied by rubber trees (Tajuddin, 1984). The remaining 75 percent could be used for other economic activities to enable smallholders or plantation owners to earn additional income.

Agroforestry is one of the approaches to utilize this idle land. This form of land use has been suggested by Nik Muhamad and Ismail Harun (1989) and Ismail Harun and Nik Muhamad (1990). Agroforestry is a collective term for land-use system in which woody plants are deliberately combined on the same land management

unit with herbaceous crops and/or animals either in some form of spatial arrangement or in sequence (Lundgren, 1982). Interplanting of *Calamus manan* (rattan) with *Hevea brasiliensis* (rubber) trees can be considered as a form of an agroforestry system.

Rattan, is a spiny climbing palm and is one of the most neglected natural resources from the tropical forests despite of it being one of the important forest produces after timber in Asia (Manokaran, 1990). There are about 600 rattan species belonging to 13 genera, mostly distributed in Southeast Asia. In Peninsular Malaysia there are 104 species of rattan from nine genera (Dransfield, 1979). The most valued economically are those belonging to *Daemonorops, Khorthalsia and Calamus*. One of the most economically important rattans found in Peninsular Malaysia is "Rotan manau" (*Calamus manan*), a large diameter (>18mm) cane.

In recent years, there has been a tremendous increase in demand for rattan especially for furniture manufacturing. Rattan is an economically vital commodity in village livehood (Godoy and Tan, 1991; Aminuddin and Nur Supardi, 1992) and has been traded worldwide for more than a century (Corner, 1966). The world trade of rattan product is estimated to be around US$ 6.5 billion (Manokaran,1990; Malaysia, Rubber Industry and Smallholders Development Authority, 1991) and the

rattan industry is estimated to account for half a million jobs.

As a result of the high commercial value, rattans are rapidly being depleted from the natural forests due to over-exploitation. Excessive logging and shifting cultivation also contributed to the decline of rattan resource in the country. The species particularly "rattan manau" can no longer be found in abundance in the country.

Measures have been taken to cultivate rattan on plantation basis to meet the future demand for this raw material (Aminuddin *et al.*, 1991, Aminuddin and Nur Supardi, 1991; Godoy and Tan,1991). In Peninsular Malaysia, rattan planting is not confined to the forest areas but also in the rubber plantations. Intercropping of rattan under rubber plantation was first introduced by the Forest Research Institute of Malaysia (FRIM) in 1980 (Aminuddin and Nur Supardi, 1986).

Research on the silvicultural and economic aspects of interplanting rattan with rubber trees is however very limited. There are still many fundamental questions unanswered particularly on the financial feasibility, growth interactions and effects on soil properties. In addition, no research has been conducted on the fertilizer requirements of rattan planted under rubber.

The objectives of this study are to:

i. determine the fertilizer regime for optimum growth of rattan under greenhouse and field conditions.

ii. assess the effects of intercropping rattan with rubber on latex production, growth of rubber trees and their effects on soil physical and chemical properties.

iii. evaluate the financial aspects of this intercropping system.

In order to achieve the above objectives this study was divided into four experiments. Experiment 1 (greenhouse experiment) was conducted at Universiti Pertanian Malaysia, Serdang, Selangor. Experiment 2 (growth performance of rattan interplanted with rubber), Experiment 3 (effects of intercropping on soil properties, latex production and growth of rubber trees) and Experiment 4 (effects of NPK fertilizer on soil properties and growth of rattan interplanted with rubber) were conducted at Bukit Ibol Mini Estate, Dengkil, Selangor, Malaysia. In addition, a financial analysis of the project was also carried out. The study was conducted over a period of two years.

CHAPTER 2

LITERATURE REVIEW

This chapter reviews two important aspects related to this study. The first section deals with the definition, concepts, practices, problems and advantages of agroforestry system. This section also describes some agroforestry practices in Malaysia and South East Asia. The second section deals with some aspects of growth, cultivation and economics of interplanting rattan with rubber. This section also highlights some comparisons in integrating rattan with other crops and animals under rubber plantation.

Agroforestry

Concept and Definition of Agroforestry

Agroforestry is not a new practice and has been defined differently by diferent researchers (Jacalne, 1984). Trees, crops and animals have traditionally been raised together on small farms throughout the world. Agroforestry is basically a land use system involving a deliberate integration of trees and shrubs with agricultural crops and/or livestock. It has the potential of ensuring sustained productivity of natural resources by enhancing soil fertility, controlling erosion and