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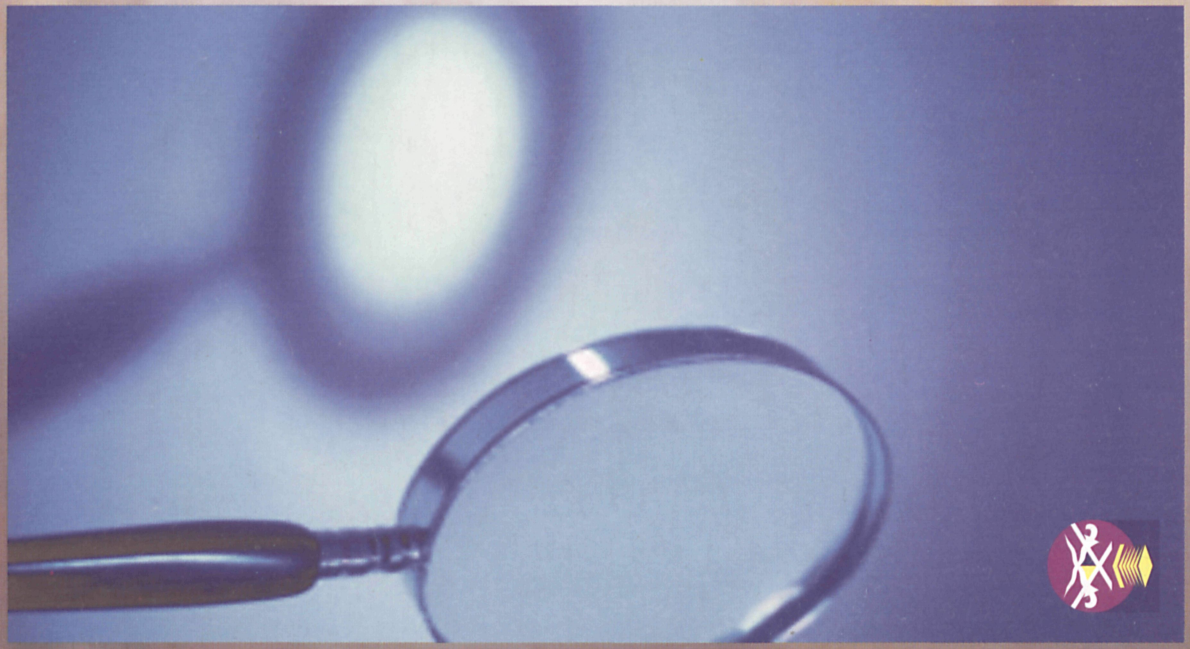

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INTEGRATION OF PLANTATION CROPS WITH SEVERAL TIMBER SPECIES : EFFECTS ON GROWTH AND YIELD

Ahmed Azhar Jaafar, Wan Hanisah Wan Ismail, Norman Kasiran,
Dr. Suhaimi Muhamed
Faculty of Applied Science
Universiti Teknologi MARA Cawangan Pahang

ABSTRACT

This research has been conducted to gather information about the integration of plantation crops such as oil palm and rubber with several timber species. The study involves government and private agencies and farmers practicing this type of agroforestry activities. It has been found that the most common type of integration involves rubber and sentang implemented by smallholder farmers to supplement the low income generated by rubber especially during the low productive periods and during replanting of the main crops. The research has shown that most respondents applied the normal agricultural management practices as in monocrops but has not experienced any adverse effects in relation to plant growth and yield (both the crop and the timber trees). This indicates that integration of crop plants and timber species is a viable approach to improve farm income. However the respondents do indicate the need for more technical advice from related agencies to improve the implementation of their integration programs and acquire better outcomes in terms of yield and income.

INTRODUCTION

Rubber and oil palm has been the main contributor to the agricultural export of Malaysia. Over-dependence on these two major industries and monoculture planting of the crops has exposed these industries to instability and vagaries of market prices. Efforts need to be taken to diversify the agricultural industry of the country to reduce over-dependence on the two major crops mentioned. Integration programs have gained recognition by growers in the country to enhance their agricultural production and farm income especially in the smallholders sector. Through integration, the cost of oil palm replanting can probably be covered by the income generated from the harvest and sale of the timber species (Mahmud and others, 1998).

Integrated farming was viewed to have promising future in the country's agricultural sector since a couple of decades ago. However, integrated farming including agroforestry has not developed into a major undertaking in the Malaysian agriculture. Lack of knowledge, budget constraints and long-term returns are a few of the many problems identified in factors that influence agroforestry implementation (Mohd. Nazip and Suhaimi, 1998). Only recently, despite these problems, farm operators especially the smallholders are beginning to practice agroforestry programs due to the low prices of the country's major farm commodities. Additional information is required to establish sound management systems which will increase program viability and additional revenue to farm operators. This will also provide proof for the private sectors and corporate agricultural organizations to be more involved in agroforestry programs.

This research is an attempt to study the technical aspects of integration of plantation crops with several timber species that constitute the basic management and implementation works on the field. It is hoped that the cumulative results obtained from this study could be used as a guideline in the future implementation of agroforestry programs.

Problem Statement

The process of implementation in the integration of different types of crops or trees on the same piece of land needs careful thought and planning. Farmers especially smallholders are also quite reluctant to embark on programs which will involve high initial costs and long-term returns although the programs will contribute to diversification and increase in farm income. The farmers can generate interim income while waiting for the timber trees to be ready to harvest that will take about 15 to 30 years. Information on the technical aspects of planting system, planting distance, fertilization, pest and disease and harvesting are still limited and fragmented.

There is a future for the integration programs to expand as government agencies are getting more involved recently. More and more government agencies are now giving support to integration programs by providing planting materials, fertilizers and technical advice. Lack of knowledge in implementing integration or agroforestry programs is partly due to the lack of research being carried out. The data obtained on the implementation aspects from this study can act as baseline reference for future programs. Thus, for the programs on integration to develop extensively and successfully, appropriate research and development is necessary.

Objectives

This research is an attempt to study the effects of integration on growth and yield of the crops involved and to identify the problems associated with integration implementation such as technical, advisory and work force requirement.

METHODOLOGY

Integration or integrated farming has long being practiced by Malaysian farmers albeit on small scales. The types of crops involved however were mostly horticultural crops and vegetables. Only recently that forestry trees were planted with these crops. The aim of this study is to provide documentation on the integration processes of plantation crops such as oil palm and rubber with timber trees. Problems encountered in the implementation of integration are also investigated.

Methods of Data Collection

The research was carried out through survey questionnaires and field observations. The survey was conducted by interviewing the respondents and field observation, i.e. measuring plant height and diameter.

Survey Questionnaires

The survey questionnaires, designed to elicit information from respondents, consist of 38 variables in five main sections, i.e. Sections A, B, C, D, E and F. Information for Sections A through E are obtained by interview while Section F by field observation.

Section A is the background information of respondents. Section B is aimed to collect information on the system of integration practiced by the respondents. Section C related to the agronomic practices carried out by respondents. Section D deals with the effects of integration on yield of agronomic crops. Section E refers to the problems faced by the farmers during implementation of integration.

Field Observation

This section (Section F) involves the measuring of plant height and diameter of both agricultural and forest crops. Members of the research team measured plant height by using clinometers or measuring tape and plant diameter at breast height (DBH) using diameter tape (Plate 1, Figure 1 and Plate 2) .

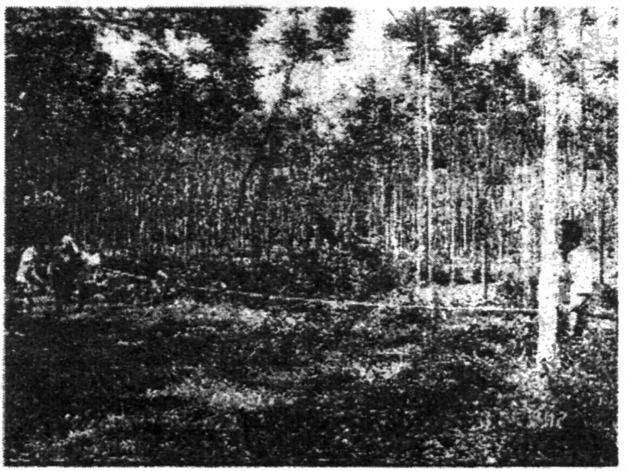

Plate 1: Measuring the height of a tree using clinometer.

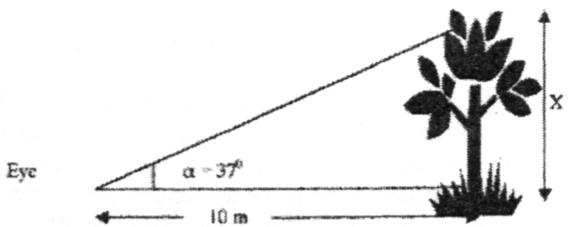

Figure 1: Computation for height of a tree

Computation for height of a tree (X)

$$\frac{X}{10} = \tan 37°$$

$$X = 10 \tan 37°$$

Where α is the angle obtained from clinometer

Plate 2: Measuring the diameter at breast height using diameter tape.

Analyses Of Data

The data obtained were analyzed by using the Statistical Package for the Social Science (SPSS) available at the UiTM Jengka campus.

RESULTS AND DISCUSSIONS

A total of 50 farmers were identified to operate agrosilviculture, i.e. integration of agricultural and forestry crops, during the survey. However, only 38 farmers could be interviewed and 33 questionnaires were considered complete and fit to be analyzed. The research team could not contact the remaining farmers and some of the farmers interviewed were quite reluctant to answer some questions in the questionnaires.

Type Of Integration System

The main type of integration being practiced is rubber + sentang (27.3 %) followed by oil palm+sentang (21.2 %) as shown in Figure 2. The remaining unanalyzed questionnaires and observations by the research group also showed that the main type of integration practiced by farmers in the country is rubber + sentang. Some of the smallholders operate their farms under direct supervision of government agencies such as Smallholders Development Authority (RISDA) and Forest Research Institute of Malaysia (FRIM) and Department of Forestry. From interviews with the farmers, the rubber planters tend to be more interested to carry out integration programs as compared to the oil palm planters. This is due to the lower prices of rubber. The other

reason is that the rubber planters are more frequently visited by officers from the government agencies especially RISDA, where they received the appropriate information and advice. Sentang is among the fastest growing trees grown in the arboretum of FRIM (Ng and Tang, 1974).

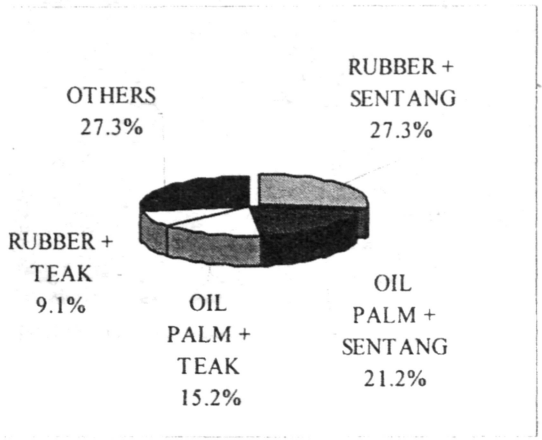

Figure 2: Major type of integration practiced in Malaysia.

The survey also found out that sentang is the most frequent timber species planted by farmers (16 out of 33 farmers). According to sources from farmers and staff of the government agencies, sentang seedlings are more easily available in the market or from the Department of Forestry. Other types of integration consist of combinations of fruits, herbs and field crops with any of the timber species (Plate 3 and Plate 4). The type of agricultural crop most frequently integrated with timber is perennial crops mainly fruit trees. This is consistent to the report by Mohd. Tayeb (1996) that food crops have been identified to be suitable as intercrops with oil palm.

Plate 3: Integration of oil palm and meranti.

Plate 4: Integration of pineapple, tongkat ali (herb) and sentang.

Size Of Farms And Integrated Farms

Only five out of the total farms visited are estates, i.e., farm size or hectarage of more than 50 hectares. The rest of the farms are smallholders (hectarage of less than 50 ha). The largest farm practicing integrated farming is located in Segamat, Johor, which belongs to a private corporate company. Out of the total 2,000 ha of the oil palm estate, only 60 ha were integrated with sentang. The largest integrated farm is 73 ha while the smallest is 0.40 ha. The average hectarage of farm in the survey is 158.3 ha and average integrated farm is 8.63 ha. These figures differ from the average hectarage of estates of 1,010.80 ha and smallholders of 5.98 ha. The average hectarage of integrated estate and smallholders is 39.20 ha and 3.17 ha respectively. The study also reveals that 42.4 % of the farmers visited have the whole of their farms integrated.

Age Of Crops

The average age of the agricultural crop at the time of the study is 6.82 years old while the average age of timber trees is 4.79 years old. This shows that the timber trees were normally planted after the plantations have been established with the main crops. However, the survey found out that most farmers practiced careful planning of their integration programs or processes whereby almost 67 % of them, i.e. 22 farmers planted their integrated crops and trees at the same time.

Planting Distance And Planting System

The planting distance and planting system of agricultural crops are similar to the standard practice of single cropping farms. In this study, the planting system of the integrated farms is categorized into 3 types, i.e. parameter (timber trees are planted as farm borders or boundaries), hedge (alternate rows or strips of agricultural crops and timber trees as shown in Plate 5 and Plate 6) and mixed or others (random mixtures of agricultural crop and timber trees). Lee and Hanafi (1978) and Nawi and others (1986) reported that hedge planting systems have shown very promising results in generating the income of oil palm plantations.

Plate 5: Hedge planting system. Alternate rows

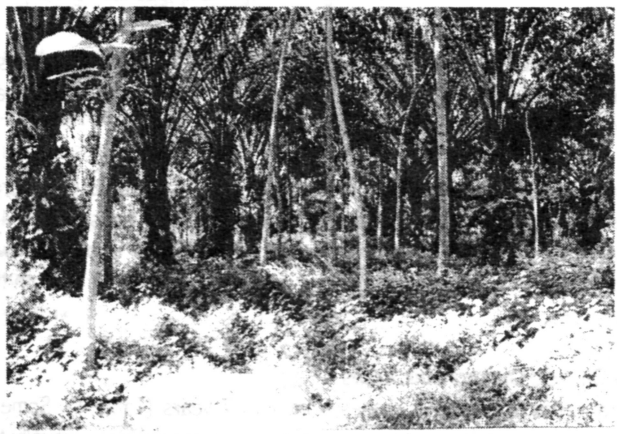

Plate 6: Hedge planting system. Alternate strips

Hedge planting is the most frequent practice system, almost 70 %, in Malaysia (Figure 3). This corresponds to the time of planting discussed earlier whereby careful planning by the farmers during the process of integration such as at lining and planting is required to obtain hedge planting system. The hedge planting system in this study consists of two different types, i.e., alternate rows and alternate strips of agricultural crops and timber trees.

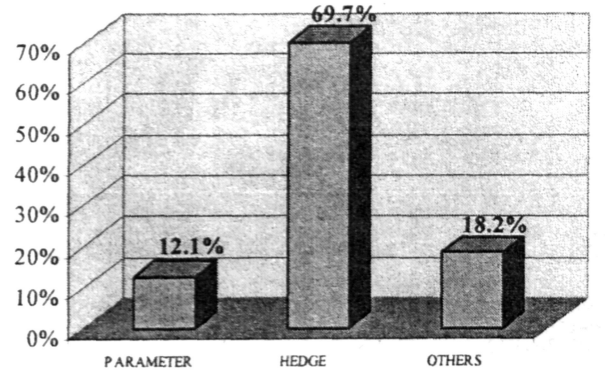

Figure 3 : Planting system of integrated farms.

Agronomic Practices

Most farmers carried out normal agronomic practices. These practices include planting systems of agronomic crops, types of fertilizers and rates of fertilizer used. Most farmers used extra dosage or additional fertilizers to fertilize their timber trees.

The frequencies of other agronomic activities carried out by farmers are also considered as normal. Frequency of fertilizer application of agricultural crops and timber trees is 3 to 4 times per year. Frequency of weeding is 2 to 3 times while frequency of pruning is once to twice yearly. Occurrence of pest and disease in the integrated farms is seldom. This applies to both the agricultural crops and timber trees.

Effects Of Integration On Yield Of Agronomic Crops

The age of agricultural crops at first yield ranges from 1 to 7 years (Table 1). Some annual or short-term crops can be harvested in less than one year while perennial crops usually take 3 to 7 years to produce yield. These are considered normal maturation periods for crops such as oil palm which matures in 3 to 4 years and durian in 5 to 7 years. Thus, the integration process does not affect the time of crop production in all the farms surveyed. The average fresh fruit bunch (FFB) yield of oil palm is 7.32 tones per hectare per year (t/ha/yr) with maximum of 20.00 t/ha/yr and minimum of 0.80 t/ha/yr. The average yield of rubber is 475.00 kilograms per hectare per year (kg/ha/yr) with maximum of 500.00 kg/ha/yr and minimum of 450.00 kg/ha/yr. These yields are quite low when compared to the national average (taken at peak yield period) as the average age of crops of the farms visited is only 6.82 years. These results show that the process of integration does not affect crop yields and farmers can still obtain normal yield of agricultural crops while waiting for the timber trees to mature.

Table 1: Age at first harvest and yield per hectare of agricultural crops.

Age and Yield	Minimum	Maximum	Average
Age of Agricultural Crops at First Harvest	1.0	7.0	3.72
Yield Per Hectare of Agricultural Crops - Oil Palm (t/ha/yr)	0.80	20.00	7.32
Yield Per Hectare of Agricultural Crops - Rubber (kg/ha/yr)	450.00	500.00	475.00

Problems Faced During The Implementation Of Integration

Some farmers faced problems related to integration during the cultivation and maintenance processes which they did not normally encounter with monocropping. These problems are divided into three main categories, i.e. technical, support system and work force requirement. Technical problems may occur during lining, planting, pruning, thinning, pest and disease control, and harvesting of agricultural crops. Farm drainage and road constructions are problems that relate to support system while work force requirement problem may involve management and control of workers. Table 2 shows that farmers do not encounter much problem in implementing integration. Only 5 out of 33 respondents faced some problems especially on technical matters. The table also indicates that most farmers need technical advice from the related agencies.

Table 2: Problems encountered during cultivation of integrated farms.

Problems and Advice	Count	Percentage of Responses
Problems Faced by Farmers :		
YES	5	15.2
NO	28	84.8
Technical	4	10.4
Supporting System	3	7.9
Work Force Requirement	2	5.3
Technical Advice Required	29	76.3

Effects Of Integration On Growth Of Agricultural Crops And Timber Trees

Data from field observations show that the effects of integration on growth of agricultural crops and timber trees greatly vary. These were mainly due to the different types of integration and agronomic practices carried out by the farm owners. Estate operators manage their farms considerably better than most smallholders do. Some smallholders could only carry out most of their agronomic practices with the aid of government agencies.

Measurements of plant height, i.e. bole height, of agricultural crops and trunk diameter, i.e. diameter at breast height (DBH), of timber trees are the only parameters taken. Data were taken from ten (10) random plants or samples of every plantation visited. The average values of these samples were then analyzed.

The average age of sentang in the oil palm+sentang integration is 9.36 years, while the average height is 7.09 m and DBH is 13.27 cm. In the rubber+sentang integration, the average age of sentang is 3.83 years, and the average height is 9.51 m and DBH is 10.64 cm. These results show that sentang tends to grow faster or taller in between rubber trees but the DBH is smaller compared to those between oil palm trees. Smaller DBH of sentang in the rubber integration is compensated by the vertical growth (height). Fierce competition for sunlight between sentang and rubber trees as compared to sentang and oil palm is the main reason for these results.

In the oil palm+teak integration, the average age of teak is 5.30 years, and the average height is 9.64 m and DBH is 16.32 cm. Meanwhile, in the rubber+teak integration, the average age of teak is 4.33 years, and the average height is 7.22 m and DBH is 9.47 cm. These data show normal growth of the teak trees in both types of integration. Thus, the integration process does not affect growth of teak trees.

There is also no significant difference recorded in the growth performance of timber trees in different planting systems of the timber carried out by the farmers.

Both visual observation and data collected show that the growth and yield of oil palm and rubber in the integration areas are normal compared to single-cropped areas. Thus, there are no adverse effects of the timber trees on plantation crops and vise versa.

CONCLUSIONS AND RECOMMENDATIONS

This study was carried out using samples that cover various types of integrated farms in Peninsular Malaysia. Only the farms that practiced integration of plantation agricultural crops with timber species were selected. These samples were shown to be representative of the common practices carried out by farm owners.

The most common type of integration being practiced is rubber+sentang. The main reason for the farmers to integrate their farms is to obtain extra income when their agricultural crops produce lower yields and during replanting of agricultural crops. Almost 67 % of the farmers establish their agricultural crops and timber trees at the same time. Hedge planting is the most frequent system practiced, almost 70 % of the farms.

Integrated farm owners carry out normal agronomic practices such as fertilizing, weeding and pruning to both the agricultural crops and timber trees. Time to first harvest and yield of the agricultural crops are the same in integrated farms as compared to single-cropped farms. Most farmers do not encounter problem related to technical, supporting and work force requirement during implementation but most of them required technical advice.

Sentang tends to grow faster in rubber plantations but has smaller trunk diameter than in oil palm plantations. Growth of oil palm and rubber is normal in the integrated areas compared to the single-cropped farms.

Since the integration process does not affect the growth and yield of the agricultural crops adversely, farm owners especially smallholders should be encouraged to integrate their farms in order to get additional revenue.

Farmers should plan the time of planting of their integrated farms so that the time of replanting of agricultural crops coincides with the harvesting of the timber trees whereby the farmers will get adequate and sustainable income to replant the agricultural crops and waiting for the crops to produce yield.

Related agencies (government or private) should conduct more programs and research in the implementation processes of integration and advice farmers on items such as types, systems, crops and trees, technical support and agronomic practices involved.

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