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THE VILLAGE WOODLOT: ITS IMPLEMENTATION IN THAILAND

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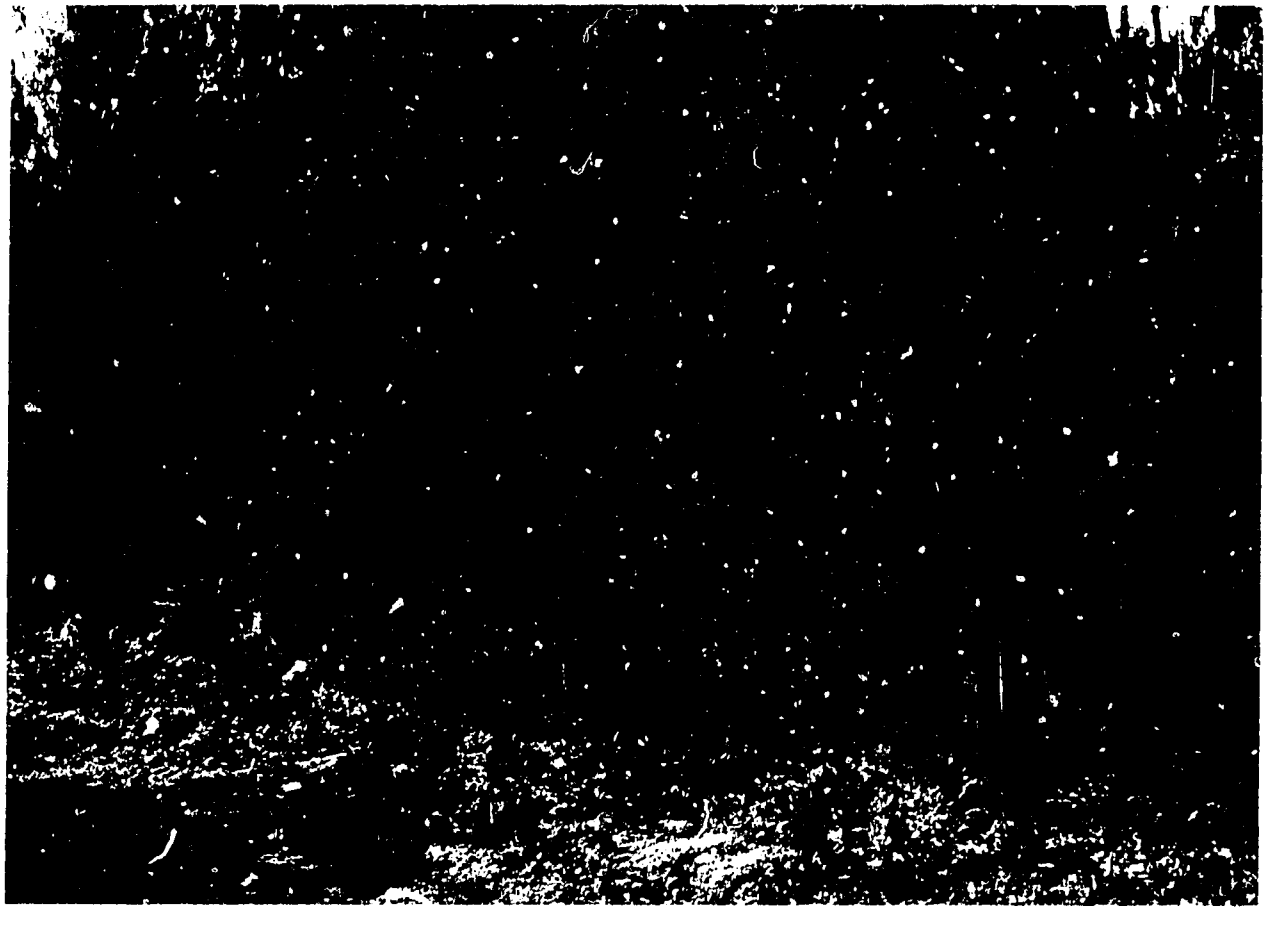

A VILLAGE WOODLOT

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Mr. Komol Pragthong
Component Leader,
Village Woodlot Project

CONTENTS

		Page
EXECUTIVE SUMMARY		9
CHAPTER 1	INTRODUCTION	
	A. Background	15
	B. Summary of Accomplishments	17
	C. Overall Project Objectives and Purpose	17
	D. Scope of Work	18
	E. Significance	19
CHAPTER 2	REVIEW OF LITERATURE	
	A. Background	23
	B. The Problem of Deforestation	24
	C. Woodlots	24
	D. Reforestation	26
CHAPTER 3	SILVICULTURAL ASPECTS OF THE VILLAGE WOODLOT	
	A. Introduction	35
	B. Planting Site Characteristics	36
	C. Silvicultural Characteristics of Tree Species Selected	42
	D. Planting Procedures	45
	E. The Areas Planted and Tree Growth	53
	F. Conclusions	62
	G. Recommendations	62
CHAPTER 4	ECONOMIC ASPECTS OF THE VILLAGE WOODLOT	
	A. Introduction	71
	B. Socio-economic Conditions	75
	C. The Demand for Fuelwood and Charcoal	80
	D. Determination of Best Rotation of Eucalyptus Plantation	80
	E. The Reforestation Program by Agroforestry System	81

Previous Page Blank

Page

CHAPTER 5 LAND USE AND SITE SELECTION FOR VILLAGE WOODLOT ESTABLISHMENT

A. Introduction 87

B. Methodology 88

C. Conclusions 99

D. Recommendations 105

CHAPTER 6 SOCIOLOGICAL STUDIES ON THE VILLAGE WOODLOT PROJECT IN NORTHEAST THAILAND

A. Introduction 109

B. Attitudes and Motives of the Villagers on the Acceptance of the Village Woodlot Project 112

C. Opinions of the School Teachers and the Buddhist Monks on the Village Woodlot Project 118

D. An Integration of the Village Woodlot into Rural Social Structure of Thai Society 127

CHAPTER 7 UTILIZATION OF WOOD OBTAINED FROM THE VILLAGE WOODLOT

A. Background 137

B. Utilization of Woodlots 138

C. Management of Benefits 144

D. Recommendations 145

CHAPTER 8 CONCLUSIONS 149

CHAPTER 9 RECOMMENDATIONS 155

ANNEX 161

EXECUTIVE SUMMARY

Realizing that the rate of forest degradation in Thailand is alarmingly high (approximately 333,000 hectares per year since 1945), the Fifth National Economic and Social Development Plan focused on the problem of deforestation as one of the priority areas in the development of alternative energy resources. The purpose of the Village Woodlot Component was to demonstrate and study the techniques of planting fuelwood crops so that there would be a sustained source of fuelwood production for villagers in the Northeast, where consumption levels are the highest according to a 1970 estimate. The Woodlot Project was carried out by the Royal Forest Department (RFD) in coordination with the National Energy Administration (NEA) under the support and supervision of USAID. The Village Woodlot Component was comprised of five sub-components, namely: Silviculture, Economics, Land Use, Sociology, and Utilization.

The project was carried out in seven provinces in the Northeast (Kalasin, Khon Kaen, Maha Sarakham, Roi-et, Si Saket, Surin, and Yasothon).

The overall purpose and objectives of the Village Woodlot Component were successfully achieved. The goal of the project was to develop greater institutional capability in the culture of plants for fuel and to support those social functions which foster the maintenance and improvement of fuel crops and of a wood resource base. The project was to establish the criteria for land selection for woodlot development; to analyze the social and economic factors of the village which promote the success of village woodlots; to determine the form of woodlots under the provision of land use, silviculture system and management; and to establish demonstration woodlots on the selected land.

The Village Woodlot Component consisted of two overlapping phases. The pre-demonstration effort was the first phase and consisted of surveys, data collection, data analysis, and receiving approval for use of public lands. The second phase began with a concurrent evaluation and plan for implementation. The scope of work for implementing the Village Woodlot Project includes: project site preparation, establishment of the Project Center, survey and analysis of the necessary data for the project, establishment of woodlots, and personnel in-service training -- study tours or observation tours abroad to RFD personnel as part of the training component.

Sub-component Descriptions

Silviculture

Relevant data were collected on soil characteristics, climate in the region, topography and other conditions necessary for the development of trees. Data on the growth of a number of tree species were collected and assessed for annual growth rate and durability. Selection of the most appropriate fast-growing tree species was made based on its potential for survival, its

ability to resist floods and drought, as well as its ability to grow well in saline and infertile soil. The species chosen as a result of this investigation was *Eucalyptus camaldulensis* (commonly referred to as red gum, river gum, red river gum).

By the third year of the study, 4,300 rai of public land (86%), school land (7%), and monastic land (7%) had been planted with this species at 41 sites. The average survival rate was 83%. By project completion, 6,000 rai had been planted.

Economics

Sample field surveys on the socio-economic conditions necessary for woodlot development were undertaken in four provinces (Maha Sarakhom, Roi-et, Yasothon, and Si Saket) to study population and education level, land tenure, and economic activities (farm activities in terms of crop production and livestock production and non-farm activities).

The proportion of households surveyed in each village varied, but averaged 25% of the total number of households. Results showed that 38.7% of the surveyed households in 8 project villages had to purchase fuelwood for their own use which indicates that the fuelwood shortage is becoming a serious problem in this region.

Land Use

Fuelwood scarcity and local needs for fuelwood were criteria used in choosing the seven provinces as sites for pilot village woodlots. Forest laws and regulations were taken into account for site selection and for ease in the process of village woodlot establishment; therefore, three types of land (public land, monastery land and school land) were chosen in each province to set up the village woodlot trial plots. Public lands were converted into village woodlots by planting *Eucalyptus camaldulensis* with a spacing of 2 x 4 m. To induce incentives, agroforestry was applied. Economic cash crops such as cassava, corn, groundnuts and tobacco were promoted to plant in the woodlots.

The three-year Village Woodlot Project showed that woodlots were successfully started on public land, school land, and monastic land.

Sociology

In its study of the potential for use of village woodlots in the Northeast, the Village Woodlot Project used an interdisciplinary approach; the sociological subcomponent studied attitudes and motives of the villagers towards accepting the project including conditions of the villagers in the project areas, attitudes towards the project, and motives of the villagers for accepting the project. It also studied the opinions of school teachers and Buddhist monks about the Village Woodlot Project, as well as general sociological conditions characterizing these two groups.

This study attempts to find out whether there is a relationship between villager attitudes towards the project and their educational level, age, and size of farm. There was an insignificant difference between the attitudes towards the project by male and female respondents. The majority of the villagers studied were positive towards the Village Woodlot Project.

In surveying the teachers and the Buddhists monks, the majority very strongly agreed with the project.

Utilization

The purpose of this subcomponent was to determine the utilization of *Eucalyptus camaldulensis* when the trees reached maturity for other purposes besides fuelwood and charcoal. Assuming the trees were five years old, the utilization subcomponent suggested the following uses for woodlot projects: fuelwood and charcoal burning, prefabricated wooden fences, stickwood furniture, log cabin walls, house posts and electric poles, agricultural tools, flooring, handicrafts, woodchips, and fuel for electric generators. To ensure durability of fresh-cut timber, seasoning and wood preservation is important for wood utilization; a training course should be set up at the woodlot locations where simple methods for seasoning and preserving could be taught.

Chapter 1

Introduction

by Dr. Tem Smitinand

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INTRODUCTION

This report is a compilation of five separate studies each researching related aspects of the Village Woodlot Project. Chapter 1 presents the general background of the project, as well as a consideration of the objectives, significance, and scope of the project, followed by a review of literature in Chapter 2. A study of the agricultural aspects of forest development is presented in Chapter 3, Silviculture. Chapter 4 examines economic aspects of the village woodlots, while Chapter 5, Land Use, investigates the optimum use of land for woodlot development. Chapter 6 studies sociological conditions in the project areas, including a survey of attitudes of the villagers, monks and teachers in accepting the project. Finally, Chapter 7 examines utilization of wood obtained from the woodlots.

A. BACKGROUND

Just before the Second World War, 1941-1944, Thailand was covered with luxuriant forests of evergreen and deciduous trees. It has been estimated that, at that time, the area of natural forests was approximately 60% of the total area of Thailand.

The impact of fast economic development and the ever-increasing population after World War II affected the natural forests through over-exploitation, illicit cutting, mining, land settlements, construction of hydro-electric dams, and super highways. Further, the use of land for cash crop cultivation and the practice of shifting cultivation (employed by the local populace and the hill tribes) left only 34% of the forest after World War II. The rate of forest degradation in Thailand is alarmingly high--approximately 333,000 hectares per year--second only to Indonesia.

The Northeast of Thailand (well-known as the Korat Plateau) consists of 16 provinces having a total area of 168,854 square kilometers. LANDSAT III in 1982 revealed that forest area accounted for 15.33% of this total region (25,886 square kilometers) in the Northeast. Naiyanaet (1983) estimated that the forest land in this region would drop to 12.17% of the total area by 1986.

Further, in 1970, the average consumption of wood fuel per capita was estimated to be 1.23 cubic meters, with the highest consumption in the Northeast. The total consumption of wood fuel for the whole country was over 44 million cubic meters of which more than 50% was fuel wood.

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Therefore, it is well-known that the shortage of wood fuel (both in urban and rural areas) is imminent based on the estimation that by 1985 the maximum limit will be 34 million cubic meters.

Thus, the Fifth National Economic and Social Development Plan focused on the problem of deforestation as one of the priority areas in the development of alternative energy resources. The U.S. Government supported the Project on Renewable Nonconventional Energy submitted in 1979 by the Royal Thai Government through USAID and implemented during the fiscal years 1981-84. The Village Woodlot Project is one component of 14 separate components involved in the Renewable Nonconventional Energy Project. Component Projects carried out include:

Village Woodlots
Industrial Biogas
Biomass Gasification
Charcoal Improvement
Energy Master Plan Support
Micro-Hydro Project
National Energy Information Center
Pyrolysis of Rice Husk
Regional Energy Centers
Solar Thermal Processes
Solar Wind Assessment
Stove Improvement
Village Survey
Water Lifting Technology

The purpose of the Village Woodlot Component was to demonstrate and study the techniques of planting fuel wood crops so that there would be a sustained source of fuel wood production for villagers in the Northeast. The Woodlot Project was carried out by the Royal Forest Department (RFD) in coordination with the National Energy Administration (NEA) under the support and supervision of USAID. The Village Woodlot Component was comprised of five sub-components, namely:

1. Silviculture
2. Economics
3. Land Use
4. Sociology
5. Utilization

The project was carried out in 7 Provinces in the Northeast (Kalasin, Khon Kaen, Maha Sarakharm, Roi-et, Si Saket, Surin, Yasothon).

B. SUMMARY OF ACCOMPLISHMENTS

The overall accomplishments of the Village Woodlot Project are summarized below:

- 6,000 rai of *Eucalyptus camaldulensis* have been planted in 7 provinces.
- One million (1,000,000) seedlings have been distributed to villagers in eight provinces.
- A field survey of the socio-economic conditions in 4 northeastern provinces was conducted.
- A sociological study was conducted to assess villagers' attitudes and motives toward accepting a village woodlot.
- A study to find suitable land for use as a village woodlot was conducted.
- An extensive educational and training program was carried out through use of radio, TV and printed materials.

C. OVERALL PROJECT OBJECTIVES AND PURPOSE

The overall purpose and objectives of the Village Woodlot Component were successfully achieved. The goal of the project was to develop greater institutional capability in the culture of plants for fuel and to support those social functions which foster the maintenance and improvement of fuel crops and of a wood resource base. The project was to establish the criteria for land selection for woodlot development; to analyze the social and economic factors of the village which promote the success of village woodlots; to determine the form of woodlots under the provision of land use, silviculture system and management; and to establish demonstration woodlots on the selected land. Specific project objectives were:

- To provide a sustained supply of wood fuel for both woodlot owners and non-woodlot owners;
- To lessen the pressure resulting from the cutting of trees in the natural forests and illicit cutting of trees on public lands in general;
- To create employment opportunities and increase income for rural families.

- To develop techniques to be used as an important first step toward a countrywide scheme; and

- To stimulate interest in tree farming by demonstrating the benefits derived from such development.

D. SCOPE OF WORK

The Village Woodlot Component consisted of two overlapping phases. The pre-demonstration effort was the first phase and consisted of surveying, data collection, data analysis and receiving approval for use of public lands. The second phase began with concurrent evaluation and planning for implementation. The scope of work for implementing the Village Woodlot Project is presented below:

- Project site preparation

  - Identification of potential project sites;

  - Identification of villages to be included in the project.

- Establishment of the Project Center

  - Determining the specifications for site development and equipment for the center;

  - Obtaining the necessary equipment and site development materials.

- Survey and analysis of the necessary data for the project.

  - Analysis of public, private, monastic and unused land management and ownership within the villages which might be used for growing fuel wood;

  - Analysis of the multiple land use options in the village which include soil condition, sources of fuel wood, intercropping, etc;

  - Determining the demand for fuel wood used in the village and surrounding areas which includes: species of wood, supply sources, final use, and market mechanism;

- Analysis of the attitudes and incentives necessary for village members to accept the woodlot concept and begin implementation, and other social and economic factors.

- Determining the method to be used for the village woodlot which is suitable for local land use, taking into account species, labor, silviculture system and management scheme.

- Establishment of woodlots

  - Selection of the village woodlot members;

  - Providing the training on establishing, maintaining and protecting the woodlot; and

  - Establishing the woodlot on a demonstration scale.

- Personnel in-service training, study tour or observation tour abroad to RFD personnel was part of the training component.

E. SIGNIFICANCE

Given the magnitude of the resource degradation issue--as well as the increasing pressure on available wood fuels--this component made a major contribution toward the long-term need for effective resource management. It directly benefits the development of the rural areas from both the socio-economic and environmental points of view and, in particular, can benefit the rural populace by increasing per capita income. In addition, the results of the Village Woodlot Project are vital to the continued resource needs of other components in the continuation of the overall Project, such as gasification and the production of charcoal as a sustained source of raw material.

Chapter 2

Review of Literature

by Dr. Tem Smitinand

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REVIEW OF LITERATURE

There have been many papers published which pertain either directly or indirectly to village woodlots, only a few of which are being reviewed in this chapter. This review of the literature will cover the following topics: a) the problem of deforestation; b) woodlots; and c) reforestation.

A. BACKGROUND

The total area of Thailand is about 513,115 km^2, based on the latest cadastral map available. In the past, just before the Second World War (1941 - 1944), the country was well covered with luxuriant forests of evergreen and deciduous trees. It was estimated at that time, that the natural forests covered about 60% of the total area of the country.

SMITINAND (1977) in giving an account of the "Vegetation and Ground Cover of Thailand" classified the forests of Thailand into 2 categories: Evergreen and Deciduous.

The evergreen forests composed a great proportion of the non-leaves-shedding species, and formed about 60% of the total forested area. It was sub-divided into 4 types: Tropical Evergreen Forest; Coniferous Forest, Swamp Forest; and Beach Forest. The deciduous Forest was subdivided into 3 types: Mixed Deciduous Forest; Dry Deciduous Dipterocarp Forest; and Swanna Forest.

The remaining ground covers consist of the limestone formations, the marshy low-lying lands among depressed areas and the agricultural lands under rice, tapioca, maize, coconut, palm-oil, and rubber plantations.

The impact of fast economic development and the ever increasing population after World War II took its toll on the natural forests. Through over exploitation, illicit cutting, mining, land settlements, construction of hydro-electric dams, super highways, the encroaching of land for the cultivation of cash crops plus the practice of shifting cultivation by the local populace and the hill tribes, only 34% of the forest was left after World War II. The rate of forest degradation is alarmingly high, approximately 333,000 hectares per year, making Thailand second only to Indonesia.

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B. THE PROBLEM OF DEFORESTATION

De Backer & Openshaw (1972) made a national survey on timber trends which was to form the basis of the FAO 1972, "Report to the Government of Thailand on Present and Future Forest Policy Goals (1970 - 2000)". This study gave the trends on the consumption of wood fuels, i.e., fuelwood and charcoal.

In 1970 the average consumption of wood fuels per capita was estimated to be 1.23 m^3 ranging from 1.0 m^3 to 1.27 m^3) with the highest consumption in the Northeast. The total consumption of wood fuels for the entire country was over 44 million m^3 per year of which more than 50% was for the fuelwood. It is well known that the shortage of wood fuels both in the urban and rural areas would be imminent in the very near future, based on the estimation that by 1985 the maximum limit will be 34 million m^3 (de Backer & Openshaw, 1972): At the same time there is still inadequate data on the availability of fuel resources as well as the resource balances for other utilizations.

C. WOODLOTS

FAO (1978) defines village woodlot under the heading, "Small-Scale Forestry" (p. 42): "This is silviculture on the scale dictated by local demand for forest products and local availability of suitable land. There is a single main product, normally firewood, and the techniques of cultivation are simple". This paper also gives relevant information on silviculture and fuelwood (pp. 51 - 53).

On the selection of species: "For rural communities, productivity in the early years is more important than later productivity, since it allows short rotations and early returns on the initial investment in planting. 'Quick starters' are preferable for this and most of these are ecological pioneer species rather than members of climate communities". Under this topic an observation is mentioned: "There is much evidence that, for certain species, the provenance or geographic location from which seed was collected may be as important a factor in adaptability and rate of growth as the talonomic species itself".

On the heating value of fuelwood: "The heat produced by unit volumes of wood of different species is determined by the factors of specific gravity, moisture content and extractives. Of these, differences in specific gravity are likely to be the most important in modifying any choice of species based on volume yield per hectare". Under this topic mention is also made on specific gravity: "It should be noted that specific gravity in fast-growing short rotation crops may differ considerably from that on the mature stand".

On special characteristics of fuelwood species: "Certain characteristics of a potential fuelwood species may become limited for particular uses. Emission of sparks is a disadvantage in an open domestic fireplace or when burned in proximity to inflammable buildings. Odor from combustion may rule out the use of certain species for cooking, fish drying and tobacco curing".

The Royal Thai Government (RTG), realising the fast dwinding of natural forests and the acute shortage of wood fuels, submitted a proposal for a project on the renewable nonconventional energy (Project No. 493-0304, USAID/Thailand, July 1979) to the United States Government of which village woodlot is one of the categories appended in Annexes XII and XV. The details of the proposed study are based on the work of de Backer & Openshaw (1972). NAS (1980) listed the benefit of woodlots: "In addition to fuel, woodlots in and around villages and cities can provide stable and pleasant surroundings. They provide shade, shelter, beautification, and habitats for wildlife, which in many areas are a valued food source. The plantations also reduce wind erosion, benefically influence local temperature and humidity, and in many cases replenish and redistribute essential soil nutrients". (p. 20).

Landgraf & Elmendrof (1981) presented a feasibility study on the woodlots and household energy which compliments the present project. Their study investigated the socio-cultural aspects vital to the planning of the Baseline Survey Component undertaken by the Meta System Co., Ltd.

USAID/Philippines (1982) described the management of a Leucaena woodlot to supply the gasifiers in the Philippines: "The woodlots will be developed on marginal lands adjacent to the paddy fields. In addition to fast-rotation tree species, the woodlots will be intercropped with grains, vegetables, or peanuts for use or sale by the farmers. In most cases the trees will probably be *Leucaena leucocephola*. The lot will be divided into three sections and operated on a three-year cycle". (p. 7).

Under the gasifier program it states: "The woodlots are developed on 6 hectares of land leased by ISA which borrows and repays the money required to develop them. The woodlot is developed over a three year period, with one-third being planted each year, and harvested in three year cycles. New trunks grow from coppices which resprout from the stumps after each harvest, eliminating replanting costs. New trunks are again harvested every three years". (p. 12).

Saphasri, B. and K. Phraekthong (1983) gave a historical review of fifteen village woodlot projects carried out by a number of organizations in Thailand, the Royal Forest Department (RFD), the Land Development Department, and the Department of Public Works used *Acacia auriculiformis*, *Eucalyptus camaldulensis*, *Leucaena leucophylla*, *Peltophorum dosyrachis* as tree crops. The projects were under different titles but have the same objectives, i.e. being either the source of fuel wood and charcoal production or the source of other kinds of wood needed by the rural community. The projects were financed either by the RTG with aid from international organizations or by loans from the World Bank.

D. REFORESTATION

NAS (1977) published a report of a joint study on *Leucaena* which gave its potentiality: "Leucaena is not adapted to truly arid or mountainous areas where firewood needs are greatest. However, it does grow well in semiarid and savannah regions of the dry tropics, as well as in the more humid lowland tropics, where the need of fuel wood is still substantial". (p. 49).

On the quality of leucaena wood it quotes: "Because their wood is more dense, Hawaiian type leucaena strains make better firewood than the Salvador type, producing more heat when they burn. They are well-suited to small-scale village and household use. But the Salvador type varieties grow faster and produce a greater quantity of wood, which makes them a suitable candidate for large-scale 'energy plantations' ". (p. 50).

NAS (1979) publishing a report of an Ad Hoc panel, gave the following comments and suggestions on fast-growing tropical leguminous trees: "*Acacia auriculiformis* is a resilient, vigorously growing small tree. It deserves much increased testing throughout tropical areas, especially those with dry seasons as long as 6 months. The tree's outstanding quality is its ability to grow in poor in poor soils where few other trees can survive". (p. 165). The tree has a draw-back: "Although it is drought tolerant, *Acacia autriculiformis* cannot withstand as severe drought as can some hybrid eucalyptus, probably because its roots are closer to the soil surface". (p. 169).

The report also gave relevant information on *Acacia mangium*, a native of Queensland, Australia: "On disturbed or burned sites, on degraded lateritic clay underlain with volcanic rock, on soils so worn out that even shifting cultivation has been abandoned, and on hillslopes infested with weeds such as *Imperata* and *Eupatorium* species, *Acacia mangium* has grown vigorously, often achieving annual production in excess of 20 m^3 per ha". (p. 195).

De Guzman (1979) observed on the disease of eucalyptus: "A new disease known as blight has been found affecting these species and this may become a major obstacle in the establishment of plantations". (p. 349). He gave the symptoms and signs affecting the eucalyp: "On infected *Eucalyptus robustus* and *Eucalyptus saligna* trees, the leaves turn brown and curl, sometimes becoming very much deformed". And "the casual organism infects the trunk or branches and causes necrosis of the bark. Later, cracks develop at the infection site from which a gummy substance usually exudes. Repeated infection usually leads to stunting and/or death of the infected tree". (p. 351).

Chijicke (1980) states: "An additional reason for a shift from conventional to plantation forestry in parts of the tropics is probably the rising demand for fuel wood as a source of energy in the developing world. Fuel wood (despite petroleum) has continued to be the major energy source and its shortage has led to low food production". (p. 1). He further remarks (p. 2) on the effect of fast-growing trees on the soil: "Forest trees, especially the fast growing ones, make heavy demands on the soil. In the case of the current plantation practice, where there is complete or near-complete biomass removal .... up to several thousand kg/ha of biologically important nutrients are removed with each harvest."

NAS (1980) cautioned the user in its publication on firewood crops: "Because of the severity of the firewood crisis, the panel has selected trees and shrubs that are aggressive and quick growing -- the threat of their weediness is too great. In any fuelwood plantation local species should always be given first priority". (p. ix).

The importance of local enthusiasm is emphasized. "Reforestation also requires massive popular support. In country after country, the lesson is plain. Tree-planting programs are most successful when local communities are most involved and when the people perceive clearly that success is in their self-interest". (p. 7).

The need to integrate forestry into rural development is recognized worldwide: "The U.S. Congress has directed the United States Agency for International Development (USAID) to focus on forestry and firewood plantations in its rural development programs. The World Bank has announced its intention to multiply its support for such activities as village woodlots, farm forestry and environmental rehabilitation. And in Nairobi, the International Council for Research in Agroforestry has been set up, aimed at coordinating the stimulating efficient land use through combining wood and food production". (p. 10).

On fuelwood management it states: "Firewood can best be produced like a farm crop without government intervention. Thousands of Brazilian farmers in the state of Sao Paulo Minas Gerais and Parana already grow eucalyptus woodlots, partly for firewood, on land generally unsuitable for agriculture... Fuelwood trees can be cultivated in small woodlots, even as individual specimens around a house or village. In some areas, such as Java and the People's Republic of China, house gardens already supply a good share of family firewood needs". (p. 21).

A number of firewood species for humid tropics (pp. 32-69) and for arid and semiarid regions (pp. 90-163) are recommended, one of which fits well with the application in Northeastern Thailand, i.e. *Eucalyptus camaldulensis*: "As firewood, the timber from *Eucalyptus camaldulensis* has few equals. It is also a good charcoal wood .... The tree will grow in many climates from tropical to subtropical; it has the ability to thrive on relatively poor soil and increase where dry seasons are prolonged". (p. 126)

Phimmanrochanangkun and Phraekthong (1983) constructed provisonal volume tables of *Eucalyptus camaldulensis* cultivated in Thailand, given collateral figures ranging from 2-90 cm. diameter (DBH) and 3-egm height, based on data collected at the Woodlot Center, Kanthralak, Si Saket. The rate of growth is very impressive. At a height of 10 m and a diameter of 10 cm, the volume of the tree is 25.6m^3 when the tree is approximately 10 years old.

Corvanich (1984) had the idea that communal forest plantation was one way of reforestation. The feasibility of the communal forest plantation in Thailand was based on the present basic needs of the populace. On the site selection he had the opinion that the acceptance of the sub-district council and the distance from the village to the plantation were vital. He estimated that the distance from the village to the plantation should not exceed 5 km.

Mangkorndin (1984) presented the trends of wood fuels, based on the households, industries, and public services in both urban and rural areas. Wood fuel consumption in Thailand during 1983 decreased in comparison to the 1970 and 1980 figures due to a higher usage of gas, oil and grid electricity. This conforms to the predictions of de Backer and Openshaw in 1972.

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Chapter 3

Silvicultural Aspects of the Village Woodlot

by Dr. Bunvong Thaiutsa

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SILVICULTURAL ASPECTS

OF THE VILLAGE WOODLOT

A. INTRODUCTION

Generally speaking, silviculture which is derived from the Latin word "silva" (tree) and "culture" is the process of growing trees. From a forestry point-of-view, it is concerned with controlling the establishment, growth, composition, and quality of forest vegetation. This can only be done in any given forest cover and locality if there is a clearly defined management objective that describes what is to be achieved. Each management objective must be interpreted in terms of the kind of stand structure which is most suitable. Simple objectives such as wood production commonly require a simple and efficient structure in comparison to complex objectives involving multiple uses of forest land and forest vegetation. The Village Woodlot is a typical example of a simple management objective of growing a man-made forest primarily to produce fuel wood for the villagers. The pilot project is concentrated in Northeastern Thailand where productive forest land is relatively depleted and, where there is a higher demand of fuel wood consumption in comparison to other regions of the country. Huamuangkaew (1983) estimated that the per capita firewood consumption in some provinces of the Northeast was 1.42 m^3/yr, while the average supply of the country recorded by the ESCAP/FAO/UNEP Group Meeting was 0.445 m^3/person/year.

However, this shortage in firewood supply is a problem not only in the Northeast, but it is also a problem in other regions of Thailand as well as in other parts of the world. Dr. Edwards S. Ayensu, Chairman of the Panel on Firewood Crops of the National Academy of Sciences (1980) mentioned that

> "more than one-third of the world's population depends on wood for cooking and heating. Eighty-six percent of all the wood consumed annually in the developing countries is used for fuel, and of this total at least half is used for cooking. The situation is growing so desperate that wood is poached from forest reserves; hedges planted around homes are stolen at night, and even scaffolding is stolen from building sites to meet shortages in firewood supplies."

Although the problem has not become as serious in Thailand yet, protective and remedial measures are promptly required. An establishment of suitable forest plantations seems to be the best way of getting away from the problems mentioned.

Hence, the principal objective of this paper is to focus on particular techniques of tree planting and tending, especially on saline and infertile sites in Northeastern Thailand.

B. PLANTING SITE CHARACTERISTICS

The Northeast of Thailand, well-known as the Korat Plateau, consists of 16 provinces having a total area of 168,854 km^2. Forest area, as was revealed from LANDSAT III in 1982, was 25,886 km^2 accounting for 15.33% of the total Regional area (Naiyanaet, 1983). Naiyanaet (1983) also estimated that forest land in this Region would drop to 12.17% of the total area by 1986, due mainly to a high population density of over 100 persons/km^2 (Chulalongkorn University Social Research Institute, 1981).

A pilot project of Village Woodlots was established in 7 provinces of the Northeast as follows:

1. Kalasin
2. Khon Kaen
3. Maha Sarakharm
4. Roi-et
5. Si Saket
6. Surin
7. Yasothon

Figure 1 illustrates the provincial distribution of planting sites. The major site is located in the area called "Thung Kula Ronghai". The area is characterized by dry, infertile, and saline soil with low productivity.

According to the review for the implementation of the Kula Ronghai Project prepared by the Social Research Institute of Chulalongkorn University (1981), the climate in this region is characterized by fluctuations in rainfall rather than fluctuations in temperature. It has a tropical wet and dry monsoon climate with a southwest monsoon rainy season from mid-May to mid-September and a northeast monsoon dry season from November to mid-March. October is considered a transitional period. The mean annual precipitation is classified as a tropical low rainfall with less than 10% of this coming during the 5-month dry season. The total amount of rainfall varies from place to place but averages

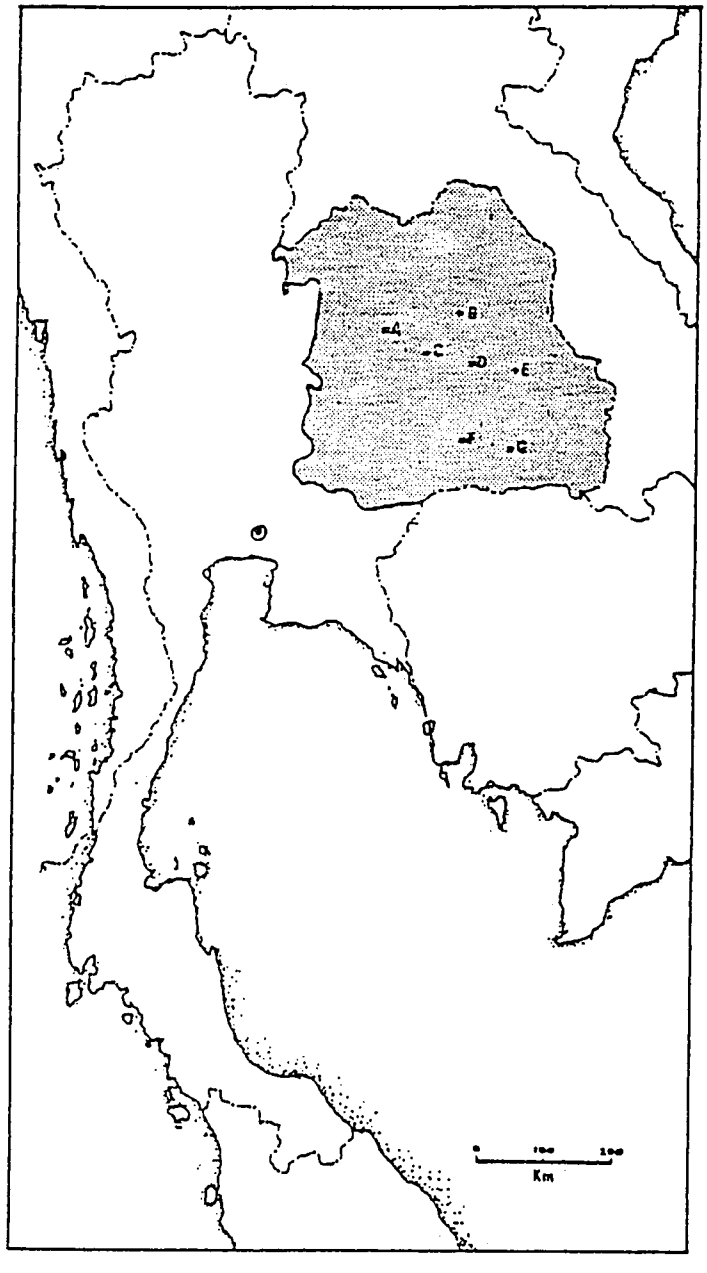

Figure 1 Planting site distribution of the Village Woodlot Project in northeastern Thailand shown by the shaded area.

A = Khon Kaen; B = Kalasin; C = Maha Sarakharm; D = Roi-et; E = Yasothon; F = Surin; G = Si Saket

about 1,300-1,400 mm/year with two rainfall peaks, in May and September. The year-round mean temperature is 27°C with a maximum of over 40°C in April while the minimum may be as low as 5°C in December. Using a pluviothermic graph, Thaiutsa (1983) found that the dry period covers at least five and half months a year, ranging from early November to mid-April. This extended dry season means that soil in the area is predominantly dry half of the year (Figure 2). Winter and summer droughts lead to uncontrolled fires. According to such climatic conditions, the potential success of any agriculture development project (bot. for paddy rice and upland crops) seems to be marginal, especially without an effective irrigation scheme. The data in Table 1 indicates the monthly distributions of rainfall, temperature, and relative humidity of Maha Sarakharm provinces.

Table 1 Monthly climatic data of Maha Sarakharm (1977-1981)

Month	Rainfall, mm	Temperature, °C			Humidity, %
		Mean	Max	Min	
Jan	1.30	23.6	34.0	12.9	63.54
Feb	4.52	26.2	37.5	14.1	61.88
Mar	31.04	30.3	39.0	18.0	59.18
Apr.	73.14	30.4	40.0	20.8	66.24
May	200.04	29.3	37.7	21.7	75.02
Jun	196.80	28.9	35.5	22.7	79.68
Jul	134.72	28.3	35.2	22.5	78.32
Aug	191.20	27.9	34.6	26.3	79.82
Sep	268.92	27.4	33.7	21.8	82.60
Oct	84.70	26.6	33.4	18.5	75.54
Nov	8.54	24.4	32.7	14.4	71.66
Dec	1.36	22.6	33.2	11.3	66.92

Soil in the Northeast is predominately laterite which is a porous indurated, concretionary material, usually red to reddish brown in color. However, soils at planting sites mostly belong to the Alluvial soils on recent fresh-water alluvium; Low-Humic Gley soil on semi-recent and old alluvial; Low-Humic Gley soils and Gray Podzolic soils on old alluvium; and Gray Podzolic soils on old alluvium (Moormann & Rojanasoonthon, 1967; Moormann et al., 1964). They are in the Roi-et (Re), Tha Tum (Tt), Kula Ronghai (Ki), Kalasin (Kn), and Yasothon (Yt) Series with Alluvial Complex (AC) in some areas. These soils are characterized by deep profiles of loamy sand and sandy loam formed from old alluvium. Drainage is poor with slow permeability due to compact siltation in subsoils. The area flooded in August and September as a result of low permeability and compact top soil. Natric horizon is commonly found in the Thung Kula Ronghai area. From a chemical standpoint, soils are low in mineral nutrients necessary for plant growth and are acidic. Soil chemical properties of some planting sites are tabulated in Table 2.

Table 2 Soil chemical properties of some planting-site provinces (Source: Thaiutsa et al., 1983)

Province	pH	O.M, %	P	K	Ca	Mg
			.....ppm.....			
Maha Sarakharm	4.7	0.94	15	33	89	46
Si Saket	4.4	0.62	2	11	55	13
Roi-et	3.5	0.39	5	23	72	14
Yasothon	4.1	0.75	3	11	69	17
Khon Kaen	4.7	0.83	4	13	76	22
Kalasin	5.0	0.98	11	29	91	53
Surin	4.8	0.71	5	11	73	26
Average	4.5	0.75	6	19	75	27

According to Naiyanaet (1983), the average percentage of forest area in the seven provinces studied was only 8.85% of the total area. Maximum forest land was recorded for Yasothon Province, 13.21%, while the minimum was in Maha Sarakham, with only 2.98% of the total area. Exploited dry dipterocarp forest is considered the only prominent forest type. The major

Eucalyptus camaldulensis trees can be planted in flood-prone areas.

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tree species are *Dipterocarpus tuberculatus*, *Dipterocarpus obtusifolius*, *Shorea obtusa*, *Shorea siameusis*, *Shorea roxburghii*, *Phyllanthus emeblica*, and *Irvingia malayana*, (see Figure 3). A personal contact with Ms. Teunchai Lakhaviwattanakul of the Royal Forest Department found that mainly natural herbs grow in the Thung Kula Ronghai area. These include the *Adenosma idianum*, *Lindernia cambodgiana*, *Xyris pauciflora*, *Drosera burmani*, *Drosera indica*, *Desmodium heterophyllum*, *Aristida chinensis*, and *Fimbristylis dichotoma*, which have an above ground biomass of 166.635 g/m^2 or 1,666.35 kg/ha. Used as forage crops, the nutritional values of these herbs seem to be slightly higher than those recommended for planting on mine tailings in southern Thailand, i.e., *Brachiaria brizantha*, *Brachiaria decumbens*, and *Panicum maximum*, (Treeyakit et al., 1983).

C. SILVICULTURAL CHARACTERISTICS OF TREE SPECIES SELECTED

The choice of a tree species to be planted for firewood production in general sites was widely discussed in a seminar on Forestry for Rural Community. Sumantakul et al., (1983) mentioned that both indigenous and exotic tree species have been chosen for planting in various parts of the country. The superior indigenous trees include *Acacia catechu*, *Combretum quadrangulare*, *Peltophorum inerme*, and *Rhizophora mucronata*, while *Acacia auriculiformis*, *Acacia mangium*, *Casurina junghuhniana*, *Leucaena leucocephala*, and *Eucalyptus camaldulensis* are the promising exotic trees.

However, the species selected for planting in such severe conditions as Thung Kula Ronghai must be taken in strict consideration. The species selected should have a high potential of survival, be flood and drought resistant as well as have the ability to grow well on saline sites with infertile soil. Based on experiences gained from field observations and literature reviews, *Leucaena leucocephala* and nitrogen-fixing trees definitely have a low survival percentage and low growth rates. Eucalypts, *Eucalyptus camaldulensis* in particular, has shown a satisfactory performance. Thus, the Village Woodlot Project selected *Eucalyptus camaldulensis* for planting at all sites. Besides its superior characteristics already mentioned, *Eucalyptus camaldulensis* is also suitable for firewood in terms of wood specific gravity and calorific value compared to other firewood crops (see Table 3).

Eucalyptus camaldulensis (common names: red gum, river gum, red river gum) is a tree species native to Australia. Its synonym is *Eucalyptus rostrata*. Eldridge (1975b) compiled over 100 references on genetic variation of *Eucalyptus camaldulensis* and mentioned that "the name *Eucalyptus camaldulensis* was given in honour of the Count of Camaldoli who had grown the tree successfully in his graden near Naples in Italy since 1822". The common name, red gum or river red gum, refers to the

Table 3 Calorific values and specific gravity of some firewood crops capable of being planted in Thailand (Source: National Academy of Sciences, 1980)

Species	Calorific value kcal/kg	Specific gravity
Eucalyptus camaldulensis	4,800	0.60
Acacia auriculiformis	4,800-4,900	0.60-0.75
Albizia lebbek	5,200	0.55-0.60
Azadirachta indica	4,244-5,043*	0.56-0.85
Calliandra calothyrsus	4,500-4,750	0.51-0.78
Cassia siamea	-	0.60-0.80
Casuarina equisetifolia	4,950	0.80-1.20
Eucalyptus globulus	4,800	0.80-1.00
Eucalyptus grandis	-	0.40-0.55
Gelina arborea	4,800	0.42-0.64
Leucaena leucocephala	4,200-4,600	-
Rhizophora mucronata	4,000-4,300	0.90
Syzygium cumini	4,800	0.77
Terminalia catappa	-	0.59

* Source: Puriyathon, 1983

rich red-brown color of the heartwood and gum and to its occurrence along watercourses in southern Australia. It is the most widely spread of all eucalypts in its native country. Even in the desert areas, *Eucalyptus camaldulensis* may be found along drainage channels.

The species is found both in areas of low and high rainfall ranging from 200 to 2,000 mm. According to the National Academy of Sciences (1980), "a lower limit of commercial plantation is 400 mm annual rainfall, although the trees will grow well in drier areas if there is seasonal flooding or a high water table". Over 500,000 ha of *Eucalyptus camaldulensis* have been planted throughout the world, especially in the countries around the Mediterranean. It regenerates itself into small thickets well for six or more regenerations. It withstands high summer temperatures and is hardy down to 3°C, though some provenances can withstand -5°C and as many as 20 frosts a year. Also, some provenances can be grown in highland areas of about 1,200 m elevation. The tree adapts well to various soil types. Most provenances tolerate periodic water-logging, while some seed sources tolerate calcium and saline soils. The leaves are not favored by livestock or wildlife. Mature trees are also found to be fairly fire resistant, although young ones are susceptible. The only limitation in reforestation programs is an appropriate seed-source selection. Seeds must be selected with particular thought to latitude, altitude, rainfall, temperature, soil type, and pest resistance.

FAO (1979) listed the main characteristics of *Eucalyptus camaldulensis* as follows:

- Ability to thrive and produce acceptable yields in relatively poor soils with a prolonged dry season;
- Ability to tolerate periodic water-logging;
- Some resistance to frost;
- A vigorous coppicer;
- Usually crooked or at least considerably more crooked than preferred species such as *Eucalyptus grandis* or *Eucalyptus globulus;*
- Thin-crowned and thus less able to suppress weed growth rapidly than a dense-crowned such as *Eucalyptus grandis;*
- Becomes chlorotic in highly calcareous soils; and
- Produces a harder, heavier and more deeply colored wood than species such as *Eucalyptus grandis* or *Eucalyptus globulus*. This makes it somewhat less suitable for pulp.

As firewood, the National Academy of Sciences (1980) emphasized that "the timber from *Eucalyptus camaldulensis* has few equals. It is also a good charcoal wood, and the steel industry in Argentina, for example, relies on its charcoal for steel making.....with the right provenance on a favorable site, *Eucalyptus camaldulensis* grows very fast. Mean annual growth increments of 2 m in height and 2 cm in diameter can be maintained for the first 10 years. Annual wood yields of 20-25 m^3 per ha have been reported from Argentina, 30 m^3 per ha from Israel, 17-20 m^3 per ha from Turkey for the first rotation (from seedlings) and 25-30 m^3 per ha in subsequent coppice rotations. On good sites, plantations are managed on coppice rotations of 7-10 years. But on poor dry sites, annual yields drop off to between 2 and 11 m^3 per ha and rotations of 14 or 15 years may be needed".

Besides fuel wood and charcoal, *Eucalyptus camaldulensis* has been used in many countries for posts and poles. It is also commonly used for shelterbelts, shade and amenity planting in dry areas. Its use as flooring blocks has been reported from Spain, Portugal, and Uruguay. Its main use in Agentina is for the production of hardboard. Attempts were made to use it for sawtimber, but the quality of sawnwood is not good. It is the main pulpwood species in Morocco, Portugal and Spain, but is reported to produce a lower grade of pulp (FAO, 1979).

With superior characteristics such as fast growing, high coppicing power, ability to thrive in poor soils with a prolonged dry season, ability to tolerate water-logging, salt tolerance and high calorific value, *Eucalyptus camaldulensis* was selected to be planted in the pilot project of the Village Woodlot in the Northeast.

D. PLANTING PROCEDURES

Seven Provincial Forest Rangers acted as planting technicians under the supervision of the project's consultants. Seeds of *Eucalyptus camaldulensis* were collected from the Si Saket seed production area and were then sent to each provincial forest office participating in this project. Seeds for this tree species are very tiny. There are 780,000 viable seeds per kilogram with a 70-80 percent germination rate (FAO, 1979). Based on experiences of nursery works at Chiang Mai, it was found that as many as 550,000 plantable seedlings could be produced from 1 kg of seeds.

Seeds are sown into plastic trays at the rate of 8-10 g/m^2 in winter, e.g., from December to February, since the weather is not too moist. Germination of most seeds may start within 7 days. Then, the frequency of watering should be reduced in order to avoid damping off. These small seedlings should be transplanted into individual plastic tubes after reaching 1.0-1.5 cm in height (Figures 4-5). The containerized seedlings were normally kept under the 50-percent shade of a greenhouse or tree

canopy for 4-6 months. Hence, seeds sown in January are expected to be field planted in May or June, at the beginning of rainy season. It is possible to grow *Eucalyptus camaldulensis* both from container-grown seedlings or from stumps, but stump planting seems to be risky in terms of the percentage of survival.

In the land use section, Dr. Sathit Wacharakitti has already mentioned the three types of planting sites selected, i.e., public land, school land, and monastery land. Site preparation will be different from place to place depending on topography, soil and vegetation characteristics. In Si Saket, for example, the entire area was ploughed by tractor while ploughing in alternative strips of 1 m width was carried out in Roi-et (Figure 6). Soil was dug into 1 ft^3 squares at each planting spot in Khon Kaen. In Maha Sarakharm province, an agroforestry system was introduced having cassava and corn as intercrops. In such case, farmers prepared their lands for planting through ploughing by water buffalo. Manual clearing of strips was carried out in Surin.

Three principal questions must be kept in mind during a planting program: where, when, and how to grow the trees. Where to grow the trees in this sense refers to the spacing of planting spots. The same spacing, 2 x 4 m^2 equivalent to 1,250 trees per ha, was used at all planting sites of the project. Actually, the spacing of 2 x 4 m^2 is only necessary when planting an agroforestry system. Wherever soil productivity is too low to grow agricultural crops, tree spacing should be reduced to 1 x 1 m^2 in order to get maximum aboveground biomass for firewood.

The question of planting time in Thailand can be answered in terms of the rain. Trees should be planted as soon as the rainy season begins. Experiences with climatic conditions in the Northeast found that the amount of rainfall is maximized in September, while the minimum tends to be in December and January. Thus, tree planting during those three months must be avoided. Information on dry periods gained from a pluviothermic graph suggested that tree planting should start in May and early June with an enrichment planting in July and August. September seems to be too late even for enrichment planting.

Planting techniques for *Eucalyptus camaldulensis* are very simple since it is an easy-growing species. However, the trees should neither be planted too deep nor too shallow. The crucial point is that the plastic bag must be removed before planting. Otherwise, the tree may develop into a bonsai-like form with small, curled leaves. A suitable amount of manure or mixed fertilizer should be added at planting time. But, it is important not to allow the root system to come in contact with chemical fertilizer during this transplanting stage.

Eucalyptus camaldulensis seedlings being transplanted into small individual plastic bags.

Officials from the land arrangement division in Kalasin Province inspecting and measuring woodlot growth.

Cultivation of a land plot in preparation for planting a village woodlot.

Plantation tending is the next planting procedures to be considered. The major tending activities of a Village Woodlot are weeding, fencing, fire protection and fertilizer application. Weeding is extremely necessary in the begining. It generally requires about 2 weeding times during the first year, in June and August. At Ban Lao School in Maha Sarakharm province *Eupatorium odoratum* (Figure 7) is the principal, fast growing weed. Weeding may be reduced through better site preparation before planting. A high density of weeds may be favored by cattle leading to a livestock problem. Hence, most planting sites need to be fenced during the first two years. Fire protection can be achieved by making a fireline surrounding the plantation. Winter ploughing may reduce both weeds and fuels.

Among the tending techniques mentioned, fertilizer application seems to be the crucial one. Kind, time, and rate of fertilization must be taken into careful consideration. It is recommended that 5-7 g of urea or 10-15 g of mixed fertilizers (15-15-15) be applied per tree from 1-2 years old in alternation with manure. Such applications should be done once every 2 months during the growing season. Late fertilization, e.g., fertilization in December, must be avoided since it results to dieback (Figure 9). Results of fertilized and non-fertilized soil analyses collected under the tree canopies revealed that the nutrient concentration of fertilized soils increased dramatically compared to non-fertilized soil nutrients. The nitrogen content at the Yasothon and Roi-et planting sites, for instance, increased 20.45 and 53.85 percent, respectively. Similarly, fertilized soil phosphorus increased 500 percent at Yasothon and 310 percent at Roi-et (Table 4).

Table 4 Nutrient concentration of fertilized and non-fertilized soils of two planting sites.

Nutrient	Yasothon Province		Roi-et Province	
	Fertilized	Non-fertilized	Fertilized	Non-fertilized
O.M., %	0.53	0.44	0.60	0.39
P, ppm	13.50	2.25	19.50	4.75
K, ppm	68.50	13.00	103.50	22.75
Ca, ppm	74.75	70.50	88.25	72.25
Mg, ppm	35.50	36.25	58.50	13.50
Na, ppm	29.75	19.00	11.25	8.50
pH	4.13	4.63	5.73	3.53

Agroforestry system in Si Saket Province. This is a woodlot plantation mixed with rice paddies.

Growing woodlot trees mixed with jute plants in Si Saket Province. This is one example of agroforestry (intercrop) cultivation.

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An example of an unhealty *Eucalyptus camaldulensis* tree.

A six-month-old *Eucalyptus camaldulensis* woodlot in Kalasin Province.

Generally speaking, manure applications are better than chemical fertilization in terms of soil amelioration. Manure improves both physical and chemical properties of the soil while mixed fertilizers only improve the chemical properties. The quality of manure depends on its sources, duration, and types of forage crops. Most manures contain 0.50 percent nitrogen, 0.25 percent phosphorus, and 0.50 percent potassium. It has been approximate that the plant nutrients in one ton of manure may be equivalent to 28 kg of 15-15-15 mixed fertilizer. At Suwannaphum District, Roi-et, the manure costs 600-800 Baht per ton.

Using leguminous plants, such as soybean (Figure 8), an intercrop is another way to improve soil nutrients, nitrogen in particular.

Besides fertilizing, soil productivity can also be improved through ploughing. In a water-logging area like Ban Song Chan, Roi-et, tractor ploughing between rows spaced 2 x 4 m^2 apart was carried out in order to improve soil drainage. Soil may also be manually hoed around each planted tree for a radius of 30-50 cm.

From a forest pathogen point of view, the common pathogens found in some planting sites are *Rhizoctonia* and *Botryodiplodia theobromae*. Both are root fungi resulting in root rot. *Aspergillus* and *Curvularia* are fungi found on trunk wounds resulting either from cattle or cassava harvesting (Figure 10).

E. THE AREAS PLANTED AND TREE GROWTH

The planting program for the Village Woodlot Project began in 1981. Only 200 rai (1 rai = 6.25 ha) were planted in Si Saket that first year. In 1982, the total areas planted included 800 rai in 4 provinces: 200 rai in Yasothon, 250 rai in Roi-et, 150 rai in Maha Sarakharm, and 200 rai in Si Saket. An intensive planting program was carried out in 1983 by planting total of 3,310 rai in 7 provinces. The areas planted by provinces in 3 years can be summarized as follows:

Eucalyptus camaldulensis bark is torn due to disease.

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Table 5 The Project areas planted by provinces in three consecutive years (rai).

Province	Public Land	School Land	Temple Land	Total
Yasothon	490	70	190	750
Roi-et	785	45	-	830
Maha Sarakham	650	80	-	730
Si Saket	630	120	-	750
Khon Kaen	350	-	100	450
Surin	200	-	-	200
Kalasin	600	-	-	600
Total	3,705	315	290	4,310
Percentage	85.96	7.31	6.73	100

According to the data presented, almost 86 percent of the total area planted was on public lands, while plantings at temples and schools took place on only 14 percent of the available area. A lack of planting technology may be the prime reason for such facts. The major areas were planted by the provincial forest rangers who were already well-trained from Forestry School. For the school teachers and village leaders, the Village Woodlot Project trained them at the time on how to plant and tend eucalyptus trees. It might be too risky to let the schools and temples grow the major sites. However, schools and temples as well as communities should play greater roles in future plantings. The provincial forest rangers may act as supervisors and coordinators.

Besides playing a principal role in planting activities during the past few years, the Provincial Forest Offices of those 7 provinces also acted as the seedling producers. *Eucalyptus camaldulensis* seedlings were produced by the offices, and then were transported to the temples, schools, and public lands where they were to be planted. In the future, eucalyptus seedings should be produced and be provided both by the Provincial Nursery Centers and by the Provincial Forest Offices. Nursery

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Centers may provide seedlings for the large-scale plantation, e.g., industrial plantations, RFD plantations, and FIO plantations. The Provincial Forest Offices could then provide seedlings for the small-scale plantations, such as for the roadside plantations, paddy bund plantations, and for Arbor-day tree planting.

Whenever tree growth factors are in consideration, the concept of the holocenotic environment of Berglund (1975) should be referred to. According to that concept, the six factors which affect tree growth either in direct or indirect ways are topographic, climatic, edaphic, biotic, pyric, and anthropeic factors. *Eucalyptus camaldulensis* planted by the Village Woodlot Project in the Northeast also follows this concept. Major factors affecting its growth and development are drought, soil, fire, weeds, and cattle (Figure 11). Drought, caused mainly by low rainfall with high temperatures, can be overcome by selecting a suitable planting time. That is, planting must be started during the early part of the rainy season. It is believed that growth and development should carry on well after the first few weeks of becoming established. Infertile soil may be corrected with fertilizer and manure applications. For cattle grazing, fencing is required. Through such measures, satisfactory growth rates of planted trees can be obtained.

Annual height increments and percent of survival of the planted eucalypts are listed in Table 5. It reveals that maximum growth, rate in terms of total height, was obtained from the Khok Phi Ba plot in Maha Sarakham province followed by the Ban La Lom School Woodlot in Si Saket province. Agroforestry systems have been used at both planting sites. Thus, maintenance of agricultural crops apparently have advantageous effects on forest crops planted. For example, higher amounts of soil nitrogen may be found if soybeans are planted as an intercrop. In a similar manner, soil permeability, drainage and bulk density may be improved if cassava is planted as the intercrop.

Growth and survival of the planted trees shown in Table 5 revealed that *Eucalyptus camaldulensis* is a promising species to be grown for fuel wood on dry and infertile sites of the Northeast. Questions on appropriate seed sources (Sa-Ardavut, 1979), seed orchards (Eldridge, 1975a), and breeding programs (Turnbull and Boland, 1984) are still required to be answered.

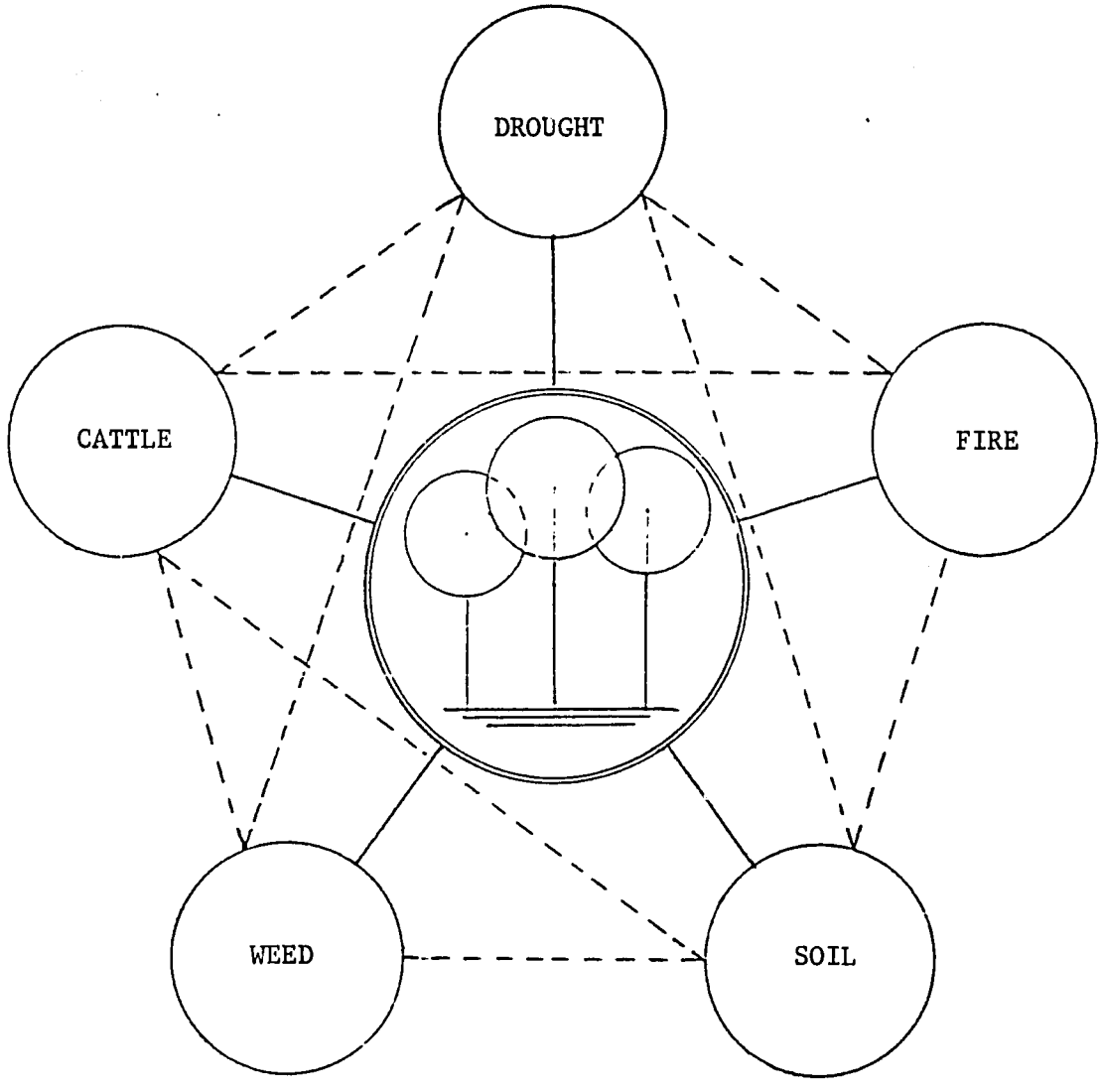


Figure 11 Factors affecting growth and development of *Eucalyptus camaldulensis* planted in northeastern Thailand. Solid lines refer to direct effects, dotted lines to indirect effects.

Table 5 Annual height increment and survival percentage of *Eucalyptus camaldulensis* planted in the Northeast.

Province	District	Planting Site	Height Increment m/yr	Survival, %
Roi-et	Suwannaphum	Ban Song Chan	0.71	95
		Ban Lao Khao	1.36	86
		Suwannaphum School	0.86	69
		Ban Chan Toei	1.51	80
		Ban Sa-rai School	-	0
	Muang Suang	Dong Kleor School	0.89	90
		Ban Don Mak Yang	1.38	98
Si Saket	Phrai Bueng	Ban Chang Kradan	2.05	90
		Ban Pong	1.81	93
	Khun Han	Ban Non Kra Sang	1.05	91
	Khu Khan	Ban Trang Sawai School	1.58	81
		Ban Ta Kain School	1.53	84
		Ban Khok Yai School	1.45	94
		Ban La Lom School	2.99	93
		Ka Yung Non Charoen School	0.88	80
		Ban Huai Tamon School	1.27	74
		Ban Phru Yai School	1.74	70
Khon Kaen	Phra Yuen	Ban Na Lom	0.55	75
		Kok Sung Nong Bo	1.70	97
	Ban Phai	Ban Don Mak Prik	0.96	83
	Phon	Wat Non Tan Phra	2.02	91

Table 5. (continued)

Province	District	Planting Site	Height Increment m/yr	Survival, %
Maha Sara-kham	Kosum Phisai	Khok Phi Ba	3.88	90
	Muang	Khok Nong Sabaeng	1.34	93
		Agriculture Colledge	1.17	98
	Chiang Yuen	Khok Nong Chat	1.42	87
		Khok Yai Kampea	1.75	70
		Nong Mun Pla School	1.32	80
		Ban Non Chat School	1.36	85
Kalasin	Kamalasai	Pa Khok Si	1.79	86
	Muang	Pa Ham Hia	1.19	80
	Somdet	Pa Nong I Lceng	1.10	89
Surin	Chom Phra	Pa Khok Fa Pa	1.25	88
Yasothon	Muang	Wat Pa Sapha Tambol	1.25	85
		Ban Nong Ku School	1.03	61
		Ban Nong Phai School	1.21	72
		Ban Sa Wang School	1.65	96
	Ko Wang	Ban Nam Om	2.20	89
		Ban Bak Yai	0.68	68
		Ban Nong Pho	0.63	76
		Ban Nam Om	0.95	93
Yasothon	Maha Chanachai	Wat Phra Buddha Bat	0.73	82
		Nong Bua	0.85	91
	Average		1.39	83

F. CONCLUSIONS

1. *Eucalyptus camaldulensis* was found to be a promising species to be planted for firewood in infertile soil of dry sites in northeastern Thailand in comparison to other native and exotic species.

2. Most planting activities including seedling production, planting site preparation, and plantation tendings have been carried out by the provincial forest offices.

3. In the past few years, plantings were concentrated on public lands rather than lands belonging to the temples and schools.

4. Only 2 x 4 m^2 spacing was used at all planting sites of the Village Woodlot Project.

5. Trees grown under the agroforestry system grew faster than those grown as forest farms. It might be possible that the trees indirectly gained some advantages from the intensive tendings of agricultural crops. However, overpruning was observed at Maha Sarakham where soil fertility was relatively high and farmers needed the land for upland-crop planting beneath 2-year-old eucalypts.

6. Early plantings in combination with alternative chemical fertilizer-manure applications could stimulate height growth. Late fertilization resulted in dieback during the summer months.

7. It is obvious that the fuel wood rotation of *Eucalyptus camaldulensis* is about 5 years, but the project was terminated at the 3-year-old plantation stage. Investigation on coppice regeneration was not possible as the project duration was not sufficient to gather complete information.

G. RECOMMENDATIONS

1. Besides *Eucalyptus camaldulensis*, other species trials should be set up somewhere in the project areas. Of course, eucalyptus grows well at the moment, but, if at all possible, the monoculture should be replaced by multi-species plantation.

2. Other components of the villages, such as schools, temples, military camps and communities, should play greater roles in fuel wood plantations in the future. Trees may be planted on school lands, in military camps, and even along the roads. Provincial forest offices may act as supervisors, coordinators and seed and seedling providers.

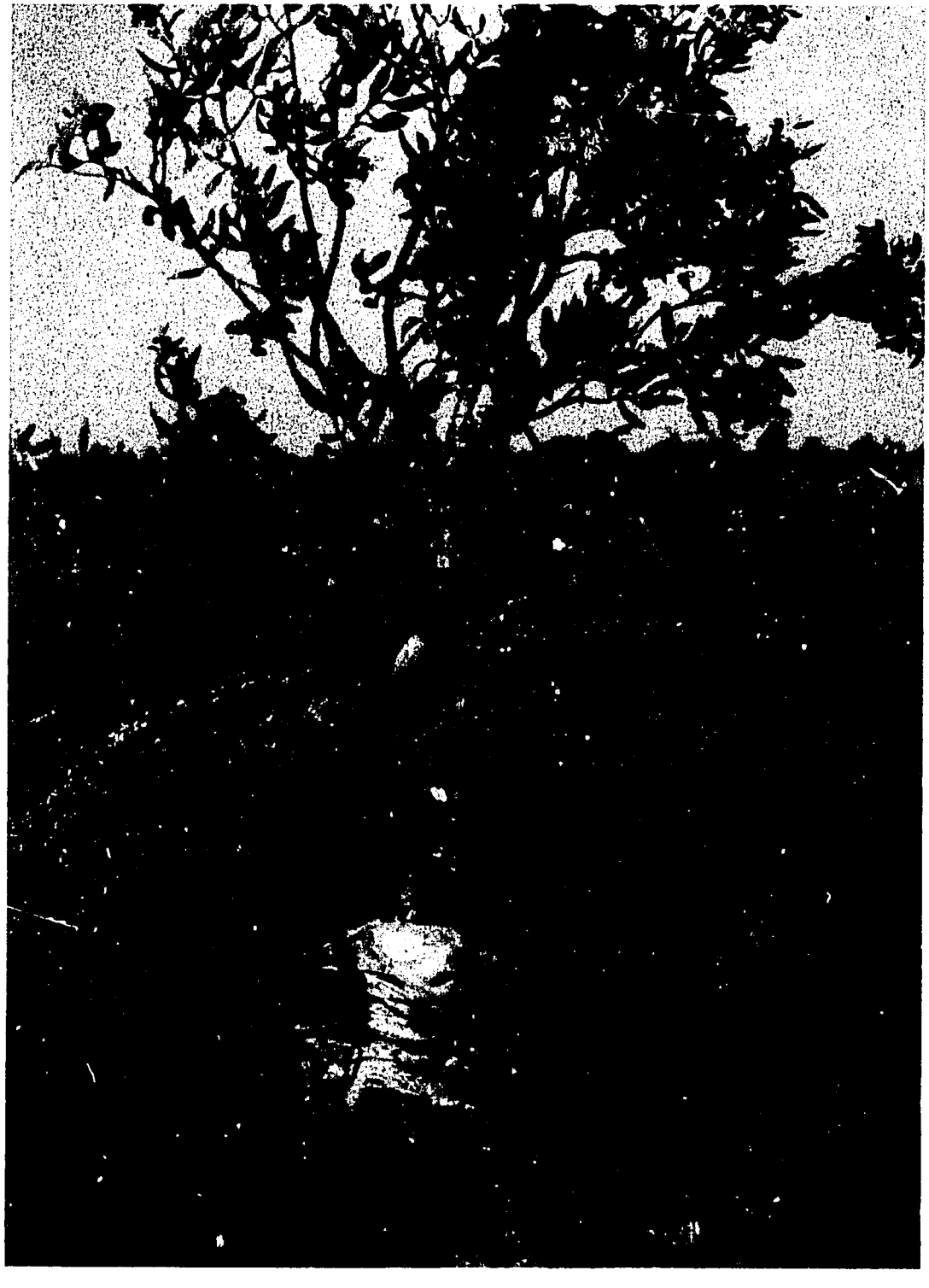
3. If planting sites are not suitable for agroforestry systems, spacing should be narrower, 1 x 1 m^2 or 1 x 2 m^2. Mechanical thinning could then be used in the third year in order to turn the management from even-aged to uneven-aged eucalyptus plantations.

4. There are different types of agroforestry systems, e.g., agri-silviculture or sylvo-pastoral. To overcome the overpruning problem found at Maha Sarakham, a suitable system should be introduced. For instance, when tree canopies grow closer in the third year resulting in unsuitability for cassava planting, grazing by livestock may be allowed. That is, the agri-silviculture system is replaced by a sylvo-pastoral system in the third year of plantation (Figures 12-13).

5. For better growth and survival, trees should be planted as soon as the rainy season begins. Small amounts of mixed fertilizers and/or manure may be applied at planting time. Late fertilization must be avoided.

6. Duration of the project should be prolonged up to 5 or 6 years instead of 3 years since the planted trees cannot be harvested for firewood at 3 years of age. Project extension may provide an opportunity to investigate appropriate silvicultural system and so on.

7. The project should concentrate on provenance trials as well as on an establishment of seed orchards of *Eucalyptus camaldulensis* in the future.



Termites have eaten the *Eucalyptus camaldulensis* roots. Preventive measures should be carried out.

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Stunted growth of an *Eucalyptus camaldulensis* tree.
The study of entomology should be pursued further.

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Chapter 4

Economic Aspects of the Village Woodlot

by Dr. Wuthipol Hoamuangkaew

ECONOMIC ASPECTS

OF THE VILLAGE WOODLOT

A. INTRODUCTION

The forest plays an important role in the Thai economy because it provides timber, water, recreation, wildlife, and other socio-cultural services for the Thai people. Nowadays the impact of deforestation cannot be considered in isolation; it must be considered along with the growth in population, particularly the growing numbers without land for dwelling and farming. Forests are disappearing at an alarming rate. In a period of 14 years, 1961 to 1974, the deforested area of the country increased by about 10.08 million hectares, or an average of 0.77 million hectares per year. The most recent study of Wacharakitt (1977), using LANDSAT-2 imagery, showed that the existing productive forest area was only 131,785 km^2 or 25.35 percent of the nation. The forest depletion has caused the shortage of various kinds of forest products, especially wood and fuelwood. In order to mitigate the problem, the reforestation program has been undertaken by the government and private sectors.

Because the standard of living of the rural people is very low, the reforestation program coupled with a rural development program will be needed. The woodlot project could be employed to overcome such problems, because it not only supplies fuelwood but also provides jobs to the villagers.

Objectives

The objectives of the economic study of the Village Woodlot Project are:

- To obtain socio-economic information about the villages under the woodlot project;
- To estimate the demand for fuelwood and charcoal of the villagers in the woodlot project area;
- To determine the optimum benefit sharing from the woodlot to the village woodlot project members;
- To estimate the best rotation of fuelwood forest plantations.

Research Methodology

Data Collection

The field survey of the socio-economic conditions of the woodlot

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project members was undertaken in the four Northeastern provinces, namely Maha Sarakham, Roi-et, Yasothon, and Si Saket.

Sampling Scheme

The proportion of households in each village and province used for this study varied, depending on constraints of time and access. The outline of the sampling scheme is as follows:

Province	Village	Total number of households	No. in sample	%
Maha Sarakham				
	Yang Sinchai	70	20	28.57
	Nong Hard	44	16	36.36
	Don Kloi	201	54	26.86
	Total	315	90	28.57
Roi-et	Sang Chan	215	48	22.32
	Nong Sra	67	18	26.86
	Som Hong	152	39	25.65
	Nong Ekhom	102	28	27.45
	Hin Kong	165	48	29.09
	Loa Kao	80	31	38.75
	Total	781	212	27.14
Yasothon	Nong Boa	26	10	38.76
	Siri Pattana			
	Moo 1	86	22	25.58
	Moo 4	58	18	31.03
	Moo 10	41	15	36.58
	Nong Po	16	6	37.50
	Bark Yai	57	16	28.07
	Nong Sam	20	10	50.00
	Nam Om			
	Moo 5	28	10	35.71
	Moo 9	115	20	17.39
	Ban Jarn	181	18	9.94

A rural program where local people can increase their incomes by cultivating firewood.

Economic condition survey of rural area people for the Community Woodlot Project.

Province	Village	Total number of households	No. in sample	%
	Total	628	145	23.08
Si Saket				
	Jung Kradan	260	75	28.84
	Ban Pong	85	24	28.23
	Total	345	99	28.69

B. SOCIOECONOMIC CONDITIONS

The purpose of this section is to highlight the socio-economic conditions of the project villages in the four Northeastern provinces: Maha Sarakham, Roi-et, Yasothon, and Si Saket. Four conditions are examined: population and educational level, land tenure, and economic activities.

Maha Sarakham

Population and Education Level

The field survey had been conducted in three project villages, namely Yang Sin Chai, Nong Hard, and Don Kloi. The average number of persons living in one household is 6. These are small villages, with total population ranging from 44,000 to 200,000. For further population data, see Annex, Table 1.

The educational level of the villagers is presented in Table 2 of the Annex. Results show that about 13 % of the total population in this area is illiterate; the majority (65.7%) have attained an educational level lower than Po. 6. Only 7.5% have been educated at a level higher than Po. 6.

Land Tenure

Most of the households in Yang Sin Chai, Nong Hard, and Don Kloi villages own their own farmland. The average areas of privately-owned land are 20.7, 30.4, and 23.8 rai respectively. There are some land tenants in this area. The number of households classified as land tenant comprise 44.3, 20.4, and 6.9 percent of the total households. In Yang Sin Chai Village, 8.58 percent of the total households practiced their farm activities on their cousins' farmland, on an area of about 43 rai per household. (See Annex, Table 3).

Crop production

From a field survey it is found that rice and cassava are the major crops cultivated. Rice is the most important subsistence crop. Average yield per rai of rice is quite low. Factors causing this low productivity per unit of rice production include soil infertility and lack of development of irrigation technology. Some of the rice production is used to supply home consumption and the surplus product is used for sale. (See Annex, Table 4). The average cost of rice production per rai is 543.85 baht. The average income from rice production is about 481 baht/rai. This indicates that rice is produced at a loss of 62.85 baht per rai.

Cassava is the most important cash crop. The average yield of cassava per rai in this area is 1.2 tons, with an average income from cassava production of 840 baht/rai. (See Table 6 of the Annex). The profit value obtained from cassava production is about 312 baht/rai.

Livestock production

Animal husbandry is also practiced by the villagers, with cattle, swine, buffaloes, ducks, chickens, geese, and fish commonly raised. The number and value of each kind of animal, by village, is presented in the Annex, Table 8.

Non-farm Activities

Labor wage earning, trading, handicrafts and collection of forest products are non-farm activities practiced by some villagers in this area. The number and percentage of households, and their non-farm income distributed by non-farm activity and village is presented in the Annex, Table 9.

Roi-et

Population and Educational Level

There are six project villages in Roi-et province, namely Song Chun, Nong Sra, Som Hong, Nong E-Khem, Hin Kong, and Lao Khaa. The average number of members per household is again 6. (See Annex, Table 10). Table 12 shows that about 16.5 percent of the total population in this project area is illiterate.

Land Tenure

Most of the villagers living in this project area (98%) owned their own farmland as the villagers did in Maha Sarakham Province. The average size of the privately owned farmland in Roi-et is about 34 rai. There are only 4 households in Son Chun village practicing their farm activities on public land (See Annex, Table 12).

Crop Production

Rice is the one major crop in this area, with surplus rice production existing in every project village. The surplus rice production is used to pay for land rent and for sale. The average rice producer will suffer a loss of about 80.5 baht/rai. (Annex, Table 13-14).

A community fuelwood forest for villagers
in Ban Nong Chard, Maha Sarakham Province.

Training village leaders so they in turn can disseminate the knowledge in their own villages.

Livestock Production

The number and value of each kind of animal, by village, is presented in the Annex, Table 15.

Non-farm Activities

The households that engaged in nonfarm activities are the minority groups. The number and percentage of households and their nonfarm income distributed by non-farm activity and village is presented in the Annex, Table 16.

Yasothon

Population and Educational Level

There are ten project villages in Yasothon Province, ranging in size from 10,000 to 118,700 people. The average number of members per household is 7. (See Annex, Table 17) The educational level of the villagers is presented in Table 18. 18.03% of the total population is illiterate.

Land Tenure

Table 19 shows that every household in all ten of the project villages has its own farmland. There are 101 households that rent additional farmland from a landlord.

Crop Production

Rice is the only major crop in this area, with rice production in every project village at a surplus. (Annex, Table 20) Since the average income from rice production per rai is 332.25 Baht, and the average cost of rice production per rai 563.67 baht, the rice producer suffers a loss of 231.42 baht/rai.

Livestock Production

The number and value of each kind of animal, by village, is presented in the Annex, Table 22.

Non-farm Activities

The households in each project village engaged in non-farm activities are the minority groups. The number and percentage of households, and their non-farm income distributed by activity and village can be found in the Annex, Table 23.

Si Saket

Population and Educational Level

There are two project villages in Si Saket Province, namely Jung Kra

Darn and Ban Pong Village. The average number of persons per household is 6. (See Table 24 of the Annex) Table 25 shows that 32.13% of the total population in this project area is illiterate. Only 2.21% are educated at a level above Po.6.

Land Tenure

Most of the villagers living in this project area occupy their own farmland. Households having their own farmland in Jung Kra Darn and Ban Pong Villages number 96.53 and 100 percent of the total households respectively. The average area of own farmland in these two villages is 15.71 and 2.18 rai respectively. There are some households that rent additional land from landlords, with the average area of this rental land comprising 17 and 23.45 rai respectively. 4.7 percent of the total households in Ban Pong Village practice their farm activities in the reserved forest land, with an average area of reserved forest land per household of about 5 rai.

Crop Production

Rice and kenaf are the major crops cultivated in this project area. Rice is the most important subsistence crop. Once again, the rice producer suffers a loss (here, 165.41 baht/rai). The planted area of kenaf in these two villages is 251 and 214 rai respectively. (See Annex, Table 29) Likewise, the kenaf producer suffers a loss (386.81 baht/rai).

Livestock Production

The number and value of each animal by village is presented in the Annex, Table 31.

Non-farm Activities

Labor wage earning and trading are the only two non-farm activities practiced by the minority groups in these two villages. The number and percentage of households and their non-farm income distributed by village and activity is presented in the Annex, Table 32.

C. THE DEMAND FOR FUELWOOD AND CHARCOAL

Results from the field survey showed that 38.7% of the villagers in 8 project villages had to purchase fuelwood for their own use. This indicates that the fuelwood shortage is becoming a serious problem in this region. (See Tables 33 - 36 of the Annex).

D. DETERMINATION OF BEST ROTATION OF EUCALYPTUS PLANTATION

Reforestation investment needed a very large amount of money and a long period of time for waiting for the trees to attain marketable size. Therefore, determination of best rotation of forest plantation is needed.

The best rotation is the optimum age of the forest plantation providing the maximum profit. Hence, the average cost and revenue per rai of forest plantation have to be computed.

The average reforestation cost per rai of forest plantation under the school woodlot project is shown in Table 37 of the Annex. Table 37 shows that the reforestation cost includes wages (for land preparation, planting, and maintenance) and cost of fertilizer. The average reforestation cost per rai is about 1,128 baht.

The average revenue per rai of forest plantation could be estimated from the average yield of wood in volume per rai. Because the trees under this woodlot project are still young, in order to determine the best rotation the growth study in the next few years is still needed.

E. THE REFORESTATION PROGRAM BY AGROFORESTRY SYSTEM

The study found that some schools in Si Saket province (namely Ban Takian, Ban La Lome, Ban Ta Rang Sawai, Ban Hui Ta Morn and Ban Prue Yai) tried to combine growing rice with Eucalyptus trees. The average yield of rice production per rai is about 17.67 tang/rai. In addition, other cash crops (Peanuts, mungbeans, Chinese kale, Chinese cabbage, tomatoes and coriander) were also combined with Eucalyptus trees. The average yield of these cash crops per rai are 60,50,100,200,60, and 100 kg respectively(Annex, Table 38).

This indicated that the reforestation program by an agroforestry system is a way to increase the productivity per unit of land. Thus, reforestation by this system should be employed, especially in the regions facing the problem of fuelwood and farmland shortage.

The Wat is a meeting place for local communities. Therefore, firewood cultivation in the temple area is a logical consideration.

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Chapter 5

Land Use and Site Selection for Village Woodlot Establishment

by Dr. Sathit Wacharakitti

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LAND USE AND SITE SELECTION

FOR VILLAGE WOODLOT ESTABLISHMENT

The Northeastern region of Thailand covers an area of 168 - 854 square kilometers, and is divided into 16 provinces as the administrative units. The population in the region is 16 million or $\frac{1}{2}$ of the total population of Thailand. Due to the general physical circumstances of this region, for example, the sandy soils and water scarcity, this region is very warm and very dry in the hot dry season. Agricultural cultivation, especially paddy rice which is the staple food, can be grown only with rain or irrigation. There is no doubt that sources of income are limited. The average income per capita in this region is the lowest compared with other regions. The people are poor, especially in the rural areas.

Population growth in this region is rather high. As a result of the population pressure the existing natural resources were exploited without control. In the past the forest resources of the Northeastern region of Thailand was the richest in the country. Since the encroachment of the natural forest for the planting of cash crops, the forested areas have been depleted at alarming rate. The study of the Royal Forest Department (1973) showed that the forested areas of the whole region comprised 50,671 km^2 or 34,15% of total area, but the latest study in 1978 revealed that the forested areas have been reduced to 31,221 km^2 or 18.49%. Therefore, the sources of timber and fuelwood are at a minimum, especially in the middle part of the region.

This study will investigate the optimum use of land under the village woodlot establishment by taking into account multivariation factors of each location, for example problems due to the conflicting use of land, lack of in communal participation, problems with division of the product, etc.

The analysis is intended to ascertain:

1. The appropriate use of the public lands;
2. The cost/benefit of using public lands;
3. Analysis of co-variance in the use of public lands; and
4. Identification of the major problems on the use of public lands for the village woodlot establishment.

B. METHODOLOGY

Site Selection

As a starting point it was decided to establish the village woodlots on the public lands of seven provinces. Public land was chosen because these areas are generally public pasture and are less productive. The criteria for site selection was based on the following:

- The public land has degraded forest with poor regeneration;
- The public land is located close to the villages and the infrastructures.
- The public land is located on the low-to-medium slope (slope not more than 35%)

Project Implementation

Public lands of seven provinces were converted into village woodlots by planting *Eucalyptus camaldulensis* with a spacing of 2 x 4 m. As an incentive, agroforestry was applied to these woodlots. Economic cash crops such as cassava, corn, groundnuts, and tobacco were planted in the woodlots in the land between the trees.

In general, the establishment of village woodlots on public land has been successful and has met the original objectives. Idle grazing public lands of 3,705 rais (6.25 rais = 1 hectare) are afforested with fast-growing tree species with spacing 2 x 4 m. in collaboration with the villagers. The planting of cash crops using an agroforestry system has been promoted for the combined use of land. In this way the villagers have earned income from the use of land for cash crops planted seasonally, while waiting for the production of fuelwood from the woodlots in certain rotation. This method has also lessened the pressure on cultivated areas and grazing lands. Interviews with the villagers reveal that they are willing to cooperate and are satisfied with the operation of the village woodlot project.

The group of villagers and the communal committee has cooperated with the project from the very beginning, in ways other than only selling labor to the project. This method creates a feeling among the villagers that the woodlot belongs to them. The communal committee will take care of the harvesting of products. Allocation of income generated from this woodlot will be decided by the communal committee. This committee has the right to vote for allocation of income; for example, they may use some fraction of the income for improvement and development of public facilities, temples, roads, wells, etc.

The models of woodlot establishment are varied, and it is difficult to choose a model best-suited to each community. For example, the village committee can cooperate with the Provincial Forest Office; the Provincial Forest Office can conduct the project with the support of labor

Use of public land for planting woodlots.

Arid areas such as this require selection of suitable types of wood for community woodlot development.

Table 1 Area of village woodlot in the public land of 7 provinces.

Province	District	Location	Area (Rai)
Kalasin	Muang	Ban Kok Nong Laeng	150
	Kuchinarai	Ban na Thom-Ban Kam Wee Hong	300
	Kamalasai	Ban Pa Pok Si	150
			600
Khon Kaen	Phra Yeun	Ban Non Soong-Nong Bo	70
		Na Lom	30
	Ban Phai	Ban Don Mark Prig	250
			350
Maha Sarakham	Muang	Ban Kok Sa Baeng	100
	Kosumphisai	Ban Kok Phi Ba	300
	Chiang Yeun	Ban Kok Nong Chard	200
		Ban Kok Yai Kham Phia	50
			650
Roi-et	Suwannaphum	Ban Laokhao-Nong E-Khem	300
		Ban Nong Sa-Ban Hin Kong, Som Hong, Ban Nong San, Ban Nong Sra	200
		Ban Don Klang	285
			785
Yasothon	Kho Wang	Ban Nam Om	330
		Ban Bark Yai	70
		Ban Nong Bo	20
	Mahachanachai	Ban Nong Boa	70
			490
Surin	Chom Pra	Ban Kog Pha Pa	200
Sri Saket	Khun Harn	Ban Nong Pho	200
	Prai Beung	Ban Prasart Yeu	30
		Ban Chang Kradan	240
		Ban Pong	360
			830
	Total		3,705

* 6.25 rais = 1 hectare

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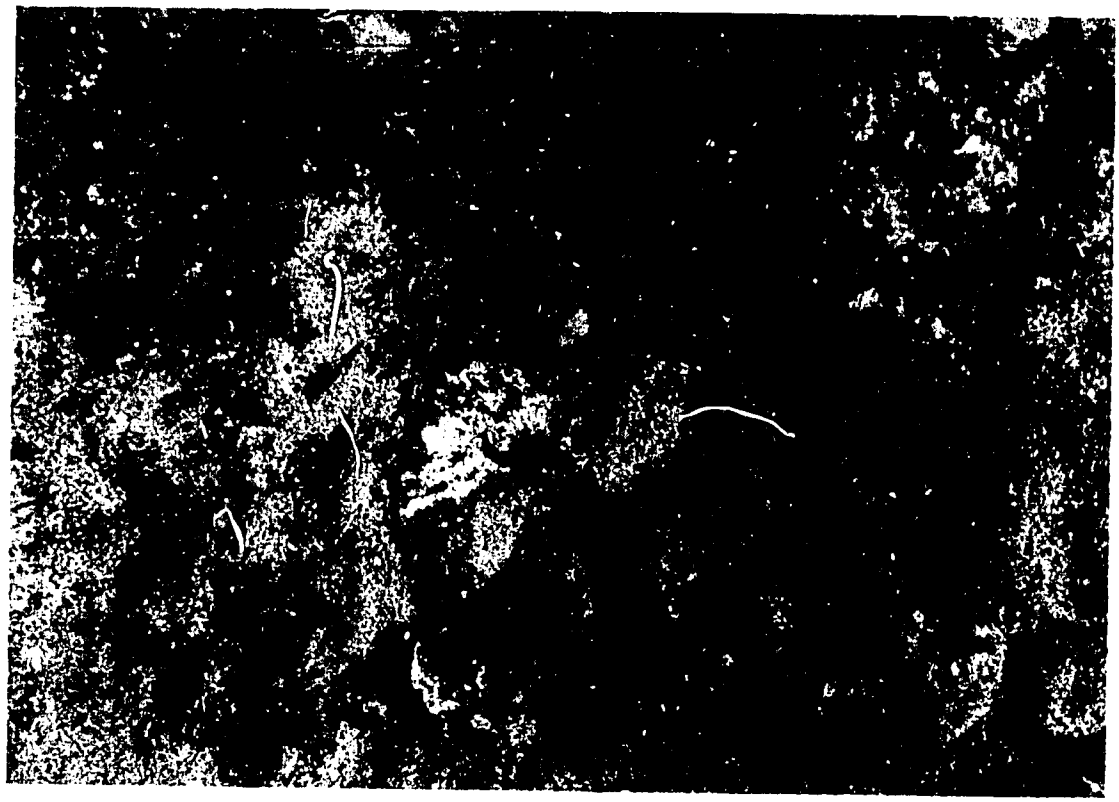

Roi-et Province is characterized by highly saline soil. It is necessary to accelerate development efforts for this environment.

An area of woodlot in Thung Kula Rong Hai, Roi-et Province. Trees were selected for planting which could survive in the arid environment characteristic of this Province.

from the villagers; The Provincial Forest Office can conduct the project alone with only minor support from hired labor. Comparisons need to be made to find out the model of village woodlot operation best applied to other villages. The current trend is to operate the woodlots by communal committee, with technical support supplied by provincial forest and district officers.

Seminar discussions of the provincial forest officers and district forest officers can provide resolutions on the problems of the harvesting and selling of forest products from the public land, temple land, and school land.

Temple lands also have been used to plant the woodlots, with the planting aimed solely for fuelwood supply. The planting space may be either 2 x 2 m., 2 x 4 m., or randomized planting. See Table 2 for details of village woodlot programs operated on temple land.

Table 2 Area of woodlot in the temple land

Province	District	Location	Area (rai)
Kalasin	-	-	-
Khon Kaen	Phon	Wat Non Taen Pra	100
Maha Sarakham	-	-	-
Roi-et	-	-	-
Yasothon	Muang	Wat Pha Sapa Tambon	115
	Kho Wang	Wat Ban Siripattana	55
	Mahachanachai	Wat Pra Puttabaht	20
			190
Surin	-	-	-
Sri Saket	-	-	-
	Total		290

The establishment of woodlots in the temple lands has been less frequent. In this first stage only two provinces, Khon Kaen and Yasothon, had set up the woodlots by planting *Eucalyptus camaldulensis* on 100 and 190 rais respectively.

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This woodlot was planted in an area which had been previously planted with fruit trees. The new plants had to be carefully placed between the existing fruit trees. (Kalasin Province)

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A view of the area surrounding Non Thon Phra Temple which was previously barren. It is now a woodlot producing fuel wood.

Actually, the planting of fast-growing tree species on the temple land has multipurpose objectives — fuelwood supply, shelter belt, shading and recreational areas. The use of land for this purpose is invaluable to the public use. It is also used as a demonstration plot for public viewing, since the temple is the center of village life. The planting was conducted on a small scale with great success. Expansion of temple land planting is necessary in the future.

School and college lands have also been used to establish the woodlots. Three hundred and fifteen rais of four provinces were afforested by *Eucalyptus camaldulensis* with the spacing of 2 x 4 m. as shown on Table 3.

The results of planting woodlots on school and college lands are threefold. With the selection system of cutting used, this plot is a fuelwood and post supply source. Furthermore, indirect benefits result--inducing the younger generation to be aware the dwindling natural resources, and uses as windbreakers, shelter belts, shading and recreational areas.

The woodlot establishment operation has been successful due to energetic cooperation of the school children and teachers. Since the woodlot establishment has been conducted for only three years and on a small scale, a follow-up program to look after this woodlot is necessary. This will allow us not only to see the final products, but also to observe the attitude of school children and teachers in the long run.

C. CONCLUSIONS

Financial support and efforts expended on this 3-year woodlot pilot project have been successful. The woodlot model is summarized as follows:

1. Public land. The idle grazing public lands of 3,705 rais had been afforested with the fast-growing tree species *Eucalyptus camaldulensis* with the spacing of 2 x 4 m. An agroforestry system was promoted by combining with the planting of cash crops. This public land forest plantation belongs to the sub-district council and is managed by this council under the supervision of the district forest officer. Allocation of the benefits will be decided by this subdistrict council.

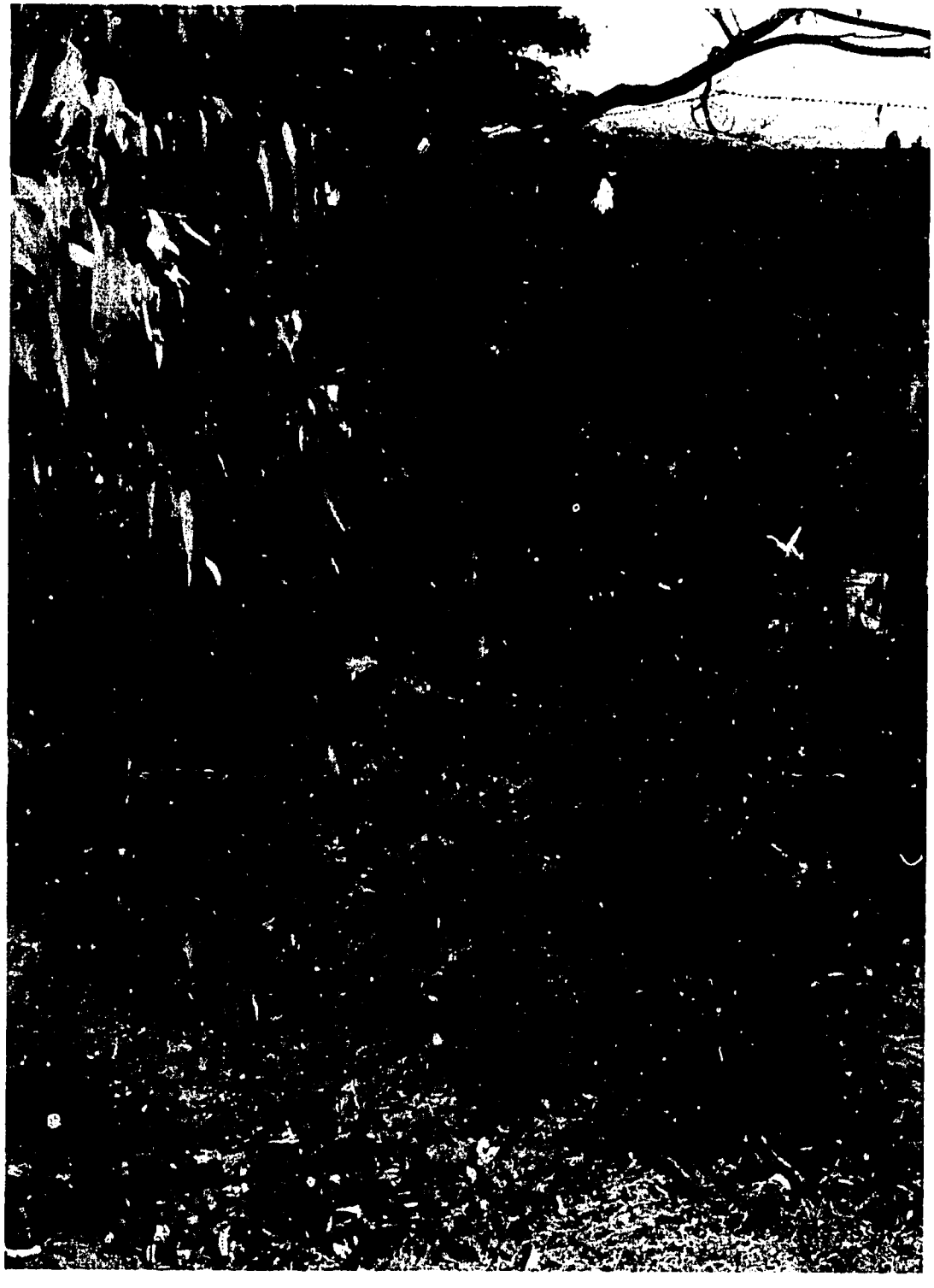
2. School land. The school land woodlot was established with the cooperation of the students and teachers under the supervision of the district forest officer. The maintenance and management of this woodlot will be conducted by the school authority led by the headmaster and the temple's rector under the supervision of the foresters. The ownership belongs to the school/college. The benefits will go directly to the school/colleges with allocation decided by the school board of authority.

3. Temple land. The temple land woodlots are established by the temple under the supervision of foresters, with ownership belonging to the temple concerned. The maintenance and further management will be conducted by the temple with the supervision of the foresters.

Table 3 Area of village woodlot in the school land.

Province	District	Location	Area (rai)
Kalasin	-	-	-
Khon Kaen	-	-	-
Maha Sarakham	Muang	Agricultural College	60
	Chiang Yeun	Ban Nong Charg School	10
		Ban Man Pla School	10
			80
Roi-et	Suwannaphum	Ban Sarai School	17
		Suwannaphum School	5
		Ban Teuy School	8
		Ban Dong Kleu	15
			45
Yasothon	Muang	Ban Nong Pao School	20
		Ban Sawang School	10
		Ban Nong Koo School	20
		Ban Bark Yai	20
			70
Surin	-	-	-
Sri Saket	Prai Beung	Ban Nong Hong School	10
		Ban Huai Tamon School	20
		Ban Khayung School	10
		Ban La-Lom School	10
		Ban Kok Yai School	20
		Ban Preu Yai School	20
		Ban Ka Kiang Chang-Lek	10
		Ban Tarang Sawai School	20
			120
	Total		315

Joint use of land as a woodlot and for animal husbandry.



Areas around schools which are not used should be planted in woodlots.

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D. RECOMMENDATIONS

The recommendations concerning the use of land for village woodlots include the following:

1. Meetings, interviews and discussions with the local people are very important as a starting point for the establishment of the village woodlot.

2. Idle grazing land should be selected as sites for the woodlots.

3. Discussion regarding allocation and distribution of the products should be made by the village or sub-district council.

4. Cottage industry and commercial industry are urgently needed to support the utilization of small wood from the woodlot plantation.

5. A continuation or follow-up program for this village woodlot is necessary.

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Chapter 6

Sociological Studies on the Village Woodlot Project in Northeast Thailand

by Dr. Narong Srisawas

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SOCIOLOGICAL STUDIES ON THE VILLAGE WOODLOT PROJECT IN NORTHEAST THAILAND

A. INTRODUCTION

Thailand, a developing or less developed country (LDC) in Southeast Asia, may be divided into four regions. The North is a forest highland area characterized by a series of mountain ranges, in the northwest rising to more than 8,500 feet in the Inthanon Peak. The central plains are a fertile, alluvial lowland based on the silt accumulations from the Chao Phraya River, which bisects the plains and flows into the Gulf of Thailand. The most fertile section of this region is the Bangkok Delta, known as the rice basket or heartland of the country. In the Northeast rises a dry upland area covering almost one-third of the country and ending at the Mekong River on the border with Laos. Peninsular Thailand, reaching to Malaysia, is a mountainous ridge.

Stretching between the fifth and 20th degrees latitude in the Northern Hemisphere for a distance of approximately 1,000 miles, and with elevations ranging from sea level to thousands of feet in the mountainous regions, Thailand has a diversity of climate, soils, and vegetation within its borders. Moreover, its somewhat central location in Southeast Asia has given it a variety of culture groups, particularly along its common boundaries with contiguous nations and in its coastal areas. Nevertheless, the Thai culture overwhelmingly dominates with its language, agricultural lifestyle, and Buddhist religion.

Historically defined as somewhat of a buffer zone between the French and English colonies to the east and west respectively, Thailand has remained an independent nation into modern times. Until 1932, an absolute monarchy, first established in the 13th century, reigned supreme. A series of largely bloodless coup d'etats has evolved a highly centralized and bureaucratic government controlled and operated by an oligarchy or a self-appointed strongman. There are three levels of government administration: 1) central or national, 2) provincial, and 3) local.

Though commonly classified as a less developed country, Thailand is somewhat unusual in that it is one of the few modern states to have escaped colonial domination. Lucian W. Pye has observed that:

> Although in Southeast Asia colonialism was the primary agent of the Western impact... (in Thailand... the Western impact) come largely under the auspices of the traditional elite... The traditional aristocracy came to assume new roles and responsibilities as officials in the departments of government set up advisors from numerous Western countries.

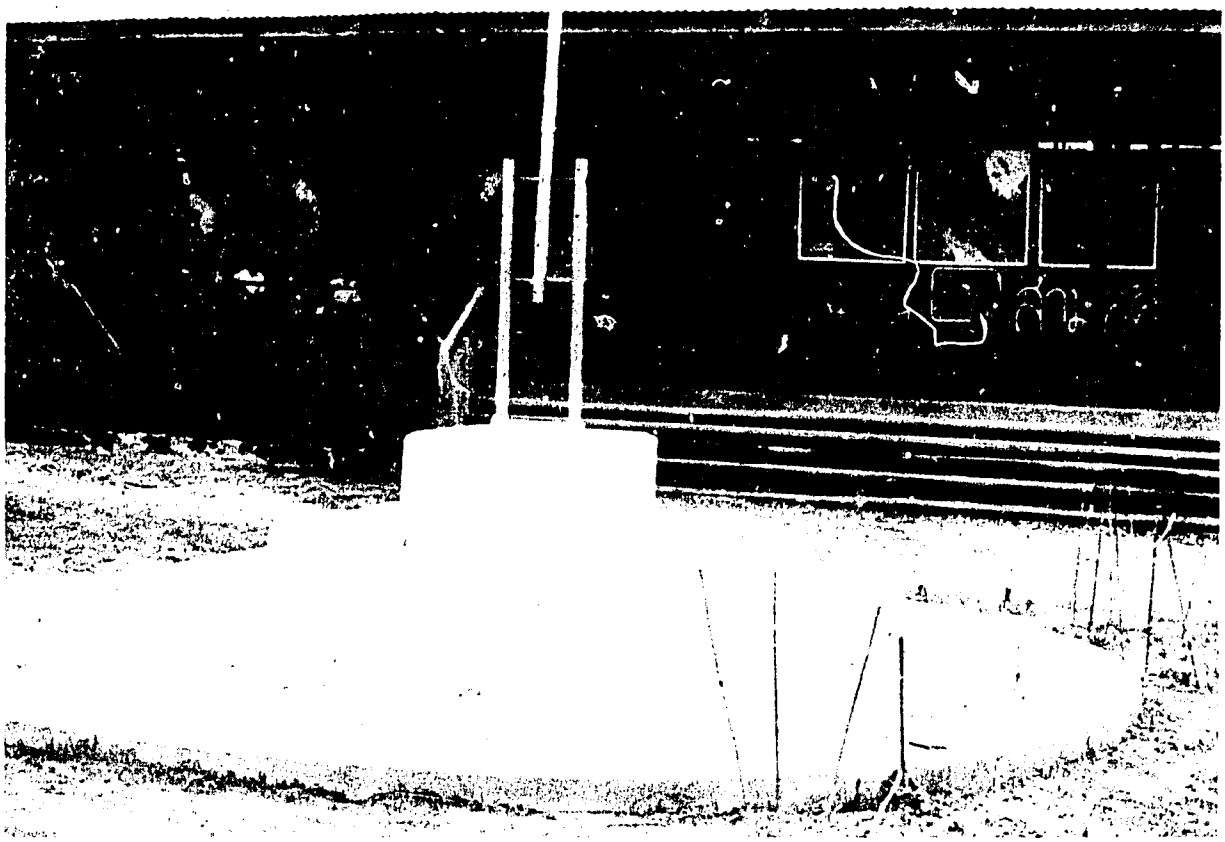
The effect of the Western impact on Thailand was less drastic than in the colonial regions and large numbers of people were not violently jarred out of their traditional modes of life. The effect, rather, was to change the character of the elite; the monarchy in time lost its autocratic powers and authority gravitated into the hands of three groups of the transformed elite; the military, the bureaucrats, and the students who have returned from studying abroad.

These three groups were all the products of the changes that the monarchy introduced; they were the most Westernized elements of Thai society. However, since the rest of the society had not changed as drastically, they came to occupy a somewhat autonomous postion, in that they did not have strong roots in the larger society and thus relations among themselves came to dominate the politics of the country. Under these circumstances, the military became the key group because of their command of the means of violence, and the coup d'etat became the main device for testing changes in relative power (Pye, 1960:97-98).

Relative to many other LDC's, therefore, Thailand has had a rather peaceful history. Lacking major deposits of minerals, easily accessible hardwood forests, or conditions conducive to the development of large plantations, foreign businesses have not generally established bases in Thailand. Development and/or modernization has largely been carried out under the aegis of national governmental programs derived from the interests of the military, the bureaucrats and students educated abroad. Thus, during the past quarter century, there have been a number of concerted efforts at rural development aimed particularly toward improvement of security, especially along the troubled borders with Malaysia, Burma, Laos, Cambodia. In these endeavors, foreign capital has been utilized to support approximately 50 percent of the cost of equipment, commodities, training and technical advice (Scoville and Dalton, 1974).

Early attempts at development were admittedly dispersed and uncoordinated. The lack of communications and transportation networks in the hinterland, combined with administrative ineffectiveness at provincial levels, frequently resulted in the failure of national programs. Thus, the substantial variations in living conditions from place to place were intensified, contributing presumably to the lack of security and existence of a fertile climate for the rise of subversive elements, especially in remote rural areas and along the nation's frontiers.

Under such conditions, attention has turned to the social and economic development of rural areas of the country, especially in poverty areas. The village woodlot project had been launched in such areas of the Northeast region five years ago. This sociological study is part of the inter-disciplinary approach to the project as a rural development program in the Northeast.



One school which was selected as a site for a community woodlot.

B. ATTITUDES AND MOTIVES OF THE VILLAGERS ON THE ACCEPTANCE OF THE VILLAGE WOODLOT PROJECT

Objectives

This section of the study has three objectives:

1. To study general conditions of the villagers in the village woodlot project areas.

2. To study attitudes of the villagers towards the village woodlot project.

3. To study motives of the villagers for accepting the villager woodlot project.

Methodology

Visits to the project areas in the Northeast were made to observe general conditions there before designing the study. Then a social survey was conducted with the interview schedules as a tool for collection of data. After construction of the schedules, pre-testing was done among the villagers in the villages nearby the project areas. Then the schedule was improved and finalized as a workable tool for data collection in the project areas. Flash cards were also used during the interview in order to collect more accurate information from the respondents. A random sampling of about 25 percent of the heads of families were drawn from the lists given to this researcher by the Amphur and Changwat Forestry Officials. A total of 547 respondent villagers were included in this sample. The actual interviewing of the respondents lasted for about one month with seven senior undergraduate and graduate students from the Faculty of Forestry, Kasetsart University, being the enumerators in the field. Eventually, a total of 439 schedules were completed for analysis in this study or about 80.26 percent of the total respondent villagers.

Limitations of Study

During the field survey there was a depression called "Sara" in the Northeast which caused an inconvenience in collection of data in the project areas. Moreover, it was the beginning of the planting season during which the villagers were busy with their farm work. Therefore, this researcher and the enumerators had to spend a great deal of time in collection of data from the respondents.

Results of Study

Sex, age, and education

The majority of the respondent villagers in the villager woodlot project areas were males. Female heads of the farm families existing in the

areas were either widows or divorcees (Table 1). Median age of the respondents was found to be 42, 43½, 44½, and 45½ in Maha Sarakham, Roi-et, Yasothon, and Si Saket respectively (Table 2). When age grouping of the respondents was considered, it was found that the majority of them were in the middle and full adult age groups. As for educational level of the respondents, it was found that most of the respondents obtained an elementary education at the Prathom 4 level only, and the highest percentage of illiterate villagers was found in Si Saket (Table 3).

Attitudes of the villagers

In this study, a three-item summated rating scale was used to measure attitudes of the villagers towards the village woodlot project. When the average attitudinal score of each respondent villager was computed, it was classified into groupings of "bad", "uncertain", "good", or "very good". An analysis of the data indicated that the majority of the respondent villagers felt "good" about the village woodlot project. The highest proportion of those who favored the project was found in Maha Sarakham, while the smallest proportion was in Yasothon (Table 4). When the attitudes were classified by sex of the respondents, it was found that there was an insignificant difference in the attitudes toward the project between male and female respondents. When age groups of the respondents were considered in relation to attitudes, it was found that the most favorable attitudes in Maha Sarakham were found in the 54-63 age group, and in Si Saket, the age group 44-53, while those in Roi-et and Yasothon were in the 34-43 category. When a correlation matrix was computed between age, size of farm land, and attitudes of the respondents toward the village woodlot project, it was found that the relationships between them were insignificant.

Motives of the villagers

Concerning the motives of villagers for the acceptance of the project, it was found that the majority of the respondent villagers accepted the villager woodlot project for three reasons: the need for ample fuel wood, the need for wood for making charcoal for home use, and the availability of wood for sale in which the increased income would belong to village or commune (Table 5).

Conclusions

This study was conducted among the villagers in the village woodlot project areas in the Northeast. Results were summarized as follows:

1. The majority of the respondent villagers were males in middle and full adult age groups with a Prathom 4 education.

2. The majority of the villagers studied had good attitudes towards the village woodlot project.

3. The majority of the villagers accepted the project because they were motivated primarily by needs for ample fuel wood, for wood for making charcoal, and wood for sale to increase income for villages or communes.

Recommendations

Based on this study and experiences in the field, some recommendations may be presented as follows:

1. Since the villagers were poorly educated people, an adult educational program should be promoted effectively by the Ministry of Education in cooperation with the Royal Forest Department in the village woodlot project areas. Basic instruction on village woodlots, agroforestry, rural environment, etc., should be included in such an educational program. This would enable the villagers to have at least some perspective and insight on the forest as a natural resource, village woodlot, and quality of local environments.

2. While the villagers have favorable attitudes towards the village woodlot project, and are anxious to plant fast-growing trees (Eucalyptus Camaldulensis) in their house compounds and on village farmland, the Royal Forest Department should expand this project to all parts of rural areas in the country. The provincial and district forestry officials should prepare a substantial amount of young trees for people who requested trees to grow in their fields, especially in backward and poverty stricken areas througout the country.

3. Under situations where the primary needs of the villagers are for fuel-wood and wood for making charcoal for home use, public land in every village should be used to grow fast-growing trees to serve such needs. If the trees can be cut for selling wood in the near future, all or the major portion of the cash earned should belong to the village, the fundamental unit of rural development activities. This will enable the villagers to acquire sufficient capital for carrying on various developmental activities by themselves with a lower governmental budget. If this recommendation could be actually performed in villages, the villagers' sense of belonging to the village woodlot program would be fostered.

4. The district and provincial forestry officials should follow strictly the policy and objectives of the village woodlot project originally set by the Royal Forest Department. In order to obtain effective cooperation from the villagers and the village or commune committees, the officials should regularly visit the project areas, and discuss problems encountered in the fields with the villagers and the village or commune committees. The district forestry officials should inform the district officer on problems and the progress of the village woodlot project, so that coordination and cooperation in carrying on the project among different developmental units at the district level would be achieved more effectively. In addition, the provincial governor should inform all the governmental officials concerned and the villagers that all benefits from the village woodlot would belong to the local villages, not to the provincial council.

5. Public relations on the village woodlot proje should be regularly released to the public at the provincial or regional level. Strengths and weaknesses of the project should be broadcast and televised through local radio and T.V. stations at least once or twice a month. Simple reading materials, e.g., folders, posters, etc., should be printed and distributed to all public and private sectors in provinces and the region.

Table 1 Sex of the Respondent Villagers

Respondents in Changwat	Males	Females	Total
Maha Sarakham	78.67% (59)	21.33% (16)	100.00 (75)
Roi-et	84.04% (158)	15.96% (30)	100.00 (188)
Yasothon	85.96% (98)	14.04% (16)	100.00 (114)
Si Saket	80.65% (50)	19.35% (12)	100.00 (62)

Table 2 Median Age of the Respondents

Respondent in Changwat	Median Age (years)
Maha Sarakham	42
Roi-et	43½
Yasothon	44½
Si Saket	45½

Table 3 Education of the Respondents

Respondent in Changwat	Illiteracy	Less than Prathom 4	Prathom 4	Higher than Prathom 4	Total
Maha Sarakham	4.00% (3)	1.33% (1)	90.67% (68)	4.00% (3)	100.00 (75)
Roi-et	6.38% (12)	5.32% (10)	85.64% (161)	2.66% (5)	100.00 (188)
Yasothon	0.88% (1)	0.88% (1)	93.85% (107)	4.39% (5)	100.00 (114)
Si Saket	41.94% (26)	3.22% (2)	51.62% (32)	3.22% (2)	100.00 (62)

Table 4 Attitudes of the Villagers towards the Acceptance of the Village Woodlot

Respondent in Changwat	Bad	Uncertain	Good	Very Good	Total
Maha Sarakham	-	14.67% (11)	82.67% (62)	2.66% (2)	100.00 (75)
Roi-et	0.53% (1)	12.23% (23)	79.79% (150)	7.45% (14)	100.00 (188
Yasothon	1.75% (2)	42.99% (49)	53.51% (61)	1.75% (2)	100.00 (114)
Si Saket	-	32.26% (20)	66.13% (41)	1.61% (1)	100.00 (62)

Table 5 Motives of the Villagers on the Acceptance of the Village Woodlot

Respondent in Changwat	Modern man	Risky in farming	Hard worker	Fuel & charcoal	Wood for sale
Maha Sarakham	93.33%	86.67%	89.33%	100.00%	97.33%
Roi-et	90.43%	76.06%	92.55%	99.47%	94.68%
Yasothon	95.61%	76.32%	94.74%	97.37%	97.74%
Si Saket	93.55%	38.71%	90.32%	85.48%	85.48%

Public relations effort in the community woodlot project.

C. OPINIONS OF THE SCHOOL TEACHERS AND THE BUDDHIST MONKS ON THE VILLAGE WOODLOT PROJECT

Objectives of the Study

The objectives of this part of the Study were twofold:

1. To study general conditions of the school teachers and the monks in the project areas.

2. To study opinions of the school teachers and the monks on the village woodlot project.

Methodology

A trip to the project areas was taken to observe the general environment of the schools and Buddhist Monasteries (Wat) which carried on the village woodlot project. There were two primary schools in Maha Sarakham, four schools in Roi-et, five schools in Yasothon, and eight schools in Si Saket. Then, the opinionnaire was constructed and brought to the field for data collection during the second trip to the project areas. There were altogether 274 teachers to whom this researcher planned to distribute the opinionnaires. But in actual collection of data, a total of 177 teachers (or 65%) completed the opinionnaires. There were two temporary Buddhist monasteries and one permanent monastery located on the woodlot project. Only nine monks out of the total 15 monks completed the opinionnaires. All the completed opinionnaires were brought from the field to the researcher's office at the Department of Sociology and Anthropology, Faculty of Social Sciences, Kasetsart University, where data processing, analysis, and writing of this report took place.

Limitations of Study

1. The collection of data occurred just before school summer vacation, while many teachers were not in schools. Therefore, this researcher could not distribute the opinionnaires to all the school teachers.

2. Summer was the time when some monks left the Wat for pilgrimages or for visiting friends in other Wats; therefore, only nine monks completed the opinionnaires.

Results of Study

Age

The school teachers in the research areas varied in age. Their median age indicated that they were early adults with a median age of 27 years in

Roi-et and Si Saket, while those in Maha Sarakham and Yasothon were 30 years old (Table 1). As for the monks, the median age was also 30 years old.

Sex

There were more male teachers than females in this study, since 101 teachers were males, while 76 were females. The highest proportion of males was in Yasothon, while that of females was in Roi-et. All the monks were males. Some nuns and novices were also found in the monasteries studied.

Marital status

Overall, more than two-thirds of the total teachers responding to the opinionnaires have been married. Most of the married teachers were found in Yasothon and Maha Sarakham, while a higher percentage of single teachers were found in Si Saket and Roi-et (Table 2).

Education

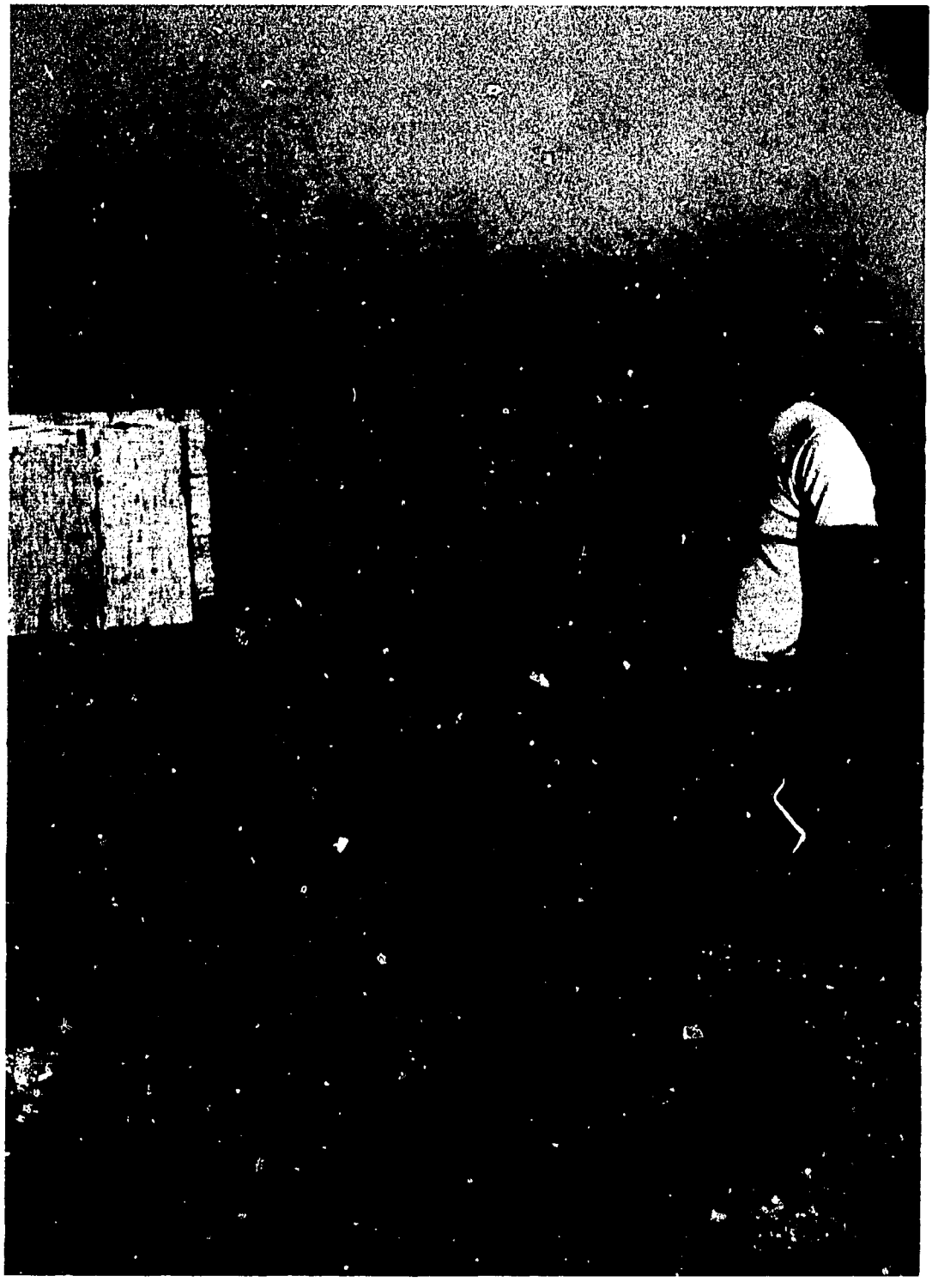
It was found that more than two-thrids of the school teachers in the areas had studied at the vocational education level, while the rest (about 32%) had received B.A. degrees, mostly in education. The highest proportion of the teachers who finished vocational education was found in Si Saket, while the highest number with a B.A. in education was in Roi-et (Table 3). Education of the monks was very low since most of them obtained only a primary education at the Prathom 4 level.

Residential period

Residential period of the school teachers in the communities varied substantially. The length of stay in a community usually reflects variations in the residents' absorption of community cultural aspects. School teachers in Maha Sarakham resided in local communities from 6 months to 13 years; those in Roi-et from 6 months to 37 years; those in Yasothon from 3 months to 43 years; and those in Si Saket from 6 months to 31 years. However, the median residential period was 4 years in Maha Sarakham, 2 years in Roi-et, 6½ years in Yasothon, and 3 years in Si Saket. Hence, the longest residential period was found among the school teachers in Yasothon, while the shortest one was among those in Roi-et (Table 4). As for the monks, the median residential period in the monastery was 3 years.

Opinions of the school teachers and the monks

It was found that the majority of the school teachers strongly agreed with the village woodlot project. The highest percentage of the school teachers who strongly agreed with the project was found in Roi-et, while the smallest one was in Yasothon. A very small proportion of the teachers who expressed disagreement and uncertainty about the project was also found in Yasothon (Table 5). As for the monks, it was found that most of them strongly agreed with the project.



Surveying the opinions of monks.
Their temple lands were to be planted in woodlots.

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Surveying public opinion in an area to be used for woodlots.

Conclusions

Research was compiled from the school teachers and the monks who carried on the woodlot project in the land areas of schools and Wats. Results of study may be concluded as follows:

1. The majority of the school teachers were early adults, predominantly male and married.

2. The majority of the teachers had obtained vocational education, while most of the monks received education up to Prathom 4 only. Residential period in communities of the teachers ranged from 2-6½ years, while that of the monks in the Wat was 3 years.

3. The majority of the teachers and the monks very strongly agreed with the village woodlot project.

Recommendations

Based on the results of study, several recommendations can be advanced:

1. Since the school teachers and the monks were in early adulthood, they were likely to be active and ready to cooperate with the village woodlot project. All the school teachers and the monks were willing to carry on this project in their schools and Wats as best as they could, provided that the trees in full growth would belong to the schools and Wats. This is because while they were engaged in this project they were not certain that they would be allowed to cut the trees for sale or for uses in the schools or Wats. They were uncertain of whether income from selling wood in the near future would belong to schools or Wat. Hence, the government agencies concerned, provincial and district forestry officials, should clearly inform the principals of the schools and the abbots that the woods will belong to the schools and the Wat.

2. Although it is likely that there is no relation between sex, marital status, and the village woodlot project, this researcher feels that males and married people would be more capable to carry on this project. This researcher has observed that the trees in schools at Yasothon (where most of males and married teachers were found) looked healthier than those in other areas.

3. It is likely that more highly educated people will become the early innovators of new ideas or technology. Therefore, expansion of this project in schools at Roi-et (where most of the school teachers obtained a B.A. in education) would be more successful than in other areas. But in the Wats where most of the monks were educated at lower levels, the provincial and district forestry officials should devote more time in supervising the monks on growing and taking care of the trees. Nuns and novices might be helpful if they were encouraged to participate in growing trees.

4. A sense of community depends on the length of the residential period. Therefore, expansion of this project in schools at Yasothon where the school teachers have the longest residential period would likely to be more successful than in other areas. As for the Wat, this researcher feels that Wat Phraputhabat at Yasothon is a good place for the local foresters to try to cope with heavy sandy soil, since the abbot there remarked that while he was willing to carry on this project, the most obvious and serious hindrance so far was the heavy sandy soil. The young trees could not stand against the heat, especially in summer season.

5. Almost all the school teachers and the monks in the study areas strongly ageed with the woodlot project because it brought development activity into the local institutions. Other activities, e.g., a young plant nursery, transplanting young trees, etc., should be taught to the teachers and the monks. Nuns and novices in the Wat should also be trained on these matters, so that sustained growth of the major rural social institutions (i.e., school, Wat) would be obtained through this project. It is hoped that the project will become a good example for rural development in the Northeast and in the nation as a whole.

Table 6 Median Age of the School Teachers

Teachers in Changwat	Median Age (years)
Maha Sarakham	30
Roi-et	27
Yasothon	30
Si Saket	27

Table 7 Marital Status of the School Teachers

Teachers in Changwat	Single	Married	Widow/ Widower	Divorced	Separated	Total
Maha Sarakham	23.08% (3)	76.92% (10)	-	-	-	100.00 (13)
Roi-et	37.70% (23)	59.02% (36)	1.64% (1)	-	1.64% (1)	100.00 (61)
Yasothon	17.40% (8)	80.43% (37)	-	02.17% (1)	-	100.00 (46)
Si Saket	38.60% (22)	59.65% (34)	-	01.75% (1)	-	100.00 (57)

Table 8 Education of the School Teachers

Teachers in Changwat	Vocational Education	B.A.	Total
Maha Sarakham	76.92% (10)	23.07% (3)	100.00 (13)
Roi-et	47.54% (29)	52.46% (32)	100.00 (61)
Yasothon	87.72% (50)	12.28% (7)	100.00 &57)

Table 9 Residential Period of the School Teachers

Teachers in Changwat	Median Residential Period
Maha Sarakham	4
Roi-et	2
Yasothon	6½
Si Saket	3

Table 10 Opinions of the School Teachers on the Village Woodlot Project

Teachers in Changwat	Strongly Disagreed	Disagreed	Uncertain	Agreed	Strongly Agreed	Total
Maha Sarakham	-	-	-	23.08% (3)	76.92% (10)	100.00 (13)
Roi-et	-	-	-	09.84% (6)	90.16% (55)	100.00 (61)
Yasothon	-	2.17% (1)	06.52% (3)	30.44% (14)	60.87% (28)	100.00 (46)
Si Saket	-	-	-	21.05% (12)	78/95% (45)	100.00 (57)

D. AN INTEGRATION OF THE VILLAGE WOODLOT INTO RURAL SOCIAL STRUCTURE OF THAI SOCIETY

It is known by rural sociologists around the world that an effective rural development program should be concerned with the change in rural social structure from a traditional to modern structure. Therefore, this village woodlot project, as a part of rural development activities in rural communities of Thailand, should be integrated into the existing social structure, if sustained growth or viability of the local system is to be achieved. According to Potter (1976), eleven structural elements in rural Thai society are presented. They are: extended family, bilateral kindred, neighbors and neighborhoods, cooperative labor exchange groups, junior-senior relationship, entourage, faction, class divisions, natural village settlement, administrative apparatus of the state, and the Wat. These elements are places where the village woodlot concept could be encouraged by district forestry officials in cooperation with the agricultural extension workers at the commune (Tambon) level.

Extended family

Though variation exists in rural communities, the extended family usually outnumbers the nuclear family. Therefore, the majority of villagers in rural Thailand live among kin, and the youngest daughter , even after marriage, will be responsible for her old perents until their death. Then, the major portion of the family and farm assets including farm land will usually belong to the youngest daughter and her family. The district forestry officials or the agricultural extension workers should approach this extended family in villages and introduce the family members to the village woodlots which could serve as fences around their houses, windbreakers in their fields, and wood for sale in their waste land.

Bilateral kindred

The atmosphere of brotherhood is a significant social climate in rural Thailand where sons and daughters of aunts or uncles will help one another in their daily life and in time of disaster, e.g., drought, flood, fire, etc. The forestry officials or the agricultural extension workers can create rapport and talk informally to this kinship with slides or film shows on the village woodlot so that brothers and sisters in villages or communities would accept and practice it in their fields.

Neighbors and neighborhoods

Neighbors and neighborhoods are important locality groups in rural Thailand. Beside kinship, neighbors and neighborhood will be the next groups in which mutual aid could be found in rural areas. Forestry officials or the agricultural extension workers should approach these neighbors by motivating them to attend meetings and presenting slides or film shows on the village woodlot. If the village woodlot idea is accepted and adopted by these locality groups, rural communities will be likely to adopt the village woodlot program before long.

The planting of community woodlots by the local population demonstrates their cheerful, wholehearted participation in local development.

Previous Page Blank

Cooperative labor exchange groups

This is an informal cooperative labor exchange or mutual aid exchange which inevitably prevails in neighbors and neighborhoods. Cooperative labor exchange may be performed among the villagers during planting, weeding, harvesting crops, or on special occasions such as new house construction, religious ceremonies, and so on. Forestry officials or the agricultural extension workers should try to approach these groups, particularly during breaks in their work, and present the village woodlot program to the group members. Flip charts, posters, etc., may be very useful in this situation so that the group members will quickly understand and easily accept the village woodlot program.

Junior-senior relationship

This is a seniority system which has existed among rural folks since the early history of the Thai nation. Forestry officials or agricultural extension workers should know how to address old folks in villages since they are still the strongest community power holders. All changes or new technologies should first be accepted by old folks; otherwise, the village members will be likely to reject changes or new ideas introduced to them.

Entourage

This is a patronage system in which persons in higher status will take care of persons in lower status who, in turn, work for those in higher status. Forestry officials or agricultural extension workers should approach persons in higher status in villages and introduce the village woodlot program to them. If accepted, these higher status persons or "rural elites" would be likely to give an order to their followers to carry on the woodlot program in their fields.

Faction

This is commonly seen in rural communities where competition and conflict still exist among members. Factions will inevitably occur, particularly during the village or commune headman election time in which leaders of conflicting parties will run for election. Forestry officials or agricultural extension workers should approach leaders of each conflicting party and encourage its members to compete in growing trees under the village woodlot program.

Class divisions

Rural Thailand is a class society where social classes exist among the villagers. Generally, there are five classes: landlords, rich peasants, middle peasants, poor peasants, and landless laborers. Forestry officials or the agricultural extension workers should approach all classes, but the poor peasants and landless laborers should be prime clientele on the dissemination of the village woodlot program in rural areas. Young trees should be given to all poor peasants free of charge so that they could grow trees around their houses or on their small farmland. The landless laborers should be motivated to reside in self-help resettlement schemes or community

forests. Agroforestry techniques should be periodically taught to these poor peasants and landless laborers so that they will be able to stand on their own feet before long.

Natural village settlement

This is a settlement pattern in which unplanned nucleared settlements predominate in rural areas in Thailand. Theoretically, settlement patterns may be organized into administrative villages and natural or sociocultural villages. There are several administrative villages in one natural village. Forestry officials or agricultural extension workers may try to find the central sociocultural village and present the village woodlot program to this community. A demonstration plot may be necessary so that the villagers living in surrounding communities could visit the plot and eventually accept and adopt the woodlot program in their own fields.

Administrative apparatus of the state

Rural communities are parts of the state in which villages are the smallest local administrative units. So far, there are about 60,000 villages in the country. There is a village committee responsible for village development affairs in each village. Therefore, forestry officials or agricultural extension workers should approach village committees and introduce the village woodlot program to them. Meetings with village committees should be organized periodically, e.g., once or twice a month. Public land in each village should be used to grow trees, and income from selling wood should belong to the villages.

Wats

This is the Buddhist monastery. There are temporary and permanent monasteries or temples in rural areas. A few monks, nuns, and novices may reside in temporary Wats in which no church buildings are allowed to be constructed. Generally, many rai of unused land can be seen on all Wats in rural areas. Forestry officials or agricultural extension workers can approach the abbots and subordinate monks and encourage them to grow trees on Wat land. Nuns and novices may also be motivated to grow trees. Help and free labor may be given to the Wat by villagers, primary school teachers, and students nearby the Wat, especially on religious days when people will go to Wat for merit making. The Wat is a very important community center in rural Thailand to the extent that all effective rural development work may be done through this center.

It may not be an easy task for one to integrate this village woodlot project into all the elements of rural social structure already mentioned. Since there is an interaction among these elements, real effort should be put forward by forestry officials (at the district and provincial levels) and by agricultural extension workers in cooperation with community development workers and rural people so that the village woodlot may be expanded to all parts of rural Thailand. Then, success will be attained in the fast growing trees program in rural areas for multipurpose uses, e.g., fuel wood, making charcoal, wood for sale, etc.

The integration of the village woodlot into the rural social structure of the Thai society may be presented diagrammatically as shown in Fig. 1.

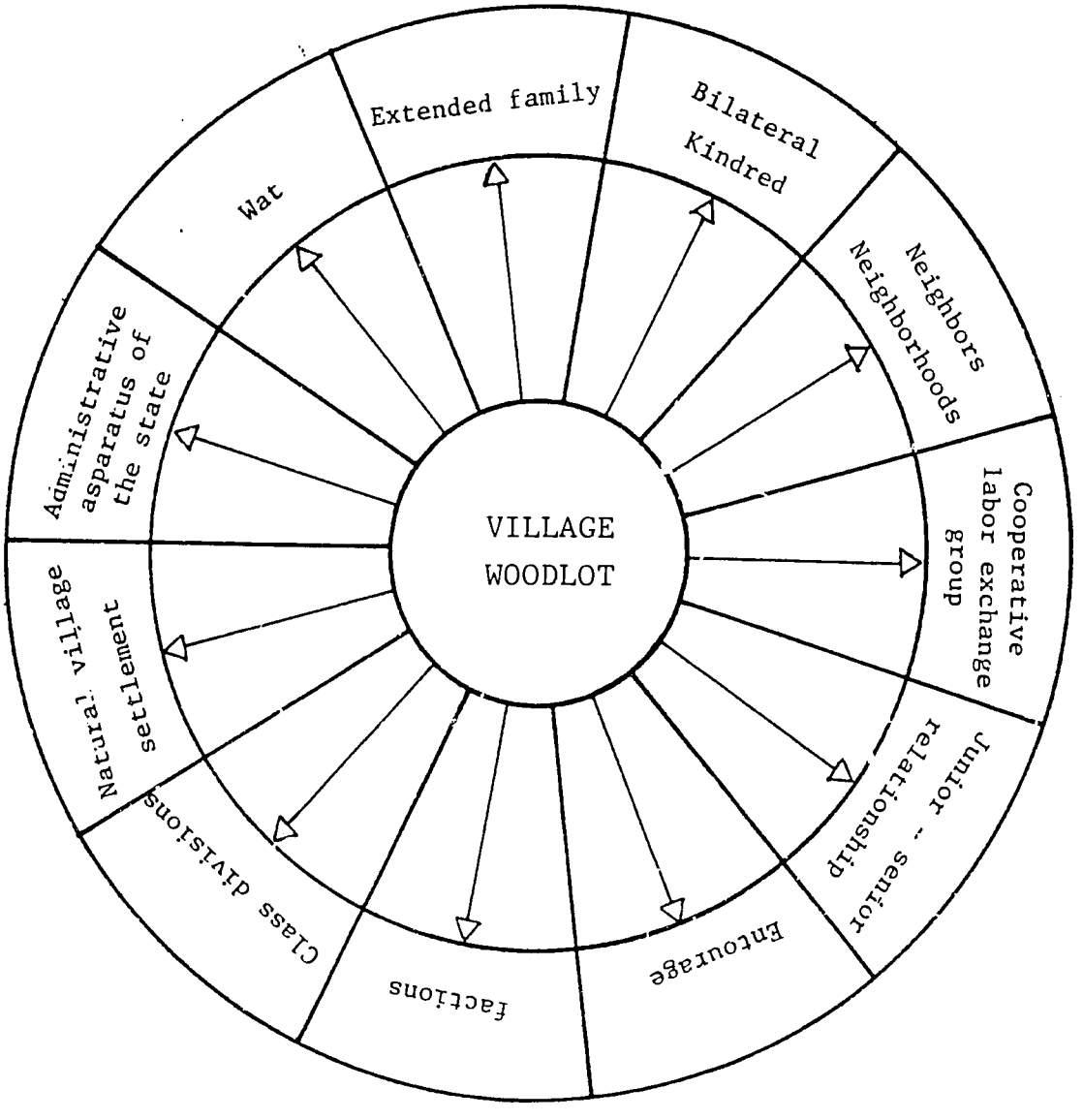

Fig. 1 Diagram showing integration of the village woodlot into rural social structure.

Conclusions

If sustained growth or viability of the local system is needed, then the village woodlot should be integrated into elements of the rural social structure of Thai society.

Recommendations

1. It is, therefore, highly recommended that, forestry officials at the provincial and district levels should work in cooperation with agricultural extension workers, community development workers, and rural people, to integrate the village woodlot into every element of the social structure.

2. Evaluation on strengths and weaknesses of the implementation should be done every one or two years.

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Chapter 7

Utilization of Wood

Obtained from the Village Woodlot

by Dr. Amnuay Corvanich

UTILIZATION OF WOOD

OBTAINED FROM THE VILLAGE WOODLOT

A. BACKGROUND

The main objective in creating a Woodlot Project was to encourage people in the villages to raise fast-growing species of trees which could be utilized as fuelwood and in charcoal burning for their daily cooking and other wood needs. The project also aimed at solving the problem of fuel shortages and at instilling the concept of conservation in the people concerned.

It was found that not only was fuelwood in short supply, but also that the villagers needed materials for house construction, house repairs, farm tools, fencing and so on. So, the utilization of the tree to be grown had to be considered both for fuelwood and other uses.

During the three-year period of the project, several fast-growing species were tried. It was found that the *Eucalyptus camaldulensis* was the only species that could grow and survive in the arid and poor soil conditions in the Northeastern region of Thailand. The species has now been planted on a large scale in the form of woodlots and as individual household trees. A short rotation of five years was set for the *Eucalyptus camaldulensis* to meet the urgent wood demands of the project's villagers.

The normal rotation of the species, when it is designated for fuelwood purposes, is five years. At five years of age approximately 20% of the planted trees will have reached 15 cm DBH and 10 meters of height. At this point, the tree will be large enough for utilizations other than as fuelwood alone.

Since this project's introduction, the planted trees have only grown for three years and have not yet reached the cutting stage. The utilization of wood can begin after the trees reach five years of age. At that time, the utilization of these trees can be considered as follows:

- The larger trees in the woodlot (those whose trunks reach 15 cm DBH) should be selected for use as house poles, log cabin walls, or electric posts for the village or for sale;

- The larger trees can be selected for making wood floorings, such as parquet or mosaic parquet floorings or into small-sized lumber. In this case small-scale forest industries, including wood seasoning and preservation, should be set up near the large-sized woodlot areas to provide additional income for the village people;

Previous Page Blank

- The smaller trees (those under 15 cm DBH) could be made into prefabricated wooden fences or stickwood furniture. These can also be for village use or for sale;

- The branches and butt-ends of the trees can then be used for fuelwood and charcoal making. Its production and resultant benefit-sharing should be organized by the village council;

- Gasifiers run by fuelwood should be introduced at the large-scale woodlots. The fuelwood gasifiers can be used to operate water pumps, rice mills and electric generators. This will also provide mutual benefits to the villagers concerned and will create a feeling of cooperation among the villagers.

B. UTILIZATION OF WOODLOTS

This report is a collection of ideas and recommended uses of this wood.

Fuelwood and Charcoal Burning

The only specific quality of wood required for fuelwood and charcoal burning is hardness. Any portion of the tree can be used as fuelwood and in charcoal making, including stump, branches, twigs, ends, forks and defective parts. Economically speaking, a good section of cut tree should be selected for other uses where thay can be more advantageous to the farmer. Present charcoal kilns and cooking stoves should be improved to obtain a higher percentage of charcoal production and more heating value.

Prefabricated Wooden Fence

Small straight branches and stems can be made into prefabricated fences for domestic use or for sale. The wood should be cut all the same length and nailed onto two crossed bars which are also cut at the same length to make a ready-made fence. These can be kept for personal use or can be sold to the public.

Stickwood Furniture

One inch diameter straight branches and stems should be selected for making stickwood furniture. The process of making such furniture is the same for bamboo and rattan furniture making. Training centers should be set up near village woodlot locations.

Logcabin Wall

Long clear boles 4 inches or more in diameter are first cut into standard lengths of 3, 4, 5, and 6 meters long; then the logs are half-split

Woodlots help meet a basic need for rural area people. This one-year old woodlot is being thinned. The timber will be used for firewood.

After thinning the woodlot, the wood is bundled to be used for staking the new plantation.

The new woodlot staked out with the poles obtained from thinning out the one-year-old woodlot.

Carrying Eucalyptus branches to be used for making charcoal after prunning the woodlot.

by sawing. The half-split logs are then edge-trimmed to make standard widths. The product can then be used for log cabin wall making. Log cabins are a new concept for the Thai people, but since it is an attractive construction material, it is one method of improving the living conditions of villagers as a whole. The product can also be sold to the public.

House Posts and Electric Poles

Long and straight stems of the larger trees can be used as house posts and electric poles for the village and can also be sold to outsiders.

Agricultural Tools

The trees of suitable size in the woodlot can be used for making and repairing the villager's agricultural tools, such as tool handles, sledges, carts, etc.

Floorings

The wood of *Eucalyptus camaldulensis* is hard and of a sufficiently good quality to make floorings and other kinds of wood lamination. A plant should be set up near the woodlot to produce small parquet, or mosaic parquet flooring and wood lamination. This plant should be set up and run as a business by the village cooperative. Wastes from the flooring and wood lamination production can be used as fuelwood,for charcoal burning or can be chipped as particle board or paper-making material. The market for these products should be investigated.

Handicrafts

Ends and wastes from trees can be used for handicraft making. The villagers should be trained in modeling and marketing, and if possible, a cooperative should be set up for running the business.

Woodchips

Even woodchipping is an intensive utilization of wood. However, in Thailand at the present time, the marketing of woodchips is very difficult as there are few woodchip based factories and these are usually located far away from woodlots. The bulky volume of woodchips also creates a very high expense of transportation to the factories. However, a pulp and paper factory at Khon Kaen has recently begun to use *Eucalyptus camaldulensis* chips for its processing. This will help to widen the woodchip market in Thailand in the near future.

Electric Generator

A small generator run by fuelwood should be set up in the villages which have a village woodlot plantation. Each set of generators is capable of producing 20-24 KVA. This is sufficient to provide electricity for a village of 100 families. Besides supplying electricity for lighting, it is recommended that the electricity also be used for water pumping and rice milling for the villagers. This will reinforce the concepts of cooperation and reciproprocity and will also give them a direct personal benefit from the woodlot project.

Seasoning and Wood Preservation

Seasoning and wood preservation is important for wood utilization, particularly for fresh-cut timber. Training courses should be set up near the woodlots where the simple techniques of seasoning and wood preservation with its appropriate technology can be taught. The emphasis should be on teaching rather than high technology.

C. MANAGEMENT OF BENEFITS

The three-year demonstration of the Village Woodlot attracted a lot of public attention. The woodlot model for self-use derived from the Village Woodlot Project can be summarized as follows:

Public Land

The public land will be managed by the sub-district council under the supervision of the district forest officer. Ownership belongs to the council, which decides on the distribution of all project benefits.

School land

The school land will be managed by the school/college authority led by the headmaster/rector under the supervision of the forester. Ownership belongs to the school/college. The benefits will go directly to the school/college, the distribution of which will be decided by the school or college board of authority.

Temple land

Temple land will be owned by the monastery concerned. Management of the woodlot will be overseen by the monastery with the advice of the forester.

Private land

Owners of the private land will manage on their own with guidance from the forester.

D. RECOMMENDATION

To integrate all project possibilities and to thus help guarantee project achievement, seminars or training courses should be set up for the villagers, district officers, and provincial officers.

Chapter 8

Conclusions

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CONCLUSIONS

Silviculture

1. *Eucalyptus camaldulensis*, when compared to other native and exotic species of wood, was found to be a promising species to be planted for firewood in the infertile soil of dry sites in Northeastern Thailand.

2. Most planting activities (including seedling production, planting site preparation and plantation tending) have been carried out by the Provincial Forest Offices.

3. Planting of project village woodlots was concentrated on public land rather than on land belonging to temples and schools.

4. Trees grown using an agroforestry system grew faster than those grown as a forest farm, though some were overpruned in Maha Sarakharm where soil fertility is relatively high and farmers needed the land for upland-crop planting.

5. Early planting in combination with alternative chemical fertilizer/manure application could stimulate height growth. Later fertilization resulted in dieback in summer.

6. More conclusions cannot be drawn since the project duration was not long enough to see complete tree growth. The fuel wood rotation for *Eucalyptus camaldulensis* is approximately 5 years and project completion saw only a three year growth. Investigation on coppice regeneration was not possible.

Economics

1. 38.7% of the households in the study purchased fuel wood which indicates that the fuel wood shortage is becoming a serious problem in this region.

2. The average charcoal consumption per capita per year for all four provinces was 1.55 cubic meters. The average fuel wood consumption per capita per year for all four provinces was 1.42 cubic meters.

3. No cost-benefit analysis could be performed as the trees were too young to harvest, so no measurements of actual yield were able to be made.

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4. The investment cost for each rai of fast-growing trees is 1,128 baht.

5. The average yield of rice production per rai is about 17.67 tang/rai when combined with Eucalyptus trees.

6. Other cash crops (namely: peanuts, mungbeans, Chinese kale, Chinese cabbage, tomatoes and coriander) can be combined with Eucalyptus tree to yield, per rai, 60, 50, 100, 200, 60 and 100 kilograms, respectively.

Land Use

1. Public Land: The idle grazing public lands of 3,705 rai have been forested with the fast growing tree species *Eucalyptus camaldulensis* with the spacing of 2 x 4 m. Agro-forestry systems are being promoted. This public land forest plantation belongs to the sub-district council and is managed by this council under the supervision of the district forest officer. Allocation of the benefits will be decided by this sub-district council.

2. School Land: The school land woodlots were established under the cooperation of the school students and teachers under the supervision of the district forest officer. The maintenance and management of these woodlots were conducted by the school authority led by the headmaster and the temple's rector under the supervision of the foresters. The ownership belongs to the school/college. Allocation of the benefits will be decided by the school/college board authority.

3. Temple Land: The temple land woodlots were established by the temple under the supervision of the foresters. The ownership of the woodlots belongs to the temple concerned. The maintenance and further management will be conducted by the temple with the supervision of the foresters.

Sociology

1. If sustained growth or viability of the local system is needed, then the village woodlot should be integrated into elements of the rural social structure of Thai society.

2. The majority of the respondent villagers were males in the middle and full adult age groups with a Prathom 4 education.

3. The majority of villagers studied had good attitudes toward the Village Woodlot Project.

4. The majority of the villagers accepted the project because they were motivated primarily by needs for ample fuel wood, wood for making charcoal, and wood for sale to increase their own income or that of communes.

5. The majority of the school teachers were young adult males who were married.

6. The majority of the teachers had received a vocational education, while most of the monks received a Prathom 4 education. The residential period in communities of the teachers ranged from 2-6½ years while that of the monks in the Wat was three years.

7. The majority of the teachers and the monks agreed very strongly with the Village Woodlot Project.

Utilization

Because the trees were not full grown it was not possible to reach conclusions as to the effectiveness of the utilization activities planned for this project.

Chapter 9

Recommendations

Previous Page Blank

RECOMMENDATIONS

Silviculture

1. Even though *Eucalyptus camaldulensis* has been established as a fast-growing appropriate species, trials with other species should be established. If it is possible, monoculture should be replaced by multi-species planting.

2. Schools, temples, military camps and communities should play greater roles in fuel planting in the future. Trees could be planted on school lands, in military camps and even along the roads. Provincial forest officers may act as supervisors, coordinators and seed and seedling providers.

3. If the planting site is not suitable for an agroforestry system, then spacing should be narrower--1 x 1 square meter or 1 x 2 square meters. If this is done, then mechanical thinning can be done in the third year in order to turn management from an even-aged to an uneven-aged plantation.

4. To overcome overpruning problems found at Maha Sarakharm, suitable agroforestry systems should be introduced. For instance, when tree canopies get closer in the third year resulting in unsuitability for cassava planting, grazing by livestock may be allowed. Thus, agri-silviculture is replaced by a sylvo-pastoral system in the third year of planting.

5. For better growth and survival, trees should be planted as soon as the rainy season begins. A small amount of mixed fertilizers and/or manure may be applied at planting time. Late fertilization must be avoided.

6. Duration of the project should be prolonged to up to 5 or 6 years instead of 3 years since the planted trees cannot be harvested for firewood when they are 3 years old. Project extension may provide an opportunity to investigate appropriate silvicultural systems.

7. The project should concentrate its future work on provenance trials as well as on the establishment of a seed orchard of *Eucalyptus camaldulensis*.

Economics

1. The way to increase the productivity per unit of land is to implement agro-forestry systems and grow other crops along with the fast growing trees.

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2. Reforestation using agro-forestry systems should be employed in the regions facing fuel wood and farmland shortages.

3. The project should continue so that the trees can be harvested and the final analyses made.

Land Use

1. Meetings with, interviews and discussions with the local people are very important first steps in establishing village woodlots.

2. Selection of village woodlot sites should concentrate on degraded or idle grazing land.

3. The management of village woodlots by the sub-district council is applicable to the present social conditions.

4. Allocation and distribution of the products or benefits should be the decision and under the direction of the village or sub-district council.

5. Cottage industries and commercial industries are urgently needed to support the utilization of small wood products from the woodlot plantations.

6. Continuation or a follow-up program for this Village Woodlot Component is necessary.

Sociology

1. It was recommended that each system in the rural social structure (extended family, bilateral kindred, neighbors and neighborhoods, cooperative labor exchange groups, junior-senior relationships, entourage, faction, class divisions, natural village settlements, administrative apparatus of the state and the Wat) be addressed by forestry officials and agricultural extension workers.

For example, the village committee (as part of the administrative apparatus of the state system) could focus on this problem and provide public land to grow trees; the resulting income would belong to the village. Another example would be to approach abbots in the Wats and encourage them to grow trees on Wat land, provide young trees free of charge to all poor peasants to grow on their own land, and motivate landless laborers to reside in self-help resettlement schemes and community forests (as part of an approach viewing class divisions as a social system).

It is, therefore, highly recommended that forestry officials at the provincial and district levels should work in cooperation with agricultural extension workers, community development workers, and rural people, to integrate the village woodlot into every element of the social structure.

2. An adult educational program should be promoted by the Ministry of Education in cooperation with the Royal Forest Department in the Village Woodlot Project areas to provide fundamental knowledge on village woodlots, agroforestry, rural enviroment, etc.

3. The Royal Forest Department should expand this project to all parts of rural areas in the country.

4. Under the conditions where the primary needs of the villagers are for fuel wood and wood for making charcoal for home use, public land in every village should be used to grow fast-growing trees.

5. The district and provincial forestry officials should strictly follow the policy and objectives of the Village Woodlot Project originally set by the Royal Forest Department. In addition, the provincial governor should inform all the villagers and governmental officials concerned that all benefits from the village woodlot would belong to the local villages, not to the provincial council.

6. Public relations dissemination of information on Village Woodlot Projects should continue over radio and TV at least once or twice a month. Simple reading materials should be printed and distributed.

7. All school teachers and monks were willing to carry on this project in their schools and Wats provided that the trees in full growth belonged to the school or Wat. Hence, the government agencies concerned should inform the principals of the schools and the abbots of the Wats that the wood will belong to the school or the Wat.

8. Evaluation on the strengths and weaknesses of project implementation should be performed every one or two years.

Utilization

Since the planted trees are only 3 years old and have not yet reached the stage of cutting rotation, the utilization of wood could be practiced when the trees are four years old. The following utilizations could be made:

1. The biggest tree trunks which reach 15 cm could be selected to be used as house poles, long cabin walls, or electric posts for the village--or could be sold.

2. The biggest trees could be used for wood flooring such as parquet or mosaic. In this case, small-scale forest industries, including wood seasoning and preservation, should be established where the large-size woodlot area is situated for additional village income.

3. The smaller trees (under 15 cm) could be used to make wooden fences and stick wood furniture for village use and for sale.

4. Branches and butt-ends of the trees left should be used for fuel wood and charcoal making; production and benefit sharing should be organized by the village council.

5. Gasifers run by fuel wood should be introduced where there is a large-scale woodlot. The fuel wood gasifier could run a water pump, rice mill, or an electric generator. The work will provide benefits to all the villagers and will create a cooperative attitude in their minds.

6. To achieve the project objectives and to complete its implementation, seminars (or training courses) should be established for training at least 3 levels of people--the villagers, district officers and provincial officers--on potential utilization of woodlot products.

ANNEX

Table 1 Number of Households and Population in Project Villages, Maha Sarakham Province

Village	No. of Households	Population	Sex				Population Aged under 13 Years	Sex				Average No. of Members Per Household
			Male	%	Female	%		Male	%	Female	%	
Yang Sin Chai	70	449	208	46.32	241	53.68	102	60	58.82	42	41.18	6.41
Nong Hard	44	300	148	49.33	152	50.67	72	23	31.94	49	68.06	6.81
Don Kloi	201	1,256	626	49.84	630	50.16	175	99	56.67	76	43.43	6.24

Table 2 Educational Level of the Villagers living in Project Area by Village, Maha Sarakham Province.

Village	Population at Each Educational Level				Total
	Uneducated	Lower than Po. 6	Po. 6	Higher than Po. 6	
Yang Sin Chai	70 (15.59)	304 (67.70)	56 (12.47)	19 (4.24)	449 (100)
Nong Hard	36 (12.00)	190 (63.34)	54 (18.00)	20 (6.66)	300 (100)
Don Kloi	157 (12.50)	824 (65.61)	162 (12.90)	113 (8.99)	1,256 (100)
Average	(13.13)	(65.73)	(13.56)	(7.58)	(100)

Remark: The figures within the parentheses are the percentages of population at each educational level.

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Table 3 Agricultural Land Classified by Type of Land Tenure, by Village, Maha Sarakham Province

Village	Types of Land Tenure								
	Own Land			Rental Land			Land Belonging in Cousins		
	No. of Households	Land Area (rai)	Average Land Area per Household (rai)	No. of Households	Land Area (rai)	Average Land Area per Household (rai)	No. of Households	Land Area (rai)	Average Land Area per Household (rai)
Yang Sin Chai	64 (91.42)	1,452 (69.94)	20.74	31 (44.28)	384 (18.49)	12.35	5 (8.58)	240 (11.57)	48
Nong Hard	44 (100)	1,339 (96.7)	30.43	9 (20.45)	45 (3.26)	5.00	-	-	-
Don Kloi	192 (95.52)	4,575 (96.94)	23.82	14 (6.96)	144 (3.06)	10.33	-	-	-

Village	Total		
	No. of households	Land area	Average Land Area per Household (rai)
Yang Sin Chai	70	2,076 (100)	29.65
Nong Hard	44	1,384 (100)	31.45
Don Kloi	201	4,719 (100)	23.47

Remark: The figures within the parentheses are the percentages of each item.

Table 4 Rice: Planted Area, Production, Value, Average Yield and Distribution of Rice Production, By Village, Maha Sarakham Province

Village	Planted Area (rai)	Production (tang)	Value (baht)	Average yield (tang/rai)	Distribution of Rice Production	
					Home consumption	For sale
Yang Sin Chai	1,358	28,436	710,900	20.94	19,390 (68.18)	9,046 (31.82)
Noug Hard	581	11,352	283,800	19.54	11,352 (100)	
Don Kloi	2,651	45,703	1,142,575	17.24	44,452 (97.26)	1,251 (2.74)
Average				19.24		

Remark: The figures within the parentheses are the percentages of each item.

Price of rice = 25 baht/tang

Table 5 Average Cost of Rice Production per Rai by Village, MahaSarakarm Province

Village	Land Rent (baht/rai)	Seedling		Labor for:						Fertilizer		Insecticide		Average cost of rice production per rai (baht)
		Quantity (tang)	Value (baht)	Land Prep. (man/day)	Planting (man/day)	Maintenance (man/day)	Harvesting (man/day)	Total (man/day)	Total wage per rai(baht/rai)	Quantity (kg)	Value (baht)	Quantity (kg)	Value (baht)	
Yang Sin Chai	100	0.52	15.60	1.59	2.45	2.71	2.74	9.49	237.25	3.85	19.25	1.10	0.50	372.60
Nong Hard	100	0.57	17.10	4.75	5.11	4.65	7.43	21.95	548.75	8.50	44.00	0.07	0.35	710.20
Don Kloi	100	0.53	15.90	7.80	3.43	2.28	3.06	16.57	414.25	3.66	18.30	0.06	0.31	548.76
Average	100	0.54	16.20	4.71	3.66	3.21	4.41	16.00	400.08	5.43	27.18	0.07	0.38	543.85

Table 6 Cassava: Planted area, Production, Value and Average Yield by Village, Maha Sarakham Province

Village	Planted area (rai)	Production (ton)	Value (baht)	Average Yield (ton/rai)
Yang Sin Chai	917	1,055	738,500	1.15
Nong Hard	588	559	391,498	0.05
Don Kloi	1,302	1,979	1,385,753	1.52
Average				1.20

Remarks: Price of cassave = 700 baht/ton

Table 7 Average Cost of Cassava Production per Rai by Village, Maha Sarakham Province

Village	Land rent (baht/rai)	Labor for: Land Preparation (man/day)	Planting (man/day)	Maintenance (man/day)	Harvesting (man/day)	Total (man/day)	Total wage per rai (baht/rai)	Fertilizer Quantity (kg)	Fertilizer Value (baht)	Insecticide Quantity (kg)	Insecticide Value (baht)	Average Cost of Cassava Production per rai (baht)
Yang Sir Chai	100	2.00	1.63	1.36	4.36	9.32	240.50	1.25	62.50	0.25	1.28	404.28
Nong Hard	100	3.24	2.80	4.60	3.19	13.83	345.75	8.04	40.20	0.93	4.65	490.60
Don Koi	100	2.55	3.95	8.40	4.55	19.53	488.25	18.42	92.10	1.26	6.31	686.66
Average	100	2.59	4.19	4.81	4.12	14.32	358.16	12.98	64.93	0.61	4.08	527.18

Remarks: Wage rate = 25 baht/day
Price of fertilizer = baht/kg
Price of insecticide = baht/kg

Table 8 Number and Value of Livestock by Village, Maha Sarakham Province

Village	Cattle Number	Cattle Value (baht)	Buffaloes Number	Buffaloes Value (baht)	Swine Number	Swine Value (baht)	Ducks Number	Ducks Value (baht)	Chickens Number	Chickens Value (baht)	Geese Number	Geese Value (baht)	Fish Number	Fish Value (baht)
Yang Sin Chai	194	970	124	620	34	51	1,628	48.84	438	10.95	23	3.45	-	-
Nong Hard	286	1,480	154	770	-	-	35	1.05	211	5.27	-	-	-	-
Don Koi	2,085	10,425	400	2,000	-	-	1,299	38.97	1,299	32.47	-	-	66,933	66.93

Remark: Value = 1000 baht

Table 9 Number and Percentage of Households, and their Non-farm Income, Distributed by Non-farm Activities by Village, Maha Sahakham Province

Village	Total No. of Households	Non-farm Activities: Labor Wage Earning			Trading			Handicraft			Collection of forest Products		
		No. of Households	%	Average Income Per Household per year (baht)	No. of Households	%	Average Income Per Household per year (baht)	No. of Households	%	Average Income Per Household per year (baht)	No. of Households	%	Average Income Per Household Per year (baht)
Yang Sinchai	70	23	32.85	3,704	-	-	-	-	-	-	12	17.14	3,130
Nong Hard	44	17	38.63	1,650	-	-	-	-	-	-	4	7.09	7,230
Don Kloi	201	17	8.45	6,720	30	14.92	4,9171	17	8.45	1,800	38	18.90	2,630

Table 10 Number of households and population in project villages, Roi-et Province

Village	No. of Households	Population	Sex: Male	%	Sex: Female	%	Population Aged Less Than 13 Years	Sex: Male	%	Sex: Female	%	Average Number of Members per Household
Song Chun	215	1,274	640	50.23	634	49.77	391	175	44.76	216	55.24	5.92
Nong Sra	67	410	207	50.48	203	49.52	113	78	69.03	35	30.97	6.11
Som Hong	152	897	417	46.48	480	53.52	249	105	43.17	144	57.83	5.90
Nong E-Khem	102	627	310	49.44	317	50.56	259	146	56.38	113	43.62	6.14
Hin Kong	165	934	452	48.39	482	52.61	224	121	54.02	103	45.98	5.66
Lao Khao	80	570	275	48.24	295	51.76	180	88	48.89	92	51.11	7.11
											Average	6.14

Table 11 Educational level of villagers living in project area, by village, Roi-et Province.

Village	No. of population of each educational level				Total
	uneducated	lower than Po. 6	Po. 6	Higher than Po. 6	
Song Chun	181 (14.21)	806 (63.26)	128 (10.04)	159 (12.49)	1,274 (100)
Nong Sva	70 (17.08)	270 (65.85)	53 (12.93)	17 (4.14)	410 (100)
Som Hong	139 (15.49)	578 (64.44)	121 (13.49)	59 (6.58)	897 (100)
Nong E Khom	166 (26.48)	406 (64.75)	15 (2.39)	40 (6.38)	627 (100)
Hin Kong	134 (14.35)	663 (70.99)	99 (10.59)	38 (4.07)	934 (100)
Lao Khoa	92 (16.14)	395 (69.29)	59 (10.35)	24 (4.22)	570 (100)
Average	(16.59)	(66.17)	(10.08)	(7.16)	(100)

Remark: The figures within the parenthesis are the percentate of population at each educational level

Table 12 Agricultural land classified by Type of land tenure by village, Roi-et Province.

Village	Type of land holding														
	Own land			Rental land			Land belongs to cousin			Public land			Total		
	No. of households	Land area (rai)	Average land area per household (rai)	No. of households	Land area (rai)	Average land area per household (rai)	No. of households	Land area (rai)	Average land area per household (rai)	No. of households	Land area (rai)	Average land area per household (rai)	No. of household	Land area (rai)	Average land area per household (rai)
Song Chun	208 (96.74)	4,979 (96.28)	23.93	12 (5.58)	114 (2.20)	9.50	6 (2.79)	36 (0.69)	6	6 (2.79)	42 (0.83)	7	215	2,171	24.05
Nong Sra	67 (100)	2,425 (94.54)	36.19	4 (5.97)	80 (3.11)	20	4 (5.97)	60 (2.35)	15	-	-	-	67	2,565	38.28
Som Hong	152 (100)	5,875 (97.36)	34.04	8 (5.26)	140 (2.64)	17.50	-	-	-	-	-	-	152	5,315	34.96
Nong E Khom	97 (95.09)	3,597 (87.36)	37.08	13 (12.74)	520 (2.64)	40	-	-	-	-	-	-	102	4,117	40.36
Hin Kong	160 (96.96)	6,028 (89.25)	37.67	21 (12.72)	726 (10.75)	34.57	-	-	-	-	-	-	165	6,754	40.93
Lao Khoa	80 (100)	2,796 (94.10)	34.95	7 (8.75)	175 (5.90)	25	-	-	-	-	-	-	80	2,971	37.13

Remark: The figures within the parenthesis are the percentage of each item.

Table 13 Rice: Planted area, production, value, average yield and distribution of rice production, by village, Roi-et Province.

Village	Planted area (rai)	Production (tang)	Value (Baht)	Average yield (tang/rai)	Distribution of rice production			
					Home consumption (tang)	For sale (tang)	Pay for land rent (tang)	Labor wage payment (tang)
Song Chun	5,666	110,354	3,310,620	19.48	49,671 (45.01)	59,103 (53.55)	1,580 (1.44)	-
Nong Sra	2,581	32,776	983,280	12.69	20,323 (62)	12,213 (37.26)	240 (0.74)	-
Som Hong	5,320	93,419	2,802,570	17.56	45,220 (48.40)	47,559 (50.90)	240 (0.27)	400 (0.43)
Nong E Khom	4,150	66,732	2,001,960	16.08	24,108 (36.12)	41,350 (61.96)	625 (0.93)	649 (0.99)
Hin Kong	6,967	116,070	3,482,100	16.66	49,065 (42.28)	67,005 (57.72)	-	-
Lao Khao	2,977	37,374	1,121,220	12.55	18.590 (49.74)	17,680 (47.30)	152 (0.42)	952 (2.54)
Average				15.83				

Table 14 Average cost of rice production per rai by village, Roi-et Province.

Village	Land rent (baht/rai)	Seeding		Labor for						Fertilizer Used		Insecticide Used		Average cost of rice production per rai
		Quantity (tang)	Value (baht)	Land Preparation (man-day)	Planting (man-day)	Maintenance (man-day)	Harvesting (man-day)	Total (man-day)	Total labor wage per rai (baht/rai)	Quantity (k.g.)	Value (baht)	Quantity (k.g.)	Value (baht)	(baht)
Song Chun	100	0.97	29.10	1.80	3.60	1.83	5.22	12.45	311.25	5.93	29.65	0.28	1.40	471.40
Nong Sra	100	0.74	22.31	1.09	4.55	2.17	3.68	11.49	287.25	5.03	25.15	0.36	1.82	436.53
Som Hong	100	0.81	24.30	1.05	3.67	4.40	3.68	12.80	320.00	7.87	39.35	0.25	1.25	484.90
Nong E Khom	100	0.99	29.70	1.23	2.96	1.43	3.75	9.37	234.25	10.21	51.05	0.17	0.85	415.85
Hin Kong	100	0.82	24.60	1.68	4.12	4.14	5.18	15.12	378.00	9.73	48.65	0.16	0.80	552.05
Lao Khoa	100	0.76	22.06	1.69	3.35	2.25	4.12	11.50	287.50	5.60	85.8	0.19	0.94	497.2
		0.84	25.49	1.42	3.70	2.70	4.28	12.12	303.04	7.40	46.60	0.23	1.17	476.32

Table 15 Number and value of livestock by village, Roi-et Province.

Value: Thousand Baht

Village	Cattle		Buffaloes		Swine		Ducks		Chickens		Geese		Fish	
	Number	Value (baht)	Number	Value (baht)	Number	Value (baht)	Number	Value (baht)	Number	Value (baht)	Number	value (baht)	Number	value (baht)
Song Chun	72	360	235	1,175	147	220.50	1,203	36.09	1,806	45.15	-	-	-	-
Nong Sra	108	540	169	845	15	22.50	500	15.00	600	15.00	-	-	-	-
Som Hong	215	1,075	260	1,250	97	145.50	1,207	36.21	1,240	31.00	96	14.40	-	-
Nong E Khom	400	2,000	200	1,000	39	58.50	749	22.47	1,223	30.57	-	-	-	-
Hin Kong	158	790	300	1,500	22	33.00	2,249	67.47	2,584	64.60	-	-	-	-
Lao Khao	300	1,500	150	750	-	-	254	7.62	872	21.80	-	-	728	0.728

Table 16 Number of percentage of households, and their non farm income distributed by non farm activitiy by village, Roi-et Province.

Village	Total number of households	Non farm activities											
		Labor wage earning			Trading			Handicraft			Collection of forest products		
		No. of households	%	Average income per household per year (baht)	No. of households	%	Average income per household per year (baht)	No. of households	%	Average income per household per year (baht)	No. of households	%	Average income per household per year (baht)
Song Chun	215	86	40.00	9,565	12	5.58	12,000	-	-	-	-	-	-
Nong Sra	67	9	13.43	8,892	9	13.43	1,800	-	-	-	-	-	-
Som Hong	152	8	5.26	12,000	41	26.97	8,070	24	15.78	1,100	-	-	-
Nong E Khom	102	31	30.39	7,371	-	-	-	13	12.74	3,400	4	3.92	603
Hin Kong	165	21	12.72	5,360	21	12.72	4,660	-	-	-	-	-	-
Lao Khoa	80	14	17.50	8,940	4	5.00	2,400	7	8.75	18,600	-	-	-

Table 17 No. of Households and Population in Project Villages, Yasathon Province.

Village	No. of Households	Population	Sex				Population < 13 years	Sex				Average no. of members per household
			Male	%	Female	%		Male	%	Female	%	
Nong Boa	26	181	98	54.14	83	45.86	47	25	53.19	22	46.81	6.95
Siri Pattana:												
Moo 1	86	503	246	48.90	257	51.10	123	68	55.28	55	44.72	5.84
Moo 4	58	391	191	48.84	200	51.60	100	89	89.00	11	11.00	6.74
Moo 10	41	283	149	52.65	134	47.35	99	55	55.56	44	44.44	6.90
Nong Bor	16	107	60	56.07	47	43.93	34	24	70.58	10	29.42	6.68
Bark Yai	57	437	230	52.63	207	47.37	145	64	44.14	81	55.86	8.09
Nong Sum	20	270	165	61.11	105	38.89	67	38	56.72	29	43.28	13.50
Narm Orm:												
Moo 5	28	175	80	45.71	95	54.29	62	28	45.17	34	54.83	6.25
Moo 9	115	767	320	41.72	447	58.28	280	130	46.42	150	53.58	6.66
Ban Jarn	118	730	330	45.20	400	54.80	208	89	42.79	119	57.21	6.18
											Average	7.37

Table 18 Educational Level of Villagers Living in Project Area by Village, Yasothon Province.

Village	No. of Population at Each Educational Level				Total
	Uneducated	Lower than Po. 6	Po. 6	Higher than Po. 6	
Nong Boa	37 (20.44)	134 (74.04)	5 (2.76)	5 (2.76)	181 (100)
Siri Pattana:					
Moo 1	65 (12.93)	341 (67.79)	61 (12.13)	36 (7.15)	503 (100)
Moo 4	78 (19.94)	291 (74.42)	11 (2.82)	11 (2.82)	391 (100)
Moo 10	90 (31.80)	161 (56.89)	20 (7.07)	12 (4.24)	283 (100)
Nong Bor	5 (4.67)	81 (75.70)	18 (16.83)	3 (2.80)	107 (100)
Bark Yai	82 (18.77)	317 (72.54)	38 (8.69)	-	437 (100)
Nong Sam	23 (8.52)	229 (84.81)	12 (4.45)	6 (2.22)	270 (100)
Nam Orm:					
Moo 5	31 (17.73)	138 (78.85)	3 (1.71)	3 (1.71)	175 (100)
Moo 9	103 (13.43)	505 (65.84)	159 (20.73)	-	767 (100)
Ban Jarn	179 (24.52)	484 (66.30)	60 (8.22)	7 (0.96)	730 (100)
Average	(18.03)	(69.75)	(10.07)	(2.15)	(100)

Remark: The figuer within the parentheses are the percentages of population at each educational level.

Table 19 Agricultural Land Classified by Type of Land Tenure by Village, Yasothon Province.

Village	Type of Land Tenure						Total		
	Cown Land			Rental Land					
	No. of Household	Land Area (rai)	Average Land area per Household (rai)	No. of Household	Land Area (rai)	Average Land area per Household (rai)	No. of Household	Land Area (rai)	Average Land Area per Household (rai)
Nong Bao	26 (100)	774 (97.35)	29.76	3 (11.53)	21 (2.65)	7	26	795	30.57
Siri Pattana:									
Moo 1	86 (100)	2,857 (96.48)	33.22	8 (9.30)	108 (3.52)	13	86	2,961	34.43
Moo 4	58 (100)	2,157 (95.14)	37.18	11 (18.96)	110 (4.86)	10	58	2,267	39.08
Moo 10	41 (100)	1,348 (100)	32.88	-	-	-	41	1,348	32.88
Nong Bor	16 (100)	41,328 (100)	25.83	-	-	-	16	41,328	25.83
Bark Yai	57 (100)	957 (89.35)	16.78	19 (33.33)	114 (10.65)	6	57	1,071	18.78
Nong Sum	20 (100)	650 (80.24)	32.50	8 (40)	160 (19.76)	20	20	810	40.50
Nam Orm:									
Moo 5	28 (100)	708.40 (100)	25.30	-	-	-	28	708.40	25.30
Moo 9	115 (100)	2,829 (100)	24.60	38 (33.04)	433 (13.27)	11.39	115	3,262	28.36
Ban Jarn	118 (100)	3,472 (94.65)	29.42	14 (11.86)	196 (5.35)	14	118	3,668	31.08

Remark: The figures within the parentheses are the percentage of each item.

Table 20 Rice: planted area, production, value, average gield and distribution of rice production, by village, Yasothon Province.

Village	Planted Area (rai)	Production (tang)	Value (Baht)	Average Yield (tang/rai)	Distribution of Rice Production	
					Home Consumption (tang)	For Sale (tang)
Nong Bao	793	7,977	239,310	10.06	4,802 (60.19)	2,796 (35.05)
Siri Pattana:						
Moo 1	2,964	40,493	1,214,790	13.66	22,114 (54.62)	18,379 (45.38)
Moo 4	2,273	22,736	682,080	10.00	12,934 (56.88)	9,802 (43.12)
Moo 10	1,011	11,161	334,830	11.03	6,816 (61.07)	4,345 (38.93)
Nong Bor	413	5,814	170,520	14.13	3,466 (59.11)	2,398 (40.89)
Bark Yai	1,071	21,678	650,340	20.24	16,432 (75.81)	5,426 (24.19)
Nong Sum	766	10,295	308,850	13.43	5,560 (54.00)	4,735 (46.00)
Nam Orm:						
Moo 5	708	9,407	282,810	13.28	4,844 (51.50)	4,563 (48.50)
Moo 9	3,266	58,200	1,746,000	17.82	24,495 (42.08)	33,705 (57.92)
Ban Jarn	3,679	34,283	1,028,490	9.32	15,560 (45.39)	18.723 (54.61)
Average				13.29		

Table 21 Average cost of rice production per rai, by village, Yasothon Province.

Village	Land Rent (Baht/rai)	Seedling		Labour for						Fertilizer Used		Insecticide Used		Average Cost of Rice Production per rai (Baht)
		Quantity (tang)	Value (Baht)	Land Preparation (man-day)	Planting (man-day)	Maintenance (man-day)	Harvesting (man-day)	Total (man-day)	Total Labour Wag per rai (Baht/rai)	Quantity (kg)	Value (Baht)	Quantity (kg)	Value (Baht)	
Nong Bao	100	0.45	13.57	0.96	4.59	1.21	4.49	11.25	281.25	16.39	81.95	0.12	0.60	472.39
Siri Pattana:														
Moo 1	100	0.60	18.00	1.42	5.00	0.81	4.66	11.89	297.25	16.16	80.80	0.33	1.15	497.70
Moo 4	100	0.77	23.10	1.72	6.02	1.33	3.00	12.07	301.75	12.50	62.50	0.10	0.50	487.85
Moo 10	100	0.81	24.30	1.68	4.90	3.75	4.05	14.38	359.50	11.11	55.55	0.69	3.48	542.83
Nong Bor	100	0.54	16.20	1.41	5.41	1.83	4.45	13.10	327.50	21.29	106.45	0.53	2.66	552.81
Bark Yai	100	1.13	33.90	2.32	8.04	1.78	7.05	19.19	479.75	16.34	31.70	1.17	5.86	701.21
Nong Sum	100	0.88	26.40	2.65	3.83	1.29	4.27	12.04	301.00	15.06	75.30	0.33	1.65	504.35
Nam Orm:														
Moo 5	100	0.56	16.80	1.45	5.62	4.45	5.31	16.83	420.75	13.28	66.40	0.07	0.39	603.40
Moo 9	100	0.46	13.50	2.96	6.66	2.11	7.04	18.77	469.25	12.30	61.00	0.46	2.31	646.36
Ban Jarn	100	0.60	18.00	2.52	6.35	4.33	5.40	18.60	465.00	7.71	35.85	0.80	4.00	622.85
Average	100	0.68	20.40	1.90	5.64	2.28	4.97	14.81	370.30	14.20	70.75	0.46	2.31	563.67

Remark: Price of rice = 30 Baht/tang
Wage rate = 25 Baht/day

Table 22 Number and value of livestock by village, Yasothon Province

Village	Cattle		Buffaloes		Swine		Duck		Chicken		Fish	
	Number	Value (Baht)	Number	Value (Baht)	Number	Value (Baht)	Number	Value (Baht)	Number	Value (Baht)	Number	Value (Baht)
Nong Boa	60	300	40	200	-	-	70	2.10	252	6.30	-	-
Siri Pattana:												
Moo 1	112	560	84	420	53	79.50	1,166	34.98	900	22.50	129,465	129.46
Moo 4	29	145	62	310	-	-	58	1.74	1,136	28.42	-	-
Moo 10	30	150	64	320	-	-	245	7.37	469	11.72	-	-
Nong Bor	13	65	21	105	-	-	50	1.50	101	2.52	18,666	18.66
Bark Yai	34	170	50	250	-	-	154	4.62	447	11.17	21,984	21.98
Nong Sum	20	100	23	115	-	-	116	3.48	710	17.75	-	-
Nam Orm:												
Moo 5	16	80	28	140	-	-	282	8.46	195	4.87	-	-
Moo 9	48	240	120	600	-	-	904	27.12	291	7.27	-	-
Ban Jarn	-	-	106	430	7	10.50	840	25.20	1,128	28.20	-	-

Table 23 Number and percentage of households, and their nonfarm income distributed by occupation, by village, Yasothon Province.

Village	Total Number of Households	Occupation											
		Labor Wage Earning			Trading			Handicraft			Collection of Forest Products		
		No. of Households	%	Average income per household per year (Baht)	No. of Households	%	Average income per household per year (Baht)	No. of Households	%	Average income per household per year (Baht)	No. of Households	%	Average income per household per year (Baht)
Siri Pattana:													
Moo 1	86	35	40.69	13,926	4	4.65	2,400	27	31.30	942	19	22.09	330
Moo 4	58	23	39.65	15,000	-	-	-	-	-	-	-	-	-
Moo 10	41	9	21.95	27,000	4	9.75	6,000	-	-	-	-	-	-
Nong Bor	16	5	31.25	1,644	5	31.25	2,400	5	31.25	420	-	-	-
Bark Yai	54	32	59.25	1,497	3	5.55	2,400	7	12.96	630	-	-	-
Nong Sum	20	20	100.00	7,200	-	-	-	-	-	-	-	-	-
Nam Orm:													
Moo 5	28	8	28.57	3,520	8	28.57	3,200	3	10.71	2,400	-	-	-
Ban Jam	118	66	55.93	3,042	22	18.64	1,733	14	11.86	750	-	-	-

Table 24 No. of Households and Population in Project Villages, Si Saket Province

Village	No. of households	Population	Sex				Population < 13 years	Sex				Average no.of members per household
			Male	%	Female	%		Male	%	Female	%	
Jung Kra Darn	260	1,300	630	48.46	670	51.54	279	130	46.60	149	53.40	5
Ban Pong	85	560	260	46.42	300	53.58	199	93	46.74	106	53.26	6.58
											Average	5.79

Table 25 Educational Level of Villagers Living in Project Area by Village, Si Saket Province.

Village	No. of Population at Each Educational Level				Total
	Uneducated	Lower than Po.6	Po.6	Higher than Po.6	
Jung Kra Darn	483 (37.22)	656 (50.54)	126 (9.70)	33 (2.54)	1,298 (100)
Ban Pong	114 (20.36)	307 (54.82)	131 (23.39)	8 (1.43)	560 (100)
Average	(32.13)	(51.83)	(13.83)	(2.21)	(100)

Remark: The figures within the parentheses are the percentage of population at each educational level.

Table 26 Agricultural Lanc Classified by Type of Land Tenure by Village, Sri Saket Province

Village	TYPE OF LAND TENURE											
	Owned Land			Rental Land			Reserved Forest Land			Total		
	No. of households	Land area (rai)	Average land area per household	No. of households	Land area (rai)	Average land area per household	No. of households	Land area (rai)	Average land area per household	No. of households	Land area (rai)	Average land area per household
Jung Kra Darn	251 (96.53)	3,954 (96.26)	15.71	9 (3.46)	153 (3.74)	17.00	-	-	-	260	4,098	15.76
Ban Pong	85 (100)	2,391 (88.85)	28.12	14 (16.47)	280 (10.40)	23.45	4 (4.70)	20 (0.74)	5	85	2,691	31.40

Remark: The figures within the parentheses are the percentage of each item.

Table 27 Rice: Planted Area, Production, Value, Average Yield and Distribution of Rice Production by Village, Si Saket Province.

Village	Planted Area (rai)	Production (tang)	Value (baht)	Average Yield (tang/rai)	Distribution of Rice Production	
					Home consumption (tang)	For sale (tang)
Jung Kra Darn	3,853	72,051	1,801,275	18.70	56,452 (78.35)	15,599 (1.65)
Bon Pong	2,482	38,942	973,550	15.69	17,813 (45.74)	21,129 (54.26)
Average				17.19		

Remark: The figures within the parentheses are the percentages of each item.

Table 28 Average Cost of Rice Production per Rai, by Village, Si Saket Province

Village	Land rent (baht/rai)	Seedling		Labor for:						Insecticide		Fertilizer		Average cost of rice production per rai (baht)
		Quantity (tang)	Value (baht)	Land Preparation (man/day)	Planting (man/day)	Maintenance (man/day)	Harvesting (man/day)	Total (man/day)	Total labor wage per rai (baht/rai)	Quantity (kg)	Value (baht)	Quantity (kg)	Value (baht)	
Jung Kra Darn	100	0.78	23.40	4.02	5.25	2.58	6.32	18.17	454.25	7.59	37.95	-	-	615.60
Ban Pong	100	0.55	16.50	2.55	6.47	2.55	4.68	16.25	406.25	10.14	50.70	0.25	1.28	574.73
Average		0.66	19.95	3.28	5.86	2.56	5.50	17.21	430.25	8.86	44.32	0.25	1.28	595.16

Remarks: Price of rice = 30 baht/tang
Labor wage rate = 25 baht/day

Table 29 Kenaf: Planted Area, Production, Value, Average Yield by Village, Si Saket Province.

Village	Planted Area (rai)	Production (kg)	Value (baht)	Average Yield (kg/rai)
Jung Kra Darn	251	20,968	62,904	83.53
Ban Pong	214	23,651	70,953	110.52
Average				97.02

Table 30 Average Cost of Kenaf Production Per Rai, by Village, Si Saket Province

Village	Land rent (baht/ rai)	Seedling Quantity (tang)	Seedling Value (baht)	Labor for: Land preparation (man-day)	Planting (man-day)	Maintenance (man-day)	Harvesting (man-day)	Total (man-day)	Total Labor Wage per rai (baht)	Average Cost of Kenaf Production per rai (baht)
Jung Kra Darn	100	2	40	2.87	5.62	9.00	3.83	21.32	533.00	673.00
Ban Pong	100	2	40	2.65	5.44	9.35	3.47	20.91	522.75	622.75
Average	100	2	40	2.76	5.53	9.17	3.65	21.11	527.87	677.87

Table 31 Number and Value of Livestock by Village, Si Saket Province

Village	Cattle		Buffaloes		Swine		Ducks		Chickens		Geese	
	Number	Value (baht)	Number	Value (baht)	Number	Value (baht)	Number	Value (baht)	Number	Value (baht)	Number	Value (baht)
Jung Kra Darn	30	150	200	1,000	217	325.50	217	6.51	1,306	32.65	41	6.15
Ban Pong	200	1000	150	750	11	16.50	1263	37.89	1,514	37.85	—	—

Value: 1,000 baht

Table 32 Number and Percentage of Households and Their Non-farm Income Distributed by Non-farm Activity by Village, Si Saket Province

Village	Total No. of Households	Labor Wage Earning			Trading			Handicraft		
		No. of Households	%	Average Income Per Household Per Year (Baht)	No. of Households	%	Average Income Per Household Per Year (Baht)	No. of Households	%	Average Income Per Household Per Year
Jung Kra Darn	260	29	11.15	16,200	22	8.46	9,600	7	2.69	120
Ban Pong	85	15	17.64	3,600	--	--	--	-	--	-

Table 33 Quantity of Demand, Utilization, and Sources of Fuelwood and Charcoal, by Village, Maha Sarakham Province

Village	Quantity of demand for fuelwood per capita per year (m^3)	Quantity of demand for charcoal per capita per year (bag)	Fuelwood and Charcoal Utilization						Sources of fuelwood				Sources of Charcoal			
			Fuelwood		Charcoal		Used Both		Own Production		Purchasing		Own Production		Purchasing	
			No. of Households	%	No. of Households	%	No.	%	No.	%	No.	%	No.	%	No.	%
Yang Sin Chai	1.59	1.84	30	42.86	10	14.28	30	42.86	57	81.42	13	18.58	29	41.43	11	15.71
Nong Hard	1.14	1.79	4	9.09	4	9.09	36	81.82	44	100	—	—	31	70.45	9	20.45
Don Kloi	1.13	1.89	12	5.98	33	16.41	156	77.61	201	100	—	—	173	86.07	16	7.96
Average	1.28	1.84														

Table 34 Quantity of Demand, Utilization and Sources of Fuelwood and Charcoal by Village, Roi-et Province.

Village	Quantity of demand for fuelwood per capita per year (m^3)	Quantity of demand for charcoal per capita per year (bag)	Fuelwood and Charcoal Utilization						Sources of Fuelwood				Sources of Charcoal			
			Fuelwood used only		Charcoal Used only		Used both		Owned Production		Purchasing		Owned Production		Purchasing	
			No. of households	%	No. of households	%	No. of households	%	No. of households	%	No. of households	%	No. of households	%	No. of households	%
Song Chun	1.32	1.72	98	45.58	30	13.96	87	40.46	170	79.07	45	20.93	26	12.09	91	42.33
Nong Sra	1.93	1.49	-	-	22	32.84	45	67.16	46	68.66	21	31.34	-	-	67	100
Som Hong	1.79	1.82	6	3.96	46	30.26	100	65.78	20	13.15	132	86.85	10	6.57	136	89.47
Nong E-Khem	1.50	1.17	14	13.73	33	32.35	55	53.92	9	8.83	93	91.17	-	-	88	86.27
Hin Kong	1.57	1.61	-	-	72	43.64	93	56.36	126	76.37	39	23.63	127	76.96	38	23.04
Lao Khao	1.37	1.31	11	13.75	15	18.75	54	67.50	57	71.25	23	28.75	44	55.00	25	31.25
Average	1.58	1.52														

Table 35 Quantity of Demand, Utilization and Sources of Fuelwood and Charcoal by Village, Yasothon Province

Village	Quantity of demand for fuelwood per capita per year	Quantity of demand for charcoal per capita per year	Fuelwood and Charcoal Utilization						Sources of Fuelwood				Sources of Charcoal			
			Fuelwood used only		Charcoal used only		Used both		Owned production		Purchasing		Owned Production		Purchasing	
			No. of households	%	No. of households	%	No. of households	%	No. of households	%	No. of households	%	No. of households	%	No. of households	%
Nong Boa	1.29	1.72	2	7.69	-	-	24	92.31	26	100	-	-	19	73.07	5	19.23
Siri Pattana:																
Moo 1	1.91	1.96	35	40.70	4	4.66	47	54.64	78	90-69	8	9.31	33	38.37	18	20.93
Moo 4	1.10	1.70	23	39.65	12	20.70	23	39.65	58	100	-	-	20	34.48	15	25.86
Moo 10	1.64	1.52	22	53.65	6	14.65	13	31.70	41	100	-	-	15	36.59	4	9.75
Nong Bor	1.16	1.45	8	50.00	-	-	8	50.00	16	100	-	-	6	37.50	2	12.50
Bark Yai	1.44	1.64	20	35.08	-	-	37	64.92	57	100	-	-	37	64.92	-	-
Nong Sum	1.03	1.24	2	10.00	2	10.00	16	80.00	18	100	-	-	18	90.00	-	-
Man Om:																
Moo 5	1.84	1.92	16	57.14	6	21.43	6	21.43	28	100	-	-	-	-	12	42.86
Moo 9	1.07	1.81	9	7.82	-	-	106	92.18	115	100	-	-	99	86.08	16	13.91
Ban Jarn	1.26	1.86	108	91.53	-	-	10	8.47	95	80-50	23	19.50	-	-	10	8.47
Average	1.37	1.68														

Table 36 Quantity of Demand, Utilization, and Source of Fuelwood and Charcoal, by Village, Si Saket Province

Village	Quantity of demand for fuelwood per capita per year (m^3)	Quantity of demand for charcoal per capita per year (bag)	Fuelwood and Charcoal Utilization						Sources of fuelwood				Sources of Charcoal			
			Fuelwood		Charcoal		Use Both		Own Production		Purchasing		Own Production		Purchasing	
			No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Jung Kra Darn	1.54	1.08	145	55.77	45	17.32	70	26.92	260	100	--	--	108	41.54	7	2.69
Ban Pong	1.32	1.27	-	-	-	--	85	100	85	100	--	--	85	100	-	--

Table 37 Average reforestation cost per rai of *Eucalyptus camaldulensis* plantation by school and province.

Province	School Name	Labor for:					Fertilizer Used		Average Reforestation cost per rai (Baht)
		Land Preparation (man-day)	Planting (man-day)	Maintenance	Total Labor (man-day)	Total Wage (Baht)	Quantity (kg)	Value (Baht)	
Maha Sarakham	Ban Nong Mun Pla	-	10	28	38	950	100	100	1,050
	Ban Nong Chart	-	9	30	39	975	80	80	1,055
	Average	-	9.5	29	38.50	962.50	90	90	1,052.50
Roi-et	Dong Klia Wittaya	-	18	27	45	1,125	50	50	1,175
	Ban Sa Rai	9	12	22	43	1,075	34	34	1,109
	Ban Jarn Teya	-	19	25	44	1,100	20	20	1,120
	Suwanna Phome	-	17	26	43	1,075	15	15	1,090
	Average	9	16.50	25	43.75	1,093.75	29.75	29.75	1,123.50
Yasothon	Ban Sawang	-	10	27	37	925	150	150	1,075
	Ban Nong Pao	-	16	24	40	1,000	100	100	1,100
	Ban Bark Yai	-	19	25	44	1,100	70	70	1,170
	Ban Nam Om	10	17	20	47	1,175	60	60	1,235
	Ban Nong Koo	-	18	20	38	950	300	300	1,250
	Average	10	16	23.20	43	1,075	136	136	1,116
Si Saket	Ban Ta Kian	-	17	25	42	1,050	120	120	1,170
	Ban La Lome	-	25	25	50	1,250	50	50	1,300
	Ban Ta Lang Sawai	-	21	23	44	1,100	100	100	1,200
	Ban Prasart Yer	-	20	24	44	1,100	80	80	1,180
	Ban Hui Ta Morn	-	19	22	41	1,025	125	125	1,150
	Ban Prue Yai	-	25	25	50	1,250	70	70	1,320
	Ban Koke Yai	-	24	26	50	1,250	40	40	1,290
	Ban Ka Yang	-	21	22	43	1,075	100	100	1,175
	Average	-	21.50	24	45.50	1,137.50	85.63	85.63	1,223.13
								Average	1,128

Table 38 Planted area, Production, Value and Average Yield of Rice Growing Coupled with Eucalyptus camaldulensis, by schools, Si Saket Province.

School name	Planted area (rai)	Production (tang)	Value (baht)	Average yield (tang/rai)
Ban Takian School	4	28	700	7
Ban La Lome School	8	208	5200	26
Ban Ta Rang Sawai School	5	100	2500	20
Ban Hui Ta Morn School	5	10	250	2
Ban Prue Yai School	3	100	2500	33.33
Average	5	89.20	2230	17.67

Remark: Price of rice = 25 Baht/tang