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A FORESTRY PROGRAM FOR SOUTH
SULAWESI, INDONESIA

presented by

Hadji Mas'ud Junus

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Forestry

Victor J. Rudolph
Major professor

Date October 12, 1978

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MSU

A FORESTRY PROGRAM FOR SOUTH SULAWESI, INDONESIA

By

Hadji Mas'ud Junus

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Forestry

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ABSTRACT

A FORESTRY PROGRAM FOR SOUTH SULAWESI, INDONESIA

By

Hadji Mas'ud Junus

There are two strong, basic phenomena which are influencing forestry in South Sulawesi, namely population growth in both Indonesia and South Sulawesi, and agricultural improvement in South Sulawesi. Both of these will increase the need for all products and services from forest resources. The timber needed for housing will increase very rapidly, as will the need for paper and other pulp products. Persistent need for fuelwood in rural areas will also increase. The need for range, wildlife, and recreation in association with forest resources will undergo expansion. There will also be continuing agricultural improvement in South Sulawesi and this improvement will increase the need for irrigation water and ultimately the need for a good forest management in all watersheds in the province, especially in the "non-concession" public forest lands. Improvement of water quality in the Bila-Walennae-Cenrana Watershed is also needed urgently for better fishing and better wildlife habitat on Lake Tempe and Lake Sidenreng.

This study has made no attempt to estimate precisely the wood consumption in South Sulawesi. Estimates of present and projected wood consumption in South Sulawesi to the year 2000 were made by using various estimates of wood consumption per capita in Indonesia and in

other provinces. Basic data on South Sulawesi's forest resources were obtained from available sources.

On the basis of projected population growth and wood consumption, a forestry program is proposed for South Sulawesi's public forests covering the next four "Replita" or 5-year periods. This program should be revised in April 1984, and every five years thereafter. There are additional studies needed to validate and revise the assumptions and proposals in this program.

This program will improve as more data from inventory and research become available for its revision and validation and for meeting its objectives by the year 2000.

This program puts emphasis on planting Pinus merkusii on bare land in the "production" and the "protection-production" public forests. This program also puts emphasis on planting suitable native species on bare land in the "protection" public forests. Both planting programs will have multiple benefits for communities adjacent to the public forest lands. They will meet the local need for fuelwood and industrial wood and will improve water quantity for irrigation and for better fishing. Moreover, the pine plantations will introduce a model of large scale multiple-use even-aged management for South Sulawesi and the whole country.

On the other hand, this program recognizes that most of South Sulawesi forests are uneven-aged with hundreds of species. A proposed research program on silvicultural systems is incorporated in this forestry program to find suitable silvicultural practices for these uneven-aged forests.

An acquisition program is also incorporated because there is a

large amount of public land still in the category of "proposed" public forests. These lands should be put into production to meet the increasing timber and other needs from forest resources.

There can be no good forestry program without good forest inventory as a major part of the program. Also, good boundary marking is a prerequisite for all other activities. If the proposed five-part forestry program including boundary marking, planting, acquisition, inventory and silvicultural research is implemented soon, then South Sulawesi may be able to meet its people's needs for forest products and other forest benefits and services by the year 2000.

DEDICATION

To my father and mother

ACKNOWLEDGMENTS

Through this great opportunity, I express my profound gratitude to Dr. Victor J. Rudolph, my major professor, for his excellent guidance and assistance throughout my study in the United States. I also express my profound gratitude to Dr. Lee M. James for his guidance and assistance throughout my program. Profound appreciation is extended to Dr. Henry D. Foth and Dr. J. James Kielbaso for their guidance and assistance throughout this course of study. My sincere appreciation goes to Dr. Donald I. Dickmann for his assistance and his willingness to serve as a member of my master-program's guidance committee.

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I am indebted to Hasanuddin University for providing me this opportunity. I am also indebted to MUCIA-AID program for its fellowship throughout my study and to The Ford Foundation for its grant to enable me to do my research in South Sulawesi, Indonesia.

I also thank all national and provincial Forest Service institutions of Indonesia which have provided me data on South Sulawesi forests. I am grateful to all others that I have not mentioned who have assisted me directly or indirectly in my studies.

During the long course of this venture, I have received

encouragment and understanding from my wife, Naisjah, my daughters, Middlyanti and Webbyani, and my son, Saljumulawahyu. Their love, patience, and sufferance throughout this difficult period has inspired me throughout this endeavor.

VITA

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Candidate for the Degree of

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FINAL EXAMINATION: October 12, 1978

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A Forestry Program for South Sulawesi, Indonesia

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CHAPTER I

INTRODUCTION

Indonesia is a large developing country in the Far East. It consists of 26 provinces, and has a land area of 2,027,087 square kilometers. South Sulawesi is located approximately in the center of Indonesia. It has a land area of 77,639 square kilometers. There has been rapid population growth both in South Sulawesi and in Indonesia. Demographers believe that Indonesia's population is growing at the rate of 2.4 percent annually. Although South Sulawesi has a slower annual rate of population growth, it is still growing at the rate of 1.6 percent and this rate is projected to increase toward the end of the century.

Population growth in Indonesia and in South Sulawesi will increase the needs for all products and benefits from forest resources. Timber needed for housing and other wood construction materials will increase very rapidly, as will the need for paper and other pulp products. Persistent needs for fuelwood in the rural areas will also increase. The needs for range, wildlife habitat, and recreation in association with forest resources will no doubt undergo expansion.

There has also been rapid agricultural improvement in South Sulawesi in the past few decades and it is assumed that this improvement will continue to the year 2000. This agricultural improvement will increase the need for irrigation water and ultimately the need

for a good forest management program in all public forests in the province. Improvement of water quality in the Bila-Walenae-Cenrana Watershed is also needed urgently for better fishing and better wildlife habitat on the watershed area.

The main purpose of this study is to estimate the future demand for forest resources products and benefits by the year 2000 in South Sulawesi, and develop a forestry program to meet the forecasted need. After studying the forestry situation and forestry problems in Indonesia and South Sulawesi from May 1977 through February 1978, the author found that there are needed a series of studies of South Sulawesi's forest resources and also of the need for forest products and benefits from these resources.

This study has examined wood consumption in South Sulawesi currently and to the year 2000. Very basic data for South Sulawesi's public forests have been collected and a proposed forestry program developed. This program is urgently needed at this time for further development of the entire forest management and research program: to meet the projected needs in time. The general program is composed of five parts, involving boundary marking, planting, acquisition, inventory and silvicultural research.

CHAPTER II

GENERAL DESCRIPTION OF SOUTH SULAWESI

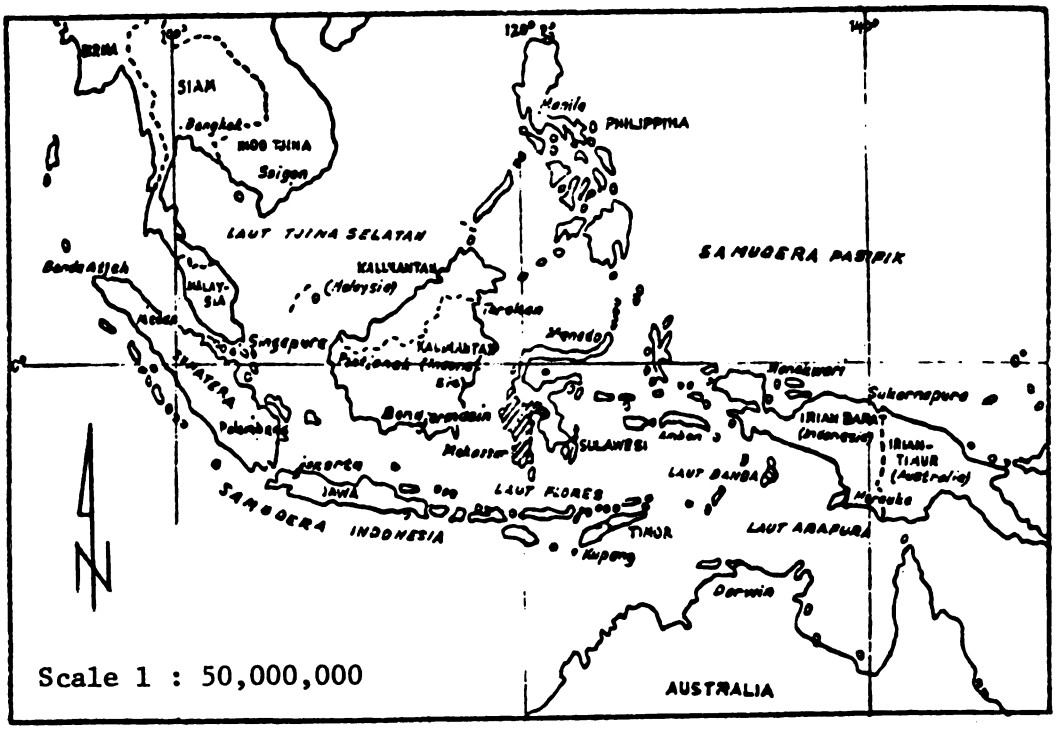
Location and Topography

The island of Sulawesi is located in the center of Indonesia. It has four branches or arms namely the north arm, east arm, southeast arm, and south arm which unite in a central trunk forming an outline like a huge letter "K." The province of South Sulawesi occupies the whole south arm, about one-half of the central trunk, about one-fourth of the southeast arm, and the whole island of Selayar to the south (Figure 1) (Van Bemmelen, 1970).

South Sulawesi is one of 26 provinces of Indonesia. Its land area is 77,639 square kilometers (University of British Columbia, 1977), which is four percent of Indonesia's total land area and is about half the size of Michigan.

South Sulawesi consists of 21 counties (kabupaten), and two municipalities (kotamadya). The counties are Bantaeng, Barru, Bone, Bulukumba, Enrekang, Gowa, Jeneponto, Luwu, Majene, Mamuju, Maros, Pangkep, Pinrang, Polmas, Selayar, Sidrap, Sinjai, Soppeng, Takalar, Tana Toraja, and Wajo. The municipalities are Pare-Pare and Ujung Pandang (Figure 2) (University of British Columbia, 1977).

The province lies between 118 and 122 degrees east longitude and one and seven degrees south latitude and is about 1,350 kilometers from Jakarta, the nation's capital. The distance between the north and



Source: Lembaga Penelitian Tanah, 1969b.

South Sulawesi

Figure 1. The Republic of Indonesia showing the location of South Sulawesi.

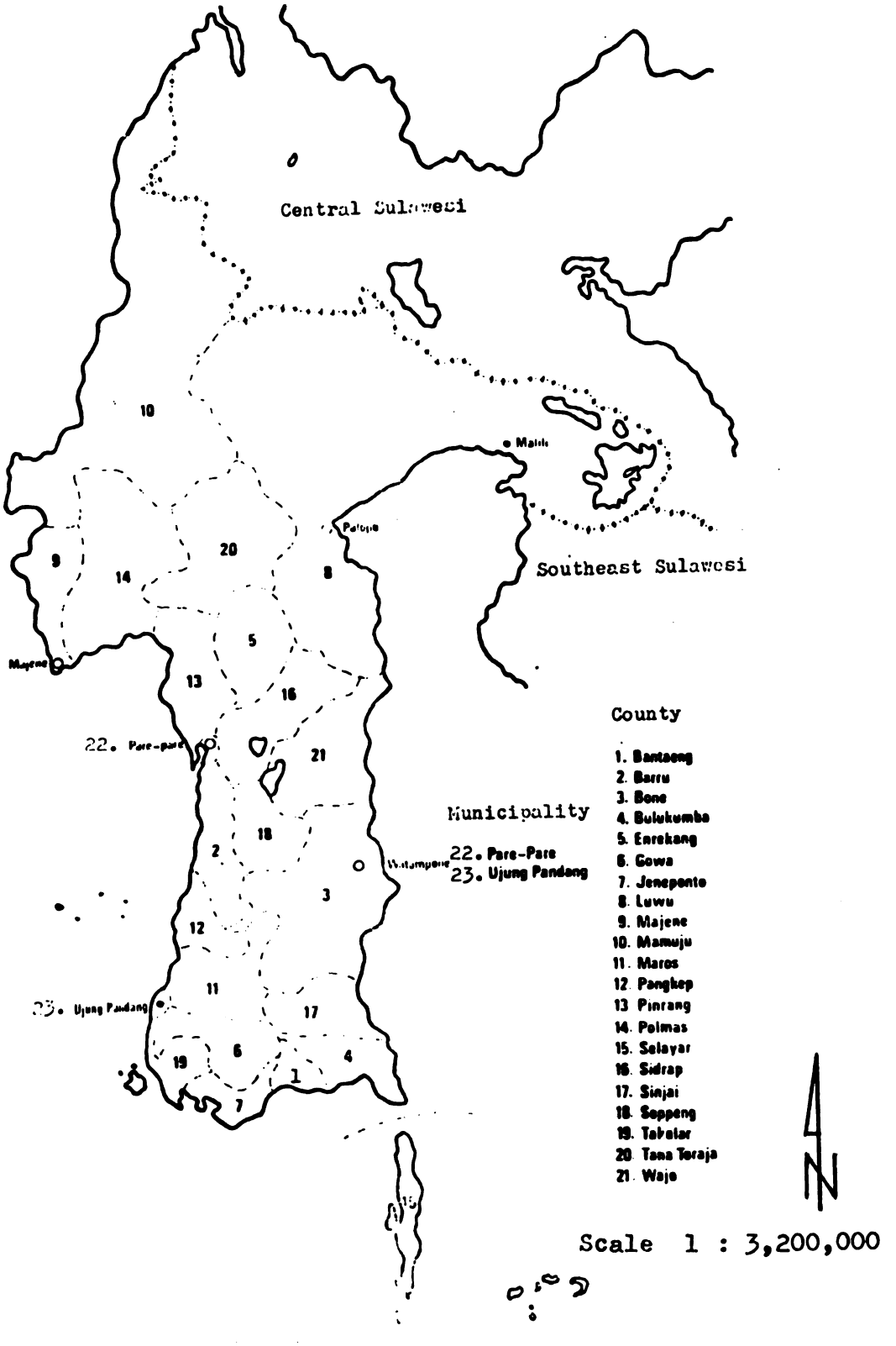


Figure 2. Counties and Municipalities in South Sulawesi. Source: University of British Columbia, 1977.

the south boundaries is about 644 kilometers. The width ranges from about 80 to 300 kilometers (Lembaga Penelitian Tanah, 1969b).

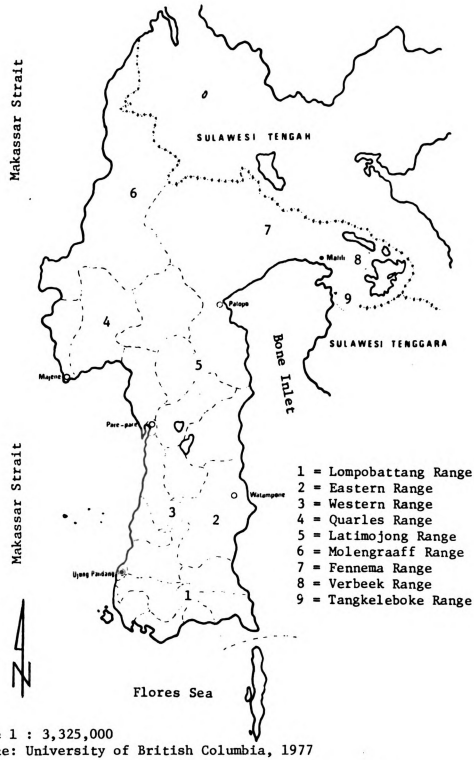
The northern boundaries of the province are north sides of the Molengraaf, Fennema and Verbeek Mountain Ranges. The eastern boundaries are east sides of Verbeek and Tangkeleboke Mountain Ranges, and Bone Inlet. The southern and western boundaries are the Flores Sea and Makassar Strait (Fig. 3).

The South arm of Sulawesi Island is divided by the Tempe Depression, which extends southeast-northwest from the mouth of the Cenrana River via Lake Tempe to the mouth of the Sadang River. The Tempe Depression had been a sea-strait until late in the geological history, as attested by the presence of young clays with recent marine shell deposits around Lake Tempe (Van Bemmelen, 1970).

There are three lakes in the Tempe Depression, namely Lake Tempe, Lake Sidenreng, and Crocodile Lake. They are drained by the Cenrana River. Lake Tempe is nine meters above sea level and a depth of two meters.

The northern portion of the south arm has the Quarles Mountains on the west and the Latimojong Mountains on the east, separated by the Sadang Valley. Van Bemmelen (1970) described this northern portion as the most mountainous area of Sulawesi Island. The Quarles Mountains rise to an altitude of 3,107 meters and the Latimojong Mountains also rise to altitudes of over 3000 meters.

The southern portion of the south arm has much lower elevations than the northern portion. The three mountain ranges in this area are the Western Range, the Eastern Range, and the Lompobattang Mountain Range. The Western and Eastern ranges are separated by Walenae Valley.



Scale 1 : 3,325,000
Source: University of British Columbia, 1977

Figure 3. The Province of South Sulawesi, Sulawesi Selatan.

The Western Range rises to elevations of over 1000 meters, the Eastern Range to about 800 meters, and the Lompobattang Mountain Range to 2871 meters above sea level.

South Sulawesi's portion of the central trunk is mainly occupied by the Molengraaf and Fennema Mountains. Most of the Molengraaf Mountains are inside the province, while most of the Fennema Mountains are outside the province.

South Sulawesi's Verbeek Mountain Range in the southeast arm rises to 1102 meters above sea level at Mount Salura. In the center of this mountain range are two grabens, Lake Towuti and Lake Matano. Lake Towuti is 293 meters above sea level with a depth of 203 meters. Lake Matano is 382 meters above sea level and is 590 meters deep (Van Bemmelen, 1970).

The Bogor Soil Research Institute uses five catagories of topographical relief to describe South Sulawesi's land surfaces. They are defined as follows:

Plain - Slopes of the Surfaces are less than three percent and the difference between the lowest and the highest altitudes is less than five meters.

Undulated - Slopes range from three to eight percent and altitude differences range from five to fifteen meters.

Highly Undulated - Slopes range from eight to fifteen percent and altitude differences range from fifteen to fifty meters.

Hilly - Slopes range from fifteen to thirty percent and altitude differences range from 50 to 200 meters.

Mountainous - Slopes are more than thirty percent and altitude differences are 200 or more.

These five categories were used by the Bogor Soil Research Institute in its agricultural survey in South Sulawesi in 1967. It covered 5.4 million hectares out of 7.8 million hectares of South Sulawesi's land area. The survey did not cover most of Luwu and Mamuju counties which are mostly forested. The survey team reported that about 18.0 percent, 3.5 percent, 12.5 percent, 11.0 percent, and 55.0 percent of the surveyed area are plain, undulated, highly undulated, hilly, and mountainous areas, respectively. The 2.4 million hectares of the province's land areas not covered by the survey are mostly highly undulated, hilly, or mountainous. Most of South Sulawesi's public forest lands are located in these highly undulated, hilly, or mountainous regions (Lembaga Penelitian Tanah, 1969a, 1969b).

Climate

South Sulawesi has a tropical climate. Accordingly, temperature fluctuations during the year are narrow, but rainfall fluctuations are wide.

Mean annual air temperature at the sea level is 26° C. Maximum and minimum annual temperatures at the sea level are 31° and 20° C, respectively. Above sea level, the temperature generally decreases 0.6° C for each 100-meter increase in altitude. The difference between maximum and minimum temperatures during the day ranges from 5° to 8° C. The differences between monthly maximum and minimum temperatures during the year are also small (Table 1) (Direktorat Bina Program Kehutanan, 1975).

The average annual rainfall varies from 1,199 millimeters in the most southern part of Sulawesi Island to 5,019 millimeters in the northern area of the province. The amount of rainfall increases

Table 1. Monthly Maximum and Minimum Air Temperatures at Sea Level in South Sulawesi, °C.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
Maximum	30.4	30.6	30.9	31.5	32.1	31.7	32.0	32.2	32.4	32.5	31.8	30.7	31.0
Minimum	22.3	21.8	22.0	21.9	20.6	20.1	18.6	18.2	17.8	17.8	19.9	21.4	20.0
Average	26.0	26.2	26.2	26.6	26.6	26.1	25.6	25.8	26.2	26.7	26.6	25.9	26.0

gradually from the south to the north of the province (Soepraptohardjo, 1971).

In Indonesia, the classification of rainfall by F.H. Schmidt and J.H.A. Ferguson based on monthly rainfall is commonly used. There are two types of months, dry months and wet months. A dry month has rainfall of less than 60 millimeters and a wet month has rainfall of more than 100 millimeters. The Q-Value is the average ratio between the number of dry months and wet months for a given region, expressed in percent. The rainfall type of an area is defined by a certain range of the Q-Value. There are five rainfall types in South Sulawesi (Table 2) (Direktorat Jenderal Kehutanan, 1976b).

Table 2. Range of Q-Value for Each Rainfall Type in South Sulawesi

Rainfall Type	Q-Value (Percent)
A	00.0 to 14.3
B	14.3 to 33.3
C	33.3 to 60.0
D	60.0 to 100.0
E	100.0 to 167.0

Food-Crop Service, Dinas Pertanian Rakyat, of South Sulawesi has categorized each county in the province according to Schmidt and Ferguson's classification. Counties included in either one or both of the A and B types are Bone, Enrekang, Luwu, Mamuju, Pinrang, Polmas, Sidrap, Soppeng, Tana Toraja, and Wajo. The five counties included in the C type are Barru, Majene, Maros, Pangkep, and Sinjai. Pare-Pare

municipality is also in the C type. Gowa, Selayar, and Takalar Counties, and the municipality of Ujung Pandang are in the D type. In the E type are included Bantaeng, Bulukumba, and Jeneponto Counties (Inspeksi Dinas Pertanian Rakyat Propinsi Daerah Tingkat I Sulawesi Selatan, 1977).

The rainfall pattern of South Sulawesi is operated by the east and west monsoons that take place during the year. According to Van Bemmelen (1970), these monsoons are the most typical monsoons in the world.

In general, the West monsoon brings a rainy season to the western part of the province while the eastern part has a dry period. The East monsoon brings a rainy season to the eastern part of the province while the western part has a dry period. Commonly, the West monsoon takes place from September to April, and the East monsoon from April to September. Thus, from September to April, it is rainy in the west and dry in the east, while from April to September, it is dry in the west and rainy in the east (Figs. 4, 5) (University of British Columbia, 1977). These monsoon seasons operate so that the more to the south the more pronounced is the difference between the wet season and the dry season, and the more contrast in the amount of rainfall between the western and the eastern parts of the province (Soepraptohardjo, 1971).

Soils

South Sulawesi has twelve great soil groups of Indonesian classification which are very much like the 1949 United States Classification of soils. They are Gley soils, Hydromorphic soils, Alluvial soils, Regosols, Lithosols, Rendzinas, Grumusols, Andosols, Brown Forest Soils, Brown Mediterraneans, Latosols, and Red-Yellow Podzolic soils (Soepraptohardjo, 1971).

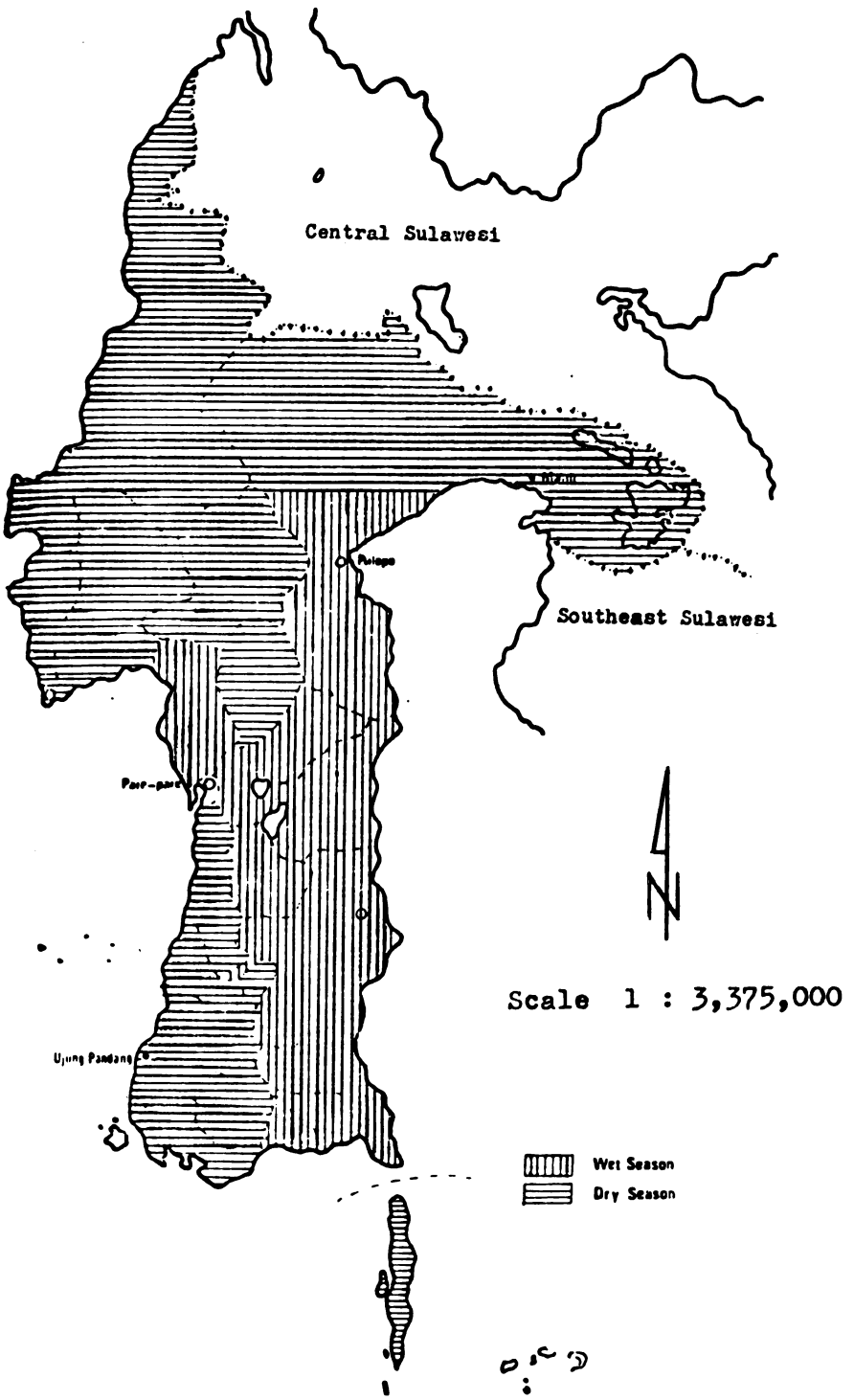


Figure 4. Wet Season and Dry Season Areas During April-September, 1975.
Source: University of British Columbia, 1977.

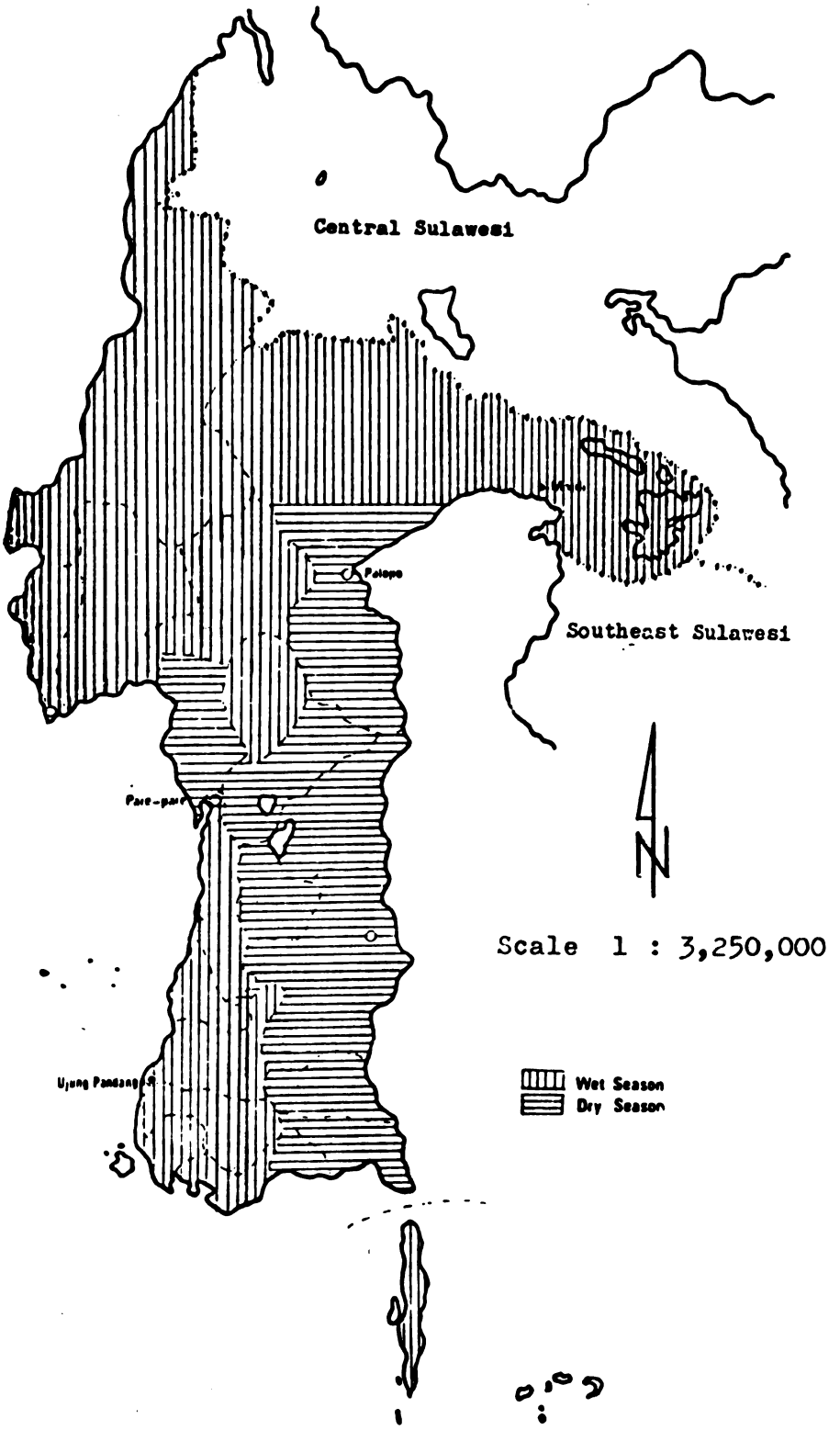


Figure 5. Wet Season and Dry Season Areas During September-April, 1975.
Source: University of British Columbia, 1977.

Brief descriptions on the twelve great soil groups and comparisons with the United States Soil Taxonomy follow (Soil Survey Staff, 1975).

1. Gley Soils

Gley soils of Indonesia are equivalent to Tropaquepts and Humaquepts of Inceptisols (Soepraptohardjo, 1976). Inceptisols are embryonic soils with few diagnostic features. They are usually moist with pedogenic horizons of alteration of parent material but not of illuviation. Suborder of Aquepts are soils saturated with water at some period in the year unless artificially drained. Great group of Tropaquepts has less than 5° C difference in mean summer and mean winter temperatures. And great group of Humaquepts shows the presence of a mollic, umbric, or histic diagnositc surface horizon or epipedon. Mollic epipedon is a thick, dark colored surface horizon which has high base saturation and strong structure so that the soil is soft instead of hard and massive when dry. Umbric epipedon also has a thick, dark colored surface horizon similar to mollic epipedon but low base saturation and may be highly saturated with hydrogen. Histic epipedon has a surface horizon which is very high in organic matter and saturated with water at some time during the year unless drained by man (Foth and Turk, 1972; Buol, Hole and McCracken, 1973; Soil Survey Staff, 1975).

Very small areas of public forests are occupied by these Gley soils.

2. Hydromorphic Soils

Hydromorphic soils of Indonesia are equivalent to Tropaquults of Ultisols (Soepraptohardjo, 1976). Ultisols have low base saturation, usually less than 35 percent, in argillic horizons and to considerable depths. Aquults are suborders which are either saturated

with water at some period of the year or artificially drained. Tropaquults are soils in the suborder of Aquults that have mean summer and winter temperature differences of less than 5° C (Foth and Turk, 1972).

Very small areas of public forest are occupied by these Hydromorphic soils.

3. Alluvial Soils

This great group of Indonesian soils are similar to Tropofluvent of Entisols (Soepraptohardjo, 1976). Entisols are recently formed soils which have no diagnostic pedogenic horizons. The suborder of Fluvents is for alluvial soils which have finer texture than loamy fine sand. Thus, Flufents have loamy and clayey textures. The soils have very simple profiles and have a diagnostic feature that the content of organic matter with depth is irregular. The formative element of Tropo of the Tropofluvent great group has connotation of being continually warm. Accordingly, Tropofluvents are Fluvents which have only a slight range in mean annual temperature (Buol, Hole and McCracken, 1973).

Very small areas of public forest are occupied by these Alluvial soils.

4. Regosols

Regosols of Indonesia consist of Psamments of Entisols and Vitrandept of Inceptisols (Soepraptohardjo, 1976). Entisols have already been described above. Psamments are entisols which have loamy fine sand or coarser texture and are well drained. The second member of Regosols of Indonesia are Vitrandepts of Inceptisols. Inceptisols have been described above. The formative element of Andepts is modified from "ando." Accordingly, Andepts means "andolike" Inceptisols.

Ando soils are dark colored, high in organic matter, and developed in volcanic ash deposits. Vitrandepts are adepts with volcanic glass-like materials (Buol, Hole and McCracken, 1973; Foth and Turk, 1972; Donahue, Shickluna and Robertson, 1971).

Small areas of public forest are occupied by these Regosols.

5. Lithosols

Lithosols are azonal soils of the 1949 United States Classification system characterized by an incomplete solum, no clearly expressed soil morphology and consisting of a mass of rock fragments from consolidated rocks which are imperfectly weathered. They are found primarily on steeply sloping land. Two very important factors that contribute to the development of these soils are the hardness of the rock and the steepness of the slope (Foth and Turk, 1972).

Small areas of public forest are occupied by these Lithosols.

6. Rendzina

Rendzinas of Indonesia's soils are equivalent to Rendolls of the United States Department of Agriculture's Soil Taxonomy (Soepraptohardjo, 1976). Suborder of Rendolls are in the order of Mollisols. Mollisols are mineral soils that have a mollic epipedon overlying mineral material with a base saturation of 50 percent or more when measured at pH 7. Suborder of Rendolls has only one great group namely Rendolls great group. In other words, there is no great group presently recognized in Rendolls. Rendolls have no argillic or calcic horizons. Their epipedons are less than 50 centimeters thick and overlie coarse fragments of calcareous rock and stones (Buol, Hole and McCracken, 1973).

Very small areas of public forest are occupied by these Rendzinas.

7. Grumusols

Grumusols in Indonesia are equivalent to great groups of Chromuderts and Pelluderts of the USDA soil taxonomy (Soepraptohardjo, 1976). The two great groups are in the suborder of Uderts and consequently are in the order of Vertisols. Vertisols are shrinking and swelling dark clay soils. Uderts are vertisols that are usually moist but in which cracks may open at some time during the year but they do not remain open for more than 90 days each year. Pelluderts have moist chromas less than 1.5 throughout the upper 30 centimeters and Chromuderts are all other Uderts (Buol, Hole and McCracken, 1973).

Very small areas of public forest are occupied by these Grumusols.

8. Andosols

Andosols are equivalent to Dystrandepts of USDA soil taxonomy (Soepraptohardjo, 1976). The soils are in the order of Inceptisols, in the suborder of Andepts. Andepts have formed either in vitric pyroclastic materials, or have low bulk density and large amounts of amorphous materials, or both. Andepts are not saturated with water long enough to limit their use for most crops. Dystrandepts have an umbric or ochric surface horizon and are thixotropic in some horizons (Soil Science Society of America, 1973; Buol, Hole and McCracken, 1973).

Small areas of public forest are occupied by these Andosols.

9. Brown Forest Soils

Brown Forest Soils are equivalent to Eutrochrepts of USDA soil taxonomy (Soepraptohardjo, 1976). The soils are in the order of Inceptisols and in the suborder of Ochrepts. Ochrepts are Inceptisols formed in cold or temperate climates and that commonly have an ochric epipedon and a cambic horizon. Ochrepts are not dominated by amorphous materials and are not saturated with water for periods long enough to limit their use for most crops. Eutrochrepts have carbonates in the cambic horizon or base saturated by NH_4OAc of 60 percent or more within 75 centimeters of the surface (Buol, Hole and McCracken, 1973).

Small areas of public forest are occupied by these Brown Forest Soils.

10. Brown Mediterranean

Brown Mediterranean soils in Indonesia are equivalent to Tropudalfs of USDA soil taxonomy (Soepraptohardjo, 1976). Tropudalfs are in the order of Alfisols and in the suborder of Udalfs. Alfisols are soils with grey to brown surface horizons, with argillic horizons that have medium to high base saturation (over 35 percent). Alfisols have formed largely under forest or savannah vegetation in climates with slight to pronounced seasonal moisture deficits. Udalfs are not as wet as Aqualfs nor as cool or glossic as Boralfs. Tropudalfs are Udalfs that have mean summer and mean winter temperatures at fifty centimeters, or lithic or paralithic contact, if shallower, which differ by less than 5° C (Foth and Turk, 1972; Buol, Hole and McCracken, 1973).

Large areas of public forest are occupied by these Brown Mediterranean soils.

11. Latosols

Latosols are a suborder of zonal soils in the 1949 United States Soil Classification. Latosols include soils formed under forested, tropical humid conditions. They are characterized by low silica-sesquioxide ratios of the clay fractions, low base-exchange capacity, low activity of the clay, low content of most primary minerals, low content of soluble constituents, a high degree of aggregate stability, and usually have red color (Soil Science Society of America, 1973). Latosols in Indonesia are equivalent to the suborder of Tropepts and the great group of Haplorthox of the USDA soil taxonomy (Soeprapto-hardjo, 1976). Tropepts are in the order of Inceptisols. Accordingly, Tropepts are the Inceptisols of the tropical regions. They have mean annual temperatures of 8° C or more, and difference in mean summer and mean winter temperatures of less than 5° C. On the other hand, Haplor-thox is a great group of soils which are in the order of Oxisols and in the suborder of Orthox. Oxisols are soils with oxic horizons. Many of these soils were formerly classified as Latosols. An oxic horizon is an altered subsurface horizon consisting of a mixture of hydrated oxides of iron or aluminum and 1:1 clay and/or quartz. Orthox are Ox-isols that are moist all or most of the time. The soils have a low to moderate content of organic carbon within the upper one meter or a mean annual soil temperature of 22° C or more. The prefix "hapl" of the great group of Haplorthox means "minimum horizon." Accordingly, Haplorthox are Orthox which have minimum horizon development.

Small areas of public forest are occupied by these Latosols.

12. Red-Yellow Podzolic Soils

In Indonesia Red-Yellow Podzolic Soils are equivalent to two great group soils of the USDA soil taxonomy, Tropudults and Paleudults (Soepraptohardjo, 1976). They are both in the order of Ultisols and in the suborder of Udults. Ultisols have been already described above. Udults are Ultisols of the humid regions where dry periods are of short duration, organic contents are low but the water table remains below the solumn most of the year, and the grey, mottled colors of the Aquults do not appear directly below the A horizon. Tropudults are Udults which have mean summer and winter temperature difference of less than 5° C. Paleudults are Udults which have less than ten percent weatherable minerals in the 20 - 200 microns separate of the upper one meter, and less than 20 percent decrease in clay content to a depth of 1.5 meters (Buol, Hole and McCracken, 1973).

Large areas of public forest are occupied by these Red-Yellow Podzolic soils.

Tropudults and Paleudults of Ultisols occupy the largest area of the province, covering about 33 percent of the land area. Tropudalf of Alfisols occupy the second largest area, about 21 percent. Tropofluvents of Entisols occur on about nine percent of the area, as do Tropepts of Inceptisols with Haplorthoxs of Oxisols. The remaining 28 percent of the area is occupied by Tropaquepts, Humaquepts, Tropaquults, Psamments, Vitrandepts, Lithosols, Rendolls, Chromuderts, Pelluderts, Dystrandepts, and Eutrochrepts (Soepraptohardjo, 1971).

Lowland areas are characterized by Tropofluvents, Tropaquepts, Tropaquults, Psamments, Vitrandepts, Chromuderts, Pelluderts, and a

small part of Tropudults with Paleudults. Most hilly areas are covered by Tropudalfs, Tropudults, Paleudults, Tropepts, Haplorthox , Chromuderts, and Pelluderts. Mountainous regions are mainly occupied by Tropudults, Paleudults, Dystrandepts, and Eutrochrepts (Soepraptohardjo, 1971).

Hilly and mountainous regions, where the public forests are located, are mainly occupied by three great group soils: Tropudalfs of Alfisols, Tropudults of Ultisols, and Paleudults of Ultisols. Accordingly, information about the three great group soils is very important to the forest management program.

CHAPTER III

POPULATION AND TIMBER CONSUMPTION

Population Distribution and Density in South Sulawesi

In 1976, South Sulawesi had a population of 5,573,422 people and an area of 77,639 square kilometers. The population density is 72 people per square kilometer. Total population, size of area, and population density for each county and municipality are given in Table 3 (University of British Columbia, 1977).

Population Growth and Projection in Indonesia

There have been three population censuses in Indonesia. The first was conducted in 1930, the second in 1961 and the third in 1971. In 1930, the population was 61.0 million, in 1961, 90.7 million, and in 1971, 120.1 million. The annual rate of growth during the period 1930-1961 was 1.9 percent, and during the period 1961-1971, it was 2.1 percent. Some foreign demographers have estimated the annual rate of population increase in Indonesia at the beginning of this decade to be 2.8 percent, but most demographers believe that 2.4 percent was more realistic (Iskandar, 1977).

Indonesian demographers have projected Indonesia's population to the year 2001 based on the 1971 population census. They project that Indonesian population in the year 2001 will be between 218.9 million to 277.3 million persons. The high of 277.3 million persons is based

Table 3. Total Population, Area, and Population Density by County and Municipality in South Sulawesi, 1976

Code No.	County or Municipality	Total Population	Area (Km^2)	Population Density (People per Km^2)
01	Bantaeng	103,623	470	220
02	Barru	138,173	924	150
03	Bone	587,974	4,555	129
04	Bulukumba	284,440	1,280	222
05	Enrekang	127,992	1,941	66
06	Gowa	327,517	1,695	193
07	Jeneponto	218,645	790	277
08	Luwu	420,608	24,349	17
09	Majene	92,256	1,932	48
10	Mamuju	82,891	12,407	7
11	Maros	186,482	1,532	122
12	Pangkep	204,543	798	256
13	Pinrang	268,436	2,509	107
14	Polmas	338,831	9,985	34
15	Selayar	94,591	224	422
16	Sidrap	191,386	2,340	82
17	Sinjai	159,294	1,075	148
18	Soppeng	235,226	1,500	157
19	Takalar	160,822	450	357
20	Tana Toraja	311,559	4,234	74
21	Wajo	369,342	2,422	152
22	Pare-Pare	79,448	111	716
23	Ujung Pandang	589,343	116	5,081
	South Sulawesi	5,573,422	77,639	72

on the assumption that there will be no change in fertility rates. The demographers called this "Assumption I." Assumptions II and III include declines by the year 2000 of 25 percent and 50 percent, respectively, in the fertility rate. And finally, Assumption IV includes a decline in fertility rate until the net reproduction rate is equal to one (NRR = 1). Under Assumptions I, II, III, and IV by the year 2001, Indonesia is going to have a population of 277.3 million, 252.3 million, 227.7 million, and 218.9 persons, respectively. Djojohadikusumo (1975) argues that a 25 percent reduction in the fertility rate is the most realistic assumption. If true, in the year 2001, Indonesia will have a population of 252.3 million persons, which is more than double the 1971 population. For any future Indonesian forestry program, this means that the physical need for timber and other products and services associated with forest resources will more than double by the end of this century.

Population Growth and Projection in South Sulawesi

There have been population censuses in South Sulawesi in 1961 and in 1971. A 1976 population estimate resulted from the election enumeration in May 1976.

Population growth in South Sulawesi has been different from population growth of Indonesia as a whole. Relatively, South Sulawesi has a lower annual population rate of growth. In 1961, South Sulawesi had a population of 4,703,545 persons, which increased to 5,179,911 people by 1971. The annual rate of growth was one percent during the ten-year period. Because this ten-year period had not been politically stable, demographers consider the rate of growth

from 1971 to 1976 as the rate of growth under "normal" conditions. During this period, the population increased at 1.6 percent annually. This slow rate of growth was the result of a net out-migration from South Sulawesi of 58,000 people each year during the 1971-1976 period. Without the migration, the natural increase would have produced a growth rate of approximately 2.5 percent annually (University of British Columbia, 1977).

Table 4 lists the population and its growth rate for each county and municipality in South Sulawesi from 1961 to 1971, and from 1971 to 1976 (Nurlan, Undated; University of British Columbia, 1977). Barru, Bone, Enrekang, Jeneponto, and Wajo Counties lost considerable population from 1961 to 1971. Between 1971 and 1976, only Bone and Pangkep Counties lost some population.

The University of British Columbia (1977) made a population projection for South Sulawesi covering a period of ten years from 1976. Assuming that net out-migration will continue to be 58,000 people annually, the Crude Birth Rate (CBR) is 45.08, and the Crude Death Rate (CDR) is 19.67, the projected population in 1986 will be 6,598,232 people. This is an annual growth rate of 1.7 percent.

There is no attempt in this study to make a population projection for the year 2000, but if the annual rate of growth of 1.7 percent will continue after 1986 to the year 2000, South Sulawesi will have a population of about 8.35 million people at that time. On the other hand, if after 1986, South Sulawesi will have a growth rate of 2.5 percent annually to the year 2000, it will have a population of about 9.32 million people then. Should the annual growth rate of 2.5 percent apply from 1976 to the year 2000, the province will have

Table 4. The Population and its Growth by County and Municipality in South Sulawesi from 1961 to 1976

Code No.	County or Municipality	Total Population			1961-1971 Percent Increase	1971-1976 Percent Increase
		1961	1971	1976		
01	Bantaeng	71,546	89,607	103,623	25.2	15.6
02	Barru	146,050	132,718	138,173	-9.1	4.1
03	Bone	671,060	596,943	587,974	-11.0	-1.5
04	Bulukumba	211,239	260,841	284,440	23.5	9.0
05	Enrekang	154,310	121,140	127,992	-21.5	5.6
06	Gowa	298,407	385,616	327,517	29.0	*
07	Jeneponto	232,059	200,605	218,645	-14.0	9.0
08	Luwu	300,499	326,062	420,608	8.5	29.0
09	Majene	43,996	78,925	92,256	79.4	16.9
10	Mamuju	60,362	69,668	82,891	15.4	18.9
11	Maros	154,795	197,424	186,482	28.0	*
12	Pangkep	167,596	205,169	204,543	22.4	-0.3
13	Pinrang	213,876	258,214	268,436	20.7	4.0
14	Polmas	227,831	313,559	338,831	37.6	8.1
15	Selayar	87,278	92,342	94,591	5.8	2.4
16	Sidrap	148,728	181,588	191,386	22.1	5.4
17	Sinjai	103,265	149,394	159,294	44.7	6.6
18	Soppeng	200,622	230,625	235,226	15.0	2.0
19	Takalar	132,667	152,553	160,822	15.0	5.4
20	Tana Toraja	279,213	308,054	311,559	12.7	1.1
21	Wajo	345,996	322,225	369,342	-6.9	14.6
22	Pare-Pare	67,992	72,471	79,448	6.6	9.6
23	Ujung Pandang	384,158	434,168	589,343	13.0	*
	South Sulawesi	4,703,545	5,179,911	5,573,422	10.1	7.6

*Rate of growth is not calculated because of boundary changes.

a population of about 10.08 million people by the end of the century. For the purposes of this study, a range of 8.35 to 10.08 million people in South Sulawesi in the year 2000 will be considered in determining future demands for timber and other products and services associated with forest resources.

Timber Exports and Imports

Before 1966 there had not been much timber exported from Indonesia. Timber exports ranged from 0.004 million cubic meters to 0.139 million cubic meters annually between 1952 and 1965. Dramatic changes took place after the Indonesian government introduced a new "Foreign Investment Law" in 1966. Beginning then, foreign investment flowed very rapidly into the country and timber exports expanded in a very short time. During the decade 1966-1976, annual timber exports increased from 0.301 million cubic meters to 19.433 million cubic meters. Table 5 presents Indonesian exports of timber and their values from 1966 to 1976 (Soedjarwo, 1973; Direktorat Jenderal Kehutanan, 1972, 1975, 1976a).

Indonesian timber exports flow mainly to Asian markets, including Japan, South Korea, Taiwan, and Singapore, but some go to Europe and other countries. Table 6 lists Indonesia's timber exports by country of destination from 1971 to 1976.

South Sulawesi started to make significant exports of timber in 1970. During the period 1970 to 1976, annual exports of timber varied from 85,000 to 227,000 cubic meters. During the same period, South Sulawesi also imported significant amounts of timber, mainly from the island of Kalimantan and the province of Southeast Sulawesi,

Table 5. Timber Exports from Indonesia and Their Values from 1966 to 1976

Year	Volume	Value
	million cubic meters	million US $
1966	0.301	3.600
1967	0.593	6.300
1968	1.041	13.000
1969	3.703	26.000
1970	7.350	101.000
1971	10.761	168.635
1972	13.891	230.349
1973	19.433	583.345
1974	18.082	725.551
1975	13.921	499.976
1976	18.649	780.879

Table 6. Indonesia's Timber Exports by Country of Destination, 1971 Through 1976[1]

Country of Destination	1971	1972	1973	1974	1975	1976
			million cubic meters			
Japan	8,384	9,687	12,166	12,187	7,587	9,884
South Korea	975	1,520	2,001	2,136	2,741	3,202
Taiwan	993	1,240	2,172	2,227	2,163	2,797
Singapore	286	498	1,488	819	755	933
Europe	287	333	393	233	221	1,445
Others	126	612	651	481	454	388
Total	10,761	13,891	19,433	18,082	13,921	18,649

[1]These data were obtained in a personal visit to the office of the Directorate General of Forestry, in Jakarta, Indonesia, in August, 1977.

Sulawesi Tenggara. These imports varied from 700 cubic meters to 35,504 cubic meters per year. In Tables 7 and 8 the development of South Sulawesi's timber exports and imports for this period are listed.

Table 7. Timber Exports from South Sulawesi, 1970-1975[1]

Year	Volume	Value
	million cubic meters	million US $
1970	0.103	0.760
1971	0.085	1.438
1972	0.110	3.854
1973	0.227	10.011
1974	0.178	4.409
1975	0.086	4.167

[1]These data were obtained in personal correspondence with Ir. Supramono Dwidjojatmoko in the Directorate of Marketing of the Directorate General of Forestry, Jakarta, Indonesia.

Table 8. South Sulawesi's Imports of Timber, 1970-1976[1]

Fiscal Year	Volume
	cubic meters
1970	700
1971	770
1972	11,154
1973	10,149
1974	15,445
1975	31,235
1976	35,504

[1]These data were obtained in a personal visit to Dinas Kehutanan Propinsi Sulawesi Selatan, Ujung Pandang, Indonesia in January, 1978.

Industrial Wood and Fuelwood Consumption

There have been no studies of industrial wood and fuelwood consumption in the province of South Sulawesi. However, some estimates have been made of industrial wood and fuelwood consumption for all of Indonesia.

In 1973, the Directorate of Marketing of the Indonesian Forest Service published estimates of industrial wood and fuelwood consumption in Indonesia from 1970 to 1990. In 1974 another estimate was published for industrial wood consumption covering the period from 1974 through 1995. These estimates indicate that industrial wood consumption in Indonesia will increase gradually from 0.083 cubic meters per capita in 1970 to 0.097 cubic meters per capita in 1995; and that fuelwood consumption in Indonesia will gradually decrease from 0.718 cubic meters per capita in 1970 to 0.300 cubic meters per capita in 1990 (Table 9) (Direktorat Bina Sarana Usaha Kehutanan, 1974; Directorate General of Forestry Directorate of Marketing, 1973).

In 1975, Bogor Agricultural University College of Forestry and Science Institute of Indonesia, Lembaga Ilmu Pengetahuan Indonesia, conducted a study of industrial wood and fuelwood consumption in the province of East Java, Indonesia. That study estimated that industrial wood consumption per capita in East Java would also gradually increase from 0.1304 cubic meters per capita in 1975 to 0.2008 cubic meters per capita in the year 2000, which is considerably higher than the estimate for Indonesia generally (Table 10) (Bogor Agricultural University College of Forestry and Science Institute of Indonesia, 1975). It may be that the per capita consumption of industrial wood in East Java may be higher than in other parts of the country. On the other hand, the study in the province of East Java projected that the

Table 9. Estimates of Annual Industrial Wood and Fuelwood Consumption Per Capita in Indonesia, 1970-1995

Kind of Wood	1970	1975	1976	1980	1985	1990	1995
				cubic meters			
1. Industrial Wood	0.083	0.085	0.085	0.087	0.089	0.093	0.097
a. Logs	0.034	0.034	0.034	0.034	0.035	0.035	0.035
b. Conversions	0.041	0.042	0.042	0.043	0.044	0.045	0.045
c. Plywood	0.002	0.002	0.002	0.002	0.003	0.004	0.005
d. Pulpwood	0.006	0.007	0.007	0.008	0.009	0.010	0.011
2. Fuelwood	0.718	0.613	---	0.500	0.403	0.300	---

Table 10. Projections of Per Capita Industrial Wood and Fuelwood Consumption in East Java, Indonesia, 1975 to the Year 2000

Kind of Wood	1975	1980	1985	1990	1995	2000
			cubic meters			
Industrial Wood	0.1304	0.1444	0.1584	0.1724	0.1864	0.2008
Fuelwood	0.5700	0.5700	0.6000	0.6400	0.6700	0.7000

consumption of fuelwood would gradually increase from 0.570 cubic meters per capita in 1975 to 0.700 cubic meters per capita in the year 2000 (Table 10).

Johnson (1976) showed that in 1970 industrial wood demand by developing nations was 205 million cubic meters and in the year 2000 this demand would be 670 million cubic meters. He also presented the United Nations' estimates of population in developing nations in 1970 and in the year 2000 as 2,500 million people and 4,700 million people, respectively. Therefore, the industrial wood demand in developing nations in 1970 and in the year 2000 would be 0.082 and 0.143 cubic meters per capita respectively. Johnson's projections of per capita wood consumption in the year 2000 fall between the two previous projections.

Based on evolving developments in South Sulawesi, it is believed that the per capita consumption of industrial wood and fuelwood in the province by the year 2000 will approximate that projected for East Java more closely than other estimates and projections. The per capita wood consumption data can be applied to the population data to obtain estimates of total wood consumption in the province. Table 11 lists these estimates for 1975 and the year 2000. The projections for the year 2000 are made for both high and low population projections to show the possible range in the demand for wood.

The consumption of industrial wood and fuelwood in South Sulawesi in the year 2000 may range from 7.5 million cubic meters to as high as 9.1 million cubic meters, depending on how the population increases. Any future forestry program for the province must take into account the future demand for wood indicated in these projections. Certainly, if the population increases as projected, the demand by the people for

wood products will accompany population increases.

Table 11. Estimates of Industrial Wood and Fuelwood Consumption in South Sulawesi for 1975 and the Year 2000

Year	Kind of Wood	Consumption Per Capita	Population	Total Consumption
		cubic meters		million cubic meters
1975	Industrial wood	0.1304	5,423,188[1]	0.7072
	Fuelwood	0.5700	5,423,188	3.0912
	Total	0.7004		3.7984
2000	Industrial wood	0.2008	8,350,000[2]	1.6767
	Fuelwood	0.7000	8,350,000	5.8450
	Total	0.9008		7.5217
2000	Industrial wood	0.2008	10,080,000[3]	2.0241
	Fuelwood	0.7000	10,080,000	7.0560
	Total	0.9008		9.0801

[1](Kantor Sensus dan Statistik Propinsi Sulawesi Selatan, 1975).

[2]Based on an annual population increase of 1.7 percent from 1976 to the year 2000.

[3]Based on an annual population increase of 2.5 percent from 1976 to the year 2000.

CHAPTER IV

SOUTH SULAWESI'S PUBLIC FORESTS

Forestry Administration

Presently, public forestry administration is attached to provincial and county administrations. There is a Provincial Forest Service, Dinas Kehutanan Daerah, in the provincial body of administration; and there is a County Forest Service, Kehutanan Daerah, for each county in the province. In fact, Pare-Pare Municipality has a Municipality Forest Service which is exactly the same as a County Forest Service. The Provincial Forest Service is simply called "Dinas Kehutanan" and administered by a "Kepala Dinas Kehutanan" or simply called "Kepala Dinas." As previously mentioned, a County Forest Service is called "Kehutanan Daerah." This County Forest Service is managed by a "Kepala Kehutanan Daerah" or simply called "K.K.D." The Municipality Forest Service is also called "Kehutanan Daerah" and managed by a "K.K.D." Accordingly, there is one "Kepala Dinas" and twenty-two "K.K.D." in the province.

South Sulawesi is the only province in Indonesia which still employs this kind of forestry administration practice. Other provinces have adopted new procedures of forestry administration. Under the new procedures, there is still a Provincial Forest Service or a "Dinas Kehutanan" which is administered by a "Kepala Dinas," but there is no County Forest Service for each county, nor any Municipality

Forest Service for Pare-Pare Municipality. The new procedures are oriented mainly to watershed separation of the forest lands in the province. One watershed or a group of combined watersheds are put under the management of a "Public Forest Administration" which is called "Kesatuan Pemangkuan Hutan" or "K.P.H." The chief of this "K.P.H." is called "Kepala Kesatuan Pemangkuan Hutan" or "K.K.P.H."

South Sulawesi's Provincial Forest Service is proposing to use the new procedures. According to the Provincial Forest Service's proposal, there will be six "Kesatuan Pemangkuan Hutan" in the province, namely "K.P.H. Lompobattang," "K.P.H. Luwu," "K.P.H. Mamuju," "K.P.H. Mandar," "K.P.H. Sadang," and "K.P.H. Walenae." K.P.H. Lompobattang will include all public forests in the Counties of Bantaeng, Bulukumba, Gowa, Jeneponto, Maros, Pangkep, Selayar, Sinjai, and Takalar. K.P.H. Luwu will include all public forests in Luwu county only. K.P.H. Mamuju also will consist of all public forests in Mamuju county only. K.P.H. Mandar will consist of all public forests in the Counties of Majene and Polmas. K.P.H. Sadang includes all public forests in the Counties of Enrekang, Pinrang, and Tana Toraja. And finally, K.P.H. Walennae will include all public forests in the Counties of Barru, Bone, Sidrap, Soppeng, Wajo, and also the Municipality of Pare-Pare. The location of each K.P.H. is presented in Figure 6 (University of British Columbia, 1977).

Forest Functions and Distribution

According to forest functions, there are four kinds of public forests in South Sulawesi namely protection forests or "hutan lindung," production forests or "hutan produksi," protection-production forests or "hutan lindung-produksi," and nature-reserve forests or

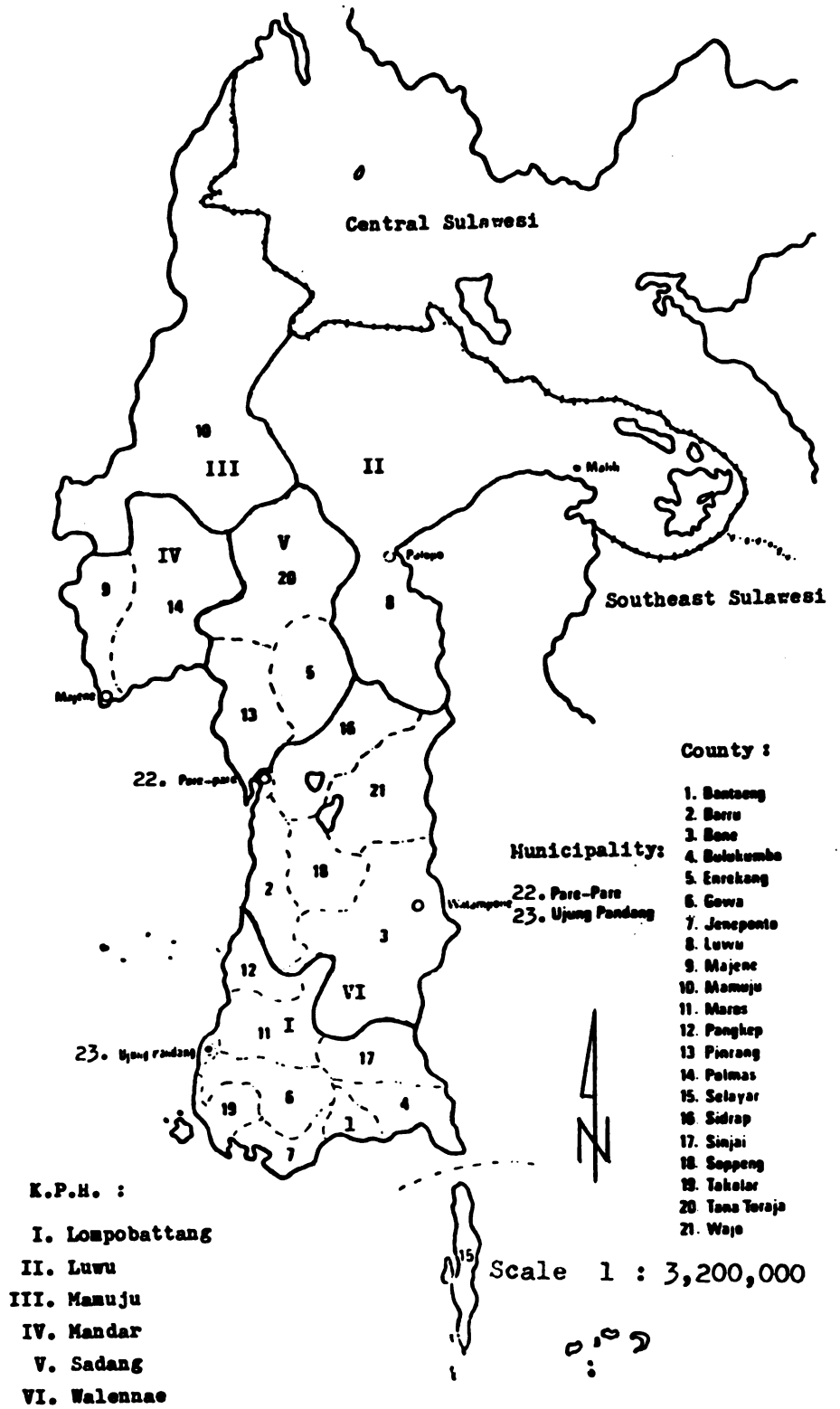


Figure 6. Names and Locations of Counties, Municipalities, and K.P.H. in South Sulawesi. Source: University of British Columbia, 1977.

"hutan suaka alam." Protection forests are public forests, and because of their natural properties, are assigned exclusively for watershed protection, flood and erosion controls, and soil conservation. Production forests are public forests assigned mainly for the production of timber and other products, such as rattan. Protection-production forests are protection forests and at the same time the forests are also assigned for production purposes. Nature-Reserve forests are public forests assigned for flora and fauna protection, or assigned for recreation or tourism. Fauna protection includes hunting regulations (Direktorat Bina Program Kehutanan, 1975; Direktorat Jenderal Kehutanan, 1976b).

In addition, within the production forests there are concession forests. They are production forests which are allocated to a private or public company to be managed for timber production purposes.

The area of each kind of forest for each county in South Sulawesi is listed in Table 12. A detailed listing of the specific forests in each county by kind of forest use is given in Tables A1 through A22 in the Appendix (Directorat Bina Program Kehutanan, 1975).

South Sulawesi has total public forests of about 3.5 million hectares. Of this total there are about 1.0 million hectares still in the category of proposed public forests. Concession forests occupy about 0.6 million hectares of the public forest lands, and there are only 18 hectares of nature reserve forests in the whole public forest system. Protection, protection-production, and production forests make up about 1.9 million hectares of public forest lands.

There are about 1.4 million hectares forested area and about

Table 12. Area of Each Kind of Forest by County and Municipality

Code Number	County/ Municipality	Protection Forests		Protection -Production Forests		Production Forests		Nature Reserve Forests	Concession Forests	Proposed Public Forests	Total Area
		Forested	Bare Land	Forested	Bare Land	Forested	Bare Land				
					Hectares						
01	Bantaeng	---	---	1,300	7,169	---	---	---	---	66	8,535
02	Barru	5,757	3,828	68,200	11,800	---	---	---	---	---	89,585
03	Bone	72,650	80,950	---	5,080	500	3,815	---	---	---	162,995
04	Bulukumba	---	---	4,500	500	---	---	---	---	62,241	67,241
05	Enrekang	31,730	23,400	---	---	---	---	---	---	5,000	60,130
06	Gowa	400	1,790	37,959	28,800	---	---	---	---	1,374	70,323
07	Jeneponto	---	---	4,188	11,686	---	---	---	---	42	15,916
08	Luwu	97,857	12,100	175,450	940	---	---	---	172,500	878,280	1,337,127
09	Majene	---	---	30,000	40,000	---	---	---	---	---	70,000
10	Mamuju	471,000	---	---	---	---	---	---	401,000	---	872,000
11	Maros	---	---	19,110	3,800	---	---	18	---	1,600	24,528
12	Pangkep	---	---	6,500	10,400	---	---	---	---	550	17,450
13	Pinrang	---	---	4,500	59,140	---	---	---	---	---	63,640
14	Polmas	---	---	148,000	100,000	---	---	---	---	---	248,000
15	Selayar	---	---	---	---	9,000	9,000	---	---	---	18,000
16	Sidrap	61,035	7,600	---	2,510	---	---	---	---	---	71,145
17	Sinjai	4,900	3,600	---	---	6,000	7,000	---	---	1,438	22,938
18	Soppeng	44,000	5,000	---	---	---	---	---	---	---	49,000
19	Takalar	---	15,624	---	---	---	3,825	---	---	---	19,449
20	Tana Toraja	70,694	76,001	---	---	---	---	---	---	7,900	154,595
21	Wajo	---	11,285	---	2,929	---	---	---	---	53,000	67,214
22	Pare-Pare	---	4,300	---	---	---	---	---	---	---	4,300
23	Ujung Pandang	---	---	---	---	---	---	---	---	---	---
Totals		860,023	245,478	499,707	284,754	15,500	23,640	18	573,500	1,011,491	3,514,111

0.5 million hectares of bare land in the 1.9 million hectares of the protection, protection-production, and production forests. The 0.5 million hectares of bare land consist of about 0.2 million hectares of bare land in the protection forests and about 0.3 million hectares in both protection-production and production forests.

The timber production from 0.6 million hectares of concession forests is mainly for export to other countries and not for the domestic timber supply in South Sulawesi. The domestic timber supply for South Sulawesi is expected mainly from the 1.4 million hectares of forested public forests and from the 1.0 million hectares of proposed public forests. If half of the 1.0 million hectares of proposed public forests are actually forested, then the domestic timber supply would be obtained from about 1.9 million hectares public and proposed public forests.

The 1.9 million hectares public and proposed public forests are uneven-aged hardwood forests with hundred species. If the Provincial Forest Service can manage the whole 1.9 million hectares public and proposed public forests by sound uneven-aged silvicultural systems and promote annual growth to about 1.0 cubic meter per hectare by the year 2000, then timber production of 1.9 million cubic meters for the domestic industrial wood supply in South Sulawesi by the year 2000 can be expected.

The estimates presented in Chapter III showed that annual industrial wood consumption in South Sulawesi by the year 2000 would range from 1.7 to 2.0 million cubic meters. Should consumption reach 2.0 million cubic meters, South Sulawesi will experience a timber deficit of 0.1 million cubic meters annually.

CHAPTER V

FORESTRY PROGRAMS FOR SOUTH SULAWESI

Five-Year Development Plan for Indonesia

The first Five-year Development Plan for Indonesia started on April 1, 1969. This five-year plan is called "Repelita" which stands for "Rencana Pembangunan Lima Tahun." The first five-year Development Plan or "Repelita I" covered the period from April 1969 through March 1974. "Repelita II" covers the second five-year period from April 1974 through March 1979. The preparation for "Repelita III" is already going on right now and books of the plan for "Repelita III" should be ready by April 1979.

The forestry program outlined in this study is intended to cover a period of 20 years starting April 1984 through March 2004. Thus, this forestry program will cover a period of four "Repelitas" namely "Repelita IV," "Repelita V," "Repelita VI," and "Repelita VII."

Program 1 - Boundary-Marking of the Public Forests

There is a big problem in the management of South Sulawesi's public forests because the foresters do not know the boundaries of their forests. The boundaries of most public forests are not marked in South Sulawesi. How can foresters work and manage the forests without knowing the exact location of the forest properties? Out of 3,514,111 hectares of public forests and proposed public forests,

there are only 62,486 hectares with established boundaries. Conflicts between the Indonesian Forest Service and local farmers and other institutions often exist because of this boundary problem.

Boundary marking of public forests is one of the jobs of the "Brigade Planologi Kehutanan," an institution under "Directorate of Forestry Planning" of the Indonesian Forest Service. The word "brigade" means "brigade" in English and "planologi" and "kehutanan" mean "planning" and "forestry," respectively. Thus "Brigade Planologi Kehutanan" means "Brigade for Forestry Planning."

The main duties of this "Brigade Planologi Kehutanan" are mapping of public forest lands and inventory of forest resources for each region in Indonesia. Each region has one "Brigade Planologi Kehutanan." "Brigade Planologi Kehutanan" of Ujung Pandang, the capital of South Sulawesi, covers the region of East Indonesia in which South Sulawesi is included. "Brigade Planologi Kehutanan" of Ujung Pandang is called "Brigade VII Planologi Kehutanan" which covers Region VII namely East Indonesia public forests. Its staff foresters are excellent, but they do not have enough budget to do their jobs, especially boundary marking.

Boundary marking of all public forests in South Sulawesi should be completed in the period of Repelita IV from 1984 to 1989. This program of boundary marking includes 553,872 hectares of bare land in public forests plus 1,375,230 hectares of land occupied by forest vegetation. A detailed plan of boundary marking is needed for this 1,929,102 hectares of public forests. This detailed plan should be ready by April 1981 so it can be used in the period of Repelita IV.

Boundary marking for the 573,500 hectares of concession forests

and the 1,011,491 hectares of "proposed" public forests could be done in the period of "Repelita IV" if there is urgent need for that such as to settle disputes. Once a "proposed" public forest becomes a public forest, boundary marking is needed immediately.

Program 2 - Plantation Establishment

The amount of bare land in South Sulawesi presented earlier reflected the situation in 1975. Starting in 1976 there was a reforestation program called "Inpres Reboisasi" which means "President Instruction for Reforestation" to plant bare land in Indonesia. In South Sulawesi, the bare land in the public forest system was to be planted with Pinus merkusii, Acacia spp., and Calliandra spp. This program was continued in 1977. Both 1976 and 1977 reforestation programs were going very slowly. Their targets were huge, but the actual reforestation success in the field was very discouraging.

In the meantime, the destruction of public forests has continued. If the number of hectares of the bare land actually converted to forest plantations annually, and the hectares of natural forests and forest plantations destroyed that became bare land each year were known, then the estimates of how much bare land there is in the public forest system at the end of "Repelita III," could be computed. Then, the planting program for the next twenty years could be determined.

If it is assumed that ten percent of the bare land has been converted to forest plantations, then at the end of "Repelita III" there will be 498,485 hectares of bare land. If 24,924 hectares are planted each year, the entire bare land area could be converted into forest plantations in a period of twenty years, assuming that the

destruction of forests discussed earlier could be kept at zero during the twenty-year period.

Planting 24,924 hectares of bare land each year is a big program. Using establishment costs of U.S. $600.00 per hectare, the program will need U.S. $ 14,954,400 or Rp 6,206,076,000 annually for establishment costs only.

The total of 553,872 hectares of bare land in South Sulawesi's public forests consist of 245,478 hectares of "protection" forests, 284,754 hectares of "protection-production" forests, and 23,640 hectares of "production" forests. It is the purpose of this program to plant the whole 553,872 hectares, not just the "production" or just the "protection-production" forests, because the 245,478 hectares of "protection" forests are very important to the water supply for productive agricultural lands in the province. Supplying enough water from the forest watersheds for agriculture lands is one of the objectives of this forestry program. In addition, some timber production can be obtained from these "protection" forests, if timber production does not impede the objectives of "protection" forests. This should be determined for each particular "protection" forest. Manual selective cutting by local people to meet their individual need for construction and fuelwood could be one alternative for obtaining very beneficial timber production from these "protection" forests.

There is really not much difference between "production" and "protection-production" forests. Every public forest, even a "production" forest, has to have a protection objective. Furthermore, these "production" forests cannot be used or managed without considering the need for protecting surrounding areas in a watershed system.

In this forestry program, "production" and "protection-production" forests are considered as one category of forests. The objectives of this category of forests are production of timber and protection of their watershed systems. Certainly, the allowable cut and silvicultural practices should be directed to meet these objectives.

The 23,640 hectares of bare land in "production" forests and the 284,754 hectares of bare land in "protection-production" forests should be planted, mainly with Pinus merkusii. These planted forests should be managed by intensive silvicultural practices, according to even-aged management by area regulation. These plantations are to be managed for domestic pulpwood supply and also for export to other countries and to other provinces in Indonesia especially on the Island of Java.

The mean annual increment of Pinus merkusii in Indonesia culminates at about an age of twenty years. In "Bonita II," the poorest site quality present, Pinus merkusii reaches maximum mean annual increment at the age of twenty-five years. In Bonita III, Bonita IV, Bonita V, and Bonita VI, it reaches annual increment at the ages of 20, 20, 15, 15 years respectively (Direktorate Jenderal Kehutanan, 1976b). For practical purposes, the culmination of the mean annual increment can be used to set the rotation at 20 years. Under area regulation with even-aged management, the following formula is used:

$$\text{Annual Cutting Area} = \frac{\text{Total Forest Area}}{\text{Rotation}}$$

When this formula is applied to the 308,394 hectares of even-aged forests, the annual cutting area is equal to 15,420 hectares.

According to the Directorate General of Forestry (1976b), maximum mean annual increments for "Bonita II," "Bonita III," "Bonita IV," "Bonita V," and "Bonita VI" of Pinus merkusii stands in Indonesia are 15.3, 16.4, 18.1, 19.5, and 22.0 cubic meters per hectare respectively. On the assumption that the average site will yield the equivalent of "Bonita III," or 16.4 cubic meters per hectare, the annual yield from the 308,394 hectares forest plantations should be 5,057,662 cubic meters each year after these forests have become fully area regulated.

Pinus merkusii is to be planted on the 0.3 million hectares of protection-production and production public forests because it is suitable for both watershed protection and high industrial wood production. The species is relatively much easier to grow on the bare land than any other commercial species available. Indonesian foresters have been growing the species for decades. Its seed supply for planting purpose is available and easy to collect, and is also cheaper than any other commercial species. Certainly, it is excellent for pulpwood production.

Another category of forests in this management program are the "protection" forests. The objective of these forests is protection of watersheds although some timber production and other commercial benefits can also be obtained from them. Reforestation of the 245,478 hectares of bare land in these "protection" forests is to be met by planting native species which are suitable for the objectives of "protection" forests. For example, the Indonesian Forest Service is planting Acacia spp., Calliandra spp., Leucaena glauca, and Anacardium occidentale for this purpose. The suitability of these

species for a particular forest should be determined by research.

It is difficult to calculate the timber yield or other commercial benefits from these "protection" plantation forests, but some of the species have high potential for commercially benefitting the local people. For example, Anacardium occidentale yields anacardium nuts which can be sold commercially. Acacia spp. or other species suitable for local fuelwood consumption are going to be very beneficial for the lime-kiln industry in Gowa County.

Program 3 - Acquisition

There are still about 1.0 million hectares of public lands in the category of "proposed" public forests. Proposals by local governments to convert these public lands to public forests are in the process of seeking approval from the Minister of Agriculture of Indonesia in Jakarta. Once a proposal is approved by the Minister of Agriculture, the public land becomes a public forest. This is mainly an administrative process but the Forest Service should keep track of the proposals so that they continue to move from one office to the next.

It is still not known how many hectares of these "proposed" public lands are occupied by forest vegetation and how many hectares are bare land. A conservative estimate is that half or about 0.5 million hectares are forested. The locations of these "proposed" public forests are very important and very advantageous to local communities. They are located next to populated rural areas and urban communities. Acquisition should be completed to put these lands into production under the management of the Indonesian Forest

Service. Otherwise, they may be sources of erosion which will be detrimental to the local communities.

The assumption was made earlier that the Provincial Forest Service can put the 1.4 million hectares of forested public forests and the estimated 0.5 million hectares of forested proposed public forests under sound uneven-aged management practices that will yield 1.0 cubic meter per hectare annually by the year 2000. This will achieve the estimated production of 1.9 million cubic meters of industrial wood. Thus, the designation of these proposed public forest lands is vital to meet needed timber production estimates.

This acquisition program should be completed in two "Repelitas," namely "Repelita IV" and "Repelita V." As soon as these public lands become public forests, boundary marking, as discussed earlier, should follow. An inventory as discussed in the next section, should also be conducted on the newly approved public forests. Both boundary marking and inventory programs for these new public forests should be completed by the turn of the century.

Program 4 - Inventory

In the vegetated public forest lands, there are two different kinds of forests, namely the non-concession and the concession forests. The non-concession forests and the concession forests comprise 1,375,230 hectares and 573,500 hectares of land, respectively. Because the non-concession forests are located adjacent to relatively heavily populated rural and urban areas, they are very important in meeting the local needs for both industrial wood and fuelwood. These

non-concession public forests have been supplying wood for the local people for centuries. Sometimes they are abused by the local people and become bare land in the public forest system.

The concession forests have a very different situation. They are located in very sparcely populated areas in Mamuju and Luwu Counties. For this reason, the concession forests are not exploited much by the local people and they are still in old growth forest condition.

Practically all timber produced from non-concession forest is consumed locally, and almost all timber produced from concession forests is exported to other countries.

There have been at least thirteen ground surveys of the concession forests; eight surveys in Mamuju County and five surveys in Luwu County. The intensities of the surveys have been very low. Survey intensities in Mamuju County range between 0.10 percent and 0.38 percent and in Luwu County between 0.12 percent and 0.26 percent. The surveys found that timber growing stocks ranged from 84 cubic meters per hectare to 214 cubic meters per hectare in Mamuju County and from 58 cubic meters per hectare to 113 cubic meters per hectare in Luwu County. The surveys recorded growing stock of all species with a diameter of 35 centimeters and larger. These thirteen surveys covered the whole concession forests of 573,500 hectares (Directorate of Forest Inventory and Planning, 1967a, 1967b, 1967c, 1970; Directorate of Forest Planning, 1971a, 1971b, 1972, 1973a, 1973b, 1973c, 1974; Directorate General of Forestry Directorate of Development Programming, 1975; Directorate General of Forestry Directorate of Planning, 1971).

The "non-concession" forests and the "proposed" public forests consist of 1,375,230 hectares and 1,011,491 hectares of public lands, respectively. All "non-concession" public forest areas are vegetated by either old-growth or second-growth forests.

There have been only three surveys conducted on the "non-concession" public forests and the "proposed" public forest areas (Brigade VII Planologi Kehutanan, 1972a, 1972b; Dinas Kehutanan Daerah Tingkat I Sulawesi Selatan, 1975).

They covered an area of only 71,000 hectares out of a total area of 2,386,721 hectares. The intensities of the first two surveys were very low, namely 0.21 percent and 0.30 percent. The intensity of the third survey was relatively high at 2.0 percent. However, the third survey covered only about 1,000 hectares. The first two surveys recorded all species with a diameter of 35 centimeters and larger, and found that volumes ranged from 34 to 41 cubic meters per hectare. The third survey recorded all species with a diameter of ten centimeters and larger and found that the volume of the 1,000 hectare forest was 26 cubic meters per hectare. However, there have not been any ground surveys on 2,315,721 hectares of both "non-concession" and "proposed" public forests.

An important objective of this forestry program is to conduct inventory surveys on the 2,315,721 hectares which have not been surveyed, and to complete the surveys by the end of the century. This means that an average of 144,733 hectares must be inventoried each year. A more detailed program will need to be prepared to specify the location of each year's inventory in a specific forest.

Program 5 - Silvicultural Research

For concession forests in Indonesia, the concessionaires are to practice three kinds of silvicultural systems, namely Indonesian Selection Cutting, "Tebang Pilih Indonesia" or TPI; Clear Cutting with Planting, "Tebang Habis dengan Penanaman; and Clear Cutting with Natural Regeneration, "Tebang Habis degan Permudaan Alam." Most concessionaires officially state that they are practising the "Tebang Pilih Indonesia," although most of them if not all do not follow the prescribed procedures.

"Tebang Pilih Indonesia" is a proposed uneven-aged management system for cutting, regeneration, and restocking of tropical rain forests in Indonesia. The system has not yet been practiced for one complete cutting cycle. In fact, the system was adopted by the Indonesian Forest Service just recently. Accordingly, there is still not enough experience to indicate that this system is the best for the Indonesian tropical rain forests. There is work being done to monitor the performance of the system, but it is not very far along.

Basically, "Tebang Pilih Indonesia" uses a cutting cycle of 35 years. In using this cutting cycle, the concessionaires are not allowed to cut any valuable species which has a diameter at breast height (d.b.h.) of less than 50 centimeters or at twenty centimeters above the buttress. To make sure that there will be enough valuable tree species for the next cutting cycle, the concessionaires should mark and leave 25 trees per hectare of valuable species which have diameters of 35 centimeters and larger. These are called "core trees," "pohon inti." The core trees should be well distributed over the cutting area.

For some areas, because of low site-index, there are not enough valuable tree species with diameters of 50 centimeters and larger; in such cases the diameter margins could be lowered and the cutting cycle adjusted according to the limits in Table 13 (Direktorat Jenderal Kehutanan, 1976b).

Table 13. Relation Between Cutting Diameter, Cutting Cycle, Number of Core Trees, and Diameter of Core Trees in Indonesian Selection Cutting

Cutting Diameter	Cutting Cycle	Core Trees	Diameter of Core Trees
Centimeter	Years	Per Hectare	Centimeter
$\geq$ 50	35	25	$\geq$ 35
$\geq$ 40	45	25	$\geq$ 35
$\geq$ 30	55	40	$\geq$ 20

There are also some rules of the "Tebang Pilih Indonesia" on enrichment planting, on elimination of climbers and weed species, on erosion prevention, and on forest safeguards. The system is complicated and it seems that the concessionaires are reluctant to adopt all the rules of the system.

The second silvicultural system is "Clear Cutting with Planting Regeneration," "Tebang Habis dengan Penanaman." There is not much to say about this system as it is largely self-explanatory. The species to be planted are commercial tree species, mainly Agathis spp., Pinus spp., Anthocephalus spp., and Shorea spp. The nursery program for this system has to be very intensive. Planting distance is 3

meters x 3 meters or 1,100 stems per hectare. Replanting should be done as necessary to reach minimal stocking of 40 percent at the age of two years (Direktorat Jenderal Kehutanan, 1976b).

The third silvicultural system is "Clear Cutting with Natural Regeneration," "Tebang Habis dengan Permudaan Alam." This system was adopted from "Malayan Clearfelling over Natural Regeneration." The system is applied only after making a systematic linear sampling that ensures that there are enough seedlings of valuable tree species for the next rotation. The sampling is called "Linear Sampling Milliacre" or LSM. The size for each sample plot is 2 meters x 2 meters which is about one milacre. At least 40 percent of the sample plots taken should have seedlings of the required species. No later than five years after logging there should be another sampling which is called "Linear Sampling 1/4 Chain Square" or simply LS1/4. The size of the sample plot is 5 meters x 5 meters which is about 1/4-chain square. At this time, there should be 60 percent stocking to qualify as having enough regeneration. Enrichment planting should follow if the stocking is less than 60 percent. In ten, 15, and 20 years after logging, stand improvements are required, such as release cutting, thinning if needed, and enrichment planting for areas which lack the required species. This system requires a rotation of 70 years for Indonesian tropical hardwoods. At the end of the rotation there should be about fifty stems of the required species per hectare (Direktorat Jenderal Kehutanan, 1976b).

The three silvicultural systems described above have not as yet been practiced in any forest in South Sulawesi, nor has any other silvicultural system like group selection cutting, seed tree method,

or the shelterwood system. Indonesian law requires the concessionaires to practice any one of the three systems, but they still do not. There is no clear reason why they do not even begin to do so.

Under this forestry program, the Indonesian Forest Service should begin to establish experimental forests in which to test the performance of the three silvicultural systems and conduct research on other suitable systems.

There will be some experimental forests needed for "concession" forest areas, and some for "non-concession" public forests. At least one experimental forest is needed for every prominent mountain-range in the province because forest conditions vary so much. The size of each experimental forest should be adjusted to that needed for each experimental purpose. The following are temporary proposed locations for experimental forests:

1. Lompobattang Mountain-Range
2. Eastern Mountain-Range
3. Western Mountain-Range
4. Quarles Mountain-Range
5. Latimojong Mountain-Range
6. Molengraaff Mountain-Range
7. Fennema Mountain-Range
8. Verbeek Mountain-Range
9. Tangkeleboke Mountain-Range

The research at all experimental forests should be coordinated by a central office and staff. It is proposed that Maros, the capital of Maros County, be the location of this central office. Maros is located about 30 kilometers from Ujung Pandang, the capital of

South Sulawesi.

The central office at Maros could also conduct other research needed for forestry development in the province.

The establishment of the experimental forests is a very urgent need, and all experimental forests should be established by the end of "Repelita V" in 1994. Accordingly, there should be at least one experimental forest established every year, starting in April 1984.

The Maros central office and headquarters should be established in the first two years of "Repelita IV," between April 1984 and March 1986. This central office would formulate what kind of forest research is needed to develop forestry programs in the province, and then arrange, conduct, and coordinate the research.

CHAPTER VI

SUMMARY AND CONCLUSIONS

South Sulawesi is one of 26 provinces of Indonesia. The province has a land area of 77,639 square kilometers, a population in 1976 of 5,573,422 people, and public forest lands of 3,514,111 hectares. The province's land area, population, and public forest lands make up four percent of Indonesia's land area, four percent of Indonesia's population, and three percent of the country's public forest lands, respectively.

The province has extensive mountain ranges where public forests are located. Most mountain ranges rise 2,000 to 3,000 meters above sea level. Mount Rantemario of Latimojong Mountain Range is the highest point at 3,440 meters.

South Sulawesi is located in the tropical belt and so are its forest lands. There is not much temperature variation from one location to the other and from one month to another around the year. However, average annual rainfall varies from 1,199 millimeters to 5,019 millimeters.

There are only two seasons during the year in the province, a dry season and a wet season.

The tropical climate has determined the kinds of soils in the province. Substantial areas of land are covered by relatively old soils. Latosols cover about nine percent of all lands in the province. Ultisols namely Tropudults and Paleudults cover 33 percent

of the lands. On the other hand, some soils are relatively young. Tropudalfs of Alfisols and Alluvial soils, Tropofluvents, make up 21 percent and nine percent of the province's soils, respectively. Other soils make up the remaining 28 percent. Both climate and soils are very favorable for forest plantation establishment and growth.

Although South Sulawesi's population is not growing as fast as that of Indonesia, it is expected that the province will have between 8.35 and 10.08 million people by the year 2000. Accordingly, by the end of the century annual industrial wood and fuelwood consumption could reach levels of 2.02 million cubic meters and 7.06 million cubic meters, respectively. Other needs associated with forest resources such as the need for irrigation water, water quality improvement, recreation, range, and wildlife habitat are not covered in this study. However, the need for these products and services will no doubt undergo expansion also.

Much work has been done in this study in just trying to obtain the very basic forestry data, such as the size and location of each public forest, whether the public forest is occupied by forest vegetation or is bare land, rough estimates of growing stock for each forest category, etc. Despite many difficulties, the author was able to assemble considerable data on which to base a proposed forestry program for South Sulawesi.

At the present time, South Sulawesi has total public forests of about 3.5 million hectares. Of this total there are about 2.0 million hectares occupied by forest vegetation and about 0.5 million hectares bare land. There are still about 1.0 million hectares in the category of "proposed" public forests. Of the 2.0 million

hectares covered by forest vegetation, there are about 0.6 million hectares in the category of "concession" forests.

An objective of this forestry program is to plant 0.3 million hectares out of 0.5 million hectares of bare land with mainly Pinus merkusii and manage these plantations by area-regulation under even-aged management.

Almost all public forests do not yet have any boundary marking. Good boundary markings are prerequisite for a forest management program because the location must be known. A boundary marking program should be conducted as early as "Repelita IV" and completed by the end of the century.

An inventory program must accompany any good forest management program, especially in the uneven-aged tropical rain forests with hundreds of species. There is an urgent need for an inventory program on "non-concession" public forests because their locations are very advantageous to meet the persistent needs of local communities for forest products and services.

There are still about 1.0 million hectares of forests in the category of "proposed" public forests. It is still not known how many hectares of these forests are occupied by forest vegetation, and how many hectares of them are bare land. A conservative estimate is that half or about 0.5 million hectares are forested. The location of these "proposed" public forests are also very advantageous to the local communities. Acquisition should be conducted to put these lands into production under the management of the Indonesian Forest Service. Otherwise they will be sources of erosion which will be detrimental to the local communities.

Research on silvicultural systems and on other forestry problems should accompany all other programs. Accumulated results from forest research and inventory are very beneficial for program revision every five years, and in time the entire program will meet the people's needs for forest products and services associated with forest resources.

The following conclusions and recommendations have resulted from this study:

1. There will be immense needs for timber and other forest-resource products and services in South Sulawesi by the year 2000, when the projected population may reach 10.1 million. Projected demand at that time may reach 2.0 million cubic meters annually for industrial wood, and 7.1 million cubic meters for fuelwood. This demand will only be met if the Provincial Forest Service employs a sound and comprehensive forest management program for all public forests in the province. The present forested public uneven-aged hardwood forests of 1.4 million hectares are estimated to produce 1.4 million cubic meters of industrial wood annually. It is also estimated that the estimated 0.5 million hectares of forested proposed public forests will yield 0.5 million cubic meters of industrial wood annually, for a total of 1.9 million cubic meters.

2. A prerequisite for good forest management is that all public forests have clear boundary markings. Most public forests in the province do not have their boundaries marked. Adequate budget allocation to "Brigade VII Planologi Kehutanan" is needed urgently to complete the forest boundary marking program for all public forests in the province by the turn of the century.

3. An inventory program for the whole public forest system must accompany this forestry program. However, there is an immediate need to carry out an inventory program for the "non-concession" public forests. The locations of these forests are very strategic to meet the needs of the local people for fuelwood, industrial wood, and other products and services associated with forest resources.

4. A large planting program is going to be the most laborious among all programs. There should be about 25,000 hectares planted each year if the Indonesian Forest Service intends to convert the estimated 0.5 million hectares of bare land into about 0.3 million hectares of conifer forests and about 0.2 million hectares of native species protection forests. The projected timber production goals for the year 2000 can not possibly be met without these plantations being established.

Planting activities will have multiple benefits for the local people until the timber is harvested and later. This plantation program is also needed very urgently to improve the soil and water conditions for agricultural areas, and for fish and wildlife habitat improvement. Moreover, the planting program will introduce a new model of large scale even-aged conifer forests to Indonesian forestry.

After becoming fully regulated on a rotation of 20 years, the 0.3 million hectares of Pinus merkusii plantations are estimated to yield 5.0 million cubic meters of industrial wood annually, to be used domestically and for export. Much of this will be in the form of pulpwood.

5. The acquisition program is meant to acquire the 1.0 million hectares of "proposed" public forest lands and to convert them

into public forests or into nature-reserve forests. The main purpose is to put the idle lands into production. Otherwise, these lands will soon become bare land and become sources of erosion that will be very detrimental to the local communities. There is also a great need to have more "nature-reserve" forests in the province. Some of the "proposed" public forests could be converted into "nature-reserve" forests.

6. Most of the forests in South Sulawesi are uneven-aged forests with hundreds of species. The Indonesian Forest Service must encourage the practice of one of the three kinds of silvicultural systems on these forests: Indonesian Selection Cutting, Clear Cutting with Planting Regeneration, or Clear Cutting with Artificial Regeneration. There has been no application of these three systems in the uneven-aged forests in South Sulawesi. A research program is needed to determine how well South Sulawesi's forests respond to the three systems, and there should also be research on other systems suitable for South Sulawesi's forests.

7. This forestry program should be revised in April 1984 and every five years thereafter.

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APPENDIX

Table A1. Public Forests in Bantaeng County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			Hectares		
01-01	Lompobattang/ Bantaeng	Protection -Production	800	1,000	1,800
01-02	Bulumalata/ Bantaeng	Protection -Production	---	169	169
01-04	Perluasan Lompo-battang/Pontoatu	Protection -Production	---	5,000	5,000
01-05	Sapabintung	Protection -Production	500	1,000	1,500
Total for Protection-Production forests			1,300	7,169	8,469
Proposed Public Forests					66
All Forests					8,535

Table A2. Public Forests in Barru County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
02-01	Wala-Wala	Protection	3,497	1,428	4,925
02-02	Pani-Pani	Protection	2,260	1,000	3,260
02-03	Bacukiki/Barru	Protection	---	1,400	1,400
Total for Protection Forests			5,757	3,828	9,585
02-04	Barru	Protection -Production	68,200	11,800	80,000
All Forests			73,957	15,628	89,585

Table A3. Public Forests in Bone County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
				Hectares	
03-02	Walenae	Protection	8,600	4,000	12,600
03-03	Gunung Tadjung	Protection	---	1,000	1,000
03-04	Ponre	Protection	42,500	22,000	64,500
03-06	Ulubila	Protection	12,000	36,000	48,000
03-07	Tellulimpue	Protection	8,750	16,250	25,000
03-09	Lerang	Protection	800	1,700	2,500
Total for Protection Forests			72,650	80,950	153,600

Table A3. (Continued)

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			------	-- Hectares -	---------
03-01	Ongko Palaka	Protection -Production	---	5,080	5,080
03-05	Matango	Production	---	815	815
03-08	Hutan Pajau Bone	Production*	500	3,000	3,500
Total for Production Forests			500	3,815	4,315
All Forests			73,150	89,845	162,995

*Pending conversion to a Protection Forest.

Table A4. Public Forests in Bulukumba County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
04-01	Lompobattang/ Bulukumba	Protection -Protection	4,500	500	5,000
Proposed Public Forests*					62,241*
All Forests					67,241

*Pending clarification.

Table A5. Public Forests in Enrekang County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
05-01	Latimojong/Enrekang	Protection	26,280	2,500	28,780
05-02	Batumila	Protection	5,100	5,000	10,100
05-04	Bamba Puang	Protection	---	15,900	15,900
05-05	Puduku	Protection	350	---	350
Total for Protection Forests			31,730	23,400	55,130
	Proposed Public Forests:				
05-03	B. Siambo	Protection			5,000
All Forests					60,130

Table A6. Public Forests in Gowa County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
06-09	Malino	Protection	400	1,790	2,190
06-01	Lompobattang/Gowa	Protection -Production	16,430	8,500	24,930
06-02	Bontomaya	Protection -Production	7,891	---	7,891
06-03	Bontoramba/Gowa	Protection -Production	848	---	848
06-04	Pao Utara	Protection -Production	6,890	---	6,890
06-05	Pangkalaeng/Gowa	Protection -Production	400	1,700	2,100
06-10	Borisallo	Protection -Production	5,500	18,600	24,100

Table A6. (Continued)

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - - -	- - Hectares -	- - - - - - - - -
Total for Protection-Production Forests			37,959	28,800	66,759
	Proposed Public Forests:				
06-06	Limbung-Timboro	Production			250
06-07	Limbung-Towa	Production			374
06-08	Limbung-Wara	Production			750
Total for Proposed Public Forests					1,374
All Forests					70,323

Table A7. Public Forests in Jeneponto County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
				Hectares	
07-01	Lompobattang/ Jeneponto	Protection -Production	---	200	200
07-02	Bulumalata/ Jeneponto	Protection -Production	---	85	85
07-03	Bontoramba/ Jeneponto	Protection -Production	1,688	---	1,688
07-05	Bangkala	Protection -Production	2,500	6,925	9,425
07-06	Kelara	Protection -Production	---	1,288	1,288
07-07	Kambutta	Protection -Production	---	1,188	1,188
07-08	Passaukang	Protection -Production	---	2,000	2,000

Table A7. (Continued)

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
Total for Protection-Production Forests			4,188	11,686	15,874
	Proposed Public Forests:				
07-04	Bontosaraung/ Jeneponto	Protection -production			42
All Forests					15,916

Table A8. Public Forests in Luwu County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			-------	-- Hectares -	---------
08-01	Nanggala III	Protection	5,000	3,000	8,000
08-02	Walenrang	Protection	4,000	5,600	9,600
08-04	Latimojong/Luwu	Protection	56,500	1,500	58,000
08-07	Hulu Sungai Lamasi	Protection	32,357	2,000	34,357
Total for Protection Forests			97,857	12,100	109,957
08-03	Malili	Protection -Production	---	940	940
08-10	Rongkong Karama	Protection -Production	175,450	---	175,450
Total for Protection-Production Forests			175,450	940	176,390

Table A8. (Continued)

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
Proposed Public Forests					878,280
Concession Forests			172,500		172,500
All Forests					1,337,127

Table A9. Public Forests in Majene County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
09-01	Majene	Protection -Production	30,000	40,000	70,000
All Forests			30,000	40,000	70,000

Table A10. Public Forests in Mamuju County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
10-01	Mamuju	Protection	471,000	---	471,000
	Concession Forests		401,000	---	401,000
All Forests			872,000	---	872,000

Table A11. Public Forests in Maros County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
11-01	Bulubualo	Protection -Production	10,000	1,300	11,300
11-02	Pangkalaeng/Maros	Protection -Production	1,610	---	1,610
11-04	Bulusaraung/Maros	Protection -Production	7,500	2,500	10,000
Total for Protection-Production Forests			19,110	3,800	22,910
	Proposed Public Forests:				
11-03	Salobaklasak	Protection			1,600
	Nature-Reserve Forests:				
11-05	Bantimurung	Nature-Reserve	18		18
All Forests					24,528

Table A12. Public Forests in Pangkep County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
12-02	Bulusaraung/Pangkep	Protection -Production	6,500	10,400	16,900
	Proposed Public Forests:				
12-01	Padang-Lompo	Protection -Production			550
All Forests					17,450

Table A13. Public Forests in Pinrang County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
13-01	Batumila/Pinrang	Protection -Production	---	1,290	1,290
13-02	Pasapa	Protection -Production	---	36,140	36,140
13-03	Talubenua/Pinrang	Protection -Production	4,500	21,050	25,550
13-04	Alita/Pinrang	Protection -Production	---	660	660
Total for Protection-Production Forests			4,500	59,140	63,640
All Forests			4,500	59,140	63,640

Table A14. Public Forests in Polmas County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			------	-- Hectares --	---------
14-01	Mamasa	Protection -Production	143,000	35,000	178,000
14-02	Polewali	Protection -Production	5,000	65,000	70,000
Total for Protection-Production Forests			148,000	100,000	248,000
All Forests			148,000	100,000	248,000

Table A15. Public Forests in Selayar County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			------	-- Hectares -	--------
15-01	Jampea	Production	9,000	3,000	12,000
15-02	Bontosikuyu	Production	---	6,000	6,000
Total for Production Forests			9,000	9,000	18,000
All Forests			9,000	9,000	18,000

Table A16. Public Forests in Sidrap County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
16-01	Bila	Protection	8,735	---	8,735
16-02	Latimojong/Sidrap	Protection	48,700	---	48,700
16-04	Nepo-Nepo	Protection	3,600	4,000	7,600
16-05	Bendoro	Protection	---	3,600	3,600
Total for Protection Forests			61,035	7,600	68,635
16-03	Batumila/Rappang	Protection -Production	---	2,510*	2,510*
All Forests			61,035	10,110	71,145

*Pending official clarification of the size of the forest area.

Table A17. Public Forests in Sinjai County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
17-01	Lompobattang/ Sinjai	Protection	4,500	500	5,000
17-04	Lajango	Protection	400	3,100	3,500
Total for Protection Forests			4,900	3,600	8,500
17-05	Palangka	Production	6,000	7,000	13,000
	Proposed Public Forests:				
17-02	Balangposong/Sinjai	Protection			1,027
17-03	Bulubabara	Protection			411
Total for Proposed Public Forests					1,438
All Forests					22,938

Table A18. Public Forests in Soppeng County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			-------	-- Hectares -	---------
18-01	Laposo/Niniconang	Protection	42,000	3,000	45,000
18-02	Perluasan Buludua	Protection	2,000	1,500	3,500
18-03	Sekkangmata	Protection	---	500	500
Total for Protection Forests			44,000	5,000	49,000
All Forests			44,000	5,000	49,000

Table A19. Public Forests in Takalar County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - - -	- - Hectares -	- - - - - - - -
19-05	Komara	Protection	---	15,624	15,624
19-01	Limbung Raya	Production	---	276	276
19-02	Lauwa	Production	---	746	746
19-03	Palleko	Production	---	1,792	1,792
19-04	Bontokadatto	Production	---	1,011	1,011
Total for Production Forests			---	3,825	3,825
All Forests			---	19,449	19,449

Table A20. Public Forests in Tana Toraja County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
20-01	Nanggala I	Protection	1,500	1,660	3,160
20-02	Sadang	Protection	7,000	1,460	8,460
20-03	Nanggala II	Protection	6,280	---	6,280
20-04	Latimojong/Makale	Protection	5,000	2,407	7,407
20-05	Tamburora	Protection	100	2,292	2,392
20-06	Karua I	Protection	17,634	2,500	20,134
20-07	Karua II	Protection	20,500	6,291	26,791
20-08	Buntu Gasing	Protection	---	11,318	11,318
20-09	Buntu Sadoko	Protection	2,200	15,202	17,402
20-10	Simbuang Besar	Protection	6,300	24,179	30,479
20-11	Masila	Protection	2,500	6,430	8,930

Table A20. (Continued)

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
20-12	Mapongka	Protection	1,680	212	1,892
20-16	Pongtora	Protection	---	2,050	2,050
Total for Protection Forests			70,694	76,001	146,695
	Proposed Public Forests:				
20-13	Ponean	Protection			3,150
20-14	Perluasan Karua I	Protection			1,250
20-15	Perluasan Karua II	Protection			3,500
Total for Proposed Public Forests					7,900
All Forests					154,595

Table A21. Public Forests in Wajo County

County and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - - -	- - Hectares -	- - - - - - - - -
21-03	Anabanua	Protection	---	11,285	11,285
21-02	Ulugalung	Protection -Production	---	2,929	2,929
Total for Protection plus Protection-Production Forests				14,214	14,214
	Proposed Public Forests:				
21-01	Laparopa/Latimojong	Protection			30,000
21-04	Hutan Payau Wajo	Production*			23,000
Total for Proposed Public Forests					53,000
All Forests					67,214

*Pending conversion to Protection forest.

Table A22. Public Forests in Pare-Pare Municipality

Municipality and Forest Code	Forest Name	Main Forest Use	Forested	Bare Land	Total Forest Area
			- - - - - -	- - Hectares -	- - - - - - - -
22-01	Alita/Pare-Pare	Protection	---	300	300
22-02	Bacukiki/Pare-Pare	Protection	---	4,000	4,000
All Forests			---	4,300	4,300

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