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OVERVIEW OF FORESTRY RESEARCH IN INDONESIA

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Abbreviations and Acronyms

AARD	Agency for Agricultural Research and Development
ADAB	Australian Development Assistance Bureau
A/D/C	Agricultural Development Council (US)
APKINDO	Indonesian Association of Plywood Manufacturers
ASEAN	Association of Southeast Asian Nations
EIOTROP	Southeast Asia Regional Centre for Tropical Biology
BPT	Balai Penelitian Ternak (Livestock Research Centre)
BPPK	Badan Penelitian dan Pengembangan Kehutanan (Board for Forestry Research and Development)
CIDA	Canadian International Development Agency
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
DANIDA	Danish International Development Agency
Departemen Kehutanan:	Department of Forestry
Departemen Pendidikan dan Kebudayaan:	Department of Education and Culture
DFSC	Danish Forestry Seed Centre (Denmark)
DIP	Approved annual budget within a government office
Fakultas Kehutanan	Faculty of Forestry
FAO	Food and Agriculture Organization of the UN
GOI	Government of Indonesia
GTZ (Ltd)	German Agency for Technical Cooperation (Ltd)
IBRD	Int'l Bank for Reconstruction and Development
IDRC	Int'l Development Research Centre (Canada)
IHH	Basic royalty on trees cut from forests
IIED	Int'l Institute for Environment and Development
IPB	Institute of Agriculture, Bogor
IUCN	International Union for the Conservation of Nature and Natural Resources
IUFRO	International Union of Forest Research Organizations
JICA	Japanese International Cooperation Agency
KLH	State Ministry of Population and Environment
LBN	Lembaga Biologi Nasional (National Institute for Biology)
LIPI	Lembaga Ilmu Pengetahuan Indonesia (Indonesian Institute for Science)
MAB/UNESCO	Man and the Biosphere Programme/United Nations Economic Social and Cultural Organization
MPI	Indonesian Timber Community
NTT	Nusa Tenggara Timur
Outer Islands	Islands of Indonesia excluding Java, Madura, Bali
Pelita IV	Fourth National Five-Year Development Plan (1984-89)
Perum Perhutani	Government-owned company responsible for forest management on Java
PPLH	Pusat Penelitian Lindungan Hidup (Environmental Study Centre)
RRL	Directorat Jenderal Reboisasi dan Rehabilitasi Lahan (Directorate General of Reforestation and Land Rehabilitation)
UGM	University of Gadjja Mada, Yogyakarta
UNCTAD	UN Committee on Trade and Development
UNMUL	University of Mulawarman, Samarinda
USAID	United States Agency for International Development

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OVERVIEW OF FORESTRY RESEARCH IN INDONESIA

1. Institutions involved in forestry research in Indonesia

Forestry research in Indonesia is conducted by a variety of institutions receiving funding from an equally diverse number of sources. The majority of funds overall and for any one of the major institutions involved in forestry research comes from the GOI national budget. As the primary government agency responsible for the management of national forest lands and the development of the forestry sector in accordance with national development goals, the Department of Forestry has the responsibility for forestry research, defined in its broadest sense to include all matters relevant to the mandate of the Department. These responsibilities include soil conservation on all lands, watershed protection, settlement of shifting cultivators, national parks and nature reserves as well as commercial forestry operations. Within the private sector, support for forestry research is largely a contribution in kind rather than a commitment of funds. The forest concessionaires permit access to their lands and facilities for the purpose of field study and, on occasion, may engage University forestry staff members on short-term contracts for research on topics of specific interest to the company. Foreign bilateral and multilateral foreign assistance agencies sponsor specific applied or adaptive forestry research activities, generally related to their development projects undertaken in cooperation with various government and non-government institutions.

1.1 GOI agencies and institutions

1.1.1 Board for Forestry Research and Development (BPPK)

(Badan Penelitian dan Pengembangan Kehutanan)

Responding to numerous and persistent requests of forest officers working in Indonesia, the Dutch colonial administration in 1913 established the first forestry research station in Indonesia at Bogor. Although the research focus of this institution was intended to be primarily the problems of forest management on Java, specifically as related the production of teak, the research work actually spanned a

broad range of topics. Extensive research was conducted on hydrology and minor forest products, as the numerous research reports on essential oils, resins, tannins, ebony, balsa, spices and charcoal indicate. The original infrastructure established some 70 years ago still today forms the basis of the forestry research system in Indonesia.

During the three decades following the departure of the Dutch in 1951, the government bureaucracy, including the forestry research institution, was reorganized several times. Together with the other institutes of the Department of Agriculture, the Forestry Research Office with its then four research institutes in 1961 was brought together under the Office of Agricultural Research. Subsequently, forestry research was reduced to two institutes, the Forestry Research Institute and the Forest Products Research Institute, and incorporated in 1974 in the Agency for Agricultural Research and Development, whose responsibility it was to oversee and coordinate research undertaken by the several specialized research institutes working on agricultural research in its broadest definition.

In 1983, this institutional arrangement again changed, as the Directorate General of Forestry separated from the Department of Agriculture to reestablish itself as a distinct Department under ministerial direction. In this reorganization, direct responsibility for forestry research was reclaimed and incorporated as the Board for Forestry Research and Development (Badan Penelitian dan Pengembangan Kehutanan (BPPK)). Chosen to head the Board and lead the reorganization of the forestry research program was Dr. Setyono Sastrosumarto, the Associate Dean for Academic Issues and Extension in the Faculty of Forestry at the University of Gajah Mada, Yogyakarta. The new Board oversees the two previously established forestry research institutes, the Forestry Research and Development Center (Pusat Litbang Hutan) and the Forest Products Research and Development Center (Pusat Litbang Hasil Hutan), both located in Bogor. The function of the Forestry Research and Development Board is to develop and coordinate research on forestry and forest products in Indonesia in accordance with Ministerial policy and national laws.

The orientation of the forestry research program in Pelita III (1979-1983) was toward research on appropriate technology for forest

development, especially the rehabilitation of critical lands and the conservation and development of forest resources. Project investigations have included, among other topics, the identification of lesser known tree species, growth characteristics and distribution of selected species, evaluation of the Indonesian selective logging system, and investigation of species suitability for reforestation. The present and potential utilization of biomass as a source of energy was also investigated. During Pelita III, efforts were initiated to establish research stations in the Outer Islands and renovate the facilities in Bogor. Funds for these activities have come from a variety of sources including the national budget, USAID, the World Bank and UNIDO.

With regard to forestry research, the Department has set two overall goals for Pelita IV, the current five-year development period, specifically, to increase the impact of research in forestry development and to improve the capabilities of the forestry research and development apparatus, including researcher skills, supporting facilities and communications. As general policy, it is felt that the research program should support the activities of the Department and be in accordance with national development policy. In order to achieve a better integration of forestry research results in forest management and utilization the Board has highlighted in its general policy the following guidelines:

(1) the forestry research and development program should be designed in harmony with the Department's forestry development programs and problems and should be adjusted each year to meet the evolving needs of the end user;

(2) the forestry research and development program should be interdisciplinary in order to develop packages of technology for the end user;

(3) the forestry research and development program should encourage and guide forestry research activities in other institutions to produce collectively and efficiently, objective, useful information;

(4) research results should be disseminated intensively and extensively by means of a variety of media and methods.

Funding for the various research projects and activities is derived

from several sources, including the routine and development budget, special grants from the President (Inpres), unexpended budgets from previous years (Siap), grants and loans from foreign development assistance agencies, and the non-state budget (such as contributions from the royalty on logs (IHH)). The initially proposed forestry research budget as outlined in Table 1 below illustrates the relative cost and priority accorded the several major research programs. The approved budget totalled approximately 82 percent of the requested sum, and actual receipts for the first two years of the five-year planning period amounted to approximately US\$4.06 million or about a quarter of the approved budget.

Table 1 Proposed budget for Board on Forestry Research Development

Program/Project	Proposed Budget	
	Million Rp.	Percent
A. Natural Resources and Environmental Conservation Development	5.00	8.0
B. Forest Production and Industry		
1. Multiple-use management and agroforestry	2.45	3.9
2. Forest development		
C. Forest, Soil and Water Conservation	3.85	6.2
D. Bio-Energy Development	3.56	6.2
E. Forestry Research		
1. Forest ecology and regeneration	7.50	12.0
2. Forest products research	12.57	20.1
3. Forest research planning and utilization	2.10	3.4
F. Infrastructure improvement	<u>19.00</u>	<u>30.4</u>
TOTAL	62.53	100

Source: Derived from Lampiran 6, Penelitian dan Pengembangan Kehutanan, Paper No. 07/00, Raker 1983, Departemen Kehutanan.

An ambitious expansion of the forestry research program, both in facilities and scope, has been proposed under this new organization. A

key feature of this proposal is the establishment of as many as 12 new forestry research stations, all in the Outer Islands, including Sumatera, Kalimantan, Sulawesi, Irian Jaya and Timor. The research programs of these centers will concentrate on applied research with special emphasis on problems resulting from local ecological conditions which affect the conservation and development of both the indigenous forests and forest plantations. Thus, the research center in East Kalimantan will be most concerned with research on management of industrial plantations and rainforest classified as Production Forests. The station at North Sumatera will focus on the management problems of the forests surrounding Lake Toba and on Pinus merkusii while the South Sumatera center will focus on timber estates and industrial plantations. On the other hand, the center to be established in Timor will study the problems of forestry in arid areas.

Dr. Setyono reported that research activities and construction work is scheduled to begin, if only at a rudimentary stage in some cases, at all of these centers during the current Fourth Five-year National Development Plan, Pelita IV (1984-1989). During the first year of Pelita IV, activity has been focused on the establishment of the research center at Samarinda in East Kalimantan. The new BPPK research station at Samarinda has received limited technical and financial assistance under a USAID project with the Agency for Agricultural Research and Development. Development work is expected to begin on four more stations in calendar 1985; these will be the centres at Jambi in South Sumatera; in South Kalimantan; at Kupang in Timor and at Manokwari, in Irian Jaya. The directors chosen to head the first two of these new centers have doctoral degrees from forestry schools in the United States. With the very limited number of Ph.D. graduates in forestry in Indonesia, approximately 30 in the entire country, it may not be possible to achieve equivalent standards at all the other research stations. It is expected that staff for these new centers will be developed both from new recruitment as well as staff transfers from Bogor.

At the international level BPPK is a member of the International Union of Forestry Research Organizations (IUFRO) and participates in international seminars and workshops on various topics organized by this

group. In addition BPPK cooperates with the International Development Research Centre (IDRC) headquartered in Canada in their regional research project on rattan. Seed collection and exchange have been organized in collaboration with CSIRO in Canberra, Australia and the DANIDA Forest Seed Centre with headquarters in Denmark. BPPK staff have also been involved in several ASEAN regional projects including the ASEAN-US Watershed Conservation and Management Project headquartered in the Philippines and the CIDA-sponsored ASEAN Forest Tree Seed Centre Project headquartered in Thailand. In 1983, Minister of Forestry, Dr. Soedjarwo, proposed that an international research center for tropical forestry be developed in Kalimantan on the lines of the international agricultural centers for various food crops. As yet this proposal remains in the conceptual stage.

The major constraints to the intensification and expansion of forestry research activities within the Department are identified as insufficient numbers of skilled and experienced personnel and the scarcity of modern equipment and facilities, especially on the Outer Islands.

Although several forestry professionals have been sent abroad for advanced education under various foreign assistance training programs, many of these individuals have been university staff members and therefore have returned to their faculty posts. Given very limited number of individuals with post-graduate degrees in forestry, there is the danger that these qualified individuals will be lured away from forestry research into administrative positions or private sector employment.

With regard to research facilities, the traditional concentration of resources and personnel in Bogor, exacerbated by staff reluctance to relocate to disadvantaged, remote areas, plus a scarcity of operational funds in past years has led to a concentration of research on Java and the decline of the few outlying research stations constructed during the Dutch administration (e.g., in Irian Jaya). Equipment and library materials at the two central research stations in Bogor also appear to have suffered from a lack of maintenance due to a shortage of operating funds. It is important to establish stations on the Outer Islands to be responsive to needs.

1.1.2 University programs in forestry

There are eight universities in Indonesia offering a regular curriculum in forestry. These institutions are:

Institut Pertanian Bogor (IPB) at Bogor (Java),
Universitas Gadjah Mada (UGM) at Yogyakarta (Java),
Universitas Mulawarman (UNMUL) at Samarinda (East Kalimantan),
Universitas Lambung Mangkurat at Banjarmasin (South Kalimantan),
Universitas Tanjungpura at Pontianak (West Kalimantan),
Universitas Hasanuddin at Ujung Pandang (South Sulawesi),
Universitas Cenderawasih at Manokwari (Irian Jaya),
Universitas Pattimura Ambon at Ambon (Maluku).

All those offering a forestry curriculum award a Sarjana, or S1 degree in forestry (at the level of Bachelor of Science) to a total of approximately 100 graduates every year. Of this group, only four universities, however, have a Faculty of Forestry, that is, at Bogor, Gadjah Mada, Mulawarman and Lambung Mangkurat. The Master and Ph.D. equivalent, S2 and S3 respectively, are offered at only two universities, IPB and Gadjah Mada.

The most active of the forestry faculties appear to be those at Bogor (IPB) and at Yogyakarta (UGM). Extensive field work is also being done in East Kalimantan at UNMUL in research activities involving German and Japanese technical assistance. Although only recently established, UNMUL has some of the most modern research facilities of any kind in Indonesia, as a result of development assistance from the Government of Japan. Due to poor communications systems and the time and expense of inter-island travel, however, many of universities located on the Outer Islands are somewhat isolated from the mainstream of activity.

Both professors and students at all of these institutions may be involved in research projects. The extent of involvement, both as to amount of time devoted to research and the number of projects, depends on the subject matter specialty and personal dynamism of the individuals involved. Research proposals developed by various researchers are reviewed by the faculty board and university research programs committee. Research funds available to the university through the

Department of Education and Culture are very limited, both in terms of the total amount available and in their orientation, priority being given to basic research.

Researchers, therefore, must look to outside sources, mainly other agencies within the government concerned with forestry and related matters, for financial support and research projects. Beginning in 1985, BPPK plans to set aside a small fund of money to support research activities at the various Faculties of Forestry and improve communications between the Department and the university forestry research communities. Presently there appears to be very little communication or coordination between the various groups involved in forestry research.

1.1.2.1 Faculty of Forestry (Fakultas Kehutanan), IPB, Bogor

The school of forestry at IPB was elevated to the level of faculty, i.e., college, in 1963. It is divided into three departments, the department of forest management, the department of forest products and wood technology and the department of forest resources and conservation. The operating budget for the faculty comes from the Department of Education and Culture (Departemen Pendidikan dan Kebudayaan). A very limited amount of research money is available through this source; the budget over the last years has remained virtually constant in real money terms. The majority of funds for forestry research in this faculty comes from the State Ministry for Population and Environment (KLH). The fact that the First Assistant Minister for the Environment, Dr. Herman Haeruman, is also a professor at the Faculty is undoubtedly to the school's advantage in this context.

The definition and preparation of research proposals is the result primarily of the initiative of the individual faculty members within the various departments. Individual research proposals are reviewed by the faculty board and the accepted proposals forwarded for consideration to the Research Institute (Lembaga Penelitian), IPB. This university-level board, headed by Dr. Toni Ungerer, is responsible for coordinating the research of all the faculties in the Bogor Agricultural University (IPB).

The Faculty of Forestry reportedly maintains a good relationship with the various Directorates General in the Department of Forestry and Perum Perhutani (the government-owned timber corporation responsible for the management of the forests on Java). Individual faculty members may contract with these groups to conduct research on topics of specific interest to the Department.

Although the majority of research work done by this faculty is conducted on Java, staff members also maintain provenance trials in South Kalimantan and Sumatra, primarily of the species Pinus merkusii, Eucalyptus urophylla and Gonystylus bancanus (ramin). Ecological studies are also being conducted to learn more about the growth of these species, the influence of various soil types on growth and succession in the natural habitat. On Java, research topics include the savanna forest, the "bantengs" (wild cattle) and wild buffalo, and the effect of people on parks. In the context of forest products, research work has focused on the development of construction material, especially the efficient use of wood, i.e., the matching of various species to specific end uses and the reduction of waste, in other words, increased materials recovery including wood residues utilization, in the forest products industry. Extensive work has been done on low-cost housing, with emphasis being given to the reduction of the wood component of new construction through the standardization of lumber sizes and improved architectural design.

Topics identified as deserving further study include research on soils and site quality with regard to timber management, natural regeneration after forest exploitation, and the wood properties of lesser known species. More work in the development of plywood composed of lesser known species would be undertaken at IPB if the appropriate testing equipment were available.

With regard to dissemination of the results of the staff research activities, it was reported that generally the sponsor or contractor of the research work has been the one to take this initiative, whether through publication of a research report or the organization of a seminar. Both the Department of Forestry and Perum Perhutani have their own publications Kehutanan Indonesia and Duta Rimba respectively, in which a summary of the research conducted for each group is

published. The only publication which the Faculty itself publishes is a review of forestry research abstracts, known as the Darmaga Bulletin which was initiated in 1978 under the editorial direction of Dr. Herman Haeruman. Although the early issues were entirely in Bahasa Indonesia, later editions have included English summaries. Unfortunately, publication has lapsed with the most recent issue having appeared in 1981.

Within Indonesia, the Faculty has a close working relationship with the Southeast Asian Regional Center for Tropical Biology (BIOTROP) as some ten IPB professors are working on the forestry research program there. In addition, Faculty staff members cooperate with professors and students of the Universitas Sumatera Utara on provenance trial plots. In 1982, the Faculty was involved with ITCI, the former corporate partner of Weyerhaeuser, in field research in East Kalimantan.

Internationally the Faculty's participation in forestry research activities, such as those sponsored by the International Union of Forestry Research Organizations (IUFRO), is very limited due to funding constraints. The US Forest Service Forest Products Laboratory at Madison has urged the Faculty to submit a proposal for a collaborative research effort. Kyoto University with funds from the Toyota Foundation recently organized a three nation study group (Indonesia, Thailand and Japan) on agroforestry. Under this project three professors from the IPB Faculty of Forestry have participated in a review and study tour of the agroforestry activities in the three cooperating countries.

The generally poor condition of the buildings, and especially the library and the laboratories, indicates that one serious constraint is a lack of operating funds, especially for maintenance. Moreover, the monies organized for research through projects generally are not available for the capital improvement of the research facilities. Another constraint on research by University staff is the amount of time which must be spent in classes and in the supervision of students. The classroom commitment especially makes it difficult for the teaching staff to participate in research projects very far distant from the campus. This is a particular handicap for the scientists at Bogor given that some 95 percent of the nation's forests are

located off Java on the Outer Islands. Given that the breadth of the Indonesian archipelago is 25 percent wider than that of the continental United States, visits to these forest areas are both time consuming and costly.

1.1.2.2 Faculty of Forestry, University of Gadjah Mada, Yogyakarta

From the sheer number of research reports produced by the Faculty of Forestry at the University of Gadjah Mada, it appears that this research group is more active than their counterparts in other universities. They have been the leaders in the field of tree improvement in Indonesia with a program which has been underway for almost a decade. Initiated in 1976, tree improvement research has been focused mainly on Pinus merkusii, but also has included eucalyptus (E. deglupta and E. urophylla). Results from these research trials, however, have yet to be analysed and translated into operational practices. In addition, UGM has conducted research on the TPI (the Indonesian Selective Logging System) and the resettlement of shifting cultivators. Much of their recent research has included work in the fields of agroforestry, multiple-use forest management and wood energy. As with the other universities, they rely upon the Department of Education and Culture for operating funds. They also carry out contract research for various divisions of the Department of Forestry, Perum Perhutani, Department of Transmigration and others.

Internationally, UGM has been working with staff from the Department of Forest Management, Wageningen Agricultural University and the Research Institute for Forestry Landscape and Planning, Wageningen, Holland, especially on the topic of agroforestry. Cooperation has been both in the areas of research and training. In addition, they have been active contributors in the IDRC research network on bamboo.

1.1.2.3 Faculty of Forestry, Mulawarman University, Samarinda, Kalimantan Timur

In 1981 the construction of a new forestry research facility, equipped with the most modern instrumentation, was completed at

University of Mulawarman with financial assistance in the amount of approximately US\$7 million from the government of Japan (JICA). Since that time, however, the facility has remained virtually unused due to lack of operational funds from the Department of Education and Culture. JICA has recently proposed a new project entitled "Tropical Rain Forest Research" which will provide Japanese technical assistance plus fellowships for overseas training (short-term and degree) and funds for equipment and supplies. According to a report of discussions between JICA and GOI officials, the Department of Education and Culture has promised to pay a special allowance, in addition to regular salaries, to senior professors from other universities who undertake research at Samarinda. At least one professor from IPB, Bogor and two from UGM, Yogyakarta are reported to be interested in this proposal. It was also reported that the State Ministry of Population and Environment which has proposed the establishment of 28 environmental centers nationwide, would consider employing the Samarinda facilities as the site one of such centers devoted to forestry topics.

The German Agency for Technical Cooperation (GTZ) also has provided assistance to UNMUL in the form of equipment and staff for a soils research laboratory, the focus of which has been forest land evaluation. In addition, three combined teaching and research positions in forestry have been funded for the past three years. Research conducted under the guidance of these technical specialists has included work in soil science, silviculture, forest management, survey methods and land-use planning.

The Board for Forestry Research and Development (BPPK) with limited assistance from USAID will develop one of its proposed 12 outlying research centers also in Samarinda at a site adjacent to UNMUL. Both USAID/RFA and JICA representatives have expressed concern that there be no unnecessary duplication of facilities, equipment and research staff and that BPPK and University working relationships will be enhanced by this close proximity. Reportedly, the difference between the activities of the UNMUL group and the BPPK group will be the field or applied research focus of the BPPK Center versus the basic research orientation of the University Faculty of Forestry. To date, however, the distinction between basic and applied research remains blurred. According to the recent JICA proposal, the primary purpose of the

University facility would be to advance forestry research for the conservation of the tropical rain forests. The accommodation of post-graduate students for their research and studies would be a second objective. Initially, the Center would be directly under the Directorate General of Higher Education in the Department of Education and Culture. At a later date the facilities would be transferred to the University of Mulawarman when the latter would have developed the necessary education and research capabilities to manage the modern facility.

Just recently, progress was made in the implementation of this proposal, originally submitted in March 1984, with the signing of an inter-governmental accord in December, 1984. The facilities, which are first class by any standards, may now become fully utilized. Formerly, inadequate housing for staff and visiting scholars was said to be a constraint; however, with the recent rapid growth in Samarinda due to developments in other sectors, the housing shortage seems to have been alleviated. The promise of extra-salary compensation to those who make the move may or may not be sufficient, however, to lure qualified research scientists from the island of Java with its many advantages, both cultural and social. Moreover, the higher cost of living in Samarinda plus the loss of possible short-term consultancies may outweigh the financial incentive offered by the Department of Education and Culture.

Several other institutions, including the Environmental Study Center (PPLH) at the Institut Teknologi Bandung (ITB) and Pajajaran University, both in Bandung, and Brawijaya University in Malang, have become involved in agricultural and environmental programs and projects with activities relating directly or indirectly to forestry. Illustrative examples of this more informal research activity include the work done by the research group on agroecosystems (KEPAS) and various individuals' research on watershed management and home gardens. In addition, students from the various universities, which may offer selected courses although not full programs in forestry, may find work through the local offices of Perum Perhutani in research activities related to development of the company's community forestry program.

1.1.3 National Biological Institute (LBN)
(Lembaga Biologi Nasional)

The LBN was established more than a decade ago under the umbrella of the Indonesian Institute of Sciences (LIPI) (Lembaga Ilmu Pengetahuan Indonesia) which reports directly to the Office of the President. As one of the state research institutions, LBN-LIPI has been given the mandate to "make an inventory and evaluate the potential of Indonesian biological resources to provide the data for the formulation of biological resources management policy and to disseminate the results of these activities for public information as well as educational purposes".

Following consultations with the major research institutes and the relevant university faculties, LBN periodically prepares a research program to coincide with the national five-year development period. In line with the overall national development policy, the program for 1984-1989 has been designed to assist in accelerating the development of eastern Indonesia. As a common focal point, an integrated program on the development of agroforestry based on the fast-growing, multi-purpose, leguminous species has been selected as the main theme of research. Within this context, leguminous shrubs and tree species for dry areas (e.g., Bauhinia sp., Caesalpinia sp., Acacia sp., and Albizia sp.), will be the focus of study. Extensive work already has been done on both Calliandra sp. and Leucaena sp. In this connection LBN is an active member of two international research networks, the Nitrogen-fixing Tree Association (NFTA) and the Winged Bean Group.

In addition, research will be carried out on ways in which to improve the productivity of both natural ecosystems (savannas and secondary forests) as well as man-made ecosystems (home gardens and dryland farm fields) by the application of improved agroforestry techniques. Researchers will also study nitrogen-fixing Rhizobium, postharvest processing and utilization of legumes, fruit tree propagation, productivity of mangrove ecosystems and palms with economic potential, including the sago palm. LBN also cooperates with MAB/UNESCO in studies of natural forest ecosystems including the cataloguing of germplasm.

With regard to facilities and funding, the Institute itself has the necessary basic equipment and facilities to implement the program proposed. LBN has responsibility for several of the biological research facilities established during the colonial period, including the Herbarium Bogoriense (established in 1844), the Treub Laboratory (established 1884), the Museum Zoologicum Bogoriense (established in 1894) as well as the Botanic Garden (established in 1817) with headquarters in Bogor and three outlying branches. For field trials, LBN maintains an experimental garden in Cibinong and an arboretum in Serpong.

The results of research activities are presented in one or more of the several periodical journals produced by LBN. These include Annales Bogorienses, Berita Biologi, Reinwardtia and Treubia. In addition BioIndonesia and Bulletin Kebun Raya are available for the publication of semi-popular articles. Dissemination of results having direct practical applications is channelled through provincial governments and other institutions in Indonesia.

Scientists at LBN are also faculty members at IPB where they teach advanced courses and supervise graduate student study and research programs. Once a year a visit is made to the University of Mulawarman in East Kalimantan. Advanced students from the outlying universities are brought to Bogor to work and study at LBN, thus enabling them to take advantage of the several libraries in the area as well as the herbarium and botanic gardens.

With regard to problems faced by the Institute, the Director indicated that the scarcity of skilled researchers and technicians was one of the major constraints. It was also mentioned, that with additional funds, on-going projects could easily be expanded or extended. As the effort spent in chasing scarce monies often proved fruitless, it was felt that such time was better spent in getting down to the job at hand, i.e., research.

1.1.4 Southeast Asian Regional Center for Tropical Biology (BIOTROP)

Established in 1968, BIOTROP is one of seven SEAMEO Center/Projects created for the purpose of furthering cooperation among Southeast

Asian nations through activities in education, science and culture. The mandate of the Center is to "identify problems, the solution of which will enhance economic development in their respective countries and to that end, to undertake research, publication and training programs and other related activities inside and outside Indonesia."

The Center is administered by a Director under the overall policy directives of the SEAMEO Governing Board which is composed of two representatives from each member country. The Director is assisted by two Deputy Directors, i.e., a Deputy Director for Programs, of which there are three, and a Deputy Director for Administration and Finance, under whom are four divisions.

The construction of new facilities for the Center was completed in 1972. Included on the approximately four-hectare compound located some six kilometers south of Bogor are the administrative center, auditorium, the library and Clearing House, classrooms, offices for the research staff, laboratories (6), green houses (2), staff houses (5), and student dormitories (64 beds total).

In 1974/5, responsibility for the Center was transferred from LBN to the Department of Education and Culture. In 1976, Dr Ishemat was seconded from the Faculty of Forestry, IPB to become director. Other management staff include both Thai and Filipino scientists. Comparatively low salaries (based on the GOI salary scale) was the reason given for the lack of Malaysian or Singaporean participation on the staff. Brunei, a recently admitted member of the ASEAN group, has not yet joined any of the Center activities.

Approximately 80 percent of the BIOTROP budget (for this year, about 800 million Rupiah, equivalent to US\$762,000), comes from GOI to be used for capital and operating expenses. SEAMEO provides an additional US\$200,000, primarily for training scholarships and participation in international meetings and personnel exchange. Australian assistance funds (ADAB) provides approximately A\$70,000 (US\$56,000) for technical assistance and staff development activities. The government of the Netherlands provides an annual contribution of books; a limited amount of research and laboratory equipment is made available by the governments of the U.K., France and Japan. In addition UNESCO provides

scholarship funds in the amount of US\$6,000.

The primary function of the Center, as defined by the Director, is research. In addition, the Center provides six-week training courses on various topics, generally focused on research methods. Research and training conducted by the Center can be grouped into three major subject areas, each having a tropical orientation: forest biology, agricultural pest biology, and aquatic biology. The research program in forest biology is further divided into studies on ecology, silvics and genetics; some ten projects are scheduled under these categories during Pelita IV (1984-1989). Beginning in the 1984/85 academic year a Master of Science Degree Program with specialities in tropical forest biology, tropical pest biology and tropical freshwater productivity will be initiated in cooperation with the Bogor Agricultural University (IPB).

Having received only two thirds of its original budget request, BIOTROP has had to cut several items from the year's list of proposed projects, including research on drought resistant plants, wildlife, mycorrhizae, enrichment planting, agroforestry ecosystems, and plant-soil-water relationship modelling for various watersheds. In addition to reinstating these topics, the Director also has expressed interest in expanding the research program into the areas of mangrove ecosystems and inland lake ecology.

There are 45 professionals working on the staff of BIOTROP; of this group 10 individuals hold doctoral degrees and eight have Master's degrees. The remainder are graduates with a Bachelor's degree. Ten of the scientists of the Indonesian staff, including the director, are also professors at the Faculty of Forestry at IPB. Foreign research scientists working at the Center include Japanese, British and French researchers on visits from as short as two weeks up to two years depending on the assignment. Japanese researchers, generally funded by JICA, are involved in cooperative research projects with members of the Center and students. The British and French scientists, who also are funded by their respective governments, assist in the development and teaching of courses as well as research.

The bias toward laboratory research, especially in plant genetics and

population statistics, reflects the fact that the Center has limited availability to field study sites. As the Center owns no forest land or experimental plots of its own, it must cooperate closely with other institutions in order to carry on field research. BIOTROP scientists work with those of IPB, University of Gadjaja Mada at Yogyakarta and University of Mulawarman at Samarinda. Within the ASEAN network, cooperative exchange programs include Kasetsart University at Bangkok, University of the Philippines at Los Banos, University of Malaya at Serdang (Malaysia) and the University of Science at Penang (Malaysia).

The results of the research work conducted by the Center's scientists may be presented in one of several BIOTROP publications. The BIOTROP Newsletter is a quarterly publication which summarizes the progress of on-going research activities as well as news of the various training courses, workshops and symposia organized by the Center. The BIOTROP Bulletin of Tropical Biology which was established as a vehicle to publish research reports is issued intermittently. In addition there is a special publication series for the proceedings of symposia, workshops, and seminars and the agenda and study materials of training courses.

The main constraints identified were the scarcity of qualified personnel. The Director pointed out that given the limitations of the GOI salary scales it was difficult to attract top grade scientists. Securing sufficient research funds also appears to be a problem.

1.1.5 Board for Technology Research and Development (BPPT)

(Badan Pengkajian dan Penerapan Teknologi)

BPPT is a non-departmental government research institution whose mandate recently was expanded to include responsibility for the coordination of all research conducted in Indonesia. To date this group has had little apparent impact, however, on forestry research. In the past the focus of this group has been on the adaptation and application of advanced industrial technology in Indonesia. Although the individual overseeing the section on biological sciences, Dr. Satari, is a forester by background, little research is being carried out by BPPT on forestry problems. Currently, a total of Rp 6 million is allocated to two projects, one regarding land-use evaluation, especially in the

Outer Islands, and the other on wood technology.

The project on land-use evaluation is examining regional planning, land-use and zoning in the areas subject to development under the GOI Transmigration Program. As approximately 80 percent of the land to be developed under the Transmigration Program is selected from the forest estate, the results of this project could be significant to forest conservation and development.

A recently graduated chemist currently works in cooperation with the staff of the Forest Products Research Center at Bogor on the BPPT sponsored project on wood technology. Minister Habibie, the head of BPPT, has requested that more research be conducted on the topic of forest products utilization. In particular, it is felt that more information is required regarding the physical properties of both the commercial and non-commercial tree species of the tropical rain forest in order to improve the utilization of this valuable resource. The advanced education and training of specialists in this field has been sponsored in part by the USAID-assisted Applied Agricultural Research and Development Project.

Dr. Satari has indicated that he would like to see more research done on a variety of tree crops which could be integrated into present farming systems or developed as the basis of new farm models. Such species include bamboo (Dendrocalamus spp., Arundinaria spp., Bambusa spp., et al.), sago (Metroxylon sagu), and "soga" (Adenanthera sp.). The latter two could become important in the context of the Outer Islands if sustainable farm models could be developed based on these crops.

In addition, Dr. Satari recommended that career opportunities for research workers should be improved and enhanced with more rewards and incentives, including the modernization of equipment and facilities. The pride and appreciation felt by research scientists when new techniques developed through research are incorporated into current management systems are rewards which he perceives are largely lacking in the context of forestry research in Indonesia at present. One important aspect which must be addressed is better dissemination of forestry research results.

1.1.6 Other GOI institutions

Several other GOI agencies and institutions are involved in research on forestry and tree crops as related to their broader mandates for research on agricultural systems or watershed development or as a result of past project responsibilities. Such groups would fall mainly under the Departments of Forestry, Agriculture and Environment.

Various activities conducted under the auspices of the Directorate General of Reforestation and Land Rehabilitation (Direktorat Jenderal Reboisasi dan Rehabilitasi Lahan) (RRL) appear to fall into this category and may be described as applied or adaptive research. This would include RRL experiments with seed multiplication and storage and seedling production in an attempt to expand techniques from laboratory levels to a scale suitable for use in the massive reforestation schemes planned by the Department. The equipment used in these facilities often is newer or more sophisticated than that available in the BPPK laboratories. Similar experimentation adaptation is being conducted in the mechanized nursery project assisted by the Finnish foreign aid in South Kalimantan. RRL will continue to be involved in applied and adaptive research on soil and water conservation technology, especially in Java where foreign technical and financial assistance for watershed development has come from a variety of donors, including FAO, USAID, World Bank and the Dutch government.

Other government research institutes not directly associated with forestry have also been conducting forestry-related research activities. The Livestock Research Center in Ciawi and the Soils Research Institute in Bogor are two such groups.

For several years now, the Livestock Research Centre (Balai Penelitian Ternak (BPT)) with Australian assistance has been conducting research on several leguminous tree species (Leucaena sp., Gliricidia sp., Calliandra sp., Sesbania sp., et al.) to ascertain the nutritional value and digestibility of leaf-meal fodder prepared from these and other tree species. BPT has recently received a research grant of \$6,750 from AID through the Forestry Support Program to continue this

research and expand their studies to include an investigation of the current supply sources and availability of appropriate tree leaf material in selected rural areas of Java.

The Soils Research Institute at Bogor has been involved with evaluation of forest soils as related to land-use planning on the Outer Islands. The research conducted in this context is further utilized in the development of sustainable agricultural and agroforestry farm models and the siting of transmigration settlements.

1.2 Non-governmental research activities

Non-governmental research can be defined as those activities for which the funding is not directly derived from the GOI national budget. This type of research falls basically into two major categories, research financed by private industry and research supported by foreign agencies and institutions. Private voluntary organizations, both domestic and foreign, may also support a minimal amount of experimentation, especially technological adaptation, however, this type of research appears to be negligible in the context of forestry.

1.2.1 Private industry

From all reports, private sector investment in forestry research in Indonesia is very limited. On occasion, an individual company may engage a University professor to address a particular problem faced by the company, however, this type of research is generally short-term and directed to immediate problem-solving rather than overall improvements to the production system. The two American forest products companies, Weyerhaeuser Co. and Georgia Pacific, which had operations in Indonesia until recently, had developed substantial research programs, from some reports investing more of the profits in research than their Indonesian counterparts deemed desirable. Since the departure of the foreign partner, this research involvement has been continued, however, on a reduced scale of funding and activity.

Research activities conducted by APKINDO and MPI activities (the Association of Indonesian Plywood Manufacturers and the Indonesian Timber Association respectively) focus primarily on marketing studies

and the investigation of the utilization of lesser-known species (especially with the South East Asia Lumber Producers Association). The actual research work of industry-financed activities may be let under contract to various consulting firms or individuals, often staff members of the university forestry faculties.

According to the teaching staff at the Faculty of Forestry at IPB, some of the forest concessionaires in Kalimantan permit students to conduct research projects on their forest holdings. Their companies also may assist the students by providing them with housing, office space and transport. Recently, there has been talk of the possible establishment of a scholarship fund for forestry students from the Outer Islands to be funded by another industry group, the Indonesian Sawmillers Association, however, no funds have yet materialized.

1.2.2 Foreign agencies and institutions

There are numerous multilateral and bilateral, government and non-government, foreign agencies and institutions operating in Indonesia which are involved in data and information collection and analysis which may also be considered a type of research. The numerous reports that are published as a result of these efforts vary widely in all aspects. The dissemination of these reports is often limited and highly arbitrary, both with regard to distribution in Indonesia as well as overseas. Many reports are only published in English, which further limits the availability of this information to a relatively small Indonesian audience.

Multilateral or international organizations active in data collection and analysis on forestry matters in Indonesia include agencies such as FAO (UN Food and Agriculture Organization), UNCTAD (UN Commission on Trade and Development), IUCN (International Union for the Conservation of Nature and Natural Resources) and WWF (World Wildlife Fund). The International Bank for Reconstruction and Development (IBRD) through its industrial division also funds applied research on pulp and paper production through project feasibility studies. A separate project provides funds for degree training of university teaching staff and research scientists in agriculture and forestry and construction and renovation of research activities.

A noteworthy project which was launched only recently in Indonesia is the joint GOI-IIED (International Institute for Environment and Development) review of policies and issues related to the sustainable development of forest land in Indonesia. This review, a cooperative effort of three Ministries (Forestry; Population and Environment; and Utilization of the State Apparatus) with the Department of Forestry as the lead agency, will be the first multi-sectoral policy review in the context of forestry conducted in Indonesia. It is significant to point out that this review will be an Indonesian undertaking with IIED representation serving as the catalyst and conduit for both financial and limited technical assistance.

Bilateral development assistance agencies of the various foreign governments also sponsor and conduct similar research related directly or indirectly to forestry. Both the Canadian and Dutch foreign assistance agencies have done extensive research in the context of land-use evaluation and planning. The German Agency for Technical Cooperation (GTZ) has sponsored research in a broad range of topics related to forestry, including forest soils, land-use evaluation, forest products trade, timber disposal from Transmigration settlement sites, land clearing, and minor forest products (e.g., rattan, forest food crops, charcoal production and marketing). Private philanthropic organizations active as development assistance agencies, such as Ford Foundation and the Agricultural Development Council (A/D/C), also sponsor research on an individual basis or in collaboration with Indonesian institutions; subjects of particular interest recently have included community forestry and agroforestry.

Students and professors from various universities in North America and Europe visit Indonesia to collect data for a variety of research purposes. Universities which appear to have developed a continuing interest and involvement in projects in Indonesia are Harvard University (US), Rutgers University (US), University of Hawaii (US), University of Hamburg (West Germany), Agricultural University of Wageningen (Netherlands) and Dalhousie University (Canada), among others. Officially, students are required to register with LIPI, a process which often is very time consuming. A few of the topics of recent interest to these researchers have included forestry in relation to land-use policy, the present and future supply and demand of tropical forest

products, the legal and institutional framework for forest industry, watershed conservation technology, wood-fuel demand and supply, buffer zones for nature reserves and protection forests, agroforestry systems and community forestry. Various professors have a long-standing relationships with one or more of the Indonesian educational or research institutions. Continuing involvement of this nature provides the opportunity and incentive for the longer term research projects with a continuity of staff and design which are so critically important in forestry.

1.3 International communication and collaboration

International cooperation in forestry virtually began in the field of forestry research with the establishment in 1892 of the International Union of Forestry Research Organizations (IUFRO), Headquartered in Vienna, Austria, the primary objective of this organization is to stimulate effective forestry research through cooperation and exchange of information between forestry research scientists. Membership is open to any organization or individual conducting research into subjects relating to forestry, forest operations and forest products. International collaboration in forestry research generally has been on either an institutional or a topical basis, which in turn falls into two major groups, species-oriented or issue-oriented.

In the case of an institutional focus, a formal relationship is established between two or more agencies or institutions. Subsequent activities may include personnel exchange programs or collaborative projects on a variety of topics. Previously the Faculty of Forestry at IPB had such a relationship with the University of Kentucky. The Faculty of Forestry at University of Gadjara Mada currently has such a relationship with the Forestry Department of the Agricultural University of Wageningen in the Netherlands. BIOTROP as regional research center for Southeast Asia has formal relationships with several universities throughout the region.

The topical focus is a much more common basis of international cooperation. This type of arrangement is reflected most clearly in IUFRO relationships whereby research scientists are organized into working

groups on the basis of their interest in various species and issues. Until recently, participation of developing country researchers in this organization has been limited. This has been due in part to the temperate forest orientation of the working groups, but also to the limited funds available to finance the participation, both in terms of research as well as travel, of developing country scientists.

In some cases research groups within various countries have taken it upon themselves to organize international collaborative research networks funded by a variety of agencies. Notable examples include CSIRO in Australia, the Nitrogen-fixing Tree Association at the University of Hawaii, the Commonwealth Forestry Institute at the University of Oxford, UK and the Danish Forest Seed Centre in Denmark. These networks have been organized by various research institutions interested in a particular species or subject of widespread interest internationally; support for these efforts has come from a variety of funding sources including multilateral and bilateral foreign development assistance agencies, private foundations and private subscriptions of interested individuals, as well as the host institution (see Appendix 3 for further details regarding these various groups). At this time Indonesian scientists participate in more than 12 such international research networks in forestry and related topics.

Additional international cooperative agreements continue to be established in the field of forestry, especially in the context of research. The UNCTAD-sponsored International Tropical Timber Agreement (ITTA), currently in the process of ratification, will support the formation of the International Tropical Timber Organization, one aspect of the mandate of which will be research. Already 42 research projects on tropical reforestation and forest management totalling US\$ 105 million worldwide have been proposed in addition to projects on tropical timber trade and marketing. Furthermore, Indonesian Minister of Forestry, Dr. Soedjarwo, has proposed the establishment in Kalimantan of an international research institute for tropical forestry, developed on the lines of the CGIAR agricultural crop research centers, to focus on the problems of tropical forestry. Within and various foreign development assistance agencies, including AID, World Bank and FAO, there has been increasing interest in the development of an international research network on fuelwood. AID has proposed an

approximately US\$40 million, 10 year project to support forestry research including a network for the exchange of information on multi-purpose tree species, especially those suitable for firewood. This project would be initiated in the Asia region and eventually extend worldwide.

2. The state of forestry research

A review of the history of forestry research in Indonesia over the past three decades indicates a somewhat tumultuous evolution that has evidenced many changes, both positive and negative. The fragmentation of research activities apparently resulted from the failure of the central research institutes to address client needs. Moreover, forestry research suffered further in its competition with the better supported agricultural sector. Recently significant progress has been made to address the inadequacies of the forestry research system. Nevertheless, gaps and constraints continue to exist which inhibit the much needed development of forestry research.

2.1 Progress and gaps

Crippled by insufficient funds and lacking effective leadership for many years, forestry research in Indonesia stagnated and ineffectual. With the main body of research facilities and scientists located at Bogor in West Java and travel funds limited, forestry research became isolated from the problems of forestry sector development, especially with regard to the management of the natural forest estate. Following Government priority given to the food production sector, the majority of GOI and foreign assistance energy and funding was channelled into the the development of food crops, primarily rice. Thus, extensive investments were made in facilities and manpower training for agriculture research with little spared for forestry. The price of this past neglect is has become apparent as the recently reorganized Department of Forestry now attempts to expand its activities.

Several recent events indicate that concerted efforts are being made to redress these deficiencies and improve the state of forestry

research in Indonesia. The most important initial changes have been essentially administrative. Firstly, the forestry research institutes were removed from under the umbrella of the Agency for Agricultural Research and Development and returned to jurisdiction of the Department of Forestry, the largest clientele for the forestry research. Secondly, the Associate Dean of the Faculty of Forestry at the University of Gadjah Mada was appointed head of the new Board for Forestry Research and Development with the administrative rank of Echelon I (Director General). With this appointment it was seen not only that the leadership of forestry research would be strengthened by new initiatives but that the possibility of improving the ties between the government and university research groups would be enhanced.

Thirdly, a Department of Forestry internal review of the GOI forestry research program and structure was conducted in which was recognized the need to decentralize research activities and address more directly and immediately the problems of the forestry sector in the Outer Islands. Subsequently, a national forestry research program was developed for Pelita IV which has proposed the expansion of the research system to include 12 new research centres in the Outer Islands. The budget proposed for forestry research during Pelita IV was a substantial US\$ 51 million. Although the actual allocation of funds for forestry research during the first two years of this cycle amounted to only approximately 25 percent of the two year budget request, the 1984/85 allocation was 74 percent more than during the 1983/84 fiscal year.

With regard to developments in forest science and technology, some of the most significant work undertaken over the past decade has been in the areas of soil conservation and watershed management, primarily on Java. This would include the essentially applied and adaptive research work sponsored by various foreign assisted watershed management projects in Central Java and the work with Leucaena in eastern Indonesia (Nusa Tenggara Timur). Other major research topics have included the silviculture and management of Pinus merkusii and Tectona grandis, the effects of logging on the production forests and plywood technology.

Major gaps, however, remain in the body of knowledge available to

guide the sustainable development and conservation Indonesia's forest resources and forest industry. Clearly the most important problem facing the forestry sector in Indonesia is one of management and the lack of information required for this task. On Java the problem may be seen largely in the context of forest plantations, primarily teak, but also pine. The problem, however, is not simply one of technology with regard to species selection and silvicultural practices, but rather one of people management. With one of the highest population densities in the world (715 persons per square kilometer), the demands on land and consequently forest resources in Java are increasingly more intense. If the forests are to survive the pressure of increasing population, sustainable management systems must be developed which are capable of mixing people with forests and of meeting local demands for fuel, fodder, building materials and other income-earning minor forest products without degrading the forest and the environment.

Although the population density on the Outer Islands is increasing steadily with spontaneous and government-sponsored migration programs, the forests of these regions currently do not face an onslaught of quite the same magnitude as on Java. Nevertheless, the major problem of the Outer Islands is also one of management, that is, management of the natural forest to insure their conservation for watershed management and sustained productivity for the continued development of the forest industries sector within the provincial economy. The problem is not unique to Indonesia; the lack of knowledge regarding the management of the tropical rain-forest was highlighted as a major research problem at the First ASEAN Forestry Conference held in Manila in October 1983. Throughout the region, traditional forest practices and management systems are being re-examined in light of the forestry experience and population growth and movement over the past decade.

Additional research topics which appear now grossly neglected in relation to their potential importance are species identification for gene pool conservation and pharmaceutical uses, minor forest products and urban forestry. Given the rate at which forests are being transformed into agricultural settlements, much greater attention should be paid to the classification of unidentified plant and animal species in all forests. In this respect there is currently a project to identify specimens collected at Bogor, supported by IBRD funding. New

collections, however, are not being made. Minor forest products also deserve a concerted research and development effort in order to increase income-generating opportunities for rural people living in or near the forests and small-scale industries in rural villages. The development of minor forest products could be especially important in the context of maintaining buffer zones for production forests, nature reserves and national parks and in enhancing the productivity of forests designated for watershed protection. Urban forestry, one of the finest tropical examples of which can be seen in neighboring Singapore, is an activity with tremendous potential to benefit, both tangibly and intangibly, the ever increasing numbers of urban poor, especially on Java. This subject, which appears virtually ignored at present, could serve not only to improve the urban environment but also to provide employment for unskilled labourers within the cities.

Above all, the most significant deficiency in forestry in Indonesia is not of the realm of technology but rather of policy. Currently there is no coherent, comprehensive GOI forest policy accepted by all elements within the Government. The conservation and development of the forest estate and associated forest industry are influenced by numerous policies, directives and regulations that may often appear confusing, contradictory and counterproductive. The GOI in cooperation with the International Institute for Environment and Development (IIED) has recently undertaken a review of the myriad of GOI policies that affect the management and exploitation of the national forest land, which in total comprises some 75 percent of the nations' total land area. A close examination of the actions of various public and private groups will be required in order to assess the impact on forest resources of various government policies and subsequently design an effective forest policy in line with national development goals as they embody various socio-cultural, political, economic and environmental objectives.

2.2 Operational constraints

From the review of forestry research activities presented above, summarizing information from various documents, discussions with numerous research scientists and observations at several forestry research facilities, several conclusions can be drawn with regard to

the constraints to improved and expanded forestry research in Indonesia. Overall the major constraint appears to be one of a scarcity of trained and experienced staff. Secondly, it is clear that outmoded or inoperable equipment in some research stations is a problem; a lack of reference materials appears to be a pervasive condition. The scarcity of funds, for maintenance of buildings and equipment as well as research trials, although alleviated somewhat in the reorganization of the Department, continues to be a major constraint for the university forestry research programs.

2.2.1 Qualified and experienced staff

The scarcity of trained manpower is one of the most formidable constraints facing the development of forestry research throughout Indonesia. With the recent expansion of the Department the requirement for trained and experienced personnel has increased sharply. Although several staff members and students have been sent overseas for advanced training and education, these numbers reflect neither the level of need nor demand. With Government priority given to agriculture, both GOI and foreign assistance, including aid to educational institutions and scholarships, have favoured agriculture. As a consequence, more students were drawn into the study of agriculture and students from the other natural resources disciplines fared poorly in scholastic competition with their agricultural peers. Thus, only approximately one percent of the some 3,000 individuals sent for training and higher education under USAID/Indonesia-sponsored programs since 1970 have been foresters.

Despite the many advantages of foreign education, there are also drawbacks, the most critical being the temperate zone and developed country bias of most forestry education programs in western countries and the lack of courses relevant to social, economic and ecological conditions in the tropics. Post-graduates returning from overseas may have little if any time to test their new ideas on home ground before being placed in positions of significant administrative responsibility. The Bureau of Planning within the Department of Forestry is currently reviewing the Departments staffing requirements over the next decade and increased efforts to promote forestry education may be expected.

2.2.2 Facilities and equipment

Forestry research laboratories and equipment available to research scientists in Indonesia span the spectrum of possible conditions, with some being the most advanced on the market. On the other hand, there is a considerable amount of forest products testing equipment (at IPB and the Forest Products Research Center at Bogor) which was supplied by USAID more than a decade ago. Most equipment appears to suffer from inadequate maintenance, both in terms of replacement parts and servicing.

With insufficient maintenance funds, botanical and wood specimen collections and libraries, often the fruit of many years of studious, painstaking endeavour, have suffered as well. The research libraries at the IPB Faculty of Forestry and BPPK forestry research centre at Bogor, display comparatively few recent additions of either books or periodicals. It is reported that subscriptions to many of the major forestry journals lapsed with the departure of the Dutch in the early fifties. It is not unusual to find many items of the collection subject to attack by beetles and stained by mildew. Library catalogues do not appear to be kept up-to-date or cross-referenced and, therefore, often reflect inadequately the available material. Publication and distribution of government and university research reports and workshop proceedings is limited and appears sporadic, very likely due to its low priority and the lack of funds. In some cases the facilities and materials do not appear well-matched with the users. Better cooperation between the various agencies and institutions involved in forestry research could contribute to dispelling some of these disparities and incongruities.

New reference collections, however, continue to be developed. One of the most recently established is the forestry library and museum in the new Department of Forestry complex which opened in Jakarta in 1983. A reference library also is included at the new forestry research center at UNMUL in Samarinda; due to a shortage of funds for the operation of this facility, however, the library, similar to the neighboring laboratories, remains largely empty and unused. Library facilities being developed under the auspices of the Agency for Agricultural Research and Development in Pasar Minggu, Jakarta, also

contain reference materials on forestry/tree crops.

2.2.3 Operating funds

A severe shortage of operating funds began to be felt most acutely in recent years with government cutbacks in the national expenditures due to the drop in oil revenues. Before the 1983 reorganization, forestry in the competition with agriculture, especially food crops, has had a difficult time in securing sufficient funds to maintain its research activities and facilities. With the return of forestry research to the fold of the Department of Forestry, the problem of competition for funds should be reduced as now agriculture and forestry will not be assessed together but through different budget applications (DIP). A consistent, long-term commitment of funds must be obtained if forestry research, especially basic research, is expected to yield worthwhile results.

2.3 Major issues to be addressed

Further progress in expanding and upgrading forestry research in Indonesia will face not only the constraints enumerated above, but a host of additional issues that broach the larger questions of how the forestry research program relates to other GOI research programs and addresses national development goals. Questions as to the definition of the research audience or clientele, the relationship between the various groups involved in forestry research, and the policy with regard to the "packaging" and dissemination of research results must be raised. These issues are all directly or indirectly related to one another. Clarification of GOI policy regarding these issues is crucial to the effectiveness of the forestry research program overall, and ultimately to Indonesia's success in the sustained conservation and development of the nation's forest resources.

2.3.1 Program priorities and responsiveness

The proposal to establish 12 forestry research stations in the Outer Islands reflects two significant points of recognition on the part of the Department: (1) that more direct attention should be paid to the

forestry problems of the outlying areas which contain the bulk of the nation's forest estate, and (2) that research facilities, including research staff, should be located closer to the area of study. What, in effect, is proposed is the decentralization of forestry research and an enhanced orientation to local problems. The responsiveness of the research program to the needs of local people, as well as the local industry and national interests, such as environmental considerations, should be reflected clearly in specific research projects and priorities. It is important to determine these priorities early in the planning stages as they in turn will influence not only the siting of the research stations and the outfitting of these facilities, but also the type of training and education of research staff.

2.3.2 Cooperation within the forestry research community

Improved communication, collaboration and cooperation among all scientists interested and involved in forestry research is essential if forestry research is to develop in a timely and efficient manner capable of affecting the future of Indonesia's tropical forests. The enormity of the task before the forestry research community, especially given the breadth and diversity of the Indonesian archipelago, is such that the GOI should make every effort to involve all capable individuals and institutions, especially the existing research stations and the university faculties of forestry, in the development of the national forestry research program. Given the scarcity of funds available to forestry research, any unnecessary duplication of facilities or staff is a wasteful expenditure of resources. A formal cooperative arrangement should be developed to involve the university staff and facilities on a regular basis in on-going research programs. BPPT, given its new mandate for coordinating all research nationwide, could be the catalyst to bring together the forestry research community.

2.3.3 Intersectoral cooperation

The relationship of the BPPK and the forestry research centers to the other GOI research institutes, especially agriculture, should be clarified and strengthened. A variety of GOI research institutes, such as the Soils Research Institute and the Livestock Research Center,

already are involved in forestry related research. Such projects should be expanded into collaborative efforts with multidisciplinary research teams including research scientists from forestry. This type of collaboration would undoubtedly prove rewarding in efforts to design improved soil and water conservation technologies, to devise appropriate silvipasture systems and to develop various agri-silvicultural farm models based on perennial tree crops for the upper watershed areas in Java and also the Outer Islands.

The problems of the rural areas are interdisciplinary by nature and so will be any truly effective solution. Trees historically have been and will continue to be an important and integral element in the rural production system as well as the rural landscape. Research programs should recognize these important intersectoral linkages and strive to develop and strengthen such mutually beneficial relationships.

2.3.4 Sharing research results

In any consideration of increased support for forestry research, more emphasis should be given to information management, both distribution and collection, with special attention directed to the needs of users at all levels. Too often, the packaging and dissemination of the research results, one of the most important aspect of the research process, is overlooked. If research results are not published, or not widely distributed or not properly logged in the library system, there is the possibility that researchers will duplicate each others' efforts repeatedly, with none of the benefits of a authentically replicated experiment which may yield comparable results. Moreover, if the results of applied and adaptive research are not prepared and distributed widely in a form easily understood by the end user, the ultimate benefit of the entire research effort may be largely lost.

A substantial amount of information already exists as a result of forestry research conducted in Indonesia over the past two centuries. A review of this literature has been prepared in English in a monumental tome entitled Indonesian Forestry Abstracts - Dutch Literature until about 1960. This publication and its cited documents are an invaluable resource which should be made available to all researchers in Indonesia. Present and future research should be built upon the

firm base of past research work, however, this can only be possible if reference facilities and materials are readily available and properly maintained. Constantly improving technology in information systems management increases the feasibility of establishing adequate library facilities even in remote areas, given appropriate budgetary allotments. Improved support for information systems and intersectoral systems linkages should be supported in any expansion of the forestry research program.

2.3.5 Inter- and intra-national cooperation

As discussed in Section 1.3 above, formal international cooperation in forestry research began almost a century ago with the establishment of the International Union of Forestry Research Organizations. Today numerous cooperative research relationships have been formed apart from the IUFRO working groups and new organizations continue to emerge. As may be seen in Appendix 3, at this time Indonesian scientists formally participate in more than a dozen such international research and information exchange networks.

International cooperation in research can be advantageous in several respects both for individuals and institutions. The sharing of knowledge, the development of common research methodologies, the standardization of equipment and instrumentation, the replication of research trials, mutual recognition and encouragement are only some of the benefits to be derived from such cooperation. Such relationships are not without drawbacks however. Many countries lack the internal, national information exchange networks, including publications, needed to disseminate the knowledge gained in international collaboration; consequently, the participating scientist may become an information "sink" rather than a distribution point; as a result in the national context the participant's colleagues may remain as isolated as ever. In countries with few research scientists, individuals involved in research on currently popular subject matter may find themselves in constant demand for a host of international meetings. Unless the scientist is very discriminating with regard to acceptance of such opportunities and distributes these invitations with colleagues, actual research work may be disrupted and suffer a decline, both in quantity and quality.

Justifiably many governments, including Indonesia, have become wary of permitting their scientists unlimited attendance in international events. A nation's first priority must be research directed to solving its own problems; to the extent that these are being addressed adequately, international consultations on these issues may offer instructive insights regarding ways in which to improve existing research programs and projects. If the issues to be discussed in the international forum are not already addressed in the national research program, neither will the scientist have anything to which to relate the gathered knowledge and experience nor anything of substance which to contribute to the group discussions.

One of the goals of international cooperation is to produce a synthesis of ideas based on a broad range of experience and experimentation, a task which requires a substantive contribution on the part of all participating scientists. This in turn requires strong, consistent support to the development of the national research programs. The development of international relationships should not come at the expense of strengthening national research systems. International cooperative research networks should operate in such a manner as to promote, as much as possible, the development of internal linkages and the broad participation of research scientists throughout the research community within a particular country.

3. Conclusions and recommendations

In some ways Indonesia may be considered a sleeping giant in the field of forestry in Asia. Although having dominated the log trade in tropical timber in Southeast Asia for many years, Indonesia has lagged behind in the field of forestry research. Recognizing these deficiencies and the need to learn more about tropical forest ecology and management if the forest industry contribution to national income is to remain strong the GOI has undertaken a reform and expansion of the forestry research system which clearly highlights its new commitment. To date, technical and financial assistance by foreign development agencies has been minimal; however, recent changes as reiterated below should offer encouragement to donor agencies. Recommendations for possible USAID action in response to these reforms are detailed in the following paragraphs.

3.1 Arguments in favor of supporting forestry research

Both the awareness on the part of GOI of the need to improve forestry research and the commitment of GOI to this objective is evidenced by the recent actions taken toward this goal as described in Section 2.1 above. Furthermore, the Board for Forestry Research and Development has proposed US\$51 million for the improvement and expansion of forestry research facilities and programs during Pelita IV (1984-1989). A reorganization of the administrative structure has taken place and a "Master Plan" is under preparation which will include an evaluation of staffing requirements. The Department of Forestry represented by the Head of the Board for Forestry Research and Development (BPPK) with the assistance of IIED is taking the lead in the review of policies affecting forest conservation and development.

With regard to national priorities, it may be seen that GOI is placing increased emphasis on the development of the Outer Islands. Given the rather poor nature of the soils in these areas, both forest and non-forest tree crops could play an important part. The forest industry can and should take a pivotal role in the development of these areas. A more active and enlightened participation by the forestry community is required if the forestry sector is to rise to meet its potential contribution to the sustainable conservation and development of Indonesia's forest estate.

3.2 Recommendations for further USAID action

There are at least three activities in progress, the outcomes of which should have an influence on USAID's decision as to whether and in what manner to pursue project development in the context of forestry research. The results of these activities should further clarify the resolve of the Department of Forestry with regard to addressing the real problems and deficiencies in the forestry research system.

The first activity is the attempt by Dr. Haeruman of the State Ministry of Population and Environment to bring together all interested institutions in the development of a cooperative research program for evaluating and monitoring the impact of the recent forest fires in the conservation forests in Kalimantan. The success

of this proposed collaborative effort should give an indication of the willingness and ability of the forestry research community to work together. The problem of scarce manpower and facilities and the issue of duplication as discussed above should not be underestimated; enhanced cooperation within the forestry research community could result to everyone's advantage and the more efficient utilization of resources.

The second activity of importance to be monitored is the "Forestry Sector Master Plan" currently being prepared in the office of the Sekretaris Jenderal of the Department of Forestry. Legislatively required of the Department by the Basic Forestry Law, No. 5 of 1967, this plan is intended to give direction to the development of the forestry sector through the year 2000. All aspects of forestry will be considered, from the development of national parks through the forest products industry, including research and manpower requirements. The draft of this Master Plan is expected to be completed in early 1985.

The third activity of interest is the recently initiated GOI-IIED three-ministry review of GOI policies affecting the sustainable conservation and development of the tropical forests, as discussed in detail in Section 1.2.2 above. The preliminary results of this investigation, which is to include information developed from a review of published and unpublished documents as well as from personal interviews with a broad spectrum of senior officials involved directly or indirectly with the forestry sector, is not expected to be available until mid-1985. Following the preparation and circulation of a draft report, a national seminar will be organized to review and discuss the research findings. As these activities are completed, it is expected that a clear view of the issues and constraints facing the development of the forestry sector will emerge. With the major problems areas defined, the task before the forestry research community also should become clear.

From the information reviewed in this report, several options for potential assistance to forestry research can be identified. These include:

- (a) technical assistance in the development of forest research policy, planning and management;

- (b) assessment of forestry research facilities and field activities;
- (c) national workshop on the future of forestry research;
- (d) development of the forestry education system, with strong support for advanced degree training of research scientists
- (e) development assistance for the outlying research stations.

Each of these possible activities is discussed separately in detail in the following paragraphs; any combination of two or more of these options could form a significant contribution to the development of forestry in Indonesia. Together, they could comprise the solid basis for an institution-building development assistance project in forestry research.

3.2.1 Forestry research policy, planning and management

Following the completion of the "Forestry Sector Master Plan" and the GOI-IIED policy review, it may be expected that recommendations will be made with regard to the revision of certain policies which will in turn would effect the forestry research program. Assistance may be required in implementing and monitoring the new policies and in revising administrative procedures and management plans.

3.2.2 Review of the forestry research system and program

In the preparation of an in-depth review of the forestry research system and program, both technical and financial assistance would be required. At the minimum, such a review could be accomplished by a team of two forestry research specialists (a senior researcher with administrative experience and a silviculturalist) with the assistance of one or two Indonesian counterparts. The team should plan to visit the location of the 12 initially proposed outlying research centres plus facilities and experimental plots on Java. The team should also attempt to locate forestry research facilities and plots established by the Dutch and subsequent researchers but since neglected, and to assess the feasibility of refurbishing and reactivating these facilities and trials. In addition to a review of ongoing research activities and facilities, the team should examine the library facilities and information distribution systems, especially the dissemination of research results to the end-users and the monitoring of the applic-

ation of these recommendations. Other constraints and issues identified in Section 2 above should come under close scrutiny as well.

An investigation of this intensity would require approximately, at a minimum, 8 weeks; given the extensive travel required, however, a time frame of 10 weeks would be more realistic. The document produced as a result of these investigations would not only be very useful in assisting BPPK planners in the siting and programming of the proposed outlying research stations. Moreover, it could provide the basic input for the preparation of a development assistance project for forestry research. For consideration of further development assistance, problem areas could be identified on a geographical, technical or other basis. For example, throughout the research system, libraries or laboratories or field trials might be identified as an aspect in need of special assistance.

3.2.3 National workshop on the future of forestry research

A national workshop organized to examine forestry research in Indonesia could provide a much needed forum to discuss future possible directions and opportunities for enhanced cooperation and collaboration within the forestry research community. In this connection the assessment of the forestry research system facilities and programs proposed in the previous section could provide a valuable discussion document. On the other hand, if it were decided that sufficient, up-to-date documentation was already at hand, the seminar could proceed directly following the completion of the IIED review (discussed in Section 1.2.2 above). The proposed meeting should include not only a wide representation of the scientific community involved in forestry research but also representatives of international foreign donor development assistance agencies interested in forestry and research activities in Indonesia. In addition, it would be advantageous to include representatives of the various international forestry research network groups (see Appendix 3) to discuss their programs and activities.

3.2.4 Education and training

As stressed above, one of the major constraints to upgrading the forestry research program is the scarcity of qualified research scientists. Virtually the only way in which to redress this situation is to increase the number of Indonesian forestry researchers pursuing advanced degrees in forestry, both in Indonesia and abroad. An associated goal should be the strengthening forestry education programs in-country in order to improve the position of forestry students in the national competition for scholarships. Short of a fully-fledged education project, which should appropriately provide assistance in curriculum development and teaching plus educational materials and facilities, including libraries, laboratories and field equipment, substantial assistance to forestry education could be rendered merely through the contribution of reference materials and scholarships earmarked for forestry.

3.2.5 Development of outlying research stations

If substantial assistance to forestry research is deemed desirable, a long-term commitment to the development of one or more of the 12 Indonesian forestry research centres should be seriously considered. A review such as proposed in Section 3.2.2 above could develop the essential information required for preparation of a project such as proposed here. Assistance would be welcomed across the board, in the development in research management skills and the provision of facilities, equipment and technical expertise. The selection of the site on which to focus assistance could be based on various criteria, including availability of technical expertise (e.g., dryland forestry as in NTT), previous USAID linkages (at Samarinda) or proximity and relevance to other USAID projects.

It is suggested that if USAID desires to pursue any of the above noted options, it would be advantageous to contact the foreign development assistance representatives of the Dutch, Australian and Japanese Embassies. Of the many donors interviewed in a recent review of foreign assistance in the forestry sector in Indonesia, these groups expressed most interest in the possibility of developing projects in the area of forestry research.

In summary, it is emphasized that the options outlined above cover the widest spectrum of possible assistance to the development of forestry research in Indonesia. Any one of these proposals could be developed into a project in its own right. The combination of two or more of the recommended options would provide substantially greater benefits. As listed above these options represent actions of increasing levels of financial commitment. Given various biological and time factors peculiar to the science of forest management, it is appropriate to emphasize the importance of long-term commitment in the context of forestry research. Research in tropical forestry is long overdue if we expect to conserve a significant portion of the tropical forest for the benefit and enjoyment of future generations. The important position of Indonesia as one of the last remaining areas of major reserves of tropical forest and the on-going efforts to develop a program for the management and development of these forest resources should not be overlooked. The entire donor community, including USAID, should take this opportunity to assist GOI in the development of this very important sector.

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APPENDIX 2: LIST OF CONTACTS

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B. Board for Forestry Research and Development

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Badan Penelitian dan Pengembangan
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C. National Biological Institute

Dr. Setijati D Sastrapradja, Director
Lembaga Biologi Nasional (LBN)
Jl. Juanda Raya No. 18, PO Box 110,
Bogor Telephone: (0251) 21 038

D. University faculties

1. Faculty of Forestry, Bogor Agricultural Institute

Dr. Sadan Widarmana, Dean
Dr. Sanusi Wiradinata, Forest Management
Dr. C. (Chris) G. Saragyar, Forest Products
Dr. Surjono Surjokusumo, Wood Engineering
Fakultas Kehutanan, IPB Kampus Darmaga,
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2. Faculty of Forestry, University of Gadjja Mada

Dr. Soenardi Prawirohadimodjo, Dean

Dr. Achmad Sumitro, Forestry Economics
Fakultas Kehutanan, Universitas Gajah Mada,
Jl. Bulaksumur
Yogyakarta Telephone: 88688

3. Faculty of Forestry, University of Mulawarman

Prof. Hadi Soetrisno, Rector
Fakultas Kehutanan, Universitas Mulawarman
PO Box 13, Samarinda, Kalimantan Timur

E. Regional Centre for Tropical Biology (BIOTROP)

Dr. Ishemat Soerianegara, Director
Dr. Zahrial Coto, Research Scientist
BIOTROP
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PO Box 17
Bogor Telephone:(0251)23 848-50

F. Board for Technology Research and Development

Dr. Satari, Chief Biological Sciences Division
Prof. M T Zen, Deputy for Natural Resources Development
Badan Pengkajian dan Penerapan Teknologi
BPPI Bldg, 13th floor
Jl. Haji M T Thamrin No. 8
Jakarta Pusat Telephone: 320 674

G. Other institutions

1. Agency for Agricultural Research and Development

Ir. Sadikan Sumintawikarta, Chairman
Badan Penelitian dan Pengembangan Pertanian (BP3)
Jl. Ragunan no. 29, Pasar Minggu,
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2. Centre for Livestock Research

Dr. John Wheeler, Manager, Project for Animal Research
and Development

Dr. Budi Tangendjaja, Research Scientist

Dr. J B Lowry, Technical Advisor

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3. Soils Research Institute

Ir. Soejadi

Badan Penelitian Tanah

Jl. Ir. H Djuanda No. 98

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4. PT Perum Perhutani

Ir. Hartono, President Director

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A. SPECIES ORIENTED

Typical interest	Lead Institution	Funding Sources	Participating Countries	Activities
Bamboo	none to date	IDRC	Indonesia, Bangladesh China, Thailand, Malaysia	Species selection & development of preservation techniques
<u>Cedrela odorata</u>	CFI, Oxford	host country	China, Sri Lanka, Thailand, Vanuatu	Seed exchange; common experimental design; infor- mation exchange; species & provenances trials
<u>Cordia alliodora</u>	CFI, Oxford	host country	India, Sri Lanka Vanuatu, Samoa, China	Seed exchange; common experimental design; information exchange
Dry zone hardwood species	CFI, Oxford	host country	India, Pakistan Philippines, China	Seed exchange; experimen- tal design; species and provenance trials; infor- mation exchange
<u>Eucalyptus</u> spp.	CSIRO, Canberra	ADAB	Sri Lanka, Indonesia, Nepal	Seed collection/exchange; species trials
<u>Leucaena</u> sp.	Univ. of Hawaii Honolulu	AID, et al.	Sri Lanka, India, Indonesia, Thailand, Philippines	Seed exchange, research designs; information exchange
<u>Liquidambar styraciflua</u>	CFI, Oxford	host country	(expected) India, Thailand, Nepal	Seed exchange; experimen- tal design; species and provenance trials
<u>Pinus</u> spp. *	CFI, Oxford	host country, ODA	Thailand, India, China Sri Lanka, Vietnam	Seed exchange, experimen- tal design, species and provenance trials
<u>P. kesiya</u> & <u>P. merkusii</u>	CFI, Oxford & DFSC, Denmark	host country, DANIDA	ASEAN countries, India Sri Lanka, Nepal, Bangladesh, Bhutan	Seed exchange, experimen- tal design, species and provenance trials
Rattan (<u>Calamus</u> spp.)	FRI, Kepong	IDRC, host countries	Indonesia, Thailand Malaysia, Philippines Sri Lanka	Inventory, information exchange, expert group meetings
<u>Tectona grandis</u> & <u>Gmelina arborea</u>	DFSC, Denmark	DANIDA, host countries	Malaysia, India Sri Lanka, Indonesia, Thailand, India, PNG,	Seed exchange; species and provenance trials; standardized research & evaluation methods; seed orchards; seed handling technology; information exchange

Continued..

B. GENERAL FORESTRY TOPICS (Continued)

Topical interest	Lead Institution	Funding Sources	Participating Countries	Activities
Tropical forest seed	ASEAN Forest Tree Seed Centre, Muak Lek, Thailand	CIDA	Thailand, Malaysia, Philippines, Indonesia, Singapore, Brunei	Seed collection grading & storage, distribution
Tropical forest management	ASEAN Institute of Forest Management, Malaysia	CIDA	Thailand, Malaysia, Singapore, Indonesia, Philippines, Brunei	Research and training " on natural tropical forest management
Multipurpose tree species	EWC/EAPI, Honolulu	EWC	Sri Lanka	
Tropical forest biology	BIOTROP, Bogor	Govt.Indonesia, SEAMEO, UNESCO, et al.	Thailand, Malaysia, Indonesia, Philippines	Basic research in ecology silvics, plant genetics, ecosystems management; publications; training & education
Agroforestry	Southeast Asian Agroforestry Network	Ford Foundation; host country	U. of Chiang Mai, Kon Kaen, Thailand; UPLB & UP Baguio, Philippines; IPB, Bogor & Inst. of Ecology, Pajajaran U., Indonesia	Collaborative research & information exchange
Agroforestry	ICRAF, Nairobi	AID, et al.	Worldwide	Research; standardized experimental methodology; information exchange; training
Highland and mountain ecosystem development	ICIMOD, Kathmandu	UNICEF, GTZ, UNESCO	Nepal, India, Bhutan, Burma, Afganistan, Pakistan	Research; information exchange
Gene resources	FAO	UNDP et al.	Bangladesh, Burma, Philippines, Thailand, Malaysia	Genetic conservation & improvement; exchange of information

Continued..

C WOOD ENERGY (Continued)

Topical interest	Lead Institution	Funding Sources	Participating Countries	Activities
Wood based energy production and consumption	Regional Wood Energy Development Programme, Bangkok	FAO/UNDP	eight countries	Exchange of materials, information & expertise; demonstration plots
Renewable energy technology, (including wood fuels)	RERIC, AIT Bangkok	UNESCO, AID, Governments of France & Japan, membership fees	400 individuals and members in 73 countries	Information collection and dissemination
Commonwealth Regional Renewable Energy Resources Information System	CSIRO, Melbourne	ADAB	Australia, Bangladesh, Cook Is., Fiji, India, Kiribati, Malaysia, Maldives, Naurie, New Zealand, Nive, PNG, Sol. Is., Singapore, SPEC, Sri Lanka, Tonga, Tuvalu, Vanuata, W. Samoa	Information collection and preparation of bibliographies
Bioenergy Users Network (BUN)	STE Office of Energy,	AID	Worldwide (in Asia: Burma, Indonesia, Tonga Kiribati, Philippines, Sri Lanka, Thailand, Fiji)	Information collection and dissemination through newsletter and expert group meetings

This list does not include the many IUFRO Working Groups involved in research of both species and topical issues in forestry.

Source: Donovan, 1984.

Appendix 4. Department of Forestry - Projection of Forestry Research Activities in Repelita IV (1983-1988)

Aspects of forestry research and development supported	Title of Research	Aspects Studied
1. Forest Inventory & forest land use	a. Methods and facilities of inventory and potentials	Volume Tables for commercial timbers, method of inventory of <u>Dipterocarpaceae</u> forest in the uplands and swamp areas
	b. Identification of tree species	Inventory of forest flora
2. Forest protection and nature conservation	a. Determination of the ecosystem potential of nature conservation areas	Population habitat and animal behaviour Inventory of flora and fauna in conservation parks Conservation of <u>Pinus</u> spp. strains
	b. Conservation and use of nature conservation areas	Management of the population Habitat of rare and endemic fauna Biology and propagation of rare flora and fauna
	c. The effects of forest fires on the ecosystem	Effects on the soil flora and fauna
	d. Environmental pollution	Effects of pesticides on the environment, water, flora and fauna
3. Reforestation and land rehabilitation	a. Care of plants	Ecology of pests/diseases and weeds, forest fires and pest/disease control, spacing, techniques of rattan cultivation, industrial and tropical forest development
	b. Selection of plants for reforestation and enrichment	Introduction of new species Population parameters Vegetative propagation techniques Provenance trials Regeneration of mangrove forests Allelopathy and stimulation of growth (acidity) Plant tolerance against lack of oxygen and soil Nitrogen fixation and nutrient cycles Mechanical reforestation Ecophysiology of species Improved quality of seeds Identification of suitable land for plantation Optimal spacing for industrial timber Effects of silviculture on flowering and fruiting
	c. Evaluation of plants	Growth patterns of selected species, wood properties and financial value of industrial timber Value of plants, composition & vegetation structure
	d. Seedling technology	Maintenance and care of seed plants Storage and processing of non-Dipterocarp seeds Effects of mycorrhiza & minerals on growth conifers

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Appendix 4. Department of Forestry - Projection of Forestry Research Activities in Repelita IV (1983-1988)

(Continued from previous page)

Aspects of forestry research and development supported	Title of Research	Aspects Studied	
(continued)			
3. Reforestation and land rehabilitation	e. Reforestation and planting patterns	Field physical surveys to determine forest areas Technical and economic feasibility reforestation etc	
	f. Systems for watershed management	Integrated farming, socio-economic aspects and watershed management systems	
	g. Criteria for establishing protected forests	Aspects of evapotranspiration, water regulation, decomposition and status of nutrients, soil conservation techniques and forest maintenance techniques	
	h. Environmental pollution	Degree of forest soil erosion sensitivity and the effects of forest conservation on surface flow, erosion and the environment	
	i. Multiple use of forest & agroforestry models	Multiple cropping techniques Agroforestry in transmigration (dryland) Silvo-pasture techniques Forest regeneration Bee biology and bee food plants Techniques for increasing cocoon production	
	j. Control and use of Imperata grasslands	Improving the quality of shrubbery and control and use of along-alang grasslands	
	k. Control of shifting cultivators	Socio-economic aspects of upland farmers and farming models	
	l. Utilization of reforestation and re-planting products	Identification of basic properties, mechanical and chemical properties	
	4. Forest exploitation	a. Identification of the basic properties of commercial and lesser known timbers	Anatomical structure, capacity for natural preservation, distention/shrinkage, specific weight, strength, machinability, peeling nature, viscosity chemical components, fibre dimension
		b. Processing and utilizing of lesser known species	Sawing, plywood production, particle wood, fibre wood working and finishing properties, economic analysis
c. Improvement of the characteristics of commercial and lesser known species		Preservation and drying, stabilization of dimensions and economic analysis	
d. Identification of rattans properties & improvement of quality		Anatomic structure, natural preservation capacity, strength, drying, working and finishing and economic analysis	

(continued)

Appendix 4. Department of Forestry - Projection of Forestry Research Activities in Repelita IV (1983-1988)

(Continued from previous two pages)

Aspects of forestry research and development supported	Title of Research	Aspects Studied
(continued)		
4. Forest exploitation	e. Biomass energy for industry & households	Specific weight, calorific value, construction of kilns, preparation of raw material, production of solid fuel, gas and liquid, techniques of collecting raw materials, economic analysis
	f. Lesser known timbers for housing	Anatomic structure, natural preservation, preserv-capacity, strength preservation techniques, drying techniques, sawing, working and finishing, economic analysis
	g. Natural forest exploitation	Logging, trucking, ergonomics, remote sensing, factors factors of exploitation
	h. Supply and demand for timber industry products	Supply potentials, supply/demand forecasting
	i. Improved efficiency & productivity of timber industry	Procedures, marketing, time and motion studies, capital requirements
	j. Teakwood industry in Java	Same as above
	k. Pine forest exploitation	Economics, technology and exploitation
	l. Biology of termites & other wood pests	Building of colony, rearing techniques,
	m. Utilization of coconut wood	Basic characteristics, mechanical and chemical processing and economic analysis
	n. Exploitation of waste in the timber industry	Particle board, pulp, fibre board, charcoal, economic analysis
	o. Tropical forest regeneration systems	Technology/ecology of dipterocarp forest, enrichment planting and residuals
	p. Method of Inventory	Volume tables of commercial species, survey methods for different forest types, inventory of flora

Source: Penelitian dan Pengembangan Kehutanan. Rapat Kerja, Raker '83, No. 07/00. August 1983. Department of Forestry, Jakarta

APPENDIX 5: ADDITIONAL REFERENCES ON FORESTRY RESEARCH

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