PD-ABW-398
91826

SCIENCE AND TECHNOLOGY

AND THE

NATIONAL ACADEMY OF SCIENCES

EFFORTS IN INDONESIA

A USAID/JAKARTA Evaluation
of the NAS Amendment to the Puspiptek Project

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September, 1988

The views expressed in this report are those of the authors and should not be attributed to the Agency for International Development.

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PREFACE

The National Academy of Sciences (NAS) began its relationship with Indonesia in 1946. This marked the beginning of a range of activities supporting science and technology cooperation. More recently, the Agency for International Development (A.I.D.) has been funding NAS workshops in collaboration with the Indonesian National Research Council (DRN). The present funding mechanism and NAS involvement require some clarification.

In 1982, A.I.D. and the Government of the Republic of Indonesia (GOI) signed a loan and grant agreement to develop the Puspiptek Energy Laboratory at Serpong as part of a science center of eleven laboratories. The core activity runs until September 1989; this project has been amended a number of times.

Amendment No. 4 to the Puspiptek Energy Laboratory Project enabled the NAS to continue its S&T workshops and activities in cooperation with the National Research Council of Indonesia (DRN) from October 1985 to December 1987. Its design goal was to transfer technology from the U.S. to the Indonesian scientific community through approximately ten joint NAS/DRN workshops and technical meetings. The activities were to focus in three areas: biotechnology in agriculture and health, marine resources, and science and technology management and information services.

The services of a U.S. Senior Science Advisor to the Professor Dr. B.J. Habibie, State Minister for Research and Technology, are covered under a separate amendment to the Puspiptek project. Dr. A.B. van Rennes has served for five years as the U.S. Technical Advisor to the Chairman of the Agency for the Assessment and Adaptation of Technology (BPPT), Dr. Habibie. (Other bilateral donors have similar technical advisors to the Minister and BPPT).

Although the Puspiptek Energy Laboratory Project, the U.S. Technical Advisor, and the NAS/DRN activities share a common project number, the three activities represent distinct modes of interaction between the US Government and the S&T community in Indonesia. The NAS program in Indonesia was not focused on energy research, and the Science Advisor was not directly involved in the NAS activities.

NAS is, however, involved in a research grants program that provides direct support of Indonesian scientific research through small grants (US$150,000 or less), funded by A.I.D. Since the inception of the program in 1981, the Office of the Science Advisor in A.I.D., Washington has provided the funds to support about seven Indonesian researchers. A parallel program of grants is also administered directly by NAS. This program has included brief training programs in Indonesia on research proposal preparation.

In October 1987, the Technical Resources Office of the Bureau for Asia and the Near-East and the Office of the Science Advisor were asked to assist in evaluating the NAS Amendment to the Puspiptek Project. This coincided with the Bureau and A.I.D.'s interest in examining the range of S&T supported activities throughout the Asia region and the programming modes in selected countries. Indonesia was of special interest because the Mission was engaged in defining its overall strategy for the next five years. Concurrently, the Office of the Science Advisor undertook its first review of the biotechnology modules of its research grants program.

However, given the breadth of the subject area, this study follows the USAID Mission's original intent to focus specifically on evaluating the NAS workshops and activities, not judging the Energy Laboratory Project per se except as it contributes to an overall understanding of the S&T infrastructure. A review of the Energy Lab project is scheduled for 1988. The Office of Science Advisor's Research Grants and the role of the U.S. technical advisor were excluded from this study. However, as part of the NAS evaluation effort, the team was charged by the Mission Director, to provide general observations on the USAID Mission resources for dealing with S&T issues in Indonesia.

A team comprised of three Americans and one senior Indonesian in the fields of research management, science, and engineering completed field work in February 1988 (See Appendix A). This report presents the team's findings, conclusions and recommendations.

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ACKNOWLEDGEMENTS

The evaluation of the scientific and technological cooperation activities between the United States Government and the Government of the Republic of Indonesia was carried out through the combined efforts of the Agency for International Development's Mission in Jakarta and the Office of Technical Resources, Bureau for Asia and the Near East, in Washington. The evaluation was conceived and planned in Jakarta by Desmond O'Riordan and Timothy Mahoney and the field study was conducted with direction and assistance from William Douglass, Acting Director of the Agriculture and Rural Development Office, and Edi Setianto. The team warmly acknowledges the logistical and secretarial support so ably provided by the Mission and thanks Mrs. Tjennei Manuama for her dedicated assistance.

The Board on Science and Technology for Development (BOSTID) of the National Research Council coordinated the project in Indonesia for the National Academy of Sciences. The team appreciates the cooperation given by Mrs. Rose Bannigan, Senior Program Officer, in documenting the workshops and other activities. The appendices to this report freely excerpt from the end-of-contract report of January 1988 that describes specific workshops and subsequent exchanges. Mrs. Banningan's close relationships with her Indonesian counterparts facilitated our field efforts.

In order to develop a comprehensive perspective of the S&T community in Indonesia, the team interviewed many people, visited research laboratories, universities, government-owned and commercial enterprises, experimental farms, and private homes (Appendix I lists the people contacted during the February field visit by their organizational affiliation). The team is especially grateful for the cooperation given by each and every person contacted, for the plant and laboratory tours, lengthy interviews, and for many thoughtful discussions on scientific research and technology development in Indonesia.

The team especially appreciates the kind interest of Professor Dr. B.J. Habibie, State Minister for Research and Technology, and Professor Dr. Sediono Tjondronegoro, Secretary to the Indonesian National Research Council (DRN), and is grateful for the opportunity for sharing their views on science and technology cooperation with the United States.

The U.S. based members of the team are particularly grateful to Professor Dr. Hariadi P. Soepangkat, Rector of the Institute of Technology Bandung, for permitting Dr. Saswinadi Sasmojo, Senior Lecturer and Head of the Research Institute, to join the evaluation team.

Without the excellent cooperation from all concerned it would have been impossible for a four person team to cover the NAS/DRN activities, or to consider the role of A.I.D. in S&T in Indonesia. As with any treatment of a complex topic requiring subjective judgments, the team must take final responsibility for errors of fact or interpretation.

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SUMMARY

In October 1987, the Technical Resources Office of the Bureau for Asia and the Near-East and the Office of the Science Advisor in A.I.D. were asked to assist in evaluating a project which facilitated science and technology (S&T) cooperation between the United States and Indonesia. To this end a team comprised of three Americans and one senior Indonesian in the fields of research management, science, and engineering completed field work in February 1988. This report presents the team's findings, conclusions and recommendations.

From 1978 to 1984 A.I.D. supported a project on "Science, Technology and Research Policy Development" activities under a contract between A.I.D. and the Board on International Science and Technology in Development (BOSTID) of the U.S. National Academy of Sciences (NAS). This activity received a total funding of US$630,000 from A.I.D. and US$450,000 from the GOI to sustain a relationship between the U.S. National Academy of Sciences (NAS) with the Indonesia S&T community which dates from 1946. Through 1984, a series of workshops and technical exchanges covered a range of topics including food policy, industrial and technological research, natural resources, rural productivity, manpower planning and systems analysis. In Indonesia, the Ministry of State for Research and Technology (RISTEK) and the Agency for the Assessment and Application of Technology (BPPT) were the cooperating agencies.

In order to continue the NAS S&T activities after 1984 the Puspiptek Energy Laboratory Project was amended. This enabled funding for the NAS cooperative program with the Indonesian National Research Council (DRN) from October 1985 to December 1987 at US$500,000 from A.I.D. and US$295,000 in counterpart funds from the GOI. The amendment design goal was to catalyze the transfer of technology from the U.S. to the Indonesian scientific community through approximately ten joint NAS/DRN workshops and technical meetings. The subject areas were: biotechnology in agriculture and health, marine resources, and science and technology management and information services.

At the conclusion of these current activities, the present evaluation was designed to consider the impact of the NAS workshop activities, and, in a broader sense, the long-term implications for the USAID role in Indonesia.

From 1985 to 1987, BOSTID assisted the DRN in organizing six key workshops and several technical meetings. The End-of-Contract Report describes these in detail* and each workshop is well documented (see Bibliography). The evaluation focussed on the six workshops covering biotechnology in agriculture, biotechnology and embryo transplants, biotechnology and steroid production, marine resources, biotechnology and marine algae, and scientific and technical information services (Appendices B to G, respectively). The appendices add details of context, team interaction, and observations to excerpts from the end-of contract report descriptions of each workshop.

Innovation is essential to successful competition on an international scale. Scientific and technical innovations emerge from long-term research, applied research, technology application development, pilot studies and demonstrations. They have significance only when they successfully appear in the market place. The report comments briefly in Chapter 2 on aspects of each of these activities in relation to the state of S&T in Indonesia.

The S&T system in Indonesia is almost exclusively in the domain of government organizations (including its university system) and government-owned enterprises. Private sector research and development (R&D) is minimal, and non-existent in most sectors, except for some small-scale operations research in a few industries.

The organizational structure of the S&T establishment has almost all of the standard, formal government departments, councils and institutes in place, defining a system that, in principle, addresses the full range of S&T requirements of the nation. Yet there are serious shortcomings in the operation and effectiveness of the system.

-- Not surprisingly, the most serious problem throughout the S&T system is the lack of adequate funding in many of the major problem areas.

-- A second major problem lies in the scarcity of experienced, motivated middle and upper management personnel in areas that require expertise in S&T.

-- The human resource problem is exacerbated by a reward system that overburdens top management and senior scientists and engineers with too many diversionary responsibilities.

-- Planning and decision-making in matters that involve S&T is done mainly by the top several dozen senior managers in government organizations. At this level, communication is good but coordination of efforts between jurisdictions appears to be minimal. Thus, at lower levels, communication between related programs and projects is often very poor.

-- Even though national priorities are often announced, as for example in biotechnology, the allocation of funding to such efforts may be woefully inadequate to ensure any level of success. There appears to be a tendency to spread available resources thinly across an array of activities rather than focusing sharply on the most promising technologies.

-- A clear expression of the total national budget directed toward the support of S&T activities is lacking. "Cross-cut" analyses that would make it possible to accurately judge the level of effort in various sectors and sub-sectors are needed.

-- Considerably less than one percent of the national budget is given as an approximate measure of the support for S&T activities.

-- Of that one percent, the fraction available for long-range Research is almost negligible. To all intents and purposes, the long-range research community in Indonesia is almost non-existent.

-- There does not appear to be a very effective infrastructure for applied research as defined above. The industrial demand for the establishment of a sophisticated applied research capability of a generic nature has not yet arisen.

-- There are, of course, short term, sharply directed applied research projects that address narrowly defined objectives.

-- Much of the work that is labeled "Research" in Indonesia actually falls under the category of "technology applications development." Although it is not in fact research, it is an extremely important capability to nourish and master if Indonesia's industrialization is to be ultimately successful.

-- Scale-up either to a pilot project or a demonstration project requires an investment community that has sophisticated access to market development and market acquisition activities as well as to management and commercialization capabilities. On the other side, it requires an S&T community that understands these requirements and is responsive to changes in the technology demanded by the commercialization process. The S&T community must also have strong credibility in the eyes of the entrepeneurial community. These are stringent conditions that are not often met in Indonesia. Thus, both sides turn to expertise from developed countries to "validate" the process. This is where the NAS/DRN programs can often play a role.

Technology flows to Indonesia through various channels: capital goods investments, international corporations and consultants, technical training and exchanges. The absorption and diffusion of technical innovations is described in Chapter 3 to indicate how the S&T community and industry interact.

General observations and conclusions about the impacts of NAS and the workshops are presented in Chapter 4. beginning with a brief history of the NAS involvement with the Indonesian S&T community, dating from 1946. (A description of the S&T institutions in Indonesia is provided in Appendix H). The Chapter concludes with a discussion of how the NAS S&T cooperation activities complement USAID programs in human resource development and employment, trade, and industrialization issues.

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The observations, interviews, and analysis of the evaluation team lead to the following summary conclusions with regard to the past and future role of the NAS S&T activities in Indonesia:

-- The NAS enjoys a unique relationship with the Indonesian S&T community. There are strong positive feelings about NAS participation at all levels from universities and institutes to ministries and departments.

-- The NAS connection is viewed by many Indonesians as the principal linkage to the U.S. science and technology community. Foreclosing the relationship would be viewed by many as a policy statement with implications broader than the actual workshop programs or the funding levels involved.

-- The NAS interactions do facilitate decision making in key priority areas in Indonesia. The NAS is viewed as an impartial, balanced, disinterested party dedicated to a process that takes full account of Indonesian interests.

-- Even though the primary flows of innovations to industrial enterprises are from the international transfer of technology embedded in capital goods and consulting services, NAS activities still provide a powerful stimulus to the S&T community to respond to international expertise on market opportunities.

-- Inclusion of transnational corporation researchers in the NAS/DRN activities has had only minimal commercial results--thus far. Its intangible benefit is in sensitizing the Indonesian S&T community to the pace of technological developments in a dynamic world market.

-- NAS involvement in the determination of the technical feasibility of a program represents a strong "validation" of the concept in the minds of those considering committing resources to the effort. Such "validation" is extremely difficult to generate from wholly internal analyses or sources.

These lead to the following recommendations for the USAID Mission in Jakarta:

-- Continue a relationship that maintains linkages between the U.S. National Academy of Sciences and the Indonesian S&T community.

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-- While continuing the relationship, reexamine over the next two years the underlying purposes of the NAS/DRN cooperative programs and their effectiveness in bringing new S&T concepts through the entire innovation cycle (as sketched in Chapter 2.); develop a new proposal for future funding consideration during this period.

-- Give more attention to the problem of follow through activities in promising areas that have been identified in workshop development activities and in the workshop output--considering the roles of the NAS and its operating arm the U.S. National Research Council, the USAID Mission and the DRN; strengthen the currently minimal coordinated activity in this area.

-- Enhance the USAID Mission's capabilities to deal with activities that are now subsumed under the generic term S&T, including not only the NAS programs and PUSPIPTEK but also important elements of programs in human resource development, education, resource development and industrialization.

-- Consider developing new institutional arrangements outside of the NAS/DRN to provide input into the problems associated with carrying promising technology past the stage of technology application development into the pilot or demonstration projects. These important stages in the process of innovation have characteristics that do not necessarily match the capabilities and constraints of NAS activities.

No recommendation is made for a follow-up evaluation team effort in this area for the immediate future. The ingredients for future planning are already in place and can be dealt with in A.I.D. in cooperation with NAS and DRN.

GLOSSARY

A.I.D. Agency for International Development

BOSTID Board on Science and Technology for International Development, Advisory board of NAS and administrative unit of the Office of International Affairs, NRC (U.S.A.)

NAS National Academy of Sciences, private organization of scientists in U.S.A.

NRC National Research Council, Advisory body of the NAS complex of institutions, including the NAS, the National Academy of Engineering, and the Institute of Medicine.

R&D, R,D&E research and development, research development and engineering

S&T science and technology

USAID A.I.D. overseas mission (in Jakarta)

In Indonesia (English Translation):

BAPENAS Agency for Development Planning (Indonesia)

BPPT Agency for Assessment and Adaptation of Technology

DRN National Research Council (Indonesia)

GOI Government of the Republic of Indonesia

IPB Institute of Agriculture at Bogor

ITB Institute of Technology at Bandung

REPELITA Five year national development plans of GOI, identified by the years covered, as follows:

I-- 1969-1974
II- 1974-1979
III- 1979-1984
IV- 1984-1989
V- 1989-1994

RISTEK Ministry of State for Research and Technology

Exchange Rate (January 1988):

US$1 (U.S.A. Dollar) = 1655 RP (Rupia)

PROJECT AND PROJECT AMENDMENT IDENTIFICATION DATA

1. Country : Indonesia

2. Project Title : PUSPIPTEK Energy Research Laboratory--Amendment No. 4. NAS/DRN Workshops and related activities.

3. Project Number : 497-0333

4. Project Dates : Loan Agreement signed - August 27, 1982
   Amendment No. 4 signed - May 8, 1985
   Project Agreement Completion Date- Sept. 30, 1989
   Amendment Completion date- Dec. 31, 1987

5. Project Funding : Loan Agreement Amendment No. 4 (A.I.D.) US$ 500,000
   Host Country Counterpart Funds US$ 295,000
   Total .... US$ 795,000

6. Mode of Implementation: Contract No. ASB-0333-C-00-5161 Oct. 2, 1985, between A.I.D. and the National Academy of Sciences (Board on International Science and Technology in Development).

7. Project Designers : USAID/Jakarta and the Agency for the Assessment and Application of Technology (BPPT).

8. Responsible Mission Officials:
   Mission Directors: William Fuller,
   David N. Merrill
   Project Officer: Desmond O'Riordan
   William H. Douglass

9. Previous Evaluations of Project or Amendment Activities: None

1. INTRODUCTION AND OVERVIEW

1.1 The Situation in Indonesia

Indonesia is the fifth most populous country in the world, with the 1988 population estimated at 175 million. Indonesia's 13,000 islands cover 5 million sq. km, extending 2,300 nautical miles along the equator. Land territory is 1.9 million sq km; ocean territory is over 3.1 million sq km.

The country is rich in natural resources, and the mining sector--the oil industry in particular--is the most important source of both export earnings and revenue to the Government of Indonesia (GOI) budget. Marine resources, including both mineral and living resources are largely untapped. Agriculture provides both the main income source and jobs, but the manufacturing sector has grown significantly in recent years. Development has been primarily in import substituting industries and a high level of Government protection has diminished both efficiency and competitiveness.[1] Recent GOI policy has promoted non-oil based exports and has encouraged industrialization. State intervention in the economy, a dominant factor in the development of Indonesia over several decades, has been relaxed somewhat by recent economic policy reforms.

Current downturns in international markets for Indonesia's exports (primarily the price of oil) have led to a severe budget crisis. The targeted development expenditure for science, research and technology was about 1,758 billion rupias which is 2.2 percent of the overall development budget in the current five year development plan, Repelita IV (See Table 1). It is unlikely that any of the expenditure targets will be reached as oil revenues decline. For example, the research operations budget for the University system was zero for fiscal year 1987.

Indonesia has a literacy rate of 62 percent. This compares to literacy rates in neighboring Malaysia and Thailand of 72 per cent and 82 percent, respectively. The GOI used revenues from the oil boom years to greatly expand primary school enrollment. A comparison of the three countries on the percentage of age groups in school is:

	Indonesia	Malaysia	Thailand
Primary school	100	99	99
Secondary school	37	49	29
Tertiery level	4	4	22

[1] Economist Intelligence Unit. Indonesia--1987 Report. The Economist, London, 1987.

Table 1

Development Expenditure in Repelita IV - Targets
(Billions of rupia; at current prices)

Expenditure	Value	Per cent of Total
Mining & energy	12,125.9	15.4
Education	11,539.5	14.7
Agriculture & irrigation	10,014.3	12.7
Communications & tourism	9,923.1	12.6
Regional development	5,379.1	6.8
Defence & security	5,238.9	6.7
Manpower & transmigration	4,551.8	5.8
Manufacturing	4,281.9	5.5
Health	3,516.5	4.5
Housing	2,980.6	3.8
Science, research & technology	**1,757.7**	**2.2**
Business enterprise development	1,689.7	2.2
Others	5,610.4	7.1
Total	78,609.5	100.0
Source of financing		
Government savings	49,495.7	63.0
Foreign aid	29,113.8	37.0
Total development funds	78,609.5	100.0

Source: Repelita IV.

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Indonesia has 45 public institutions and 533 private institutions of higher education.[2] The University of Indonesia system is the primary locus of research and academia. The pay scale for faculty is so low that "moonlighting" at a variety of jobs is a necessity. Cultural traditions tend to favor non-technical disciplines, rather than the hard sciences or engineering and the country suffers from a great shortage in engineers and skilled technical manpower. However, a World Bank Loan (XIX) for US$93 million is funding training abroad and six major research centers in science and technology.

1.2 Overview of National Academy of Sciences Evaluation

1.2.1. The A.I.D.-Funded Project in S&T Cooperation

From 1978 to 1984 the Agency for International Development (A.I.D.) supported a science and technology project with the GOI. One of the five project activities was entitled "Science, Technology and Research Policy Development" and implemented by a contract between A.I.D. and the Board on International Science and Technology in Development (BOSTID) of the U.S. National Academy of Sciences (NAS).[3] This activity received a total funding of US$630,000 from A.I.D. and US$450,000 from the GOI to sustain a relationship between NAS and the Indonesia science and technology (S&T) community which dates from 1946. Through 1984, a series of workshops and technical exchanges covered a range of topics including food policy, industrial and technological research, natural resources, rural productivity, manpower planning and systems analysis. The Ministry of State for Research and Technology (RISTEK) and the Agency for the Assessment and Application of Technology (BPPT) were the cooperating agencies.

In order to continue the NAS S&T activities after 1984 the Puspiptek Energy Laboratory Project was amended. This enabled funding for the NAS cooperative program with the Indonesian National Research Council (DRN) from October 1985 to December 1987 at US$500,000 from A.I.D. and US$295,000 in counterpart funds from the GOI. The project amendment design goal was to transfer technology from the U.S. to the

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[2] from "Indonesia: Education and Human Resources, Sector Review." by IEES, Learning Systems Institute Florida State Univ. for A.I.D. Project No. 936-5823., 1986, Vol I, page 1-30.

[3] The project implementing body for the NAS was BOSTID, a unit in the Office of International Affairs of the National Research Council (NRC). The NRC is the operational arm of the NAS complex of institutions, including NAS, the National Academy of Engineering, and the Institute of Medicine. Thus BOSTID staff could draw upon distinguished members of these three institutions, as well as other scientists and engineers.

Indonesian scientific community through approximately ten joint NAS/DRN workshops and technical meetings.[4] The activities were to focus in three areas: biotechnology in agriculture and health, marine resources, and science and technology management and information services.

In October 1987, the Technical Resources Office of the Bureau for Asia and the Near-East and the Office of the Science Advisor were asked to assist in evaluating the NAS Amendment to the Puspiptek Project. A team comprised of three Americans and one senior Indonesian in the fields of research management, science, and engineering completed field work in February 1988. This report presents the team's findings, conclusions and recommendations.

According to the Mission's original structure for the study (Appendix A), the evaluation was to focus on the larger S&T community, the specific contributions of the NAS/DRN workshop activities, and the implications for further A.I.D. programming. A.I.D./Washington interest in this evaluation has been concerned with the programming of S&T in countries in the region with quite different levels of S&T infrastructure, such as India, and Thailand. Concurrently, the Office of the Science Advisor, which administers the Program in Science and Technology Cooperation (PSTC) research grants, had questions about seven studies it had funded in Indonesia since 1981 (limited to $US 150,000 each). At the same time the field study was to be carried out, the United States Agency for International Development (USAID) Mission was presenting its strategy for the next five years in Washington. Ultimately, the evaluation focused upon the original request from the Mission: what have been the contributions of the NAS/DRN cooperative program to the strengthening of the Indonesian S&T community, what should be the future role of NAS and how should the Mission position itself to deal with S&T issues?

1.2.2 Evaluation Report Overview.

Innovation is essential to successful competition on an international scale. Scientific and technical innovations flow from long-term research, applied research, technology application development, pilot studies and demonstrations. The report comments briefly in Chapter 2 on aspects of each of these activities in relation to the state of S&T in Indonesia. Technology flows to Indonesia through various channels: capital goods investments, international consultants, technical training and exchanges. The absorption and diffusion of technical innovations is sketched in Chapter 3 to compare how the S&T community and industry interact.

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[4] The DRN became the cooperating agency for the NAS activities under the funding through an Amendment to the PUSPIPTEK project (see Preface). "NAS/DRN" will hereafter describe the two cooperating agencies, BOSTID for the NAS and DRN for the RISTEK, that carried out the amendment objectives.

From 1985 to 1987, BOSTID assisted the DRN in organizing six key workshops and several technical meetings. The End-of-Contract Report describes these in detail[5] and each workshop is well documented (see Bibliography). The evaluation focussed on the six workshops covering biotechnology in agriculture, biotechnology and embryo transplants, biotechnology and steroid production, marine resources, biotechnology and marine algae, and scientific and technical information services (Appendices B to G, respectively). The appendices add details of context, team interaction, and observations to excerpts from the end-of contract report description of each workshop.

General observations and conclusions about the part played by NAS and the workshops are presented in Chapter 4. This section begins with a brief history of the NAS involvement with the Indonesian S&T community, dating from 1946. (A description of the S&T institutions in Indonesia is provided in Appendix H). The Chapter concludes with a discussion of where NAS S&T cooperation activities fit into the USAID programs in human resource development and policy dialogue on employment, trade, and industrialization.

The final Chapter of this evaluation report presents observations about the contribution of the AID funded NAS activities in Indonesia and, as well, a number of recommendations to the USAID mission.

2. SCIENCE AND TECHNOLOGY IN INDONESIA

2.1 Competitiveness

Competitiveness is the central challenge to the maintenance of a stable and prosperous industrial, commercial or agricultural enterprise. This is equally true for public and private institutions. It is equally true for the largest developed nations and for smaller, newly emerging, developing countries. Modes of operation that once were satisfactory as "local ways of doing business" must now yield to the fact that in almost all important human enterprises, competitiveness is now fully internationalized.

Competitiveness in any sector or in any enterprise is not a permanent status that once achieved is automatically maintained and renewed. It is instead a dynamic state that requires constant adjustments of human, financial, physical and technological resources. Enterprises must be flexible enough to adapt to the inputs of new developments and new initiatives that arise around the world. This flexibility, this adaptability is a hard-won capability. It is difficult

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[5] Cooperative Activities in Indonesia on Science, Technology, and Research Policy Development, End-of-Contract Statement Contract # AID ASB-0333-L-00-5161-00, October 2, 1985 - Jan. 1, 1988.

in the policy sphere where information is of mixed quality and incomplete. It is difficult in the financial sphere where risks and rewards must be weighed. It is most difficult when success is dependent upon the reorientation, the training and the motivation of large numbers of people in new enterprises. This occurs for example in the introduction of major new technologies in agriculture or in industry. The time required for assurance of success can be uncomfortably long and the required investments uncomfortably large.

The competitiveness of every component of the Indonesian economy is increasingly important, if not critical. The thrust towards industrialization, the promotion of non-oil exports, the emphasis on creating employment for a growing population of better educated young people, the need to achieve and maintain self-sufficiency in agricultural production--all pose challenges to Indonesian leaders and managers.

2.2. Innovation and S&T System Programs

While the pace of national competitiveness will be driven by national policies based upon broad macro-economic analyses, micro-economic sector analyses, trade, tariff and regulatory structures, there are other forces at the management and technical levels that also require attention. Among these are human resource development, physical resource development and technical and economic infrastructure development to promote the process of innovation.

The concept of innovation as an important national policy issue has been developed in recent years largely by analysts concerned with research and development (R&D) policy or, as it is sometimes called, science and technology policy. While definitions invariably are debateable, a precise formulation is not required here. Innovation may be defined as the process that takes a new idea from its conception through proof of principle, through development, into production and finally (and most importantly) into the marketplace as a viable commercial or industrial product or process. The new idea can emerge anywhere. It can be for an entirely new commercial product, a new way of exploiting a natural resource, a modification of an existing technology, or even a streamlined accounting or procurement system. While the concept of innovation is often associated with scientific activity and R&D programs, it is important to understand that new ideas can and do arise at every stage of the industrialization process, from the laboratory to the production line to the boardroom (for example, in the form of new methods for creative financing). A successful climate for innovation is one that stimulates continuous adaptation and optimization of <u>every</u> aspect of an operating system or enterprise.

The S&T system of a country is a critical element in the process of innovation. This system, the technological infrastructure, includes

the education system, all of the skilled and professional human resources, all commercial and government enterprises and organizations that are concerned with scientific inquiry, with technology development or acquisition, or with technology adaptation, and utilization. It is people and the organizations that train, equip, and reward them for the pursuit and application of knowledge for useful purposes. Without an effective S&T infrastructure a country will inevitably fall behind in the competitive international market place.

The S&T infrastructure of Indonesia was examined in the evaluation from this viewpoint in order to determine if there are any major gaps in the system that inhibit the innovation process. For convenience, S&T system activities will be divided into five program categories:

-- Long-range (basic) Research
-- Applied Research
-- Technology Application Development
-- Technology Pilot Projects, and
-- Technology Demonstrations

While these terms are somewhat imprecise, the following discussion of general characteristics of each of these categories provides a convenient descriptive framework for analysis of the state of the S&T system in Indonesia.[6] This will also be useful in providing a framework for considering the question of the USAID Mission role in the S&T process (Section 4.3).

2.2.1 Long-range Research

-- Often called basic research or fundamental research, Long-range Research efforts are driven by the inner logic of the science and are not goal oriented in the sense of working towards specific applications.

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[6] In his keynote address at the NAS/DRN "Workshop on Marine Algae Biotechnology," Professor Dr. D.A. Tisna Amidjaja , Chairman of the Indonesian Institute of Science (LIPI), referred to "a long chain of sequences," necessary to convert seaweed to a product with the highest value-added. This begins with "basic research on seaweed" taxonomy, distribution, physiology, etc.; "applied research on [seaweed] farming techniques," etc.; "technology assessment, engineering, and pilot projects" to establish model industries on a limited production scale; "[c]ulminating in upscaling of production to produce an economic commodity." (NRC report of workshop, 1985, page 91)

-- The timeframe for useful application of new knowledge thus developed is typically very long. In a scientifically developed country it can range from ten to fifteen years or more.

-- Except in the broadest sense, it is extremely difficult to match this kind of research with specific development programs. It is even difficult to tie it into specific applications research programs.

-- Long-range Research is peer group driven. In every field of science there is a fully internationalized peer group that sets the pace, maintains communication and judges quality.

-- The range of subjects and research activities is extremely broad. Participation is most often in a steeply vertical mode. This invites narrow specialization. Thus, full coverage of a variety of fields would require an extensive national program.

-- The tendency towards specialization inhibits communication and coordination between local groups and local projects. It also inhibits communication with applied research programs and industrial development efforts both within country and abroad.

-- Long-range research appears to be expensive both in terms of equipment and high-level manpower support when subjected to conventional cost-benefit analysis.

-- The most powerful argument for maintaining a strong nucleus of effort in selected fields of science and engineering lies in the deep relationship between basic research and the educational process. Every industrialized nation exploits that relationship in its educational system. Some exposure to the creativity and intellectual excitement that can accompany basic research can do much to shape and inform the thinking processes of young scientists and engineers. Without it, the world of science can appear to be a, "black box" manipulated by someone else "out there". This is why so much of the world's basic research is done in conjunction with university systems.

-- A second powerful argument for maintaining a nucleus of basic research activity in selected fields is that it creates a cadre of faculty, staff and young scientists that provides a window on the world of new ideas and developments that is constantly being renewed abroad. As higher technical levels of achievement are attained this window becomes increasingly important. Given the rapid rate of change abroad, it takes a high level of sophistication to adopt and adapt even ten year old technology.

2.2.2 Applied Research

-- Applied Research is an activity sometimes called short-range research or applications research. It must be tightly coupled to a specific application objective.

-- This kind of research can, and ideally should, evolve into a sustained generic program that seeks to illuminate and define all of the important properties and possible applications of a broad class of systems. An example might be a program to study, define and exploit the potential applications of alkaloids or steroids derived from local natural products.

-- Often, Applied Research will be focused sharply on solving a specific problem that has arisen in connection with a raw material, a product or a process.

-- Applied Research relies heavily upon results derived from Long-range Research but it does not undertake to extend them. Rather, it uses the concepts and the instrumentation from basic research simply as tools to achieve specific objectives in specific projects.

-- It is important to recognize that Applied Research is truly a research activity. It is fully as intellectually demanding as basic research. It seeks to apply the full range of available concepts and tools to the organization and resolution of complex systems. Properly organized, it provides a responsive, adaptive capability to deal with the deeper questions that arise in any developing technology.

-- This type of research requires stimulating leadership. Senior and junior managers must be constantly exposed to first-class operations at home and abroad.

2.2.3 Technology Application Development

-- In the S&T spectrum, Technology Application Development is the type of activity that might best be described as the earliest application of engineering principles to the solution of a well-defined problem. The term engineering is meant in its broadest sense. It includes all aspects of mechanical, civil, electrical, industrial, agricultural and bioengineering, etc.

-- This activity is not a research activity nor is it a science activity in the terminology of S&T employed here. It involves project development in the field of applied technology. It is dominated by very specific goals and very

specific success criteria. These criteria include close consideration of the economic costs and projected benefits of every project or program. Social values are a necessary, if not always explicit, consideration.

-- Technology Application Development programs rarely depend directly upon parallel long-range research efforts. They may, from time to time, depend temporarily upon Applied Research results to resolve specific issues that arise or to provide needed assessment data. More typically, they rely upon the application and adaptation of well understood engineering practices to the task at hand. Their goal is "proof of principle" in a functioning model or prototype system.

-- These programs require strong leadership to maintain close coordination of effort among a variety of contributers, who typically come from different backgrounds.

-- Even if "proof of principle" is achieved in a prototype stage, the process of innovation requires that this development move forward into a Pilot Project stage or into a Technology Demonstration stage[7] or (rarely) directly into production and marketing. This is a very difficult transition.

2.2.4 Technology Pilot Projects

-- Most Technology Application Development programs that result in a "proof of principal" have unanswered questions about the economics of scale that might accompany full-scale production. Indeed, experience has shown that scale-up often reveals unforeseen problems that can make the activity uneconomical.

-- Thus, there is a serious element of risk involved in scale-up. Potential investors (including governments) require critical assessments of the costs and the risks before committing to support a new development. This requires a high level of confidence in the capabilities and judgements of the project proponents. In developing countries, more often than not, there has not been enough time and experience to establish such credibility and investors look to experts from advanced countries to share the evaluation, the risk and the profits.

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[7] A.I.D. reports often use the terms "pilot project" and "demonstration project" interchangeably. This categorization of the innovation process discriminates on the basis of scale, intent, and supporting resources between the two stages.

-- For many developments, a modest sized Technology Pilot Project can be designed to test the effects of scale-up and to minimize costs. Nevertheless, it requires expert engineering skills to adapt projects to local manpower conditions, local government constraints, transportation, communication, supply and, most importantly, markets.

-- Marginal success of a pilot operation does not guarantee industrialization or commercialization of the process or product.

2.2.5 Technology Demonstrations

-- Technology Demonstration projects and programs come at the end of the S&T spectrum and typically deal with proven technologies that have potential wide-scale applicability, but which involve start-up times and costs that may be unattractive to investors.

-- They are usually undertaken by governments in the interests of social values and long-term development goals. More often than not, they are designed to create markets that will later attract investors to complete the process of industrialization.

-- Because of the size and complexity of most Technology Demonstration efforts, they require extremely strong management structures and other specialized needs that may require the aid of resources from outside the country.

2.3. The State of S&T in Indonesia

The S&T system in Indonesia is almost exclusively in the domain of GOI organizations (including its University system) and government-owned enterprises. Private sector R&D is minimal, and non-existent in most sectors, except for some small scale operations research in a few industries (e.g. pharmaceuticals). Enterprises such as the State Enterprise for Fertilizer, the State Enterprise for Oil and Gas, and the State Enterprise for Electricity do have R&D units. Their primary function is basically directed towards solving operational problems and to provide technical inputs required for planning purposes. Some of this effort is conducted in company facilities and projects are also contracted out to university staff.

The organizational structure of the S&T establishment is described in detail in Appendix H. Almost all of the standard, formal government departments, councils and institutes are in place, defining a system that, in principle, addresses the full range of S&T requirements of the

nation. Yet there are serious shortcomings in the operation and effectiveness of the system. We highlight these with reference to the five categories of the S&T innovation spectrum above.

-- Not surprisingly, the most serious problem throughout the S&T system is the lack of adequate funding in many of the major problem areas. This is related to the difficulties facing the national economy and is likely to continue for some time. S&T activities are being supported by outside assistance programs but local management and local commitment to innovation are stifled by the situation.

-- A second major problem lies in the scarcity of experienced, motivated middle and upper management personnel in areas that require expertise in S&T. This human resource problem will not be solved simply by developing more Doctorates from institutions at home and abroad. It will require real modifications in the system to encourage and reward initiative, independence and risk-taking.

-- The human resource problem is exacerbated by a reward system that overburdens top management and senior scientists and engineers with too many diversionary responsibilities. Because of extremely low pay scales, the most productive and capable people are driven to dilute their efforts and energies by taking on a number of parallel assignments. Over time, this creates a low expectation for performance and success--an expectation that is all too often fulfilled.

-- Planning and decision-making in matters that involve S&T is done mainly by the top several dozen senior managers in GOI organizations. At this level, communication is good but coordination of efforts between jurisdictions appears to be minimal. Thus, at lower levels, communication between related programs and projects is often very poor.

-- Even though national priorities are often announced, as for example in biotechnology, the allocation of funding to such efforts may be woefully inadequate to ensure any level of success. There appears to be a tendency to spread available resources thinly across an array of activities rather than focusing sharply on the most promising technologies.

-- A clear expression of the total national budget directed toward the support of S&T activities is lacking. "Cross-cut" analyses that would make it possible to accurately judge the level of effort in various sectors and sub-sectors are needed. While a "science indicators" project has been initiated at the Indonesian Institute of Science (LIPI) through UNESCO auspices, it will be several years before it will begin to be a useful instrument.

-- Considerably less than one percent of the national budget is given as an approximate measure of the support for S&T activities. This estimate almost certainly does not include some of the major Technology Demonstration programs such as the aircraft industry, nor does it include international assistance programs.

-- Of that one percent, the fraction available for Long-range Research is almost negligible. To all intents and purposes, the Long-range Research community in Indonesia is almost non-existent. The principal point of contact with the world community in this area is through the young scientists and engineers who are trained in major laboratories abroad. Upon their return, they discover that it is not realistic to attempt to continue to be productive in a Long-Range Research mode in Indonesia at this time. The transition is often somewhat painful for them before they settle into more practical programs.

-- There does not appear to be a very effective infrastructure for Applied Research as defined above. While there are a few collaborations on systematic assessments or baseline studies that might thus qualify, they are the exception. The industrial demand for the establishment of a sophisticated applied research capability of a generic nature has not yet arisen. It is expensive and it all too often appears to have too long a payback period for potential investors and developers.

-- There are, of course, short term, sharply directed Applied Research projects that address narrowly defined objectives.

-- Much of the work that is labeled "Research" in Indonesia actually falls under the category described above as Technology Application Development. This work is based upon the application and, to some extent, the adaptation of standard technological and engineering practices. Although it is not in fact research, it is an extremely important capability to nourish and master if Indonesia's industrialization is to be ultimately successful. It occupies the attention of senior and junior scientists and engineers at universities and research institutions. Its extension is heavily dependent upon the development of well trained cadres of high level technicians.

-- After "proof of principle" is established in some product or process, the next step in the innovative process is a scale-up either to a pilot project or a demonstration project. This requires an investment community that has sophisticated access to market development and market acquisition activities as well as to management and commercialization capabilities. On the other side, it

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requires an S&T community that understands these requirements and is responsive to changes in the technology demanded by the commercialization process. The S&T community must also have strong credibility in the eyes of the entrepeneurial community. These are stringent conditions that are not often met in Indonesia. Thus, both sides turn to expertise from developed countries to "validate" the process. This is where the NAS/DRN programs can often play a role.

3. TECHNOLOGY FLOWS TO AND WITHIN INDONESIA

Indonesian industry has not been stagnating for lack of innovation from the science and technology system within Indonesia. In 1973, the manufacturing sector was 10 per cent of GDP compared to 40 per cent for agriculture, forestry, and fisheries at constant market prices. A decade later the manufacturing sector's contribution was 15 percent, and in 1988, the projected share of GDP was 19 percent, while agriculture, forestry and fisheries share declined to 30 percent in 1983, and was projected at 26 percent for 1988.[8] Innovation is essential to sustained industrial growth, but these changes were driven largely by the inflow of technology from abroad.

This section examines the role that the international transfer of technology performs in Indonesian industrial development. The subsequent flow of new technology within Indonesia (innovation diffusion) is dependent on the absorptive capacity of the infrastructure and its ability to master a given technology. Each aspect is treated below.

3.1 The International Transfer of Technology

-- International technology transfer is controlled by government regulation and promotion, and is subject to the vagaries and inconsistencies of such systems. The formal structure for such regulation in Indonesia lies within the Agency for Coordination of Foreign Investment.

-- Investment in the heavy industries (energy, basic chemical, fertilizer, mining, etc.) is in the government domain and negotiated through multilateral development banks and bilateral loans.

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[8] These figures and estimates were compiled in Citibank's Executive Guide to Indonesia. (Distributed by U.S. Department of Commerce.)

-- Promoted industries (electronics, pharmaceuticals, vehicle and engine assembly, and so on) are established through joint ventures with multinationals which provide equity, licensing agreements, management, operations, capital equipment, and some training. Equity participation by foreign interests is limited to 49 percent and must decline over time.

-- Consulting and engineering design brings in technology for projects in both heavy industries and promoted industries. Foreign consulting firms are required by GOI regulation to have an Indonesian partner.

-- In fact the primary control of international technology transfer lies within the transnational corporations and the international consulting firms. While the mainstream of this transfer is directly to Indonesian industries, there is also a spillover to the broader S&T community. This absorption is primarily through members of the community (academics and R&D research personnel in GOI institutes), who take on informal assignments with private firms as Indonesian consultants.

3.2 Innovation Absorption, Diffusion, and Technological Mastery

The spectrum of S&T programs leading to innovations can be conceptualized as a vertical flow process as shown in Figure 1 (though as indicated in Chapter 2, innovations arise from every stage of productive enterprises, not just research or technology applications development). Similarly, international flows of technology are conceptualized as horizontal flows to a country. As noted above, these flows are not only to enterprises, but also to the science and technology community.

The desired consequence is absorption or acquisition of the technological innovations by productive enterprises in the indigenous S&T system. Figure 1 represents this absorption process leading to two subsequent effects: diffusion of innovations within the economy and subsequent technological mastery. These concepts are common in the literature of technology[9] and may be briefly clarified as follows:

-- Diffusion is the process by which an innovation spreads throughout an economy or society. Spontaneous diffusion occurs when conditions favor adoption, e.g. the technological innovation increases productivity, is accessible and affordable; and the receivers of the innovation already have or can readily acquire the necessary skills.

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[9] See for example, Innovation in Organizations by the National Science Foundation, 1983; Innovation Diffusion by Everett Rogers, 1983; "The Acquisition of Technological Capability in Developing Countries" by Carl Dahlman and Larry Westphal, Finance and Development The World Bank, 1983.

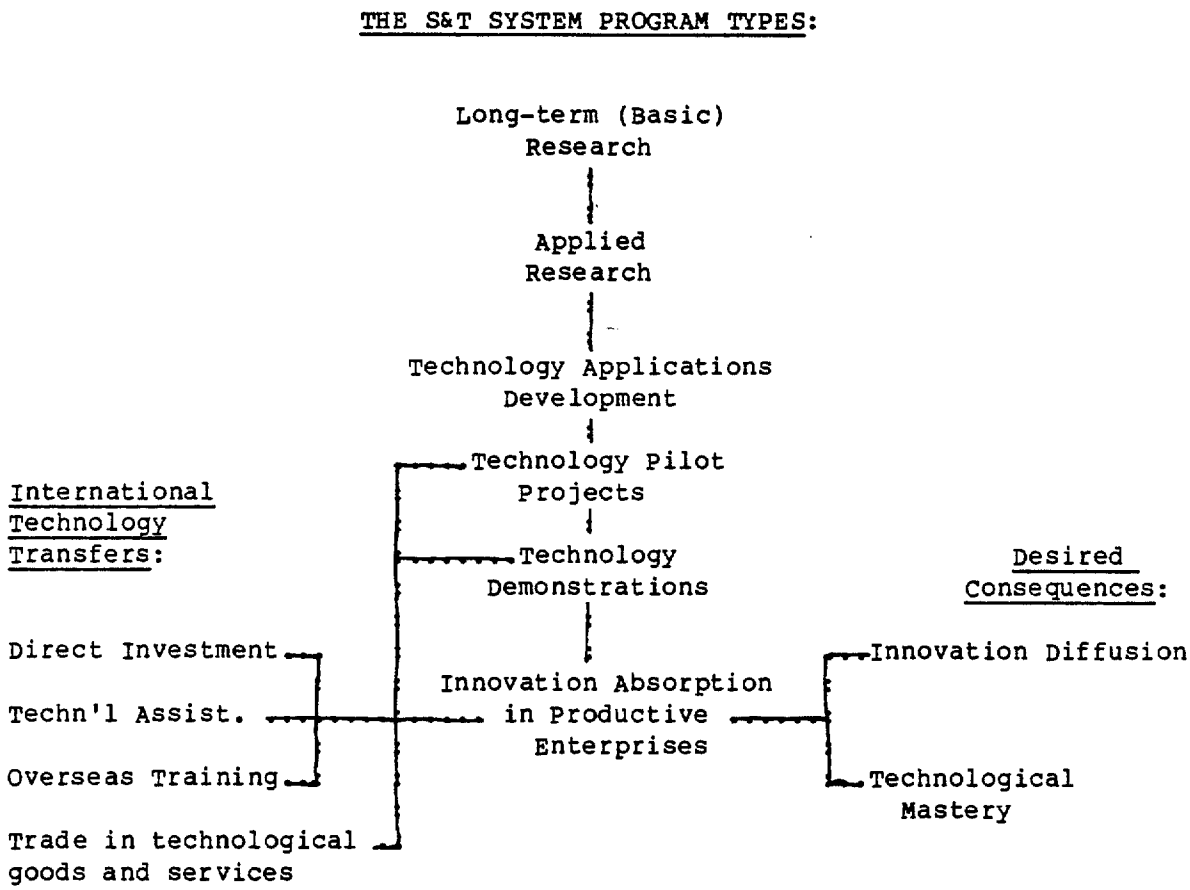

Figure 1. The Desired Consequences of both S&T System Programs and International Technology Transfers

-- Programs specifically structured to diffuse an innovation from public sector to private sector (characterized as "technology transfer" in U.S. Government circles) are designed to widen the net of beneficiaries.

-- Technology Demonstrations are successful programs when the activity promotes adoption of the innovation by individuals or groups outside the demonstration project. Capital projects are then replicated at other sites or other markets when investors are convinced that returns are likely to be adequate.

-- Ideally such innovations will diffuse to a variety of enterprises so as to maximize the benefit to the economy. However, unless the diffusion process is provided with market opportunities and investment, it is not likely to be economically sustainable.

-- Technological mastery is the desired outcome of the successful adaptation of an improved technology. Command of the mastered technology will then be such that the process or techniques can then be further adapted by the user to new problems and opportunities.

-- Mastery results from acquiring some degree of understanding of the underlying technological principles. Without mastery, utilization of a technology under changing conditions (environment, markets, etc) will eventually lead to inefficiency, and a noncompetitive position.

-- It is seldom in the interest of multinational firms to transfer technology so as to facilitate mastery, and thus risk losing control over the technology. Joint venture and comprehensive licensing agreements do often address this problem but with varying degrees of success.

-- Technological mastery may ultimately depend on establishing links to Applied Research programs as a foundation to further Technology Applications Development and improvement. However, multinational firms are only likely to carry out Applied Research in a developing country in connection with a foreign investment if site specific conditions cannot be readily duplicated in the mother country.

-- To advance Indonesia's technological development, the goal for receivers of a technology is to gain mastery of it. Without mastery, the inevitable changes in technological products, production processes, and markets mean that Indonesian enterprises will be technologically stagnant and quickly lose their competitiveness.

3.3 Transfer from S&T Community relative to International Technology Transfer

-- The flow of technology from the innovation process of research, technology applications development, pilot and demonstration projects as sketched in Chapter 2 is often thwarted by lack of confidence within the business investment communities in local mastery of new technologies (See Section 2.3). Businessmen often have limited access to technological knowledge. On the other side, the S&T community is seldom conversant about markets and business preconditions for adoption and diffusion of technologies.

-- This suggests the need for a transfer agent with both technical knowledge and entrepreneurial skills. This call for someone who can champion a technology through the stages of development, adaptation, and pilot testing, and knowledgeably interact with entrepreneurs, managers and market analysts. Such people are in short supply around the world, especially in developing countries. In Indonesia, the transfer agent's role rests with a few enterpreneurial academics with ties to business and venture capital.

-- The GOI's formal transfer agent is the Agency for the Assessment and Application of Technology, BPPT, (see Appendix H). It has the role of identifying and promoting commercialization of technology for business and industry. However, it is only beginning to develop the capabilities to carry out venture analysis.[10] In the long term, the transfer agent role is probably better left to the private sector.

-- In the innovation process, the S&T community may advocate technologies for a variety of reasons, only one of which may be the market. Conservation of resources, environmental protection, promotion of social aims, industrial development strategies all provide rationales for innovative activity. The fruit such activities ultimately bear depends on creating a bridge from pilot or demonstration to diffusion and mastery.

4. The NAS/DRN Workshops and the Indonesian S&T Community

4.1 History of NAS Involvement in Indonesia

Formal relations between the Council of Sciences for Indonesia and the U.S. National Academy of Sciences (NAS) were first established in

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[10] The evaluation team examined four prefeasibility studies by BPPT and could not fault the enthusiasm shown, but the analyses was not altogether convincing.

1946. In 1967 the collaboration continued with the Indonesian Institute of Sciences (LIPI) the successor to the Council.

The operating arm of the NAS, the National Research Council (NRC), has direct access to all of the resources of the NAS and, as well, of the National Academy of Engineering and the Institute of Medicine. Thus, it provides direct connections to senior scientists and engineers in every sector of the U.S. academic and industrial communities. This makes it possible for the NRC to structure teams of U.S. participants to match almost any conceivable area of Indonesian interest.

In response to specific requests from Indonesia, the NAS in 1968 began to cooperate in organizing and sponsoring a number of conference workshops focusing upon science and technology issues relevant to Indonesia's development challenges. The subjects of the workshops were determined in discussions between the NRC and Indonesian counterparts with the cooperation and concurrence of A.I.D. which provided funding for the activities.

The first workshop in 1968 dealt with food production and national policy on food. This was followed by workshops on industrial technology and natural resource management. Recommendations developed from these efforts were incorporated into the GOI five year development plans (REPELITAS). To this day, the recommendations, especially on food policy, are regarded as having been highly influential in setting Indonesian national policies. Table 2 lists the activities from 1968 to 1987. Appendices B-G describe activities since 1985 in detail.

In 1973 the Indonesian Cabinet was expanded to include a Minister of State for Research. The 1978 the Ministry's function was broadened, and renamed the the Ministry of State for Research and Technology. The collaborations on science and technology between Indonesia and the United States were continued through the newly formed Indonesian Ministry for Research and Technology (RISTEK) and the U.S. NAS. The mode of collaboration continued to be that of jointly sponsored workshops on topics of developmental relevance to Indonesia. Workshop topics included follow-up of earlier conferences to evaluate progress and respond to new priorities.

Most of the NAS activities in Indonesia have been directly supported by USAID. Among the projects funded was a $630,000 grant (project #497-0265) to enable the NAS and RISTEK to co-host conferences and other technical exchange activities. In 1985, USAID committed $500,000 to enable these activities to continue through an amendment to the PUSPITEK Energy Lab project (#497-0333). The purpose of the amendment was "to provide additional funding for a two-year cooperative program between the U.S. National Academy of Science and the GOI Office of the Minister of State for Research and Technology". At this time the Indonesian counterpart agency for the NAS became the newly formed Indonesian National Research Council (DRN).

TABLE 2

Timeline of Activities of the National Academy of Science in Indonesia

ACTIVITIES PRIOR TO FUNDING UNDER THE PUSPIPTEK AMENDMENT:

Date	Activity
1968	Workshop on Food Policy
1971	Workshop on Industrial and Technological Research
1972	Workshop on Natural Resources
1981	Workshop on Ethanol as an Alternative Source of Fuel
1982-3	Marine Science Exchange Program
1982	Workshop on Technology for Increasing Rural Productivity
1982	Panel Discussions on Science and Technology Planning & Forcasting
1983	Workshop on Single Cell Protein
1983	Ad Hoc Seminar on Planning & Coordination of Research & Technology in the United States
1983	Workshop Planning, Implementation and Evaluation of Research and Technology
1983	Symposium on Potential Indonesia - US Collaboration in Science and Technology

ACTIVITIES UNDER THE PUSPIPTEK AMENDMENT:

1985	
December	Workshop on Marine Algae Biotechnology*
1986	
March	Workshop on Biotechnology in Agriculture*
June	Follow-up Meeting on Embryo Transfer and Animal Production*
	Workshop on National S&T Information Services*
September	Follow-up Meeting on Bioconversion of Agriculture By-Product
October	Ad Hoc Discussion on Science Policy
November	Steering Committee Meeting for Workshop on Marine Resources
December	Workshop on Biotechnology of Steroid Compounds as Contraceptives & Drugs.*
1987	
January	Technical Meeting to Follow-up Science and Technology Information Network
February	Technical Meeting on Embryo Transfer and Animal Production*
June	Workshop on the Development, Management, and Utilization of Indonesian Marine Resources*

* Activities covered in detail in appendices B-G.

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The general purpose of all of these activities was to establish an enduring relationship between the Indonesian and U.S. science and technology communities. An explicit effort was made to ensure that "the activities ... in this cooperative program link directly with the Mission's assistance goals stated in the Country Development Strategy Statement (CDSS)". A greater emphasis was also placed on the involvement of the private sector in the project activities. Other goals of the project included enhancing the capability of the Indonesian science and technology community to contribute to the broad development objectives of the country through the DRN.

4.2. Observations on NAS Contributions

The NAS enjoys a unique relationship with the Indonesian S&T community. There are strong positive feelings about NAS participation at all levels from universities and institutes to ministries and departments.

The NAS connection is viewed by many Indonesians as the principal linkage to the U.S. science and technology community. After 40 years, it has taken on a symbolic character for those who value broad interactions with U.S. interests. Foreclosing the relationship could appear to be a policy statement with implications broader than the actual workshop programs and funding levels involved . Many Indonesians would view this as a clear signal of a lack of interest on the part of the U.S. in Indonesian S&T development.

NAS involvement in the determination of the technical feasibility of a program represents a strong "validation" of the concept in the minds of those considering committing resources to the effort. Such "validation" is extremely difficult to generate from wholly internal analyses or sources.

The NAS interactions do facilitate decision making in key priority areas in Indonesia. The NAS is viewed as a balanced, impartial, disinterested party dedicated to a process that takes full account of Indonesian interests. Therefore, judgements arising from programs in which it participates are given considerable weight.

The early workshops from 1968 to 1984 dealt with broader policy issues than the more recent technically oriented series. Essentially all of the recommendations of the 1968 workshop on food and nutrition have been implemented through inclusion in national planning documents. Repelita V is now in preparation and the DRN is reviewing a set of recommendations for inclusion in the national plan. It is anticipated that some workshop conclusions and recommendations will be incorporated into this document. Members of the DRN feel that the cooperation with the U.S. National Academies lends weight to their positions in the establishment of a science and technology strategy for Indonesia. Many Senior Indonesians have indicated that conclusions reached in the NAS workshops are frequently cited in support of and as justification for specific programs.

The NAS/DRN workshops strove to improve networking among Indonesian scientists and to create contacts betwwen Indonesian and American scientists and engineers. Travel budgets in Indonesia are severely restricted and seminar programs are often weak or nonexistent. A fragile telecommunications network further isolates people working in different institutions. The NAS/DRN workshops provided Indonesians at different levels with the opportunity to meet each other and discuss more technical topics than those usually covered in national policy meetings of groups such as the DRN or the National Committee on Biotechnology.

Although some view the NAS/DRN workshops as a part of the Indonesian science and technology establishment under the control of the Ministry for Research & Technology (RISTEK), this outlook is only partially shared by the broader Indonesian scientific community. They concur that the choice of topics largely reflects the Ministry's direction but they recognize that follow-up funding allocations and implementation of workshop recommendations are predominantly in the hands of the GOI departments and the private sector. For example, the Embryo Transfer Workshop follow-through depends on the Department of Agriculture (see Appendix D); the Steroids Workshop follow-up rests in private sector and government-owned enterprises (see Appendix C).

A number of activities related to the subject matter of each of the NAS workshops were cited as "follow-on" activities, inspired by the workshop. Since in every case the workshop was one element in an ongoing set of plans or activities it is difficult to draw a one-to-one correspondence or lineal dependence with subsequent events. Nevertheless, while there were surely verifiable "follow-on" activities the general impression is that more can and should be done to organize and promote such activity both on the NAS and on the Indonesian side.

Many of the NAS workshops looked into areas that appear to have future potential for commercialization or industrialization following a period of technological development. The workshops themselves fall far short of providing even a framework for such development. The exceptions are the Marine Resources workshop (Appendix E) and the Marine Algae Workshop (Appendix F). Some feasibility studies for further development activities have been conducted in Indonesia following the workshops. Absent a strong champion in a position of power, they are not likely to be effective in generating risk capital for demonstration or commercialization programs. Further intervention by an outside "validation team" may be required. It does not appear obvious that NAS is the natural institution to perform this function.

Even when a technology champion exists, outside forces can dampen enthusiasm for continuing the venture. In the case of steroid production from sonanum, the changing world market condition which drastically cut the price of steroids, appears to have postponed further development. (See Appendix C).

Indonesia does not yet possess a sufficient critical mass of scientists and engineers to form a cohesive, self sustaining scientific community. This is particularly noticeable in the absence of active professional societies, the lack of peer review processes, the percentage of PhDs trained outside the country, and in the diversity of research interests.

Top scientists in Indonesia are very thinly spread and most hold multiple positions each bearing significant responsibilities, usually of an administrative nature. Because of the small numbers many researchers are isolated scientifically both from others in their field and especially from commercial interests and requirements.

Research funding is scarce in the Indonesia operating budget allocation from the GOI support. The university research operating budget was cut to zero in 1987-88. Outside of the Inter-University Centers, which are funded through a separate loan from the World Bank, many labs can mount only marginal efforts leading to ineffective use of the available research manpower.

4.3 The NAS Activities relative to USAID programs

The innovation process stages as sketched in Section 2.2 provides a useful paradigm for examining the relationship of the NAS/DRN activities to two programming thrusts of the USAID. In the following, we compare the influence of the NAS/DRN activities on human resource development and on employment, trade and investment promotion.

4.3.1 Proposed USAID Strategies

A.I.D. Washington, the USAID Mission in Jakarta, and the Republic of Indonesia are involved in a cyclical process of setting a bilateral assistance strategy for the next four or five years. This coincides with the RI activities to formalize Repelita V, covering the years 1989-1994. Among the programming themes for development assistance are the topics of human resource development and employment, trade and investment promotion. These themes are tied to an overall strategy to strengthen bilateral cooperation and facilitate the process of economic reform begun several years ago by the RI. In a period where the levels of development assistance are declining, the Mission feels the need to focus on two or three problem areas, build on existing projects in those areas, and upgrade USAID staff capabilities in those select areas. In this scheme S&T activity has been deferred until 1993 as a sector for programming.

The USAID mission's stance appears to define Science and Technology in a restricted sense that somehow focuses upon the NAS activities, the Puspiptek Energy Lab, and the Science Advisor to the

Minister of State for Research and Technology. At the same time, the Mission clearly appreciates the A.I.D. Washington analysis of research content in the Asia region USAID portfolios that indicates Indonesia has the largest percentage of project funding engaged in research and research capacity building[11]. It is justifiably proud of the over $240 million spent to strengthen Agricultural research capabilities in Indonesia over the past decade alone.

4.3.2 NAS and Human Resource Development

The contributions that NAS/DRN activities make to the innovation process are diagrammed in Figure 2 as curves of influence on the level of human resources development. On the spectrum from Long-term Research to innovation diffusion and technological mastery the impact of the efforts of NAS/DRN is centered around Applied Research and Technology Application Development. When the collaboration supports a LIPI initiative, e.g. the Biotechnology in Agriculture Workshop and the Marine Resources Workshop, the primary influence on human resources development has been on Applied Research. The two tails of the curve indicate the spread to Long-term Research and to Technology Application Development, but these have been a minimal influence. When the NAS/DRN program is closely associated with BPPT interests, as in the case of the Workshop on Marine Algae Biotechnology, then the NAS/DRN influence on human resource development shifts to center on the Technology Application Development and can extend to the Pilot Project area.

For comparison, one can judge other A.I.D. activities on the same continuum. The USAID support of agricultural research is a much broader curve that influenced activities from Applied Research and Technology Applications Development to Technology Demonstrations. Human infrastructure development in Health, and in Population has been much more centered on delivery systems, the Pilot Project, Demonstration Project, and Innovation Diffusion portion of the sprectrum. Other programs in the USAID portfolio could be similarly characterized.

4.3.3 NAS and Employment, Trade, and Investment

The significance of technological advance to economic development has been well studied and thoroughly documented. The improvement of product and process technologies is a clear goal of A.I.D. development assistance, but the means of achieving it provides many options. The international transfer of technology through trade in capital goods and services is one means. Transnational corporations dominate this process,

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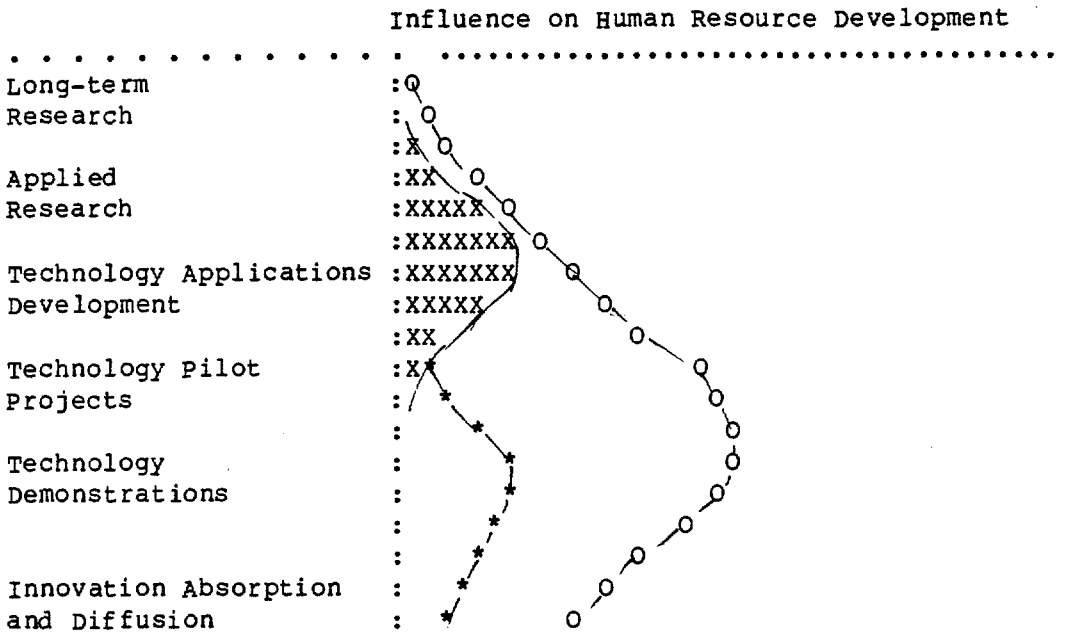
[11] "An Assessment of S&T Activities in the ANE Region," draft by Peter Delp and Janet Rice for the Office of Technical Resources, Bureau for Asia and the Near East, Agency for International Development, October, 1987



KEY:

XXX NAS/DRN Influence

OOO Agricultural Research Support

*** Health Research and Delivery Systems Support

Figure 2. The influence of NAS activities on the innovation process and human resource development in relation to other USAID funded programs

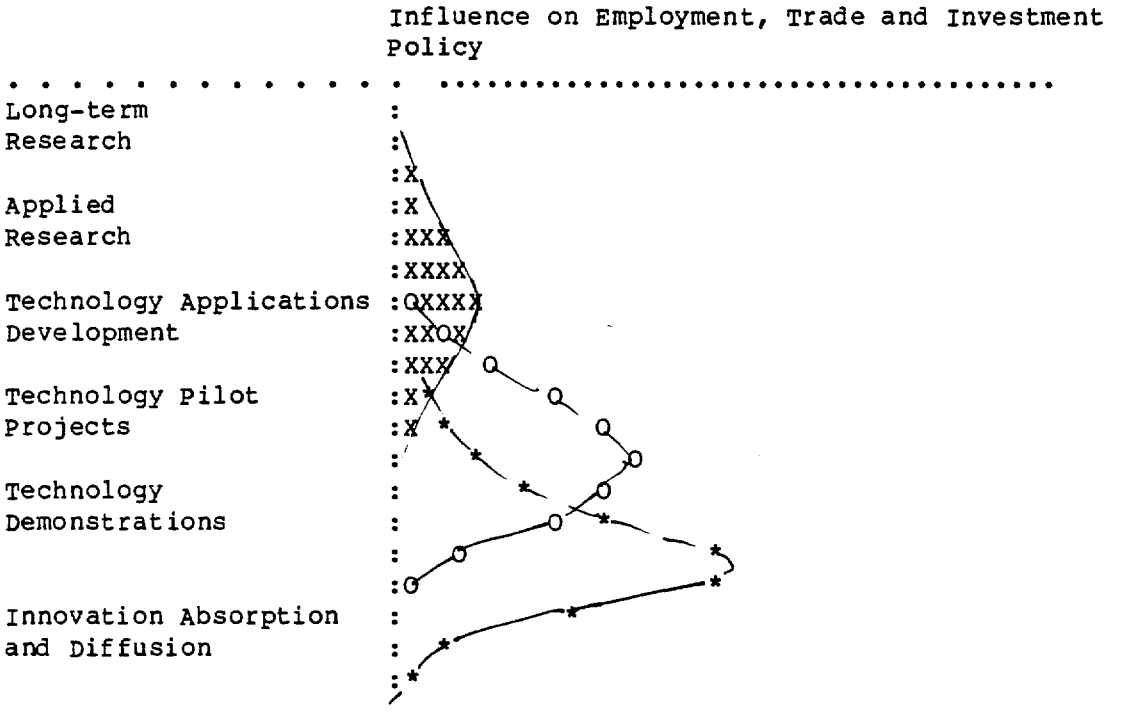
though smaller firms bring in new technologies to Indonesia, usually through consulting services. Building indigenous capacity to identify, select, acquire and adapt technology is another means. Also, strengthening Applied Research capability promotes capacity for Technology Applications Development as sketched in Section 2.2.

Technological advance comes about through trade and investment. It need not be at the cost of jobs, but ideally occurs as an upgrading of the skilled labor base. The ties to employment levels are complex, not only because technology improvements shift the factors of labor relative to other factors of production, but because of world markets. For example, the number of employees in an industry can be raised by encouraging investments in technological processes that favor labor over capital. However, the gains can be quickly lost when the production plant loses its share on the world market to products produced by improved technologies. The ability of exporters to gain and hold market share is closely tied to quality relative to price. Quality is tied to worker and management skills and to a continuous program of technological advance .

USAID is funding under its Development Studies Project (DSP) a three-year program to examine dynamic comparative advantage for specific industries in relation to industrialization policy. The evaluation team has met with the contractors, a DSP/Boston research team, in both Washington and Jakarta. The evaluation team did not have time to examine whether this DSP/Boston technical assistance effort, centered in the national planning board, BAPENAS, will address technology policy from a broad perspective (e.g including human resource needs and scientific research infrastructure, along with economic policy reform). Efforts by the DSP team to establish ties with the BPPT are significant.

The team had the opportunity to discuss the future plans of USAID Private Enterprise Offices to develop a major project in export trade and investment. While the project is in an embryonic stage, the discussions pinpointed some of the distinctions which need to be made between market development, technology brokering roles, and venture capital financing.

The S&T innovation spectrum is useful for examining the potential influence of the NAS activities on Employment, Trade and Investment Policy Development, in comparison to other activities. Figure 3 suggests that the NAS role in influencing such policies covers the range from Applied Research to Technology Applications Development. While not insignificant, it could be dwarfed by the technical assistance to BAPENAS offered by the Employment, Trade, and Investment team from Boston under the DSP. Their impact is likely to be on pilot or demonstration efforts. Similarly, the Private Enterprise Office export promotion initiative may have impact through a demonstration effect. By comparison, the multinational corporations operate at the diffusion stage, and only rarely does their influence spread into the domains of Applied Research. Yet when a transnational firm focuses its attention on Technology Applications Development and Pilot Activities, it is an effective force.



KEY:

XXX NAS/DRN Influence

OOO DSP/Boston Technical Assistance to Bapenas

*** Multinational Corporations

Figure 3: The influence of NAS Activities on the innovation process and employment, trade and investment policy.

Thus, for a process that promotes continual upgrading of production technology, the NAS role could be especially valuable when circumstances favor the transition of the subject activity into pilot and demonstration stages. This has been the case with the Marine Algae program. Through NAS/DRN workshops, the project brought FMC Marine Colloids back into the seaweed harvesting picture in Indonesia. (See Appendix F).

5. SUMMARY CONCLUSIONS AND RECOMMENDATIONS

The observations, interviews, and analysis of the evaluation team lead to the following summary conclusions with regard to the past and future role of the NAS S&T activities in Indonesia:

-- The NAS enjoys a unique relationship with the Indonesian S&T community. There are strong positive feelings about NAS participation at all levels from universities and institutes to GOI ministries and departments.

-- The NAS connection is viewed by many Indonesians as the principal linkage to the U.S. science and technology community. Foreclosing the relationship would be viewed by many as a policy statement with implications broader than the actual workshop programs or the funding levels involved.

-- The NAS interactions do facilitate decision making in key priority areas in Indonesia. The NAS is viewed as an impartial, balanced, disinterested party dedicated to a process that takes full account of Indonesian interests.

-- Even though the primary flows of innovations to industrial enterprises are from the international transfer of technology embedded in capital goods and consulting services, NAS activities still provide a powerful stimulus to the S&T community to respond to international expertise on market opportunities.

-- Inclusion of transnational corporation researchers in the NAS/DRN activities has had only minimal commercial results--thus far. Its intangible benefit is in sensitizing the Indonesian S&T community to the pace of technological developments in a dynamic world market.

-- NAS involvement in the determination of the technical feasibility of a program represents a strong "validation" of the concept in the minds of those considering committing resources to the effort. Such "validation" is extremely difficult to generate from wholly internal analyses or sources.

These lead to the following recommendations for the USAID Mission in Jakarta:

-- Continue a relationship that maintains linkages between the U.S. National Academy of Sciences and the Indonesian S&T community.

-- While continuing the relationship, reexamine over the next two years the underlying purposes of the NAS/DRN cooperative programs and their effectiveness in bringing new S&T concepts through the entire innovation cycle (as sketched in Chapter 2.); develop a new proposal for future funding consideration during this period.

-- Give more attention to the problem of follow through activities in promising areas that have been identified in workshop development activities and in the workshop output--considering the roles of the U.S. NAS/NRC, the USAID Mission and the DRN; strengthen the currently minimal coordinated activity in this area.

-- Enhance the USAID Mission's capabilities to deal with activities that are now subsumed under the generic term S&T, including not only the NAS programs and PUSPIPTEK but also important elements of programs in human resource development, education, resource development and industrialization.

-- Consider developing new institutional arrangements outside of the NAS/NRC to provide input into the problems associated with carrying promising technology past the Technology Application Development stage into the Pilot Project or Demonstration Project stages. These important stages in the process of innovation have characteristics that do not necessarily match the capabilities and constraints of NAS activities.

No recommendation is made for a follow-up evaluation team effort in this area for the immediate future. The ingredients for future planning are already in place and can be dealt with in A.I.D. in cooperation with NAS and DRN. For example, LIPI is currently working with UNESCO to develop science indicators for Indonesia.[12] They currently have developed 19 indicators. Science indicators can be useful tools for comparison of science and technology activities and progress in different countries. A.I.D. should be able to use such data in future planning for S&T and therefore it is in the interest of the USAID Mission to support and track these efforts.

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[12] An NAS workshop on manpower planning in Indonesia in the early 1980's brought together National Science Foundation and U.S. Office of Technology Assessment panelists with the Indonesian Institute of Sciences staff (LIPI) to discuss the concept and purpose of science and technology indicators.

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APPENDIX A

Evaluation Approach

1. Scope of Work

This study will proceed by focusing on four basic sets of questions:

A. Overview of Indonesia S&T

1. What are the primary sources of technological development in Indonesia? What has the role of the Government (through LIPI, DRN, etc.) been? What has the role of the universities been, and, what has the role of the private sector been (both domestic and international)?

2. Has Indonesia tended to emphasize and/or invest in specific areas of S&T? Has this been due to Government policy, comparative advantage, or other factors?

B. NAS and Indonesian S&T development.

1. To what extent has NAS, and through NAS the U.S. S&T community, established an enduring relationship with the Indonesian S&T community? Are there activities underway outside the scope of the project which indicate that the Indonesians view NAS as a valuable resource in the furtherance of their S&T objectives? What are the options open to AID to help foster more enduring linkages between the S&T communities of the two countries.

2. Does the capability exist in Indonesia to take advantage of the high level U.S. S&T resources to which NAS has access? Do these capabilities primarily exist in the universities, in technical Ministries, or in their public sector institutions? What are the capabilities of the private sector in this regard?

3. Are there specific Indonesian development problems in which the relationship with NAS has proven to be particularly critical or useful in developing solutions?

C. Current NAS component of PUSPIPTEK Contract

1. How have seminar topics been selected; who has been involved? Are the topics of the seminars of direct relevance to the immediate challenges facing Indonesia, or are the topics more closely linked to the long-term problems that the country must eventually address?

2. Have the seminars jointly hosted by NAS involved the leaders of Indonesia's S&T community, both in the public and private sectors and from the universities? What role has the DRN played?

3. What follow-up actions have resulted from the seminars? Is there evidence that they in any case contributed to policy changes? Have they promoted greater collaboration between various segments of the S&T community, specifically the private and public sectors?

D. USAID Role

1. How critical has USAID support been to furthering the long-term goal outlined earlier through the support it has provided over the years for NAS activities in Indonesia?

2. How critical has USAID support been to success of activities funded under the PUSPIPTEK amendment.

2. Evaluation Methodology

The evaluation team was comprised of four persons:

-- A senior U.S. research scientist with broad experience in R&D Management and S&T Policy in Developing Countries of South-East Asia (Dr. Robert E. Hughes)

-- A key Indonesian S&T expert familiar with the NAS S&T cooperative activities (Dr. Saswinadi Sasmojo);

-- An A.I.D. specialist in science and technology and technology transfer with experience in evaluating A.I.D. programs, especially in small-scale enterprise, marketing and commercialization of technology (Dr. Peter Delp); and

-- A US scientist in the biotechnology field, with knowledge of regulatory issues, and familiar with A.I.D.'s Program in Science and Technology Cooperation programs and grants (Dr. Janet Rice).

The evaluation effort drew on other expertise, meeting with economists working in the development, industry, and trade research project both in Indonesia and the U.S.; and World Bank staff concerned with Indonesian policy, research, and programs, including the technical training fellowship program.

The team met in Washington for background interviews, document review and analysis on Thursday January 21, 1988. Interviews were held with staff of the ANE Bureau, Office of the Science Advisor, Center for Development Information and Evaluation, topic coordinator for impact evaluation series on AID supported Agricultural Higher Education; and Ms. Rose Bannigan and Ms. Wendy White, BOSTID. Before leaving Washington the team contacted U.S. participants in the workshops for interviews.

The team arrived in Indonesia on February 1, 1988 and met with both the USAID Mission Director and his staff, including both program and project officers, and with Embassy officials in charge of economic, commercial and scientific affairs. Interviews were arranged with representatives of the S&T community, including Government organizations (RISTEK, DRN, LIPI, BPPT, PUSPIPTEK, Department of Health, Department of Agriculture, BAPPENAS), several universities (IPB, ITB, UI), regional laboratories (BIOTROP, IRRI), the Indonesian private sector, other donors, and multinational corporations. These individuals are identified in appendix I.

Most of the interviews were held in Jakarta, but the team visited Universities and Laboratories at Serpong, Bogor, and Bandung in W. Java, and traveled to Nusa Dua in Bali to see the seaweed experimental farm (see Appendix F). Members of the team toured laboratories and production facilities, including the aircraft plant at Bandung. At the conclusion of these visits the team had the opportunity to meet with the Minister of State for Research and Technology to discuss the findings.

A preliminary draft report was circulated to key USAID staff and a presentation given just prior to departure of the team from Indonesia. A complete draft was sent to the Mission one month later for review and comment from GOI officials. The final report was prepared in Washington, taking into account Mission and Washington comments, and BOSTID comments.

APPENDIX B

Biotechnology in Agriculture

1. Context

-- High expectations for the potential exploitation of genetic engineering and "biotechnology" have been expressed in industrialized countries. Developing countries are beginning to look to elements of this rapidly unfolding science to create new opportunities in medical, agricultural and aquacultural technologies. Biotechnology research and utilization has been established as a national priority at the highest levels of the Government of Indonesia (GOI).

-- Agricultural development and increasing rural incomes are priorities both for the GOI and for USAID. Several relevant A.I.D. funded projects include the Applied Agricultural Research Project ($33 million over 12 years) the Sumatra Agricultural Research Project ($9.5 million over 10 years) and the new Agricultural Research Support Program ($41 million). It is estimated that past and current USAID direct support for agricultural research in Indonesia total over US $250 million.

-- With substantial assistance from the International Rice Research Institute (The Philippines), Indonesia was able to achieve self-sufficiency in rice production early in this decade. Several of the high yielding varieties were developed in Indonesian experimental stations through conventional hybridization research.

-- The greatest yield increases of the "green revolution" were obtained in rice production in the irrigated areas of Indonesia by the mid-1970s. Continued gains in crop yields now depend on the development of stress-resistant strains that will flourish on marginal lands. One promise of biotechnology in plant research is the acceleration of testing and adaptation of crop species.

-- Indonesia has many agricultural by-products and wastes that could be utilized through biotechnology to produce useful products, including food for people and animals and industrial products.

-- Biotechnology encompasses a wide range of activities some of which are accessible at relatively modest levels of technical expertise. Nevertheless, the most successful applications of these technologies will require extensive research and sophisticated backup and delivery systems.

-- Personnel, equipment, and physical facilities for agricultural biotechnology research and development are relatively expensive when compared to traditional agricultural methods, but not when compared to many areas of high-tech industrialization.

2. Summary of Workshop and Related Activities

The Board on Science and Technology for Development (BOSTID) of the U.S. National Academy of Sciences (NAS) and the Indonesian National Research Council (DRN) jointly planned and held a workshop on "Biotechnology and Agriculture." Excerpts from the BOSTID summary of the workshop and subsequent activities follow:

> Held in Jakarta, March 13-14, 1986, this workshop was organized by the National Committee for Biotechnology of the Office of the Minister of State for Research and Technology [RISTEK] under the sponsorship of the Indonesian National Research Council [DRN]. The primary objectives were to exchange information on and experience in implementing biotechnology for agriculture, to discuss how in its present state and in the future biotechnology might increase agricultural production in Indonesia, and to set priorities for a program that would apply biotechnology to agriculture in four areas: embryo transfer and animal production, plant tissue and cell culture, plant nitrogen fixation, and bioconversion of agricultural by-products.
>
> ...
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> Particular attention was given in the workshop to the industrial potential of products that may arise from the application of biotechnology as well as how to increase agricultural output. Attention was focused not only on near-term prospects, but also on the longer term which will be affected by the use of biotechnological techniques.
>
> Prior to the workshop a one-day visit was made to the Marihat area to meet with officials of the oil palm estate, research center, and palm oil factory located there. The next two days were spent in the Bogor area visiting officials of Bogor Agricultural University [IPB], staff of the Bogor Research Institute for Estate Crops, [and] several dairy farms, as well as Tapos, the personal farm of President Soeharto.
>
> ...
>
> A technical meeting on the bioconversion of agricultural by-products was held in Indonesia September 2-3, 1986 in follow-up to the March biotechnology workshop. This meeting resulted from correspondence between Dr. Robert Busche, U.S. panelist at the biotechnology workshop, and Dr. A.M. Satari, deputy chairman of the Agency for the Assessment and Application of Technology (BPPT), and the visit to the United States by Dr. Haryanto Dhanutirto, assistant deputy II to the Minister of Research and

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Technology and chairman of the biotechnology workshop organizing committee. The purpose of the meeting was to design a research plan that would eventually lead to the production of animal feed and other items from agricultural by-products.

...

Presentations made at the meeting indicated the willingness of MBI [Michigan Biotechnology Institute] to participate in a collaborative project to produce animal feed from forest residue. MBI would provide the necessary training for the Indonesian scientists at its facilities and assist in the development of a pilot-scale plant. The costs would be shared by MBI and the Indonesians. The pilot scale plant would later be transferred to Indonesia. This package ensures that the Indonesians would not only participate in the research and development part of the design activities but would also be trained to operate the plant. Summary minutes of the meeting were prepared by BOSTID staff and given to both USAID/Indonesia and the DRN.

Arrangements were made for Dr. Satari and Dr. Didin Sastrapradja, chairman of Indonesia's National Committee on Biotechnology and Assistant Minister II to the Minister of State for Research and Technology to visit both the MBI and Werner-Pfleiderer offices for further discussions during their visit to the United States in October 1986. Although Minister Habibie has concurred in this project and given his approval to move ahead with negotiations on the animal feed proposal, the current financial situation in Indonesia necessitated a delay in instituting this program. Initially, however, the Indonesians hope to be able to cover training costs through AID's General Participant Training Project.[1]

3. Evaluation Team Interviews

The team interviewed the following members of the steering committee of the NAS/DRN Workshop on Biotechnology in Agriculture:

-- Didin S. Sastrapradja, vice-chairman for research at LIPI, chairman of National Committee on Biotechnology, assistant minister II to the Minister of State for Research and Technology, member of DRN

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[1] Excerpts from "Cooperative Activities in Indonesia on Science, Technology, and Research Policy Development: End of Contract Statement," pages 3-4, written by BOSTID for Contract No. AID ASB-0333-L-00-5161-00, October 2, 1985 - Jan. 1, 1988, National Academy of Sciences, Washington DC.

- -- A. A. Loedin, director of research, Ministry of Health
- -- Sediono M. P. Tjondronegoro, assistant minister V, RISTEK, secretary of DRN
- -- Setijati D. Sastrapradja, director, National Center for Research in Biotechnology
- -- Susono Saono, researcher, biological sciences, LIPI
- -- Haryanto Dhanutirto, assistant minister (III) RISTEK
- -- Charles C. Muscoplat, President Molecular Genetics, Inc. and University of Minnesota
- -- Ms. Rose Bannigan, BOSTID.
- -- A.M. Satari, deputy chairman, BPPT

The team interviewed the following researchers in biotechnology who participated in the workshop:

- -- Robert M. Busche, president, Bio-En-Gene-Er Associates, Delaware
- -- Gustaf A. Wattimena*, IPB
- -- Livy Winata Gunawan*, IPB

The team also interviewed the following scientists working in biotechnology fields who did not attend the workshop or technical meetings:

- -- Pratiwi Sudarmono, laboratory director and researcher, University of Indonesia
- -- Soelaksono Sastrodihardjo, director life sciences lab, Inter-University Center, Institute of Technology Bandung
- -- Tri Binarko Suselo, Tropical Forest Biology Program, SEAMO - BIOTROP--Regional Research Institute South East Asian Regional Center for Tropical Biology
- -- Adam Messer*, visiting scientist from Cornell University at BIOTROP, Bogor
- -- Atie Srie Duriat*, senior researcher in plant pathology, Lembang Horticultural Research Institute
- -- Sudjoko Sahat*, Potato Research Coordinator, Lembang Horticultural Research Institute
- -- Anggoro Hadi Permadi, Director for Research, Lembang Horticultural Research Institute
- -- Sudarwohadi Sastrosiswojo, Entomologist, Lembang Horticultural Research Institute
- -- Sampurno Kadarsan, director biological institute, LIPI

The team also interviewed several technical advisors from other donor projects:

- -- Professor Bram de Groot, Plant biotechnology consultant, University of Nijmegen, The Netherlands
- -- Dr. Van Meers, project ATA

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*Grantees for A.I.D.'s Program in Science and Technological Cooperation, under the Office of the Science Advisor in Washington

-- Japanese technical assistant, Lembang Horticulture Research Institute

4. Observations of the Evaluation Team

-- After the initiating workshop on the general topic of biotechnology in agriculture, technical meetings were arranged by BOSTID in three of the four topic areas: bioconversion of agricultural by-products, biotechnology of steroid compounds as drugs (see Appendix C), and embryo transfer and animal production (see Appendix D).

-- No progress was found with regard to the clear-cut proposal from the U.S. firm Bio-En-Gene-Er Associates to establish an animal feed industry through the bioconversion of agricultural byproducts. BPPT is still seeking Indonesian investors to implement the proposed program for construction of a pilot plant--perhaps having difficulty convincing investors why they should finance a pilot plant that would be sited initially in the U.S.

-- In general, the evaluation found no significant follow-up as yet in the form of continued contact between US and Indonesian agricultural biotechnology workshop participants. This was not for lack of interest among select US participants.

-- Workshop proceedings were published in English by the DRN with an introduction in Bahasa Indonesian. The report's distribution appears to have been limited--the team interviewed a number of scientists with potential interests in the field, but who were unaware of any published report.

-- Current applied research efforts on agricultural biotechnology in Indonesia are predominantly on tissue culture to (1) propagate and multiply important crops for production, and (2) production of secondary metabolites from plant species. The level of effort appears as of early 1988 to be marginal in many areas.

-- Research is decentralized: tissue culture programs to improve vegetable crops are carried out by department of agriculture in Lembang; tissue culture efforts to improve plantation crops are conducted by the Department of Agriculture in Bogor; tissue culture of a broad spectrum tree species is being examined at BIOTROP in Bogor; other tissue culture experiments to produce secondary metabolites are being done by researchers at ITB and IPB. These efforts appear to be uncoordinated.

-- Private transnational companies are also working on tissue culture of important crops such as rattan but the status of such efforts is not available. Several young researchers have been

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hired away from public sector laboratories to work for an Indo-Swiss firm in the Bogor area, presumably in applied biotechnology research.

-- Some of the Inter-university Centers, being established through a World Bank loan, are now in the process of developing biotechnology programs, training staff and purchasing equipment. Agricultural biotechnology is designated for IPB, industrial biotechnology for ITB, and medical biotechnology for the University of Indonesia and Gaja Mahda University in Yogyakarta.

-- At present, effective coordination is lacking among Inter-university Centers, the National Center for Biotechnology (under LIPI), university laboratories, and departmental research centers. Since these are new programs with innovative technologies, this is not surprising. However, the team was discouraged in its interviews to find only two or three individuals who could articulate prospects for coordinated research and development programs in the area of biotechnology.

-- Several prefeasibility studies have been carried out by the biotechnology project formation team of BPPT and issued by the National Committee for Biotechnology Development in Indonesia as part of the volume entitled Penetrating Projects in Biotechnology. In a cursory examination of the prefeasibility studies, the evaluation team found the projects to be enthusiastically promoted, but financial analyses that was not altogether convincing.

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[2] The studies were on "Lignocellulosic Forestry and Agricultural Wastes," "Industry for Rhizobium Innoculants," "Production of Rattan Seedlings by Tissue Culture," and "Embryo Transfer for Beef Production."

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APPENDIX C

Biotechnology in Steroid Production

1. Context

-- Indonesia, with about 175 million people, is the fifth most populous country in the world. Sixty-three percent of the population is located on Java and Bali, an area which represents only seven percent of the total land area in the country.

-- The crude birth rate is now 30 per 1000 population, decreased from 41 per 1000 population in 1970. However, the annual population growth is still over 2.0 percent. The population is young and demographics indicate that the population will reach about 250 million early next century.

-- Contraceptive prevalence rates (a measurement of the use of modern birth control techniques) increased from 4 percent in 1970 to 58 percent in 1986. This is generally recognized as an outstanding success.

-- A.I.D. has a long history of support to the family planning programs in Indonesia. Recent projects provide contraceptive commodities, technical assistance, and support for experimental and other programs aimed at improving management and reducing costs. A.I.D. has invested $51.5 million since 1978 with the goal of decreasing the crude birth rate to 22 births per 1000 population and increasing the contraceptive prevalence to 65 percent in 1989 and to 75 percent by the year 2000 in both rural and urban areas.

-- Distribution of contraceptives grew from several million cycles in 1970 to more than 65 million cycles in 1985. An estimated 150 million or more cycles will be required by the year 2000. These increases not withstanding, foreign assistance (almost exclusively from the A.I.D.) to supply oral contraceptives is a diminishing fraction of the cycles distributed.

-- Prior to 1986 Kimia Farma, a government-owned company operating on a for-profit basis, produced more than 90 percent of the oral contraceptives distributed in Indonesia. Steroid compounds are the basis for manufacturing oral contraceptives. All requirements are imported.

-- In 1985-1986 the fraction of steroid-based contraceptives distributed free of charge by the National Family Planning Coordinating Board (BKKBN) was 58.1 percent.

-- The Government of Indonesia (GOI) has placed a high priority on becomming self-sufficient in the supply of steroid-basedcontraceptives. Several prospective steroid sources from agricultural wastes have been identified.

-- The BKKBN sponsored a seminar on steroid compounds for contraceptives in June 1981, the main aim of this seminar was to interest several large transnational corporations in investing in production facilities in Indonesia. Dr. Hyun K. Kim, a scientist at the U.S. National Institutes of Health, was a technical consultant. Apparently, none of the firms were sufficiently interested.

2. Summary of Workshop and Related Activities

The Board on Science and Technology for Development (BOSTID) of the U.S. National Academy of Sciences (NAS) and the Indonesian National Research Council (DRN) jointly planned a workshop on "Biotechnology of Steroid Compounds as Contraceptives and Drugs" following discussions in Indonesia in March 1986 and in Washington in May 1986. This workshop was held December 15-17, 1986. Excerpts from the BOSTID summary of the workshop and subsequent activities follow:

> The primary objectives of the workshop were to exchange information on and experience in the implementation of biotechnological techniques in producing steroid contraceptives and drugs, to discuss how biotechnology might be used now and in the future to produce steroid contraceptives and drugs from natural resources, and to set priorities for an action program in this area to enhance the national capability. Particular attention was given in the workshop to the utilization of indigenous natural resources. To produce the necessary steroid compounds for contraceptives and drugs, however, a total as well as partial synthesis was recommended for adoption.
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> Dr. Utarto, president-director of PT Kimia Farma, served as overall chairman of the workshop. ... A summary report prepared by BOSTID staff officer Rose Bannigan was published in October 1987.
>
> Since the workshop several of the Indonesian officials from Kimia Farma have received research and expired patent information from the U.S. panelists. Dr. Kim [the scientist from the NIH who had attended the 1981 seminar on steroid manufacture] has indicated his willingness to visit Indonesia for 30-60 days to work in the laboratory

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at Kimia Farma and, after that time, arrange for several of its staff members to undertake research for a year at one of the NIH laboratories where they can develop the laboratory techniques needed to produce steroids. While in Jakarta in February 1987 Mrs. Bannigan met with the officials of Kimia Farma and discussed the situation. They will be in direct touch with Dr. Kim and, subsequently, with Professor Sediono and Mrs. Bannigan regarding any potential future collaboration.[1]

3. Evaluation Team Interactions

The evaluation team interviewed several members of the workshop steering committee:

- -- Didin S. Sastrapradja, chairman National Committee on Biotechnology
- -- Sediono M. P. Tjondronegoro, DRN
- -- Oei Ban Liang, director Biotechnology IUC at Bandung
- -- A. M. Satari, BPPT
- -- Susono Saono, Biological Institute, LIPI
- -- Haryanto Dhanutirto, RISTEK
- -- Rose Bannigan, BOSTID

Members of the workshop organizing committee were interviewed:

- -- Jana Anggadiredja, BPPT
- -- Haryanto Dhanutirto, RISTEK

The following workshop participants were interviewed:

- -- Arini, research and development staff, Kimia Farma
- -- Gustaf A. Wattimena, researcher in tissue culture, IPB
- -- Livy W. Gunawan, researcher in tissue culture, IPB

The team visited the offices and production facilities at Bio Farma, a state enterprise manufacturing pharmaceuticals in Bandung and were met by:

- -- Mrs. S. Soeharto, Chemist and Commercial Director
- -- Dr. J. Soetarjo, Veterinarian and Production Director
- -- Thamrin Poeloengan, DVM, Company Secretary

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[1] Excerpts from "Cooperative Activities in Indonesia on Science, Technology, and Research Policy Development: End of Contract Statement," pages 6-8, written by BOSTID for Contract No. AID ASB-0333-L-00-5161-00, October 2, 1985 - Jan. 1, 1988, National Academy of Sciences, Washington DC.

The team also visited the offices and the research lab at Kimia Farma in Bandung. Kimia Farma was represented by:

- -- Zainut Yasin, General Manager
- -- Mrs. Arini S., Research and Development
- -- Kusara, Production Manager, Quinine-Cinchona Plantation Department
- -- Mrs. Ilya Sumargonio, Head of Production Quality Control
- -- M. U. Kuswana, Head of Rifampicin-Quinine-Cinchone Plantation Department

4. Observations of the Evaluation Team

-- U.S. workshop participants report minimal contact with their Indonesian counterparts after returning to the U.S. There have been requests for reprints of papers referenced in the workshop report. At least one Indonesian workshop participant had not yet seen the workshop report.

-- With regard to Dr. Kim's offer to assist in developing steroid production from solanum, two developments seem to have negated any response from Indonesia:

> It was reported to the evaluation team by a senior scientist at ITB that the Peoples Republic of China has been dumping steroids on the world market decreasing their value from US$80 per kg. to US$35 per kg.; and
>
> Kimia Farma is producing oral contraceptives under a licensing arrangement with the Dutch company, Organon.

-- An invited participant working in production at pt. Kimia Farma did not attend the workshop, because he was convinced that the material covered was too theoretical to be of practical value to the company.

-- The recommendations suggest that Indonesia focus on three applications in the steroid field. Scientists at Kimia Farma felt that these recommendations should have been made more specific and prioritized according to an analysis of the Indonesian resources and the world market.

-- The participants in the working group for the production of steroid compounds by plant cell and tissue culture expressed more satisfaction with the workshop than did the organic chemists from Kimia Farma. They were more interested in the problems of obtaining a plant variety from which the berries could be harvested more easily.

-- Kimia Farma is establishing an R&D capability largely by investing in sophisticated hardware for the characterization and quantification of reaction products. The laboratory is staffed by one recent university graduate, who can draw on scientists working on production lines.

-- Kimia Farma has signed an agreement with the Institute of Technology Bandung (ITB) for "collaborative" research on antibiotic production.

-- The Bio Farma facilities at Bandung appear to be devoted solely to production under licensing agreements with no apparent interest in or resources devoted to applied research.

-- The Agency for the Assessment and Application of Technology (BPPT) does not have a team working on steroids. The NAS/DRN workshop was handled through BKKBN, the National Family Planning Organization.

-- BPPT, however, has begun a collaborative research program on the production of solanum through tissue culture with a German organization.

-- Tissue culture research on the production of secondary metabolites for use as medicines, pesticides or other products is being carried out at the Bogor Agricultural University (IPB) and at ITB.

APPENDIX D

Biotechnology in Embryo Transfer

1. Context

-- The genetic stock of Indonesian cattle is poor; average milk production is 22 liters per day as compared to 35-40 liters per day in the United States.

-- Record keeping at both large and small dairies is weak.

-- Indonesia does not currently have the capability to progeny test young bulls.

-- Bulls used in the artificial insemination program at Lembang are of marginal genetic quality. The program is dominated by Holstein and local Brahman breeds.

-- Embryo transfer, as used to multiply rare breeds, strains, or individuals, reduces costs from shipping and quarantining of imported livestock breeds.

-- Success of embryo transfers (Holstein and White Brahman) in Indonesia measured by Granada International Corporation was a 35 percent pregnancy rate although the conformation of White Brahman's obtained was marginal. Pregnancy success rates for embryo transfer under optimal conditions are 60-80 percent.

--The U.S. participants at the workshop commented:

> Given its current success rate, embryo transfer could lead to an increased rate of genetic improvement from 10 to nearly 100 percent depending principally on the current intensity of sire selection and on the trait(s) in question. The possible effects of this alternative technology on the rate of genetic improvement in milk yield in dairy cattle using artificial insemination has been estimated at 100 kg per cow and using embryo transfer, 158 kg per cow per year.[1]

2. Summary of Workshop and Related Activities

The Board on Science and Technology for Development (BOSTID) of the U.S. National Academy of Sciences (NAS) and the Indonesian National

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[1] Comments by U.S. Participants, Technical Meeting on Embryo Transfer and Animal Production Summary Report pg. 7.

Research Council (DRN) jointly planned and held a workshop on embryo transfer. The BOSTID summary of the workshop and subsequent developments are excerpted below:

> At the request of the DRN, BOSTID provided a panel of U.S. experts for a joint technical meeting on embryo transfer and animal production, which was held in Jakarta, February 23-24, 1987. ... The primary objectives of the technical meeting were to assess the present status of knowledge about and experience in embryo technology and animal production technology in Indonesia, identify gaps between the current situation and the actual requirements, determine the embryo transfer program, and set priorities for an action program to establish a center for embryo transfer and animal production. Such a center would provide the advanced technology, animals, embryos, semen, and modern training to produce genetically superior livestock for Indonesia and eventially livestock products for international markets.
>
> After the meeting adjourned field visits were made to the Lembang area near Bandung where the U.S. participants visited an artificial insemination center, a milk cooperative, a government-run dairy, and a private dairy. On the return trip to Jakarta the group visited the Kariyana Feedlot at Cicurug. A report summarizing the papers presented and the conclusions and recommendations of the joint group was published in November 1987.[2]

3. Evaluation Team Interactions

The team met with the Indonesian members of the Steering Committee:

- -- Didin S. Sastrapradja, LIPI, DRN, RISTEK
- -- Haryanto Dhanutirto, RISTEK
- -- Sediono M. P. Tjondronegoro, DRN
- -- Susono Saono, LIPI
- -- A. M. Satari, BPPT, DRN

The team had the opportunity to meet with Indonesian members of the Organizing Committee:

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[2] Excerpts from "Cooperative Activities in Indonesia on Science, Technology, and Research Policy Development: End of Contract Statement," pages 7-9, written by BOSTID for Contract No. AID ASB-0333-L-00-5161-00, October 2, 1985 - Jan. 1, 1988, National Academy of Sciences, Washington DC.

-- Haryanto Dhanutirto
-- Jana Anggadiredja (BPPT)
-- Ida Kusumah (BPPT)

The team was unable to meet with Mozes Toelihere, formerly at Bogor Agricultural University, because he has been promoted to Rektor of the University in East Timor and was not available in Java.

The team interviewed the following U.S. workshop participants:

-- Jerry J. Reeves, Washington State University
-- Donald E. Farris, Texas A&M University

4. Observations of the Evaluation Team

-- The evaluation team found no evidence of continued contacts between U.S. participants in the workshop and their Indonesian counterparts after their return to the United States. The two U.S. participants contacted were not involved in planning the workshop.

-- The team was unable to confirm any interest by U.S. companies in assisting with training and utilization of embryo transfer in Indonesia.

-- The Agency for the Assessment and Application of Technology (BPPT) has had a staff member dedicated to embryo transfer since 1985. After the workshop in 1987 a team of ten was formed to promote the commercialization of embryo transfer. The team consists of five staff from BPPT, two from IPB in Bogor, one at the artificial insemination center in Lembang and one person from the milk cooperative in Bandung.

-- A prefeasibility study on Embryo Transfer for Beef Production was carried out by the biotechnology project formation team of BPPT and issued by the National Committee for Biotechnology Development in Indonesia as part of a volume entitled Penetrating Projects in Biotechnology.

-- BPPT has proposed a pilot demonstration program to introduce embryo transfer in Indonesia and submitted it for approval to the the Minister of State for Research and Technology. They estimate that embryo transfer will take hold in four years and become cost effective ten years after the commencement of their pilot demonstration project. The project will import 100 embryos, implant them at the artificial insemination center in Lembang into donors selected from medium sized dairy farms (greater than 20 cattle). The impregnated cows will be cared for by the local

farmers and the offspring will be purchased by BPPT for 400,000 Rp, (Typical price for a calf is 150,000 Rp) raised on a coconut estate in Java and the best selected for further breeding.

-- Reportedly, the Ministry of Agriculture is using embryo transfer technology to breed Bali cattle.

-- Several staff from Tapos, the personal farm of President Soeharto, have been trained in embryo transfer in Texas.

Appendix E

The Development, Management and Utilization of Indonesian Marine Resources

1. Context

-- Indonesia's 13,000 islands covers 5 million sq. km., extending 2,300 nautical miles along the equator. Land territory is 1.9 million sq. km.; ocean is over 3.1 million sq. km.[1] The coastline is 81,000 km.[2]

-- Indonesia's seas cover 62 percent of its territory. About 1.7 million sq. km. of seas (about half the territory) are less than 100 meters in depth.[3]

-- Export earnings from fisheries was more than US$250,000 in 1985.[4]

-- Per capita fish consumption is still the lowest among the Asia countries, but accounts for 30-50 percent of the intake of dietary protein.[5] Fishermen, using small boats and simple gear, provide about 90 percent of the overall marine fisheries production.[6]

-- the Amindo Jaya project is a joint survey program between the U.S. Naval Oceanographic Office and Dinas Hidro-Oseanografi. Survey ship operating costs to the United States Government (USG) are $15 million annually and encompass geodetic, hydrographic and magnetic surveys.

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[1] Dirk Frankenberg, "Background Paper on Oceanography and Marine Resources," Summary Report of the Workshop on the Development, Management, and Utilization of Indonesian Marine Resources, National Academy Press, Wash. DC, 1987, pg. 105.

[2] Emil Salim, "Keynote Address," Summary Report of the Workshop on ... Marine Resources ...., pg 127

[3] Purwito Martosubroto, "Development And Management of Indonesian Marine Fishery Resources," Summary Report of the Workshop on ... Marine Resources ...., pg. 68.

[4] Martosubroto, pg 71

[5] Hasjim Djalal and Boer Mauna, "The Law of the Sea Convention and Indonesian Responses," Summary Report of the Workshop on ... Marine Resources ...., pg. 17.

[6] Martosubroto, pg. 69.

-- The Indonesian Seas Throughflow Experiment (INSTEP), is a proposed bilateral research program between the National Science Foundation (NSF), several major universities, the National Oceans and Atmospherics Administration (NOAA) in the United States and civilian and military organizations in Indonesia.

2. The NAS-DRN Workshop and related activities

The Board on Science and Technology for Development (BOSTID) of the U.S. National Academy of Sciences (NAS) and the Indonesian National Research Council (DRN) jointly planned and held a workshop on the development, management, and utilization of Indonesian marine resources. Excerpts from the BOSTID summary of the workshop and subsequent activities follow:

> In 1986 the DRN invited BOSTID to join it in sponsoring a workshop on the development, management, and utilization of Indonesian marine resources. As a first step a small steering committee from the United States and Indonesia met in Jakarta, November 16-19, 1986 to draft the agenda and to determine the proper participation from both Indonesia and the United States, the appropriate presentations to be made, and the background materials needed to make the workshop more valuable and relevant. Two U.S. panelists scheduled to take part in the workshop participated in this meeting as members of the steering committee. ...
>
> Following this meeting, Dr. Frankenberg, Dr. Gross, and Dr. Arnold Gordon, Lamont Doherty Geological Observatory, Columbia University, met with U.S. and Indonesian officials to discuss the development of the Indonesian Seas Throughflow Experiment (INSTEP) program. Specifically, they reviewed the requirements of INSTEP from Indonesia, its appropriateness for inclusion in the existing U.S. - Indonesian bilateral science agreement, and the appropriate time frame for the approval of a 1988 field activity.
>
> On the morning of November 25, 1986, Dr. Gordon presented an open seminar on "The Role of Indonesian Seas in Global Ocean Transport" to an audience at the Indonesian Institute of Science (LIPI). It was attended by about 150 Indonesian officials interested in this topic.

During a visit to Jakarta in February 1987, BOSTID staff officer Rose Bannigan met with Dr. Kasijan Romimohtarto, chairman of the workshop organizing committee and director of the R&D Center for Oceanology, and his assistant, Dr. M. Kasim Moosa, to review the final workshop agenda and to discuss potential U.S. participation.

This workshop, held in Jakarta, June 16-23, 1987, was designed to assess how much is presently known about marine resources, identify those with the greatest potential for development, point out constraints that might limit their development, and recommend actions that might overcome these constraints.

The level of knowledge of Indonesia's seas differs greatly among fields. The enormous biological diversity and productivity of these seas have supported both scientific study and fisheries for more than 300 years. Consequently, the biological resources are best known. Exploitation of offshore petroleum and tin resources, as well as recent academic interest generated by recognition that Indonesia's geological setting was created by the interaction of six lithosperic plates, has resulted in a growing national and international emphasis on Indonesian geology. Knowledge about the physical and chemical characteristics of Indonesia's seas has lagged behind biology and geology, however.

The two days of discussions by the three working groups--oceanography, living resources, and mineral resources--resulted in summaries of present knowledge about Indonesia's seas as well as conclusions and recommendations about the potential of specific resources. Two kinds of conclusions and recommendations were produced by the working groups: (1) general conclusions and recommendations with which all the working groups concurred, and (2) resource-specific conclusions and recommendations that differed for various commodities.

All three working groups concluded that Indonesia's Exclusive Economic Zone (EEZ) contains resources that could be developed to the benefit of Indonesia and its people. These resources range from the information needed to predict climatic change and basic ocean productivity in Indonesia, to increased harvests of such commodities as tuna and shrimp, to the gold and other valuable minerals that could be recovered from offshore deposits.

In all cases the groups pointed to the lack of knowledge about Indonesia's ocean phenomena as a constraint to realizing the potential of these resources. It was thus recommended that ocean research continue to be expanded both within Indonesia and through cooperative projects with Indonesian scientists and those of other nations. The working groups also agreed that manpower development programs should continue to be emphasized. The living resources group, however, felt that this should occur more at the high school and technical levels, while the mineral resources and oceanography groups felt the focus should be at the college and postgraduate levels. All groups agreed that Indonesian scientists should continue to be sent abroad for advanced training. This was particularly recommended for those undertaking physical and chemical oceanographic studies. ...

A summary report of the workshop has been prepared by Mrs. Bannigan and distributed to U.S. and Indonesian participants.

Following the Workshop, another planning meeting regarding the INSTEP program was held in Jakarta.[7]

3. Evaluation Team Interactions

The team interacted with Dr. Sediono M.P. Tjondronegoro, secretary of the DRN, who served as overall chairman of the workshop. Dr A.M. Satari, Deputy Chairman for Basic and Applied Sciences, BPPT, and his assistant, Rachmaniar Rachmat, were interviewed by the team. Dr. Aprilani Soegiarto, Assistant Minister at Ristek, and Mr. Jana Anggadiredja provided information on specific follow-up activities.

After their return from the field, the team communicated with Prof. Maxwell Doty, East-West Center, Univ. of Hawaii, and Prof Dirk Frankenburg, University of North Carolina, who were U.S. participants at the workshop.

4. Observations of the Evaluation Team

-- The workshop on Marine resources fits the mode of the workshop

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[7] Excerpts from "Cooperative Activities in Indonesia on Science, Technology, and Research Policy Development: End of Contract Statement," pages 3-4, written by BOSTID for Contract No. AID ASB-0333-L-00-5161-00, October 2, 1985 - Jan. 1, 1988, National Academy of Sciences, Washington DC.

on Biotechnology in Agriculture in 1986 and the earlier workshops organized for the GOI by NAS on food production and natural resources. While technical papers were presented and discussed, the primary purpose was bringing people together and focussing on issues and priorities.

-- The general conclusion was that while the economic potential, scientific benefits, and ecological concerns about the development of marine resources have been acknowledged, they have been only partially surveyed. The discussions between the GOI and USG on areas of common interests indicate that further S&T collaboration will follow.

-- For example, environmental pollution to the marine biomass, stemming from oil tankers from the Mideast, unregulated coastal industries, and increased fertilizer and pesticide use, is a rising concern of the GOI and its scientists.

-- It will take some years before we can expect to find concrete results of this workshop, though ongoing programs of oceanography and marine resource surveys will continue, assisted by other USG agencies. For example, an earlier survey of coastal areas for seaweed potential took more than a year to gain approval from the GOI, in part because of defense considerations.

-- A conclusion reached by the participants at the workshop expresses concern over the current level of R&D support:

> Research is needed at all stages of the development, use and management of Indonesia's living marine resources. For example, to attract capital for fisheries development, information on the distribution, abundance, and production of the resource in question is need to predict a return on investment, be it by government or the private sector. Gear development and technology must also be analyzed. At present, only US$60,000 is devoted to fisheries research, while fisheries exports alone exceed $300 million annually.[8]

-- an ASEAN Project proposal on the development and utilization of seaweeds in Southeast Asia was submitted to the ASEAN Committee on Science and Technology. The LIPI Center for Research and Development on Oceanology and the Maritime Fish Research Institute and BPPT would participate in this US $1.8 million proposal.

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[8] Conclusions and Recommendations of the Working Group on Living resources, Workshop on Marine Resources Summary Report, page 84.)

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Appendix F

Workshop on Marine Algae Biotechnology

1. Context:

-- Marine algae represent a major resource with over 15,000 documented species worldwide.[1]

-- Agar and carrageenan is used in the food industry as a gelling agent and thickener, as well as a nutrient medium for bacteriological and agronomic research. Both are established products with world production figures of over 20,000 tons/year, representing a total market value of over 200 million dollars.[2]

-- Indonesia's 13,000 islands covers 5 million sq. km., extending 2,300 nautical miles along the equator. Land territory is 1.9 million sq. km.; ocean is over 3.1 million sq. km.[3] The coastline is 81,000 km.[4]

-- Indonesia's seas cover 62 percent of its territory. About 1.7 million sq. km. of seas (about half the territory) are less than 100 meters in depth.[5]

-- In 1983, the Indonesian coastal farmers were harvesting seaweed from wild crops. Only 2.5 per cent was cultivated production. Yields and quality were too low to gain a world market share.

-- In 1984 the BPPT formed an Indonesian Seaweed Committee to introduce and test new technologies for cultivating seaweed. They developed an experimental farm for mariculture in Bali.

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[1] UNIDO, Project Concept Proposal: Workshop on the Potential Industrial Use of Marine Natural Products for Developing Countries. Typed draft by R.O.B. Wijesekera for Pharmaceutical Industries Unit, Chemical Industries Branch, Dept of Indust. Operations, UNIDO, 1988, pg.1.

[2] UNIDO, pg 2.

[3] Dirk Frankenberg, Background Paper on Oceanography and Marine Resources of Indonesia's Offshore Seas, Summary Report of the Workshop on the Development, Management, and Utilization of Indonesian Marine Resources, National Academy Press, Washington, DC: 1987, pg. 105.

[4] Emil Salim, Keynote Address, Summary Report of the Workshop on ... Marine Resources, pg 127.

[5] Purwito Martosubroto, Development And Management of Indonesian Marine Fishery Resources. Summary Report of the Workshop on Marine Resources, pg. 68.

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-- USAID has funded a Fisheries Research and Development project at US$7 million in grants and loans from 1986 through 1992. The project will install viable fisheries research programs at the DOA and key universities that will address significant regional fisheries production and marketing constraints.

2. The NAS-GOI Workshop on Marine Algae.

The Board on Science and Technology for Development (BOSTID) of the U.S. National Academy of Sciences (NAS) and the Indonesian National Research Council (DRN) jointly planned a workshop on "Marine Algae Biotechnology". This workshop was held December 11-13, 1985. Excerpts from the BOSTID summary of the workshop and subsequent activities follow:

> This workshop ... was organized by the Seaweed Research Team of BPPT to explore the current and future potential of marine algae as an increased source of income for Indonesians living in the coastal areas. ...
>
> Processed seaweed plays a significant role in many areas of manufacturing as it is used to produce agar, algins, carrageenans, and other substances, which in turn are used in pharmaceuticals and cosmetics as well as for other industrial purposes. Thus, particular attention was given in the workshop to the industrial potential of seaweed products for both the domestic and export markets. Both their near-term and longer term propects (the latter will be affected by the use of biotechnological techniques) were examined.
>
> Prior to the workshop site visits were made to the Bali area where seaweed is being farmed. There both the U.S. and Indonesian participants were able to observe first hand the growing and harvesting methods for marine algae and to inspect the various species of algae in that area. The group also visited algae warehouses to observe algae in its final state before sales to customers. ...
>
> A report in English was published and distributed to all participants, the DRN, and to USAID/Indonesia.[6] ...
>
> As a result of the marine algae workshop an official of Marine Colloids, a subsidiary of the FMC Corporation,

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[6] National Research Council, Workshop on Marine Algae Biotechnology. December 11-13, 1985, Jakarta, Indonesia. Washington, D.C.: National Academy Press, 1986.

visited Indonesia in late March 1986 to indicate the company's interest in helping the Indonesian government produce marine algae and to make arrangements with private Indonesian algae sellers to purchase Indonesian algae. Subsequently, Marine Colloids gave letters of credit to three Indonesian companies to sell algae.

Marine Colloids seaweed farming specialist Dr. Reuben Barracca, from their Philippine farming operation, is working with the ISC [Indonesian Seaweed Committee] team in Bali. He has been helpful in introducing better farming techniques as well as better postharvest technologies. As a result, the farming area in the Bali area has been expanded and efforts are being made to have farmers grow E. cottonii rather than E. spinosum, since the former species is more in demand in the world market. Reportedly, the Indonesian algae farmers in the Bali area have increased their incomes considerably by using better harvesting and postharvest techniques and changing the species of algae grown.

According to the Indonesian officials involved in this program, the world market for E. cottonii is 45,000 metric tons. Indonesia exported 2,800 tons in 1985 and 5,500 tons in 1986. Moreover, it hopes to sell 7,000-7,500 tons in 1987, and forecasts sales of 8,500-9,000 tons in 1988. Marine Colloids and their subsidiary FMC in Denmark as well as Kopenhagen Pectin, are buying seaweed from Indonesia. In addition, it is possible that the French company, Satia S.A. may soon become a buyer, making Indonesia a source of seaweed for the three largest seaweed consumers in the world.

The ISC has organized another experimental farm in the southern Sulawesi area where seaweed farmers grow Gracilaria, another type of seaweed that is in demand in the international market and can provide the highest income for farmers. A third experimental area may be established off the coast of Sumba. Thus far, officials from nine areas in Indonesia have requested assistance from the ISC. According to Dr. Barracca, the algae farming areas in Indonesia are better than those in the Philippines.

Marine Colloids plans to establish a pilot carrageenan plant in Indonesia and is currently doing a feasibility study to determine the most appropriate plant site. It is also trying to identify a local company to act as a partner. Marine Colloids will begin processing when a constant supply of 3,500-4,000 tons of seaweed is available in country in addition to the amount exported. ISC members are also in the process of

establishing a laboratory to examine other potential uses of seaweed.

Following the workshop, three members of the Indonesian seaweed committee visited the headquarters of Marine Colloids and FMC in Maine and attended courses on marine algae at the universities of North Carolina and Hawaii in June and July 1986. On their return trip to Indonesia they visited the Marine Colloids marine algae farm in the Philippines. With this training, funded under the USAID General Participant Training II Program, the Indonesians are now able to test the gel strength of algae sold in the international market so that they can obtain an appropriate and satisfactory price. In fact, the ISC has been doing laboratory tests for Indonesian companies so they can establish their own price. Furthermore, the ISC sends algae samples to the Marine Colloids laboratory to verify their laboratory results.

Five students from universities in Jakarta, who are doing research and writing their theses on marine algae, are also working with the ISC. A total of about 20-21 students in Indonesia are writing a thesis on seaweed, some focusing on research and others on the production process and its potential usage.

The ISC staff has been doing a very good job in implementing this program and working with Marine Colloids officials and the Indonesian community. In addition, they have been holding training sessions on postharvest technology techniques in the Bali area for the farmers, buyers, and government institute workers. Officials from the Marine Colloids headquarters have said that this relationship has worked better than they initially thought possible.[7]

3. Evaluation Team Interactions:

The team met with Dr. Sediono M.P. Tjondronegoro, secretary of the DRN, who served as overall chairman of the workshop. The BPPT Basic Sciences Deputy, Dr. Satari and his assistant Rachmaniar Rachmat were interviewed by the team. Dr. Aprilani Soegiarto, Assistant Minister at Ristek, and Mr. Jana Anggadiredja provided information on specific follow-up activities.

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[7] Excerpts from "Cooperative Activities in Indonesia on Science, Technology, and Research Policy Development: End of Contract Statement," pgs 3-4, written by BOSTID for Contract No. AID ASB-0333-L-00-5161-00, Oct.2, 1985 - Jan. 1, 1988, National Academy of Sciences, Washington DC.

The team visited a seaweed farming experiment station in Geger Beach, Bali, and met with Mr. Reuben Barracca, from FMC-Marine Colloids. The team also discussed seaweed exporting with Hariadi Adrian a local purchasing agent for Kopenhagen Pectin Factory (KPF), a Danish firm.

After their return from the field, the team communicated with Mr. Don Renn, Senior Research Scientist at Marine Colloids, Rockland, Maine, and Prof. Maxwell Doty, East-West Center, Univ. of Hawai, who were U.S. participants at the workshop.

4. Observations of the Evaluation Team

-- Indonesia's biological marine resources including fisheries and marine algae have tremendous potential for this island nation. The exploitation of these resources in a renewable process of sustained harvesting is a challenge.

-- USAID's interest coincides with the GOI: carefully planned exploitation of coastal marine resources provides an opportunity to better the lives of Indonesians living along coastal areas.

-- The industry has converted only in the last few years from harvesting wild plants to cultivation of species introduced from the Philippines a decade ago. Now 60 percent of production is cultivated.

-- Interviews with seaweed farmers in Bali and the buying agent for KPF gave some indication of the cultivation practices and income from harvesting marine algae. However, the level of activity was reportedly much larger on Nusa Panida, an island two hours by boat off the coast.

-- BPPT has set aside a room at PUSPIPTEK for basic tests on the seaweeds for export.

-- The interviews gave a somewhat mixed picture of the local testing capabilities, reported by BOSTID. The lab at Puspiptek in Serpong, West Java was described as simply a spare room. The people in the field did not give much weight to its use for checking quality. However, Jakarta informants described a more significant role for this testing. Would-be investors can verify seaweed values by sending a small sample to the Lab.

-- The Marine Colloids representative, Mr. Barracca provides a valuable service. He sends test samples to the parent company in Maine, thus giving a confirmation to field estimates of potential from the native and new species.

-- BOSTID staff report that this facility enables Indonesians to bargain for a better price in export sales, by providing independent analysis of Indonesian products offered for sale.

-- Marine Colloids has its main production facilities in the Philippines, and is interested in broadening its supply base. (Ironically, we were informed that the initial efforts in the early 1960's in Indonesia were shifted to the Philippines after the political unrest in the mid 1960's.) The senior research fellow at FMC Marine colloids is enthusiastic about Indonesian seaweed production in the world market.

-- In June 1987, a training and seaweed promotion effort was carried out by BPPT, bringing in DOA fisheries extension officers and potential investors in seaweed farming.

-- Members of the Indonesian Seaweed Committee were firmly convinced that more short-term training was needed for personnel.

-- The net effect of the Marine Algae workshop held in 1985 should probably be viewed as part of an overall building of interest in the economic potential of seaweed farming. The mix of US academics and private company representatives was a strong feature of the workshop.

-- the ASEAN Project proposal on the development and utilization of seaweeds in Southeast Asia was submitted to the ASEAN Committee on Science and Technology. The LIPI Center for Research and Development on Oceanology and the Maritime Fish Research Institute and BPPT would participate in this US $ 1.8 million proposal for the US ASEAN Dialogue.

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APPENDIX G

S&T Information Services Workshop

1. Context

-- The NAS amendment to PUSPIPTEK Energy Lab identified S&T Management as a third area - after biotechnology and marine resources. A workshop on Planning, Monitoring and Evaluating S&T had been held in 1983. At this workshop, the issue of S&T information networking was raised.

-- Information Services for the S&T Community can be viewed as two or more clusters, which are not yet connected. Around one cluster are the key universities in Java, IPB, UI, ITB, Gadjah Mada and ITS. These universities have library facilities and interlibrary loans to handle physical documents.

-- Another cluster of information services is respresented by the non-departmental S&T institutions and laboratories, centered around the Indonesian Institute of Sciences, LIPI. As an immediate step the Indonesian Center for Scientific and Technical Documentation (PDII) is officially charged by the RISTEK, the Minister of State for Research and Technology, as the focal point for S&T information services.

-- The Computer Sciences Center (CSC) at University of Indonesia, Jakarta, received a grant in 1985 to link three Universities. This has now spread to 4 regional centers.

-- In 1984 the CSC of the University of Indonesia convinced the Indonesian satellite corporation to provide one year of free use for a data communications network that provided an international link.

-- The telecommunications company, Perumtel, has a fiber optic system connecting central switching stations in Jakarta working on full digital switching system. Connections from the central switching stations to subscribers are using the conventional cable channels.

2. The S&T Information Services Workshop and Related Activities

The Board on Science and Technology for Development (BOSTID) of the U.S. National Academy of Sciences (NAS) and the Indonesian National Research Council (DRN) jointly planned and held a workshop on science and technology (S&T) information services. Excerpts from the BOSTID summary of the workshop and subsequent activities follow:

The idea of establishing a network of science and technology information (STI) services was introduced in Indonesia some 15 years ago. To date, however, the emphasis has been primarily on building collections of information and developing resources. Services provided to the scientific and technical user communities have remained inadequate for meeting the rising demand for timely and relevant information. Because the needed information is increasingly in electronic form, Indonesian information professionals must be able to access information regardless of its format and actual location. Moreover, increased access to information, which has resulted from new technologies for information storage, requires a well-developed infrastructure. Efficient document delivery systems, trained and service-oriented manpower, and strong administrative coordination are all required components of the network.

In 1986 the National Research Council of Indonesia invited BOSTID to join it in sponsoring a workshop and conference on building a network of science and technology information services in Indonesia. As a first step the organizers asked that the chairman visit Indonesia to assist in preparing a draft plan that could be used as a background paper for the workshop. Accordingly, Dr. Vlademir Slamecka and Ms. Wendy White, BOSTID's information services manager who staffed the activity, visited Indonesia, March 16-22, 1986. During this period they had discussions with many of the principal representatives of the Indonesian library and information community, and helped draft the terms of reference for the workshop.

Held in Jakarta, June 16-18, 1986, the workshop explored the systems and services required to support the information needs of the scientific community. At an open conference held on June 19, following the workshop, the plan of action devised by workshop participants was presented to decision and policy makers, information professionals, and the media.

A primary objective of the workshop was to devise a long-term model of how science and technology information should be networked within Indonesia, with elements to be phased in during the next 1-15 years. Five working groups were charged with the tasks of developing recommendations and formulating a plan of action for an STI services network. These groups addressed the following topics:

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1. Nature of STI services
2. STI services coordination
3. STI information technologies
4. Marketing of STI services
5. Manpower for STI services

The English-version report of the workshop and conference has been published and distributed to the U.S. and Indonesian participants.

The participants in the Workshop and Conference on Science and Technology Information Services agreed that a meeting of technical experts was needed to formulate the detailed design of the STI services network and develop a demonstration prototype. This meeting was held in Jakarta in January 1987. Specifically, it was held to appoint a technical expert team to implement the network, to organize a national secretariat to coordinate the network, and to organize a training program.

Since the technical meeting the Indonesian steering committee has presented a proposal to Dr. B.J. Habibie, Minister of State for Research and Technology, who in March approved the plan in principle, so that funding for the proposed STI network, called IPTEKnet in Indonesia, can be sought. It was decided at the technical meeting that the steering committee should focus on implementing IPTEKnet in one industrial sector as a demonstration project. The anticipated success of the project would then encourage other sectors to join the network. Both the aerospace and pharmaceutical industries are now being considered as candidates for the pilot project.

As an immediate step the Indonesian Center for Scientific and Technical Documentation (PDII) has been selected as a server node, and will be connected to the University of Indonesia's electronic mail network. The network will then expand as funds become available, and as information service is required by the Indonesian scientific community.

Through an electronic mail network at the Georgia Institute of Technology, Dr. Slamecka continues to provide advice to the principle technical architect of IPTEKnet, Dr. Joseph Luhukay of the University of Indonesia's Computer Science Center.[1]

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[1] Excerpts from "Cooperative Activities in Indonesia on Science, Technology, and Research Policy Development: End of Contract Statement," pages 3-4, written by BOSTID for Contract No. AID ASB-0333-L-00-5161-00, October 2, 1985 - Jan. 1, 1988, National Academy of Sciences, Washington DC.

3. Evaluation Team Interactions

The workshop and proposed recommendations of workshop participants were discussed with the Director General of the Directorate for Higher Education, Prof. Dr. Sukadjii Ranoewihardjo . The team also met with Dr. Joseph Luhukai, Director of the Computer Science Center, University of Indonesia.

The team met with Prof. Dr. Doddy Tisna Amidjaja, the Chairman of LIPI, and Ms. Luwarsih Pringgoadisurjo, the Director of the Center for Scientific Documentation and Information, (PDII). Mr. Herudi Kartowisastro, a Deputy to the Director General, provided additional insights into the workshop and follow-up activities.

The team communicated with Prof. Vlademir Slamecka Georgia Institute of Technology, and Ms. Sarah Thomas, Director of the National Agricultural Laboratory. Both were U.S. participants at the workshop. Prof. Slamecka was involved in the design and implementation of the Egyptian Science and Technical Information Services Project, funded by USAID. Ms. Thomas developed Agricola, an agriculture data base.

The team was briefed in Washington, D.C., by Ms. Wendy White, BOSTID's information services manager, who organized the workshop and followup conference.

4. Observations of the Evaluation Team

-- So far as the evaluation team could determine, there are presently no established science and technology information bases in Indonesia which can be accessed electronically. The Center for Scientific Documentation and Information, PDII, has a minicomputer and the MINISIS software from the the International Development Research Center in Canada.

-- The view was expressed that information is not yet valued in the society. It will be necessary to demonstrate the services and stimulate demand for and sharing of information.

--PDII is proposing a system called Infonet which will initially tie the LIPI and PUSPIPTEK laboratories between Jakarta and Serpong with a fiber optics network. This will use the Perumtel conduits -- a 15.2 km link to Serpong is not yet available. The Association of Fiber Optic Producers of Japan may provide funding. Two local area networks using fibre optic communication channels will soon be established; one will serve the LIPI complex of Jakarta and the other will serve the LIPI complex laboratories at Serpong (the PUSPIPTEK complex). These two local area networks

are planned to be linked, again using a fiber optics telecommunication channel.

-- A proposal for the establishment of IPTEKnet, a computer telecommunication network for scientific and technical information service in Indonesia to serve the S&T community, was issued by Ir. Herudi Kartowisastro, the Deputy Chairman for Technology, LIPI. Funding is being sought through foreign assistance. The estimated project cost is US $7.2 million.

-- Electronic networking is being proposed, with the UNINET system linking eight universities through telephone lines, with funding from the World Bank. This system uses the UI - Computer Sciences Center's design of a virtual operating system for the VAX, based on UNIX. Subject to technical (communication protocol) compatibility, it is envisaged that the UNINET will eventually facilitate communciation to the IPTEK-net.

-- Connections of these networks to each other and to data services outside Indonesia has been problematic. The UNINET system was connected through the Canadian Satellite to services in the USA and Europe, but this was not heavily utilized, or sustainable.

-- While PDII is establishing an S&T documentation base, it is only in beginning stage. Because of declining budget, PDII has had to cut its subscriptions to core abstracting journals. A charge is being introduced for information services.

--PDII's current staff of 200 includes 50 librarians and science graduates. Private companies are able to hire away the staff because of low salaries.

-- The University of Indonesia Computer Science Center has been able to build up an installed base of about $US 3 million with half of this donated from US industry (Data General, Digital Eguipment, Hewlett Packard).

-- The Center for the Analysis of Science and Technology Policy of LIPI has just signed a US$550,000 agreement with the UNDP to start a S&T Indicator system in cooperation with the UNESCO.

APPENDIX H

Overview of the Indonesian S&T Community

1. The Minister of State for Research and Technology.

The Government of the Republic of Indonesia (GOI) policy on research and technology and the coordination of research and development activities in Indonesia is managed by the State Minister for Research and Technology (RISTEK). This Ministry was established by Presidential Decree on May 11, 1978 and its functions and task are defined in subsequently issued Presidential Decrees (Numbers 28/1978, 45/1983, 25/1983). The Minister, Professor Dr. B.J. Habibie, reports directly to the President and advises him on matters relating to the above described responsibilities.

As stated in the initiating Presidential Decree, the State Minister for Research and Technology has to manage research and development of technology in the country so that these efforts are directed towards integrated efforts in support of national development. As described in the last Presidential Decree, the tasks of the State Minister for Research and Technology have been expanded to cover:

-- Formulation of GOI policies on all aspects of research, development, and the utility of research and technology in planning and implementing national development;

-- Systematic planning of activities that lead to the above policies;

-- Coordination of research and technological activities of all GOI agencies to assure a concerted effort overall;

-- Coordination of those operations concerned with research and technology of the following GOI institutions: Indonesian Institute of Sciences (LIPI), National Atomic Energy Agency (BATAN), National Coordinating Agency for Surveys and Mapping (BAKOSURTANAL), National Aviation and Interspace Institute (LAPAN), the Center for Science, Research and Technology (PUSPIPTEK) and the Central Bureau of Statistics (BPS.

The State Minister for Research and Technology is assisted by a State Ministerial Secretary and five Assistant Ministers assigned responsibility for General Planning, Research and Technology Development, Institutional and Research Manpower Coordination, Research and Technology Program Supervision, and Coordination of Formulation and Evaluation of Policies and Major Programs on Research and Technology.

Aside from his ministerial position, the State Minister for Research and Technology is also appointed as the Chairman of the Agency for the Assessment and Application of Technology (BPPT) and also as the Chairman of the National Research Council (DRN).

2. The Indonesian National Research Council (DRN)

The DRN was established on January 7, 1984 by Presidential Decree Number 1 of 1984 and its members were appointed and sworn in on November 28, 1984. The DRN is an advisory body to the State Minister for Research and Technology concerned mainly with:

-- Formulation of major national research programs,

-- Monitoring the planning and implementation of major research programs, and

-- Direction and control (supervision) of research and technological activities.

The DRN operates under a framework referred to as the "National Matrix for Research and Technology." Members serve on five committees: Basic Human Needs; Natural Resources and Energy, Industrialization; National Security and Defense; and Social, Economics, Culture, Philosophy, Law and Regulations. Each group covers the four categories of land, sea, air, and space and environment.

At the operational level, GOI research and development activities are implemented by government departments, non-departmental establishments, and universities. Each are described in more detail below:

3. The Departmental (Ministerial) R&D agencies.

Each department of the GOI, with few exceptions, has an R&D unit which operates at the level of a Director General, and is designated as an Agency for Research and Development. Each agency manages a set of Centers for Research and Development. The R&D activities within the unit are closely related and directed to support the operations of the relevant department. Established departmental R&D agencies are those of the Departments of Agriculture, Health, Forestry, and Industry. The Ministry of Mines and Energy has several well established R&D Centers on oil, gas, and mineral resources, but these centers are not organized into a single departmental R&D agency.

4. The non-departmental Research and Development agencies and institutes.

The six non-departmental R&D establishments have the following basic functions[1]:

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[1] adapted from "R&D Organization in the Government Sector of Indonesia", by A.S. Luhulima, in National Research Council, Workshop on Planning, Monitoring, and Evaluation of Research and Technology in Indonesia, Washington D.C.: National Academy Press, 1984, pg 73..

-- BAKOSURTANAL (National Coordinating Agency for Surveys and Mapping) produces base maps, and topographical, oceanographical, meteorological, and other thematic maps. This agency is also responsible for surveying, inventorying, and evaluating natural resources;

-- BATAN (National Atomic Energy Agency) conducts research on nuclear energy, the exploration for uranium, and the production and application of isotopes;

-- BPPT (Agency for the Assessment and Application of Technology) explores technologies compatible with the situations and conditions in Indonesia, and by special assignment is also responsible for their application in industries;

-- BPS (Central Bureau of Statistics) is responsible for collecting and analyzing national statistics;

-- LAPAN (National Aeronautics and Space Institute) concentrates on the use of space technology for resource inventory, weather forecasting, and communications; and

-- LIPI (Indonesian Institute of Sciences) is responsible for research activities in the social sciences and humanities, engineering sciences, and natural sciences. LIPI also provides scientific and technical services such as information, instrumentation, and calibration; formulates national science policy to be proposed to the government; and promotes the popularization of science in society.

These nondepartmental agencies are directly responsible to the President of the Republic of Indonesia, but technically they are coordinated by the Minister of State for Research and Technology.

Plans are for most of the laboratories and R&D support facilities of the above non-departmental R&D agencies or institutes to be housed within the compound of the National Center for Science and Technology Development (PUSPIPTEK), located at Serpong, west of Jakarta. The construction of the facilities of the PUSPIPTEK was started in 1978.

Presently the laboratories and research facilities in operation at PUSPIPTEK include:

-- the laboratory for Materials and Construction Testing of the BPPT;

-- the wind tunnel facilities of the BPPT;

-- the Siwabesi 30 Megawatt nuclear research reactor complex of BATAN;

-- the Laboratory for Instrumentation of LIPI; and

-- the Laboratory for Energy Resources of the BPPT, which is still to be completed.

Also a laboratory for research on manufacturing processes is being planned with Japanese and German assistance.

5. The University Research and Development establishments.

The universities in Indonesia have been, and are still the major resource of R&D activities in Indonesia. The universities have three functional missions: education, research, and service to the community. Accordingly, the universities may have an Institute for Research and an Institute for Services to the Community which operate in parallel to the conventional educational divisions (Divisional Faculties).

Subject oriented research is carried out by the laboratories residing in the Departments of each Faculty. A typical "University Institute for Research" is comprised of up to five Centers for Research which emphasize problem oriented research in their activities.

The Inter-University Centers. Although the universities have three basic missions, i.e. education, research and service to the community, the dominant activity is education. Of the nine universities which grant master's degrees (S2) and doctorates (S3), four have been selected to participate in a $147 million World Bank project. The University of Indonesia (Jakarta), the Institute of Technology at Bandung, the Institute of Agriculture at Bogor, and the University of Gadjah Mada (Yogyakarta) have been assigned to accomodate and manage Inter-University Centers (IUCs).

Each IUC has designated laboratories and subject areas. For example, the IUC labs at the Institute of Technology in Bandung are: (1) life sciences, (2) biotechnology--focused on industrial processes, (3) microelectronics, and (4) engineering sciences. For the duration of the World Bank loan (1985-1990) the IUCs have approximately $200,000 of operational research funds for each laboratory. In principle any scientist in Indonesia can apply for funds through the IUC system and if their project is approved they perform the work in the IUC labs. Proposals are peer reviewed. In practice, laboratories in the IUCs are staffed predominantly by the faculties of the home institution or by direct hires to the IUC. The funding is therefore mostly under the direction of a senior scientist at the home institution who carries out the research projects with the assistance of several junior scientists.

The IUC project also contains a substantial training component and many Indonesians are currently working for their doctorates outside the country. IUC administrators expect the research programs to become more focused and specific projects to be designed in the next few years as students graduate and return to Indonesia.

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6. R&D by the State Enterprises

Relatively little research and technology development is conducted outside of the government research institutions. A small number of enterprises such as the State Enterprise for Fertilizer (PUSRI), the State Enterprise for Oil and Gas (PERTAMINA), and the State Enterprise for Electricity (PLN) have R&D units. Their primary function is basically directed towards solving operational problems and to provide technical inputs required for planning purposes. Some research is conducted in company facilities and other projects are contracted out to university staff.

7. Observations on Manpower and Financial Resources

Some figures discribing the manpower resources related to S&T development are given in Table H-1. While the organizational set-up is practically all in place, forming an S&T institutional infrastructure, the Indonesian S&T community still has a long way to go to establish itself. Major problems are:

-- insufficient qualified and dedicated manpower working in the R&D area; senior scientists and engineers are heavily burdened with the S&T institution building process;

-- insufficient incentives and rewards to those working in R&D establishments and the universities; nevertheless, persons having advanced degrees can only find challenge in these establishments;

-- limited research funding from the GOI and private sector; the Indonesian industry has not reached a state where R&D is an effective element in the competitive process; and

-- at a stage of economic development where the majority of the people still live at a subsistence level, long-range research aimed primarily at gaining knowledge is considered to be an unaffordable luxury; applied research and technology application development, where the results can be seen to be useful in contributing solutions to immediate development problems are acceptable in principle, but resources required to do it effectively are difficult to mobilize.

APPENDIX I

Persons Contacted during Evaluation*

1. Office of the State Minister for Research and Technology (RISTEK)

Minister of State for Research and Technology:
Professor Dr. B.J. Habibie [2,4,10]
Assistants to the State Minister:
Professor Dr. Didin S. Sastrapradja [2,3,9]
Professor Dr. Sediono M.P. Tjondronegoro [2]
Staff of the Assistant Minister for Research and Technology Institutions:
Mr. Rio Rachwartono
Staff of the Assistant Minister for Development of Research and Technology:
Dr. Harjanto Dhanutirto [4,6]
Mr. Jana Anggadiredja

2. DRN-National Research Council

Chairman: Professor Dr. B.J. Habibie [1, 4, 10]
Vice Chairman: Professor Dr. D.A. Tisna Amidjaja [3]
Secretary: Professor Dr. Sediono M.P. Tjondronegoro [1]
Committee for Basic Human Needs:
Vice Chairman: Professor Dr. A.A. Loedin [7]
Professor Dr. A.M. Satari [4]
Dr. Setijati D. Sastrapradja [3]
Professor Dr. Didin S. Sastrapradja [1,3,9]
Committee for Natural Resources and Energy:
Dr. Aprilani Soegiarto [3,9]
Dr. Lolo Panggabean [5]
Professor Dr. John A. Katili
Committee for Industrialization:
Ir. Herudi Kartowisastro [3,5]
Professor Dr. Ir. Harsono Wiryosumarto [4]
Committee for Social, Economies, Culture, Philsophy, Law and Regulations:
Professor Dr. Sediono M.P. Tjondronegoro [1]
Dr. Astrid S. Susanto Sunario [8]

3. LIPI-Lembaga Ilmu Pengetahuan Indonesia (The Indonesian Institute of Science

Chairman: Professor Dr. D.A. Tisna Amidjaja [2]

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* The list repeats names as appropriate to clarify each person's organizational responsibilities. Cross-references are numbered in brackets. Senior officials where many hats, and this cross-listing is indicative, not exhaustive.

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Vice Chairman, Director National Biological Research Center:
Professor Dr. Didin S. Sastrapradja [1,2,9]
Deputy Chairman for Natural Sciences:
Dr. Aprilani Soegiarto [2,9]
Deputy Chairman for Technology:
Ir. Herudi Kartowisastro [2,5]
Director, Center for Analysis of Science and Technology Development:
Mr. Djoko Pitono
Head of Center for Research and Development for Biology:
Dr. Sampurno Kadarsan
Center for Research and Development on Biotechnology:
Head: Dr. Setijati D. Sastrapradja [2]
Head of the Information and Services Division: Mr. Susono Saomo
Director, Indonesian Center for Scientific Documentation and Information (PDII): Ms. Luwarsih Pringgoadisurjo
Research and Development Center for Oceanography: Dr. Kasean
Deputy Chairman of Technology: Dr. Ir. Muhammadi Siswo Soedarmo
Staff of Deputy Chairman: Mr. Dipo Alam
Bureau of Coordination and Science Policy:
Chief: Subagjo Soemodihardjo
Mr. A. Lebdo Suwarto
Bureau of International Relations
Mr. T. Hainald

4. BPPT-Agency for the Assessment and Application of Technology (BPPT)

Chairman: Professor Dr. B.J. Habibie [1,2,10]
Special Assistant to the Chairman: Dr. S.B. Joedono
Deputy Chairman for Technology Development:
Dr. Harysonto Wiryoshamarto [2]
Deputy Chairman for Basic and Applied Sciences:
Professor Dr. Ir. A.M. Satari [2]
Team Leader for Embryo Transfer: Drh. Ida Kusuma, MSc.
Team Leader for Marine Algae: Ms. Rachmaniar Rachmat
Senior Scientist: Dr. H. Haryanto Dhanutirto [1,6]]
U.S. Technical Advisor to the Chairman: Dr. A.B. van Rennes

5. PUSPITEK - National Center for Science and Technology Development

Energy Conversion and Conservation Technology (BPPT):
Director, Dr. Lolo M. Panggabean [2]
Laboratory for Strength of Materials, Components, and Structures (BPPT):
Head, Ing. Gunawan Sakri Soemargono
National Institute for Instrumentation (LIPI):
Director, Ir. Herudi Kartowisastro [2]
Head, Technical Cooperation Division, Research & Development Center for Calibration, Instrumentation and Metrology (LIPI): Ir. Iranto

6. Academia

Institute Pertanian Bogor (Bogor Agricultural Institute - IPB)
Head of Division of Biotechnology Inter-University Center:
Professor Dr. Gustaf Wattimena
Department of Agronomy: Dr. Livy Winata Gunawan

Institute Technology Bandung (Bandung Institute of Technology - ITB)
Rector of the University: Professor Dr. Hariadi P. Soepangkat
Divison of Biotechnology Inter-University Center:
Head, Professor Dr. Oei Ban Liang
Division of Life Science Inter-University Center:
Head, Dr. Soelaksono Sastrodihardjo
Division of Microelectronics Inter University Center
Head, Professor Dr. Samaun Samadikun
Department of Chemical Engineering
Junior Faculty Member, Mr. Robert Manurung
Dr. Harjanto Dhanoetirto [1,4]

University of Indonesia
Head, Division of Biotechnology, Inter-University Center:
Dr. Pratiwi Sudarmono
Head, Computer Science Center:
Dr. Joseph Luhukay

7. Government Research Departments:

Department of Health
Head, Research and Development, National Institute of Health:
Professor Dr. A.A. Loedin [2]

Department of Agriculture
Lembang Horticultural Research Institute:
Director of Research: Dr. Anggoro Hadi Permadi
Senior Researcher: Dr. Atie Sri Duriat
Senior Researcher: Dr. Ir. Sudarwohadi Sastrosiswojo
Potato Research Coordinator: Ir. Sudjoko Sahat

Department of Education and Culture
Director General for Higher Education:
Professor Dr. Soekadji Ranuwihardjo

8. BAPPENAS-Agency for National Development Planning

Assistant to the Chairman, Head of the Bureau for Social Communication and Science: Dr. Astrid S. Susanto Sunario [2]

9. Regional Institutes:

SEAMO - BIOTROP--Regional Research Institute South East Asian Regional Center for Tropical Biology
Tropical Forest Biology Program: Tri Binarko Suselo
Visiting Scientist/PSTC Grantee: Mr. Adam Messer, MSC.

International Rice Research Institute
Mr. Walter Tappan

ASEAN Committee on Science and Technology
Chairman: Prof. Dr. Didin S. Sastrapradja [ ]
Assistant to the Chairman: Dr. Aprilani Soegiarto [2,3]

10. Indonesian State Enterprises and Private Sector

IPTN - Industri Pesawat Terbang Nusantara (Aircraft Manufacture, State Enterprise):
President Director: Professor Dr. B.J. Habibie
Secretary to the President Director: Mr. Tatang Endan
Director of Program Coordination: Mr. Djermani Sandjaja

Biofarma (Pharmaceutical Manufacturer, State Enterprise)
Chemist, Commercial Director: Mrs. S. Soeharto
Veterinarian, Production Director: Dr. J. Soetarjo
DVM, Company Secretary: Thamrin Poeloengan

Kimia Farma (Chemical Manufacture, Quasi - State Enterprise)
General Manager: Zainut Yasin,
Research and Development: Mrs. Arini S.
Production Manager, Quinine-Cinchona Plantation Department: Mr. Kusara
Head of Production Quality Control: Mrs. Ilya Sumargonio
Head of Rifampicin-Quinine-Cinchone Plantation Department: M. U. Kuswana
General Manager, Jakarta Production Unit: Soemantri

Farmers:
Mrs. Nyoman Sarni, Geger Beach, Nusa Dua, Bali
Mr. Hentas Taslimin, Pangalengan, Java

11. Other Donors and Consultants in Indonesia

Project ATA (Dutch):
Plant Biotechnology Consultant, University of Nijmegen, the Netherlands: Prof. Bram de Groot

Boston/DSP, Employment,Trade and Industralization Study (Consultants to BAPPENAS):
Trade/Industry Policy Advisors:
Prof. David Wheeler, and
Prof. Gus Papanek, Boston Institute for Developing Economies, Inc.
Dr. William Cole

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Inst. INDECO data utama (agribusiness consulting firm, Bogor):
Senior Advisor: Dr. William Collier,

12. Multinational Corporations

Kopenhagen Pectia Factory (KPF), Denpasar, Indonesia
Director C.V. Eucheuma: Mr. Hariadi Adnan,

FMC Corporation - Marine Colloids Division,
Marine Agronomist: Ruben T. Barraca
Senior Scientist: Dr. Donald Renn

13. U.S. Private Sector

Molecular Genetics, Inc.:
President, Charles M. Muscoplat

Bio En-gene-er Associates, Inc:
President, Dr. Robert Busche

14. U.S. Universities

Tissue Culture for Crops Project, U. of Colorado:
Dr. Murray Nabors
University of Minnesota:
Dr. Charles Muscoplat
Washington State University:
Dr. Jerry J. Reeves
Texas A&M University:
Dr. Donald E. Farris
Georgia Institute of Technology:
Dr. Vlademir Slamecka

15. National Institute of Health (NIH)

Contraceptive Development Branch, National Institute of Child Health and Human Development: Dr. Hyun K. Kim

16. BOSTID-Board on Science and Technology for Development

Senior Program Officer: Mrs. Rose Bannigan
Information Services Manager: Ms. Wendy White

17. American Society for Engineering Education

Executive Director, Prof. Carl Willenbock

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18. U.S. Department of Agriculture

U.S. National Agricultural Laboratory, Beltsville, Maryland:
Senior Scientist,Dr. J,M, Kaper
Ms. Sarah Thomas

19. U.S. Embassy - Jakarta

Deputy Chief of Mission: Mr. Michael Connors
Science Attache: Mr. Jeff Lutz
Economic Affairs: Mr. Bruce Duncombe
Foreign Commercial Services: Mr. Paul Walter
Commercial Attache, Medan: Mr. M. Lewis

20. United States Agency for International Development - Jakarta

Mission Director: Mr. David Merrill
Deputy Mission Director: Mr. James Anderson
Office of Program and Project Support:
Director: Ms. Margaret Bonner
Mr. Timothy Mahoney
Mr. Dan Westrick
Office of Agriculture and Rural Development:
Acting Director: Mr. William Douglass
Mr. Edi Setianto
Mr. Desmond O'Riordon
Director, Office of Private Enterprise: Mr. Gordon West
Director, Office of Population and Health: Mr. Emmanuel Volgaropolous

21. AID Washington

Office of Technical Resources:
Deputy Chief: Mr. Richard Cobb
Division Chief, Energy and Natural Resources: Dr. Robert Ichord
Division of Agriculture and Rural Development: Mr. Dennis Weller
Office of Science Advisor: Dr. John Daly
Center for Development and Information and Evaluation:
Dr. Gary Hansen

22. World Bank

Infrastracture Operations Div., Asia Country Dept.
Mr. Ben Fisher

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