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The Agency for Agricultural Research and Development of INDONESIA

October 1981

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International Service for National Agricultural Research
P. O. Box 93375 2509 AJ The Hague Netherlands

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Introductio..

The Director General of the Agency for Agricultural Research and Development (AARD) of Indonesia requested a review of that agency by the International Service for National Agricultural Research (ISNAR). A team of eight persons (three ISNAR staff officers and five consultants --see Annex 1) carried out a review in the country from 5 to 28 August 1981.

Terms of Reference

Specific terms of reference were jointly approved by the Director General of AARD and the Director General of ISNAR. The terms of reference -- which are Annex 2 of the report of the mission -- directed that the review include the following main points:

* A retrospective view of the program and organization in terms of progress, special problems, research priorities, allocation of resources, and the impact and appropriateness of external assistance received to this time;
* the suitability of the agency's structure to implement its program;
* the efficacy of its procedures for establishing research objectives, maintaining research priorities, and evaluating and modifying its research programs;
* the efficacy of the links of research to production;
* a look to the next three to five years as to the needs for reorientation of research priorities and programs, organizational structure, allocation of resources, and projected external assistance.

The Report

Principal results of the review are presented in three sections. The first section deals with some retrospective analysis of AARD since its creation by Presidential decree in 1974, plus observations concerning present problems, opportunities, strengths, and constraints. The second section presents the recommendations by the mission team. The organization of the report follows main points derived from the terms of reference for both the retrospective and future-oriented analyses. A third section deals specifically with areas recommended for immediate attention, especially where external aid is considered essential for optimum development of the research organization.

In Retrospect

The terms of reference guiding the review of AARD called for ISNAR to make an independent appraisal of the program and organization of the agency since its establishment in 1975. The team was asked, in the process of its review, specifically to examine the appropriateness of AARD's work in the field of research priorities, staffing, organizational structure, allocation of resources, and projected external assistance, as well as the efficacy of links of research with the practice of agricultural production.

The creation of a new organization to coordinate the agricultural research of a country the size of Indonesia is a challenging undertaking. The agency has performed well in meeting the challenge and consolidating its wide span of activities over this short operational lifespan. The future of AARD, and through it the future of the integrated agricultural research system in Indonesia, depends on that agency's continuing ability to respond to the challenge of its mandate.

AARD was established by Presidential decree in 1974 within the Ministry of Agriculture. With creation of AARD, which was itself a major structural change in the organization of agricultural research in Indonesia, the development of the present national agricultural research system began. Prior to that time, national research activities existed mainly in relation to specific commodity groups under separate directorates general within the Ministry of Agriculture: food crops, industrial crops, livestock, fisheries, forestry, estate crops, and sugar.

The national agricultural research system embodied in AARD was given the responsibility (a) to establish research and development in agriculture according to the policy stated by the Minister of Agriculture and (b) to manage all technical executive units in agricultural research and development within the Ministry of Agriculture.

The formation of AARD represents an historic and progressive step in the evolution of agricultural research in Indonesia.

Progress

AARD has existed a short time, especially when measured in the context of time in the continuing, accumulative process of generation of knowledge through research. The eventual effects of AARD, in terms of increased output of food and fiber in Indonesia, cannot be judged yet. More appropriate criteria for judging its effectiveness now are related to its assembling of resources, its base for expansion of research activity, and the continuation and strengthening of programs that were already in existence.

Testimony to Indonesia's capabilities in agricultural research was evident when the team was in the country: National media reported the alltime record rice production of 1981, in which research had played a key role, as had support packages and motivation carried to Indonesian growers by the BIMAS program. The review team had access to the manuscript of the five-year report of AARD, which was then in press. That report cited many cases of important research results flowing from the work of AARD scientists. It also gave numerous examples of multidisciplinary projects which are undoubtedly more easily stimulated and managed under the present unified organizational leadership of AARD.

AARD has achieved changes in resources, structure, and processes that make agricultural research in Indonesia considerably stronger than it was in times before AARD.

The review team examined many of those changes, as directed by the terms of reference of the mission. It comments here on findings in relation to AARD's brief past and the present situation.

Programming and Allocation of Resources

Over the period since it was established, AARD has made advances in coordinating the research programs of the individual directorates general. It has spelled out research programs for the individual sectors in accordance with production targets set by the directorates general.

In planning its research program, AARD has been confronted with the challenge of how best to allocate its resources in order to produce the optimum results in research related to agricultural development. To meet this challenge, AARD has moved from program formulation based on maximizing individual commodity production to an approach that places more stress on the needs of farmers in terms of projected benefits. AARD is working now to integrate a national focus on research planning for priority crops (at present 26) and problem-oriented programs (six presently).

Before the creation of AARD, agricultural research programs in Indonesia were related specifically to commodities. These research programs were apparently pointed towards answers to certain demands for improved technology on a specific crop (with demands often articulated from outside the system) or the programs grew out of research interests within the system. The implementation of such programs was facilitated by the backup extension and other services of the directorates general, in the case of rice by BIMAS, and by other agencies -- including those dealing with marketing and pricing for certain commodities.

Since AARD assumed responsibility for agricultural research, it has continued to provide technology for these same commodities. This was a logical strategy during the transitional period. Demands on AARD's scientific expertise have now grown, however, and it has been recognized that a broader problem-oriented approach may be more desirable than one that is commodity-specific. AARD does research in support of agricultural development and productivity in a country, it may be observed, in which most farmers grow a range of commodities in a complex farming system, rather than single commodities in monoculture. Farmers' needs are more than to maximize production of those food crops where research has already played an important role; technology is also required for other food crops (such as maize, cassava, soybeans, and others), also for highland and lowland vegetables and fruits, which are part of the Indonesian diet. Farm families also need assistance in optimizing incomes from non-food crops, where there is visible demand and where the soils have potential for this type of development.

AARD has received substantial financial support over the past five years to develop a national research program: Large amounts came from Indonesian authorities (about 5 percent of the Ministry of Agriculture budget in 1979-80 went to AARD); and significant amounts have come from various donor and lending agencies, most from outside Indonesia. All this indicates that the agency has created awareness of its programs and confidence in the results of its work.

The development of AARD's research program has brought it additional responsibilities, particularly in the Outer Islands -- where lie many of the potential contributions of research to the continuing development of agriculture in Indonesia. To cope with this task AARD has utilized assistance from abroad in several areas of operation, notably in planning. The focusing of this developmental aid to achieve priority goals in Indonesian agricultural research is of major concern to AARD.

The team did not probe deeply into budgeting aspects in AARD, but it noted responsiveness by the planning unit in the Ministry of Agriculture and by BAPPENAS to recommend support for well-developed plans. These open relationships have encouraged AARD to strengthen its capability in planning and budgeting, crucial processes in the effective allocation of AARD resources to the areas of priority for agricultural research. In the view of the review team, the importance of AARD's Centre for Agricultural Programming and of continued emphasis on staffing it to meet fully the role it is creating can hardly be over-emphasized.

Organizational Structure

Under the present organizational structure, a large number of units are directly responsible to the Director General of AARD: Five central commodity research institutes (food crops, industrial crops, forestry, livestock, and fisheries) and six centers -- each responsible for activities in a specific area of AARD (research programming, agro-economic research, statistics and agro-data processing, library, agricultural quarantine, and soil research) plus the secretariat, and -- through the AARD Head's chairmanship of the respective management boards, estate crops and sugar research. (The team noted that a number of persons well-qualified for and experienced in research were involved in administration in central research institutes, yet appeared to take no active role themselves in research. The team suggests continuing consideration within AARD of the costs and benefits associated with the institutes; it believes there may be other means of management that would divert to administration fewer of the persons who have scientific qualifications that are now in short supply in AARD.)

Since the geographical span and the range of research activities are vast, the agency has embarked on a massive program to develop its infrastructure. This has taken place in part through the creation of four centers to support research in the respective national programs for rice, (Sukamandi), palawija crops (Malang), highland vegetables (Lembang), and rubber (Sungei Putih, in Sumatra). AARD has also emphasized support on programs for research centers strategically located throughout Indonesia; these outlying centers are being developed to meet the commodity needs of the zone. This latter program is still new, and the focus for its future is still being developed along the lines of the individual comparative research advantage of the respective institutes.

The problems faced by units within the network of AARD research institutes are many and varied. The programs developed and proposed within this complex network present the challenge for AARD to derive a viable strategy for its total national research development program. Leadership for this activity has been given to CARP. The Centre for Agro-Economic Research (CAER) has a principal role in providing the analytical support for the rationale on which CARP will develop this strategy.

The review team expressed concern that such a large number of second echelon positions currently report to the Director General of AARD. While

it did not have opportunity to examine this issue in sufficient depth to determine possible implications, the team calls its concern to the attention of the Director General of AARD.

(The review team discussed its concern on this point and offers a suggestion for possible reorganization within the second echelon. One configuration suggested by the team for the consideration of AARD leaders would combine current central research institute responsibilities under three deputy directors of research -- one each for crops and soils, for animal sciences, and for forestry -- plus one deputy director for administration, all with suitable supporting staff.)

Staffing

The leadership of AARD has recognized that it is individuals who build or change institutions. Unless there are individuals available with competence, institutions cannot be developed. AARD has undertaken an aggressive program over the past five years to increase both the numbers and capabilities of its staff. The task of identifying personnel with high potential for training, the logistics and management of a truly massive manpower development scheme, the infrastructure creation which will support trained personnel, and a number of other activities have necessarily demanded much attention and resources. AARD has made impressive achievements in these areas, yet the manpower situation continues to represent a major constraint on current AARD operations. The issue may require even higher priority attention by AARD than it is already receiving.

The growing demands of AARD's research program have not awaited the results of the manpower developmental efforts that have been started. To assure an appropriate quality of research in certain areas during this time, it has been necessary to rely substantially on expatriate personnel.

Another factor that appears to limit research output for AARD by its own scientists is the complex and multiple systems that influence remuneration and promotion. An observation of the team was that staffs appear to place more emphasis on generating projects and leading them than on actual completion and reporting of research results. If the team's perception is accurate, compensation policies may be a probable cause. Basic salary levels for research positions appeared to the team to be comparatively low, with research scientists supplementing their incomes through secondary jobs and non-research activities for which they were paid separately. It appeared also that salaries for researchers in institutes dealing with, for example, sugar and estate crops (as well as those in corporations) were better than for those in comparable positions within AARD. The situation is not peculiar to AARD; it is said to be general in Government of Indonesia institutes. Nevertheless, the team considered this situation to be a factor limiting AARD performance. It suggests careful consideration of means by which the policies in effect for sugar and estate crops researchers may become the standard for equitable rewards to agricultural scientists performing comparable work.

It was the review team's perception that there is a clear distinction within AARD between the administrative (structural) line and the research (functional) line; personnel policies of the two lines differ on some factors. It was understood that the research line, for example, provides a potentially longer security of employment by its later age of mandatory retirement, but it provides lower levels for promotion. Apparently some AARD administrative staff members go into the research line but, in fact, continue to be involved mainly in administrative activities;

they thus occupy posts that could otherwise be filled by active research staff. On the other hand, it was understood that some qualified scientists go into the administrative line because it offers greater potential for advancement. AARD loses scientists from "functional" research posts when they move to "structural" positions within AARD or in universities, or when they leave government service to join private industry or state corporations. While the scientific expertise of the latter may continue to serve Indonesian agriculture broadly, their loss results in setbacks to AARD research programs. The reason often cited for such moves is remuneration, which is a central factor in career development.

The review team observed another factor that in some cases affects the ability of AARD leaders to respond promptly to staffing needs at different research sites. That factor is the reluctance felt by some AARD staff to accept reassignment that would change both their own working site and the living environment of their families. For some, that reluctance is to leave current postings in Java, especially in West Java near the administrative capital; for others, especially some who are native to Outer Island locations, the reluctance is to move to Java. Individuals undoubtedly have different reasons for their feelings; the effect is the same, however, to limit AARD's flexibility to use specialized personnel to the optimum (if human factors were irrelevant). Present inducements appear to fall short of dealing with this barrier to shift of personnel. While the team did not offer specific recommendations, it urges continuing AARD efforts pointed toward career enhancement for its staff, recognizing the significance of family as well as professional considerations when a change in assignment means a change in location.

Agricultural universities and AARD have laid the base for an important symbiotic relationship. These universities are the technical training ground for most of AARD's future scientists, and their faculties are filling increasingly strong roles in research contributions. The team commended the cooperative spirit it found between AARD and leading universities. It believes that the relationship will work to the advantage of both -- and in the longer run to the benefit of Indonesian agriculture.

Links of Research to Agricultural Production

The ultimate test of AARD's success will be determined on Indonesian farms. Under the present organizational arrangement, personnel of agencies other than AARD make the direct contacts in working with producers on utilizing the results of research.

The terms of reference for this mission concerned the efficacy of the links but were not interpreted to include concern with the organizational structures or operations of those other agencies (which appeared on limited observation to be complex, diffuse, and in some cases duplicative).

The team saw evidence of the adoption of technologies that have come from the work of AARD: for example, the alltime record rice production announcement noted, which is evidence of the transfer of results. The overall reaction of the team was in general agreement with one appraisal of the delivery system it heard stated: "It is working -- but not well enough." While it was not appropriate for the team to attempt an appraisal of the non-AARD elements of the system, it did concern itself with the points at which AARD links with those organizations.

The current effort to strengthen the field stations of AARD is bringing more research personnel into closer contact with the farmers and the farming systems into which their technology will be fitted. This closer geographic contact can result in a clearer understanding by the researchers of the opportunities and constraints that impinge on farmers' adoption of proposed technologies. That closer contact, plus such activities as field days, tours, and on-farm testing of new technologies, can provide more interactions of researchers with extension personnel, as well as more opportunities for them personally to see and talk to farmers. This should benefit researchers, since sharper definition of research problems should emerge from these more extensive contacts in the field. The stationing of more AARD scientists throughout the production areas may also permit more frequent formal and informal training contacts with the subject matter specialists of the extension services than have been the usual pattern in the past.

In addition to developing personal contacts with staffs of delivery agencies, AARD has moved to strengthen its ability to disseminate research results via print means. The review team saw numerous examples of materials prepared by AARD for use by others -- most often for use by subject matter specialists of extension units. Although the team was not competent to judge the intrinsic quality of material published in the Indonesian language, it noted much variation in the observable characteristics -- such as quality of printing, use of graphics, etc. These differences may be due to different emphases given to dissemination by different units: the team met academically trained communication specialists in only two units, although many more persons were involved in preparation of material. The team did not have direct access to work by or on behalf of AARD in which radio, television, or other media were utilized.

The review team endorsed the recent development of a National Library of Agricultural Sciences, especially in the definition of its responsibility to include publications and information preparation, in addition to the vital library services to provide AARD staff with access to world knowledge in agricultural sciences. Having created this agency-wide structure, AARD is now in a position to develop means of extending dissemination services more evenly throughout the institutes that comprise it.

The review team noted, during its stay in the country, a workshop on writing which should directly benefit AARD's communications efforts. This indicates awareness of a need for training in this area; however, the team believes that training for communications and information needs should be expanded further as an integral part of agency-wide programs to equip personnel to meet AARD's responsibilities to the nation.

External Assistance

External assistance to agricultural research in Indonesia began before AARD was created. It has been accelerated in AARD's relatively short existence. While the team was not in a position to quantify the effects of past external assistance, it saw many aspects of it: Construction programs, some still underway, are providing exceptionally good research facilities at many locations. Dozens of future AARD scientists are studying abroad and hundreds are at Indonesian universities. Expatriate personnel under technical assistance have made, and continue to make, strong contributions to Indonesian agricultural research.

The nature of technical assistance programs is varied. In some cases experts have been brought into AARD units to serve a specific post or purpose. In some cases the foreign expert has clearly increased Indonesians' capabilities and confidence; in others he or she has mainly served a line function, personally carrying out research or filling a specific administrative role. In the latter instance, little addition may have been made to Indonesia's capacity to continue the work.

Most external assistance appears to play a positive role in agricultural research in Indonesia; however, the team considers that its impact might be still greater if AARD's own plans and needs could be made more explicit. A number of external aid projects in the past appear to have been initiated out of donor suggestions rather than from Indonesian requests. This situation has changed in the last few years, and the BAPPENAS "Blue Book" now lists a number of projects identified by AARD units. However, the team believes that this list can be improved further to spell out more clearly the priorities of the agency and perhaps to reflect less the interests of individual directorates. The list would be stronger were it to be prepared as an integral part of AARD's comprehensive research program.

While many relatively small separate external assistance projects may add to a considerable total, they assess an important cost to AARD. That is the staff time and attention required to administer the project -- often without project funds specifically allocated for that purpose -- and to provide required counterpart personnel. This problem may be especially disruptive to priority programs when another unit of government, without consultation with AARD, accepts a project on AARD's behalf . This brings a demand for attention that competes with AARD's own priorities, and it appears to be less than fully consonant with the Government of Indonesia decision to place all agricultural research under one agency, AARD.

A Look to the Future

The Government of Indonesia created AARD. Its intention to have AARD contribute centrally to the development of the nation remains clear. The current five-year plan, Repelita III, lays out formidable challenges to this agency, which is responsible for technology to solve problems that constrain agricultural production.

Repelita III calls for the following achievements during the years 1979-84:

* Increase the quantity and quality of food production adapted to consumer wishes;
* Increase the quantity and quality of livestock and fish production;
* Increase the production of nonfood agricultural commodities to defend the balance in foreign exchange;
* Improve the techniques for soils utilization;
* Assess the productivity of lands suitable for transmigration and expansion programs.

These broad national goals can be used by AARD to derive specific objectives for research to provide better technologies or to remove constraints. In the area of food production, AARD will need to increase research attention to the palawija and horticultural crops; neither has been emphasized in the years when primary attention has been given to building rice production. While continuing to build its research capability in livestock, AARD needs now to put more short-term commitment on research into fish production, including both in inland waters and from marine operations. It was reported that coconuts, cloves, and pepper offer the most immediate potentials among nonfood crops for export; the goal of eliminating the import of cotton for the nation's textile industry calls for research to solve existing production problems. Assessment of land production capacities and techniques of soil utilization brings obvious needs for research.

The review team utilized these policy targets as it studied AARD's present capability to meet what is expected of it. The team thus moved on from its appraisal of AARD's base of current and growing strength to consider and recommend future actions that the team believes will enable AARD to meet these objectives. In this section the team recommends actions believed to be appropriate for the short-term future; the team suggests a number of steps that are clearly within AARD's own capabilities and options.

Programming and Allocation of Resources

There is obvious need within AARD for a strong capability for planning and evaluating agricultural research programs. Team members endorse the administrative priority and backing now being given to the Centre for Agricultural Research Programming (CARP). They suggest, however, that the range of essential activities under its purview, and the extent and depth of data it must handle, call for staff competences beyond those presently envisaged. It must be a strong unit, able -- for and with the head of AARD -- to define priorities for subsectors and total program and to complement, but not duplicate, activities of planning bureaus in the Ministry of Agriculture and the Ministry of Research and Technology.

Agricultural development encompasses a variety of interrelated factors. AARD's recent move away from a purely commodity approach in programming research indicates awareness of these interrelationships. It is the team's opinion, however, that AARD should strive even more vigorously for an integrated approach. This could involve efforts to enhance contributions of the social scientist in relation to the work of the physical scientist. Development of the role and function of CARP, with the supportive input of the Centre for Agro-Economic Research (CAER), is an area where immediate action seems appropriate.

The problem-oriented areas identified by AARD, such as in the specific national programs, are points where the integrated approach to research may be developed. CARP can be the focal point to coordinate the work in these areas, rather than to delegate it to individual research institutes.

Because the need for a strong CARP is so clear, and to assure having both the physical and intellectual resources equal to the task, it is recommended that specific assistance be sought from external sources: assistance for (a) developing expertise in data gathering and analytical capacities (both human and technological); (b) continuing advisory support for systematic planning; and (c) providing sufficient financial base to initiate and test fully the methods and functions prior to their eventual absorption into the structure of AARD.

Effective research programming requires a continuing flow and assessment of evaluative information. Data are needed to keep track of progress toward assigned objectives as well as to determine the returns to specific allocation of resources to various uses. Evaluation appears to the team to be central within the work of CARP; however, the team did not observe the assignment of what it considers sufficient resources to carry out this vital service. The areas of need include at least management information on personnel activity, periodic reports of activity and progress in terms of assigned projects, and reviews of operations and output. (Evaluation is developing as a specialized area of management, one that appears to need to be exploited more aggressively for AARD.)

Any research program depends on the budget available to it. The team noted with some concern possible effects of what it considered an imbalance between development and routine budgets on the long-term development of AARD's research program. The team understood that much of the construction of elements of infrastructure and also significant parts of many ongoing research projects were funded from development allocations. It was the concern of the team that development funds are not imbedded in the routine budgets of the agency; they do not thus imply the continuity of funding essential to develop research programs that must extend over a number of years. A secondary concern was whether funding bodies will be sufficiently responsive with routine allocations to permit AARD to gain the staff and supporting resources necessary to use well the excellent facilities being achieved with development funds. A careful examination of this area should be made over the next few years to ascertain alternative strategies for future budgetary procedures -- if the matter is as viewed by the team.

Programming is one of several facets that relate to the productivity of resources used in research. The team suggests that the following points -- which may add small but significant increments of productivity -- are worth consideration:

* Increase the priority given to research in the time of the scientists; reduce requirements for activities that do not directly yield scientific output. (The team noted that many AARD scientists were required to spend considerable time in handling administrative details, which competes for time and attention needed in research pursuits.)

* Provide a stronger base of technical, clerical, and other support personnel so less of the scientists' time must be devoted to logistical needs. (Research cannot be done, of course, without appropriate supplies and services; when support personnel are not available to attend to them, the scientist must.)

* Create a cadre within AARD of research managers to complement the work of the research scientists. (The importance of this issue and suggestions on implementing it are discussed in the manpower section that follows.)

* Continue to seek ways of sharing expertise of the scarce scientific talent across more programs and locations. (The team was concerned to find situations where there appeared to be little contact and interaction among scientists of the same discipline even when they were located in reasonable proximity.)

* Examine and develop plans to maximize the use of existing physical resources. This will reduce the need for expenditures for additional resources. (The team supports the philosophy of regionalization that it found at work in development of new facilities. It suggests that there be some consideration given to making existing facilities available to other programs and units, where this could be done efficiently.)

* Recognize the scarcity of resources available within AARD, identify the resources that may be available from related fields, and plan accordingly. (It is the view of the team that the growing competence of CARP makes it possible for AARD management to undertake a master plan for research. That appears to be one way to achieve greater use of existing resources, including capabilities of such other groups as the agricultural universities. It must be noted, however, that any master plan should be under regular review and updating.)

Manpower Resources

There have been numerous and wide-ranging studies of manpower needs for agriculture in Indonesia. These studies can be of great value to experts in manpower planning. However, they do not provide the tactical or strategic recommendations for action to solve AARD problems. Only qualified persons working within the AARD research planning section can do that.

The limited number of Indonesian agricultural scientists cannot be increased much in the short run. However, it may be possible to enhance the productivity of those who are now available. The team observed that many qualified agricultural scientists appear to be doing administrative work instead of research. With scientific expertise so limiting, there should be an advantage to AARD to assure by every possible means that qualified scientists be as fully employed as possible in research activities.

In preparation for work on a master plan for manpower, which the review team sees as an essential step, it is urged that AARD carefully examine the productivity of managerial and scientific personnel. AARD may gain in both

managerial efficiency and research effectiveness by dividing these necessary tasks. Such consideration may lead to:

* Reallocating tasks for many present personnel, relieving research leaders of some administrative activities and sharpening the focus of managerial assignments (with appropriate training or re-training).

* Identifying and articulating present and anticipated functions within the research system (providing a firmer base on which individuals may develop their own careers).

* Reflecting seriously on whether it is using, or proposing to use, its human resources to best advantage -- to AARD's advantage as well as to the advantage of those employed.

A strong research system needs a critical mass of personnel on which it counts to develop its programs. That critical mass means scientists in sufficient numbers and specializations to be able to respond promptly and effectively to the existing research needs. There should be minimum dependency on short-term, project-related personnel. This requires:

* Critical analysis of the present policy that guides AARD in attracting, developing, and maintaining its human resources. (In the years immediately ahead, many persons will join after periods of study and training arranged by AARD. To gain optimum returns from its investment in trained personnel, AARD must have human resources policies that both encourage the persons to remain in AARD employment and to work creatively and productively on AARD's behalf.)

* Providing terms of employment comparable to those available elsewhere within AARD or in similar employment outside AARD. (The team has made specific reference to differences in policies for AARD research staff and apparently comparable staffs in sugar and estate crops areas. It suggests that the policies in effect in the latter be considered the norm to which AARD policies are made consonant.)

Constraints related to remuneration have been identified by several observers as main stumbling blocks to the full dedication to the work at hand by AARD's skilled personnel. The team agrees that remuneration is important but suggests that AARD should also examine other factors that may affect the productivity of its staff. Attention should be given to:

* Strong support in policies applicable to AARD scientists and their prospects of moving into higher earning and status brackets without changing their careers -- permitting a scientist to remain in his field and still have opportunity to earn rank that is truly consistent with the importance of his contribution to his country.

* Facilitating more mobility of staff within a discipline, such as across commodity or geographic institutes, in order that younger scientists have broader opportunities to advance in their work.

* A closer working relationship with expatriate personnel -- a relationship in which the expatriate works toward phasing out his or her own role. (The team has called attention to its concern that in some programs expatriates have emphasized only immediate research or administrative objectives, leaving few effects of stronger performance capabilities in Indonesians with whom they have been associated.)

* Developing training programs in areas of current weakness, areas where external assistance may be needed. In many cases this may require expert assistance in curriculum development and training of trainers who may then extend the programs throughout the agency.

A master plan for personnel should be based on a clearly articulated research plan. The team observed that AARD could benefit from greater attention to its medium- and long-term research programs in order to plan with greater precision its manpower development and related training needs. The research plan identifies the specialists needed, where they should be located, the technical, support, and administrative staff required, and the duration of specific projects. These factors should guide programs to recruit, train, locate, and service the research scientists.

The team observed a number of issues which appear to be current constraints in the area of human resources. It is aware that AARD is taking remedial action in some cases and that most of these issues may be resolved when AARD achieves long-term plans for both research programs and human resources. Pending completion of such planning, the team recommends a number of actions that it believes will immediately improve AARD's human resources situation. To carry these out, AARD may wish to:

* Seek to obtain from the Government of Indonesia adequate basic salaries for research scientists (possibly through exemption of scientific personnel from existing government service policies that appear to encourage them to engage in non-research activities.)

* Establish AARD policies that overcome perceived inequities in postings to different regions in order to assure that persons with the necessary research or management skills may be posted to the site where that capability is needed. (The policy will need to be able to accommodate differences perceived from opposite views: some value most highly the West Java postings, while some may require special incentives to leave outlying regions to move to assignments in Java.)

* Recruit and train sufficient technical and support staff to provide skills and services that enhance the work of the scientist. There is a particular need to improve the training and career potential for those who manage experiment station operations. (This area of training is dealt with in the section on external assistance. The team believes, however, that AARD may itself develop programs to strengthen training of this nature and suggests immediate consideration in light of the needs emerging from development of new research sites and the return of persons from advanced training in science.)

* Provide training opportunities for current senior AARD staff, whose earlier disciplinary specialization will not be utilized through employment as active laboratory or field researchers, so they are better qualified as research managers. Such training as business and management courses and professional visits to similar institutes in neighboring countries may be more relevant to their work than would advanced degrees.

* Utilize more fully the opportunities for training provided in international agricultural research centers and institutes. As AARD increases its attention on palawija and horticultural crops, it will need a variety of research and support skills. AARD has utilized some of these sources of training already, but additional opportunities

should be sought in other centers that can contribute certain training in relation to specific crops.

* Undertake immediate and concentrated planning to utilize optimally the personnel now studying under AARD sponsorship. The team learned that criteria for selection of persons for advanced study could generally emphasize only a level of academic potential and need not be related specifically to fields of research specialization; it was not feasible at the time of selection to determine where an individual would be utilized upon completion of training. However, the fields of science of these persons are known now, and their return to AARD can be forecast; detailed planning now becomes critical for effective assignment.

* Develop pre-service training programs that will result in more rapid orientation and qualification. This seems most needed for newly employed agricultural graduates but might be desirable as well for persons joining AARD after absence for advanced study. As a minimum, new employees should be assigned as trainees or interns for periods of one to several months to work with skilled seniors.

Expatriate staff and Indonesians with advanced training abroad will continue to be important sources of skills required in AARD. However, in the long run Indonesia must develop its own capacity to educate the persons needed to operate its society: this includes agricultural researchers.

Indonesian agricultural universities play the key role in training scientists for AARD research. AARD should support universities' efforts to gain better Government of Indonesia funding for (a) salaries that encourage able young junior faculty members to remain and (b) for resources needed to permit university scientists to engage in basic research that is tuned to the needs of applied research.

The review team noted the growing capabilities of three agricultural universities in particular, IPB, Gadjah Mada, and Brawijaya. All continue to require large inputs of funds and skilled faculty . Other universities are in even greater need than the three cited. As AARD spreads its research facilities and operations more widely throughout the nation, potential contributions of many regional universities become vital, and AARD could benefit from greater cooperation with them. External aid may be necessary to stimulate the needed improvement in teaching and research capabilities. AARD may be able to help inform donors of the needs of these universities and their importance to AARD's progress and to agricultural output.

Structure and Organization

The general pattern of organization within AARD, the team observed, is for commodity-oriented institutes, both central and regional. Regional research appears to be controlled, supervised, and budgeted within the commodity focus, without strong horizontal linkage between institutes concerned with different commodities. In such a structure, scientific discipline tends to be a second tier; scientists of the same discipline are separated by commodity.

The team believes it would be useful to consider recasting the regional institutes as integrated, multicrop, multidisciplinary groups. Such an orientation should minimize duplication of scientific efforts. Farmers in the regions have problems that go beyond single commodities; integrated regional institutes should be more able to deal with problems of the region

through better coordination and interrelation of scarce research expertise. When dealing with a multicrop farming system, researchers will need the participation of skilled persons from several disciplines -- and the results of their work may be more readily adaptable to the farms in their region. At the same time, the scientific resources from individual disciplines may be spread over additional commodities (such as the work of the crop protection specialist which need not be limited to a single assigned crop). The concept of greater economy of scale may permit support staff of greater specialized abilities to be assembled and more fully utilized.

AARD has undertaken a large task in the development of national programs in 26 crops and six other program areas. The team offers one suggestion in relation to organization for that task. In some programs, especially those with a strong multidisciplinary requirement, the program might be better served by designation of a lead institute rather than by the appointment of a person as national coordinator. An institution can provide a wider range of expertise than one person possesses, and the planning should be better if done by a group at one institute. As needs change over time, one institution can change personnel and support assignments more readily than can occur with individuals in widely separated units. Some lead-institute functions could, and probably should, be provided by some regional units.

AARD has made rapid strides in expanding its research sites and developing facilities. The team commends AARD for achievements in this area; however, it notes its concern about lack of an articulated master plan for the experiment stations. The team believes that AARD should, in the long term, look toward such a developmental plan. In the next few years it should examine:

* The efficiency of AARD regional institutes and the possible recasting of their functions.

* The sharing of regional and subregional facilities (a) to support integrated research plans for regional development and (b) to reduce demands for additional funds for physical facilities by making more efficient use of those already in existence. (The research institutes for food crops and industrial crops at Medan provide a case in point.)

* The possibility of nominating regional institutes as leaders in developing national commodity programs along with implementation of the research function.

Communications. The smooth functioning of any organization depends in considerable measure on an effective flow of information within its various units. Knowledge developed by each unit should be easily accessible, as well as transferable, within the organization. This involves improved two-way communication among the separate structural units. The team was concerned about the relatively limited, and what appeared to be largely downward, communication between AARD units.

A large, dispersed organization needs investment in qualified personnel and efficient technology to assure prompt and accurate communication. The information flow should be two-way and interactive among the staff. When research actitivies are spread geographically, as is true in AARD, there is clear need for effective gathering and synthesis of research results among the scientists and units, followed by dissemination to users and others. These are tasks for trained specialists.

The review team suggests a study of communications problems and potentials; findings might lead to organization of communications services into an AARD-wide unit.

Role of Centre for Agricultural Research Programming (CARP). Suggestions offered here point toward dividing and spreading research activity as AARD regionalizes facilities and staff postings and, at the same time, they point toward closer coordination of the work. To achieve both purposes -- with which the review team is in accord -- AARD will require an increased input of leadership. This function seems appropriate for CARP, especially if the unit is strengthened along lines recommended by the team in the programming section (pages 9 and 10).

In addition to assigned planning and monitoring functions, CARP would be expected to examine and study continuously the need for new research activities and for adjustments in existing research. For CARP to fulfill its role successfully, it must have a central place in the structure of AARD. It must be able to work influentially with the research institutes.

Role of Centre for Agro-Economic Research (CAER). The relationship of CAER to CARP and the rest of AARD deserves further study. CAER's mission needs to be wide, including: (a) problem identification and interpretation of results; (b) monitoring effects of agricultural policy in relation to application of research outputs; and (c) forward planning studies. CAER's function is currently hampered by the lack of manpower and facilities at every level of the system. These needs deserve immediate attention and action, in the view of the review team.

Role of Centre for Agricultural Data Processing (CADP). The information gathered, analyzed, and made available to CAER and CARP for further interpretation is an essential part of the comuterized data base required for effective research planning and management. Continued strenthening of CADP to provide this service is important for the overall program of AARD.

Linking Research and Production

As a general conclusion, the team considered that AARD should seek additional means to strengthen the linkages between researchers and the organizations that carry results to producers. The formal systems are outside AARD's authority, so the agency can only look to its own opportunities to make the most of those options within its scope. The team suggests actions to strengthen links through several steps, including those that follow:

AARD could set up national and regional technical committees, organized in connection with the centers and institutes, which could help assure that AARD scientists give priority to farmers' needs. The committees might meet annually to review, within their respective areas, the technical content of research and its contributions to development. The activities of such technical committees might be coordinated through CARP.

AARD could initiate more frequent contacts among (a) AARD scientists, (b) extension workers, and (c) producers. Such direct consultations might be even more valuable if carried out often in the fields of farmers where problems are found.

AARD could encourage closer association among its research staff at different levels and with producers. These associations should strengthen AARD's ability to define production problems more accurately, to tap a wider range of potential contributions to research solutions, and to improve the fit of technology to local circumstances. The team believes that production would be further increased if AARD would:

* Increase the amount of research conducted on farmers' fields, especially adaptive research. Many trials could be carried out cooperatively with extension staff.

* Provide additional time for AARD researchers to take part in field days, tours, or demonstrations that show farmers either trials or materials from the researcher's area of responsibility.

* Base more of the research effort on experimental variables drawn from the conditions and situations of farmers. (An example is the on-farm research methodology described by CIMMYT, the international center for improvement of corn and wheat, with headquarters in Mexico.)

The dissemination of research results to agricultural producers in Indonesia is primarily by person-to-person contacts, augmented to some extent by printed materials and some mass media. The person-to-person channels of communication will continue to be the most important. However, several areas could be strengthened by more attention and more resources:

* Extension workers -- who are administratively separate from AARD -- need regular training and current information from AARD. More time of experienced researchers should be devoted to this need.

* AARD staffs -- in centers, regions, and districts -- should make themselves more available as sources to the subject matter specialists of Agricultural Information Centres, Agricultural Development (or Technology) Centres, as well as other media.

The recent establishment of certain AARD-wide services in library, information, and publications is endorsed in principle by the team. The team is of the opinion, however, that linkages would be stronger and more effective if the scheme were broadened so that, among other functions, it would also have system-wide responsibility for dissemination of research results. This might require the consolidation of communications units that are now administered in different institutes and jurisdictions, or at least means of more effective coordination of the use of resources.

External Assistance in the Immediate Future

The mission terms of reference called specifically for the team to look ahead three to five years to consider external assistance needed to support AARD research programs. The team was apprised of some 14 areas where, according to AARD's appraisal, the agency either lacks sufficient experience or requires additional resources to develop the emphasis needed.

In addition, AARD leadership discussed its desire to aggregate separate assistance programs into three so-called umbrella projects. The purpose would be to sharpen the focus of aid programs and to reduce the pressure on limited AARD administrative resources. There is thought to be considerable economy of scale possible through such integration of donor support, especially in increased productivity of counterpart personnel. A distinct advantage of such an integration would be AARD's ability to channel all projects through an administrative scheme that could more actively monitor external assistance and the relevant commitments on behalf of AARD.

The review team concurs in the logic of this position and recommends thoughtful donor consideration.

Framework of NAR III

One umbrella project proposed by AARD would group together three individual projects for strengthening AARD institutionally plus three others related to food production. The six are seen as amenable to the funding framework associated with the Third World Bank Project (NAR III).

The review team had independently framed recommendations for increased attention to the three institution-strengthening areas; the team agrees that external support is needed for professional expertise and finances. The three areas for institutional development support are:

* Centre for Agricultural Research Programming
* Centre for Agro-Economic Research
* Information and communications

The team recognizes the need for expanded research attention for the crops noted below:

* Horticultural crops, including highland and lowland vegetables and fruits;
* Industrial crops, especially coconuts, cloves, cotton, and pepper.

The research will require a firmer resource base with both technical and financial assistance from abroad. The team observed excellent research facilities under development at Lembang, where the horticultural crops research would be focused. With these facilities and the increased scientific capacity as persons return from advanced training, a further investment in horticultural research should bring an early and significant payoff. The result should be research to provide new technologies that can bring the increase in quantity and quality of food called for in Repelita III.

Although its appraisal of industrial crops research was less encompassing than for food crops, the team observed important needs. The potential of industrial crops to provide additional farm income and --

either directly or indirectly -- to improve trade balance through increased exports, creates ample rationale for more investment here. Foreign assistance through experienced research and administrative personnel and financing will be needed, in the view of the team, to bring this research program promptly to a point for takeoff.

Another project recommended under this umbrella deals with aquaculture and mariculture. The team noted much potential for increasing animal protein supplies through strengthening Indonesia's current fish production. Much inland water can be utilized in fish farming if there is appropriate research-based technology; annual catches from marine areas should be expandable with better technology. The team concluded that increases in animal proteins for dietary improvement could be achieved much more rapidly through technology for fish production than from other livestock programs. It recommends these areas for immediate emphasis in external assistance.

Natural Resources and Land Use

A second umbrella program would be focused on natural resources and land use. Areas under this umbrella -- for which the team offers strong support -- would include: land-use systems, with particular reference to new lands for transmigration; forest resource development; and fisheries resources development. (The team's recommendations on research on land-use systems, page 23, and support for transmigration and land expansion, page 21, are discussed more fully below.)

Another area suggested by AARD officials is the expansion of plant genetic resources for crop improvement research through gene banks or germplasm banks. Except for some 5,000 accessions of rice, limited attention in AARD has been devoted to this area. The review team did not examine this area of research in depth, since it was not in the terms of reference; however, it suggests that AARD cooperate with the National Biological Institute at Bogor and, through it, with the International Board for Plant Genetic Resources. External assistance may be necessary for that activity in AARD.

Management and Ecology

A third umbrella project -- of a more micro-oriented nature -- would be focused on water management at the farm level, agricultural machinery, fertilizer efficiency, and the ecological impact of intensive agriculture. The team strongly supports the start of research on these areas, suggesting that CAER become involved in studying complex economic issues involved..

The review team urged increased attention to agricultural machinery, as proposed under this umbrella, having observed in the Outer Islands the constraint of labor availability at crucial crop stages. Productivity of farmers and land could be enhanced there through finding and adapting simple machines that could multiply the results of available human and animal power.

Varied cropping systems are used in different soil and climatic situations in the country. Addition of fertilizers is essential to maintain levels of output on most farms. Efficient use of fertilizer must be based on sound and extensive research and it is the conclusion of the review team that more AARD resources than assigned at present are needed to develop the widespread and systematic program needed to build the knowledge base for improved fertilizer efficiency.

While its purview of Indonesian agriculture did not include focus on water management at the individual farm level or on the ecological effects of intensive agriculture -- two other AARD topics proposed under this umbrella -- the team endorses the concerns in principle. Both are crucial elements in Indonesian agriculture, from the standpoint of family income and broader social well-being.

The review team's time and span of observation in Indonesia were limited, as has been noted. It did not have the opportunity to deal with all of the potential priority programs for AARD, but there was general similarity between the team's independent evaluations and AARD's own choice of priorities. Those areas have been cited above. In addition the team offers below additional observations related to areas where external assistance is judged to be potentially productive in the immediate future.

Transmigration

Migration out of Java became institutionalized and basic structures were laid down for transmigration policy in the Government of Indonesia regulations of 1972 and 1973. Under Repelita III implementation of various parts of that policy was transferred from the Directorate General for Transmigration to the agencies. AARD was thus given responsibility for agricultural research in relation to transmigration.

AARD support of transmigration is coordinated by a scientist located in the Centre for Soils Research. The research supports the expansion of new agricultural areas and the regional development program. It is also expected to develop packages of technology keyed to utilization of new land resources under sustained agriculture.

There has not been time since Repelita III began for AARD to develop fully a research program related to transmigration. The program has not been developed as rapidly as the needs have grown. The review teams urges that AARD define its long-term policy on research to support transmigration, interacting with that ministry as the program is developed.

In reviewing transmigration, the team noted an apparent assumption that a stabilized agriculture can be readily established in areas that were formerly under shifting cultivation. This assumption needs to be examined critically by ascertaining the main agricultural production constraints that have faced earlier transmigrants and by evaluating their performance.

More needs to be done to identify actual or potential constraints. The team saw evidence that some transmigrants originally engaged in agriculture had found it necessary to earn their living through off-farm employment. An April 1981 World Bank review and report on transmigration recommended increased diversification through greater use of aquaculture, the introduction of small livestock, secondary food crops, and tree crops. Some evidence of work on secondary crops was seen in the development of intercropping at the Maros Research Station. However, the team felt that much more needs to be done, particularly in terms of investigating the potential contributions from livestock, fisheries, and tree crops. The location of the coordinator of transmigration research in the Centre for Soils Research may have led to a bias towards soils as the object for the use of funds for transmigration research. A broadly integrated program is suggested, in which the output of all agricultural sciences may be merged with the social sciences to provide a framework for the development of the

regions in which transmigration is taking place. CARP can play a leading role in coordinating AARD's several contributions to transmigration.

The present approach to agricultural research in transmigration areas presupposes an ideal optimization by the family of land, labor, capital, and management. The land area will remain, but capital will dwindle if labor and management are not effective. Labor is scarce in the Outer Islands, and efforts should be made to increase productivity through additional manageable forms of animal or motor energy. At present the only ways of managing labor appear to be hiring others, using children as workers, or reducing the area cultivated. The team recommends initiation of research directed towards optimizing the use of manpower for agricultural production in transmigration areas. It also recommends a major new research activity in mechanization. It recognizes that the type of research needed on land use systems in transmigration areas is complex. In view of this complexity, and the considerable volume of external funding being provided to support transmigration, it suggests that this is a research field in which external support would be needed and useful.

Mechanization

The review team repeatedly read and was told that in the Outer Islands increases in agricultural production are more limited by labor constraints than by land resource shortages. Thus research on increasing productivity of human labor would seem to justify a high priority, if the desired agricultural production is to be achieved in these lands.

The team recommends that an agricultural engineering research unit be established and that it should give particular attention to non-motorized mechanization that would be appropriate in Indonesia. Rapid progress may be possible by screening hand tools and machines used elsewhere in the region. Emphasis should also be placed by AARD on determining the availability of crop varieties that are responsive to such labor-saving methods as minimum tillage, which may be an alternative to mechanization in some instances. External assistance, possibly from an ASEAN country rather than a developed one, could accelerate progress.

Palawija Crops

Relatively little research attention has been given to food crops other than rice, in which results have been spectacular. Present national goals call for increases in quantity and quality of food for the Indonesian diet. Several other crops thus come into prominence. Cassava, sweet potato, and maize appear to be those with potential to make important improvements in nutrition for Indonesia's rapidly growing population. There is potential for large increases in productivity and production of each; good research will be required for each. Policy makers need also to consider carefully other support elements -- such as transport, processing, pricing, and marketing -- which are recognized to have been key factors in the success story of rice.

Cassava occupies about 1.4 million ha in Indonesia, with a national yield average of about 9 t/ha. That yield is low in comparison to averages in neighboring countries, and it is less than one-third the 30 t/ha potential of two varieties recently developed in Indonesia. Yields of cassava vary widely according to soil type; much research is needed to develop varieties that will yield well over a wide range of production

situations. Research will be crucial as well to seek out and adapt technology for optimum yields under various farming situations.

Sweet potato currently is grown on one-fourth as much area as that of cassava. Its high production potential -- which appears possible through sound research -- qualifies it for major attention by AARD scientists. AARD can draw assistance from several international agricultural research centers for both genetic resources and for personnel development. Still, progress in adapting varieties and fitting technology to the many different locations and systems of Indonesian farmers requires commitment of local resources.

Although maize is the second cereal in importance in Indonesia, further attention to research for its improvement is still required. The most obvious needs are for plants that (a) require a relatively short growing season and (b) are resistant to certain pests and diseases (especially to the disease, downy mildew). Various techniques in growing maize -- use of fertilizers, pest control, and intercropping and sequential cropping with grain legumes, for example -- need improvement through research. Maize production under irrigated and rainfed conditions also needs study. The main areas of maize concentration are East Java and the islands of Sulawesi and Timor. The leadership function for maize improvement research might well be located in an institution in one of those areas.

Industrial Crops

Export crops have long played important economic roles in Indonesia. Coconuts, cloves, and pepper appear to offer significant opportunities for improvement and, through them, contributions to the nation's trade balance.

The islands of Indonesia offer a genetic base of wide diversity in coconuts. Relatively little advantage has yet been taken of that diversity through systematic collection and exploitation. Some recent progress, such as hybrids of tall-by-tall and tall-by-dwarf plants, shows that important improvements can be made through research. Pest and disease control need considerable strengthening to accompany improvements in breeding.

Indonesia offers an immense scope for cultivation of cloves, especially in the Outer Islands. The die-back disease now presents a serious threat, and high-standard research is needed to deal with it. There is also considerable room for improvement in clove productivity per tree, per unit area, and in quality of the essential oil produced. Stronger research on cloves should bring a high return to the country.

Pepper offers opportunities for improvement through expanded research. There is scope for much improvement through breeding for vine hybrids that are higher yielding and of better quality. Pest and disease control need continuing research attention. Research is also needed in relation to the farming systems in which pepper is grown with other crops such as coconuts and cloves.

Indonesia now imports a large share of the cotton needed for its textiles industry. There appears to be considerable opportunity to establish cotton in East Java and the Outer Islands. If that could be done successfully, it would bring obvious benefits in trade balance. The questions appropriate to research are many and varied. A strong national research program seems to be required, one that is well coordinated, multidisciplinary in approach, and with locations that represent the varied agronomic and socio-economic situations under which cotton may be grown.

Soils Research

The Centre for Soils Research (CSR) has overall responsibility within AARD for soil research in Indonesia. Its mandate is one of the most important -- and challenging -- in AARD: there are land and water conservation problems in many areas now farmed; great emphasis is being placed on transmigration; and forested areas are important in relation to land and water conservation as well as to earning foreign exchange.

The team endorses the umbrella program concept of a carefully developed and coordinated plan for expansion of research on: land-resource inventory, land-capability classification, land-use planning, and applied soil management investigations, as well as continuing soil testing and management services for farmers and other agricultural producers. Long-term research programs of the type needed will be hampered until such inventories are available.

Although most of the new lands for agricultural development are well-watered and naturally forested, they may differ on many characteristics, due to precipitation, altitude, topography, soil-forming parent materials, type of vegetation, and other factors. The differences may be great even within short distances; the suitabilities of soils which appear the same may be strikingly different. (Most of the forested soils, for example, have two generally unfavorable characteristics -- they are strongly acidic and of low natural fertility. They present special problems when brought under cultivation: when cropped, the organic matter in such soils is converted quickly, and plant nutrient constituents become soluble and are soon leached below the level of agricultural crop roots; their inherent fertility may be used or lost in as few as one to three years.)

Inventories of prospective lands for development are needed to enable wise allocations to forestry, livestock production, arable agriculture, tree crops, and so forth, according to the specific capabilities of the land under cultivation. The team observed that in the Outer Islands there is urgent need for inventories on a regional or subregional basis. Land capability classification and land-use planning are needed to guard against misuses and unnecessary deterioration or destruction of the land resource in individual areas. Facilities and capabilities should be developed so routine determinations of soil physical and chemical properties can be carried out quickly and used to identify land suitabilities for various crops, fertilizer and lime requirements, appropriate crop combinations or sequences, and so forth. (Such soils research capabilities can be used to advantage by agriculture throughout Indonesia, not simply where agriculture is now becoming established in new land areas.)

Existing infrastructures, proximity to communication services, and broad reconnaissance surveys have probably played a part in identifying the areas most likely to be developed during the next decade. It is suggested that CARP -- in conjunction with CSR and in accord with regional or local needs -- select priority areas and seek international assistance to deal with them. The need will be to obtain quickly the detailed inventories, plans, and soil management information for the individual areas. To implement this suggestion, one can foresee a need for many young Indonesian undergraduates and recent graduates to associate with the regional or local surveys, the laboratory analyses, the field experiments, and related activities. In this way Indonesia may become self-sufficient in soils research within a decade or so, being better able then to meet national goals for agriculture.

Animal Protein Supplies

Repelita III set goals for increasing animal protein supplies in the diets of Indonesians. The most important components of Indonesia's livestock industry are cattle and buffalo; most of them are owned by small farmers and are found in herds with only one or two adult animals. They subsist on crop residues and roadside grazing.

The scope is limited for significantly increasing the productivity of these large ruminants; that scope is closely related to the possibility of change in farming systems and in crop varieties, since such changes provide the basis for altering the availability of byproducts for livestock feed.

The best prospects for increasing beef production probably lie in opening new grazing lands in the eastern islands, although that is likely to be carried out through large enterprizes rather than by peasant farmers. The prospects are limited for significantly increasing pig meat and milk production: the former for religious reasons and the latter because the current level of milk production represents less than 0.5 kg per capita per year. A phenomenal rate of growth in milk production (which would not be easy to bring about) will only make a small reduction in milk imports.

The areas of considerable potential increase are poultry and small-ruminant production. But even if good progress is made with these species, it will be difficult to do more than maintain current livestock-derived animal protein intakes, given the rapid increase in human population and the current tendency of over-slaughter of cattle and buffalo due to strong market demand coupled with high prices for meat.

The best prospects for increasing animal proteins are believed to be through raising the production and consumption of fish, which is currently three times as important as meat and milk in terms of human intakes of animal protein. In spite of this, fish consumption is only about one-third of the level of nearby countries and has been static for the last decade.

Currently marine fishing provides three-fourths of the fish catch, although the annual marine catch is still less than 30 percent of the sustainable yield. High growth potential lies largely in offshore fishing, since coastal areas in Java and Sumatra are already overfished. But the development of the offshore resources is likely to require considerable capital for boats and processing facilities; as in cattle ranching in the Outer Islands, the primary impact of improved technology is likely to benefit the national economy rather than to provide social and economic benefits to small farmers.

This same thing cannot be said for inland fisheries, which are still relatively underdeveloped in Indonesia in spite of the nation's enormous amount of inland water. Aquaculture in Indonesia has lagged far behind other Southeast Asia countries, although in recent years its considerable potential has been recognized. Promising developments are starting to take place, albeit on a limited scale. Modern husbandry techniques make it possible to produce large quantities of animal protein and high incomes from limited areas of inland water.

The prospects for increasing both animal protein supplies and small-farm incomes through better exploitation of inland waters -- particularly through aquaculture -- are such that this activity would appear to warrant considerable priority in terms of both development planning and research

resource allocation. In view of its newness in Indonesia, it appears to be a suitable field for enhanced external support. A similar observation applies to coastal mariculture, where a program has already commenced, aided by the Government of Japan.

A General Concern: AARD's massive program to develop physical facilities throughout the country appears to be well advanced, but a large growth in the agency's routine budget appears to be necessary to assure continuing effective use of these new facilities. The team was concerned that the current trend of growth in routine budget may not be sufficient to meet this goal. The team recommends that AARD be assured -- before seeking or accepting further external aid for physical aspects of institution building -- that the maintenance of existing and already-planned facilities can be adequately funded by the routine budget. It is suggested that additional capital expenditures should only be developed as part of AARD's overall research plan. Further, the team believes that AARD should give highest priority to the development of improved facilities in other regions before developing more facilities on Java, especially if agriculture is to be promoted more heavily in the Outer Islands.

Manpower Development

In the view of the team, the most immediate needs in terms of external cooperation are for carefully defined technical assistance for both manpower development and for research specialists. Although extensive manpower development activities are underway now, there are additional needs, some of which are urgent. The team recommends that some priority should be given to the following:

Research management training The phenomenal growth in AARD's budget and manpower in the last few years has created a need for more trained research managers. AARD has commenced in-service courses in this subject, which are particularly important for senior personnel. Such training needs to be carried out in Indonesia and to be related closely to Indonesian circumstances. External donors can contribute importantly, particularly through the provision of specialized personnel.

Station operations management training. Appropriate planning and qualified management are needed for the large field stations being developed by AARD. The persons in charge of such stations will require a broad interdisciplinary grasp of topics such as land preparation and protection, roads and plot layout, treatment records, programming and budgeting, etc. Such individuals are not easy to find, and special training is likely to be required, probably overseas on similar stations.

During the rapid buildup in facilities and staff, many AARD personnel are likely to be abroad for training periods up to four years. During this time new facilities may be difficult to utilize to the optimum. This represents a concrete opportunity for expatriate specialists to provide inputs, even though their effective counterparts are likely to be abroad. A number of donors are reluctant to provide technical assistance personnel in such circumstances, yet it offers an effective way of helping Indonesia while its agricultural research program is growing so rapidly. Donor flexibility in such circumstances would be useful.

The team considers that AARD's proposed overall manpower plan should include a component relating to its needs for technical assistance personnel. AARD may gain from outside assistance or consultations in preparation of such a plan. Indonesia may now benefit from a newer type of technical assistance. The traditional form (whereby expatriates spend one to three or more years in a particular technical assistance posting) may no longer to fit Indonesia's needs, except in special cases. Expatriates in long-term assignments tend to be predominantly either younger persons (who may lack experience) or older people (who are at or nearing retirement). Mature, able, and active scientists in mid-career in a developed country are seldom available for continuous postings of a year or more. Some activities (for example, plant breeding and the study of some pests and diseases) are seasonal and may not require talents of expatriates on continuous long-term posting throughout each year.

In planning for technical assistance, AARD should try to reduce the proportion of expatriate personnel on these traditional continuous, long-term arrangements. It should attempt to develop an approach whereby some senior scientists spend a number of shorter periods (one to four months each) in Indonesia over a term of several years. Such arrangements may offer the advantage that more experienced and higher-caliber expatriates become available who would otherwise not be. During these short visits, expatriates should work in close consultation with AARD scientists. The latter would then remain with the challenge and responsibility of continuing the work. In some cases the short-term expatriates should be able to act as advisers of AARD personnel who are working towards graduate degrees. Expatriates might also have a consulting or advisory role to departments, individual staff members, or graduate students in nearby agricultural universities.

Another important role that short-term expatriate advisers could usefully fill is as a member of program or review committees for key AARD research programs or centers. To fulfil this role productively, a person with continuity and considerable familiarity with Indonesian agriculture is essential. In many instances the sort of scientists who could fulfil this role could also provide some of the other desired inputs.

The engagement of appropriate specialists from other developing countries represents another source of technical assistance that is only now starting to be exploited. Able people of suitable qualification can seldom be spared for extended periods from their home countries, but a series of short-term postings might be manageable.

A Concluding Note

In a period of little more than five operational years, AARD has made excellent progress in carrying out the mandate of the Government of Indonesia. This review team observed evidence of developing capacity and some evidence of societal returns to expenditures in agricultural research, which is a long-term investment.

This report does not give major attention to specific achievements of the AARD organization; much less is stated than could have been. However, the review was especially focused on seeking out opportunities for strengthening the organization.

The review team's emphasis on needs does not imply a negative balance; rather, it represents a perception that confidence can be vested in the future development of AARD. The achievements of its first years indicate its capacity to provide leadership, initiative, creativity, and responsible utilization of funds from both internal and external sources. There remain many opportunities in which investment in AARD for agricultural research in Indonesia will provide favorable returns. In some of those areas, in the team's opinion, AARD is fully able to proceed on its own. In others, needs exist for access to additional resources, for developmental consultancies in managerial and technical areas as well as for funds and physical resources. Some of these opportunities fall within the mandate of ISNAR, which was formed to provide services to national agricultural research systems. ISNAR stands ready to respond within its areas of competence to requests from AARD and the Government of Indonesia for continuing cooperation.

Annex 1

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Annex 2

Review of the Agency for Agricultural Research and Development (AARD), Indonesia. The review will be carried out in June/July 1981 by a team supplied by ISNAR with concurrence by AARD.

1. The review will examine the AARD to make an independence appraisal of the program and organization which it has developed since its establishment under Decrees 44 and 45 of 1974, issued by the President of Indonesia and the subsequent Decree of May 2, 1975 issued by the Minister of Agriculture which provided for more detailed responsibility and an organizational framework for the agency. Specific attention will be given to:

   (a) a view in retrospect of the program and organization in terms of progress, special problems, staffing, research priorities, allocation of resources, the impact and appropriateness of external assistance which it has received to date.

   (b) a look to the future three to five years as to presently stated objectives for the program and organization as to the appropriateness of research priorities, staffing, organizational structure, allocation of resources, projected external assistance and additional external assistance which might be appropriate.

   (c) the suitability of the agency's structure to implement its program.

   (d) the efficacy of its procedures for establishing research objectives, maintaining research priorities and evaluating and modifying research programs.

   (e) the efficacy of links of research with the practice of agricultural production (f.i. through extension services, development bodies, farmer organization etc.)

2. The outcome of the review is to be a report on the findings of the review and recommendations as to points la-le plus any other points which may arise which should be noted for consideration during the review.

Annex 3

Background Document

Introduction

The background document was written prior to the pre-mission to Indonesia. It was intended to serve as a general introduction to the agricultural system in that country and in particular to present the role of AARD within the system. The paper was to be read in reference to a number of appendices with various details of the overall system.

After the pre-mission, in which the facts contained in the document and the appendices were checked, a few alterations were made. If the backgroun document were to be done over at this time, some changes would be made. Some recasting would be done to reflect the important points that follow:

a. Contrary to the impression given in the background document, the World Bank has recently shown positive concern with studying the ways of improving the linkages between research and extension.

b. There has recently been closer contact between the International Potato Center (CIP) in Peru and the Vegetable Research Institute in Lempang.

c. According to recent performance (last $2^{1}/2$ years) and to recent informed forecasts it would appear that rice production in Indonesia has a much greater potential than was previously estimated.

To facilitate the reading of this document the definitions of certain terminology used are given below:

Repelita is Indonesia's term for its series of five-year programs. Ten Repelitas are projected; three have been introduced to this time.

Repelita	I	Indonesia's first five year program	1969-74
Repelita	II	Indonesia's second five year program	1974-79
Repelita	III	Indonesia's third five year program	1979-84

NAR - National Agricultural Research

NAR I (1979-81). The first such projects supported by the World Bank to strengthen agricultural research in Indonesia by establishing production-oriented agricultural research programs for four commodity groups of importances to Indonesia. It was under NAR I that AARD was established within Ministry of Agriculture to consolidate and provide guidance for all future research to be undertaken by the Ministry. AARD's work to be supported by a separately established agency AAETE (Agency for Education, Training and Extension).

NAR II (1981-1989). The second project supported by the World Bank, primarily directed to expand and strengthen Indonesia's agricultural

research institutions developed under NAR I. In particular the project includes substantial technical assistance, training at M.Sc. and Ph.D. levels in Indonesia and abroad, and physical development of research centers and institutes.

Palawija Crops refers to secondary crops in Indonesia . Originally this referred to food crops planted on sawah fields after the main rice crop, when not enough water was available for a second inundated rice crop. The name refers to the same crops without regard to being grown on sawah fields, after rice, or on dry rainfed land . Palawija crops are:-

cereals:	maize, and sorghum.
tubers:	cassava, sweet potatoes
grain legumes:	soybeans, groundnuts, mung beans

Estate Crops The name was introduced after World War II and referred to the crops grown on (mainly Dutch-owned) estates or plantations, which were taken over by government and became a responsibility of GOI. Research on these crops was done at institutes or stations owned and financed by the private estates. These estates and their research stations were brought under a new Ministry of Estate Crops, which was brought into the Ministry of Agriculture as a Directorate General of Estate Crops. When AARD was established the research stations were removed from the Directorate General of Estate Crops and placed under the wings of AARD. Because of their previous history they still maintain a special position in the organization. Research Institutes for Estate Crops focus work on: oilpalm and rubber (on estates); tea and cinchona; coffee, cocoa and tobacco (on estates); and sugar.

Industrial Crops refers to crops that are grouped together for focus of research in Indonesia. They are usually grown by small holders. Industrial crops include: spices -- pepper, clove, cinnamon, and vanilla; fibers -- cotton, ramee, and jute; medical -- herbs; and essential oils -- citronelle grass and others. Tobacco and cocoa grown by smallholders are also considered industrial crops.

Research on these crops was carried out at the General Research Institute of Agriculture before the war. After World War II this section -- as non-food crops -- was separated from the general institute and placed in what was named Research Institute for Industrial Crops. The Central Research Institute of Industrial Crops, formerly under the jurisdiction of the Directorate General of Estate Crops, was moved into AARD. At the end of 1979 the institute was fully incorporated into AARD.

Bimas (Bimagan Marsal) literally translated means "mass guidance." It is a national program to raise food crop production and farm income by supplying credit and cash inputs at subsidized prices.

Bulog (Badan Urusan Logistic) is a government agency responsible for national food price stabilization (particularly rice, wheat, and sugar), food distribution, and rice stock authority.

General Background

The Republic of Indonesia is an archipelago with a total land area estimated at just over 1.9 million km^2. The largest land area is the Kalimantan islands comprising 28%; other geographic divisions and areas

are Sumatra and its islands, 25%; Irian Jaya, 22%; Sulawesi, 10%; Java and Madura, 7%; Bali/Nusa Tanggara, 4%; and the Moluccas, 4%. Indonesia's 1979 population totalled 146 million (80% lived in rural areas,) and it is expected to continue to grow at a rate of 2.25% per annum through to the year 2000. The Java and Madura region already has a population density of some 690 persons per km^2; the projected growth rate there may bring severe problems; the same rate or higher could benefit Irian Jaya, which has three persons per km^2.

Indonesia's third five-year development plan (Repelita III) reaffirms its trilogy strategy of development from previous years. Its three goals -- equity, growth, and national stability -- are to be pursued by various means. Generation and diffusion of job opportunities are considered the most important. The plan visualizes a decrease from 19.3% to 14% in the share of development expenditures that go for agriculture and irrigation during Repelita III. As a result of this decrease, and because of the increased support proposed for other sectors of the economy, agriculture's contribution to gross development product (GDP) is expected to decline from its present share of 31.1% to 27.2% by the end of Repelita III.

Indonesia exports a wide range of primary and semi-processed agricultural commodities. Together with timber and fish, agricultural commodities presently account for 80% of the non-oil exports and approximately 35% of total exports. In recent years Indonesia has been a net importer of rice, which accounted for 3% of Indonesia's 1979 import bill. That percentage is expected to decline to 2.4% in the next five years, but by 1985 it will represent the highest rate of increase for an individual commodity -- at current prices, 231% higher than in 1979 .(In the past two years rice production has actually been at or above the consumption levels in Indonesia.)

Agricultural Highlights

Although Indonesia's third five-year plan projects a declining share of agriculture in GDP, agriculture is the largest single sector in the economy. Despite considerable scope for growth in many subsectors of agriculture, the Government of Indonesia's target of a 3.5% average annual growth rate for agriculture as a whole represents a formidable challenge. It is possible in technical terms, but will require considerable governmental investments and improved support programs. Some parts of Indonesian agriculture -- for example, the important rice industry -- are already achieving levels of productivity comparable to international standards; hence higher levels will become more difficult to attain. In the case of rice the projected increased output of 4.3% would have to be sought through bringing more land in outer island lands under rice production. On the other hand, productivity of non-rice crops (including horticulture), most tree crops, fisheries, and animal husbandry lags in comparison with other countries in the region. The 3.5% increase projected for agriculture will require an annual growth rate of between 5% and 7% for secondary crops plus significant improvements in the other sectors.

The potential of permanent upland cropping in new areas is strongly influenced by topographic slope, which determines the degree to which the cultivated soil surface is vulnerable to erosion. A 1979 World Bank

Survey[1] estimated that over two-thirds of the upland area of the islands outside Java is unsuitable for annual cropping. (The study did not report crop suitability by specific soils.) Soils information for Indonesia is limited. For large areas in Sulawesi and Irian Jaya, only schematic maps are available, based on geological and terrain data. Large areas of Sumatra and Kalimantan have only exploratory data based on limited ground study. In the development of new lands outside Java, interest centers on swamp soils (about 48 million ha) and the red-yellow podzolics and their associated soil complexes (about 54 million ha). The tidal swamps, which are being settled spontaneously, are considered the most promising for development. These are one of the target areas for current and projected irrigation developments associated with the government's transmigration program.

Irrigation is of critical importance in Indonesia, although its monsoonal climate brings annual rainfall ranging between 1,500 to 3,000 mm in the rice-producing areas. About 94% of all rice output in Indonesia is produced on sawah land, 85% with irrigation and 15% rainfed. The upland rice share in total output has been steadily declining, now about 6%. Sugar is the only other major crop under irrigation in Indonesia. Little has been done to irrigate either maize or wheat, two important food commodities in Indonesia. Wheat -- which is not yet grown in Indonesia -- was estimated to have accounted in 1977 for about 3% of total food energy consumption; imports totaled about 1 million tons.

About two-thirds of rural Indonesian households rely on agriculture as the major source of income. The income of a majority of these households is dependent on plots of less than 1 ha. (Estimates of 2 ha are cited as the minimum subsistence size for calorie production for a family of five persons). With such small land holdings, it appears unlikely that much increased employment can come from the existing land structure. Where double-cropping and more intensive cultivation practices have been introduced, those developments have been accompanied by a greater use of labor-saving techniques. These techniques have tended to displace labor in the area of harvesting, weeding, and rice pounding -- which particularly affects the female labor force in agriculture. Females are traditionally dependent on those activities to be recognized as employed in agriculture (they account for 40% of total agricultural employment). As a result of these changes in techniques, roles of many women, have become limited to the unpaid agricultural work in the family.

Availability of uncultivated land outside Java has contributed to an increase in the area farmed by smallholders. Progressively less productive land has been available for these farmers, many of whom had become virtually landless as farm size decreased under increasing rural population. New lands have been brought under cultivation as a result of expansion of estates and the transmigration settlement programs. While these moves have generated more agricultural employment, the increased employment has been mainly in seasonal and contractual labor on the new estates. New settlers face many difficulties in the transmigration programs, with as yet few effective support services available.
Indonesia's agriculture is divided into six main sectors: food crops, estate crops, industrial crops, livestock, fisheries, and forestry.

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[1] Source: IBRD Report No. 2374 IND "Indonesia - Supply Prospects for Major Food Crops", March 3, 1979.

Food Crops

Since national independence, rice has become the most important food crop in the Indonesian agricultural economy. Rice represents 61% of the harvested area of six major food crops; the remaining crops and shares are: maize, 18%; cassava, 10%; soybeans, 5%; peanuts, 4%; and sweet potatoes, 2%. Over 50% of the rice area harvested is in the region of Java and Madura, which represent less than 7% of the land area of Indonesia. The yield of rice harvested in Indonesia (presently about 3 t/ha) is relatively high for the region. Per capita production in 1978 was about 110 kg. (Optimum annual production for rice-consuming countries is estimated to be 165 kg per person. The Indonesian production level would be considered more adequate if the secondary food crops yields were not so low.)

A wide variety of vegetables and fruits are grown as food crops in Indonesia. They are a vital part of the Indonesia diet, which otherwise would be mainly restricted to cereals and tubers. Agricultural surveys tend to show these crops as of minor importance. This may be a statistical aberration, partly because the culture of these crops is diffuse and relatively unorganized, and partly because horticultural crops have failed to attract the attention of authorities in the period since World War II and until recently.

Estate Crops

The main estate crops are oilpalm, rubber, tea, cinchona, coffee, cocoa, and tobacco. When grown on estates, these crops are primarily designated for export -- in particular, oilpalm and rubber are traditional earners of foreign exchange. The share of production of certain estate crops by smallholders -- rubber, coffee, and tobacco -- is considerably higher than production on the estates.

Industrial Crops

Industrial crops include coconuts, spices, fibers (cotton, ramee, and jute), plus tobacco and cocoa grown by smallholders. With the exception of tobacco, these crops go primarily to meet the needs of small-scale domestic industries; they are considered a subsector of agriculture only for purposes of research.

Livestock

Livestock represents a small sector in Indonesia's agriculture. Except for sheep and goats, which increased marginally, the number of livestock registered has remained the same over the last 10 years.

Fisheries

Fisheries production, which is a major earner of foreign exchange, has increased nearly three-fold over the past 10 years. The major advances have come in marine fishery and inland-culture fisheries. Open water, inland fishery has shown little development.

Forestry

Forestry is one of the fastest growing activities in Indonesia. Next to oil, it is the biggest source of export earnings. Some of the richest timber stands in the world are in Indonesia, including the largest concentrations of tropical hardwoods to be found anywhere. Approximately 1.2 million km^2, 60% of Indonesia's land area, is forest. A third of it has been designated for timber production.

Agricultural Needs and Research Programs

Indonesia seeks to improve the performance of the agricultural sector as a means to promote its overall economic and social development. The Government of Indonesia sees the agricultural sector as performing a vital function within the national development objectives laid down in Repelita III: equity, growth, and national stability.

Increased agricultural productivity is seen as a means of (a) improving the welfare by alleviating poverty of millions dependent on this sector; (b) stimulating industrial growth through an increased supply of raw materials and greater effective demand for industry's products; (c) contributing towards more balanced development of the regions, since agricultural production is spread throughout the country.

The government plans to improve the nutritional quality of the national diet by improving the availability of better quality food at reasonable prices and by increasing annual production of meat, eggs, milk, vegetables, fruit, and marine fish. Production targets call for increases of between 2% to 10% to serve domestic consumption.

The economic, social and political dimensions of food production are reflected in goals of improving nutrition, reducing under-employment, raising productivity, and providing access by the poor to their basic needs. However, the pervasive problem of poverty is recognized: the bulk of the population has difficulty in affording food, even if adequate supplies can be produced. It would appear, therefore, that the main problem facing the agricultural sector is to satisfy two sides of the equation: to produce and distribute sufficient food at the lowest cost for domestic consumption, while ensuring that employment opportunities are increased within this sector.

The agricultural sector is confronted with a sizable task if it is to meet the objectives laid down for it in Repelita III. The task will have to go beyond simply increasing agricultural productivity. Objectives of equity, growth, and national stability imply that benefits of increased agricultural productivity will be shared.

The pursuit of food security and increased employment for the nation appear to be main government priorities for the agricultural field. Increased productivity in the main subsectors of agriculture is the means stated by authorities to serve these priorities. The task of agricultural research includes the search for ways in which productivity in agriculture can be increased.

Agriculture in Repellita III

Repelita III lays out five basic programs to increase production in Indonesia's agricultural subsector:

Increase in food production: This program envisages increasing rice production at an average annual rate of 4.3% (about double the rate of population growth) and increasing secondary (palawija) crop production by an annual rate of 5% to 7%.

Increased rice production in Java, where over 50% of Indonesia's rice is harvested, can only come from increased yield per hectare. Various experiments have shown that yields can be increased, but various constraints face the small rice farmers. The main focus has been breeding for locally adapted high-yielding varieties, based on genetic material supplied by the International Rice Research Institute (IRRI) and other international and national research centers. Earlier maturity and pest and disease resistance are other characteristics sought in local breeding efforts.

Rice production can be increased outside Java through expansion of area as well as by intensification. Technological research is applied in areas now farmed as well as in the new transmigration areas. Research on upland rice, which has been meager, is being extended with germplasm from IRRI and other sources.

More intensified research on production technology for the palawija crops is called for in government plans to achieve increased yields and greater total production.

Nutritional surveys in Indonesia indicate that consumers in the lowest three income deciles obtain about 40% of their calories from cassava and maize and 46% from rice. Consumers in the upper three income deciles obtain about 14% of their calories from cassava and maize and 59% from rice. Despite needs recognized for some years, research accomplishments on palawija crops have been limited. The yields, compared to other countries in the region, continue to be low; little follow-up support to expand production of these crops is provided by government pricing, credit, or food distribution policies. Greater activity has occurred in recent years -- horticultural research and development of superior strains of fruits and vegetables are being identified with resistance to pests and diseases. Data are not yet available on the extent to which these advances are going into production by farmers in Indonesia.

Research on cropping systems has demonstrated potential to increase food production in many areas of Indonesia, especially where food shortages have occurred. In one example, the best cropping pattern in some areas was shown through research and practice to be rice followed by maize intercrop, planted at some time early in the wet season, followed by cassava planted as a relay crop 30 days after rice and maize. Until recently this approach to diversification of food crop production was the closest research in Indonesia had come to actively increasing the production of secondary food crops.

Rehabilitation of irrigation systems, with research into the development of new areas for irrigated and rainfed cropping -- particularly in the islands outside Java -- are other activities directed towards overall increase in the food subsector.

Increase of livestock and poultry: Increase in animal production is closely connected with the aim to improve nutritional levels in Indonesia. Increased support is proposed for the breeders. In addition to facilitating credit to breeders, the program envisages research in eradication of disease, as well as in availability of high-yielding genetic lines of livestock and poultry. Backstopping support is foreseen to stimulate the breeding of livestock and poultry in the new transmigration areas. Programs call for to combining breeding and animal feeding with food crops production for a diversified agriculture. Considerably more investigation is required into pricing, support policies, marketing, and processing facilities to stimulate livestock and poultry production.

Increase fisheries production: Increased fisheries production is needed for two purposes: as an export and foreign exchange earner and to support increased domestic consumption. Improved infrastructure is required -- docks, water ponds, etc.; also needed is improved technology in the art of traditional fishery. Also intensive instruction activities are needed to increase fish and sea water catches, while assuring that cultivation seeds or stocks are not disturbed. More production of inexpensive fish, especially for the home market, is visualized through increased utilization of garden ponds and wet rice fields and by improving processing, preservation, packaging, and storage.

Increased estate crop production: Many efforts are called for to increase per-hectare yields of estate crops and to expand into new areas..

Such a program requires research into improved plant species and disease and pest control, as well as research on processing of estate products. Steps are being taken to relate this work to migration and settlement programs,as well as to open new areas to estate companies. Activities of estate production are primarily centered on rubber and coconut, Indonesia's main cash crops. Attention is also being given to sugar cane production, primarily outside of Java in dryland areas, possibly in rotation with staple food crops. Special research is being directed at increasing two other crops that earn foreign exchange -- coffee and cocoa. Increased production has potential to provide employment in production and processing. Research activities are to be expanded to benefit the smallholders and estates in Java, the smallholders in the outer islands and transmigration, industrialization, or nucleus estates. Improved operational management is seen as a need in estate crops production.

Increased forest production: A program aimed at increasing the efficiency of timber production, Indonesia's main foreign exchange earner, would expand the introduction of high-yielding varieties (which are in harmony with the environment) and increase utilization of byproducts and non-forest products. Where production is directed towards labor-using processing industries, residents who live close to the forest regions can benefit. This will require increased guidance on multiple uses of the forest products. Research is to be stimulated in developing

forest areas and in rehabilitating existing forests alongside other types of agricultural production -- such as rice, shellac, honey, cattle, livestock, and pasture feed.

These programs will not be operated in isolation. Plans have been set out for the agricultural subsectors programs above to be supported by programs from other sectors:

Transmigration
Village development
Agricultural education and training
Young generation
Women's role
Natural law guidance
Weaker economic expansion and guidance
Land, water, and forest safety
Natural resources and environment guidance

The budget for Repelita III envisages each of these programs as having its own research component, as the following table shows:

Table 1. Budget for Repelita III, 1979-80 through 1983-84 (in millions rupiahs) for science, technology, and research.

Sector, subsector, or program	1979/80 Devl. Budget	1979/80-1983/84 Devl. Budget
Science, technology, and research sector	58,147.7	447,600.0
Sub-sector for the Expansion of Science and Technology	4,935.0	60,941.0
Sub sector for research	53,212.7	386,659.0
General research program	9,683.0	104,000.0
Agricultural and irrigation research program	19,800.0	117,794.0
Industrial research program	2,060.0	23,715.0
Mining and energy research program	1,330.0	8,000.0
Communication and tourism research program	2,200.0	16,500.0
Trade and cooperatives research program	400.0	1,685.0
Labor and transmigration research program	1,988.5	23,500.0
Regional, village and urban research program	275.0	1,800.0
Religions research program	164.0	1,600.0
Program for research into educational apparatus, younger generation, national culture and beliefs in the one mighty God	636.0	5,000.0
Health, social welfare, women's role, population, and family planning research	890.0	20,500.0
Peoples' housing and research program	230.0	20,000.0
Social communications and journalism and information research program	400.0	4,065.0
Government apparatus research program	1,565.4	8,500.0
Program to improve and expand statistics	11,590.8	30,000.04

Ministry of State for Research and Technology

The Presidential decree of 1975 established the Ministry of State for Research and Technology. This new cabinet-level ministry gave authority to that minister for a wide range of functions designed to improve planning and operations of research supported by the government. The minister's approval is required for research budgets of all ministries prior to approval by the National Planning Agency (Bappenas).

The functions of this ministry include:

Review of research priorities;
Consideration of allocations of funds to ensure scope or magnitude of support commensurate with the problems;
Final decision, after review with the Institute for Government Organization (LAN), on the organizational structure for the various research agencies (such as AARD).

The Ministry of State for Research and Technology is responsible for supervising all research in Indonesia. For the period 1979-80 through 1983-1984, this represents 86% of the ministry's development budget. This includes the money allocated to the agricultural and research program, which is 30% of the total research budget (by far the highest single sum of all the monies earmarked for research). Of this latter amount, 66% (13,105 million Rp) was designated to AARD's development budget in 1979-80; 3.5% (1,950 Rp, 1.715 million planned plus an additional 217 million, was provided in 1979-80) was spent by the universities on agricultural research and development.

Agricultural Research

Indonesia's national agricultural research system is primarily supported by AARD. This concentrated structure for management replaced the diverse pattern for research management that existed earlier. The present system continues under challenge from universities, the National Science Development Board (LIPI) and the Ministry of State for Research and Technology. The challenge is especially noted in relation to funding of the research to support programs on agricultural development issues.

The Agricultural Research Board (ARB) within the Ministry of Agriculture -- chaired by the minister -- is comprised of five directors general within the ministry (Food Crops, Forestry, Fisheries, Animal Husbandry and Estate Crops) plus the heads of AARD and the Agency for Agricultural Education, Training and Extension (AAETE). This board was established under NAR I, the outcome of a government decision in 1974 to reorganize the Ministry of Agriculture (with financial assistance from the World Bank). In that reorganization, the research functions and responsibility for extension methodology were removed from the directorates general and placed into the AARD and AAETE. Responsibility for all agricultural research and development at the national level was thus assigned to AARD; AAETE assumed responsibility for agricultural education, training, and extension methodology[3].) However, responsibility was continued within the five directorates general for administration of extension services in the provinces (see Organigram for National Food Crops Extension Project, p. 00). The ARB is responsible for research policy in agriculture, for its funding, and for the coordination of research programs.

The Presidential decree of 1974 established AARD within the Ministry of Agriculture. With the establishment of AARD, development of a national agricultural research system began. Prior to that time, national research activities existed only in relation to specific commodity groups under specific directorates general within the Ministry of Agriculture.

AARD Responsibilities

AARD was given statutory responsibility to establish research and development in agriculture according to the policy stated by the Minister of Agriculture and to manage all technical executive units in agricultural research and development within the Department of Agriculture. Within this mandate AARD defines its mission as organizing and channelling agricultural research programs along specific routes "that produce tangible results in terms of practical solutions to agricultural programs, which in turn support national development goals." (See AARD brochure published in 1980.)

The mandated functions of AARD are reflected in its operational policy as follows:

> To plan and prepare programs and to coordinate policy for the management of research and development within the Department of Agriculture.
>
> To organize and formulate technical policies, including the setting up of programs and methods, that involve personnel recruitment, financial administration and management, equipment supply and maintenance, scientific reports, research and development management according to the policy stated by the Minister of Agriculture.
>
> To manage a number of research centers, centers for research and development, institutes, laboratories, experimental farms to monitor the management, maintenance and development of units which are the main responsibility of the Department of Agriculture.
>
> To evaluate the findings of research and development performed by these units.

Organizational Structure

Since its establishment in 1975, the organizational structure of AARD has undergone several changes. AARD's priority in 1975 was seen as coordinating work done by the various research institutes within the Ministry of Agriculture. In this task, AARD's head was assisted by a secretariat and five research centers (for soil research, for agro-economic research, for statistics and agro-data processing, for agricultural quarantine, and the library for agriculture and biology). The research centers, which are all located in Bogor, were given both line and staff functions. They assisted the head of AARD in the coordination of program planning, in the implementation of research, and in the conduct of research not being performed by the institutes.

The control span of the AARD became extensive. By Presidential decree in 1979, the government established five central research institutes (food crops, fisheries, animal husbandry, forestry, and industrial crops) and

one new research center (for programming and monitoring). All were located in Bogor. Only the directors of these central institutes, plus those of the research centers, report directly to the AARD head. The 18 commodity research institutes under these five central research institutes are so grouped by Ministerial decrees of 1975 and 1980. Because of previous historical and legal actions, the Research Institute for Estate Crops and the Sugar Research Institute each has a separate management structure -- the head of AARD serves as chairman of both management boards. They are part of the national agricultural research system.

The following table shows the location and the major programs of these 18 research institutes, plus those of the six estate crops research institutes.

Table 2. AARD research institutes, with locations and major programs (grouped under appropriate central research institutes).

A. Central Research Institute -- Food Crops	Major commodities researched
Sukarami, Sumatra	Rice, palawija, vegetables
Bogor, West Java	Rice, palawija
Lembang, West Java	Vegetables
Sukamandi, West Java	Rice, palawija
Malang, East Java	Palawija, rice, fruits, vegetables
Banjarmasin, South Kalimantan	Rice
Maros, South Sulawesi	Rice, palawija, vegetables
B. Estate Crops Research Institute (under Board of Management)	
Bogor, West Java	Rubber, rubber technology
Medan, North Sumatra	Oilpalm
Jember, East Java	Coffee, cocoa
Rubber Research Institute Sungai, Putih, South Sumatra (Estates)	Rubber
Rubber Research Institute, Sembawa, South Sumatra (small borders)	Rubber
Tea Research Institute Gambung, West Java	Tea, chinchona
C. Central Research Institutes -- Industrial Crops	
Malang, East Java	Tobacco, fiber crops
Bogor, West Java	Coconuts
Mapanget, North Sulawesi (Manado)	Coconuts, cloves
Tanjungkarang, Lampung, South Sumatra	Pepper, cloves
D. Central Research Institute -- Animal Husbandry	
Animal Husbandry Research Institute Bogor, West Java	Animal husbandry
Animal Health Research Institute Bogor, West Java	Animal health
E. Central Research Institute -- Forestry	
Forest Research Institute, Bogor, West Java	Forest
Forest Products Research Institute Bogor, West Java	Forest products
F. Fisheries Central Research Institute	
Fish Technology Research Institute Jakarta	Fish technology
Marine Fisheries Research Institute Jakarta	Marine fisheries
Inland Fisheries Research Institute, Bogor	Inland fisheries

Budget and Priorities

The government has provided AARD with budget increases of about 5% per annum since its establishment in 1974-75. In 1979-80 the allocation for research (excluding bilateral assistance) was approximately Rp. 17 billion (US$27 million) -- about 5% of the Ministry of Agriculture budget. This represents about 0.2% of agricultural GDP, approximately average for agricultural research expenditures in low income countries. AARD's total expenditure during the five-year period 1979-1984 is estimated at Rp. 140 billion (US$225 million), excluding bilateral assistance; the remaining funds came from by international development banks.

AARD appears to have formulated priorities within a twofold policy of seeking to: (1) improve its ability to increase agricultural productivity by developing capacity in fields of agricultural technology and know-how; (2) improve the ability of its local manpower in agricultural research in order to meet the need for increased agricultural productivity.

AARD Progress

It can be observed that AARD has made considerable progress.

a. It has developed an infrastructure to enhance agricultural research within a four-point program for food crops: for rice, secondary crops, cropping systems, and vegetables. (The plan for national agricultural research was established in 1974-75 in accordance with requirements of the World Bank, which assisted in its financing.) Evidence is seen in the network of institutes for food crops and their substations being developed in Java, Sumatra, Sulawesi and Kalimantan.

b. Capabilities have been strengthened in the appropriate institutes to improve agricultural technology in fisheries, forestry, and estate research -- all coordinated under their respective centers in Bogor.

c. The work of these institutes and centers is further supported by the services of the centers for soils, agro-data processing, and agro-economic research. Their work will be further strengthened by the services of the Center for Agricultural Research Programming, which was established recently. From an organizational point of view, AARD appears to be well designed to provide the scientific ingredients required for increasing agricultural productivity in Indonesia as set out in goals of Repelita III.

   This approach has placed considerable pressure on AARD to reap the practical benefits of its research. Research appears to be narrowly focused on plants, animals, and soils with perhaps inadequate attention to the problems of rural communities and consumers.

Institutional Linkages

The flow of research findings to application in producers' fields requires strong institutional linkages. Research may not be put to use

if it is not supported by an adequately aligned extension service; an extension service that is not directly backstopped with a strong research structure may be ineffective. AARD is confronting the problem of how best to communicate with the agricultural production system, how to pass on its research findings as well as those from the international research centers and other sources. The reorganized structure of AARD in 1979-80 shows departments for program and communication under individual centers and institutes. AARD's mandate gives it the role of presenting its findings to the extension services, which are operationally under the authorities of the individual directors general.

Programming

AARD's research programs are primarily based on what the government has stipulated as the needs for Indonesian agriculture - a reflection of the "command approach" to research. Utility of the research is finally subject to how agriculture works at the farmer level. However feedback to research from the agricultural system in Indonesia is left to informal communications among farmers' levels, the experimental farms, and the local extension agents. An effective channel still needs to be developed through which researchers can be kept well informed of the working of agriculture in Indonesia. This is necessary if agricultural research is to strengthen its rationale upon which to base its priorities for research and allocation of resources.

AARD's Centre of Agro-Economic Research could apparently set the framework in which AARD could develop priorities within its research objectives. Two functions of this center were laid down in the original organizational plan for AARD: (1) to do research into ways of translating new specific knowledge into economic possibilities at farm level, and (2) to do research on ways in which agriculture can best serve Indonesia's national economic policy.

Little data were found that deal with plans emanating from this center or with a proposed overall program for its work. Such evidence as was found of work done in the field of socio-economic or agro-economic research has been carried out until now by the Agro Economic Survey, an independent organization outside AARD.

AARD results seek accord with the national food strategy and also to be in line with the need to improve the welfare of those involved in food production -- men, women, landless farmers, and smallholders, as well as those in large estates . AARD could benefit from an improved program design for the work of its centers and institutes, plus a cadre of well-trained research managers, and a "high quality staff confident in their own work and enough respect for other fields that they do not feel the need to defend themselves, nor are they afraid to make contribution in fields other than their own," as written by Ralph Cummings, Jr., in 1981. A clearly delineated program would show how the needed personnel of higher educational attainments may be used. This utilization plan would include:

a. The best ways of adequately using expatriate personnel,

b. Ways in which skilled staff can best evaluate research from abroad against the alternative of developing local capabilities in agricultural technology, and

c. Analyzing the implications of research findings -- for instance, new technology of productions can worsen the situation of women who are involved in food production, food preparation, house maintenance, collection of fuels, water, etc.; and that perspective should influence research efforts.

Major problems facing AARD in pursuing an effective research policy may be summarized to include the following:

Investment in research facilities could be considered excessive relative to development of high quality, appropriate scientific staff;

Many facilities appear to be operated without clear programming (the objectives of research are not clear, so it is not clear how AARD decides on its research priorities or how it dedicates its resources);

Fiscal management is an administrative burden on research productivity;

Those making major research decisions may fail to give adequate weight to the socio-economic factors that contribute to productive research;

Insufficient attention may be devoted to the type of information required to provide the basis for analysis abd establishment of research priorities;

There is pressure to produce from all sides (including outside donor agencies); AARD haa concentrated on working on as many things as it could; a "collection of findings" has resulted with little analysis and drawing out of the implications.

Extension Services in Agriculture

At present there is said to be more improved production technology available in Indonesia than farmers are using. While the organization of extension services is under the mandate of the Ministry of Agriculture, the management is delegated to the coordinated effort of three main groups within that ministry: AARD supplies the research-based inputs to the extension services; the individual directorates general service the individual units of extension services; and the Agency for Agricultural Education, Training and Extension (AAETE) supplies the advice on methodology. The pattern is further complicated by implementation at farmer's level carried out in coordination with provincial governors who answer to the Ministry of Home Affairs for their administration of certain extension services. The extent to which these three groups coordinate their activities strongly influences the services provided. (The margin between available and applied technology is affected by other factors such as inputs, risk, uncertainty, and incentives arising from current price levels and marketing arrangements).

The role of the directorates general in the Indonesian extension services is largely an historical one. It is a direct result of the BIMAS (Bimisgan Massal - which is literally translated to mean "mass guidance"), a national program started in the mid-sixties to raise agricultural production and farm income by supplying credit and cash inputs at subsidized prices. The function of directorates general within

this was to develop "BIMAS" through the use of extension workers. Today they provide the major share of the extension services in the provinces. Among the directors general there is a substantial difference between de facto responsibilities for extension services. The Directorate General for Food Crops has perhaps been the most dynamic staff in the field of extension services; with the assistance of the World Bank, there has been the recent development of "polivalent" extension staff (PPLS) who work closely with the rural extension centers under the directorate. These rural extension centers promote field trials specifically directed at the community where they are located. The other directors general have extension workers who are "monovalent" (PPS) or specific subject matter specialists. It would appear that responsibility resides in the directors general to pursue programs that will increase Indonesia's agricultural production and to coordinate supportive programs to achieve this end. Through research, AARD supplies technology towards this end, and AAETE contributes through supplying methodologically trained manpower to staff the extension services. Such a design reinforces a "command approach" to agricultural production and highlights the "top down" stream to supply inputs for increasing agricultural production.

Also part of the linkage between research and extension service in Indonesia are the agricultural development centers, which are under the provincial agricultural services, and which in turn are administratively responsible to the provincial governor but technically responsible to the appropriate director general in the Ministry of Agriculture. In the course of their work, the agricultural development centers (now called agricultural development boards) carry out field trials in which AARD is not involved, either in the implementation or evaluation stages.

Also in each province is the kanwil, an officer who is administratively responsible directly to the Ministry of Agriculture. The kanwil has an advisory and coordinating role with respect to the various technical activities undertaken by the ministry in the provinces. It appears that there is also an implementary role by delegation for AAETE projects. In some provinces the kanwil is also responsible for rural information centers.

This operational design in extension services is considered unlikely to change in the near future. There appears to be ample scope to pursue research that would be, in fact, more congruent with the needs of agricultural producers. Such a research program would require close cooperation of AARD with AAETE and the directors general.

Manpower and Training in Agricultural Research

As part of the current development plan, the government has started implementing the second phase of its longterm strategy to improve the quality and supply of agricultural manpower. It is closely aligned with the government's plan to strengthen the role played by AAETE in supplying higher skilled agricultural manpower: it includes incorporation of home economics and pre-service training of women extension agents plus a program for training forestry technicians.

The government's plan is less specific on ways of improving the quality and supply of manpower in agricultural research. Although there are various planned and existing research programs in agriculture at institutions of higher education, there is no defined national policy on

the scope and nature of agricultural research in these institutes or on their relationship to the research responsibilities of AARD in the Ministry of Agriculture. AARD may make strenuous efforts to stimulate cooperative research with these institutes but that does not make up for what appears to be a chronic shortage of capable research management personnel within AARD [2]. Personnel are needed with skills in research entrepreneurial techniques to optimize the dissemination of research findings.

Shortages of manpower able to manage agricultural projects appear frequently in connection with World Bank-assisted projects; it has been concluded that: (1) managerial problems continue to be the most pervasive and serious in project implementation and (2) the difficulties are likely to increase.

Increased linkage between AARD and higher education institutes in Indonesia offers good potential for increased use of qualified research personnel. This requires a more clearly defined role of the universities and other such institutions vis-a-vis the national research effort, together with an assurance of adequate regular funding to implement any relationship that might be developed.

AARD's link is not clear with AAETE's work in the field of education and training for agricultural research. It may be that AAETE's role might be upgraded to provide a source of high level agricultural manpower both for research and extension work.

AARD's link to attract able management personnel from the private sector is not given in the data available. As in other countries, however, this will depend on the financial incentives the government is prepared to give in order to make such transfers attractive.

External Aid to Indonesia's Agricultural Research

AARD's associated research institutes are presently working with 12 foreign donors in 21 research programs in Indonesia. The total budget for these projects is estimated at US$250 million; 55% is contributed by the foreign donors, with the remaining amount provided by the Government of Indonesia. Of the US$139 million being contributed by foreign donors, (2.5% of the total 1981 commitment made in 1978), US$125 million (90%) is related to two World Bank projects: National Agricultural Extension II project, 1981-86, and its National Agricultural Research III project, 1981-89.

Eight other projects totalling US$27 million were implemented. Fifteen others (value US$45 million) were requested as of April 1981. The total foreign donor assistance to AARD agricultural research program was US$185 million.

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2 Of the total technical and managerial manpower in agriculture of Indonesia (estimated in 1979 to be 45,167 persons), only 1,546 persons or 3.4% were attached to AARD; 2,301 or 5% were found in institutes for higher education, and a further 5% in the private sector.

Information on the monies involved or data on the programs extent or planned in other sectors of agricultural research in Indonesia (by higher education institutes, the private sector, or other ministries) has not been readily available.

The data available on agricultural research programs being carried out by AARD and its institutes with foreign donor assistance indicate that most are institution-specific, particularly geared to institution building. In two cases there is mention of a tie-up with an international research center -- in both cases, with IRRI. No mention was found of linkages with CIMMYT to support Indonesia's development of its wheat and maize crops nor with CIP in respect to the United Kingdom-sponsored program for seed potato production. (In large measure, of course, this may be due to lack of analysis of these projects by the writer, since data on these projects has not been gathered.)

The World Bank's contribution to Indonesia's agricultural research was reflected in the establishment of AARD and AAETE in 1975 and to the development of these agencies since then. In view of the need for a closer link between research and extension, referred to above, it is surprising that little direction has come from program sponsors to promote systematic coordination procedures, between themselves as well as with the directorates general -- also within agricultural research generally in Indonesia (including the universities, private sector, and other ministries) and extension work in Indonesia.

Concluding Remarks

From this overview of agriculture and agricultural research in Indonesia, the following main points emerge :

Research appears to be oriented to a "command approach." There does not appear to be sufficient information available on how agriculture production is organized at the producer level nor how the products are distributed and marketed. These characteristics are likely to be different in different regions represented in Indonesia; a more consumer-oriented approach to research would seem to be required. This approach is possible only if research is tuned in to the local needs for increasing agricultural productivity and to the role for support services in achieving this productivity. (A typical example in the need for location-specific research in relation to returns to fertilizer inputs.)

There appears to be need for a flexible and skilful interpretation of the role of research and its findings at every level of the agricultural research system.

There exists a need for broad-based analysis on the interaction of agricultural production and research; the research establishment should be in a position to review production more from a multicommodity than monocommodity basis.

Annex 4

Schedule of ISNAR Review Mission to AARD

5-29 August 1981

Wednesday	5 August	Members arrive in Jakarta
Thursday	6 August	Joint meetings with:
Friday	7 August	Ministry of Agriculture)
Saturday	8 August	Ministry of Technology)
Sunday	9 August	Bappenas)
		USAID)
		World Bank)
		IADS (Dr. E. Oyer))
Monday	10 August	ISNAR Team's general meeting with AARD in Bogor, 9.00 a.m.
Tuesday	11 August	Croup meetings of ISNAR's Mission with AARD, Bogor 8.00 a.m.
Wednesday	12 August	Joint meeting of ISNAR team with AAETE, BIMAS, AARD, Jakarta 9.00 a.m.
Thursday	13 August	ISNAR team's field visits
Friday	14 August	(For Dr. Kern, Dr. Paulsen, Mrs. Weerema,
Saturday	15 August	and Dr. Nestel: 13-14 August in Jakarta
Sunday	16 August	then to the field)
Monday	17 August	
Tuesday	18 August	
Wednesday	19 August	
Thursday	20 August	
Friday	21 August	
Saturday	22 August	
Sunday	23 August	
Monday	24 August	ISNAR Review Mission writes first draft report
Tuesday	25 August	Hotel Hyatt Aryaduta, Jakarta
Wednesday	26 August	
Thursday	27 August	
Friday	28 August	Final meeting with AARD.
Saturday	29 August	Team leaves

Annex 5

Places Visited by ISNAR Review Team

Java

General

The Minister of Agriculture	Jakarta
Bureau of Planning - Department of Agriculture	Jakarta
Bureau of National Planning (BAPPENAS)	Jakarta
The World Bank Indonesia Resident Mission	Jakarta
The USAID Mission Jakarta	
BULOG - The Department of Research	Jakarta
The Office of Kanwil (Ministry of Agriculture)	Malang
IADS Offices	Bogor
Senior Officers of AARD, AAETE, BIMAS	Jakarta
Directorate for Transmigration	Jakarta
Sugar Mill Factory	Jatirota

AARD

Office of the Director General	Jakarta
Center for Agricultural Research Programming (CARP)	Jakarta
Center for Agricultural Economic Research (CAER)	Jakarta
Center for Soils Research	Jakarta

Food Crops

Central Research Institute for Food Crops	Jakarta
Research Institute for Food Crops	Bogor
Research Institute for Food Crops	Sukumandi
Research Institute for Food Crops	Malang
Research Institute for Food Crops (Highland Vegs)	Lembang
Research Station for Fruits	Siomulyo
Food Crops Experimental Station	Kendalapayak
Research Institute for Food Crops	Padang

Estate Crops

Central Research Institute for Estate Crops	Jakarta
Research Institute for Estate Crops	Jember
Pasuruan Sugar Research Institute	Pasuruan

Industrial Crops

Central Research Institute for Industrial Crops	Bogor
Research Institute for Industrial Crops	Malang

Livestock and Fisheries

Central Institute for Animal Sciences	Bogor
Research Institute for Animal Science	Bogor
Animal Production Research Institute	Bogor
Inland Fisheries Research Institute	Bogor
Centre for Animal Research and Development	Bogor

Central Fisheries Research Institute	Jakarta
Marine Fisheries Research Institute	Jakarta
Fish Technology Research Institute	Jakarta
Animal Production Research Station	Jakarta

Forestry

Research Institute for Forestry and Forestry Products	Bogor
University of Brawijaya	Malang
Agricultural Information Centre of AABTE	Kayuambou/Lembang
Rural Extension Centre	Pandaan
Agricultural Development Centre (now renamed Agricultural Training Board)	Bedali-Lawang

Sumatra

Food Crops

Food Crops Research Institute	Sukarami
Research Station	Sumani
Experimental Farm	Gungung

Estate Crops

Research Institute for Estate Crops	Medal
Rubber Research Institute (under construction)	Sg. Putih

Industrial Crops

Livestock and Fisheries

Inland Fisheries Research Station	Palembang

Soils

Soils Laboratory	Bukittini

Other

Transmigration Settlement	Situum

Kalimantan

Food Crops Research Institute	Banjaramasin
Agricultural University	Banjaramasin

Sulawesi

General

Offices of the Kanwil (Ministry of Agriculture)	Ujung Pandang
Offices of the Kanwil (Ministry of Agriculture)	Kendari
Joint discussions with representatives of individual commodity research station in southeast Sulawesi	Kendari

Food Crops	
Food Crops Research Institute	Maros
Food Crop Experimental Farm	Waiwatoba
Food Crop Experimental Farm	Puriala
Industrial Crops	
Research Institute for Industrial Crops	Manado
Inland Fisheries Research Station	Maros
Transmigration Projects	
	Makaleo
	Puriala
	Meraka
Estate Crops	
Cotton Estate Plantation	Kendari
Other	
Agricultural Training Centre	Batankuluk
Agricultural Information Centre	Maros
Universities	
University of Southeast Sulawesi	Kendari
Ambon	
Fish and Technology Research Station	Ambon

List of Acronyms

AARD	Agency for Agricultural Research and Development
ASEAN	Association of South East Asia Nations
BAPPENAS	Badan Perencana Pembangunan Nasional (national development planning agency)
BIMAS	Bimingan Massal (mass guidance)
CADP	Centre for Agricultural Data Processing
CAER	Centre for Agro-Economic Research
CARP	Centre for Agricultural Research Programming
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CSR	Centre for Soil Research
IARC	International agricultural research center
IITA	International Institute for Tropical Agriculture
IPB	Bogor Institute of Agriculture
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
NAR III	National Agricultural Research III (program with the World Bank)
NLAS	National Library for Agricultural Sciences
USAID	United States Agency for International Development