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REPORT TO:

USAID/INDONESIA

GOI, AID/W-S&T

NEED FOR SEED TECHNOLOGY RESEARCH IN INDONESIA

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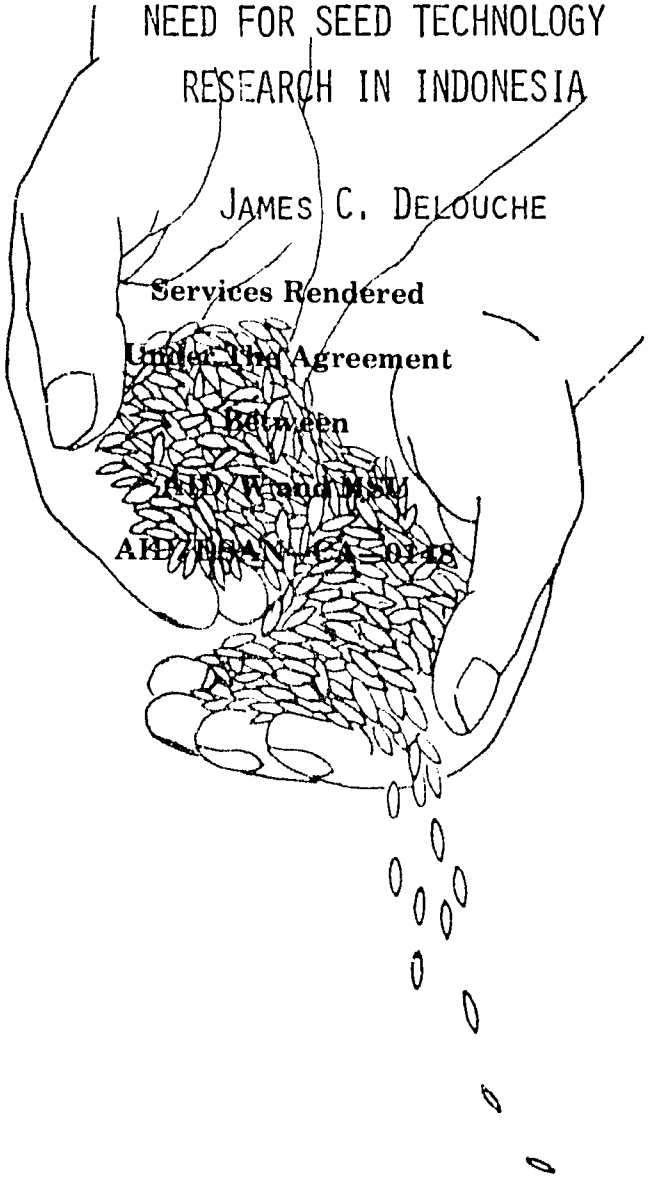

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REPORT TO: USAID/Indonesia, GOI (AARD), AID/W-S&T

TITLE: Need for Seed Technology Research in Indonesia

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COOPERATIVE AGREEMENT: AID/DSAN-CA-0148

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REPORT SUMMARY

The results of most analyses of the foci for agricultural research in Indonesia in the years ahead indicate that palawija crops should be accorded priority attention: soybean, corn, peanuts, sorghum, mungbeans and possibly wheat.

Assessments of the impediments and constraints to intensification and extensification of palawija crop production in Indonesia invariably single out the "seed problem", "seed constraint" or "seed storage" as a major constraint or impediment.

The "seed problem" in palawija crops has multiple causes and is manifested in several ways which can and do constrain production and limit what can be accomplished in intensification/extensification programs: (1) supply inadequacies which range from non-availability to untimely distribution; (2) quality deficiencies which result in less than optimal plant densities for efficient production or in stand failures; and (3) interactions and/or combinations of short supply and poor quality which can effectively sabotage palawija crop improvement programs.

Seeds of the palawija crops, especially soybean and peanuts, are much, more difficult to produce and save under the humid tropical conditions of Indonesia than rice seeds. Not only are the seeds of the palawija crops not well adapted for survival under humid tropical conditions, but because they are secondary crops - opportunity crops -farmers have less experience in seed saving and give less attention to it. The seed saving model is rice, and it just doesn't work well for palawija crops. Changes in cropping patterns as a result of intensification programs and more assured irrigation often result in shifts in the season of production of palawija crops, and, thus, change the terms under which seeds have to be saved and stored, (e.g., shift from wet

to dry season production or vice versa). Or, the introduction of a new crop or variety might change things so that seed saving practices have to be revised on basis of trial and error.

The seed problem for palawija crops has both immediate and longer term aspects: production is presently impeded and intensification programs thwarted because of inadequate seed supply; the diffusion of improved varieties is and will be impeded for the same reason. Resolution of the palawija crops seed problems will require transfer of technology and training now underway under the WB Seeds II project and problem solving research and development including some basic research for the long term. It is evident and recognized by the technical people involved in seed supply in Indonesia that technology transfer and training alone will not resolve the seed problem.

Research and Development (R&D) efforts of two major sorts are needed: problem solving, very applied, and relatively low risk R&D aimed at the near term loosening of the seed constraint as possible through improvements in the procedures/techniques of seed production, harvesting/threshing, drying and storage for the climatic conditions in Indonesia; and longer term, but still goal oriented R&D with associated higher risk (and potentially greater pay-off) with objectives of releasing the seed constraint by effecting improvements in the inherent qualities, performance capabilities, and longevity (quality retention) of seed of improved varieties and selected crops (soybeans, peanuts, corn, sorghum) through breeding, and enhancement of seed quality through treatments. R&D efforts under the problem solving approach should have two aspects focussed on the two "settings" of seed problems: large scale seed production/supply operations such as those carried out by the Perum Sang Hyang Seri (National Seed Corporation) and beginning private sector enterprises; and on-farm seed saving activities (selection, drying, storage).

The nature and apparent causes of seed problems for palawija crops in Indonesia are sufficiently clear to permit tentative identification of the most promising areas for R&D attention by seed kind for the next 4-5 years (near-term, problem solving approach) and 8-10 years (longer term approach). These are set forth in the report for soybean, corn, peanut, mungbean, other food crops and speciality crops.

Organization and implementation of a seed research program within the proposed ASRP is recommended. The program would organize and formally link seed research teams at 2 to 5 FCRIs and IPB, and establish cooperation with the public and private sector seed production/supply organizations. Near minimal and maximal levels-of-effort are set forth for consideration.

BACKGROUND

USAID/Indonesia requested the services of a seed technology research consultant under terms of the Miss. State Univ.-AID/DSAN-0148 Cooperative agreement for about 1 month in August-September, 1984. The consultation was requested in connection with preparation of a new agricultural sector research support project for Indonesia under the Mission's development assistance program.

Dr. James C. Delouche, Professor, In Charge, Seed Technology Laboratory, Mississippi State University, was assigned to the consultation. He arrived in Jakarta on September 4 and departed September 28, 1984.

A draft report of the consultancy report was delivered to USAID/Indonesia before departure.

NEED FOR SEED TECHNOLOGY RESEARCH IN INDONESIA

1. Present Situation

1.1 The results of most analyses of the foci for agricultural research in Indonesia in the years ahead indicate that palawija crops should be accorded priority attention. Indeed the thrust of GOIs food policy seems to be shifting from rice sufficiency to food sufficiency as the goal for rice is being approached. Food sufficiency would certainly involve increases in the production and productivity of important second echelon food and feed crops such as soybeans, peanuts, sorghum, mungbeans and possibly wheat.

1.2 Assessments and catalogings of impediments and constraints to intensification and extensification of palawija crop production in Indonesia invariably single out the "seed problem", "seed constraint" or "seed storage" as a major constraint or impediment. Dixon, for example, attributed the low yield of soybean to "seed storage factors" in his report on "Estimating Agricultural Sector Growth Rates During Repelita IV" (1984) to the Bureau of Planning, MOA, RI, and singled out seed storage as a focus of research in his recent ASRP consultancy. Hardwood and Traywick (1984) make several recommendations related to improvements in basic seed production, processing and storage in their review of and recommendations on AARD's Research Facilities and Support Services. Similarly L. Van Staveren in his working paper, "An Overview of Palawija Agriculture/With Reference to Research in East Java" (1984) stated, "...research has shown that year-round multiple cropping arrangements can be more profitable than rice growing provided that biological and sociological constraints are overcome. Important constraints include the availability of suitable seed for recommended farming practices....." The current WB Seeds II project, which among other things will establish 12 (or 18) seed centers over the next 2 years with emphasis on palawija crop seed, was justified on the basis that advances in palawija crop agriculture could proceed in an orderly manner only on the base of improved seed supply.

1.3 Expressions of concern about the "seed problem" in palawija crop agriculture are not new. Similar concerns have been voiced at least since the late 1960s when seed program development efforts (rice) were seriously initiated in Indonesia with the preparation of the WB financed Seeds I project.

1.4 The "seed problem" in palawija crops has multiple causes and is manifested in several ways which can and do constrain production and limit what can be accomplished in intensification/extensification programs:

(1) Supply inadequacies which range from non-availability to untimely distribution (hence untimely availability).

(2) Quality deficiencies which result in less than optimal plant densities for efficient production or in stand failures.

(3) Interactions and/or combinations of short supply and poor quality which can effectively sabotage palawija crop improvement programs.

1.5 Indonesia agriculture is dominated by rice as it is in most countries in the region. In Indonesia and other countries, perceptions of the "seed problem" for other crops and approaches toward their resolution (when made) are highly colored by the rice model. The rice model is not a good one because rice seed are distinctive among major seed kinds in terms of quality retention and longevity under humid tropical conditions. The other kinds of seed just do not do well under such conditions and the complexity of the seed problem is relatively great, and greatest in the case of soybeans and peanuts.

1.6 Approaches toward a satisfactory resolution of the palawija crop seed constraint must encompass the technology transfer, institutional arrangements and training that have worked well for rice, and solutions/answers to the many technical problems involved from an appropriate level of effort in research and development.

2. Rationale for Seed Research Effort

2.1 Seed program/industry development has long been singled out as a major tactic in the strategies for agricultural development in the LDCs. Up to the present, the main objective of seed program development has been replacement of traditional varieties of the major food crops with improved varieties, rather than seed supply per se. Seed are multiplied, processed, packaged and distributed not because there are no seeds or the supply is inadequate, but rather to reap benefits in terms of increased production by replacing traditional varieties with superior varieties. Seeds are simply the most convenient and usually the only practical mechanisms for effecting a change in varieties. Since seed - unlike other inputs - are multiplied rather than consumed in the production process and farmers have worked out good seed storing practices for main crops, substantially superior new varieties diffuse rather rapidly within adapted areas from farmer to farmer.

2.2 As mentioned seed programs have been established in most LDCs primarily to introduce and replace varieties rather than to supply seeds per se. Indeed the initial large-scale diffusions of the new HYVs of wheat and rice in the mid-1960s were accomplished with only limited assistance from organized seed programs: HYVs of wheat from Mexico were introduced into India and Pakistan by buying up "grain" in Mexico and air shipping to India and Pakistan - weed seeds and all! "Versions" of IR-8 rice diffused all over Luzon from demonstration plot to farmer to neighbor, and so on. Yet, despite the rapid and widespread dissemination of the truly superior new HYVs of wheat and rice without benefit of a seed program/industry, it was soon recognized that a crop production program based on improved varieties was like being on a treadmill. Breeding and varietal improvement have to be continuous with periodic release of ever "newer" varieties just to maintain the gains made from the initial replacement of traditional varieties with improved varieties. And, some sort of organized seed production and supply system is needed for the orderly and periodic replacement of varieties of the crops under improvement. Thus, except in the case of hybrids in a few LDCs (e.g. India) the capacity of the seed production and supply system seldom exceeds 10-20% of the total seed needed for planting. The rest of the seed needed can be (are) saved by farmers as they were for generations before the introduction of the HYVs. Seed saving practices in traditional agriculture are usually quite satisfactory because the crops improved are major crops long and well adapted to the area, e.g., rice in the Philippines, Indonesia, Thailand, etc.; wheat in North India and Pakistan; sorghum in the semi-arid rainfed areas of India, and so on. There was not a general shortage of rice seed of adequate quality for planting in Indonesia prior to the introduction of the HYVs, but there was a shortage or high yielding gene sets in the rice populations then under cultivation.

2.3 Since attention has been primarily focused on the introduction and periodic replacement of HYVs of the important crop, seed program/industry development has been considered primarily a matter of technology transfer, training and management. Quality problems have not been of overriding concern because the kinds of seed involved, e.g., rice, are resistant to stresses and not difficult to produce and store, or climatic conditions are not severely adverse in terms of effects on seed quality (i.e., sorghum and wheat areas in India), or the importance of introducing and replacing varieties is deemed so important that quality problems are tolerated. These considerations have been (and remain) appropriate and have worked well where varietal replacement has been the main concern, and the supplying of seeds for planting per se only incidental.

2.4 The seed situation with palawija crops (called secondary crops because they are decidedly second to rice) in Indonesia is very

different than that encountered during the replacement of the traditional rice varieties with HYVs and their periodic replacement up to the present, and the differences must be recognized. Production of soybean, peanut and to a lesser extent corn, mungbean and sorghum are presently constrained and has been for some years because supplies of seed are inadequate for planting - seed of any variety. In the case of rice there was not and has not been any general shortages of seed - only shortages of seed of superior varieties.

2.5 Seeds of the palawija crops, especially soybean and peanuts, are much, much more difficult to produce and save under the humid tropical conditions of Indonesia than rice seeds. Indeed rice seeds are well adapted to humid tropical conditions which is one reason rice was one of the very few seed propagated food crops grown in the humid tropics for thousands of years. Not only are the seeds of the palawija crops not well adapted for survival under humid tropical conditions, but because they are secondary crops - opportunity crops - farmers have less experience in seed saving and give less attention to it. Indeed some transmigrant farmers have essentially no experience with the palawija crops they are attempting to cultivate let alone knowing how to save seed. The seed saving model is rice, and it just doesn't work. Changes in cropping patterns as a result of intensification programs and more assured irrigation often result in shifts in the season of production of palawija crop, and, thus, change the terms under which seeds have to be saved and stored, (e.g., shift from wet to dry season production or vice versa). Or, the introduction of a new variety might change things so that seed saving practices have to be revised on basis of trial and error. For example, the introduction of a yellow corn variety into South Sulawesi caused a lot of confusion and problems in both grain and seed post harvest operations: the yellow variety had large ears with large cobs which required "later" harvest and longer drying than the traditional white varieties with small cobs; the large cob acted as a water reservoir and retarded drying rate.

2.6 The seed problem for palawija crops has both immediate and longer term aspects: production is presently impeded and intensification programs thwarted because of inadequate seed supply; the diffusion of improved varieties is and will be impeded for the same reason. Resolution of the palawija crops seed problems will require transfer of technology and training now underway under the WB Seeds II project and problem solving research and development including some basic research for the long term. It is evident and recognized by the technical people involved in seed supply in Indonesia that technology transfer and training alone will not resolve the seed problem. (A sizeable tonnage of soybean seed "died" a few days ago, i.e., Sept. 1984, on the drying floor at the Perum Sang Hyang Seri operations in Sukamandi in the "shadow" of facilities representing a multi-million dollar transfer of technology.)

2.7 There are no short cuts and and no magic high-tech that would obviate the need for a substantial and sustained research effort to establish the best seed production, harvesting, threshing and storage procedures, develop site specific appropriate technologies, adapt "transferred" technology as needed to fit Indonesian conditions, and effect genetic improvements in the quality and longevity of the seeds of palawija crops - all required to loosen the seed constraint to a manageable level. Problem solving seed research, genetic improvements in seed longevity, the establishment of reasonably efficient large scale production/marketing of seed, encouragement and support of private sector initiatives in seed supply, and improvements in on-farm seed saving practices could fully release palawija crop intensification efforts for the constraint of seed supply shortages in 5-7 years, with significant improvements in 2-3 years.

3. Relevance to Proposed ARSP Project Elements

3.1 A program of research in seed technology with mission of assembling and devising technical strategies and technology for improving palawija crop seed production and supply at on and off farm levels has relevance to and is supportive of the five project elements proposed.

3.1.1. Research Management: Research management must assume the responsibility for reducing technical problems that prevent or impede the delivery of its research products, such as the seeds of improved varieties and packages of improved practices, to its client group - the farmers. The maintenance of improved varieties, production of breeder seed, supervision of basic seed production, and technical assistance/support to public and private seed producers would all be involved in fulfillment of research management's responsibilities.

3.1.2. Facilities Management: Experience gained by seed technologists involved in research and an enhanced appreciation of the importance of upkeep and use of the seed facilities at the Research Institutes in support of research goals would be one consequence of a research program in seed technology.

3.1.3 Research Agenda: An applied agricultural research agenda addresses real and current constraints as well a longer range opportunities taking into account risks and benefits. The seed problem in palawija crops is a real and current constraint and will continue as such until it is resolved. The risks associated with most of the R&D outlined later are low, or put another way, the probability of success in high, and even partial success could unlock a substantial flow of benefits.

3.1.4 Linkages: The research program in seed technology envisaged offers one of the very best opportunities in the ASRP for establishing operational linkages between the Research Coordinating Center for Food Crops, the several mandated Food Crops Research Institutes, other Central Research Institutes (e.g, industrial crops), IPB, possibly Universitas Andalas, Padang, the Department of Food Crops, the Perum Sang Hyang Seri, P. T. Pertani, P. T. Kapas, Patri Tani, the Seed Certification and Market Control Group and emerging players in the private sector such as the local interests in corn seed production and their international/multi-national partners, e.g., Cargill, Inc., Chareon Pokphan (CP), Pioneer Hybrid International, San Miguel, Inc. These would be in-country institutional linkages. Some of the international research centers and U.S. institutions would be the external linkages. Programmatically, main linkages would be with the plant breeding, post-harvest, agricultural mechanization and plant protection programs.

3.1.5 Private Sector: Information and developments arising out of the R&D program outlined would be very helpful - even critical - to private sector participants in seed production and supply. In turn, feedback from the private sector would be invaluable in guiding the research along the most constructive goal oriented lines.

4. Research Needs in Seed Technology Area

4.1 Research and Development (R&D) efforts of two major sorts are needed to produce the information, technologies and materials required for improving the efficiency of food crop seed production and supply in Indonesia and, especially, the quality of the seed produced. They are:

1) Problem solving, very applied, highly adaptive and relatively low risk R&D aimed at the near term loosening of the seed constraint as possible through improvements in the procedures/techniques of seed production, harvesting/threshing, drying and storage, and assembly/adaptation of the most appropriate quality assurance/control procedures for the climatic conditions in Indonesia.

2) Longer term, somewhat basic but still goal oriented R&D with associated higher risk (and potentially greater pay-off) with objectives of releasing the seed constraint by effecting improvements in the inherent qualities, performance capabilities, and longevity (quality retention) of seed of improved varieties and selected crops (soybeans, peanuts, corn, sorghum) through breeding, and enhancement of seed quality and longevity by means of selective chemical (fungicides, insecticides, fumigants, anti-oxidants) treatments, and, in the still longer term, by exploiting advances in biotechnology.

4.2 The two sorts of R&D efforts outlined are not mutually exclusive - they are not really alternatives. Rather, they represent complementary (and potentially synergestic) approaches toward a common goal. Developments arising out of both will be crucial for achieving a "best" solution to seed problems within the context of and limitations imposed by the humid tropical climate of Indonesia.

4.3 R&D efforts under the problem solving approach should have two aspects focussed on the two "settings" of seed problems: large scale seed production/supply operations such as those carried out by the Perum Sang Hyang Seri (National Seed Corporation) and beginning private sector enterprises (i.e., hybrid and composite corn seed); and on-farm seed saving activities (selection, drying, storage). The former aspect is most often the sole focus of all seed R&D efforts, while the latter has essentially been ignored except in footnotes or "asides" in socio-economic and anthropological studies. Both aspects are important. Large scale, "industry" type seed operations such as those of the Perum Sang Hyang Seri and the emerging private sector are the essential mechanism for multiplying, producing and distributing seed of new crop varieties as they issue out of breeding and crop improvement programs, and the periodic replacement of the varieties with still newer varieties -- activities crucial for increasing and/or stabilizing crop yield. Despite their importance, however, large scale industry type seed operations in Indonesia are not likely to provide more than 20-30% of the total seed requirement of self- and open-pollinated cereal and grain legume crops even into the early and mid-1990s. The remainder of the seed used to plant the various crops will be "saved" by farmers from their own production or bartered for from the homestocks of other farmers in the community. It has generally been assumed that farmer seed saving practices are either satisfactory or they cannot be improved even when not satisfactory, and this assumption has effectively precluded attention other than socio-anthropological on farmer seed saving operations. Yet, even though small scale, a farmer's seed saving operations in a humid tropical climate are beset by all the problems that attend large scale operations plus some that are peculiar to "small scale." The consequences of these problems in terms of losses in productivity and income are the same whether farmer saved or industry supplied seed are involved. Concentration of all or even most R&D attention on seed industry problems to the exclusion of on-farm saving problems would represent less than a half-way measure when the severity of the problems and potential pay offs from their resolution require a full measure of attention and effort.

4.4 The nature and apparent causes of seed problems for palawija crops in Indonesia are sufficiently clear to permit tentative identification of the most promising areas for R&D attention by seed kind for the next 4-5 years (near-term, problem solving approach) and 8-10

years (longer term approach). A first order of business in implementation of the new ASRP would be to review, expand, revise, detail and prioritize the R&D opportunities listed below into several umbrella projects with appropriate packages of subprojects.

4.5 Soybean

Overview

4.5.1 Soybean is the most important grain legume in Indonesia. It is grown as a sole crop after rice on irrigated and wet lands and in mixtures with maize, cassava and sorghum on uplands. The area planted in 1981 was about 880,000 ha which yielded an average of 0.85T/ha. for a total of 690,000T. About 80% of the soybean production is in Java (50% in East Java) with the other 20% on the outer islands.

4.5.2 Soybeans are unquestionably the most attractive crop for allocation of the research resources that would become available under the ASRP. As Dixon points out in his consultancy report, soybeans is a most promising crop on both the demand and supply sides. In 1984 an equivalent whole bean tonnage of, perhaps, 700,000T of whole beans and meal will be imported into Indonesia - somewhat more that will be produced in-country. Demand, hence prices, is strong and expected to expand further with continued growth of the poultry industry (feed use). On the supply side, supplies are low in part because of low yields - which have been essentially static for the past 10 years. There is great scope, therefore, to substantially increase the area planted and yield through well funded, accelerated, goal oriented and interdisciplinary research. Research outputs that would lead to very substantial growth in production through area and yield increases include:

1) Varieties with improved tolerance and/or resistance to major pests and environmental stresses; incorporation of "promiscuous" innoculation and superior "storability" characters in new varieties.

2) Varieties developed with improvements noted above but "designed" to fit into major cropping systems.

3) Most economical mix of liming, other soil amendments and fertilizer for soybeans in mococoulture and crop associations (to permit economical yields on and use of acid, high aluminum soils).

4) Improved post-harvest practices.

5) Improved and assured seed supply.

4.5.3 Although improvements in seed supply are mentioned last in the listing above, they are crucial. Experiences in other countries such as Brazil, Thailand, and the U.S., have clearly shown that a key base for take-off in soybean production is an adequate and assured supply of reasonably good quality seed at both the farm and industry levels, and that this base is harder to achieve for soybeans than for other kinds of major food crops. The seeds of modern varieties of soybeans are, unfortunately, among the most delicate and short lived kinds of seed. Their longevity decreases - or they deteriorate more and more rapidly - as temperature, humidity and rainfall increase. Thus, the seed problems are enormous, but not insurmountable, in the humid tropics. And, it is a near certainty that the soybean yield and area in Indonesia will not advance in a consistent way until and unless the seed problems are surmounted and the constraint loosened substantially.

Near Term, Problem Solving R&D

4.5.4 Timing of Production:. Trials should be initiated to determine the best time for soybean seed production in terms of the quality and quantity of seed produced, probability of rain during the harvest/threshing period, drying efficiency, and length of the storage period. The best systems identified through R&D for each major production area should be intensely promoted along with other components of the soybean extensification and intensification programs. Example: In South Sulawesi the seasons are opposed on the east and west sides because of the central spine of mountains. Opposing wet and dry seasons of this sort offer an excellent opportunity to produce seed on one side of the province for almost immediate planting on the other side - thus, reducing the storage period to a month or less -provided scheduling and transportation can be worked out. Example: Is it better to schedule seed production for harvest during the driest period even though the storage period might be 6-8 months, or to play all the cards on the shortest possible storage period even though the probability of rain during harvest and drying is high? Technical and economic analyses would be needed to answer these questions. The R&D effort would, overall, seek the best compromise in production timing between seed quality/quantity and cost.

4.5.5 Harvest/Threshing/Drying. There is no doubt that many, perhaps most, of the seed quality problems in soybeans (and other crops) have their origin in the cycle/sequence of harvest-threshing-drying. Most varietal purity problems arise during the cycle as a result of admixing on the drying and threshing floor, and most viability and vigor problems are initiated and progress as a consequence of physical and physiological damage of the seeds. The whole plant harvesting procedures used by the Perum Sang Hyang Seri in its large scale production are especially conducive to seed damage as demonstrated just a few days ago (mid-September, 1984) at Sukamandi: a combination of rain and plastic covers over harvested unthreshed

plants on the drying floor to keep off the rain caused severe heating resulting in essentially a complete loss of 50T of soybean seed, perhaps, half of the total production. For large scale production of soybean seed some level of mechanization of harvest and threshing will be necessary. R&D work needs to be undertaken to compare the efficiency and effectiveness of direct combine harvest and threshing, whole plant harvest with mechanized threshing after some drying followed by complete drying as needed to reduce moisture content to 10-11%, traditional whole plant harvest with drying on the plant and hand threshing, and various combinations. Trials are also needed to determine the best stage of maturity for harvest of soybean (for seed) under conditions in various areas in Indonesia. The best stage for harvesting seed might not be the best one for harvesting grain. Soybean in East and West Java are harvested at different stages (about 1-1 1/2 wks. difference). Which is the best stage for seed production? Information arising out of R&D activities related to season of production as mentioned above would need to be taken into account in establishing the best time and methods of harvest and threshing.

4.5.6 Drying: Reduction of seed moisture content to a a level that will permit retention of germination for the period desired under the temperature at which the seeds will be stored is the absolutely essential step in seed storage operations. The storage period and storage temperature variables determine the moisture content to which the seeds have to be dried. Technical and economic studies are needed to establish the most efficient and effective levels of the two variables (levels that are achievable) for soybean seed in the context of cropping systems and energy cost (drying) in important soybean production areas in Indonesia. Systems need to be devised that take maximum advantage of solar energy with minimum risk of seed damage from rain and heating. Simple but critically important studies of the "thermodynamics" of the drying floor need to be undertaken and completed so that criteria for floor drying utilizing available solar energy can be established for soybean seed. The perennial questions on methodology for drying floors and concerns about heat buildup at the seed layer level must finally be answered and settled. This will not involve a lot of sophisticated, highly instrumental theoretical work. Mainly, some trials are needed with good measurement of temperature and seed moisture content followed by evaluations of the quality of the seed. R&D is also needed to define the most effective and economical drying systems combining sun drying of whole plants followed by threshing and artificial drying of the threshed seed down to 10%. The lowest moisture content achievable with sun drying in different areas and in different seasons needs to be determined so that the extent of artificial drying (if needed) and the maximum length of the storage period can be established. A good R&D program in the area of seed drying is needed not only because drying is the most critical step in terms of seed quality but also because it is or can be the most costly in terms of energy use. The information

derived from studies on soybean seed would, in part, be applicable to other kinds of seed, e.g., heat build-up and transfer on drying floors.

4.5.7 Storage: The first requisite for a successful seed storage program is good quality seed. The computer maxim "garbage in, garbage out" applies equally well in paraphrase to the seed storehouse: "deteriorating seed in, deteriorated seed out." Thus, R&D for seed storage necessarily assumes that the seed will be produced, harvested, threshed and dried in the manner and by procedures most conducive to maintenance of quality. Given the quality of seeds of a specific kind entering storage and the conditions under which they are to be stored, it is not difficult to calculate a rather accurate maximum storage period, or conversely, the degree to which storage temperature and/or seed moisture content would have to be moderated to achieve a specific storage period. The main researcheable questions relate to accurate assessment of the quality of the seed entering storage, interactions involving storage insect pests and packaging materials, and the comparative costs of several potential storage systems: air conditioned; ambient with moisture vapor retardant packaging; ambient with porous packaging and periodic redrying. Systems devised for seed storage must also take into account the segments of the storage period during distribution, marketing, and at the farm site until the seed are planted.

4.5.8 Farmer Seed Saving Operations: The researcheable areas and activities outlined above are mainly applicable to seed program/industry type operations. These are important but the needs would be less than half met unless a substantial effort is made to improved farmer seed saving practices. During the next 5 years, 75 to maybe 95% of the soybean seed used to plant the crop will come from the farmers' own stocks or those of other farmers within the village. There are just excellent opportunities to extract very substantial benefits from improvements in the quality of farmer saved seed with an almost token investment in R&D and very modest investment in materials. The first step would be to characterize (describe) present seed saving practices for soybeans as they might vary from province to province and among the islands. An analysis of the descriptive survey information obtained (or available from secondary sources) should suggest possible improvements. Simple inexpensive improvements could then be devised for extension to the farmers in an area. Possible scenario: System might be devised based on a reusable polyethylene plastic bag (20 to 30 kg capacity), an inexpensive humidity indicator (paper strip impregnated with lithiuim chloride often given away at hardware stores in U.S.), and a dash of insecticide. Seed selection procedures would be used with seed identified as seed before harvest (and not simply taken from the grain), then harvested, dried on a drying floor to 10-11% moisture, packed in plastic bag with insecticide and humidity indictor, and redried every time humidity indicator changed from pink to blue indicating rise in moisture content.

Redrying as needed would be the key. Drying floor procedures would be adapted from those established in large scale studies above. Many other scenarios can be visualized based on a modest R&D effort in an on-farm setting, e.g., small seed production plots on rice levees. Some of the farmers successfully adopting the improved seed saving procedures might be persuaded in time to develop a local seed supply "business" as a sideline to their farming operations.

Longer Term - More Basic R&D

4.5.9 In the longer term the best and most cost effective solution to the soybean seed quality problem in the humid subtropics and tropics would be to incorporate superior deterioration retarding and longevity prolonging characteristics (inherent) into soybean varieties. It has been demonstrated that seeds of modern soybean varieties on which the tremendous expansion of soybean production worldwide in the past 30 years has been based are structually more delicate and physiologically shorter lived than those of the varieties used prior to 1950 (in U.S.). Breeders, as it were, appear to have inadvertently reduced seed quality in their continuous selection of soybean grain best suited to industrial processing. In the early 1970s researchers at Miss. State University demonstrated that the "hardseeded" character in soybean reduced the rate of deteriorative processes in the seed and greatly prolonged storage life without appreciable detriment to industrial quality. They recommended that different degrees of hardseededness be incorporated in varieties developed for areas with moderate to severely adverse climatic conditions. In the late 1970s researchers at IITA (Ibadan, Nigeria) began to systematically screen the soybean germplasm for resistance to seed deterioration and improved storage life, and substantial progress has been made. Lines with superior seed storability have been identified (ironically two of the lines were collected in Indonesia many years ago), and the inheritance is being worked out. These advances offer tremendous potential for reducing the soybean seed deterioration and storage problem to a manageable level in humid tropical countries around the world including Indonesia. They would, of course, need to be combined with appropriate technologies of harvesting, drying, storage, good management, and so on.

4.5.10 Indonesian soybean breeders have become aware of these developments (especially during the World Soybean Research Conference III at Iowa State University in August 1984). They are anxious to obtain the appropriate lines for evaluating and making crosses in Indonesia. Working with seed technologists/physiologists as they do with plant pathologists and entomologists, breeders should be able to ascertain the degree of hardseededness needed in Indonesia and incorporate it into improved varieties in the next 5 years. Since most of the soybean produced in Indonesia are used for human food

rather than oil and protein cake the effects, in any, of the hard-seeded character on processing of the seeds for tahu and tempe would need to be established as a first step.

4.5.11 Other inherent properties or characteristics of soybean seed are believed to be associated with superior seed qualities and should be taken into account in the soybean breeding programs: smaller (relatively) seed size is associated with resistance to mechanical damage, better storability, and more rapid emergence; capability for germination under reduced oxygen tension which should be associated with better emergence from wet soils.

4.5.12 Genetic improvements in the propagation and viability and vigor retention characteristics of the seed of soybean varieties combined with other characteristics such as promiscuous innoculation for more efficient nitrogen fixation under low soil pH, and chemical seed protectants to reduce seed rots and seedling blights should dramatically improve yields. These advances, however, can only be achieved through a long-term R&D effort allocated adequate resources. Indonesia has the capacity and capability for the R&D effort needed with some technical assistance, adequate operational support, and appropriate priority.

4.6 Corn

Overview

4.6.1 Corn is the second most important cereal food crop in Indonesia. The area planted ranges from 2.1 to 3.5 million ha. with an average yield of about 1350 kg/ha. About 70% of the corn is produced in Java with 43% in East Java alone. In his consultancy report for the ASRP, Dixon ranked corn second on his list for research attention in the food crops sector despite contentions of other economists that the demand for corn is limited and essentially met. Dixon properly recognizes that the recent introduction of hybrids and improved composites and the rapidly expanding animal feed industry could dramatically change the demand situation and/or the patterns and areas of production. For example, even without any increase in demand there is every justification for expanding and intensifying research on varietal and hybrid development (cooperation with private sector), fertilization, post-harvest handling and storage of corn. The high yield potential of hybrids and composites offer an excellent opportunity for increasing yield and production efficiency which could reduce prices and stimulate demand or with constant demand would release hectares for other crops and improved farm income.

4.6.2 Corn seed are more resistant to deterioration under humid tropical conditions than soybean seed but more susceptible to storage insects. Although with the present varieties and levels of

management the corn seed constraint is not as critical as it is for soybean, any increase in level of inputs including use of hybrid seed and better management in order to elevate yields would require substantial improvements in the quality - germination/emergence - of the seed because of the high correlation of yield with plant density in corn - high yields are only attainable at optimum densities. Thus, the percentage of seed planted which could be expected to produce a plant needs to be predictable, and it can only be predicted if quality is relatively high. Furthermore, the very much higher seed costs for hybrids or improved composites require that planting rates be reduced to a minimum, which requires that the seeds be protected with fungicides and insecticides, which, in turn, adds to costs and makes assurance of high emergence (quality) even more crucial. Types of R&D activities that would lead to improvements in corn seed quality are briefly discussed below.

Near-Term, Problem Solving R&D: (Large Scale Operations)

4.6.3 Trials and problem solving attention are needed in the areas of corn seed harvest, drying, shelling, density grading, storage and treatment to establish operational procedures and sequences that are most important for retention of seed quality. The R&D activities should be aimed at establishing (for seed): the optimum season for production; best moisture content for harvest; most efficient and effective sequence of solar and artificial drying; best moisture content for shelling; criteria for sizing and density grading; most effective and efficient packaging material and moisture content at packaging; and minimal requirements for maintenance of seed quality during storage.

4.6.4 While the R&D agenda seems long, it is not complex and could be completed in 4-5 years with excellent progress in 2-3 years. There is enough information available from experiences in other countries to support an array of assumptions that would permit efforts and resources to be focused on critical site-specific questions/areas. There is no doubt that information deriving from the R&D would permit the efficient large scale production of good quality hybrid and composite seed in Indonesia. On the other hand, there is a good probability that if the emerging private sector corn seed industry in Indonesia is not supported by timely and appropriate R&D within AARD, poor seed quality (loss of germination during storage, insect damage) and farmer dissatisfaction (as a consequence) could set back the introduction of hybrids as has unfortunately happened in several countries in the past.

Farmer Seed Saving Practices

4.6.5 Traditional corn farmers such as those in East Java appear to have worked out satisfactory seed saving procedures for traditional varieties. Some adaptive R&D is needed, however, to

modify procedures so that they are satisfactory for some of newer improved varieties and/or hybrids which have different maturation and drying characteristics (larger ears and cobs), and differing degrees of susceptibility to storage insects. Overall an improved "system" for on-farm saving of seed based on practical, inexpensive materials is needed. This could be especially beneficial as corn production is taken up by transmigrants and others who have limited or no experience with corn. In the case of hybrids, of course, the seed saving habit would have to be discarded.

Long-Term, More Basic R&D

4.6.6 There are opportunities to improve the qualities of corn seed through breeding just as there are for soybeans. Such inherent characteristics as tight husk covers and small cobs significantly affect the incidence of field infestation with insects and the rate and efficiency of drying. There is also considerable variation in corn for emergence capability under seed bed conditions of excess or deficit water supply, and mechanical impedance by soil crusts. Sources of these qualities need to be identified through screening so that they can be taken into account in breeding programs.

4.6.7 A prime area for R&D and continued effort is seed treatment. New chemistry is becoming available and/or in the pipeline which will have profound effects on crop production and protection. Downy mildew, for example, is an important disease of corn and sorghum. Some degree of plant protection has been achieved through resistant varieties, but this resistance has not been stable or complete and the overriding need for resistance has limited advances in yield potential. Now, downy mildew can be controlled season long with a systemic fungicide applied as a seed treatment. Use of the seed as the delivery system for the fungicide is a marvel of efficiency. A hundred kg of corn seed can be treated with the chemical in a few minutes and with little expenditure of labor as compared to hours or days required to spray or dust the chemical on the 5 ha. that can be planted with 100 kg of seed. Furthermore, a minimum amount of chemical is needed because it is placed where needed precisely and uniformly. As mentioned, a long term - even continued -effort is needed to establish the best seed treatments for corn and to keep abreast of the new developments.

4.7 Peanut

Overview

4.7.1 Peanut is an important food grain legume with strong demand in Indonesia. They are produced on 375,000 to 450,000 ha., 70% in Java, and total production is up to about 450,000 tons. An Australian technical assistance group is assisting with improvements in peanuts. A major impediment to acceleration of programs for

expansion and intensification of peanut production is a disease -peanut mottle virus. Most present varieties or lines are susceptible but a few appear to be resistant. As soon as resistance/susceptibility is sorted out, intensification can commence.

4.7.2 Peanut seed, like soybean seed, have certain weaknesses which contribute to quality problems. Peanut seed are short lived, even shorter lived than soybean seed if removed from the pod. The development of the peanut seed underground, the bulkiness of the seed in pod, and high seeding rates all place demands on on-farm and larger scale seed supply programs which frequently are not met. Near and long-term R&D efforts are needed to reduce the seed problem to a manageable level so that the constraint imposed by seed supply and quality on development is loosened to some extent.

Near-Term, Adaptive R&D - Large Scale Operations

4.7.3 The indeterminant habit of peanuts contributes substantially to seed problems. Trials are needed to establish the stage of maturity for harvest that is best under Indonesian conditions. Drying sequences and procedures conducive to maintenance of seed quality also need to be worked out, as also storage conditions. The benefits of seed treatment on emergence and stand establishment need to be determined. The use of gravity tables to separate pods with immature seed, or empty pods (aborted seed) needs to be evaluated and, if effective, introduced in large scale seed production operations.

Farmer Seed Saving Practices

4.7.4 Procedures used by farmers to save peanut seed need to be evaluated so that they can be improved. Special attention needs to be given to selection of the seed during shelling just before planting. Drying and periodic redrying procedures need to be worked out so that germination does not drop too drastically during storage.

Long-Term, More Basic R&D

4.7.5 The varieties of peanut grown in Indonesia have little or no seed dormancy. As a consequence, germination of the seed while still in the soil before harvest is frequent, and deterioration during "curing" (drying) is rather rapid. The important of seed dormancy in peanut varieties for use in humid, rainfed areas is well established. For example, peanut varieties grown in the Southeastern U.S. (humid, rainfed - VA, GA, FL, AL) all have dormant seed, while those produced in semi-arid areas of TX and OK have little or no dormancy. Sources of dormancy are available and the inheritance is worked out. Incorporation of seed dormancy in Indonesia varieties would represent a high

step toward resolving seed quality problems. Attention also needs to be given in breeding to pod quality and resistance to infestation with Aspergillus flavus so as to reduce aflatoxins.

4.7.6 Seed quality problems in peanuts are frequently caused by microelement deficiencies such as Co, Mb, Mn, all of which are correctable with a spray at modest cost. The use of gypsum as a readily available source of Ca to minimize "pops", i.e., empty and aborted seed, and improve vigor is also well established in the U.S., Brazil and other countries. Analyses need to be made to identify deficiencies so that corrective steps can be taken.

4.8 Other Food Crops

4.8.1 Near-term problem solving R&D and longer term seed related research are also needed for other important or potentially important food crops so that seed supply and quality problems can be overcome. On-farm seed saving and storage practices need to be improved for mungbean and sorghum seed and worked out for wheat seed which, if successfully introduced, would be a new crop for Indonesian farmers.

4.8.2 In the case of longer term, more basic research, emphasis in breeding of sorghum needs to be given to weathering resistance and seed dormancy, in mungbeans to uniformity of emergence, glossiness and color of the seed coat, and resistance to storage insects. Transitory dormancy in wheat seed would also be important in Indonesia, as well as a capacity for germination under relatively warm temperatures. In wheat, seed treatment procedures would need to be worked out for control of major diseases. For sorghum, chemical seed treatments for control of downy mildew would need to be researched.

4.9 Specialty Crops

4.9.1 Cover and soil building crops are needed for pastures and for planting in young estate crop plantations, hillsides, transmigration areas, etc. In most cases plantings recommended cannot be made because seeds are not available. Procedures for producing seeds of cover and forage crops useful in Indonesia need to be worked out as possible. There is no reason why satisfactory seed production of important forage and soil conserving crops cannot be established, especially in the private sector.

4.9.2 The seed constraint is also operative in vegetable, fiber and industrial crops, and so on. While it is not recommended that these be given major attention within the ASRP during the immediate future (next 3-5 years) because efforts must not be too diffuse and diluted, the information and technologies arising out of the near-term and long-term R&D efforts on the major food crops would - in most cases - be translatable to other seed propagated crops, and

the work would serve as a model for those involved with the crops of lesser priority. Informal cooperation would be established with the agencies and institutes that deal with the non-food/feed crops.

4.10 Biotechnology

4.10.1 Biotechnology in an "in" word used all too often in a meaningless manner or in situations where it has little, if any, relevance. Even when it has meaning and its relevance is obvious, many consider the whole area of biotechnology as "far horizon" - something to think about but not with any urgency. In the general area of plant propagation, however, biotechnology is highly relevant and its applications horizon is not at all distant. Most major U.S. and multi-national seed breeding firms - such as those introducing hybrid corn into Indonesia - have made and continue to make heavy investments in biotechnology, and perceive beginning pay-offs in the next few years with substantial returns by the early 1990s. Biotechnology was spawned in the laboratories of a few of the elite public/private universities in the U.S. and the rest have been hustling to position themselves to participate in the creation of biotechnology on at least to exploit that created by others.

4.10.2 Biotechnological developments such as tissue culture, somatic embryogenesis and microencapsulation have already impacted "vegetative" propagation of plants, production of disease free clones, and the maintenance of germplasm of vegetatively propagated crops such as cassava, yams, sugarcane, and disease control. Developments that could have profound effects on food crop propagation and production are in the pipeline. The season long control of downy mildew of corn by application of a tiny amount of chemical to the seed before planting is an example of "high-tech" biotechnology already here.

4.10.3 The seed research initiated under the ASRP should interact closely and strongly from the beginning with the Institute of Biotechnology. As the momentum of seed research picks up after the first year or so, research areas with the best potential for collaboration should be identified and work planned.

5. Settings and Availability of Facilities

5.1 The main settings for the proposed research are excellent and well positioned, facilities are or will soon be adequate, and most of the equipment that will be needed is or will soon be available. A moderate amount of specialized equipment, however, would be needed to meet the needs of the research program envisaged as indicated below.

Central Research Institute for Food crops - Bogor

5.2 The Central Food Crops Research Institute (FCRI-Bogor) at Bogor, which has a "pioneering" research mission, is constructing new facilities financed in part by the USAID under the Applied Agriculture Research project. These facilities will include laboratory space, drying floor, field equipment and, or course, field plots would be available. Under the WB Seeds II project, two conditioned seed storage units will be provided. The main equipment/instruments needed for seed research would be temperature and humidity monitoring instruments ($5000), seed moisture tester ($1200), small seed cleaner ($2500), high temperature/humidity chamber for screening soybean lines for superior longevity ($5000), and miscellaneous instruments and supplies ($5000) for total of $18,700.

The Central FCRI-Bogor is located within a few minutes drive from the Seed Technology Laboratory, Agronomy Department, IPB.

IPB Seed Technology-Agronomy

5.3 The Seed Technology Laboratory, Agronomy Department, has basic facilities and equipment needed for seed quality evaluations connected with seed research. Very substantial facilities are being constructed and equipment procured under the WB seeds II project. While these new facilities are primarily intended for teaching/training they will provide an excellent setting for seed research and will be so used. The new facilities are on the new IPB Campus. The items of equipment and instruments that would be needed but are not available include a fractionating aspirator ($2500), multiple electrode conductivity meter for evaluating seed storage potential ($5000), small seed vertical pneumatic separator ($1500), components for small seed dryer ($2500) and miscellaneous ($4000) for total of $13,000. About 7 ha. of plot land are available for research in seed production, emergence, etc.

Food Crops Research Institute - Sukamandi

5.4 The FCRI-Sukamandi with mandate for wet and irrigated lands has excellent facilities and has just been elaborately equipped under a WB project. The Food Quality, Chemistry and Post-Harvest labs are equipped for the most sophisticated research ranging from electron microscopy of seed coats to electrophoretic separation of isozymes. About the only equipment that might be needed and is not now available would be temperature and humidity measuring/monitoring devices ($5000), seed moisture tester ($1500) and components for a small research dryer ($3500) for total of $10,000.

5.5 The FCRI-Sukamandi is located just across the road from the large scale seed production and processing operations of the Perum Sang Hyang Seri which would provide a near perfect setting (with all necessary facilities and equipment) for conducting the large scale

adaptive, problem solving research described earlier for soybeans, corn and mungbean. There is no doubt that the Perum Sang Hyang Seri would welcome collaboration with open arms to resolve the many seed problems of palawija crops.

Food Crops Research Institute - Malang

5.6 The FCRI-Malang with main mandate for palawija crops is being substantially upgraded in terms of both facilities and equipment with assistance from the Netherlands. Plans for construction and equipment include a seed laboratory wing. Two conditioned seed storage units are being erected under terms of the WB Seed II project. A "seed specialist" is among the Dutch technical assistance team. About $12,000 in special monitoring and necessary instruments and devices that will not be provided from Dutch assistance would be needed. The Dutch assisted facilities are delayed and might not come on stream until 1986-87.

Food Crops Research Institute - Sukarami

5.7 The FCRI-Sukarami is just completing excellent facilities and last procurement of equipment will be made soon. Very adequate provisions have been made for a seed technology laboratory with basic testing equipment, seed storerooms, drying floor and dryers, threshers, and cleaning equipment. Main items that would need to be procured would be special temperature and humidity monitoring devices for seed research, about $6000.

The FCRI-Sukarami is excellently positioned for comparison of seed storage in lowlands and cooler uplands, and for adaptive seed research aimed directly at problems confronting the transmigrant farmers.

Food Crops Research Institute - Maros

5.8 The FCRI-Maros is being upgraded under assistance from the USAID financed Applied Agriculture Research Project - the main station and several substations. Main equipment needed would be temperature and humidity measuring devices ($5000), a small seed cleaner ($2500), and miscellaneous ($2500) for total of about $12,000.

5.9 The FCRI-Maros is located near one of the regional Seed Certification and Market Control Laboratories which is keenly interested in collaborating on research related to seed production and testing problems. This laboratory has good testing equipment and field plots for variety testing.

5.10 Depending on the level-of-effort desired, several to all of the settings above could constitute main sites for the seed research and the bases of the major participants. Other settings could be obtained as needed through collaboration with other institutes and the private sector as the work got well under way.

6. Suggested Organization

6.1 Since the proposed ASRP would assist AARD in fulfillment of its research missions, the seed research component should be organized within AARD with one formal linkage or collaborative arrangement with IPB. Other collaboration and cooperation would be needed and should be established but primarily on a mutual interest, opportunity, task oriented basis.

Leadership and Coordination

6.2 The seed research activities involving selected FCRIs and IPB formally, and other participants informally would need leadership and coordination. A Coordinator would be designated from among the senior staff in the Research Coordinating Center group at Bogor. The senior participant from IPB would be Deputy Coordinator and a Seed Problem Identification and Project Development (SPIPD) Committee would be formed consisting of designated representatives from the selected FCRIs, Perum Sang Hyang Seri, P.T. Pertani, the Seed Certification and Market Control group, and the private sector with the Coordinator as Chairman and the Deputy Coordinator as Vice-Chairman. The SPIPD committee would take leadership in identifying and prioritizing problems, developing the plan of research, and requesting, receiving, reviewing, and making recommendations on research as necessary. The committee would give specific and continuing attention to establishing and maintaining the closest linkages and collaboration among the formal and informal participants. It would meet (1-2 days) twice in the first year, and at least annually thereafter for the period of the project.

Research Teams at the FCRIs and IPB

6.3 Research teams would be formed at the selected FCRIs to carry out the research. A team would generally consist of:

Seed Technologist (M.S. or Ph.D.)	1
Assistant Seed Technologists (Ir.)	1-2
Technicians	2-3

6.4 This team would conduct research alone and in collaboration with pertinent plant breeders, plant protection specialists, post-harvest specialists and others. It (the team) could be augmented from time to time by graduate students from IPB or U.S. universities posted for research on thesis and dissertation problems.

6.5 The IPB team would consist of the head of the Seed Technology Laboratory, 3-4 assistants, and 3-5 graduate students - all part time because of need to take care of academic responsibilities.

Allocation of Research Responsibilities and Collaboration

6.6 At the onset, a comprehensive and prioritized seed research program for 5 year period would be prepared and agreed on. Phased and priority research would be "allocated" to the participating FCRIs and IPB in accord with mandate, experiences of staff, location (e.g., proximity to Perum Sang Hyang Seri operation) and other factors as determined by the SPIPD Committee. Budgets would be prepared to effect an adequate and appropriate allocation of resources that would permit timely implementation of the research programs at each site.

Role of Technical Assistance

6.7 The role of the long term technical assistance provided (2-3 years) would be to advise, guide, stimulate and assist the coordinators and other participants with implementation of the programs of research, the establishment of linkages with private multi-national seed and agri-chemical companies, U.S. institutions, seed research groups in other countries in region, pertinent international research centers and to obtain short term assistance of the proper type at timely intervals.

6.8 The short term technical assistance would assist with analyses of specific seed problems, help devise research strategies, help implement crucial research, and assist with interpretation of results and establishment of recommendations, procedures and technologies based on the research results obtained for implementation by farmers and large scale seed producers.

6.9 Depending on the mode of the technical assistance, "taking" selected researchers from the FCRIs and IPB into U.S. institutions for "hands on" familarization with specialized seed research techniques for 2-3 month period would be possible and extremely helpful. The possible modes of technical assistance are discussed in the next section.

7. Technical Assistance

7.1 Two to three years (24-36 months) of long term assistance and 12-15 m/m of short term technical assistance are recommended for the seed research component depending on the level-of-effort provided for and the project duration (4 or 5 years). Until a long meeting at Bogor on September 24 with S. Sadikin, Prof. Sajad and Noel Mamipic, technical assistance expert from the Philippines with WB Seeds II project, I had thought that 15-16 m/m short term technical assistance (3-4 m/m per year) would be sufficient. My Indonesian colleagues, however, feel strongly that long term technical assistance is needed to give the seed research component status and leverage so as to ensure - to extent possible - that attention and resources would not be diverted or withheld. They also believe, and I agree, that the long term assistance would not replace or substitute for critical and timely short term hands-on assistance.

7.2 There are, of course, many modes and arrangements for technical assistance: Title XII Institutions (BIFAD), AID or Country contracts, U.S. universities or consulting firms, personal services contracts and so on. I strongly urge that a new mode being "pushed" by AID/S&T be closely looked into for at least the short term technical assistance required. The new mode involves a "buy-in" by the USAID Mission (from grant funds in projects) of technical assistance and supporting services from established on-going centrally funded AID contracts or cooperative agreements, such as the Miss. State Univ.-AID/DSAN-CA-0148 on seed program/industry development. The mode is new and not yet well worked out but the idea is excellent. Such an arrangement in the present case, for example, would ensure 3-4 m/m in-country services/year from the group of Seed Technologists at Mississippi State University with continuous support and backstopping from MSU throughout the period of the project. The technical assistance made available would be highly expert, most familiar with seed problems in tropical climates, and intimately known by the Indonesian participants in seed research and seed production operations.

8. Level of Effort

8.1 The level of effort selected for the seed research component of the ASRP will necessarily be a compromise based on considerations of

overall priorities, available resources, specific research capabilities and probabilities of success. A level-of-effort out of proportion to needs and capabilities would be wasteful even though the cost/benefit ratio turned out to be high. On the other hand, a token effort would "acknowledge" the seed constraint but not address it.

8.2. Two levels-of-effort are set forth in the tables in 8.2.1 and 8.2.2. Level A would be the maximum level based on my judgements relating to scope of activities needed and capabilities. It would essentially involve all of the FCRIs. Level B would be a near minimum program of seed research. It would involve formal collaboration among 2 FCRIs and IPB, with possible informal cooperation with several other FCRIs. A lesser effort would probably not be productive because a "critical mass" would not be established. The long-term technical assistance (24 mos.) under Level B could be eliminated without too much detriment to the research <u>if</u> adequate general TA were available (e.g., crop physiologist, general plant breeder) within the overall project. Short term technical assistance, however, would need to be about 12 m/m for 4 years (3 m/m/yr.).

8.2.1 LEVEL OF EFFORT "A"

COST ESTIMATES AND SUGGESTED PHASING

Item and Phasing	Unit	Cost US$ Unit	Cost US$ Total
1. Technical Assistance			
a. Long term (36 m/m)	12 m/m	110,000	330,000
b. Short term (3 mo/yr./4 yrs)	month	11,000	132,000
Vehicle (Sedan) for long term TA	No	15,000	15,000
2. Salaries - Indonesia Staff			
a. Coordinator form FC Coordinating Center-Bogor (5 yrs.)	year	6,000	30,000
b. Admin./Sec'y support for Coordinator (5 yrs.)	year	2,500	12,500
c. Deputy Coordinator (IPB, 25%, 5 yrs. plus, admin./sec'y)	year	3,500	17,500
d. Seed research teams for IPB and 5 FCRI* (each team of 1 seed technologist, 1 ass't seed technologist, 3 technicians)	year	8,000 x 6 teams x 5 yrs.	240,000
e. Graduate students at IPB and other Universities posted for research at the FCRI (12 m/m/institute(s) per year for 5 yrs. at $100/mo.)	year	6,000 x 5 yrs.	30,000
3. Travel within Indonesia for coordinators, TA persons and research staff/yr.	year	13,000 x 5 yrs.	65,000
4. Supplies and supporting services ($3000/team/yr.; 6 teams x 5 yrs.)	year	18,000 x 5 yrs.	90,000
5. External training (in US) (3 students, 2 yrs. each)	year	15,000 x 6 yrs.	90,000
6. Research familarization and training tours at U.S. institutions and international research centers (3 m/m yr. for 4 yrs. at avg. $4,000 per m/m)	month	4,000 x 12	60,000
7. Equipment (specialized for 5 FCRI plus IPB)	1st year order		85,000
8. Annual meeting and workshop expenses (20 persons, 5 days, per year for 5 yrs.)	meeting	6,000 x 5	30,000
9. Publication expenses	year	2,000	10,000
		TOTALS For 5 years	$1,237,000

*5 FCRI: Bogor, Sukamandi, Malang, Sukarmi, Maros.

3.2.2 LEVEL OF EFFORT "B"

COST ESTIMATES AND SUGGESTED PHASING

Item and Phasing	Unit	Cost US$ Unit	Cost US$ Total
1. Technical Assistance			
a. Long term (34 m/m)	12 m/m	110,000	220,000*
b. Short term (3 mo/yr./4 yrs)	month	11,000	132,000
Vehicle (Sedan) for long term TA	No	15,000	15,000
2. Salaries - Indonesia Staff			
a. Coordinator from FC Coordinating Center-Bogor (50% time/5 yrs.)	year	3,000	15,000
b. Admin./Sec'y support for Coordinator (50% time/5 yrs.)	year	1,000	5,000
c. Deputy Coordinator (IPB, 25%, 5 yrs. plus, admin./sec'y)	year	3,500	17,500
d. Seed research teams for IPB and 2 FCRI** (each team of 1 seed technologist, 1 ass't seed technologist, 3 technicians)	year	8,000 x 3 teams x 5 yrs.	120,000
e. Graduate students at IPB and other Universities posted for research at the FCRI (18 m/m/ per FCRI per year for 5 yrs. at $100/mo.; 2 FCRI)	year	3,600 x 5 yrs.	18,000
3. Travel within Indonesia for coordinators, TA persons and research staff/yr.	year	8,000 x 5 yrs.	40,000
4. Supplies and supporting services ($3000/team/yr.; 3 teams x 5 yrs.)	year	9,000 x 5 yrs.	45,000
5. External training (in US) (2 students, 2 yrs. each)	year	15,000 x 4 yrs.	60,000
6. Research familarization and training tours at U.S. institutions and international research centers (3 m/m yr. for 3 yrs. at avg. $5,000 per m/m)	month	5,000 x 9	45,000
7. Equipment (specialized for 2 FCRI and IPB)	1st year order		40,000
8. Annual meeting and workshop expenses (15 persons, 5 days, per year)	meeting	4,500 x 5	22,500
9. Publication expenses	year	1,000	4,000
		TOTALS For 5 years	$799,000

* Long term TA might be deleted if ample and appropriate TA provided in overal project.

**2 FCRI: Sukmandi and Bogor or Malang

ANNEXES

ANNEX A

Jakarta
September 27, 1984

M E M O R A N D U M

TO: Alan R. Hurdus, USAID/Indonesia, AGR

FROM: James C. Delouche, Miss. State University _____

RE: Technical assistance mode for seed research component in proposed ASRP project

1. AID/W/S&T has charged its contractors and cooperators in centrally funded specialized technical assistance areas to explore possibilities for collaborative research with institutions in selected countries and mechanisms for funding such collaborative research in part, with the AID Bureaus and Missions and others involved in development assistance. The essential aims of this "new" concept are to: add a research dimension to long term and on-going technical assistance activities (e.g., seed technology with Miss. State U., grain technology at Kansas State U.), so that problems limiting the effectiveness of TA can be reduced; strengthen developing research capabilities in the more advanced LDCs and assist them in accomplishment of development objectives through research; concentrate on common research "themes" so that results would have wide application; and link together (network) several research efforts in and among regions, as possible, so as to broaden the research base and attack on problems, thus, increasing the probability of great pay-offs.

2. Dr. H. D. Bunch, Director, International Programs, Miss. State U., visited in Indonesia, Thailand and Philippines last May to discuss collaborative research under the umbrella of the long term AID/MSU centrally funded cooperative agreement in the areas of seed technology and seed program/industry development. In Indonesia IPB expressed great interest in collaborative research in seed technology and an informal memo of mutual interest was signed. Officials from AARD also expressed interest. (There were also excellent responses from Kasetsart Univ. in Bangkok and University Philippines College of Agriculture, Los Banos).

3. The proposed ASRP strengthening project with AARD offers a near perfect opportunity to link a well establishment AID/S&T centrally funded cooperator (MSU) to an AID financed research program for collaboration in a priority researchable area. The linkage could be through the 3-4 man months/yr. of short term technical assistance that would be needed and which would be financed from grant funds. The

Mission in developing the project would provide for a "buy-in" of, say, 3 months/yr. technical assistance under the AID/MSU centrally funded cooperative agreement (AID/DSAN-CA-0148). The "buy-in" would finance MSU activities under the ASRP project in Indonesia.

4. If USAID/Indonesia feels that this new mode for short term technical assistance (not long term which would have to be handled differently) might be suitable for the ASRP project, indication of interest in "buy-in" into the AID/MSU CA should probably be in the PID.

cc: H. D. Bunch, MSU
R. I. Jackson, AID/W (S&T)

JCDelouche:rh

ANNEX B

October 10, 1984

M E M O R A N D U M

TO: Alan R. Hurdus, USAID/Indonesia/ARD

FROM: James C. Delouche
Mississippi State University

RE: Seed operations by AARD units for internal supply and supply for trials and demonstrations.

1. The matter of internal seed supply in AARD, which we had discussed, was omitted from my draft report partly as a result of oversight but also because it appears that a solution is in sight.

2. The shortages of seed for research, trials and demonstrations which have plagued the research units in the past decade appear to have been brought about, or at least worsened, by over-reactions to apparent excessive time, effort and funds expended on "seed activities" in the late 1960s or early 1970s. This is not unusual. So-called agricultural experiment or research stations in many countries in the past (and even up to present in some) devoted most of their efforts to seed production. Indeed, the proceeds from seed sales were often the mainstay of the operational budget. While the research stations in Indonesia were not predominantly involved in seed operations, administrators did perceive that an inordinate portion of the operational budget was being expended on seed activities some years ago, and decided that this had to be phased out. Unfortunately the phasing out went too far and I believe this is now generally recognized.

3. Recognition of the problem was the first step toward its resolution. The inadequacy of the stream of breeder and foundation seed was recognized in formulation of the WB Seeds II project. Funds are provided for stock seed farms and for equipment, storerooms and operations at many of the stations in support of the Palawija crops seed program under Seeds II. Lack of even the most basic equipment and facilities is (was) one of the main factors contributing to internal shortages of seed: seed were produced then lost because of inadequate drying, storage insects and so on. In addition to the WB, AID and the Dutch financed projects are providing seed facilities and equipment at Sukarami, Malang and Maros. These several steps should provide an adequate physical setting for the level of seed operations needed.

4. Equipment and facilities will establish an adequate physical setting but will not assure that seed will be produced in adequate quantities at the proper time. The production of seed for internal use, demonstrations, etc., and breeder seed for the certification system must be accepted as a legitimate aspect and extension of crop improvement research. Most agricultural research systems accept responsibility for production of the breeder and basic seed needed by the seed industry for multiplication and by the extension service and others for demonstrations and trials. This responsibility is then carried out by the support services and management thereof of the stations under the general guidance of the plant breeders. Thus, the Traywick/Harwood report is very appropriate in this area. Indeed, they recommend short courses and in-service training in seed operations in the general upgrading of supporting services.

5. The PID should indicate that emphasis would be given to "legitimate" seed operations (breeder and basic seed), improvements of the management and supporting services of the institutions to include adequate operational funds and appointment of an Agronomist, In Charge, of seed operations at each institute (jr. level).

6. I'm convinced that the solutions to the internal seed supply problems are at hand in terms of facilities and improvements in management without large investments.

scc