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AN ANALYSIS OF THE POTENTIAL OF SOYBEANS IN BANGLADESH

by
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May 1974

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Scope of Work

The recommendations in this report come from a 17-day visit by the consultant to Bangladesh in May 1974. Due to May Day, a Buddhist holiday and inclement weather there were constraints on contacts that could be made. In addition, in some areas visited the experimental plots already had been harvested or would be planted in June or late August. Nevertheless, enough data were obtained by the consultant to provide a reasonably good idea of the potential of soybeans in Bangladesh.

The assignment was to determine whether among the possible food legumes and oil seed crops in Bangladesh if soybeans appear to have a place and if so, to formulate a research program for soybeans for the Bangladesh Agricultural Research Institute (BARI) that would:

1. Specify the kinds of problems that should be addressed and outline the experimental design for getting answers to the problem. The research should take into consideration the existing cropping patterns, especially rotations with rice.
2. List the facilities, equipment and commodities required to carry out the research program on a three-year phased program.
3. List training requirements
   a. with early emphasis on practical training.
   b. degree training to follow later.
   c. identify persons for training.
   d. list locations where training should take place.
4. Estimate need for expatriate consultants for a three-year period beginning in July 1974.

Pertinent Information about Bangladesh Agriculture

1. Cropping area. The net cropping area in Bangladesh is around 21.7 million acres. The cropping area sown more than once equals a little more than 11.1 million acres. Therefore, the total cropped area is approximately 32.8 million acres (9).

2. Crops. Rice is grown on 74 percent of the total cropped area in Bangladesh (10). Since rice is the major crop all other crops and cropping patterns must relate to it. Below is a list of major crops in Bangladesh and their total cropping area (9):

Crop(s)	Total area (000 acres)
Rice	24,210
Cereal grains (wheat, barley, millets, maize)	611
Jute	2,200
Sugar cane	404
Pulses (lentils, chickpeas, chickling vetch, mung beans, pigeon peas, etc.)	920
Oil seeds (rape, mustard, peanuts, coconuts, linseeds, castor beans)	826
Chillies, onion, garlic	406
Cotton	18
Banana	97
Potato	214
Tea	110
Tobacco	109
Betel nut	99
Miscellaneous	2,576
Total cropped area	32,800

3. Rainfall pattern. The total rainfall in various district towns in Bangladesh varies from 56 to over 150 inches per year. The months of November to February are comparatively dry with less than one inch of rainfall per month. However, starting in March the rainfall increases monthly until June, July and August when some district towns can get as much as 25 inches of rain per month. In September and October the rainfall generally decreases. Therefore, during the monsoon period, when about two-thirds of the land area is flooded, there is too much rain for most crops except perhaps for rice and jute. During the winter period, the precipitation is too low for assured performance of many winter crops (6).

4. Geographical location and day length. Bangladesh is situated between 20.50°N and 26.50°N latitude (6).

Months	Day length
November-March	10-12 hours
March-June	12-14 hours
June-September	14-12 hours
September-November	12-10 hours

5. Temperatures. During the summer months, that is, March to June, the ranges in temperatures are from around 90 to 70 (°F). During the monsoon months, that is, July to October, the ranges in temperatures are from the high 80's to the middle 70's. During the winter months, that is, November to February, the ranges in temperatures are from the low 80's to the middle 50's (6).

Current World Status of the Soybean

During the first three decades of the twentieth century, soybean production was largely confined to East Asia; China, Indonesia, Japan and Korea were the major producers of soybeans. In these countries the soybean is utilized as a food in liquid, powder or curd forms to make miso (fermented soy paste), shōyu (soy sauce), tōfu (soy curd), natto (fermented soy cheese), tempeh, yuba, kinako, hamanatto, kochu chang and soy milk. Immature green soybeans and soybean sprouts are considered highly nutritious and consumed in great quantities.

In the late 1940's and early 1950's, the U.S. overtook China and eventually all of the East Asian countries in soybean production. In 1973, approximately 56 million acres of soybeans were grown in the U.S. or 74 percent of the world soybean production. The People's Republic of China and Brazil produce 12 and 8 percent of the world soybean production, respectively. Other countries with sizable soybean acreages are Mexico, Indonesia, South Korea, Canada, the U.S.S.R., Romania, Paraguay and Columbia (1).

In the U.S. the two primary products of the soybean are oil and meal (protein). Varieties currently grown in the U.S. contain oil contents from 20 to 23 percent and protein contents from 39 to 45 percent. The refined fraction of crude soybean oil is converted to margarine, shortening, mayonnaise, salad oils, salad dressings, mellorine and sandwich spreads. Most of the soybean meal is used as a source of high protein in animal feeds for the production of milk, butter, eggs, poultry, beef, pork and lamb. A small percentage of soybean oil and protein is used in industrial products. Recent developments in the utilization of soybean protein in form of concentrates, isolates, and textured protein for human consumption offers a partial solution to man's protein needs in a world with a rapidly growing population. On a protein per pound basis, the soybean is today the cheapest source of protein (2).

Status of the Soybean in India

During the Colonial Period, the British introduced the soybean into India for use as a forage, green manure and cover crop. However, the soybean could not compete with the rapidly growing cowpea (Vigna unguiculata), hyacinth bean (Dolichos lablab--new scientific name Lablab purpureus), or sannhemp (Crotalaria juncea) and eventually lost favor among farmers. Over 40 years ago, Mohandas Gandhi advocated that the soybean should be used as a food by the nonmeat-eating Hindus. Unfortunately, when the soybean was prepared in the traditional manner in the home it could not compete with the more tasteful mung (Phaseolus aureus--new scientific name Vigna radiata) arhar (Cajanus cajan), gram (Cicer arietinum), black gram (Phaseolus mungo) and masur (Lens esculenta) dals.

Approximately seven years ago, a joint USAID/University of Illinois/India soybean project was initiated at the G. B. Pant University of Agriculture and Technology, Pantnagar, U. P. and at the J. Nehru Agricultural University, Jabalpur, M. P. The soybean project was designed to break down the barriers between institutional cooperation and the barriers among departments within an institution. Soybean coordinators were appointed at both institutions. All experimental plots were placed on the same fields or nearby fields. Meetings were held to discuss the appropriate research to be conducted during the year and the results of the previous year's experiments were analyzed. Ultimately, an All-India Coordinated Soybean Scheme was organized to enable other institutions to join the program. Today, especially at the G. B. Pant University of Agriculture and Technology, there is an excellent cadre of trained scientists in all areas of soybean production as well as in marketing, processing, seed multiplication, extension and home science. At least three solvent extraction plants currently are operating in India. A number of booklets have been published at Pantnagar and

the University of Illinois providing the rural homemaker the basic recipes for use of whole soybeans in sweets, snacks, cookies, cakes, soups, curries and dals (3, 4).

Basic Principles in Soybean Production

There are certain basic agronomic principles that apply to soybean production in order to obtain optimum yields. Obviously, competing crops, economics, soil, climate and management practices will influence the distribution of soybean acreage. A few of the fundamental principles are outlined below.

1. Soybeans do best on deep, well-drained soils with good water-holding capacity. Water stress during the flowering period can be a major factor in limiting soybean yields. On the other hand, prolonged water logging results in death of deeper roots. At least 20 inches of water (rainfall and/or irrigation) during the growing season is needed to produce a reasonably good crop of soybeans.
2. For economic production, soybeans must be inoculated with *Rhizobium Japonicum*. The bacteria maintain a symbiotic relationship with the soybean plant. The nodules formed on the soybean roots provide the soybean plant with nitrogen, while the soybean plant provides the bacteria with an energy source in the form of carbohydrates. The *Rhizobium Japonicum* bacteria are aerobic organisms. During anaerobic conditions, such as excess water logging of the soil, the organisms will not be able to survive or will survive in reduced numbers. In general, once soybeans have been inoculated with *Rhizobia*, there is no need to keep adding inoculum to soybeans planted in the same field nor is there any need to add nitrogen fertilizer to soybeans.
3. Soybeans do best on soils having a pH in the range of 5.8 to 6.5. Liming soils to pH levels which eliminate toxicity of aluminum and/or

manganese should provide an environment favorable for nodulation and *Rhizobia* activity. In addition, molybdenum is essential for the symbiotic nitrogen fixation process. Soybean yields will be reduced when there is an inadequate supply of molybdenum in the soil. Fortunately, the solubility of soil molybdenum is increased as the pH of the soil increases. This is another reason why soybean yields increase when acid soils are limed.

4. Soybeans generally respond to phosphorus fertilization and may respond to potassium fertilization. Depending on specific locality, soybeans may respond to fertilizers containing the elements such as copper, iron, sulfur, boron and zinc.

5. The soybean is responsive to day length. Soybeans will remain in the vegetative state until the day length is shortened, at which point, the mechanisms for flowering and pod setting are triggered. In North America, the soybean varieties have been classified into 12 maturity groups based on day-length response. In Canada and in the northern parts of the U.S. the varieties classified as Maturity Group (MG) 00, 0 and I are grown. In the central part of the U.S. the varieties belonging to MG II, III, IV and V are grown. Along the Gulf Coast the varieties grown belong to MG VIII. South of Continental U.S. are the subtropical and tropical zones. Varieties adapted to these regions are classified in MG IX and X. Hence, soybean varieties are adapted to narrow ranges in latitude, but can be grown along a belt within the same longitude.

Soybeans usually are grown during the rainy or kharif season. In the Northern Hemisphere they usually are planted in April and May and harvested in October and November. The planting and harvesting dates are reversed in the Southern Hemisphere.

Status of the Soybean in Bangladesh--Past Research

There is no commercial acreage of soybeans in Bangladesh. Apparently, the earliest soybean research scheme sanctioned by the Government was approved in the year 1960-61 effective June 1961 (5). Below is a summary of past experimental work on soybeans in Bangladesh.

a. Germplasm resources. Starting in 1961, soybean germplasm continuously has been introduced in the country by the Agricultural Research Institute from the U.S., People's Republic of China, Republic of China, Japan, etc. Apparently, due to poor storage conditions much of the seed has been lost (5).

b. Varietal trials. From 1963 to 1967, regional soybean trials were conducted at Dacca, Jamalpur, Rajshahi, Bogra and Kishorganj using six varieties, viz., S3, C2, Pelican, Barmeli, Acadian and CNS. The trials were conducted during the kharif season in a randomized block design with four replications. The highest yielding variety was S3 which averaged 1,410 pounds per acre (23.5 bushels) over all years and locations. Fertilizer rates, inoculum application, spacing or date of planting information have been omitted from the report (5).

A rabi season (dry winter) experiment was conducted at Dacca in the year 1971-72. The highest yielding variety was S3 which produced 362 pounds per acre (6 bushels). Apparently the experiment was conducted without irrigation (7).

A variety trial was conducted in 1967 by the Food Science and Botany Sections of the Bangladesh Council for Scientific and Industrial Research, Dacca (8). The varieties tested were C2, Barmeli, P3, K16, T18, Acadian, Pelican, M1 and S3. The seeds were sown at a distance of two feet between rows and nine inches between plants. Cow-dung was the only

fertilizer applied to the plots. Seed yield was found to be maximum in S3 (30.32 gm/sq. ft.). The variety matured in 169 days. The seed of S3 contained 17.8 percent oil.

c. Fertilizer trials. A fertilizer trial using N, P and K each at three levels, viz., 0, 20 and 40 pounds per acre was conducted at Dacca for two years and at Jamalpur for one year (5). The experiment was conducted in the kharif season. The results of the experiment showed that soybeans did not respond to N, P or K alone or any combination. The investigators believed that the leaching of fertilizer due to excess rainfall affected the treatments. Nevertheless, the investigators recommend the following fertilizer rates for soybeans:

1. N - urea at 66 pounds per acre or 4,000 pounds cow-dung per acre and supplemented with 44 pounds per acre of urea.
2. P - triple super phosphate at 112 pounds per acre.
3. K - muriate of potash at 40 pounds per acre.

d. Inoculum. An inoculum study was conducted at Dacca and Jamalpur (5). One variety, Barmeli, was tested against four treatments, i.e., no inoculum and three strains brought into Bangladesh by a U.S. agricultural advisor. The results indicated that there were no significant differences in the soybean yields due to inoculation of seed.

e. Spacing trials. An experiment on the effect of spacing on the yield of soybeans is being conducted at Joydebpur, Jamalpur, Hathazari, Bogra and Kishorganj (5). There are nine treatments in the experiment:

1. Broadcasting seed.
2. Between rows, 12 inches; within rows, 9 inches between plants.
3. Between rows, 12 inches; within rows, 12 inches between plants.

4. Between rows, 18 inches; within rows, 6 inches between plants.
5. Between rows, 18 inches; within rows, 9 inches between plants.
6. Between rows, 18 inches; within rows, 12 inches between plants.
7. Between rows, 24 inches; within rows, 6 inches between plants.
8. Between rows, 24 inches; within rows, 9 inches between plants.
9. Between rows, 24 inches; within rows, 12 inches between plants.

Thus far, the best yields were obtained in the kharif (rainy season) with treatment No. 5 and the rabi (dry season) with treatment No. 4.

Status of the Soybean in Bangladesh--Present Research

In 1973, Mr. Duane Moore, a recent graduate of Purdue University, joined the Mennonite Central Committee in Bangladesh as their soybean and sorghum agronomist. The Mennonite Central Committee's activities are funded by the Canadian International Development Agency.

Mr. Moore obtained soybean seed from Purdue University, Dr. Edgar Hartwig, USDA/Stoneville, Mississippi, and from G. B. Pant University of Agriculture and Technology. Mr. Moore and his wife visited G. B. Pant University and other institutions in India conducting soybean investigations.

In Bangladesh, Mr. Moore has been extremely effective in working around the bureaucracy against institutional cooperation. He has distributed eight to ten varieties of soybean seed to about 20 different institutions. This past February a tremendous number of variety (really exploratory) trials were planted throughout the country. In addition, Mr. and Mrs. Moore publish The Bangladesh Soybean Newsletter. Thus far two issues have been printed. The newsletter is an effective mechanism whereby Mr. Moore can keep all interested parties up to date on soybean activities in Bangladesh, India and elsewhere. The trials set up by Mr. Moore are in fact the major agronomic research effort on soybeans in Bangladesh.

The consultant visited as many of the trials as time permitted and they are listed below:

1. Bangladesh Council for Scientific and Industrial Research, Dacca.
2. Bangladesh Agricultural University, Mymensingh.
3. Savar Dairy Farm, Dacca District.
4. Jurain Nutrition Project, Dacca District.
5. Kotwali Thana Central Cooperative Association, Comilla.
6. Mennonite Central Committee trials (3), Maijdi Court area.
7. Agricultural Research Institute, Joydebpur.
8. Agricultural Research Institute, Substation Ishurdi.

Unfortunately, the consultant was not able to see an experiment being conducted on the land of the North Bengal Sugar Mills. The agronomists at the mill were intercropping soybeans with sugar cane in new sugar cane fields. The idea behind the experiment was to determine if it was possible to harvest a crop of soybeans before they were shaded out by sugar cane.

UNICEF/Dacca is interested in the use of soybeans as a kitchen garden vegetable. In 1975, they will import 8,000 pounds of soybean seed from the U.S. and distribute the soybeans in one-pound packages to 8,000 primary schools. In addition to soybeans, they are importing huge quantities of other vegetable seed. It is the consultant's understanding that UNICEF has been training primary school teachers via short courses, on the fundamentals of kitchen gardening.

At the Bangladesh Council for Scientific and Industrial Research, Dr. Omar Faruque is developing low-cost nutrition foods for babies and school children based on soybeans and peanuts.

Potential of Soybeans in Bangladesh

The soybean is considered a kharif (rainy season) crop. However, in Bangladesh the rice crop has preference over all other crops during the kharif

season. Moreover, it is highly doubtful that under the high rainfall and flood conditions which prevail in the country during the kharif seasons that soybeans could be grown successfully.

In the consultant's view the growing conditions during the winter months of November to February are wrong for the soybean. The temperatures are at their lowest, the day lengths are too short and there is a low rainfall pattern during the winter months.

There is good possibility that soybeans can be successfully grown during the summer months from mid-February to mid-May. The temperatures, day-length periods and rainfall are all increasing during this period. Supplemental irrigation whenever available should increase the chances of an excellent crop. During the summer months, soybeans would not necessarily compete in all districts with the rice crop. The consultant has not visited all districts, but from information he has been able to obtain, it would appear that soybeans would have a reasonably good chance in the Pabna, Kushtia and Ishurdi areas and perhaps in the Comilla and Noakhali areas.

Based on the above comments by the consultant, it would be advisable for BARI to organize a modest coordinated adaptive soybean research program. The research program should be geared to answer questions that would be needed by farmers if they are to successfully raise a soybean crop.

Analysis of Soybean Research at BARI

In the consultant's view, the soybean research trials being conducted by the Bangladesh Agricultural Research Institute are essentially nonproductive, uncoordinated and the work should be discontinued and reevaluated. The BARI soybean workers appear to be isolated geographically, academically and perhaps linguistically from the main stream of soybean research. The consultant was surprised to find out how little is known about soybean research being conducted elsewhere, especially the research being carried out in India.

In defense of the soybean workers at BARI, it must be stated that the salaries are low, the facilities to carry out field research are almost non-existent and the general atmosphere conducive to conducting agricultural research appears to be very poor.

Coordinated Adaptive Soybean Program at BARI

A three-year phased coordinated adaptive soybean research program is outlined below. In general, the consultant's views toward team efforts or coordinated research follow those expressed by Mr. James E. Bryan (12) concerning potato research at BARI. The consultant takes the position that there is no need for excessive expatriate technical assistance or excessive study-tours or degree training programs.

The aim of the program is to be able to answer the following questions within a three-year period:

1. Can soybeans compete with other crops in Bangladesh?
2. What inputs are necessary to raise a good crop of soybeans?
   a. Fertilizer--kinds and amounts.
   b. Pesticides.
   c. Irrigation.
3. What are the proper spacing requirements?
4. Is it necessary to reinoculate soybeans after they are rotated with rice?
5. What are the proper management systems?
   a. Planting on the ridge vs. on a flat bed.
   b. How many times must the crop be weeded?
   c. When should soybeans be planted?
6. Are there certain genetic restraints that limit yields?
   a. Need for sources of plant resistance to a particular pathogen or pest.
   b. Need for earlier flowering or maturing germplasm.

A. Coordinator

The director of BARI should appoint a qualified scientist to serve as the leader and coordinator of the Coordinated Adaptive Soybean Program. The coordinator is the key person in the program. The appointment is essential for any potential support for the program in Bangladesh or from other countries. If the director of BARI cannot locate such a person, then such a person will have to be developed. In the interim, an expatriate consultant will have to provide the leadership. In any event, the coordinator must have official approval to bring in all departments within BARI and any institution that wishes to participate in the program.

The coordinator should have a working knowledge or at least an appreciation for research in plant breeding, pathology, entomology, and agronomy. In addition, the coordinator should have organizational abilities. It would be preferred if the coordinator had a Ph.D. or at least an M.S. degree with experience. The coordinator should be acquainted with soybean research being conducted in other countries and should act as a funnel between Bangladesh scientists and potential resources such as INTSOY (International Soybean Resource Base) and AVRDC (Asian Vegetable Research and Development Center).

B. Support Personnel (B.S. or M.S. degree)

	Year 01	Year 02	Year 03
Agronomist	1	1	1
Economic Botanist (Breeder)	1	1	1
Plant Pathologist	1/4	1/4	1/4
Microbiologist	1/2	1/2	1/2
Entomologist	1/4	1/4	1/4
Production Economist	0	1/4	1/2
Statistician	1/8	1/8	1/8

Other than the coordinator, the agronomist and economic botanist (breeder) should be the only full-time scientists working on the project. The other positions should be utilized on a part-time basis. In fact, it would be a good idea to assign a team of specialists to work on pulses. There are many similarities between the soybean and the other pulses. Information gained from one pulse often can be transferred to other pulses.

C. Support of Program

The Government of Bangladesh through BARI must provide support for the members of the team.

1. Rank and salary should be equal to other research institutes such as BRRI.
2. The program must be given some assurance of continuity.
3. The team members should receive vertical promotions and not be forced to move elsewhere to get promoted.
4. Funds must be made available to the coordinator and his team so that they can:
   a. Travel to assist and supervise trials at substations.
   b. Travel to collaborating institutions.
   c. Purchase fertilizer, pesticides, bags, tags, stakes, and hand tools.
   d. Pay for one or two field assistants.
5. Large equipment such as tractors, plows, etc., must come out of general station funds. This implies that each station will have ample operating funds to support the soybean as well as other projects.

D. Research Stations

1. Central Station, Joydebpur. The land must be formed properly so that there is reasonable drainage on the station plots (11) and a rational crop rotation system developed for land utilization.

2. Substations. There is little purpose in conducting massive numbers of trials without adequate supervision or guidance. It seems more reasonable to develop competence at one station at a time so that by the third year two or three substations plus the Central Station are coordinated in the soybean program.

E. Research Trials

1. All field trials should be examined by the statistician for his design approval. It is useless to conduct an experiment and then ask the statistician to work out some formula to make the data "more scientific."
2. At least for the first year, the program should lean heavily on the assistance of INTSOY to provide seed for variety trials and any other seed needs. The coordinator should contact Dr. M. C. Saxena, G. B. Pant University, Pantnagar, for additional seed.
3. In the first year, the pathologist and entomologist should survey the variety trials, date of planting trials, etc., for pests and pathogens. This implies that they must get out into the field and work on someone else's plots.
4. All trials should be conducted on the same field or nearby fields. Signs should be posted providing in detail where each experiment is located. This implies inter- and intradepartmental cooperation.
5. The date of planting, spacing trials, and fertilizer trials should contain enough surface responses to assist the production economist in evaluating the crop potential. For example, an experiment measuring the response of soybeans to 0, 40 or 80 pounds of K per acre with five replications is of little use to a production economist. He would prefer to analyze the response of soybeans to 0, 20, 40, 80 and 160 pounds of K per acre with three replications.

F. Facilities and Equipment Needs

1. Transport

   a. Coordinator and his team: one jeep with provision for spare parts, maintenance, and fuel.

2. Laboratory

   a. Assuming all personnel will be assigned to Joydebpur, and the new facilities will have general use laboratories, then no extra laboratory facilities are needed. For the first year, all protein and oil content analyses of seed can be serviced by INTSOY.

3. Seed Storage

   a. It is assumped that adequate cold storage facilities will be built at Jobdebpur.

G. Time Phasing of Personnel

1. July 1, 1974

   a. Coordinator of Coordinated Adaptive Soybean Program

2. September 1, 1974

   a. Agronomist

   b. Economic Botanist

3. October 1, 1974

   a. Microbiologist

   b. Entomologist

   c. Statistician

   d. Pathologist

4. July 1, 1975

   a. Production Economist

H. Training

1. Short-term study tours

   a. The coordinator should spent at least two months at G. B. Pant University of Agriculture and Technology, Pantnagar, India looking into all aspects of their soybean research program. His logical counterpart at the University should be Dr. M. C. Saxena. Special arrangements will have to be made with the Government of India.

   b. Around the middle of October 1974, the University of Illinois is conducting a one-week soybean workshop in Addis Ababa, Ethiopia. The agronomist and economic botanist should go to the meeting to meet with counterparts working in other countries.

   c. The plant pathologist, entomologist and microbiologist should spend the summer of 1975 working with scientists at the G. B. Pant University of Agriculture and Technology, Pantnagar. Special arrangements will have to be made with the Government of India.

2. Degree training

   All candidates for M.S. or Ph. D. degrees should be bonded by the Government of Bangladesh that upon completion of training they will return to Bangladesh and work for a specified period of time at BARI. It is difficult for the consultant to determine at this time how many candidates should be selected. Nevertheless the numbers of candidates should be severely restricted and the selection process based on merit.

I. Expatriate Consultants

1. Long term

   a. Most probably an experienced soybean agronomist will be needed to guide the coordinator of the soybean program. If possible, his tour of duty should be for two years. The search for such a person should begin as soon as possible to coincide with the appointment of the coordinator of the soybean program.

2. Short term

a. 1974-75 (one-month period)

(1) Entomologist--during the growing season

*(2) Pathologist--during the growing season

(3) Statistician--prior to growing season

(4) Microbiologist--during the growing season

*(5) Plant Breeder--during the growing season.

b. 1975-76

(1) Production economist--after the growing season

(2) Three-man team review of program--after the growing season. The team should address itself to answering the fundamental question of whether the program should be continued with the addition of certain components such as extension and food science or should the program be terminated.

c. 1976-77

(1) Three man months of specialist assistance as determined by team reviewers.

The consultants should present one or two lectures in their specialty, provide on-the-job training and advise on specific projects.

*If possible these positions should be filed by the Indian scientists, Dr. Y. L. Nene and Dr. B. B. Singh. Both scientists were trained in the U.S. and they are on the staff of G. B. Pant University of Agriculture and Technology. They are more familiar with disease problems of soybeans on the subcontinent than U.S. scientists.

List of Persons Contacted in Bangladesh

USAID - Dacca

1. Mr. Lawrence C. Heilman--Chief, Institutional Development Division
2. Mr. Edward A. Glaeser--Project Manager, Rural Development
3. Mr. David Sarker--Project Analyst, Rural Development

US Embassy - Dacca

4. Mr. Carl O. Winberg--Agricultural Attache

Bangladesh Government

5. Dr. Kazi M. Badruddoza--Director, BARI
6. Mr. Abdul Khaleque--Economic Botanist (Pulses and Oilseeds) BARI
7. Mr. Md. Shahabuddin Mia--Assistant Economic Botanist (Pulses and Oilseeds) BARI
8. Dr. Lutfur Rahman--Assistant Professor (Pulses and Oilseeds), Department of Crop Botany, Bangladesh Agricultural University, Mymensingh
9. Dr. (Mrs.) Flora Z. Majid--Senior Research Officer, Botany Section, BCSIR, Dacca
10. Dr. Md. Shaledullah--Agronomist, Botany Section, BCSIR, Dacca
11. Dr. Shiraj Hossain Khan--Chief, Technical Section, Agriculture Division, Planning Commission
12. Dr. Oman Faruque--Director, Jurain Nutrition Project, Dacca and Senior Research Officer, BCSIR, Dacca
13. Mr. A. K. Islam--Agronomist, Jurain Nutrition Project, Dacca
14. Miss Romana Padlan--IVS Agriculturalist working at the Kotwali Thana Central Cooperative Association (KTCCA), Comilla
15. Mr. M. S. Ahmad--Rice Breeder, Bangladesh Rice Research Institute (BRRI), Joydebpur
16. Mr. Md. Abdul Momen--District Agricultural Officer, Pabna
17. Mr. Ashraful Islam--Assistant Botanist, Agricultural Research Substation, Ishurdi
18. Dr. Motlubor Rahman--Principal Cane Breeder, Sugarcane Research Institute, Ishurdi

Others

19. Mr. Carl D. Fanning--TVA Team, Consultant on Fertilizer for USAID/Dacca

20. Mr. Harold A. Kramer--Agricultural Engineer, Consultant to World Bank on Seed Storage for the BADC

21. Mr. Donald W. Shields--Program Officer, UNICEF/Dacca

22. Mr. Hermann Thorwart--Agricultural Economist, Dairy and Cattle Improvement Farm, Savar (Bangladesh-German Project of Technical Cooperation)

23. Mr. Kurt Aggelor--Agronomist, Dairy and Cattle Improvement Farm, Savor (Bangladesh-German Project of Technical Cooperation)

24. Dr. Md. Ibrahim--Diabetic Association of Bangladesh, Dacca

25. Mr. and Mrs. Duane Moore--Mennonite Central Committee, Maijdi Court area (Noakhali District)

26. Dr. L. Merrick Lockwood--Agronomist, IVS/CORR, Jalchatra

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List of Pulses Grown in Bangladesh

Bangla Name	Scientific Name	English Name
Masur	Lens esculenta	Lentil
Moong	Vigna radiata	Mung bean
Gram	Cicer arietinum	Bengal gram
Mash-kalai	Phaseolus mungo	Black gram
Arhar	Cajanus cajan	Pigeon pea
Matar	Pisum satnum	Common pea
Kheshari	Lathyrus sativus	Chickling vetch
Shim	Lablab purpureus	Hyacinth bean
Barbati	Vigna unguiculata	Cowpea
Gari-kalai	Glycine max	Soybean
Cheena badam	Arachis hypogaea	Peanut