IFDC

Vol. 7—No. 2
June 1982

ISSN 0149-3434

Report

an update on the work & progress at the International Fertilizer Development Center

China Workshop Points to New Horizons

"A contagious enthusiasm developed during the meeting, and the momentum increased during the workshop. By the time we reached the rice paddies and saw the deep placement technique in practice, everyone was swept along with enthusiasm to extend this research even further."

Such was the way Dr. E. T. Craswell, IFDC Soil Scientist and one of the participants, summarized the International Workshop on Efficient Nitrogen Management, held in Fuzhou, China, April 26-May 4.

Cosponsors

The workshop was cosponsored by the Fujian Academy of Agricultural Science (FAAS), Fuzhou; the International Rice Research Institute (IRRI); and IFDC. The Fujian provincial government and FAAS provided attractive facilities and ensured the smooth operation of the workshop. Mr. Liu Chung-Chu, Vice President, and Mr. Yang Ya Bao, Deputy Director for Daily Affairs of FAAS did an outstanding job with local arrangements for the workshop.

Dr. R. B. Diamond, IFDC Fertilizer Evaluation Coordinator, was the Coordinator of the Workshop. Besides Dr. Diamond, the IFDC technical team participating in the workshop and making presentations were: Dr. P. J. Stangel, Deputy Managing Director; Dr. E. T. Craswell, Soil Scientist; Mr. M. T. Frederick, Chemical Engineer; Dr. Y. H. Chuang, Market Development Economist; and Dr. Dennis O'Brien, Economist serving as a Fertilizer Evaluation Specialist.

An FAAS staff member demonstrates the use of a deep-placement applicator for urea supergranules on paddy rice.

Fifty-four fertilizer specialists from 14 countries participated in this workshop.

Focus

"The primary focus of the workshop was to evaluate the potential of deep placement of nitrogen fertilizers as a means of improving nitrogen efficiency and rice production," Dr. Stangel said. "For the first time we brought together at one location the necessary expertise to get these technologies produced, evaluated, and introduced to the farmer."

The workshop was unique in several aspects. Dr. E. T. Craswell pointed out one of these. "The workshop was held in China where they are actually practicing deep placement of fertilizer in the farmers' fields; the rest of us are just doing research," Dr. Craswell said.

More than 25 technical papers were presented on the various aspects of improving nitrogen efficiency, particularly through deep placement of supergranules. It appears that ammonia volatilization is the major means of nitrogen loss for fertilizer applied to flooded paddy. This loss may be curbed through the placement of nitrogen 5-10 cm below the soil surface.

Workgroups

Besides the presentation of the technical papers, the workshop featured four

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workgroups. All of the participants were assigned to one or more workgroups. These workgroups concentrated on four areas: production of modified urea products, agro-economic evaluation of urea supergranules in farmers' fields, applicator research and development, and future agronomic research on more efficient use of nitrogen fertilizers.

"IRRI brought applicators to the workshop and participants had a chance to use these and the Chinese equipment in the fields," Dr. Craswell said.

"These workgroups functioned as basic "think tank" groups where gaps in research were identified," Dr. Stangel said.

Field Trips

Several field trips were included as part of the workshop. "In Jiangyang county, the participants observed the production of briquettes in large quantities and their application in farmers' fields. This is an area where the use of deep-placement applicators is relatively widespread," Dr. Stangel said.

Visits to FAAS and an ammonium bicarbonate factory near Fuzhou were also on the itinerary.

Outgrowths

As a result of this workshop, FAAS, IRRI, and IFDC are considering a cooperative project to develop and improve equipment to manufacture and deep place fertilizer.

Other outgrowths of the workshop include several pilot projects to be established in individual countries interested in evaluating these technologies. "These pilot projects will function as laboratories for testing the precision and reliability of applicators," Dr. Stangel said. "They will allow an opportunity to measure farmer acceptance of this technology and identify areas where further improvements are needed."

"Dr. Dennis O'Brien will carry the research plan for farm-level evaluation of supergranules to Indonesia and use this as a basis for his program," Dr. Craswell said.

"The workshop will provide a good base from which to implement the fertilizer placement program in the Philippines," Dr. Diamond said. "Burma will start two pilot agricultural development projects in the near future. India has been collaborating closely with IFDC and IRRI through the International Network for Soil Fertility and Fertilizer Evaluation for Rice (INSFFER) on the evaluation of deep placement of supergranules. The Philippines, Thailand, and Sri Lanka have ordered briquetting equipment and requested that applicators be sent to their respective countries for testing."

"Since the Chinese have shown that increased yields resulted when they use their applicators to deep place fertilizer briquettes, a potential market exists for large granules or briquettes of urea that can be used in this way," Mr. Frederick said. "This fact should provide the impetus to companies producing this large-size fertilizer material to refine their processes."

The workshop achieved its purpose, and groundwork was laid for future research. "The success of the workshop was largely attributable to the outstanding efforts of the host country," Dr. Stangel pointed out. ■

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Mr. Liu Chung-Chu, Vice President of FAAS, addresses the International Workshop on Efficient Nitrogen Management. Dr. P. J. Stangel, IFDC Deputy Managing Director, is seated on the right.

Training Course Provides More In-Depth Study

In conjunction with the China workshop, IFDC conducted an in-depth International Training Course on Nitrogen Management, May 4-13, in Fuzhou. Fourteen participants from five countries attended the course.

The participants included 7 from China, 2 from Thailand, 2 from the Philippines, 2 from India, and 1 from Sri Lanka. These participants had attended the workshop and were from countries planning to initiate pilot projects.

This training program offered an opportunity for intensive study on how to conduct field trials and analysis and to interpret results. The participants gained experience in the use, operation,

and maintenance of briquetting and deep-placement equipment.

Dr. R. B. Diamond, IFDC Fertilizer Evaluations Coordinator, was leader for the training program.

Chinese farmers carry application equipment and fertilizer to their fields.

Lecturers from several Chinese organizations, IRRI, and IFDC presented papers on such topics as experiment design, statistical analysis, economic analysis, fertilizer properties and fate in soil, biological fixation of nitrogen, and the use and operation of briquetters and applicators.

"The participants gained a practical insight by taking several field trips," Dr. Diamond said. "They visited an ammonium bicarbonate factory in Fuzhou. They also visited the INSFFER and other fertilizer trials and observed profiles of paddy soils."

The training course met its objective of increasing the participants' knowledge of conducting and analyzing experiments in nitrogen management for improved efficiency. This is evidenced by the fact that the participants' final test scores showed a 34% increase over the baseline scores on the pretest. ■

Technology Transfer Exemplified in PUSRI Granulation Plant

The excellent quality of the granular urea being produced at P.T. PUSRI in Palembang, Indonesia, is the end result of technology transfer that began in 1977.

One of the papers presented at the China workshop, entitled "Granulation of Urea at P.T. Pupuk Sriwidjaja," related this technology transfer. The paper was written by Mr. Dede Sudarsana, Chemical Engineer of P.T. PUSRI, and delivered by Mr. M. T. Frederick, IFDC Chemical Engineer.

Mr. Sudarsana recounted the results of technical assistance provided by the Tennessee Valley Authority (TVA) and IFDC to his company in its efforts to convert the finishing section of one of its fertilizer plants from the production of prilled urea to that of granular urea.

P.T. PUSRI, a company owned by the Government of Indonesia, operates a large nitrogen complex at Palembang, Indonesia. Total design capacity of the four plants in the complex is 1.6 million metric tons of urea per year. During the production year ended on December 31, 1981, the actual total production from the four plants was 1.5 million metric tons of urea plus 21,661 metric tons of ammonia.

In the middle 1970s, PUSRI became concerned about deterioration that was taking place in the urea prill tower. Pollution of the atmosphere by urea dust from the prill tower was also a problem. As a result, a project was undertaken to make recommendations about repair or replacement of the prill tower.

"A team of IFDC engineers visited Palembang in January 1977 and presented PUSRI a preliminary proposal for replacing the urea finishing section with a pan granulation process developed by TVA," Mr. Sudarsana said.

A project was initiated to implement the IFDC proposal. In choosing to produce granular urea, PUSRI had two objectives in addition to the need to replace the badly deteriorated prill tower and eliminate the pollution problem.

The first of these objectives was to introduce technology that would provide the basis for improving nitrogen efficiency in Indonesia through the use of modified urea such as large granules and sulfur-coated urea. The second objective was to develop the engineering expertise within PUSRI to design and build process plants by using the experience already gained during the design and construction of the four existing plants.

"Early in 1977, a team of PUSRI engineers was sent to IFDC/TVA to complete the process design and establish specifications for the equipment," Mr. Sudarsana said.

PUSRI completed the construction in late 1980, and the plant began production in February 1981. In less than 2 hours from the initial startup of the unit, on-specification product was being sent to storage.

"Although the plant has had the normal mechanical problems experienced in any new plant, the mechanical operation has been good from the beginning," Mr. Sudarsana said. "A major contributing factor to this success was the complete and carefully planned training program that IFDC conducted for the PUSRI operating personnel."

Since the granulation unit was retrofitted to an existing urea production unit, an effort was made to use as much of the existing facilities and equipment as possible. As a result, difficulty in reprocessing the scrubber solution to recover the urea content has been encountered. PUSRI engineers in collaboration with

IFDC engineers have developed a plan to install the necessary equipment to concentrate the scrubber solution and recover the urea for recycle to the granulation unit. An interim operating plan has also been developed to ensure the efficient operation of the granulation unit while the equipment modifications are being made.

In spite of these problems, the product quality is excellent. The granules are hard and spherical, and the size range can be closely controlled by changing the screens and making corresponding changes in the slope and speed of the pan granulator. All of the product is bagged as produced, and the storage properties are good.

PUSRI's Marketing Division reports that the farmers "like the new product very much." The physical quality is much better than that of the standard prilled product; also the new product has improved storage properties.

"The objectives of the PUSRI project have been met," Mr. Sudarsana said. "Design, procurement, and construction of the granulation unit were accomplished by PUSRI personnel with IFDC serving as advisor." ■

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Review Committee Appraises IFDC's Programs

"The progress of IFDC's programs is excellent...its nitrogen research program is exactly on target...no other organization is providing training in the systematic way that IFDC is." These were the words of Dr. G. W. Cooke, former IFDC Board member and now Honorary Scientist, Rothamsted Experimental Station, England, and consultant to IFDC, at the conclusion of the program review committee meeting held at IFDC Headquarters March 8-12.

The committee was established by the IFDC Board of Directors at its meeting on October 6, 1981, to review and assess IFDC's programs. Besides Dr. Cooke, other committee members are: Dr. Ola Heide (Chairman), IFDC Board member and Rector of the Agricultural University of Norway; Dr. S. K. Mukherjee, former IFDC Board member; and Dr. Richard Reidinger, Economist with the World Bank in Washington, D.C.

The committee praised the progress of the nitrogen research program. The flooded rice program was deemed exceptionally successful.

"Half of the nitrogen that a developing-country farmer buys vanishes; it's lost," Dr. Cooke said. "The farmer benefits from only 50 cents of every dollar he spends on fertilizer. In IFDC's flooded rice program, progress is enormous because it has been shown that the farmer can benefit from 85 cents of his dollar."

"Scientifically and intellectually the paths to achieving high efficiency of fertilizer by farmers are now clear. There are technical and economical obstacles to overcome, but what has to be done is now known."

The upland nitrogen program is viewed as being off to a very good start.

"On the phosphate side, IFDC has a unique role because it doesn't own any phosphate mines; therefore, it has no impetus to sell one particular product over another. In South America, it is doing a fine job of providing advice on the use of phosphate rock resources."

The committee highly approved IFDC's technical assistance and training programs. As for technical assistance, IFDC's technical staff were judged to be giving the best possible advice from a chemical engineering, economic, marketing, and agronomic standpoint.

"IFDC's training programs are well coordinated from the aspect of who needs the training, where it should be given, and how it should be given," Dr. Cooke said.

Six projects were given priority for future work. The efficiency of urea fertilizers was given top priority. The committee set 100% efficiency as the goal.

The development of partially acidulated phosphate rock was another priority project. "Partial acidulation of phosphate rock is viewed as a very important growing point within IFDC's program," Dr. Cooke said. "It has the potential of providing developing countries with a high-quality material at less cost than fully acidulated material."

Sulfur research is the third priority project. Another project to be given priority in future research is the foliar application of nutrients.

Work to enhance the biological fixation of nitrogen was also of high priority. "Because it doesn't involve payment of money by farmers for nitrogen fertilizer, the biological fixation of nitrogen should be encouraged wherever it is practical and possible," Dr. Cooke said.

Mr. Mike Lupin, IFDC Research Chemist, demonstrates the briquetting of urea to members of the Program Review Committee. Pictured (from left) are Dr. George Cooke; Dr. Ola Heide; Mr. Lupin; Dr. S. K. Mukherjee; Mr. O. W. Livingston, Director of IFDC's Fertilizer Technology Division; and Dr. D. L. McCune, IFDC's Managing Director. Not pictured is Dr. Richard Reidinger.

"There's probably a lot IFDC can do to supply, in association with phosphate fertilizer, bacteria that plants need to fix nitrogen. This part of the program should be extended."

The interaction of fertilizers and water was another high priority project. "As the nitrogen program expands into the drier regions of the world, we need to know more about the relationship of the uptake of fertilizer by crops and the amount of water available to crops from rainfall or irrigation," Dr. Cooke said.

The committee decided that a second meeting was needed to consider further the areas of technical assistance, training, and economics. This meeting will take place prior to the October meeting of the IFDC Board of Directors. ■

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Indonesia—

ADAB Funds IFDC Project in Southeast Asia

The Australian Development Assistance Bureau (ADAB) is funding an IFDC project entitled "Research Into More Efficient Use of Fertilizers in Southeast Asia," that began recently. Initially the project is focused in Indonesia where it has become the key component of a national program on fertilizer efficiency. The national program covers all aspects of fertilizers including production, marketing, distribution, and use.

The memorandum of understanding between the Indonesian Ministry of Agriculture, acting through the Agency for Agricultural Research and Development (AARD), and IFDC was signed June 5.

While the main base of the project will be the Center for Soils Research in Bogor, Indonesia, it will involve economists, agronomists, engineers, soil scientists, and extension specialists from other ministries. Eventually this work will be extended to other countries in Southeast Asia.

Dr. Eric T. Craswell, IFDC Soil Scientist, is the project manager. Dr. Brian Palmer, Soil Scientist, is the IFDC liaison scientist in Indonesia; he will be joined in July by Dr. Dennis O'Brien and Dr. Robert Wetselaar, Soil Scientist.

"The goal of the program is to increase agricultural production in Southeast Asia," Dr. Craswell said. "The program will achieve its goal by developing, evaluating, and introducing more efficient fertilizer products and practices for rice and other crops in Southeast Asia."

The program involves a number of training courses that will be held at IFDC Headquarters, at the University of New England in Australia, and in mainland China.

Eight Indonesian scientists attended a training course on phosphorus, sulfur, and potash fertilizer efficiency, which was held on February 8 - March 1, 1982, at the University of New England in Australia.

"The purpose of the course was to review various aspects of plant nutrition and fertilizer technology that are relevant to studies of phosphorus, sulfur, and potash fertilizer efficiency," Dr. Craswell said. "The course also involved laboratory, greenhouse, and fieldwork on fertilizer efficiency. Instructors for the course included Dr. Graeme Blair of the Agronomy Department, University of New England, and Dr. Leo Korentajer and Dr. Brian Palmer, IFDC Soil Scientists."

After returning home, the eight Indonesian scientists will conduct research to develop fertilizer management strategies for crop production in the outer islands of Indonesia. This research will be coordinated from the Center for Soils Research in Bogor where Dr. Palmer, IFDC's Liaison Scientist, will be based.

One of the project's other main research areas is the farm-level evaluation of urea supergranules for rice. This material is considered to be particularly suitable for the intensive rice production areas in Java.

Another major area of the project will be research on the fate of nitrogen fertilizers applied to rice under Indonesian conditions. Experiments will be conducted to study the effects of nitrogen fertilizers on nitrogen fixation, the nitrogen-supplying capacity of the soil, and the fate of experimental fertilizers that are used for growing rice.

It is hoped that the research activities in Indonesia will provide technology for the more efficient use of fertilizer resources and energy and lead to increased production of lowland and upland crops. More efficient fertilizer materials and management practices will directly help the small farmers who have difficulty in adopting the presently recommended practices. ■

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Project Uses Free Nitrogen From Air

Farmers in developing countries may soon have a good substitute for expensive nitrogen fertilizer—the use of improved inoculants for legume crops.

A collaborative research project to evaluate fertilizers as carriers for bacteria (Rhizobia) was begun 2 years ago by Mississippi State University (MSU) and IFDC. Initial results are promising.

Mr. Shmuel Carmon, Special Project Engineer, currently is the IFDC coordinator of this project. Dr. H. L. Peterson, Associate Professor, and Dr. R. J. Kremer, Research Associate, are the MSU counterparts on the project.

Rhizobia constitute a family of bacteria that can take nitrogen from the air and make it available to legumes. The bacteria forms nodules on plant roots. The nodules are the site of a symbiotic

relationship between the plants and the bacteria: the plant supplies the bacteria with energy and minerals while the bacteria fix the gaseous nitrogen in the air and make it available to the plant in a usable form.

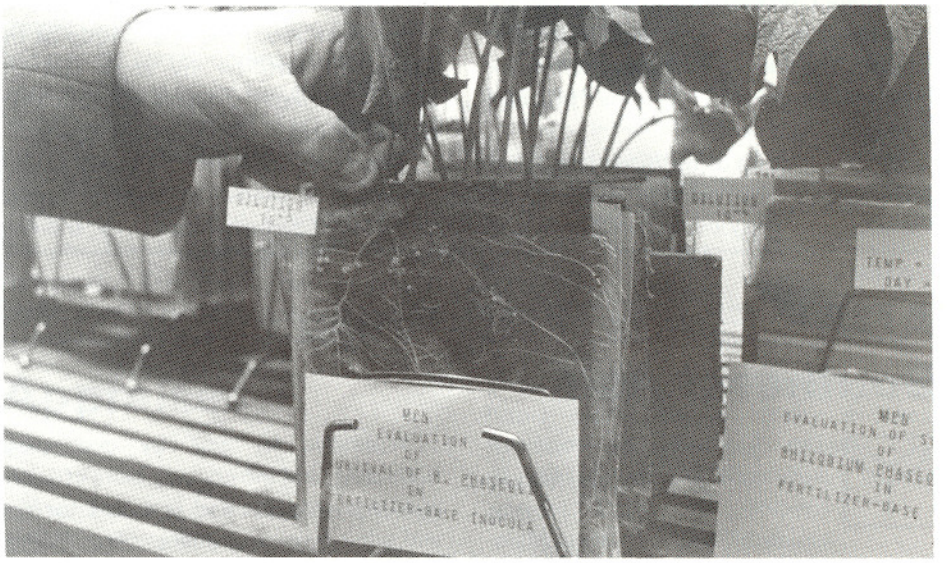
The IFDC/MSU team has been attacking the problem of how to apply the bacteria to a fertilizer carrier and still maintain a product that is not sensitive to a high storage temperature and humidity. The fertilizer must be a compatible carrier for Rhizobia and keep them alive.

The technique under evaluation in this cooperative project involves application and evaluation of oil-suspended freeze-dried Rhizobia onto various fertilizer carriers. IFDC is preparing the material and MSU is conducting the evaluation.

"An interesting phenomenon occurs when the bacteria are placed in the wet soil," Mr. Carmon said. "After 3-4 days, the water penetrates the oil, and the bacteria escape from the oil and are active again. It is not clear how this happens."

Two other methods of application are used. One method consists of freeze drying the bacteria to form a powder. This powder is then applied to wet seed. Once the bacteria are wet, they are viable (active) again and become very sensitive to heat and loss of moisture.

Another method of applying the bacteria is to blend the bacteria with clay to create a carrier in which the bacteria are alive. This form is also sensitive to heat and loss of moisture.



Evaluation of nodule-forming effectiveness of fertilizer coated with *Rhizobium phaseoli* under growth-chamber conditions.

The IFDC/MSU team has experimented with two forms of Rhizobia, one for beans and the other for peanuts. Greenhouse tests conducted by MSU and IFDC have shown promising results with regard to the nitrogen-fixing ability of Rhizobia.

Even though the project is in its initial stages, the results look promising. But there remain many questions to be answered.

"In stage B we need to determine how the bacteria escape from the oil when they come in contact with moist soil," Mr. Carmon said. "We need to find the best oil and the best conditions under which this concept can be used. We must learn more about the basic mechanisms behind the concept."

Legume inoculation with Rhizobia may be one of the practical solutions for supplying nitrogen for crop production in many of the developing countries of the tropics and subtropics. As part of an overall plant nutrition program, fertilizer containing Rhizobia may help to solve the protein deficiencies occurring in developing countries. ■

Headquarters—

Bangladesh Data Analysts Acquire New Capabilities

Six Bangladesh data analysts and statisticians, who have returned home after participating in a special IFDC data processing training program, are now able to process and analyze data collected on their country's use of fertilizer.

The participants took part in the training program at IFDC Headquarters, January 18 to March 12. They learned how to process and analyze data using the Statistical Analysis System (SAS) and the Statistical Package for the Social Sciences (SPSS) as an analytical base.

Their IFDC instructors were Dr. C. A. Baanante, Economist, Mr. P. R. Parker, Research Associate, and Ms. R. G. Hufstedler, Assistant Programmer/Data Processor. The program included classroom lectures, practical application using the computer, and field trips to Chattanooga to tour the Tennessee Valley Authority's Computer Center and Nashville to tour Vanderbilt University's computer facilities.

For the past 4 years, these data analysts have supervised the collection of data on Bangladesh's use of fertilizer. This work was part of a project undertaken jointly by IFDC and the Bangladesh Agricultural Research Council (BARC) at the request of the U.S. Agency for International Development (USAID) and the Bangladesh Agricultural Development Corporation (BADC). The purpose of the project was twofold. It was conducted to determine the degree to which the benefits of fertilizer use in Bangladesh are shared by different classes of farmers. It also sought to determine the extent to which fertilizer helps create employment in agriculture.

A detailed farm survey at 10 different locations, covering 1,053 farms, was carried out for the fall 1979 rice crop.

"The results of a preliminary report indicate that a larger percentage of small-farm landholders use fertilizer and that they use more fertilizer per unit of land than the larger farm operators," Dr. S. S. Sidhu, Economist and Project

Coordinator, said. "The benefits of fertilizer use are fairly well distributed among different farm classes, and fertilizer use increases employment of rural labor to a considerable degree."

In an interview at the program's conclusion, two of the participants, Ms. Selina Begum and Mr. Rezaul Hossain, told of their experiences.

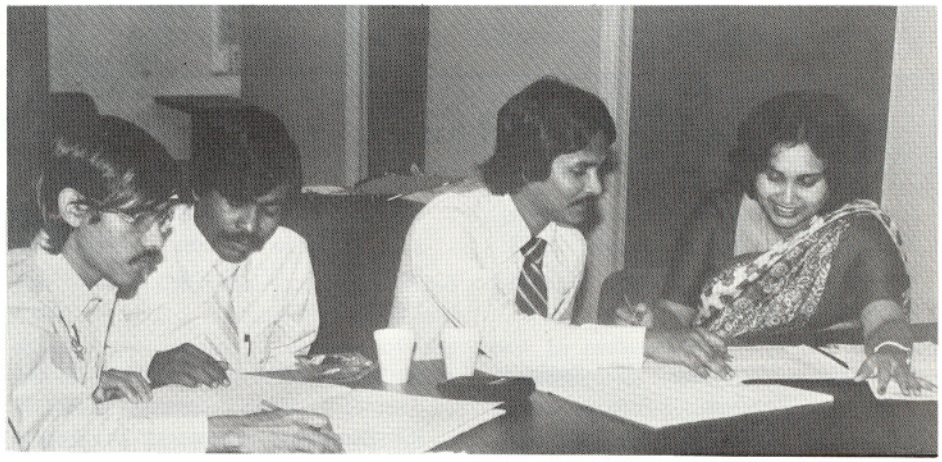
"When we return to Bangladesh, we will introduce methods of data processing that are new to our people," Ms. Begum said. "We can apply what we learned by using the computer at the University of Engineering and Technology at Dacca."

"We will now be able to process and analyze the data ourselves," Mr. Hossain said. "Previously this work had to be done at IFDC."

The knowledge that these participants acquired at IFDC will allow them to speed up the process of data analysis on the fertilizer equity study in their country.

"We can more quickly see the results of our study," Ms. Begum said. "As a result of this study, we hope that farmers will be motivated to use more fertilizer to produce more food. The farmers need to know more about the use of fertilizer and the recommended rates."

"When we turn in our report to the Government of Bangladesh (GOB), the GOB will have to decide what to do about the problems," Ms. Begum said. "As a result of the study, we have a practical knowledge of the farmers' problems. But the authorities will be responsible for motivating the farmers to solve these problems and use more fertilizer to produce more food."■



Data analysts from Bangladesh complete an assignment as part of a special data processing training program at IFDC Headquarters. Shown (from left) are Mr. A.T.M. Rezaul Ahsan, Mr. Md. Rezaul Hossain, Mr. Mohammad Ali, and Ms. Selina Begum.

India and Indonesia—

Dual-Centered Program Marks First for IFDC

Twenty-one managers of Asian fertilizer distribution systems participated in IFDC's first dual-centered overseas training program, April 11-24. In India the program was conducted in cosponsorship with the Fertiliser Association of India (FAI) and in cosponsorship with P.T. Pupuk Sriwidjaja (PUSRI) in Indonesia.

The distribution training program was designed for senior- and middle-level managers in governmental or private organizations. These managers are responsible for planning or operating systems for fertilizer distribution in the Asian region. The 21 participants included 6 from India, 6 from Indonesia, 5 from Malaysia, 1 from Burma, 1 from Pakistan, 1 from Sri Lanka, and an observer from the Economic and Social Commission for Asia and the Pacific (ESCAP), Bangkok, Thailand.

IFDC's technical program manager was Dr. W. E. Clayton, Transportation/Distribution Specialist. Other IFDC staff members presenting papers during the program were Mr. R. S. Giroti, Associate Training Coordinator; Mr. M. T. Frederick, Chemical Engineer, and Mr. J. J. Schultz, Engineering Coordinator. Various representatives of P.T. PUSRI, FAI, and Indian companies and organizations made presentations.

This program dealt with the theoretical and practical aspects of fertilizer packaging, physical distribution, and handling.

"The program was divided equally between classroom presentations and field trips," Dr. Clayton said. "A wide range of field trips provided the participants with an opportunity to see how distribution works in practice in different countries."

After arriving in Bombay, India, the participants toured three facilities during the first half of the program. These were Kandla port, the Indian Farmers Fertiliser Company (IFFCO) factory at Kandla, and the Bombay port.

"At Kandla port, one of the first ports in India to handle bulk fertilizer, the group toured a fully mechanized bulk-handling facility," Dr. Clayton said. "At IFFCO we observed a very efficient operation. We also saw manual unloading and bagging at the Bombay port."

The following week the participants traveled to "the garden city" of Singapore to visit the Jurong wharves. There they observed modern bulk facilities handling many types of products besides fertilizer. At Jurong they toured the port and the fertilizer bulk terminals operated by Southeast Asia Fertilizer Company (SEAFCO), and the International Minerals and Chemical Corporation (IMC).

Palembang, Indonesia, was the next setting for this truly international program. "At P.T. PUSRI in Palembang, the participants witnessed sophisticated systems using mechanical equipment for loading bagged and bulk fertilizer into ships," Dr. Clayton said. "Marketing all of the fertilizer produced at Palembang and by other producers in Indonesia, P.T. PUSRI is a very efficient company. The participants were extremely impressed."

Next on an island-hopping tour, the participants traveled to Surabaya, Java, where they saw the PUSRI port bagging

station that receives fertilizer from self-discharging bulk ships. In Malang, Java, the group saw an inland storage depot where fertilizer is received by train and truck.

"From Jakarta the group traveled to P.T. Pupuk Kujang to tour a relatively new fertilizer factory," Dr. Clayton said. "Kujang has a very good production record and has modern handling equipment in the storage area and for rail and road loading."

The general consensus was that the program achieved its objectives very well.

"The participants were highly appreciative of the opportunity to learn about systems employed outside their own countries," Dr. Clayton said. "They had a chance to observe these systems firsthand and to engage in technical exchange through discussions with faculty members and other participants."■

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Upcoming Training Programs

Regional Fertilizer Marketing Training Program for Africa, August 2-13; Ibadan, Nigeria; Mr. L. B. Williams, Program Manager.

Fertilizer Marketing Management Training Program; August 16-September 24; IFDC Headquarters; Dr. R. T. Smith, Program Manager.

Special Program on Marine Insurance and Cargo Loss Adjusting; September 27-October 1; IFDC Headquarters.

Fertilizer Efficiency Research in the Tropics Training Program; October 3-22; Zamorano, Honduras; Dr. Adolfo Martinez, Program Manager.

Maintenance and Production Management Training for Fertilizer Producers; October 11-29; IFDC Headquarters; Mr. J. J. Schultz, Program Manager.

Regional Fertilizer Marketing Training Program for Asia; November 6-19; Jakarta, Indonesia; Dr. K. J. Byrnes, Program Manager.

Contact IFDC's Training and Manpower Development Coordinator for more information on these programs.

IFDC Report

Published Quarterly by the
International Fertilizer Development Center

IFDC is a public, nonprofit organization dedicated to increasing food production through the development of new and improved fertilizers and fertilizer know-how for developing countries.

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