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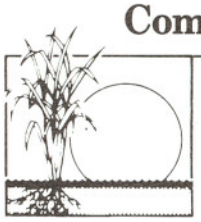
Report

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

Headquarters—

Computer Simulation Models Help Solve Crop Production Puzzle



Research on computer simulation models, being conducted by a large informal network of multidisciplinary scientists from throughout the world, can help policymakers and farmers in developing countries minimize their risks and increase crop yields.

Scientists at the International Fertilizer Development Center (IFDC), in collaboration with others from Michigan State University, the U.S. Department of Agriculture, International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT) and many other research organizations, are at the forefront of developing crop models suitable for use in developing-country agriculture. These comprehensive models, called Crop Evaluation Through Resource and Environment Synthesis (CERES) models, can predict the impacts of such factors as daily weather, soil properties, crop characteristics, and management practices on agricultural production. They can be used to extrapolate research findings from one region to another and, thus, mobilize a vast amount of experimental data.

In this issue...

Research on computer simulation models, being conducted by a large informal network of multidisciplinary scientists from throughout the world, can help policymakers and farmers in developing countries minimize their risks and increase crop yields.

Crop models have potential for studying various production problems such as land suitability, fertilizer and pest management, irrigation, and yield forecasting. Thus, these models allow the testing of assumptions about the value of economic inputs like water, fertilizers, and pesticides.

In other words, computer simulation models can help take some of the guesswork out of farming. For example, when farmers apply fertilizer they must decide how much to apply, and to make this decision they need some knowledge of the likely response. Traditionally, information needed to predict a specific response is obtained from field experiments that test several increasing dressings of each nutrient to show how the fertilizer affects crop yields. This response information then forms the basis for deciding the correct amount to apply. This response, however, can vary greatly from year to year due to the uncertainties of weather. If this variation can be quantified, fertilizer decisions can be optimized even given the uncertainties of response that prevail.

"An appropriately designed operational model," says Dr. Doug Godwin, IFDC Agronomist/Systems Modeller, "could be used in the following applications: risk analysis for strategic planning, within-year management decisions, large area yield forecasting, policy analysis, agroclimatic zoning, identification of fertilizer-responsive area, and definition of research needs."

Dr. Joe Ritchie, Distinguished Professor of Crop and Soil Science, Michigan State University, and Dr. Susan Otter-Nacke, formerly with the Technical University of Munich, F. R. Germany, have defined the main features needed for user- oriented models. They should be designed to use only a minimum of inputs. The input data should be readily available, particularly from developing-country institutions. They should reliably account for known phenomena and accurately simulate field research findings. The program

Crop models have potential for studying various production problems such as land suitability, fertilizer and pest management, irrigation, and yield forecasting.

should be written and structured in such a way that it can be readily understood by any user.

"In order to accurately simulate crop growth, development, and yield, the model takes into account several processes," Godwin says. "These include phenological development, especially as it is affected by genetics and weather; crop growth and yield; soil water balance and water use by the crop; soil nitrogen transformations; and nitrogen uptake and use by the crop."

IFDC staff members have participated in the development of the fertilizer components of crop models for maize, wheat, sorghum, and rice; they are also involved in the development of models for barley and millet. These models are developed in collaboration with national scientists in several countries including Colombia, India, Thailand, Uruguay, and Venezuela.

"Unfortunately, models have limitations as they do not include all factors that occur in reality," says Dr. Upendra Singh, IFDC Systems Modeller/Soil Scientist. "Therefore, these models must be tested at various sites to account for site-specificity and other shortcomings." The models have been tested in many diverse environments, including Australia, Canada, India, Indonesia, Mexico, Netherlands, Philippines, Syria, Thailand, United Kingdom, and Kansas and Hawaii (U.S.A.).

Crop models complement and make more effective the costly and time-consuming field experimentation traditionally used in agricultural research. By using these models scientists can generate information to help government planners, extension agents, and farmers make desirable choices.■

Photo by Charles Butler

This IFDC team builds computer simulation models to help solve the crop production puzzle. These models can help developing-country policymakers and farmers minimize their risks and increase crop yields. From left, the team members are: (standing) Dr. Doug Godwin, Agronomist/Systems Modeller; Dr. C. A. Baanante, Economist; (seated) Carla Humphries, Computer Operator/Programmer; and Dr. Upendra Singh, Systems Modeller/Soil Scientist.

Headquarters—

TAC Reviews IFDC's Past, Present, and Future Activities and Achievements

A 6-member team representing the Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR) recently reviewed IFDC's programs and priorities.

During its May 1988 meeting, the CGIAR emphasized the importance of the international agricultural research centers' (IARCs) recognition of developing technology that will not only sustain agricultural growth over the long term but also preserve the natural resource base.

During June 5-9, the following members of a TAC mission visited IFDC: Professor Raoul Dudal, Chairman of the Center for Irrigation Engineering, Katholieke Universiteit Leuven, Belgium; Dr. Ken-Ichi Hayashi, Director General, National Institute of Agrobiological Resources, Japan; Dr. E. T. York, Chancellor Emeritus, University of Florida; Dr. Luis Marzo, Managing Director, ESPINDESA, Spain; Dr. Pedro A. Sanchez, Coordinator of the International Tropical Soils Program, North Carolina State University; and Dr. Michael Collinson, Scientific Advisor, CGIAR Secretariat. Dr. Robert Wagner, former President of the Potash and Phosphate Institute and currently a member of the IFDC Board, participated in the meeting as an observer.

Since IFDC's creation in 1974 the Center has been considered for inclusion in the CGIAR. In 1979 TAC first reviewed IFDC for possible induction into the CGIAR System. In late 1979 the CGIAR decided to defer its decision but invited IFDC to become an associate member—a status held by the Center since that time. During its May 1988 meeting, the CGIAR emphasized the importance of the international agricultural research centers' (IARCs) recognition of developing technology that will not only sustain agricultural growth over the long term but also preserve the natural resource base. This recognition included the possible expansion of the CGIAR system to incorporate some of the activities being undertaken by

the non-CGIAR centers, including the associate members. The TAC was given the responsibility of assessing ten of these institutions, including IFDC.

During the TAC Review, various IFDC staff members made presentations that covered the following topics: the background of the Center; its programs; research results and impact; governance, management, and methods of operation; and a profile of resources.

After reviewing the mission reports, TAC may proceed to the next stage, whereby those centers whose activities might be eligible for CGIAR support would be subject to a more detailed assessment in the form of external program and management reviews. ■

Photo by Charles Butler

TAC team members examine some of IFDC's publications. From left, Dr. Luis Marzo, Dr. Ken-Ichi Hayashi, Dr. Robert Wagner (IFDC Board Member), Dr. Michael Collinson, and Dr. E. T. York.

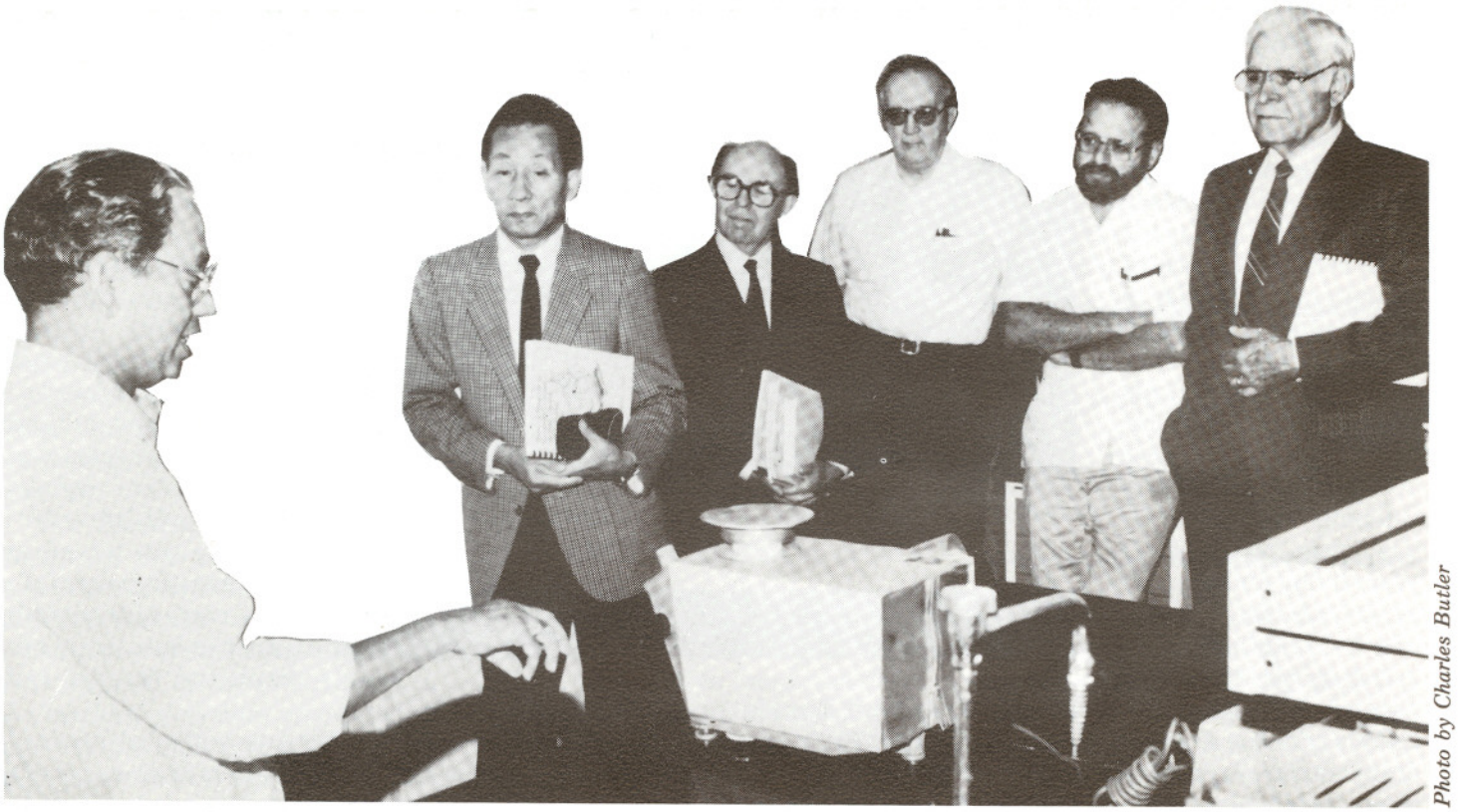


Photo by Charles Butler

Members of the TAC Mission listen as Dr. R. G. Menon (left), IFDC Soil Scientist, explains the P_i soil phosphorus test. They are: Dr. Ken-Ichi Hayashi, Professor Raoul Dudal, (Dr. Donald L. McCune, IFDC Managing Director), and Dr. Pedro A. Sanchez. Dr. Robert Wagner, IFDC Board member (far right).

Headquarters—

President of Winrock International Addresses IFDC Century Club

"Sustainable Agricultural Development: The Challenge of the 1990s" was the speaker's subject for the eleventh annual Century Club banquet. Robert Havener, President of Winrock International Institute for Agricultural Development, headquartered in Morrilton, Arkansas, made this presentation.

Winrock International is a private, nonprofit institution founded to help alleviate human hunger and poverty through agricultural development. It was created in 1985 with the merger of the Agricultural Development Council, the International Agricultural Development Service, and the Winrock International Livestock Research and Training Center. These three organizations shared a common heritage stemming from the philanthropic traditions of the Rockefeller family. The three original organizations had more than 50 years of combined agricultural development experience.

Winrock Photo

Robert Havener, President
Winrock International

As head of Winrock International, Havener is responsible for planning, organizing, and directing an organization that has research and development projects and over 200 staff located in 20 developing countries. He has spent the past 25 years living and working in Asia, Latin America, and the Middle East.

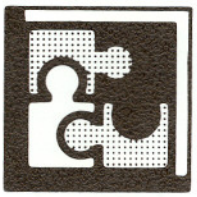
During the era of the Green Revolution, Havener managed the Ford Foundation's agricultural grants to Pakistan. In the '70s he was director of the Arid Land Agricultural Development Program, which focused on rainfed farming systems in the 22 countries of the Middle East. Prior to being selected to head Winrock International in 1985, Havener served for about 8 years as Director General of the International Center for Maize and Wheat Improvement (CIMMYT), headquartered in Mexico.

In Havener's address on "Sustainable Agricultural Development: The Challenge of the 1990s," he pointed out that in just a little over one decade we must "make room for, employ, and produce food for an additional 1.2 billion people. Globally, that amounts to adding a new China to our community of nations. In Asia, where soon 70% of the world's people will live, this will mean creating a new India or an additional 750 million people in Asia, where land resources are already taxed to the limits."

Havener predicted that, based on current Asian crop yields, the additional Asian population will require an extra 170 million ha of cultivated land, 45 million ha of which will need to be irrigated; an additional 150 million tons of cereal production; 6½ million tons of additional fertilizer, etc.

Even though the Green Revolution produced spectacular results, Havener alluded to the fact that particularly in Asia but also in Latin America and some parts of Africa, "our engine of agricultural growth is running out of steam. The genetic potential of the new high-yielding varieties has largely been exploited in the well-endowed areas."

Havener pointed out that the area under cultivation in China and India has remained stable or declined over the past 5 years. He believes that greater production from more fertile lands must, of necessity, play a vital and expanding role, and that requires increased as well as maintained soil fertility.■



Zambia—

Improved Marketing System Prescribed for Fertilizer Sector

Two IFDC staff members recently participated in a study that recommended significant changes be made in Zambia's fertilizer marketing system to cure some of the ills of that country's fertilizer sector.

"The Zambian Government has recognized that the present marketing system is not adequately serving Zambia's farmers."

At the request of the Government of Zambia and with support from the U.S. Agency for International Development, a study team, comprised of L. B. Williams, IFDC Liaison Scientist for East and Southeast Africa; John H. Allgood, IFDC Market Analyst; F. Chenoweth, Production and Marketing Advisor, Planning Division, Zambian Ministry of Agriculture and Cooperatives; A. Mwanaumo, Principal Economist, Planning Division, Zambian Ministry of Agriculture and Cooperatives; V.R.N. Chinene, Dean, School of Agriculture, University of Zambia; and J. K. McPhillips, Soils and Crops Advisory Officer, Mount Makulu Research Station, Ministry of Agriculture and Cooperatives, examined Zambia's present fertilizer marketing system during March 18-May 10.

"The Zambian Government has recognized that the present marketing system is not adequately serving Zambia's farmers," says Allgood.

The study team estimated that in 1988 physical losses of fertilizers in the marketing system amounted to about K70.0 million (US $7 million), and across-the-border sales to the neighboring countries amounted to 20,000 product tons valued at about K76.0 million (US $7.6 million).

But there is a solution to these problems. As outlined by Williams, "increased food production and farmer income and reduced pressure on the national budget can be achieved through the implementation of a more efficient fertilizer marketing system. The recommended fertilizer marketing system will incorporate improvements in the areas of organizational structure, retail marketing, competition, timely availability, pricing, appropriate fertilizer use, and institutional linkages."

Central to the establishment of food self-sufficiency in Zambia is the efficient use of adequate amounts of appropriate fertilizers. Chemical fertilizers will always be critical to the performance of the agricultural sector. Recent research findings also confirm that current high-yield levels of crops cannot be maintained without the adaptation of a regular liming program to reduce soil acidity and supply calcium and magnesium. Zambia is fortunate in having several deposits of agricultural lime, and the study team recommended that these deposits be developed as quickly as possible. Zambia has other indigenous agromineral resources, such as phosphate rock, that can be used to reduce its dependence on imported fertilizer products.

"Fertilizer consumption in recent years has been declining due to the inadequacy of supplies," says Allgood. "It is estimated that Zambia is now using only about 200,000 product tons of fertilizers. If fertilizer could be supplied on a timely basis, use would likely increase by at least 8% per year."

The study team recommended that Nitrogen Chemicals of Zambia, Ltd., take a more active role in fertilizer marketing, particularly regarding demand analysis, procurement, and distribution to the provincial level. Emphasis would also be placed on encouraging private-sector involvement in fertilizer marketing. Under the improved marketing system, increased competition for the farmers' business would be created with the establishment of more retail outlets. According to Williams, the retailer who offers the best service and/or lowest price would receive more business from the farmers.

As for a pricing policy, the study team suggests that the current policy be replaced by one that accurately reflects the cost of doing business, provides an adequate financial incentive to encourage others to engage in fertilizer marketing, and encourages efficiency of operations.

To allow for phasing out of the subsidy over a 5-year period, the team recommended that the pricing policy be modified and the credit system be fortified to meet the increased financial needs of farmers.

The potential benefits of the improved marketing system are very substantial. "It is currently estimated that the system has the potential to save Zambia up to K490 million (US $49 million) by the third year of operation," Allgood says. "Some of the savings that are possible include foreign exchange—K130 million (US $13 million), yield loss—K216 million (US $21.6 million), and leakage—K76 million (US $7.6 million).

Central to the establishment of food self-sufficiency in Zambia is the efficient use of adequate amounts of appropriate fertilizers.

Williams adds a final note. "The recommended marketing plan can only be successful if it is fully endorsed by the Zambian Government. Zambia needs this marketing system now, but the Government must ensure that foreign exchange is available on a timely basis for fertilizer procurement on the international market." ■

Training Activities

Three Training Programs Utilize Microcomputers

Headquarters—

Computer Simulation for Crop Growth and Fertilizer Responses

Learning how a comprehensive simulation model of crop growth and nutrient dynamics is constructed and how this can be applied to real world problems were the goals of a recent training program held at IFDC Headquarters. This new training program, conducted during May 15-26, attracted thirteen participants from 13 countries. They were from Brazil, Colombia, Fiji, Guyana, Indonesia, Jamaica, Kenya, Kuwait, Malawi, Malaysia, Thailand, Trinidad-Tobago, and the United States.

Experts from IFDC, the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT), and other international and national agricultural research centers formed the program faculty.

The program focused on a description of the CERES crop simulation models; the application of the simulation models to fertilizer, cropping, and environmental problems; techniques for database management; and obtaining data for use in simulation modelling studies. It described the practical approaches to simulating the effects of soil, climatic, and management factors and their interaction with the nutrient needs of crops. In addition, this training program showed how the processes of crop uptake of nutrients and response to fertilizer can be simulated. Hands-on, practical sessions on microcomputers demonstrated the application of simulation models to cropping systems in various regions of the world.

(Also see article on page 1 concerning IFDC's progress in its crop modelling program.)■

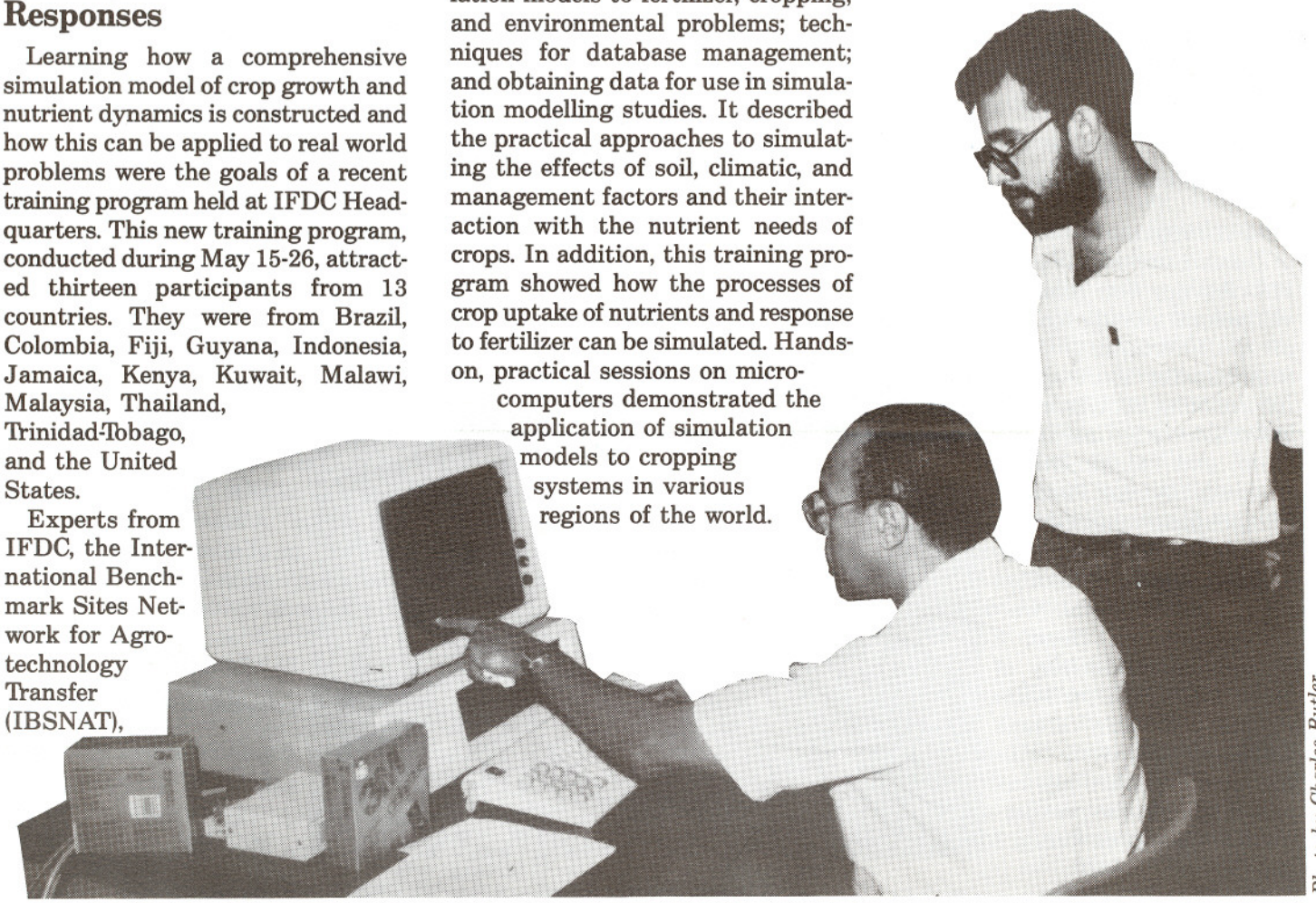


Photo by Charles Butler

Dr. Upendra Singh (right), IFDC Systems Modeller/Soil Scientist, looks on as a participant in the Training Program on Computer Simulation for Crop Growth and Fertilizer Responses completes an exercise on a microcomputer.

Togo—

Statistical and Economic Analysis of Fertilizer Experimental Data

Offered in French and English, this program emphasized practical applications of statistical and economic analysis. During April 17-28 this program was conducted at the IFDC-Africa Center in Lomé, Togo. There were 22 participants from 13 countries—Botswana, Egypt, Gambia, Ghana, Kenya, Madagascar, Malawi, Niger, Nigeria, Rwanda, Senegal, Togo, and Barbados.

The program covered the basic aspects related to experimental statistics gathered on experimental stations and on-farm trials. It featured lectures, discussions, exercises, and computer workshops to introduce participants to the use of computers and to solve practical problems when dealing with fertilizer data.

The participating agronomists were exposed to updated developments and techniques in design and

Headquarters—

Data Collection, Analysis, and Projections for Fertilizer Sector Studies

Properly collected and analyzed data and projections were the focal point of this recent training program. Nineteen participants from 10 countries (Egypt, India, Indonesia, Madagascar, Mali, Rwanda, Venezuela, Uganda, Yemen Arab Republic, and Zambia) attended the program conducted at Headquarters; Nashville, Tennessee; and Washington, D.C., during April 17-May 5.

The program objectives focused on: data collection including sources and sampling methods; data analysis techniques including use of computers and analytical methods; and making fertilizer demand projections including advantages and disadvantages of alternative methods.

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To gain a practical viewpoint, field trips were arranged to various agencies and organizations involved in fertilizer sector data collection, analysis, and projections. ■

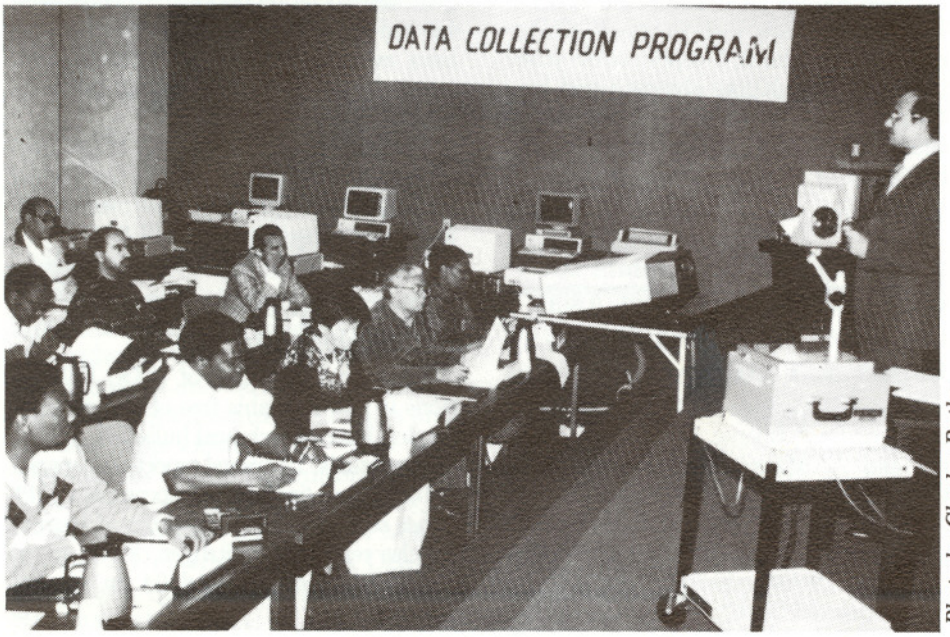

Photo by Charles Butler

Dr. Balu L. Bumb, IFDC Economist, addresses the participants in the Data Collection Training Program.

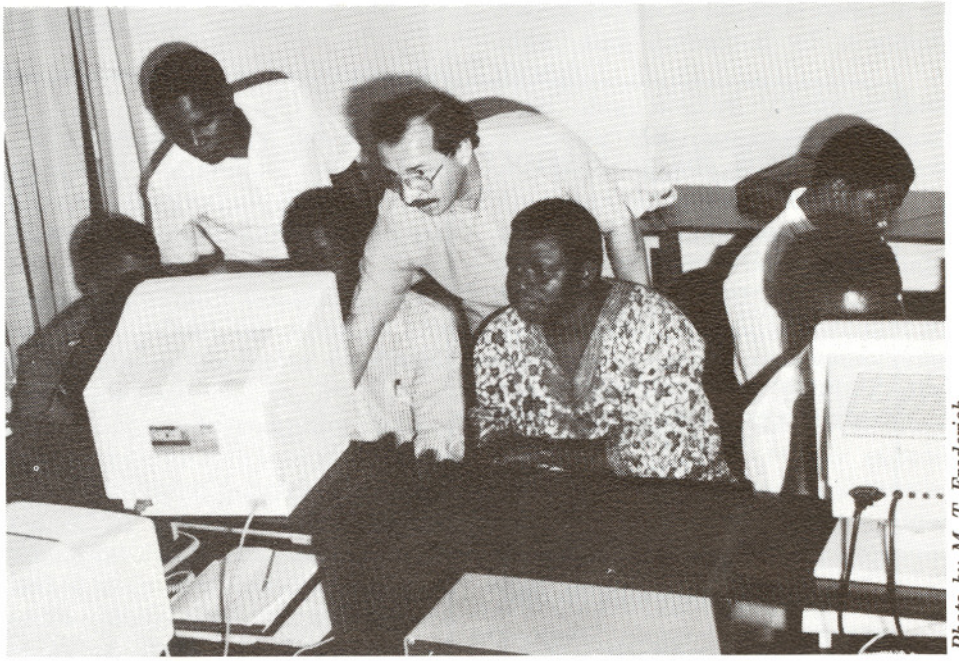

Photo by M. T. Frederick

Dr. Adolfo Martinez (center), IFDC Agricultural Economist, assists the participants in the Training Program on Statistical and Economic Analysis of Fertilizer Experimental Data.

analysis of fertilizer research experiments, on-farm trials, and evaluation of residual effects. The agronomists applied techniques of economic analysis on experimental results that allowed them to integrate concepts of agronomic and economic efficiency of fertilizer products and nutrient evaluation.

The use of computers provided the participants with basic knowledge for their future activities concerning preparation of formats for experimental data analysis, generation of data for fertilizer evaluation, data management techniques, the use of statistical packages for data analysis, data interpretation of results from computer outputs, graphic analysis, and the use of computers and hand calculators as tools to improve research activities. ■

Recent IFDC Publications

The Benefits of Fertilizer Use in Developing Countries

This addition to the IFDC Paper Series was authored by Carlos. A. Baanante, Economist; Balu L. Bumb, Economist, and Thomas P. Thompson, Rural Sociologist.

In this paper, the economic and social benefits of fertilizer use for economic development and food security in the developing countries are discussed and summarized.

In ordering this paper, please address your inquiries to the IFDC Purchasing Department and request IFDC Paper Series, P-8. The price of this publication is US $4.00 for U.S. addresses and US $7.50 for overseas addresses.

Global Fertilizer Perspective, 1960-95: The Dynamics of Growth and Structural Change

This study, which provides an analysis of growth and structural change in the fertilizer sector at the global and regional levels, was prepared by Balu L. Bumb, Economist. This comprehensive publication focuses on how economic, agroecological, technological and institutional factors and the policy environment have influenced global and regional fertilizer use and production during the last quarter of a century and how these factors may affect growth in fertilizer use and production during the 1990s. In addition to analyzing growth and structural changes in the fertilizer sector, the study also provides demand projections, supply projections, and supply/demand balances for nitrogen, phosphate, and potash in the 1990s.

Please address your orders for this IFDC Technical Bulletin, T-34, to the IFDC Purchasing Department. The price of the study is US $100 (including shipping and handling); the executive brief (T-35) may be purchased for US $10 (including shipping and handling).

Agroecological Constraints to Crop Production in West Asia and North Africa and Their Impact on Fertilizer Use

This IFDC Paper Series title was authored by P. Cooper, M. Jones, H. Harris, and A. Matar of the International Center for Agricultural Research in the Dry Areas (ICARDA). The paper (IFDC-P-9) was presented at the Workshop on Fertilizer Sector Development and Agricultural Production in Selected Countries of the Mediterranean, Middle East, and North Africa, which was held during 1988 at IFDC Headquarters.

This publication describes some of the major characteristics of the region's climate and soils and indicates how these two factors interact to determine crop yield potentials. It also provides an overview of agriculture in the region and highlights the general association between expected rainfall and the types of farming practices that have evolved. The impact of important agroecological factors on fertilizer responses is described.

To order IFDC P-9 from the IFDC Purchasing Department, buyers in the United States will need to include a payment of US $4.00 and those overseas, US $7.50.

1989 Edition of the IFDC Publications List

An up-to-date listing of IFDC Publications is now available free of charge. This catalog lists 34 technical bulletins, 7 reference manuals, 12 annual reports, 11 special publications (including proceedings), 11 paper series titles, 127 reprints of journal articles relating to nitrogen, 81 on phosphate, 13 on sulfur, and 94 on general topics.

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