

FINAL PROJECT REPORT  
POSTHARVEST GRAINS SYSTEMS R&D

Cooperative Agreement DAN-4144-A-00-5095-00  
Cooperative Agreement DAN-4144-A-00-1020-00  
Basic Ordering Agreement DAN-4144-B-00-6002-00

FY 1986 - FY 1993



**KANSAS  
STATE  
UNIVERSITY**

**FOOD & FEED GRAINS INSTITUTE  
MANHATTAN, KANSAS 66506**

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## SECTION I

### POSTHARVEST GRAIN SYSTEMS R&D PROJECT

The Postharvest Grain Systems R&D Project was initiated October 1, 1985, under the Agency for International Development (AID), Bureau for Research and Development, Agriculture (R&D/AGR), Cooperative Agreement DAN-4144-A-00-5095-00. In 1991, the project was extended under Cooperative Agreement DAN-4144-A-00-1020-00 with a completion date of September 29, 1993. A companion agreement to the cooperative agreements, the Basic Ordering Agreement (BOA) DAN-4144-B-00-6002-00, provided a contractual mechanism for AID Missions to procure the service of the Food and Feed Grains Institute (FFGI) staff for technical assistance and training.

#### Project Description

The goal of Postharvest Grain Systems Project activities was to increase the availability of cereal and legume grain supplies in developing countries through the application of (1) improved technical, marketing, and management procedures which are cost-effective, and (2) policy initiatives which increase efficiency and productivity.

The general areas of activity were: (1) conduct applied research activities related to postharvest grain systems and agribusiness in developing countries; (2) provide opportunities for graduate students from developing countries to participate in such research activities; (3) provide technical advice and assistance on postharvest grain systems and agribusiness development; (4) publish, collect, and distribute materials on technical, marketing, and management processes in postharvest grain systems and related agribusiness operations; (5) provide academic and short-term training at Kansas State University (KSU) and overseas; and (6) continue existing (and create new) relationships with developing-country and other national and international organizations involved in postharvest grain systems.

#### Expected Outputs

The expected outputs of activities under the core project and the magnitude of these outputs over the life of the project was defined as 18 research projects in grain storage, handling, conditioning, and processing; 11 research projects in marketing, food security programs, and agribusiness development; 10 to 15 LDC graduate students performing research; 37 research findings disseminated; five demonstrations of research results; 40% increase in the capacity of the Postharvest Documentation System; eight Grain Storage and Marketing Short Courses; and 10-15 LDC graduate students receiving training at KSU.

The expected outputs of activities under the buy-in portion of the project and the magnitude of these outputs over the life of the project was defined as 11 research projects in collaboration with LDC research agencies; five training manuals developed and disseminated; 50 short- and long-term assistance

activities<sup>1</sup>; 10 in-country and KSU short courses, workshops, and seminars; five short-term in-country and/or KSU training of trainers courses; two basic training courses using slide-tape series and/or audiovisual tapes for use by participant trainers under the training of trainers courses; two short-term training courses for decision makers; and two on-the-job training at operational levels; continue active membership in the Group for Assistance on Systems Relation to Grain After Harvest (GASGA); establish one new linkage with international and regional institutions; and establish one new linkage with LDC research or training institutions.

Further detail of expected outputs and magnitude of outputs is set forth in Annex I.

### FFGI Staff

The FFGI staff who participated in the project are as follows:

Ulysses Acasio, Storage and Processing Engineer  
Roe Borsdorf, Agricultural Economist/FFGI Coordinator  
Maurice Baalman, Research Assistant  
Merla Brookman, Keyboard Operator II  
Rosemary Burroughs, Mycologist  
Katie Carnahan, Keyboard Operator II  
Do Sup Chung, Storage and Processing Engineer  
Charles Deyoe, Director  
Karen Dungey, Office Specialist  
Judy Exdell, PHDS Research Assistant  
Rolando Flores, Agricultural Engineer  
Kathy Foster, Linguist  
Ekramul Haque, Storage and Processing Engineer  
Cornelius Hugo, Agricultural Economist  
Khalid Kebatti, Linguist  
J. D. Lea, Agricultural Economist  
Richard Maxon, Agricultural Economist  
Mary Ann Muth, Keyboard Operator II  
Kenneth Neils, Agricultural Economist  
Barbara Petersen, Keyboard Operator II  
John Pedersen, Grain Storage Specialist  
Richard Phillips, Agricultural Economist  
Wade Ramsey, Training Coordinator  
Carl Reed, Grain Storage Specialist  
Donna Schenck-Hamlin, PHDS Coordinator  
Harlan Shuyler, Entomologist  
Dionisia Trigo-Stockli, Mycologist  
Valerie Wright, Entomologist

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<sup>1</sup> Technical assistance, research, and information buyins are defined in the report as either formal or informal. Formal buyins are those which are contractual agreements through BOA. Informal buyins are contractual agreements directly between the sponsoring organizations and FFGI.

## SECTION II

### RESEARCH ACTIVITIES

Research activities were carried out in two basic areas: grain storage, handling, conditioning, and processing; and grain marketing and agribusiness development.

#### Research Projects

Forty-three research projects were initiated. Of the research project initiated, 37 were completed. The following is a description of the research projects with a detail of published results.

#### **Bibliography of plant materials for stored-product insect control**

Collect reports and reviews describing insecticidal, repellent, and anti-feeding activities of plant materials for stored-product insect control through the Postharvest Documentation Service (PHDS) database searches and compile into an annotated bibliography. Review current knowledge and research in this area and make recommendations for future research. Results published in FFGI Research Report No. 29.

#### **Update of annotated bibliography on Prostephanus truncatus, the larger grain borer**

An annotated bibliography was published in 1983, which included references up to that time. Develop an update to provide a source of current information on all aspects of this storage pest for scientists working towards control. Results published in FFGI Research Report No. 24.

#### **Early detection of insect pests in stored grain and estimation of stored-product insect population size**

Develop, improve, and standardize methods of detecting insects at low population densities in bulk and bagged grain. Through the use of detection devices, develop a method to determine insect population densities, and use density level in management decision-making for insect control. Results published in the Journal of Kansas Entomology Society, Journal of Economic Entomology, and a presented paper.

#### **Design, construction, and testing of natural convection grain dryer**

Study the performance of natural convection dryers built in Peru in order to determine their optimal operational conditions and methods. Conduct tests on rice, corn, cocoa, and coffee at various initial and final moistures, grain depths, and fuel rates. Results presented in FFGI Research Report No. 33.

### **Underground storage of grain**

Determine the factors influencing the atmospheric composition in underground storage pits, and observe the effects on insect populations and the rate of deterioration of the grain. Results published in a Ph.D. dissertation.

### **Naturally-occurring pesticides**

Obtain naturally-occurring plant materials from Pakistan for evaluation. Determine their effectiveness in controlling insects and other pests in stored grain, and determine the nature and mode of action of the substance when possible.

### **Naturally-occurring pesticides, Phase 2**

Develop a modified free-choice chamber for evaluating repellent action of naturally-occurring plant materials and refine the methodology for evaluation.

### **Naturally-occurring pesticides, Phase 3**

Conduct an in-depth study of Artemesia ludoviciana (white sagebrush) as a source of stored-grain protection. Results published in a Ph.D. Dissertation and in a presented paper.

### **Naturally-occurring pesticides, Phase 4, Diatomaceous Earth**

Evaluate the effectiveness of a Diatomaceous Earth product formulation for control of stored-product insects under laboratory conditions and its effect on grain quality parameters.

### **Evaluation and comparison of simple methods for detecting internal insect infestation in grain**

Evaluate and compare current simple methods for detecting internal insect infestation in various grains and develop modified improved methods.

### **Effects of fine material in grain on drying and airflow**

Determine the effect of fine material and broken kernels, moisture content, and packing factors in corn on airflow resistance. Develop a mathematical model that will describe the effects of fine material content on airflow resistance through a bed of corn. Develop a mathematical model that will predict the effects of moisture content and packing factor on airflow resistance through a bed of corn. Results published as report of KSU Agricultural Experiment Station, in an M.S. Thesis, and in Transactions of the American Society of Agricultural Engineers (ASAE).

### **Field infestation of grains by stored-product insects**

Conduct field and laboratory studies to determine whether selected stored-product insects are capable of infesting wheat in the field during head development of while stored unthreshed. Research results published in an M.S. Thesis.

### **Three-roller cereal mill and milling using triangular roll configuration**

Design, construct, and test a new type of roller mill for processing grain. The objective is to test the feasibility of reducing the initial investment as well as operating and maintenance costs of milling. Results presented in Feed Management, Cereal Foods World, Feed International, Transactions of ASAE, in a Ph.D. Dissertation, and two presented papers.

### **The saltation velocity of wheat materials in horizontal flow**

Find the saltation velocity of wheat, flour, and other wheat materials; correlate experimental data with existing equations that are available in fields unrelated to grain processing; and develop prediction equations for saltation velocity of wheat materials. Results published in an M.S. Thesis.

### **Distribution of herbicide in corn wet milling fractions from contaminated water sources**

Determine whether atrazine in water used in corn wet milling is concentrated in any of the various products of the milling process.

### **Wet-milling of wheat**

Design a simple wet-processing facility for separating starch and gluten from wheat. Results published in a report of the Department of Agricultural Engineering.

### **Handling of soybean meal**

Determine various physical properties of soybean meal affecting the mean flowability and develop a method for improving flowability from a bin. Results published in Cereal Chemistry, Journal of Applied Engineering in Agriculture, Transactions of ASAE, Proceeding of Soybean Utilization Conference, and in a presented paper.

### **Effect of rice storage conditions on milling**

Determine the effect of various short-term storage conditions and related factors on the quality of milled rice. Results published in an M.S. Thesis and in Journal of Cereal Chemistry.

### **Analysis of grain particle separation**

Determine physical and aerodynamic properties of various fractions of grain samples and select proper screen sizes and airflow settings for separating various fractions of grains. Results published in Journal of Cereal Chemistry, Transactions of ASAE, in a Ph.D. Dissertation, and as an ASAE paper.

### **Varietal resistance in Peruvian maize cultivars to stored-grain weevils**

Search for resistance in Peruvian maize genotypes to the maize weevil by studying physical characteristics of kernels, antibiotic factors, olfactory and gustatory

responses of weevils. Results published in a Ph.D. Dissertation, Annual Entomological Society of America, Journal of Kansas Entomology Society, Turrialba, and Annual of Entomological Society of America.

#### **Factors affecting the storage of grain sorghum**

Determine the potential for stored-grain insect loss prevention in sorghum storage, and assess the effects of head type, storage method, and physical and chemical kernel characteristics on insect development and damage caused by stored-product insects. Results published in a Ph.D. Dissertation, Journal of the Kansas Entomological Society, Journal of Stored Product Research, Journal of Economic Entomology, and Insect Science Application.

#### **Comparison of losses in three types of storage in Honduras**

Compare grain losses in three types of village environments using three types of treatment strategies, and compare the village treatments with controlled, simulated traditional storage on the basis of loss reduction. Results published in two Ph.D. Dissertations and FFGI Research Report No. 31.

#### **Evaluation of methoprene as a stored-grain protectant**

Evaluate the effectiveness of methoprene, a synthetic juvenile hormone, as a grain protectant for controlling stored-grain insects in wheat. Results published in a Ph.D. Dissertation.

#### **Aeration of rough rice under humid tropical conditions**

Study the use of aeration under humid tropical air conditions to assess the variables of air temperature, grain temperature, relative humidity, moisture content, and airflow rate. Establish proper aeration operating conditions for humid tropical regions. Results published in Journal of Cereal Chemistry.

#### **Grain storage facility design: concrete vs. steel**

Examine the advantages and disadvantages of concrete and steel grain storage facilities for tropical regions, design several types of storage facilities, and develop a computer model for optimum grain storage facility design. Results published in an M.S. Thesis, FFGI Research Report No. 32, and in two presented papers.

#### **Moisture sorption and quality loss in bagged grain stored under tropical conditions**

Study rates of moisture sorption in bagged grain under simulated tropical conditions and measure deterioration in grain quality during storage. Results published in FFGI Research Report No. 34, Transactions of ASAE, and an ASAE paper.

### **Effect of fines on static pressure during natural air drying of corn**

Determine static pressure changes with respect to the levels of broken and fines and airflow rate during yellow corn drying by natural air. Examine the drying rate changes with respect to the levels of broken and fines, packing factors, and airflow rate during yellow corn drying by natural air. Research results published in an M.S. Thesis, and two articles in Journal of Cereal Chemistry.

### **Computer simulation model for grain processing systems**

Develop a general computer simulation model for a grain storage facility. This model will allow the testing of different alternatives in order to optimize the system operation from a technical and economic point of view. Results presented as papers at the meetings of the American Association of Cereal Chemists, American Society of Agricultural Engineers, and Latin American Chapter of Association of Operative Millers.

### **Effectiveness of chlorpyrifos-methyl as a grain protectant under varied conditions of storage**

Determine the effect of high treatment temperatures on the efficacy of chlorpyrifos-methyl as a grain protectant against Rhizopertha dominica and Tribolium castaneum. Results published in an M.S. Thesis.

### **Effectiveness of chlorpyrifos-methyl as a grain protectant under varied conditions of storage, Phase 2, Repellency**

Determine the repellent or attraction effect of chlorpyrifos-methyl as a grain protectant.

### **Computerized system for feasible agribusiness development for microcomputers**

Adapt the programs of feasibility analysis, master projection analysis, proforma financial analysis, and linear transportation analysis to microcomputers with appropriate user manuals and case studies for application to developing-country conditions. Six individual research projects completed. Results published in FFGI Special Report No. 13, 14, 15, 17, 20, 23, 24, 25, 26, 27, 30, 31, and 32, and in a presented paper.

### **Quantitative analysis to support developing-country grain policies and programs**

Assist policymakers and implementing agencies in developing countries to formulate and carry out public intervention programs to achieve more effective national and international systems for food grain production, distribution, and utilization. Seven individual research projects completed. Results published in FFGI Research Report No. 27; FFGI Special Report No. 21, 28, 28A, and 33; one M.S. Thesis; three Ph.D. Dissertations; and two presented papers.

### **Research Project Buy-ins.**

Three research projects were conducted through informal buy-ins. They are set forth as follows.

### **Loss Assessment Study in Costa Rica**

A collaborative research project on postharvest losses was conducted with the Centro para Investigaciones en Granos y Semillas (CIGRAS) in Costa Rica. The objectives of the research effort were to (1) review known grain loss assessment methodologies, (2) select grain loss assessment methods to be used, (3) evaluate grain losses (weight and quality changes) during normal grain handling, drying and storage operations at the Consejo Nacional de Producción (CNP) facilities, (4) analyze grain cleaning and drying operations with respect to grain quality, thermal efficiency, and costs, and (6) develop grain loss reduction strategies. Research results were presented in FFGI Research Report No. 28 and 30; and an M.S. Thesis.

### **Field Trials of Iprodione on Stored Corn in Kansas**

Research was conducted on a commercial brand of Iprodione known as Rovral for the storage of high-moisture corn. The research encompasses large-scale trials of Rovral in stored corn and the effect of formulation and time of treatment on efficiency of Rovral. Research results are the sole property of the sponsor of the project.

### **Development of a Multi-Period, Multi-Modal Transshipment Program for Microcomputers**

Design, develop, and test a multi-period, multi-modal transshipment optimization program which would operate on a microcomputer, yet be capable of addressing problems large enough for application to real world problems. Apply the resulting program to two transshipment-storage-processing case problems. Document the program and its use for case problems, and prepare a user's manual complete with microcomputer program diskettes. Research results published as a user's manual by the Kansas Department of Transportation.

### **Graduate Student Research Activities**

Nineteen graduate students performed research directly related to the areas described above. These graduate students and their areas of research are as follows:

E. Arce-Diaz, Costa Rica -- Evaluation of Grain Losses and Grain Drying Performance at Large Grain Storage and Handling Facilities in a Developing Country (Some CNP Operations in Costa Rica)

A. Arrevillagas, Venezuela -- Effect of Fine Material on Static Pressure During Grain Drying

C. Benavides, Costa Rica -- Design of Grain Handling and Storage Facilities for Tropical Countries

H. Ben Hamza, Tunisia -- Field Infestation of Wheat by Stored-Grain Insects

J. Espinal, Honduras -- Comparison of Traditional and Improved Methods of Farm Maize Storage in Honduras

- R. Flores -- Computer Simulation Model for Wheat Flour Milling Systems
- P. Guritno, Indonesia -- Analysis of a Three-Roller Mill for Grain Processing
- A. Hamid, Pakistan -- Static Pressure Drop as Affected by Indian Meal Moth Webbing in Corn
- A. Hashem, Egypt -- Egyptian Food System Development, Simulation of Alternative Strategic Plant for Egyptian Food Security
- B. Kanujoso, Indonesia -- Analysis of Rough Rice Aeration Under Tropical Conditions
- A. Itto, Sudan -- Semi-Underground Grain Storage: The Effects of Moisture, Temperature, and Interseed Atmospheres on the Quality of Grain Sorghum in Lined and Unlined Pits
- F. Mejia, Dominican Republic -- Effect of Moisture Content on Milling of Rough Rice Stored for Short Periods of Time
- L. Pinel, Honduras -- Effect of Grain Moisture Content and Application Temperature on Chlorpyrifos-methyl Effectiveness
- L. Shen, China -- The Saltation Velocity of Wheat Materials in Horizontal Flow
- A. Song, China -- Analysis of Grain Particle Dynamics in Separation
- N. Ullah, Pakistan -- White Sagebrush, Artemesia ludoviciana Nutt. (Asteraceae) Flower Extract as a Protectant for Wheat Against Stored-Product Insects
- R. Urrelo, Peru -- Factors Affecting Oviposition, Development, and Behavior of the Maize Weevil Sitophilus zeamais Motschulsky in Peruvian Maize Accessions
- L. Wongo, Sudan -- Factors Affecting the Storage of Sorghum (Display Sorghum bicolor (L) Moench) Grain
- M. Zeledon, Costa Rica -- Low Dosage Methoprene As a Protectant Against Stored-Product Insects and Assessment of Their Damage

In addition, eight other graduate students conducted research under guidance of the FFGI staff in areas relating to development in their own countries or in neighboring countries. They are as follows:

- F. Anjum, Pakistan -- Electrophoretic Identification, and Technological Characterization of Pakistani Wheats
- E. Arce-Diaz, Costa Rica -- Competitiveness of the Feedlot Industry in Northern Mexico under Free Trade with the United States
- W. Barantes, Costa Rica -- An Economic Analysis of the Substitution of Hard Red Winter Wheat for Dark Northern Spring Wheat in the Costa Rican Milling Industry

M. Cassama, Guinea-Bissau -- Farm Level Grain Storage in Guinea-Bissau.

J. Espinal, Honduras -- Economic Losses Associated with Zabrotes subfasciatus (Coleoptera: Bruchidae) and Acanthoscelides obtectus (Say) (Coleoptera: Bruchidae) Infestations of Stored Dry Beans (Phaseolus vulgaris (L.) in Southeastern Honduras

M. Kerpisci, Turkey -- Effect of Variety and Drying Temperature on Proteolytic Enzyme Activity of Yellow Dent Corn

K. Kouakou, Ivory Coast -- Application of a High Protein Legume in the Development of Composite Flour Bread

H. Shah, Pakistan -- Effect of Eliminating Subsidy on Irrigation Water: An Analysis

SECTION III  
TECHNOLOGY TRANSFER

FFGI Staff Publications

The FFGI staff published 13 Research Reports, 23 Special Reports, and three Working Papers. The FFGI staff were also authors of 112 other publications relating to postharvest grain systems. A list of publications follows.

**FFGI Research Reports**

Toquero, Z. September 1985. "Institutional Factors Affecting Rice Postharvest Practices in the Philippines." Research Report No. 22.

Agbo, C., and R. Phillips. September 1985. "Alternative Grain Stabilization Programs for Nigerian Food Security." Research Report No. 23.

Wright, V. January 1986. "An Updated and Annotated Bibliography of Prostephanus truncatus (Horn) (Coleoptera: Bostrichidae): A Pest of Stored Grain." Research Report No. 24.

No, S., et al. January 1986. "Potential Uses of Grain Sorghum for Formula Feeds in Korea." Research Report No. 25.

Park, K., D. Chung, and R. McElhiney. January 1986. "User's Guide of Computer Program for Feed Mill Design." Research Report No. 26.

Hashem, A., et al. January 1986. "Egyptian Food System Development: Simulation of Alternative Strategic Plans for Egyptian Food Security." Research Report No. 27.

Chung, D.S., et al. January 1988. "Evaluation of Grain Losses in Some CNP Operations." Research Report No. 28.

Burroughs, R., D. Schenck-Hamlin, and V. Wright. August 1988. "A Bibliography of Plant Materials Tested for Activity Against Stored-Product Insects." Research Report No. 29.

Arce-Diaz, E., and D. Chung. February 1989. "Evaluation of Grain Losses and Grain Drying Performance at Large Grain Storage and Handling Facilities in a Developing Country (Some CNP Operations in Costa Rica)." Research Report No. 30.

Espinal, J., and J. Pedersen. September 1989. "Comparison of Traditional and Improved Methods of Farm Maize Storage in Honduras." Research Report No. 31.

Benavides, C., and D. Chung. December 1989. "Design of Grain Handling and Storage Facilities for Tropical Countries." Research Report No. 32.

Haque, E. January 1990. "A Natural Convection Grain Dryer for Humid Developing Countries." Research Report No. 33.

Guritno, P., E. Haque, and D. Chung. February 1990. "Moisture Sorption of Bagged Grain Stored Under Tropical Conditions." Research Report No. 34.

#### FFGI Special Reports

Phillips, R. May 1986. "Information for Using Fortran Programs with MS-DOS Microcomputers." Special Report No. 13.

Phillips, R. May 1986. "IRR Feasibility Analysis Program for Use on MS-DOS Microcomputers." Special Report No. 14.

Phillips, R. May 1986. "Proforma Financial Analysis Program for Use on MS-DOS Microcomputers." Special Report No. 15.

Reed, C. December 1986. "Characteristics and Limitations of Methods to Estimate Losses in Stored Grain." Special Report No 16.

Phillips, R. February 1987. "Transportation Linear Program for Use on MS-DOS Microcomputers." Special Report No. 17.

Schenck-Hamlin, D., and M. de Jordan. October 1987. "Directorio de Proyectos de Poscosecha en Latino América." Special Report No. 18.

Flores, R. January 1988. "Quality as an Integral Component of a Grain Storage and Handling Facility." Special Report No. 19.

Phillips, R. January 1989. "IRR Feasibility Analysis Program for use on MS-DOS Microcomputers, Release 2," Special Report No. 20.

Borsdorf, R., M. Baalman, and C. Hugo. February 1989. "Economic Analysis for Investment Decision-Making." Special Report No. 21

Schenck-Hamlin, D. September 1989. "Proceedings of the GASGA Workshop on Postharvest Information Management April 17-19, 1989." Special Report No. 22.

Phillips, R., and R. Flores. September 1989. "Programa para Analisis de Factibilidad Económica para uso en Microcomputadores con MS-DOS." Special Report No. 23.

Phillips, R. October 1989. "Regression Projective with Multiple Options for use on MS-DOS Microcomputers, A. Master Projections." Special Report No. 24.

Phillips, R. October 1989. "Regression Projective with Multiple Options for use on MS-DOS Microcomputers, B. Proration Projections." Special Report No. 25.

Phillips, R., and J. Tiao. December 1989. "Transportation Linear Program for Use on MS-DOS Microcomputers, Release 2." Special Report No. 26.

Phillips, R. February 1990. "Proforma Financial Analysis Program for Use on MS-DOS Microcomputers - Release 2." Special Report No. 26.

Hugo, C., and J. Lea. April 1990. "A Primer for Implementing a Successful Food Policy Program: The Case of Rice in Guinea Bissau." Special Report No. 27.

Hugo, C., and J. Lea. April 1990. "L'ABC de la Mise en Place D'un Programme Réussi D'un Politique D'alimentation: Le Cas du Riz en Guinée Biseau." Special Report No. 28.

FFGI Staff. May 1990. "Glossary of Terms - English, Spanish, French - Storage, Volume I." Special Report No. 29.

FFGI Staff. May 1991. "Glossary of Terms - English, Spanish, French - Marketing, Volume II." Special Report No. 29.

Phillips, R. February 1991. "Economic Impact Analysis for Agroindustrial Development." Special Report No. 30.

Phillips, R. March 1991. "Programma Para el Análisis de Factibilidad Económica Para uso en Microcomputadores con MS-DOS." Special Report No. 31.

Phillips, R., and J. Lea. July 1991. "Programme pour l'Analyse de Faisabilité TRI pour Micro-ordinateurs MS-DOS, Edition 2." Special Report No. 32.

Hugo, C., R. Maxon, and U. Acasio. September 1991. "Integrating the Technical and Marketing Approach for Profitable Utilization of Grain Postharvest Technology." Special Report No. 33.

#### **FFGI Working Papers**

Lea, J.D. 1988. Agriculture in Afghanistan: A Background Paper Focusing on Wheat. Working Paper No. 1.

Flores, R. 1989. Public Law 480 - A Description of Its Mechanics and a Case Study. Working Paper No. 2.

Borsdorf, R., and M. Baalman. 1990. Sustainable Agriculture and the Postharvest Grain System. Working Paper No. 3.

#### **Other Publications**

Chung, D., et al. 1986. "Review of the State of the Art in Grain Cleaning - Volume I." Research Report, KSU.

Chung, D., et al. 1986. "Review of the State of the Art in Grain Cleaning - Volume II." Research Report, KSU.

Chung, D., et al. 1986. "Review of the State of the Art in Grain Cleaning - Volume III." Research Report, KSU.

Chung, D., et al. 1986. "Review of the State of the Art in Grain Cleaning - Volume IV." Research Report, KSU.

- Chung, D., and C. Lee. 1986. "Physical and Thermal Properties of Grains." ACIAR Proceedings.
- Chung, D., et. al. 1986. "Grain Aeration and In-Store Drying in the U.S.A." ACIAR Proceedings.
- Chung, K., et. al. 1986. "Enzymatic Hydrolysis, Viscosity Reduction and Fermentation. Brewer's Condensed Solubles III." Cereal Chemistry.
- Chung, D.S. 1986. "Storage Handling Improvements Needed to Curb Grain Losses." Presented at the World Grain Congress, Jakarta, Indonesia.
- Hugo, C. 1986. "Methodology for Analyzing Marketing Alternatives for Basic Grains at the Producers Level." Paper presented at the 3rd Latin American Round Table on the Prevention of Postharvest Grain Losses.
- Naewbanij, M., et. al. 1986. "Ergosterol Versus Dry Matter Loss as Quality Indicator for High-Moisture Rough Rice During Holding." Cereal Chemistry.
- Reed, C. 1986. "Loss Assessment in Wheat Stored on the Farm in the State of Kansas, U.S.A." Paper presented at the 3rd Latin American Round Table on the Prevention of Postharvest Grain Losses.
- Rho, K., et. al. 1986. "Retardation of Rancidity in Deep-Fried Instant Noodles." Journal of American Oil Chemistry Society.
- Schenck-Hamlin, D. 1986. "Using Special Libraries to Interface with Developing-Country Clientele".
- Wongo, L., et.al. 1986. "Tannins in Sorghum and Their Relationship to the Development of Three Stored-Grain Pests." Journal of Kansas Entomological Society.
- Wright, V. March 1986. "The Importance of Training and Extension in the Protection of Food Grains After Harvest." Paper presented at Symposium on Post-Production Entomology.
- Wright, V. 1986. "Methods for Culturing Stored-Grain Insects."
- Chung, D. 1987. "Hygroscopic Properties of Agricultural Products in chapter on Feed and Crop Storage." Volume III: Environmental Systems Engineering, Handbook of Engineering in Agriculture.
- Chung, D. 1987. "Storage and Handling Improvement Needed to Curb Grain Losses." World Grain.
- Eckhoff, S.R., et al. 1987. "Evaluation of Wisconsin Breakage Tester." Research Report, KSU.
- Schenck-Hamlin, D. July 1987. "Access to Postharvest Information: A Regional Proposal." Paper presented at the 8th Annual Meeting of the Interamerican Agricultural Librarians and Documentalists Association.

Chung, D.S. 1988. "Storage and Handling of Soybeans and Soybean Meals." Proceedings of Soybean Utilization Conference.

Chung, D.S., et al. 1988. "Adsorption Rate and Equilibrium Moisture Content of Sound Kernels, Broken Kernels, and Light Materials in Various Grains." AACC Paper No. 207. Cereal Foods World.

Chung, D.S. 1988. "Fundamentals of Grain Storage." Paper presented at Grain and Feed Handling Conference, Taipei, Taiwan.

Chung, D.S. 1988. "Use of Concrete or Steel Bins under Tropical Conditions." Paper presented at the Grain and Feed Handling Conference, Taipei, Taiwan.

Chung, D.S. 1988. "Planning and Design of Grain Handling Facility." Paper presented at the Grain and Feed Handling Conference, Taipei, Taiwan.

Chung, D.S. 1988. "Storage and Handling of Soybeans and Soybean Meals." Paper presented at the Soybean Utilization Conference, Seoul, Korea.

Eckhoff, S.R., et al. 1988. "Moisture Content and Temperature Effects on Wisconsin Breakage Tester Results." Trans. of ASAE.

Eckhoff, S.R., et al. 1988. "Magnitude and Sources of Error in Wisconsin Breakage Tester Results." Trans. of ASAE.

Schenck-Hamlin, D. May 1988. "Documentation of Postharvest research as a Solution to Cereal Loss." Paper presented at the International Cereals Congress.

Wu, P.D., et al. 1988. "Breakage Susceptibility of Re-wetted and Blended Corn Samples." Trans. of ASAE.

Chung, D.S., et al. 1989. "Evaluation of Laboratory Model Grain Cleaning and Separating Equipment."

Guritno, P., et al. 1989. "Moisture Absorption of Bagged Grain Under Tropical Conditions." ASAE Paper No. 89-6527.

Flores, R. 1989. "Quality is Chief Priority in Grain Storage Units." Agribusiness Worldwide.

Flores, R. 1989. "Computer Simulation Program for Wheat Flour Milling Systems." Paper presented at the meeting of Association of Operative Millers.

Hugo, C. 1989. "Utilización Beneficiosa de la Tecnología Postcosecha a Nivel de Productor." Paper presented at the Seminar on Reduction of Postharvest Grain Losses.

Maxon, R. 1989. "Resolving Policy Issues in Grain Marketing." Paper presented at the 12th ASEAN Technical Seminar on Grain Postharvest Technology.

Negrini, O., et al. 1989. "Evaluation of Laboratory Model Grain Cleaning and Separating Equipment - Part II." AACC Paper No. 6.

- Quiring, V., and D. Schenck-Hamlin. 1989. "A Cereal Grains Research Bibliography: Serials in Manhattan Library Collections." KSU.
- Pedersen, J. 1989. "Effects of Insects and Pests on Seed and Grain Quality." Paper presented at the 43rd Annual Corn and Sorghum Research Conference.
- Reed, C. 1989. "Determinación del Costo en las Perdidas de calidad del Gran Almacenado a Nivel del Finca en el Estado de Kansas, EEUU." Paper presented at the Seminar on Reduction of Postharvest Grain Losses.
- Song, A., et al. 1989. "Stochastic Compartmental Modeling of a Grain Cleaning Process." ASAE Paper No. 89-6544.
- Spillman, C.K., et al. 1989. "The KSU Wheat Hardness Tester." ASAE Paper No. 89-6012.
- Ullah, N., and J. Pedersen. 1989. "White Sagebrush (Artemisia ludoviciana Nutt.) as a Repellent for Stored Grain Insects." Paper presented at the 64th Meeting, S.W. and Rocky Mountain Division, AAAS.
- Wang, Y.J., et al. 1989. "Evaluation of Laboratory Model Grain Cleaning and Separating Equipment - Part I." AACC Paper No. 5.
- Wongo, L., and J. Pedersen. 1989. "Effect of Sprouting on Infestibility of Grain Sorghum by Stored-Grain Insects."
- Wright, V. 1989. "Using Insect Traps to Monitor Stored-Grain Insects on the Farm." Paper presented at the International Congress of Entomology.
- Acasio, U., and R. Maxon. 1990. "Bulk Handling and Storage of Grains: A Pakistan Experience." Paper presented at the 13th ASEAN Seminar on Grain Postharvest Technology.
- Abbouda, S., et al. 1990. "Heat and Mass Transfer in Stored Milo, Part I." Transactions of ASAE.
- Abbouda, S., et al. 1990. "Heat and Mass Transfer in Stored Milo, Part II." Transactions of ASAE.
- Anderson, K., et al. 1990. "An Economic Analysis of Producer's Decisions Regarding Insect Control in Stored Grain." North Central Journal of Agricultural Economics.
- Arrevillagas, A., et al. 1990. "Static Pressure Drop in Corn Bed as Affected by Moisture Content and Fine Materials."
- Chung, D., and K. Park. 1990. "Importance of Feed Quality for Livestock Production." Korea Journal Vet Res.
- Chung, D. 1990. "Importance of Feed Quality for Livestock Production." Paper presented at the Annual Meeting of Korean Society of Veterinary Medicine.

Chung, D. 1990. "Grain Cleaning and Separation." Paper presented at the International Workshop on Corn and Soybean Quality, Urbana, IL.

Song, A., et al. 1990. "A Stochastic Compartmental Model Simulating a Grain Cleaning Process." Trans. of ASAE.

Chung, D. 1990. "Evaluation of Imported Feed Grains Handling and Distribution Systems in Korea." Korea Feed Association.

Chung, D., and K. Park. 1990. "Importance of Feed Quality for Livestock Production." Korea Journal of Vet. Res.

Flores, R. 1990. "Empirical Model to Predict the Cumulative Ash Curves of Hard Red Winter Wheat." Paper presented at the American Association of Cereal Chemists Annual Meeting.

Flores, R. 1990. "Modelo de Simulation en Computador para Sistemas de Molienda de Trigo." Paper presented at the Latin American Chapter of the Association of Operative Millers Meeting.

Flores, R. 1990. "Empirical Milling Model for Hard Red Winter Wheat." Paper presented at the American Society of Agricultural Engineers Winter Meeting.

Haque, E. 1990. "Roller Mills - An Advanced Three Roller Design." Feed Management.

Kanujoso, B., et al. 1990. "Moisture Changes in Grain During Aeration Under Warm Humid Conditions." Journal of Cereal Chemistry.

Kanujoso, B., et al. 1990. "Study of Desorption and Adsorption in Grain Aeration." Journal of Cereal Chemistry.

Mills, R., and J. Pedersen. 1990. "A Flour Mill Sanitation Manual." Egan Press.

Reed, C., et al. 1990. "Wheat Quality Deterioration Caused by Insects and Molds During the First Months of Storage on Farms and in Country and Terminal Elevators in Kansas." Journal of Kansas Entomological Society.

Reed, C. 1990. "Effects of Insect Infestation of Farm-Stored Wheat on its Sale Price at Country and Terminal Elevators." Journal of Economic Entomology.

Reed, C., et al. 1990. "Cost and Effectiveness of Chemical Insect Control Measures in Farm-Stored Kansas Wheat." Journal of the Kansas Entomological Society.

Song, A., et al. 1990. "Drag Coefficients of Corn kernels." Transaction of ASAE.

Song, A., et al. 1990. "A Stochastic Compartmental Model Simulating Grain Cleaning Process." Transactions of ASAE.

- Song, A., et al. 1990. "Physical Properties of Various Fractions in Corn Samples." *Journal of Cereal Chemistry*.
- Urrelo, R., and V. Wright. 1990. "Development Stages of the Maize Weevil, Sitophilus zeamais Motsch., and Their Behavior Within Kernels of Resistant and Susceptible Maize." *Annual of Entomological Society of America*.
- Urrelo, R., and V. Wright. 1990. "Influence of Susceptible and Resistant Maize Accessions on the Development of Sitophilus zeamais Motsch. (Coleoptera: Curculionidae) with Initial Feeding in Specific Kernel Areas." *Journal of Kansas Entomological Society*.
- Urrelo, R., and V. Wright. 1990. "Oviposition Performance of Sitophilus zeamais Motsch. (Coleoptera: Curculionidae) on Resistant and Susceptible Maize Accessions." *Journal of Kansas Entomological Society*.
- Urrelo, R., et al. 1990. "Screening for Resistance Against the Maize Weevil Sitophilus zeamais Motsch. in Peruvian Maize." Turrialba.
- Urrelo, R., and V. Wright. 1990. "Development and Behavior of Immature Stages of the Maize Weevil, Coleoptera: Curculionidae Within Kernels of Resistant and Susceptible Maize." *Annual of Entomological Society of America*.
- Wongo, L., and J. Pedersen. 1990. "Effect of Sorghum Sprouting on Adult Progeny Production of Stored-Grain Insects and Larval Degermination of Kernels." *Journal of the Kansas Entomological Society*.
- Wongo, L., and J. Pedersen. 1990. "Effect of Threshing Different Sorghum Cultivars on Sitotroga cerealella (Oliv.) and Sitophilus oryzae (L.) (Lepidoptera: Gelechiidae and Coleoptera: Curculionidae)." *Journal of Stored-Product Research*.
- Wongo, L. 1990. "Factors of Resistance in Sorghum Against Sitotroga cerealella (Oliv.) and Sitophilus oryzae (L.)." *Insect Sci. Applic.*
- Chung, D., and J. Lee. 1991. "Principles of Parameters for Grain Cleaning and Separation." *Uniformity by 2000. Proceedings of International Conference of Maize and Soybean Quality*.
- Chung, D., and C. Lee. 1991. "Review of Principles and Parameters for Grain Cleaning and Separation, Chapter III." Uniformity by 2000. Edited by L.D. Hill.
- Chung, D. 1991. "Overview of Grains and Their Products Drying." *Cereal Foods World*.
- Chung, D. 1991. "Bulk Handling and Brewer's Spent Grain". Paper presented at the American Society of Agricultural Engineers Winter Meeting.
- Flores, R.A., et al. 1991. "Evaluation of a Laboratory Dockage Removed." *Cereal Food World*.

- Guritno, P., et al. 1991. "Moisture Movement Through Bagged Grains." Trans. of ASAE.
- Haque, E. 1991. "Application of Size Reduction Theory to Roller Mill Design and Operation." Cereal Foods World.
- Haque, E. 1991. "Theory of Size Reduction and Application to Roller Mill Design and operation." Paper presented at the First Engineering Symposium of the American Association of Cereal Chemists Annual Meeting.
- Haque, E. 1991. "A Modular On- and Off-Farm Grain Dryer for Developing Countries." Paper presented at the American Society of Agricultural Engineers Winter Meeting.
- Haque, E. 1991. "Reinventing the Roller Mill." Feed International.
- Haque, E. 1991. "Three-Roller Cereal Mill Using Triangular Roll Configuration." Transactions of ASAE.
- Reed, C., et al. 1991. "Pitfall Traps and Grain Samples as Indicators of Insects in Farm-Stored Wheat." Journal of Economic Entomology.
- Zhuge, Q., et al. 1991. Isolation of Gluten and Starch from Ground, Pearled Wheat Compared to Isolation from Flour." Cereal Chemistry.
- Wang, Y., et al. 1991. "Bulk Handling of Brewer's Spent Grain." ASAE Paper No. 91-6594.
- Abbouda, S.K., et al. 1992. "Heat and Mass Transfer in Stored Milo I - Heat Transfer Model." Trans. of ASAE.
- Abbouda, S., et al. 1992. Heat and Mass Transfer in Stored Milo II - Mass Transfer Model." Trans. of ASAE.
- Chung, D., et al. 1992. "Grain Cleaning Equipment - Specifications and Manufacturers." KSU.
- Chung, D. 1992. "Progress Report on Wet-Process for Separating Gluten and Starch from Wheat for Non-Food Uses." Department of Agricultural Engineering.
- Flores, R., and D. Chung. 1992. "Drying Lower Grade Asparagus." Paper presented at the 1992 Annual Meeting of the International Food Technologists.
- Kang, Y., et al. 1992. "Finite Element Analysis of Fracture in a Wheat Kernel." ASAE Paper No. 92-3526.
- Kang, Y., et al. 1992. "Physical Properties of Wheat." ASAE Paper No. 92-6554.
- Lea, J. 1992. "Applied Policy Analysis of the Rice Marketing Sub-sector of Guinea-Bissau." Journal of International Food and Agribusiness Marketing.

Lea, J., et. al. 1992. "Final Evaluation: Polish International Agriculturalist Program." Land O'Lakes.

Maxon, R. and U. Acasio. 1992. "Introduction of Bulk Grain Handling in Pakistan." Paper presented at the 15th ASEAN Seminar on Grain Postharvest Technology.

Pedersen, J. 1992. "Insects: Identification, Damage, and Detection." Storage of Cereal Grains and Their Products. Edited by D. Sauer. American Association of Cereal Chemists, St. Paul, MN.

Phillips, R. 1992. "Mill Management Optimization - Planning and Analysis." Paper presented at AOM Technical Conference.

Phillips, R. 1992. "Macroeconomic Policy Environment for Agribusiness Development in Indonesia." IMCC Technical Assistance Team Report.

Reed, C. 1992. "Development of Storage Techniques: A Historical Perspective." Storage of Cereal Grains and Their Products. Edited by D. Sauer. American Association of Cereal Chemists.

Reed, C. 1992. "Grain Cooling, Moisture Translocation, and Theories of Convection Currents." Extended Abstract. Proceedings of the International Symposium on Stored-Grain Ecosystems.

Reed, C., and F. Worman. 1993. "Quality Maintenance and Marketing of Wheat Stored on Farms and in Elevators in Kansas: Description, Techniques, and Innovations." AES Bulletin, KSU.

Schurle, B., et al. 1992. "Impacts of Policy Changes on Discounts for Insects in Farm-Stored Wheat." Staff Paper 93-4, Department of Agricultural Economics.

Acasio, U. 1993. "Convertible Warehouses for Grain Storage in Developing Countries." Paper presented at the International Winter Meeting of the American Society of Agricultural Engineers.

Phillips, R. 1993. "Network Flow Transshipment Model for Use on MS-DOS Microcomputers, Users Manual." Kansas Department of Transportation.

Phillips, R. 1993. "Mill Management Optimization -- Planning and Analysis." Association of Operative Millers Bulletin.

Reed, C. 1992. "Postharvest Losses of Basic Grains and Consequences for Consumers." Paper presented at the Semara Tecnico Cientifica del INCAP.

#### Theses and Dissertations

Theses and dissertations authored by the FFGI staff-supported graduate students are as follows:

### **M.S. Theses**

Espinal, J. 1986. "Comparison of Traditional and Improved Methods of Farm Maize Storage in Honduras."

Arrevillagas, A. 1987. "Effect of Fine Material on Static Pressure During Grain Drying."

Benavides, C. 1987. "Design of Grain Handling and Storage Facilities for Tropical Countries."

Arce-Diaz, E. 1988. "Evaluation of Grain Losses and Grain Drying Performance at Large Grain Storage and Handling Facilities in a Developing Country (Some CNP Operations in Costa Rica)."

Kerpisci, M. 1988. "Effect of Variety and Drying Temperature on Proteolytic Enzyme Activity of Yellow Dent Corn."

Mejia, F. 1988. "Effect of Moisture Content on Milling of Rough Rice Stored for Short Periods of Time."

Negrini, O. 1989. "Evaluation of the Performance of Laboratory Model Grain Cleaning and Separating Equipment for Grading Difference Classes of Grain."

Akhimien, C. 1990. "Feasibility Analysis of Production of Corn and Soybeans on 1,000 Acres of Land in the United States to be Applied in Nigeria."

Ben Hamza, H. 1990. "Field Infestation of Wheat by Stored-Grain Insects."

Hamid, A. 1990. "Static Pressure Drop as Affected by Indian Meal Moth Webbing in Corn."

Pinel, L. 1990. "Effect of Grain Moisture Content and Application Temperature on Chlorpyrifos-methyl Effectiveness."

Cassama, M. 1991. "Farm Level Grain Storage in Guinea-Bissau."

Hooshmand, H. 1991. "Effect on Gamma Irradiation on Mycotoxin Degradation and Protein Quality of grains with Different Moisture Content."

Shah, H. 1992. "Effect of Eliminating Subsidy on Irrigation Water: An Analysis."

Shen, L. 1992. "The Saltation Velocity of Wheat Materials in Horizontal Flow."

### **Ph.D. Dissertations**

Hashem, A. 1985. "Egyptian Food System Development -- Simulation of Alternative Strategic Plant for Egyptian Food Security."

Wongo, L. 1986. "Factors Affecting the Storage of Sorghum [Display Sorghum bi-color (L) Moench] Grain."

- Zeledon, M. 1986. "Low Dosage Methoprene As a Protectant Against Stored-Product Insects and Assessment of Their Damage."
- Eusebio, V. 1987. "Railroad Pricing Behavior for Export Wheat in Selected Areas in Kansas: the Pre- and Post-Staggers Eras."
- Kanujoso, B. 1987. "Analysis of Rough Rice Aeration Under Tropical Conditions."
- Urrelo, R. 1987. "Factors Affecting Oviposition, Development, and Behavior of the Maize Weevil Sitophilus zeamais Motschulsky in Peruvian Maize Accessions."
- Itto, A. 1988. "Semi-Underground Grain Storage: The Effects of Moisture, Temperature, and Interseed Atmospheres on the Quality of Grain Sorghum in Lined and Unlined Pits."
- Flores, R. 1989. "Computer Simulation Model for Wheat Flour Milling."
- Kouakou, K. 1990. "Application of a High Protein Legume in the Development of Composite Flour Bread."
- Song, A. 1989. "Analysis of Grain Particle Dynamics in Separation."
- Ullah, N. 1990. "White Sagebrush, Artemesia ludoviciana Nutt. (Asteraceae) Flower Extract as a Protectant for Wheat Against Stored-Product Insects."
- Anjum, F. 1991. "Electrophoretic Identification and Technological Characterization of Pakistani Wheats."
- Wang, Y. 1991. "Analysis of Grain Kernel Rebound Motion."
- Arce-Diaz, E. 1992. "Competitiveness of the Feedlot Industry in Northern Mexico under Free Trade with the United States."
- Barrentes, W. 1992. "An Economic Analysis of the Substitution of Hard Red Winter Wheat for Dark Northern Spring Wheat in the Costa Rican Milling Industry."
- Guritno, R. 1992. "Analysis of a Three-Roller Mill for Grain Processing."
- Kwon, Y. 1992. "Differential pricing in Rail Transportation of Wheat in Kansas After Rail Deregulation: A Pooled Cross-Sectional Time Series Analysis."
- Espinal, J. 1993. "Economic Losses Associated with Zabrotes subfasciatus (Coleoptera: Bruchidae) and Acanthoscelides obtectus (Say) (Coleoptera: Bruchidae) Infestations of Stored Dry Beans (Phaseolus vulgaris (L.) in Southeastern Honduras."

#### Distribution of Publications

FFGI distributed each Research Report, Special Report, and Working Paper published to the International Agricultural Research Centers and a selected list of developing country postharvest institutions. FFGI also distributed these

reports, as well as Technical Assistance Reports, on request. The distribution of these publications over the life-of-project is as follows.

Year	Tech. Asst. Reports	Research Reports	Special Reports	Other Reports	Total Reports	Number Countries
FY 1986	200	194	57		451	31
FY 1987	299	32	96		427	38
FY 1988	117	40	99		256	31
FY 1989	451	253	265	87	1,056	43
FY 1990	411	245	391	69	1,116	65
FY 1991	213	104	331	17	665	51
FY 1992	546	45	179	1	771	39
FY 1993	851	16	64		931	30
TOTAL	3,088	929	1,482	174	5,673	

Papers Presented at Seminars, Conferences, and Workshops

The FFGI staff presented 32 papers at seminars, conferences, and workshops concerning the results of research or other informational on postharvest grain systems. Papers presented are as follows.

Do Sup Chung presented a paper entitled "Storage Handling Improvements Needed to Curb Grain Losses" at the World Grain Congress, Jakarta, Indonesia.

Valerie Wright presented a paper entitled "The Importance of Training and Extension in the Protection of Food Grains After Harvest" at the Symposium on Post-Production Entomology, Monterrey, Mexico, March 15-19, 1986.

Cornelius Hugo presented a paper entitled "Methodology for Analyzing Marketing Alternatives for Basic Grains at the Producers Level" at the 3rd Latin American Round Table on the Prevention of Postharvest Grain Losses, Cali, Colombia, October 27-31, 1986.

Carl Reed presented a paper entitled "Loss Assessment in Wheat Stored on the Farm in the State of Kansas, U.S.A." at the 3rd Latin American Round Table on the Prevention of Postharvest Grain Losses, Cali, Colombia, October 27-31, 1986.

Donna Schenck-Hamlin presented a paper entitled "Access to Postharvest Information: A Regional Proposal" at the 8th Annual Meeting of the Interamerican Agricultural Librarians and Documentalists Association, Guatemala City, Guatemala, July 11-18, 1987.

Donna Schenck-Hamlin presented a paper describing the PHDS data base, document delivery service, and acquisition activities at the Encuentro Latinoamericano sobre el Almacenamiento y Conservación de Granos Básicos, Mexico City, Mexico, September 23-25, 1987.

Do Sup Chung presented a paper entitled "Fundamentals of Grain Storage" at the Grain and Feed Handling Conference, Taipei, Taiwan, January 16-24, 1988.

Do Sup Chung presented a paper entitled "Use of Concrete or Steel Bins Under Tropical Conditions" at the Grain and Feed Handling Conference, Taipei, Taiwan, January 16-24, 1988.

Do Sup Chung presented a paper entitled "Planning and Design of Grain Handling Facility" at the Grain and Feed Handling Conference, Taipei, Taiwan, January 16-24, 1988.

Donna Schenck-Hamlin presented a paper entitled "Documentation of Postharvest Research as a Solution to Cereal Loss," at the International Cereals Congress, Lausanne, Switzerland, May 29-June 2, 1988.

Valerie Wright presented a paper entitled "Using Insect Traps to Monitor Stored-Grain Insects on the Farm," at the International Congress of Entomology, Vancouver, Canada, July 4-8, 1988.

Do Sup Chung presented a paper entitled "Storage and Handling of Soybeans and Soybean Meals", at the Utilization of Soybeans Conference, Seoul, Korea, August 16-21, 1988.

John Pedersen presented a paper entitled "International Activities of the Food and Feed Grains Institute", at the 11th ASEAN Technical Seminar on Grain Postharvest Technology, Kuala Lumpur, Malaysia, August 22-25, 1988.

Cornelius Hugo presented a paper entitled "Utilización Beneficiosa de la Tecnología Postcosecha a Nivel de Productor," at the Seminar on Reduction of Postharvest Grain Losses, Loja, Ecuador, April 4-7, 1989.

Carl Reed presented a paper entitled "Determinación del Costo en las Perdidas de calidad del Grano Almacenado a Nivel del Finca en el Estado de Kansas, EEUU," at the Seminar on Reduction of Postharvest Grain Losses, Loja, Ecuador, April 4-7, 1989.

Rolando Flores presented a paper entitled "Computer Simulation Program for Wheat Flour Milling Systems," at the meeting of the Association of Operative Millers, Seattle, Washington, May 20-24, 1989.

Richard Maxon presented a paper entitled "Resolving Policy Issues in Grain Marketing" at the 12th ASEAN Technical Seminar on Grain Postharvest Technology, Surabaya, Indonesia, August 29-30, 1989.

Rolando Flores presented a paper entitled "Empirical Model to Predict the Cumulative Ash Curves of Hard Red Winter Wheat" at the American Association of Cereal Chemists Annual Meeting, Washington, D.C., October 29-November 1, 1989.

Rolando Flores presented a paper entitled "Modelo de Simulación en Computador para Sistemas de Molienda de Trigo" at the meeting of the Latin America Chapter of the Association of Operative Millers, Orlando, Florida, April 20-22, 1990.

Do Sup Chung presented a paper entitled "Importance of Feed Quality for Livestock Production" at the Korean Society of Veterinary Medicine Conference, Seoul, Korea, May, 1990.

Do Sup Chung presented a paper entitled "Grain Cleaning and Separation" at the International Workshop on Corn and Soybean Quality, Urbana, Illinois, May, 1990.

John Pedersen presented a paper entitled "Effects of Insects and Pests on Seed and Grain Quality" at the 43rd Annual Corn and Sorghum Research Conference, Wichita, Kansas.

Richard Maxon presented a paper entitled "Bulk Handling and Storage of Grains: A Pakistan Experience" at the 13th ASEAN Seminar on Grain Postharvest Technology, Brunei, Darussalam.

Ekramul Haque presented a paper entitled "Theory of Size Reduction and Application to Roller Mill Design and Operation," at the American Association of Cereal Chemists Annual Meeting, Dallas, Texas, October 15-16, 1990.

Ekramul Haque presented a paper entitled "A Modular On- and Off-Farm Grain Dryer for Developing Countries," at the American Society of Agricultural Engineers Winter Meeting, Chicago, Illinois, December 19-20, 1990.

Do Sup Chung presented a paper entitled "Bulk Handling and Brewer's Spent Grain," at the American Society of Agricultural Engineers Winter Meeting, Chicago, Illinois, December 15-16, 1991.

Carl Reed presented a poster display entitled "Grain Cooling, Moisture Translocation, and Theories of Convection Currents," at the International Symposium on Stored grain Ecosystems and the International Conference on Controlled Atmosphere and Fumigation in Grain Storage, Winnipeg, Canada, June 8-12, 1992.

Cornelius Hugo presented a lecture entitled "Grain Storage and Marketing Issues in Privatization," at the International Workshop Over Prevention of Postharvest Losses, Tegucigalpa, Honduras, May 30, 1992.

Richard Phillips presented a paper entitled "Mill Management Optimization - Planning and Analysis," at the Association of Operative Miller's Technical Conference, San Diego, California, May 24-26, 1992.

Carl Reed presented a paper entitled "Postharvest Losses of Basic Grains and Consequences for Consumers," at the Sámara Técnico Científica del INCAP, Guatemala City, Guatemala, September 8-10, 1992.

Ulysses Acasio presented a paper entitled "Introduction of Bulk Grain Handling in Pakistan at the 15th ASEAN Seminar on Grain Postharvest Technology.

Ulysses Acasio presented a paper entitled "Convertible Warehouses for Grain Storage in Developing Countries," at the International Winter Meeting of the American Society of Agricultural Engineers, Nashville, Tennessee, December 16-18, 1992.

### Postharvest Documentation Service

The Postharvest Documentation Service (PHDS) is a computerized data retrieval system which was created in August 1978, to provide a centralized collection of documents pertaining to the postharvest systems of cereal grains, legumes, and oilseeds. Under the Postharvest Grains Systems R&D Project, PHDS provided copies of available documents to developing country researchers, government agencies, and private institutions and individuals upon request at no charge. Other services provided by PHDS included acquisition information and computerized document searches.

Over the life-of-project, PHDS increased its acquisition base by over 200%. The number of clients served tripled. Requests for documents totaled over 43,000, or slightly over an average of 5,500 per year. Information by services provided by fiscal year is detailed on the following page.

Informal buy-ins. Through an information buy-in, PHDS provided informational services as follows.

#### **Database of Funded Research on Corn Quality and Utilization**

Develop and maintain a database of corn utilization for the National Corn Growers Association. The purpose of the database is to centralize project information on corn utilization and quality research.

#### **Crop Utilization Research Database -- Wheat Option**

Develop and maintain a database of wheat utilization for the National Association of Wheat Growers. The purpose of the database is to centralize national and international public- and private-funded wheat utilization activities and research.

### Individual Technical Information Requests

During the project, the FFGI staff responded to 121 individual requests for technical information relating to postharvest grain systems. These technical information requests were from individuals in 16 developing countries.

### Technical Assistance

The FFGI staff provided technical assistance services to AID Missions and developing countries through BOA as well as through direct contractual agreements.

BOA Buy-ins. Under BOA, FFGI responded to nine requests for technical assistance. These AID Mission buy-ins are described as follows.

#### **Belize (FY1986/87)**

Evaluate alternatives and formulate a viable program for postharvest food systems development and support, with special focus on the functions of the Belize Marketing Board (BMB). Assist in the installation and adjustments of rice mill

POSTHARVEST DOCUMENTATION SERVICE

Activity	FY 1986	FY1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	TOTAL
Acquisitions									
Annual	1,635	785	4,207	2,625	1,835	1,367	2,517	8,116	23,087
Cumulative	9,090	9,875	14,082	16,707	18,542	19,909	22,426	30,542	
Clients									
Annual	226	144	438	-5	41	185	313	132	1,474
Cumulative	685	829	1,267	1,262	1,303	1,488	1,801	1,933	
Requests									
Annual	5,543	2,947	4,562	2,826	2,942	8,832	9,505	6,158	43,315
Cumulative	23,936	26,883	31,445	34,271	37,047	45,879	55,384	61,542	
Number of Countries	N/A	N/A	N/A	57	52	63	69	65	

equipment as well as to conduct training for supervisory and operational personnel of rice mill. Conduct a study of the operations of BMB and the marketing of agricultural products in Belize. Preparation of the Toledo Agricultural Marketing Project Paper.

**Belize (FY87)**

Provide assistance in developing a plan to restructure BMB and assist BMB in developing a price stabilization program suitable to the country's needs and integrated into a long-term development strategy.

**Panama (FY87)**

Advise on overall management and provide on-the-job training to personnel responsible for daily operation of three grain drying and storage facilities, including off-loading, weighing, bagging, drying, and storage. Develop a preventive maintenance plan for the care of plant equipment and train personnel in the application of that plan. Assist in establishment of procedures for receiving grain from producers. Establish procedures for efficient flow of grain into and out of the facilities. Establish procedures for the sale of grain to millers. Assess the need for improving grain quality at all levels in the system, with recommendations on how to accomplish these improvements.

**Costa Rica (FY88)**

Evaluation of the current and alternative policy scenarios and programs of CNP. The evaluation was conducted by development of a "CNP Model" to simulated the CNP operating conditions and policies. The model was validated by application to recent experience of CNP. The final stages of the evaluation applied specifications of policy alternatives for testing, the simulation of outcomes for the specified alternatives, and the formulation of recommendations.

**Guinea-Bissau (FY90)**

Conduct a rice marketing study which included (1) description of characteristics and analysis of recent trends in rice production, import/export, and consumption, (2) structural analysis of the marketing system for rice in the country, (3) conduct and performance analysis of the rice marketing system, and (4) analysis of recent and current governmental policies, intervention strategies, and programs, and their impact on rice production, marketing, and consumption.

An amendment to the buy-in added additional activities. These were (1) the presentation of a seminar series to government officials, donor agency officials, and private-sector representative on the finding of the rice marketing study, and (2) development of an action plan for the Office of AID Representative concerning strengthening agricultural policy development and implementation in Guinea-Bissau.

**El Salvador (FY92)**

Services provided under this buy-in were to:

- Provide technical assistance and training to the Basic Grains and Beans Transition Team (Privatization Unit) of the Ministry of Agriculture as well as private-sector representatives interested in buying or acquiring the use of grain storage and processing facilities to be divested by government. These activities were to (1) upgrade relevant capabilities of the team, (2) analyze offers and options to privatize facilities, monitor the divestiture process, and prepare progress reports on the divestiture, (3) provide technical assistance and training to entities acquiring facilities, (4) analyze policy, legal, regulatory, and informational issues as related to the privatization process, and (5) coordinate the divestiture process with other governmental institutions, and international donor and financial agencies.
- Provide information and support systems essential to a price-driven food production and marketing system through a series of seven studies conducted to provide necessary support for liberalized trade activities.

#### **Africa (FY92)**

Under the auspices of the Bureau for Africa, conduct a study of national food security stock policies and procedures in Africa. The purpose of the study was to synthesize the literature and experience on the national public-sector food grain stocking policies and procedures.

The study had two principal elements. The first is a description and general assessment of food-grain stock management policies and procedures, including the compilation of an inventory of food security stocking systems currently operating in Africa. The second element is five case studies of food grain reserve systems, taking a historical perspective, specially assessing their impacts on food security as well as contributing to a broader understanding of (1) the economic and financial sustainability of national food security stocking policies under variable market conditions, (2) the managerial and institutional requirements for implementing food stocking policies, and (3) the technical feasibility of constructing storage facilities and ensuring against pest damage.

#### **Sri Lanka (FY92)**

Conduct a food importation and distribution study based on the background that government involvement in the food system appears to be excessive and that there exists an overlapping set of state agencies and corporations which own and operate food distribution facilities.

Analyze the existing food importation and distribution system of Sri Lanka by (1) describing target food commodities in terms of their demand and supply, (2) prioritizing the target commodities by their relative importance, (3) describe the structure, conduct, and performance of the market for commodities under study, and (4) evaluate and compare the economic and technical efficiencies at each stage in the commodity marketing system.

Identify and analyze government institutions, practices, and policies which, if modified, would reduce the role of government as an active participant in the commercial food system. Determine the appropriate roles of the public and

private sectors in order to optimize economic efficiency while maintaining adequate food distribution coverage.

**Sri Lanka (FY93)**

Conduct a study encompassing (1) the cost/price efficiency of the wheat flour distribution system and recommend implementation procedures and methods which will result in significant increases of efficiency and competitiveness, and (2) the retail and wholesale operations of the Cooperative Wholesale Establishment and identify unprofitable retail units and uneconomic wholesale commodities.

Informal Buy-ins. FFGI responded to 26 requests for technical assistance through contractual agreements outside of BOA. These technical assistance requests are described as follows.

**Costa Rica (FY86)**

Prepare the terms of reference for an evaluation of CNP directed at improving the CNP's administrative and operational efficiency, focusing on CNP as a Government of Costa Rica (GOCR) institution and the GOCR policies that have contributed to the CNP's critical economic situation.

**Bolivia (FY87)**

Conduct a study of Bolivia's wheat and flour markets and related policy issues to provide a basis for (1) future decision-making pertaining to additional wheat sales to Bolivia under PL480, (2) recommendations concerning the content and implementation of a national wheat policy, and (3) a consensus among policymakers involving a national wheat policy to maximize the incentives provided to local producers.

**Guinea-Bissau (FY87)**

Provide assistance in the reduction of storage losses which included (1) review of current storage methods used by villagers in selected areas and suggest how methods could be modified to reduce losses, (2) outline a method to measure the extent of losses using traditional versus modified methods, (3) assist the National Plant Protection Service in establishing a national collection of identified stored-product pests, (4) review warehouse practices and fumigation methods used at national warehouses, and (5) recommend procedures for setting up a section with the National Plant Protection Service capable of providing technical advice to farmers on reducing village-level storage losses.

**Belize (FY88)**

Development of a program for commodity price stabilization for basic grains.

**Egypt (FY88)**

Project design for a proposed grain and fertilizer storage project.

**Kenya (FY89)**

Conduct a needs assessment study to determine the requirements for improving the organizational structure of the nine regional offices of the Kenyan National Cereals and Produce Board.

**Egypt (FY89)**

Conduct a study to develop practical guidelines for rational allocation of fertilizers from fertilizer plants and port facilities, with a view to improve the efficiency of the fertilizer transportation system.

**Egypt (FY89)**

Conduct a study to (1) review the horticultural sub-sector, (2) project the horticultural supply and demand, and (3) determine the economic benefits of a proposed integrated horticultural marketing project.

**Ecuador (FY89)**

Provide assistance to (1) review and revise the strategic reserve concept paper prepared by the Instituto de Estrategias Agropecuarias (IDEA), (2) develop, in collaboration with the Policy Analysis Unit of the Ministry of Agriculture (MOA) and IDEA, an evaluation of the advantages and disadvantages of alternative strategic reserve policies, and (3) prepare a summary of the evaluation with recommendations for the Vice-President of Ecuador and MOA.

**Haiti (FY90)**

Conduct a survey to ascertain how to determine the most reasonable operating costs of La Minoterie D'Haiti, a wheat flour mill in the Republic of Haiti. The study encompassed (1) evaluation of what the mill's current production and delivery costs and costs under an efficient system, (2) determination of mill's current extraction rate and extraction rate under an efficient system, (3) calculation of the fair price, under an efficient system, of wheat flour and wheat by-products owned and sold by the mill, and (4) a toll milling charge for wheat not owned by the mill.

**AID/S&T/AGR (FY90)**

Conduct a comprehensive evaluation of the Soybean Utilization and Research Project's performance and implementation in accordance with the scope of work of the revised cooperative agreement and log-frame of the project.

**Guatemala (FY90)**

Assist the Instituto de Nutrición para Centro América y Panamá staff in review and revision of a manual on controlling the quality of donated food commodities with suggestions for improving the technical soundness and usability of the manuals by field personnel responsible for handling, storage, transportation, and quality control of food products.

**Haiti (FY90)**

Provide advice to La Minoterie D'Haiti on adjustments in milling operations in order to blend soft red wheat received in the first shipment under the FY89 PL480 Title II Emergency Program with the hard red winter wheat which will be provided to Haiti in the remaining shipments under this program.

**Haiti (FY90)**

Provide a written report which includes (1) an update of the previous analysis of production costs and milling operations of La Minoterie D'Haiti conducted, and (2) an item-by-item description of actions undertaken to date and remaining to be undertaken by La Minoterie D'Haiti under the terms of a memorandum of understanding between USAID/Port-au-Prince and Government of Haiti.

**Guinea-Bissau (FY90)**

Conduct a cashew market study with the objective of providing a better understanding to the government cashew policies and intervention programs as well as the structure, conduct, and performance of the domestic cashew market. A secondary purpose was to provide a better understanding of the world cashew market for domestic policy and private-sector development purposes. The study was composed of (1) an analysis of the cashew production/processing phase in Guinea-Bissau, (2) an analysis of the cashew marketing/export phase within the country, and (3) an analysis of the international cashew trade.

**El Salvador (FY91)**

Assess the feasibility of a proposed plan to privatize El Salvador's basic grain and edible bean markets from two perspectives: (1) economic, and (2) technical.

**Guinea-Bissau (FY91)**

Present a seminar series on the Policy Analysis Matrix (PAM) methodology for analyzing agricultural policy, and present the results of a study on the cashew industry in Guinea-Bissau.

**Guinea-Bissau (FY91)**

Construct a project design and develop a project paper. The goal of the project was to reinforce a supportive environment for the growth of the agricultural private sector. The purpose of the project was to strengthen the capability of the government to develop and implement agricultural and food security policies that support rational resource utilization in a market-directed economy.

**Guinea-Bissau (FY91)**

Review a CILSS report on history, current status, and future of the agricultural sector in Guinea-Bissau.

#### **Guatemala (FY91)**

Provide assistance to Instituto de Nutrición para Ciento América y Panamá (INCAP) to diagnose and evaluate problems in the processing, handling, storage, marketing, and quality assurance of basic grains, sub-products, and derivatives for the Central American region. Assist in the design of methodologies for country studies which will assess the grain management issues described, review country study data, assist with analysis of data, and participate in a final workshop where conclusions from the studies will be drawn.

#### **Indonesia (FY92)**

Provide assistance to initiate start-up implementation tasks of the Agribusiness Development Project. This involved (1) development of a first-year work plan for public-sector component of the project, (2) development of a training plan for public-sector personnel, (3) preparation of the associated implementation letter, (4) development of a scope of work for, and catalog of, past and present policies, regulations, decrees, and provincial rules that affect agribusiness, (5) define and supervise implementation of a series of studies to analyze and determine the implications of current and proposed policies, (6) develop alternative strategies on how different ministries will identify and rectify problems with regulations and their implementation, and (7) gather and review literature on various development programs.

#### **Guinea-Bissau (FY92)**

Conduct a ponteiro study to determine the degree to which ponteiros (commercial farmers) are financially and economically profitable so as to derive an indication of the degree to which they are making efficient use of resources.

Conduct a domestic rice marketing study to provide information on and analysis of the domestic rice marketing, distribution, and processing system from its first assembly points to the wholesale level. Study is to assess the efficiency of the system and identify major deficiencies in the system. Construct a model of the domestic rice industry that can be used to evaluate the (1) impacts of government policy on the ability of domestically produced rice to compete with imported rice, and (2) financial feasibility of alternative market channel configurations, focusing on alternative sizes and locations of rice mills.

#### **Ukraine and Russian Federation (FY93)**

Conduct a study to (1) identify storage constraints and develop recommendations to address constraints, (2) determine the feasibility and develop recommendations on low-cost on-farm and/or nearby storage facilities, (3) provide technical assistance to host-country counterparts on technical aspects of establishing, operating, and maintaining storage facilities that will minimize losses, (4) identify training and technical assistance needs, and (5) identify potential marketing and investment opportunities for U.S. manufacturers and suppliers of storage facilities, equipment, and technology.

### Poland (FY93)

Conduct an evaluation of activities under the Land O'Lake's cooperative agreement with the Agency for International Development.

### Haiti (FY93)

Provide services of a long-term staff person to the Productive Land Use Systems Project in Haiti. Specific responsibilities are to (1) design, implement, and report on baseline studies of land use practices, (2) design and carry out surveys to determine partial farm budgets and the applicable socio-economic indicators to establish key criteria to evaluate project impact on farm families and their environment, (3) analyze and monitor marketing structures which affect farmers selection of crop, land use, and farming systems, and analyze, monitor, and stratify adoption rates of various technologies, practices, tree species, and crops to assist grantees in their planning.

### El Salvador (FY93)

El Salvador Private Basic Grains and Edible Bean Markets, Phase 2. Continuation of the divestiture process of government-owned grain handling and storage facilities. Encompasses the actions of (1) support to the Privatization Unit of MOA, (2) direct support to beneficiaries of privatization (technical assistance, training), and (3) training in grain production and marketing statistics for División general de Estadísticas Agropecuarias staff.

### Technical Assistance Reports

As a result of the above described technical assistance activities, a number of reports were published by the FFGI staff. These reports are as follows.

Maxon, R., et al. December 1985. "Alternative Scenarios for Commodity Price Stabilization Programs in Belize." Technical Assistance Report No. 106.

Phillips, R., et al. June 1986. "Recommended Evaluation of Policies and Programs of the Consejo Nacional de Producción (CNP), Costa Rica." Technical Assistance Report No. 107.

Stryker, H. October 1986. "Report on Grain Storage Facilities in Panama." Technical Assistance Report No. 108.

Maxon, R., et al. July 1986. "The Toledo Agricultural Marketing Project, A Working Paper." Technical Assistance Report No. 109.

Hugo, C., et al. December 1986. "Policy Alternatives for the Production and Marketing of Wheat in Bolivia." Technical Assistance Report No. 110.

Acasio, A. March 1987. "Proposed Agricultural Mechanization Program and Curriculum at the Escuela Agrícola Panamericana (Zamorano), Honduras." Technical Assistance Report No. 111.

Phillips, R., et. al. July 1987. "Toward Commodity Price Stabilization in Belize." Technical Assistance Report No. 112.

Phillips, R., et. al. February 1988. "Gearing CNP to Support Agricultural Change in Costa Rica: An Evaluation of Policies and Programs of the Consejo Nacional de Producción." Technical Assistance Report No. 113.

Flores, R., and P. Reddy. September 1989. "La Minoterie D'Haiti - An Analysis of Production Costs and Milling Operations." Technical Assistance Report No. 114.

Reddy, P. November 1989. "La Minoterie D'Haiti Wheat Blend Study." Technical Assistance Report No. 115.

Flores, R., and P. Reddy. February 1990. "La Minoterie D'Haiti - An Update of Production Costs and Milling Operations." Technical Assistance Report No. 116.

Reddy, P. March 1990. "La Minoterie D'Haiti Wheat Blend Study II." Technical Assistance Report No. 117.

Lea, J., et al. April 1990. "Rice Production and Marketing in Guinea Bissau: A Contribution for Policy Dialogue." Technical Assistance Report No. 118.

Lea, J., et al. September 1990. "A Review of the Cashew Sub-sector in Guinea Bissau." Technical Assistance Report 119.

Reddy, P. October 1991. "PL480 Export Flour to Haiti and Update of La Minoterie's Operations." Technical Assistance Report 120.

Hugo, C., et. al. September 1991. "Invigorating the Seed Industry in El Salvador." Technical Assistance Report No. 121.

Neils, K., et. al. January 1992. "National Food Security Stock Policies and Procedures in Sub-Saharan Africa, Literature Review and Inventory." Technical Assistance Report No. 122.

Borsdorf, R. and M. Moran. January 1992. "Food Importation and Distribution Study, Sri Lanka." Technical Assistance Report No. 123.

Neils, K., et. al. January 1992. "National Food Security Stock Policies and Procedures in Sub-Saharan Africa, Case Studies." Technical Assistance Report No. 124.

Lea, J. and A. Barbosa. May 1992. "Rice Marketing in Guinea-Bissau: A Study to Develop Information for Policy Makers." Technical Assistance Report No. 125.

Borsdorf, R., et. al. September 1992. "Marketing and Investment in the Grains Area Ukraine and Russia." Technical Assistance Report No. 126.

Neils, K., et. al. May 1992. "National Food Security Stock Policies and Procedures in Sub-Saharan Africa, Recommendations." Technical Assistance Report No. 127.

Hugo, C., et. al. October 1992. "The Agricultural Inputs Industry in El Salvador." Technical Assistance Report No. 128.

Borsdorf, R., et. al. October 1992 "An Assessment of the Storage of Grains in Ukraine and Russia." Technical Assistance Report No. 129.

Langworthy, M. November 1992. "The Ponteiro Census: Descriptive Results and Economic Analysis." Technical Assistance Report No. 130.

Hugo, C., et. al. December 1992. "A Supply Response Study for Basic Grains in El Salvador." Technical Assistance Report No. 131.

Neils, K. February 1993. "Training Manual in Marketing for the Personnel of the Agricultural Statistics Office of the Government of El Salvador." Technical Assistance Report No. 132.

Robles, J. February 1993. "Manual de Entrenamiento del Personal de la Dirección General de Economía Agropecuaria El Salvador." Technical Assistance Report 132B.

Borsdorf, R. February 1993. "The Wheat Flour Distribution System in Sri Lanka and The Wholesale and Retail Operations of the Cooperative Whole Establishment." Technical Assistance Report No. 133.

Ramos, H., et. al. March 1993. "Effects of the Structural Adjustment Program on the Demand and Consumption of Basic Grains in El Salvador." Technical Assistance Report No. 134.

Hugo, C. and K. Neils. July 1993. "Structural Reforms and the Need for a Strategic Basic Food Reserve in El Salvador." Technical Assistance Report No. 135.

Borsdorf, R. October 1993. "Cereals Consumption in Sri Lanka." Technical Assistance Report No. 136.

## SECTION IV

### ON-CAMPUS TRAINING

On-campus training activities involved (1) academic degree training in five disciplines, (2) the annual Grain Storage and Marketing Short Course (GSMSC), and (3) special short courses and programs which were presented upon request.

#### Academic Degree Training

During the first two years of the project, funding was provided for academic training for four students. Due to budget limitations after that time, no graduate students were funded by the project beyond that period.

The FFGI staff advised and assisted students sponsored by other national and international organization who are working on degrees in fields related to postharvest grain systems. The five academic disciplines are agricultural economics, agricultural engineering, entomology, grain science, and food science.

During the life-of-project, the FFGI staff assisted and advised 40 graduate students from 21 countries whose studies related to postharvest grains systems. Thirty-six graduates received degrees and four graduate students are in the process of completing their degrees. Graduate students, degree earned, and year of graduation, by academic discipline, are as follows.

#### **Agricultural Economics**

E. Arce-Diaz, Costa Rica	Ph.D.	1992
W. Barantes, Costa Rica	Ph.D.	1992
A. Hashem, Egypt	Ph.D.	1985
D. Avila, Honduras	M.S.	1989
R. Ingle, Honduras	M.S.	1993
Y. Kwon, Korea	Ph.D.	1992
C. Akhimien, Nigeria	M.S.	1990
A. Osunsan, Nigeria	M.S.	1990
H. Shah, Pakistan	M.S.	1992
V. Eusebio, Philippines	Ph.D.	1987
K. Mulenga, Zambia	M.S.	1991

#### **Agricultural Engineering**

A. Song, P.R.C.	Ph.D.	1989
E. Arce-Diaz, Costa Rica	M.S.	1988
C. Benavides, Costa Rica	M.S.	1987
O. Negrini, Costa Rica	M.S.	1989
A. Hamid, Pakistan	M.S.	1990

### Food Science

B. Kanujoso, Indonesia	Ph.D.	1987
M. Kerpisci, Turkey	M.S.	1988

### Entomology

J. Espinal, Honduras	Ph.D.	1993
M. Cassama, Guinea-Bissau	M.S.	1991
R. Urrelo, Peru	Ph.D.	1987
A. Itto, Sudan	Ph.D.	1988

### Grain Science and Industry

L. Shen, P.R.C.	M.S.	1992
R. Flores, Costa Rica	Ph.D.	1989
M. Zeledon, Costa Rica	Ph.D.	1986
F. Mejia, Dominican Republic	M.S.	1988
J. Espinal, Honduras	M.S.	1986
L. Pinel, Honduras	M.S.	1990
H. Hooshmand, India	M.S.	1991
P. Guritno, Indonesia	Ph.D.	1992
K. Kouakou, Ivory Coast	Ph.D.	1990
F. Anjum, Pakistan	Ph.D.	1991
N. Ullah, Pakistan	Ph.D.	1990
L. Wongo, Sudan	Ph.D.	1986
H. Ben Hamza, Tunisia	M.S.	1990
A. Arrevillagas, Venezuela	M.S.	1987

### Grain Storage and Marketing Short Course (GSMSC)

The annual seven-week GSMSC was held at KSU from 1986 through 1992. The 1993 GSMSC was canceled due to the insufficient number of participants enrolled.

The course was directed towards persons involved in the storage and marketing of cereal grains and legumes in developing countries, including grain-handling facility managers, grain quality control agents, agricultural extension specialists, food security officers, grain marketing managers or analysts, and economic and market development planners. The course was designed to relate subject matter to basic food policies, basic food systems development, and grain storage and merchandising operations in developing countries.

Participants received two weeks of basic instruction in the areas of grain properties, storage methods and procedures, principles of drying and aeration, pest control, principles of management and operations, principles of marketing, and grain marketing systems and their development. Following the two weeks of basic instruction, participants took part in a week-long study tour. The tour allowed participants to observe, compare, and contrast the U.S. grain marketing and storage system and the role of the public and private sectors in that system with that of their own country's grain marketing and storage system. Following this basic instruction and study tour, each participant was allowed to elect to

specialize in either marketing or storage, and received an additional three weeks of in-depth training in the chosen area.

The course was conducted in English with simultaneous translation into French and Spanish. Course manuals and other instructional material were provided in three languages.

During the life-of-project, this annual course was attended by 185 participants from 55 countries. A list of participants is set forth in the following pages.

#### Special Short Courses and Programs - BOA Buy-ins

Two special short courses and training programs were presented at KSU through buy-ins under BOA.

##### **Food Aid Managers Training Course, Grain and Grain Products (FY90, FY91)**

A two-week training program to convey a general description of the different technical aspects, procurement, and management processes that take place in the movement of grain and grain products in the food chain from farm to PL480 recipients in developing countries. This training program was directed towards food aid managers stationed in Washington, D.C., and overseas posts.

The course content contained the following areas: introduction to postharvest grain systems, properties of grains, inspection system and practices, grain and grain product storage and handling facilities, grain quality preservation, commodity processing systems (wheat milling, corn milling and processing, extrusion of grain products, rice processing, pulse processing, vegetable oil processing, flour blends and quality control), economics of grain processing, commodity transportation, commodity and freight purchases, commodity supplying - an industry perspective, and monitoring, accountability, and auditing in the food aid process.

The 1990 course was attended by 26 participants, composed of six from AID/Washington, 10 from AID field missions, seven from private voluntary organizations, two from World Food Programme, and one from USDA.

The 1991 course was attended by 26 participants, composed of four from AID/Washington, 13 from AID field missions, seven from private voluntary organizations, and two from World Food Programme.

#### Special Short Courses and Programs - Informal Buy-ins

Nine special short courses and training programs were presented at KSU through informal buy-ins.

##### **Agroindustrial Project Analysis Short Course (FY89/FY93)**

A six-week short course with the objectives of training participants in the practical analysis of small- and medium-scale agribusiness project within a marketing, procurement, and processing systems framework. Participants are expected to develop knowledge and skills to: (1) identify critical marketing,

## Grain Storage and Marketing Short Course Participants

1986		1987	
Country	Participant	Country	Participant
Chile	J. Olavarría	Belize	G. Bardalez
Colombia	D. Castillo		D. Foreman
	J. Soto	Brazil	I. Pacheco
	M. Aguilera	Cape Verde	A. Fernandes
El Salvador	F. Conzalez		P. Cardoso
	M. Laínez	Chad	N. Laoubara
	A. Mira	Colombia	H. Contreras
Ghana	E. Amankwa		C. Peña
Haiti	M. François		M. Romero
Indonesia	R. Naseh	Haiti	J. Francoeur
	S. Purnomo	Ivory Coast	S. Melan
	A. Rachman	Malawi	I. Kazanga
	A. Sukardi	Mauritania	Z. Sidi Boubacar
Kenya	R. Bomett		M. Abidine Sidi
	G. Ogola		I. Sow
	K. Munia	Mexico	B. Morales
Mali	K. Sidibe		R. Valenzuela
Niger	B. Hama		M. Martínez
	I. Mahamadou	Nigeria	S. Lawai
Pakistan	A. Hayee		P. Olajide
	G. Mughal	Pakistan	M. Khan
Rwanda	E. Nizeyimana		A. Dasti
Somalia	A. Jibril		S. Maken
Togo	A. Biliwa		S. Kalwar
	A. Kolou		M. Baig
	B. Kamba		S. Qureshi
Zaire	B. Mbuyu	Paraguay	D. Gonzalez
		Somalia	A. Abdullahi
			M. Sheik
		Turkey	A. Arkun
			N. Kazang
			S. Erciyes
			R. Arat

## Grain Storage and Marketing Short Course Participants

1988		1989	
Country	Participant	Country	Participant
Bolivia	H. Múnoz	Brazil	O. Ribeiro
Burkino Faso	A. Traore		M. Teixeira
Cameroon	R. Wanzie	Burundi	B. Baithazar
C.A.R.	A. Mokombo	Cameroon	A. Tangwe
Colombia	R. Vargas	Costa Rica	B. Blackman
Ethiopia	G. Dessalegn	El Salvador	O. Gómez
Honduras	G. Pérez	Haiti	V. Irvin
	A. Morazán	Kenya	I. Kiiru
	G. Murillo		F. Odok
Madagascar	P. Rakotoson		S. Injairu
	H. Ramanoelina	Madagascar	R. Bernard
	J. Ravelomanantsoa		R. Rakotoarimanana
Malawi	L. Rompwa	Mexico	A. Tornero
	V. Mhango	Morocco	B. Abdellatif
Mauritania	M. Biha		L. Grass
Mexico	J. Guani	Pakistan	S. Shahabuddin
	E. Negrete		A. Chaudhry
	E. Calvillo		I. Baluch
Mozambique	E. Julio	Somalia	M. Osman
Nigeria	N. Obinatu	Swaziland	L. Diamini
Pakistan	G. Rasul	Togo	A. KoúSanta
	I. Junejo	Tunisia	H. Hamza
	G. Memon	Turkey	M. Bumin
P.R.C.	Y. Yuan		L. Emiroglu
Philippines	E. Cayabyab		C. Aydemir
Somalia	M. Osman		B. Yardimci
Turkey	A. Naibantoglu		M. Turgut
	E. Oksuz	Yemen	M. Al-Morrisy
	K. Unal		K. Al-Aghbard
	A. Uz		A. Mohammed
Zambia	M. Chitalu	Zambia	C. Emmanuel
	W. Mulenga		J. Chikwanda
	M. Chilemya		S. Mukelabai
	F. Katumbi		

## Grain Storage and Marketing Short Course Participants

1990		1992	
Country	Participant	Country	Participant
Belize	E. Jacobs	Chad	M. Abderamane
	A. Gomez	Congo	L. Matokot
Cape Verde	V. Texeira	Ecuador	L. Balladares
China	L. Zhu	El Salvador	V. Alegria
	Y. Tong		R. Aleman
Guatemala	V. Mayorga		E. Cruz Palencia
	G. Nowell		F. Gonzalez
Guinea-Bissau	C. Ribeiro	Honduras	R. Almendarez
Honduras	F. Reyes		J. Galindo
Kenya	E. Owiti		M. Lobo
Mexico	J. Aranda		J. Marconi
	E. Magallon		V. Zelaya
	A. Armenta	Jamaica	D. Geoghagen
Morocco	M. Korachi	Ivory Coast	R. Sears
	M. Farjan	Mexico	P. Seañez
Pakistan	S. Ahmed		J. Varquez Martinez
	A. Ahmed	Myanmar	A. Oo
	T. Mahmood		S. Tun
	S. Ahmed		
Paraguay	C. Gaona		
	M. Amarilla		
Poland	S. Konewka		
	L. Switala		
Tunisia	M. Barkia		
	K. Touhami		
Yugoslavia	A. Novakovio		
Zambia	R. Musukwa		

  

1991	
Country	Participant
Botswana	L. Modidi
Burkina Faso	K. Kabore
Guatemala	J. Ruiz
Morocco	A. Ait El Gadi
	R. El Mezroud
Mexico	E. Herrera
	C. Livas-Hernandez
	J. Zuniga
Nicaragua	E. Vanegas
	G. Perez
Panama	A. Gonzales
Venezuela	E. Guarecuco

production, procurement, processing, and distribution components in agribusiness projects, (2) identify data collection and analysis needs for each component, (3) calculate financial and economic impacts, (4) determine internal rates of return on investment, and (5) identify socio-economic and institutional factors that affect agribusiness projects.

Participants received instruction in the areas of definition of agroindustrial projects, role of agroindustrial project in economic development, role and value of a systems approach in project analysis, role of the analyst; definition of the steps in project analysis; market analysis; analysis of procurement and processing operations; determination of information needs; methods of information collection including interviews; technical analysis; economic analysis; financial analysis; calculation of internal rates of return and return on investment; sensitivity analysis; identification of socioeconomic and institutional issues; and methods and formats to present the project analysis. Six field trips to tour operational facilities allowed participants to discuss planning, analysis, management, and finance with private-sector firms and entrepreneurs.

The 1989 course was attended by three participants from two countries. The 1990 course was attended by 13 participants from 11 countries. The 1991 course was canceled to a low participant enrollment. The 1992 course was attended by 12 participants from 10 countries. The 1993 course was attended by 17 participants from eight countries. A total of 45 participants from 27 countries attended this annual short course. A detail of participants and their respective countries is provided on the following page.

#### Grain Storage Management Short Course (FY90)

The Grain Storage Management Short Course (GSMGTSC) was provided for managers and technicians involved in the storage and management of cereal grains in Pakistan. The objective of the course was to increase participants' knowledge and skills in the areas of basic principles of grain storage, causes of grain loss, prevention of grain deterioration, grain inspection, and management and operational procedures. Emphasis was placed on the handling and storage of grain in bulk.

Participants received instruction in the areas of management of facilities, properties of grains, aeration and drying, inspection systems and practices, microorganisms, storage pests, pest control, and storage structures. Four field trips to tour operational facilities allowed participants a practical view of grain handling and storage facilities.

Eleven Pakistani participants attended the short course, their names, positions, and agencies are as follows

M. Abbas, District Food Controller, NWFP Food Department  
M. Azhar, Deputy Director, Punjab Food Department  
M. Kassi, Purchase Officer, Pakistan Storage and Services Corporation (PASSCO)  
M. Iqbal, Senior Project Manager (Field), PASSCO  
A. Shah, Deputy Project Manager (Field), PASSCO  
S. Taireja, Food Inspector, Directorate General Food, MINFA  
M. Hussain, Assistant Manager - Marketing, Punjab Seed Corporation

## Agroindustrial Project Analysis Short Course Participants

1989			
Country	Participant		
Bangladesh	K. Hasan		
	M. Ghaziul Hug		
Haiti	J. Nerette		
1990		1993	
Country	Participant	Country	Participant
Burundi	P. Camirirwa	El Salvador	A. Camara
	R. Ntareme		C. Carcamo
Cameroon	N. Joseph		R. Perdomo
Egypt	A. Mostafa		J. Soto
Honduras	G. d'Estephen	Mali	A. Camara
Indonesia	T. Napitupul	Myanmar	T. Aung
Nepal	T. Shrestha		T. Than
Pakistan	H. Shah		S. Aye
Rwanda	S. Mugesera	Nigeria	J. Agbaji
	A. Uwizeye		J. Alamina
Turkey	Y. Koca		A. Eyong
Zimbabwe	A. Rukovo		A. Oqua
Zaire	T. Mulubay		R. Ekuma
		P.R.C.	J. Jia
		South Korea	J. Kim
		Sri Lanka	S. Daniel
		Venezuela	L. Arraez
1992			
Country	Participant		
Cameroon	J. Agwe		
Guinea-Bissau	A. Barbosa		
	R. Djata		
Ivory Coast	K. Valhoua		
Kenya	U. Khosla		
Morocco	S. Mammass		
Myanmar	U. Htay		
	U. Wai		
Nepal	A. Tandon		
Nigeria	V. Afonja		
Philippines	B. Manalansang		
Zambia	C. Banda		

M. Khattak, Section Officer, Storage, MINFA  
M. Alam, Assistant Entomologist, Punjab Cotton Research Institute  
A. Qadir, Assistant Botanist, Cereal Crop Research Institute  
S. Khan, Training Officer, Storage Technology Development and Transfer Project

#### **Flour Mill Executive Training Program (FY90)**

Conduct a five-week training program for two Pakistani flour mill executives. The training program included attendance in a two-week International Grains Program (IGP) Flour Milling Short Course. The remaining three weeks of the program provided training in grain quality preservation, grain storage and handling, and flour quality control. A series of field trips to private-sector milling operations, grain storage and handling facilities, pasta-processing plants, and related businesses were conducted.

The participants were: S.M. Shabbir, Chief Executive Officer, Rawalpindi Flour and General Mills Ltd, Rawalpindi; and S.T. Sadiq, Executive Director, Sinhala Flour and General Mills Ltd, Islamabad.

#### **Bulk Grain Storage Management Short Course (FY93)**

Conduct a six-week Bulk Grain Storage Management Short Course for a group of participants from Pakistan. The goal of the training is to enhance the skills of participants in the area of storing and handling grain in bulk form and to assist the current effort underway in Pakistan in moving from a bagged-grain to bulk-grain system. The objective of the course is to increase participants' knowledge and skills in the areas of properties of grains; handling, cleaning, and conditioning of grain; grain protection; and management of grain storage facilities.

Participants received two weeks of basic instruction on the following topics: postharvest systems; moisture and its measurement; sampling and inspection; physical, biochemical, and other changes of grain in storage; structures of cereal grains; microorganisms and mycotoxins; grain cleaning systems and equipment; grain handling systems and equipment; grain drying and aeration systems; and storage-related systems. After this two-week period of basic instruction, the participants received further instruction on the following topics: stored-grain insect biology and identification; vertebrate pests and identification; methods of pest control; inspection of storage facilities; inspection of grain; housekeeping; physical and mechanical control of pests; organization, direction, and cost control of facilities management; fumigations; grain inventory control and management; managerial planning; stock position and management with computers; inventory control of equipment and supplies with computers; and inventory and management reporting with computers. Field trips included such locations as local farmer cooperatives, research laboratories, grain inspection services, air-supported storage structures, equipment manufacturers, equipment and facility design companies, a board of trade, grain and flour corporations, and several grain elevators.

Nine Pakistani participants attended the short course, their names and agencies are as follows:

G. Ahmed, PASSCO  
M. Bokhari, Balochistan Food Department  
J. Hashmi, PASSCO  
M. Hayat, PASSCO  
S. Jamali, PASSCO  
S. Khan, PASSCO  
F. Sheikh, Sindh Food Department  
N. Tajwar, Punjab Food Department  
I. Unar, Sindh Food Department

**Bulk Grain Storage Engineering Short Course (FY93)**

Conduct a six-week Bulk Grain Storage Engineering Short Course for a group of participants from Pakistan. The goal of the training is to enhance the skills of participants in the area of storing and handling grain in bulk form and to assist the current effort underway in Pakistan in moving from a bagged-grain to bulk-grain system. The objective of the course is to increase participants' knowledge and skills in the areas of properties of grains; handling, cleaning, and conditioning of grain; planning and selecting bulk storage facilities; and repair, maintenance, and inventory of storage facilities and equipment.

All participants received two weeks of basic instruction on the following topics: postharvest systems; moisture and its measurement; sampling and inspection; physical, biochemical, and other changes of grain in storage; structures of cereal grains; microorganisms and mycotoxins; grain cleaning systems and equipment; grain handling systems and equipment; grain drying and aeration systems; and storage-related systems. After this two-week period of basic instruction the participants received further instruction on the following topics: grain handling equipment design; stored-grain pests and control; grain drying principles; drying facilities and operations; planning of storage facilities; design of aeration systems; design of dust control systems; design of auxiliary systems; design of electrical systems; design of storage and handling facilities; supervisory and consulting engineering; inspection and inventory of equipment; and repair and maintenance programs. Field trips included such locations as local farmer cooperatives, research laboratories, grain inspection services, air-supported storage structures, equipment manufacturers, equipment and facility design companies, grain and flour corporations, and several grain elevators.

Five Pakistani participants attended the short course, their names and agencies are as follows:

M. Akram, Punjab Food Department  
Z. Aziz, PASSCO  
M. Bukari, PASSCO  
Z. Iqbal, PASSCO  
M. Malik, PASSCO

**Grain Grading and Inspection Short Course (FY93)**

Conduct a four-week grain grading and inspection short course for a group of participants from Pakistan. The objective of the training is to enhance the

skills of participants in the area of grain grading, grain inspection, and the development and implementation of grain quality standards.

During the first week of instruction, participants received instruction in such topics as: U.S. grain marketing systems; U.S. grain transport systems; U.S. warehousing laws; grain sampling theories and practices; sampling strategies and plans; sampling practices; U.S. grain inspection service; Pakistani and U.S. grain inspections; and sample analysis theories and practices.

The second and third weeks of the course were spent in technical training in wheat and rice grading (respectively) with the Federal Grain Inspection Service (FGIS). During Week 4, participants received hands-on technical training in corn grading, as well as discussing the development of future action plans as they relate to the situation in Pakistan.

In addition to the week-long study tours to FGIS in Kansas City, Missouri, and Stuttgart, Arkansas, field trips to a local cooperative elevator, a wheat farm, a flour mill, and the Kansas State Warehouse Examiner's Division of FGIS were used to enhance the practical orientation of the training course.

Nine Pakistani participants attended the short course, their names and agencies are as follows:

M. Abbasi, PASSCO  
R. Ahmed, PASSCO  
M. Hussain, Punjab Food Department  
S. Khan, PASSCO  
J. Khan, Balochistan Food Department  
A. Lehri, Balochistan Food Department  
N. Manghi, Ministry of Food, Agriculture and Cooperatives  
K. Muhammad, PASSCO  
H. Sheikh, Punjab Food Department

### Training Manuals

The following training manuals were developed for use in the previously described short courses, and for use in the Seed Improvement Training Course presented by the Seed Technology Laboratory at Mississippi State University.

Storage Manual, Grain Storage and Marketing Short Course  
Marketing Manual, Grain Storage and Marketing Short Course  
Pests of Stored Grains and Seeds and Their Control  
(Seed Improvement Training Course, MSU)  
Food Managers Training Course, Grain and Grain Products  
Agroindustrial Project Analysis, Text  
Agroindustrial Project Analysis, Workbook  
Agroindustrial Project Analysis, Exercises  
Agribusiness Planning and Financial Analysis, Volume I  
Agribusiness Planning and Financial Analysis, Volume II  
Milling Executives Training Program  
Grain Storage Management Manual  
Grain Storage Engineering Manual

**Grain Grading and Inspection Manual**  
**Integrating the Technical and Marketing Approach for Profitable Utilization of**  
**Grain Postharvest Technology.**

## SECTION V

### IN-COUNTRY TRAINING

In-country training activities involved special short courses and programs which were presented upon request.

#### BOA Buy-ins

Two short courses and training programs were presented in two countries as buy-ins under BOA. A description of these short courses and training programs is set forth below.

#### **Chad (FY1986)**

Presented a six-day training course, Training in the Quality Preservation of Stored Cereal Products in Chad, for warehouse managers from CARE/Chad, World Food Program, Red Cross/Red Crescent, Catholic Relief Services, and Chadian National Cereals Office. The course was attended by 25 participants. A training manual was prepared in the French language.

#### **Sudan (FY87)**

Training programs in grain storage management for warehouse managers and other supervisors operating grain storage facilities belonging to the Agricultural Bank of Sudan and the private sector.

#### Informal Buy-ins

Four short courses and training programs were presented in four countries under direct contractual agreement between the funding agency and FFGI. A description of these short courses and training programs is set forth below.

#### **Honduras (FY87)**

Conduct an evaluation of existing areas of study in farm mechanization at the Escuela Agrícola Panamericana (EAP), and provide assistance in the academic programming for new areas of study in farm mechanization.

#### **Dominican Republic (FY90)**

Provided training services for the conduct of the five-day Food Storage and Handling Workshop. This included development of training schedule, selection and development of training aids and materials, preparation of a training manual for use in the workshop, facilitation of workshop, and training in the fields of physical management of commodities, warehouse sanitation, warehouse conditioning, and disposal of damaged commodities. Thirty-two participants from nine countries attended the workshop.

### **Bolivia (FY91)**

Provided training services for the conduct of a six-day Food Handling and Storage Workshop. This included schedule and program design, and training in the fields of physical management of commodities, warehouse sanitation, warehouse conditioning, and disposal of damaged commodities. Forty-four participants from private voluntary organizations (PVOs) in three countries attended the workshop.

### **Indonesia (FY92)**

Presented a three-week Agroindustrial Project Analysis Short Course for Heads of Bureau of Planning subdivisions, Ministry of Agriculture. The objectives of the short course were to increase participant's knowledge and skills in (1) the critical issues of agroindustrial project analysis relating to marketing, procurement, and processing, and (2) analytical techniques available to analyze the operational, economic, financial, and social feasibility of an agroindustrial project.

The participants received instruction in definition of agroindustrial projects, role of the analyst, role and value of a systems approach in the analysis, steps involved in conduct of the analysis, product market analysis, raw material procurement market analysis, processing facility analysis, calculating internal rates of return on total capital invested, using sensitivity analysis to predict how alterations in assumptions affect the rate of return, and methods and formats to present the results of the analysis. The participants were formed into four working groups and selected an Indonesian agribusiness for use as a case study. The cases selected for analysis were: (1) cassava processing, (2) cattle slaughter and meat processing, (3) crepe rubber processing, and (4) shrimp production and processing. They were guided through a complete planning and feasibility analysis of their selected cases.

Twenty-six participants attended the course, of which 22 were from the Ministry of Agriculture and four from the Ministry of Industry.

### **El Salvador (FY91-93)**

As a part of the El Salvador Basic Grains and Edible Bean Markets Project, a series of seminars were presented based upon (1) privatization of the grain industry, and (2) studies conducted for support of liberalization of the economy. These seminars are as follows:

- One seminar for members of the seed industry on status of seed industry and present programmatic approach to implement action recommendations for invigorating the industry.
- Two seminars for beneficiaries of the privatization effort of public grain handling and storage facilities. Topics included relevant issues for grain production and marketing under a liberalized trade regime, and the nature and role of a grain merchandising firm in a liberalized trade regime.

- Two seminars for private-sector firms and public participants on status of fertilizer and pesticide industry.
- Ten seminars for potential beneficiaries of the privatization effort of public grain handling and storage facilities. Topics included (1) relevance of macro and sectorial reforms to basic grains production, marketing, and the privatization program, (2) relevant aspects of the privatization program, and (3) potential benefits and risks associated with buying a facility and running it as a grain merchandising firm.
- Two seminars (CENTA and private sector) to review relevant results and conclusions of agrochemical industry study.
- One seminar for policy-makers on mobilizing resources for improved agricultural policy analysis and decisions in El Salvador.
- Two seminars for private sector on export of ethnic Salvadorian foods to the U.S.
- One seminar for the Unidad de Análisis de Políticas Agrícolas (UAPA) in supply response for basic grains in El Salvador.

As a part of the El Salvador Basic Grains and Edible Bean Markets Project, a series of training sessions were conducted for the staff of the Dirección General de Economía Agropecuaria El Salvador (DGEA) and UAPA in marketing and production information and statistics.

- Three-week OJT course in (1) area frame and production statistics, and (2) marketing information and statistics.
- Two-week OJT course in marketing information and statistics.
- Two-week OJT course in area frame and production statistics.

#### Training Manuals

The following training manuals were developed for use in the in-country short courses previously described.

Preservation of Stored Cereal Products in Chad  
 Workshop on Handling of Grains and By-Products  
 Training Manual in Marketing for the Personnel of the Agricultural Statistics  
 Office of the Government of El Salvador (English and Spanish)  
 Manual de Entrenamiento del Personal de la Dirección General de Economía  
 Agropecuaria El Salvador

## SECTION VI

### NETWORKING

#### GASGA

FFGI has been a member of GASGA since 1974. Other members of this group are Natural Resources Institute (NRI), United Kingdom; Centre de Cooperation-Internationale en Recherche Agronomique pour le Développement (CIIMYT/CIRAD), France; International Development Research Center (IDRC), Canada; Australian Center for International Agricultural (ACIAR), Australia; Food and Agriculture Organization (FAO), Rome; and Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Germany.

This group attempts to reduce food losses and increase the quantity and quality of food available to people in developing countries. The FFGI staff attended each of the annual GASGA executive meetings from 1986 through 1992. FFGI hosted the 22nd Annual Executive Meeting in June of 1990, at KSU. In addition, FFGI translated, printed, and distributed the Spanish version of a technical bulletin on the larger grain borer, Prostephanus truncatus in 1988.

#### Escuela Agrícola Panamericana

Over the life-of-project, FFGI collaborated with the Escuela Agrícola Panamericana (EAP) in the following activities:

- Review of facilities for the development of the International Seed and Grain Science Center at EAP.
- Development of a proposal entitled "The Development of a Seed and Grain Science Center for Central America and the Tropics at EAP, Zamarana, Honduras."
- Development of a proposal entitled "Training Proposal for Appropriate Seed and Grains Postharvest Technology" for solicitation of funding for training from the Interamerican Development Bank.

#### Mississippi State University

FFGI and the Seed Technology Laboratory at Mississippi State University (MSU) have exchanged faculty for lectures during their respective short courses (GSMSC and Seed Improvement Training Course) over the life-of-project. The FFGI staff provided lectures covering grain and seed infesting insects, insect biology and identification, rodent and bird biology and identification, and integrated pest management in seed storage for the Seed Improvement Training Course. The MSU staff provided lectures in seed handling and storage for GSMSC.

#### International Research Centers

In an attempt to develop cooperative linkages with international research centers, a series of letters was sent to such centers. These letters inquired

as to the extent of their postharvest activities (such as research, technology transfer, training) and if there was an interest on their part in cooperative undertakings. Responses from these letters indicated that postharvest activities were either minor or non-existent. The response also indicated that because of the low level of postharvest activities, interest in cooperative actions was nonexistent. A letter was sent to the responsible AID/R&D/AGR project officer explaining the results of the inquiries.

Other

- Explore with Centro para Investigaciones en Granos y Semillas (CIGRAS), Guatemala, the possibilities for collaboration in postharvest grain systems development.
- Explore with Dirección General de Servicios Agrícolas (DIGESA) and Instituto Nacional de Comercialización Agrícola (INDECA), Guatemala, the possibilities for collaboration and the status of the grain postharvest system and needs for technical assistance, training, information services, and networking.
- Explore the possibilities for the development of a master plan for grain stabilization with Consejo Nacional de Producción (CNP).

SECTION VII  
PROJECT ACCOMPLISHMENTS

Constraints

During the course of the project (eight years), the original level of funding was reduced. Initially, funding was reduced by 20%. Then funding was reduced a further 12% for a total funding reduction of 29%. In the final three years of the project, funding was reduced a further 23% for a total reduction of annual funding of 45% from the original projected funding level. However, the outputs were never realigned to reflect the dramatic reduction in funding.

This reduction in funding affected the ability of the project to conduct effective networking activities as well as the project's ability to assess and determine the impact of project activities in research, training, and technology transfer.

However, the majority of magnitude of outputs were achieved as shown in the following subsection.

Project Achievements -- Magnitude of Outputs

A comparison of the projected magnitude of expected outputs and outputs achieved is presented in Annex I.

**Core Project**

The project exceeded expected research outputs by 148%, with LDC graduate students performing research at KSU 167% over the target set. Dissemination of research findings to the International Agricultural Research Centers (IARC) and LDC agencies was slightly under the target at a 97% achievement rate. In training, only seven out of the projected eight GSMSCs were conducted due to a lack of minimum number of participants in 1993. The number of graduate students supervised by the FFGI staff and who received degrees exceeded the target by 240%. Achieving networking targets was hampered by funding reductions. Active participation was maintained by FFGI in GASGA, but no collaborative actives could be developed with IARC. A continued collaboration with EAP was carried out over the life-of-project, however no new collaborative activities with other institutions could be developed. This was primarily a result of setting new priorities due to funding constraints.

**Buy-ins**

Achieving targets on buy-ins is more a reflection on how donor agencies, including AID, had focused their development programs and consequently their funding priorities, rather than project actions.

- Only one collaborative research project with an LDC research agency was conducted.

- Buy-ins in technology transfer achieved 78% of project target. Only nine out of the 39 buy-ins came through BOA, a rate of only 23%.
- Buy-ins for in-country and KSU short courses, workshops, and seminars was 370% of project target. Twenty-four of the 37 training activities came through BOA.
- Buyins for short-term training for decision makers achieved 50% of project target.
- Buyins for in-service and on-the-job training was 150% of project target.
- There was no achieved outputs for training of trainers or development of basic training courses. No requests were received for these types of training programs.
- Eighteen training manuals were developed and distributed. This was 360% of project target.

#### Impact of Project Activities

FFGI attempted to assess the impact of its activities. However, it is often difficult to evaluate the exact results in well defined or quantitative terms. The difficulty is furthered by not having available funding resources with which to do assessments.

Some of the known impacts are set forth as follows.

#### **Research**

- José Espinal returned to Honduras and is using his research results to improve farm-level storage of corn through a postharvest project of the Ministry of Natural Resources
- Eduardo Arce-Diaz carried out research at CIGRAS to use in academic training with the result that research in conjunction with academic training prepared him for a management position at CNP.
- The collaborative research project on postharvest losses conducted with CIGRAS in Costa Rica produced a method of measuring grain losses during the storage period inside of the bin. The procedure, called the "Wet Grain Volumetric Method," utilizes the initial and final grain volume, bulk density, and moisture content inside the bin to calculate the initial and final grain dry matter weights. Results obtained with this method were tested against the direct measurement of weight losses of the grain in an experiment. The accuracy obtained was +/- 2.0% of the direct loss recorded. The observations and analyses of the results produced practical recommendations for CNP management regarding grain handling, drying, preservation, and aeration practices. This method can be used for measuring grain losses during storage in other developing countries.

- Results of research conducted in grain drying applicable to small-scale operations were published as an FFGI Research Report. Distribution of this report due to requests was quite large (110 copies). The results of this research were applied to drying needs in Belize and Peru under other project operations.
- Results of research conducted in computerized systems for feasible agribusiness development for microcomputers were published in 14 FFGI Special Reports. These reports (and accompanying program disks) have been widely distributed, and are now being used as supplements to training manuals. Thus the impact of this research is being furthered by a different method of distributing the results of the research.

### **Training**

Upon completing their education, the following graduate students are now employed as follows:

- L. Dávila returned to the Instituto Hondureño de Mercadeo Agrícola (IHMA) to assume a position in management.
- J. Espinal returned to Honduras to become director of a postharvest project of Ministry of Natural Resources.
- B. Kanjuso is a professor in the Department of Chemical Engineering at Gaju Mada University, Jakarta, Indonesia.
- C. Benavides is chief of the Engineering Division of the CNP, San Jose, Costa Rica.
- R. Urrelo is a professor at the Universidad Nacional Agraria de la Selva in Tingo María, Peru.
- A. Itto is a member of the faculty at the University of Jubba in Sudan.
- F. Mejia is employed in a quality control laboratory in the Dominican Republic.
- A. Hamid is employed by the Punjab Department of Irrigation, Pakistan.
- N. Ullah is a senior scientific officer with the Postharvest Management Research Institute, Pakistan Agricultural Research Council.
- L. Pinel is a faculty member of the Seed and Grain Science Center, EAP, Zamorano, Honduras.
- F. Anjum is a professor on the Faculty of Agriculture, University of Agriculture, Faisalabad, Pakistan. He has established a quality control laboratory and is working with the flour milling industry in improving the quality of milled products.

- Y. Kwon is an assistant director in the Ministry of Agriculture, Seoul, Korea.

Short courses conducted at KSU provided training in grain storage, handling, processing, and marketing as well as agribusiness development to 319 participants. Some specific results of training can be identified.

- The participants from Pakistan were mostly employed by institutions involved in the Storage Technology Development and Transfer (STDT) Project. One of the major activities of that project was the conversion of wheat procurement, storage, handling, and distribution from a bagged-wheat system to a bulk-wheat system in the Punjab Province. In 1993, after the close of the STDT project, the Pakistani institutions involved in wheat merchandising continued the conversion program. In 1993, some 75,000 mt of wheat was handled in this manner. While this is only a minor portion of the total wheat volume merchandised, it was five times greater than the volume handled in bulk form in 1992. Current indications are that this program will continue. Evidently, training of personnel for the agencies involved in wheat merchandising did have an impact.
- Participants from Belize trained in the GSMSC worked for BMB and the BMB Rice Mill. These trainees were responsible, with technical assistance, for renovating the rice mill and upgrading its operation so that the facility was more cost effective.
- Participants from El Salvador trained in the Agroindustrial Project Analysis Short Course and the GSMSC are involved in privatization activities of grain storage, handling, and processing facilities in El Salvador. This privatization action has been in process for two and one-half years and is well over 50% complete.

### Technology Transfer

The project has endeavored to transmit technology in the most cost effective manner. In this area the following actions seem to be of paramount importance given the obvious demand for information.

- Services provided by PHDS are request driven. Throughout the life of the project PHDS provided documents on request at an average rate of 5,400 documents per year. This document delivery system serviced nearly 2,000 clients in some 65 developing countries. As a result of this demand for information on postharvest grain systems, the rate of addition to the document base averaged 2,900 new documents per year.
- Distribution of publications, beyond those automatically sent to IARCs and selected developing-country postharvest institutions is also request driven. Over the life-of-project an average of 700 FFGI publications per year were shipped to response to requests. Over this time period, publication requests came from a range of 30 to 64 developing countries.
- The FFGI staff had the opportunity to present some 32 papers at seminars, workshops, and conferences concerning the results of research, technical

assistance activities, or other information involved with postharvest grains systems. The majority of these presentations were by request. Nineteen of these presentations were made to audiences which were largely dominated by participants from developing countries.

### Technical Assistance

Accomplishments through technical assistance provided as a part of the Postharvest Grains Systems R&D Project is best set forth by two examples which were buyins under the BOA.

#### EL SALVADOR PRIVATE BASIC GRAINS AND EDIBLE BEAN MARKETS PROJECT

More than 1.5 million Salvadorians produce and sell basic grains (white corn, rice, sorghum) and edible beans for a major portion of their income. These commodities are the primary food stuffs in the Salvadorian diet, providing an average 70% of the daily caloric and protein intake of the population. Rough grains such as corn and sorghum represent major raw commodity inputs in the feed manufacturing industry and snack foods.

Since the early 1950s the production and market systems for basic grains and edible beans have been affected by government intervention through the Banco de Fomento Agrícola (BFA), and the Instituto Regulador de Abastecimientos (IRA).

In 1989 the Government of El Salvador (GOES) began a comprehensive macroeconomic and structural reform program to redress the deteriorating economic and social conditions in the country. With the reduction in macroeconomic and structural distortions, and in order to maintain the pace of adjustments taking place in the economy, it became critical to revise agricultural-sector policies, incentives, and institutions.

As part of El Salvador's comprehensive economic reform and structural change, GOES entered into a program of modernizing the agricultural sector. The hub of this challenge is the Programa de Reforma e Inversión en el Sector Agrícola (PRISA) to be financed with funds from the World Bank (WB). One of PRISA's six original components was the Agricultural Products Market Improvement Component, designed to assist and strengthen the private-market system for agricultural products, including basic grains and edible beans. USAID/San Salvador supported the PRISA project by providing technical assistance and training to the basic grains part of this project.

The privatization of public companies and institutions is one of the many structural reform policy instruments being used to redefine the public role, transfer appropriate functions to the private sector and diminish state intervention and public costs. Beginning in 1989 GOES ceased its direct intervention in the production and marketing of basic grains and edible beans. The Ministry of Agriculture (MOA) was charged with the privatization of the public grain procurement agencies that are under its responsibility, namely IRA and BFA. Therefore, the grain handling and storage facilities of these two institutions represent the foci of the

privatization program of MOA. Although BFA maintains a strategic reserve of grains and beans, IRA ceased operations completely.

Aside from the fiscal objective, two other socio/economic objectives are key for the privatization program of the GOES grain handling and storage facilities. First, GOES wants to increase the level of competition in the markets for basic grains and edible beans, that is to increase market efficiency, and second to achieve a more equitable market process. To achieve these socio/economic goals it is a GOES priority to transfer most facilities to groups which in the past have not enjoyed an equitable participation in the grain markets, namely the grain producers of the nation, and secondary to other marketing agents.

In 1991 the Food and Feed Grains Institute (FFGI), Kansas State University (KSU) began providing technical assistance to GOES under contract with USAID/San Salvador. The purpose of this activity was to (1) assist the MOA Privatization Unit (PU) with the divestiture process of the IRA and BFA grain handling and storage facilities, and (2) to undertake research, provide information, and improve support systems essential to market driven basic food production and market systems, and (3) to provide a "bridge" until the Agricultural Products Market Improvement Component of the PRISA project became effective.

The close collaboration between FFGI and the GOES Privatization Unit has led to the following results.

#### Privatization

All 16 grain handling and storage facilities belonging to IRA have been legally and technically inspected. Values have been established through appraisal procedures, and estimates of rehabilitation established. The Treasury Department issued official appraisals making the facilities available for sale. The sales prospectuses have been elaborated and were distributed to prospective clients.

IDB has waived the "no-sell" clause of its financing contract with GOES for the four new facilities belonging to BFA. This will allow planning of the sale of the facilities and transfer of the financing obligations to the private sector.

The GOES privatization strategy for the grain handling and storage facilities (steps, procedures, conditions, etc.) has been reviewed and approved by the Secretary of Agriculture. The legal aspects of the privatization strategy have been reviewed and approved by the Secretary of Justice. An Executive Order offering the facilities for sale was issued in October 1992.

Potential buyers were identified and briefed about the privatization effort and potential benefits, and how to participate in the bidding process.

Managerial, marketing, and technical skills and experience of potential buyers have been reviewed in preparation for the expected need to provide technical assistance and training to future owners.

Ten IRA facilities were put up for sale on December 7, 1992. Firm and valid offers have been received for six installations. Sale and transfer to the private sector is expected during March 1993.

The other ten IRA facilities will be transferred to the private sector during 1993, either through public sales or as bonded grain storage enterprises.

One of the BFA warehouses was offered for sale in January 1993. The four grain handling and storage facilities are now being appraised, and will be offered for sale in the next few months.

A plan has been elaborated to privatize CENTA's Division of Seed Technology which would meet the GOES obligations under the Structural Adjustment Loan with WB.

Training in grain storage and marketing was provided to members of PU, the Agricultural Policy Analysis Unit (PAU), and the private sector.

#### Market Environment

Studies on the seed industry, the agricultural inputs industry, and basic grains production have been published and shared with the public and private sector. Studies on basic grain production and market information, and structural reforms and impact on demand for basic food grains are near completion. The study on food policy, grain market development, and strategic grains reserve is currently being completed. The study on the export potential of value added derived from traditional grain crops is in the research stage.

Many seminars, workshops, and talks have been given to private- and public-sector institutions regarding research undertaken.

The above activities have led to the following initiatives:

- \* A national seed industry committee composed of public- and private-sector representatives was set up to guide transformation of the industry from a dying national cartel to a responsive and competitive regional industry by modernizing the 1971 Seed Law, streamlining seed imports, registration, and certification regulations, and by shifting production and marketing functions to the private sector.
- \* GOES is in the process of harmonizing the differentials in import tariffs for raw materials and finished products used in the agricultural inputs industry; discussions are on-going to adjust CENTA's research parameters to gain improvements in fertilizer and pesticide utilization, and with Dirección de Economía Agropecuaria

(DGEA) to improve collection, analysis, and dissemination of data relevant to the industry and users.

- \* The first supply response functions for basic grains were developed and presented to PAU in MOA. Policy analysts are being trained in its use; and DGEA is adjusting its statistical data base to provide PAU with the necessary information for analysis.
- \* PAU has initiated a series of adjustments to its process of gathering, analyzing, and disseminating production and market information on basic grains which will benefit policy analysts, producers, market agents, industrial users, and consumers.
- \* A three-week on-the-job training program was provided for members of DGEA and PAU. This training was designed to overcome many of the shortcomings uncovered during the study phase. It has resulted in improved data quality, timeliness of publications, and policy analysis.
- \* The FFGI staff has provided assistance to GOES and the private sector on an ad-hoc basis. This assistance has (1) supported GOES in defending the import price band for basic grains on many occasions, (2) provided expert-witness information on the worldwide situation and the outlook for basic grains to members of the Gabinete Económico as well as private-sector market agents, (3) reviewed projects and programs related to the agricultural sector, and (4) developed terms of reference for technical assistance to be provided by other entities.

#### Status of Privatization of Grain Handling and Storage Facilities

The current and projected status of sales of grain handling and storage facilities are as follows:

Total facilities available for sale = 20

Date Offered For Sale	Number Offered	Sold
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December 1992 (IRA)	10	6
March 1993 (IRA)	8	5
July 1993 (BFA)	2	2 (estimate)
December 1993 (BFA)	2	2 (estimate)

## NATIONAL FOOD SECURITY STOCK POLICIES AND PROCEDURES IN SUB-SAHARAN AFRICA

Food security stock policies and procedures have been given a great deal of attention by the international community particularly since the declaration on the eradication of hunger and malnutrition by the 1974 World Food Conference convened by the General Assembly of the United Nations. In addition, structural adjustment programs of the IMF and the World Bank have led governments of many developing countries to a general downsizing through privatization of government assets, the elimination of producer and consumer subsidies, etc. Such government austerity programs have required many such governments to consider alternative, more cost-effective strategies for maintaining national food security in their respective countries.

Within this context of structural adjustment along with the dramatically increasing populations and food security needs of many developing countries, the Bureau for Africa contracted FFGI in 1991-92, to conduct an in-depth study of the food security stock policies and procedures in sub-Saharan Africa (SSA). The objective of this study was to synthesize the literature and experience on national public sector food-grain stocking policies and procedures in SSA. The results of the synthesis were to help governments and donors understand better the conditions under which the establishment of national food-grain reserves can cost-effectively contribute to increased national food security.

The study specifically included (1) an in-depth literature review and inventory of national food security stock policies and procedures in the SSA countries, (2) case studies of food security stock policies and procedures in Chad, Malawi, Mali, and Zambia, (3) a synthesis of the literature, inventory, and case study findings, and (4) recommendations on cost-effective strategies that address the economic and financial sustainability issues, the managerial and institutional requirements, and the technical feasibility issues involved in maintaining national food security in the SSA countries.

Some of the more significant results from this work indicated that:

- \* Many of the SSA countries need to clearly establish their objective for maintaining national food security stocks. Emergency stocks are the only physical stocks famine-prone SSA countries undergoing structural adjustments should be considering as a part of their national food security policies. Stabilization and working stocks were not found to be cost-effective nor supported by donors in the SSA countries.
- \* Recommendations need to be given with a regional perspective. The three regions, the Sahel, IGADD, and SADCC, have much different agricultural resources, food security management, and institutional constraints. For instance, many countries in Western Africa (Sahel), where drought and food deficits remain chronic problems, have an established management and institutional base for operating relatively efficient food security stock policies and procedures. Many of these countries have already made an effort to minimize their food security stock levels. However, in an effort to lower the extremely expensive procurement and storage costs, alternative strategies such as maintaining warehouse receipts and/or financial stocks should be considered.

On the other hand, the IGADD region, except for Kenya and Uganda, has not only agricultural resource constraints but also institutional and political constraints that will need to be addressed urgently in order for these countries to implement sound food security policies.

- \* Economic and financial sustainability of emergency food security policies and procedures are a function of the targeted size of the security stock, the amount of donor support, the extent of liberalization in the economy, the trade-off between physical and financial stocks, the population size and growth rate, the domestic grain supply and demand, and the quality and quantity of available private-sector storage.
- \* Governments of the SSA countries account for total costs, including all opportunity costs, of food security stocks in order to be able to determine a cost-effective target size for emergency food security physical and/or financial stocks.
- \* Famine-prone governments form a joint committee with donors for the purpose of making food security decisions, such as use, replenishment, and funding of the emergency stock. Also, food aid be used in the context of an entire structural adjustment program in which the food aid is serving more than one purpose.
- \* An autonomous (yet government and donor funded) public sector, food security management institution without ties to the market be put into operation under a performance contract with the government of each famine-prone SSA country.
- \* Proper economic incentives be provided to technical grain storage managers and technicians so that established recycling, sampling, and inspection programs of the security stocks be done efficiently and effectively.

The assessments and recommendations on national food security stock policies and procedures in the SSA countries were particularly timely as drought conditions in southern Africa in 1992 caused a decrease in the region's corn production to about 30% of the average level. With food security issues at the forefront for the first time in many years in southern Africa, many countries of SADCC have had to re-think their policies and procedures and, where possible, consider many of the recommendations given in the FFGI food security project reports.

Over 65 copies of the food security project reports have been distributed upon request to food security stock management institutions throughout sub-Saharan Africa, international donors, USAID Missions throughout the world, and other interested organizations. The work has been presented formally at international agricultural development conventions. In addition, follow-up work by FFGI in assisting individual countries, including Morocco and El Salvador, implement more modern and cost-effective approaches to maintaining food security has been accomplished through USAID sponsorship.

ANNEX I  
EXPECTED OUTPUTS AND ACHIEVEMENTS

Core Project

Activity	Expected Output	Achieved Output
<b>Research</b>		
Applied research in grain drying techniques applicable to small farms and agribusiness enterprises	5	5
Applied research in grain conditioning, handling, storage, applicable to small farms and agribusiness enterprises	5	10
Applied research projects directed towards the development of practical methods of quality preservation in LDCs and applicable to small farms and agribusiness enterprises	5	6
Applied research in the field of processing systems and practices	3	3
Applied research in marketing systems, food security programs, price and market policies, and agribusiness development	11	13
LDC graduate students (M.S. and Ph.D.) performing research at KSU and their respective institutions	10-15	27
<b>Technology Transfer</b>		
Research findings disseminated to IARCs, LDC agencies, missions, and other institutions and organizations	37	36
Research results demonstrated to LDC researchers, agency employees, extension workers, farmers, and agribusinesses	5	32
Increased capacity of the Postharvest Documentation System	40% inc.	
	Acquisitions, Average Annual Increase	271%
	Clients Served, Average Annual Increase	279%
	Document Requests, Average Annual Increase	206%

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Activity	Expected Output	Achieved Output
<b>Training</b>		
Annual seven-week Grain Storage and Marketing Short Course for a maximum of 35 participants annually	8	7
Long-term academic training of graduate students at KSU	10-15	36
<b>Networking</b>		
Active participation by FFGI will be continued with active memberships in GASGA	1	1
Continue collaborative research, technology transfer, or training linkages with international and regional institutions and establish new linkages; e.g. IICA, IRRI, CIMMYT, ICARDA, REDSO/W AND REDSO/E	1	0
Continue collaborative research, technology transfer, or training linkages with LDC institutions and establish new linkages; e.g., CIGRAS, CNP, IMA, and IHMA in LA and UPCA in Philippines and FCRI-Bogor in Indonesia in Asia	1	0
<b>Research</b>		
Collaboration with LDC research agencies in development of cost effective technologies in grain conditioning, storage, processing, and marketing and in performing loss assessment studies	11	1
<b>Technology Transfer</b>		
Short- and long-term assistance; pre-feasibility, and marketing studies; Assessment, evaluation, and recommendations in PHDS improvement; Recommendations designed for small farmers and marketers for grain conditioning in storage, handling, processing, and marketing processes; Evaluation of economic and technical studies and proposals	50	Research 2 Information 2 Tech. Asst. 35

Activity	Expected Output	Achieved Output
<b>Training</b>		
Training manuals developed and disseminated	5	18
In-country and KSU short courses, workshops, and seminars of 3 days to 6 weeks	10 KSU In-country	11 26
Short-term in-country and/or KSU training of trainers courses	2	0
Development of basic training courses using slide-tape series and/or audiovisual tapes for use by participant trainers under the training of trainers courses	2	0
Short-term training courses for decision makers	2	1
In-service and on-the-job training at operational levels within the ministries of agriculture, LDC public and private organizations and institutions	2	3

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