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APPLIED SCIENCE AND TECHNOLOGY RESEARCH IN EGYPT
Quarterly Report No. 18, Phase II
January-March 1986

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Project Number 263-0016

Report prepared by:

Board on Science and Technology for International Development
Office of International Affairs
National Academy of Sciences/National Research Council
Washington, D.C.
April 1986

INTRODUCTION

This is the eighteenth quarterly report, Phase II of the Applied Science and Technology Program in Egypt covering the period January-March 1986. The program is supported under Contract NEB-0016-C-00-1058-00 of the United States Agency for International Development (AID) with the National Academy of Sciences/National Research Council (NAS/NRC). Within the NAS/NRC the Board on Science and Technology for International Development (BOSTID) is responsible for program implementation. The earlier quarterly reports are available from BOSTID, the U.S. AID/Cairo and the AID Document Library in Washington.

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APPLIED SCIENCE AND TECHNOLOGY RESEARCH PROGRAM IN EGYPT

PHASE II. Eighteenth Quarterly Report

January-March 1986

I. Program Policy, Planning and Management

A. Joint Consultative Committee (JCC)

The sixteenth and final meeting of the JCC was held in Cairo (JCC XVI) in November 1985. In February 1986, Dr. Gilbert White, Chairman, U.S. JCC panel, gave a final report to the Board on Science and Technology for International Development (BOSTID). Within the National Academy of Sciences/National Academy of Engineering/Institute of Medicine complex, BOSTID is the organization responsible for program planning and management. Also present at the BOSTID meeting were Dr. Mary Carter, Associate Administrator, Agricultural Research Service, U.S. Department of Agriculture, and a former JCC member, as well as Dr. Ralph Smuckler, BOSTID chairman and member of the 1984 evaluation team for BOSTID's assessment of the Egyptian program. Dr. Bernard Wilder, AID/Cairo Associate Director for Human Resources Development was in Washington on other business for the AID Mission in Egypt and participated in the discussions.

Dr. White in his introduction stressed that BOSTID took on the challenge of the program in Egypt as an experiment in applying the special resources and talents of the NAS/NRC to a complex S&T for

development effort. At the request of the Egyptian Academy of Scientific Research and Technology (ASRT), the overall goal was to change attitudes of scientists and development managers in Egypt toward research and its application to local problems. This constitutes a long-term commitment to human resource development, to institutional change and growth, and to linking the Egyptian and American scientific communities in new partnership endeavors. Dr. White made the following observations:

1. The JCC was a special binational policy and strategy mechanism that worked rather well. The members, both Egyptian and American, had remarkably long periods of continuity over the 8-year life span of the project. Continuity was important for stability of policy management and program administration. It was a visible sign of the partnership aspects of the overall program.

2. The NAS/NRC departed from its usual practice in overseas programs by having a resident representative on site in Cairo. Stationing a representative in Egypt met with "mixed success." It must be recognized that any resident representative has a limited function in program management and implementation. Therefore, he or she must possess qualifications in training and experience that match the program goals. The person must possess traits of adaptability, tact, intuition, judgment, and a high level of persuasive skills. A resident representative needs to create a "style" of operation and communication

in relation to the needs of the program; the management representatives of AID, ASRT and NAS/NRC; and the ambience of the local scientific scene. It is a difficult job, but one that can pay great dividends in communication and catalyzing action both within the projects and by the sponsors. It must be recognized as a "costly" investment of time, talent, and fiscal resources.

3. The impact of the program on the overall management of the ASRT and NRC/Cairo is not readily determined. Both organizations entered the Applied Science and Technology Research Program with the desire to institute new R&D management systems. U.S. and other foreign management practices were found to be relevant but not readily adaptable to Egyptian management situations. The R&D management training activities did spark a movement for change which requires time for optimum development. There are, however, factors external to ASRT and NRC/Cairo which arise from Government of Egypt policies and from local customs that are amenable only to long-term changes. The conclusion one must reach is that the 8 year time period of the program was sufficient to try a number of experiments and suggest some new management methods but insufficient to promote the degree of change envisioned in the original design of the Applied Science and Technology Research Program.

4. The National Research Centre has adopted a major change in the method of doing its research. Multidisciplinary approaches to problems are now actively pursued. There is also more attention to multi-

institutional sponsorship. The end-users, either an industrial client or villagers and farmers, are now routinely incorporated into project planning, design, implementation, and evaluation.

5. The dissemination of R&D results is viewed in a new light by researchers. No longer is technical feasibility the predominant criterion. Economic assessment of project viability and social acceptance of results are as important, if not more important, to insure that R&D results can be applied. This new attitude is one of the prime factors in the evolutionary process occurring in NRC/Cairo and other R&D institutes affiliated to the ASRT.

6. Many specific achievements have occurred in the program. Those that relate to NAS/NRC involvements include:

- A movement on the part of the NRC/Cairo More and Better Food team to design a more comprehensive rural development project in collaboration with other Egyptian groups (Ministries of Agriculture, Irrigation, Health; Organization for the Development of the Egyptian Village, and universities.)

- A recognition that the Biogas team has particular expertise in diverse engineering related areas, including energy policy and program design, municipal waste management, technology assessment, and industrial systems optimization for chemical industries.

- Establishment of a multidisciplinary team in the Central Metallurgical Research and Development Institute capable of problem solving for phosphate and other chemical-based fertilizers manufacture and application.

- Creation of a state-of-the art facility for surface science R&D and its application to such industrial processes as corrosion and catalysis.

- Institutionalization within NRC/Cairo of R&D management training for projects and programs that serve the interests of all ASRT affiliated research institutes.

- Support in collaboration with the ASRT 5-year R&D program for technical and socio-economic evaluation of irrigation systems in the new lands.

B. Research and Development (R&D) Management Systems

During the February-June 1986 time extension of the NAS/NRC contract for activities with the ASRT under the Applied Science and Technology Research Program, a scope of work statement (Annex A) has been agreed upon that gives prominence to R&D management activities at NRC/Cairo. Special attention is focused upon the institutionalization process for the Programming and Marketing-Techno-economic Studies Offices.

As a first step, Dr. M. El Hossieny Abd El Salam, Director, Programming Office, NRC/Cairo, prepared a background report entitled "The National Research Centre: In-house Project System" which describes the evolution of project proposal/internal contracting procedures and rationale for all projects funded by NRC/Cairo from its regular operating budget. (Because of its length the report is not included as an annex to this document but is available by writing to the NRC/Cairo Programming Office.)

Similarly, Dr. M.M. El Halwagi, Director, Marketing and Techno-economic Studies Office at the Centre prepared the background document "Marketing of the National Research Centre Services: Background and Future Strategies." (Also available from NRC/Cairo).

These two reports were used as an information base to arrange a series of study visits to institutions in the U.S.A. for Dr. Abd El Salam and to institutions in the U.S.A. and Turkey for Dr. El Halwagi. Each person was seeking information and examples of innovative management practices, new training materials and methods, and mutually supportive research institution-client relationships which can be adapted to Egyptian plans for greater attention to contract supported R&D.

Highlights of Dr. Abd El Salam's itinerary to the USA were:

- Visits to NSF, NAS/NRC and AID/Washington to discuss research grant management and evaluation

- Visits to the U.S. Department of Agriculture (USDA) principal R&D laboratories in Beltsville, Maryland, and to the USDA Northern Regional Laboratory, Peoria, Illinois, to contrast program and project management systems, planning, and evaluation methods

- Visits to the University of Wisconsin Engineering Research Center to review university sponsored and contract sponsored R&D

- Visit to the Ohio State University Agricultural Research and Development Center to understand management systems for state funded programs

- Visit to Washington University, St. Louis, Missouri to discuss biotechnology in agriculture, in the context of a large private university R&D organization.

- Visits to the Battelle Laboratory, Columbus, Ohio, and to the Midwest Research Institute, Kansas City, Missouri to review management systems in large, contract research organizations.

Dr. El Halwagi's itinerary included:

- The Scientific and Technical Research Council of Turkey (TUBITAK) laboratories in Ankara and Istanbul to review that institution's successful industrial extension operations as a possible model for R&D marketing at NRC/Cairo.

- SRI International (formerly Stanford Research Institute), Menlo Park, California, to observe marketing methods under a management philosophy which requires all R&D personnel to assume responsibility for marketing.

- Midwest Research Institute, Kansas City, Missouri, to discuss marketing methods with a major, regionally oriented, not-for-profit R&D organization.

- The Environmental Protection Agency and the World Bank (Washington) to discuss management of R&D in the context of municipal and waste water treatment programming.

The study visits to the Midwest Research Institute had the aspect of specifically tailored discussions with fewer time constraints that allowed a more in-depth treatment of the topics. For Dr. Abd El Salam these included (a) proposal evaluation methodologies, (b) management information systems, (c) project financial controls, (d) evaluating R&D

for commercialization, and (e) international project management. For Dr. El Halwagi the theme was "marketing" and included (a) marketing to industry, (b) marketing to government, (c) marketing economics and marketing management services, and (d) marketing of "new technologies".

Another day in Washington was given to a discussion seminar in which Drs. Abd El Salam and El Halwagi gave presentations on project/program management and evaluation in Egypt and on marketing/technology assessment with opportunities for discussion before a panel consisting of:

- Dr. K.P. Ananth, Director, Washington Operations, Midwest Research Institute
- Mr. James Blackledge, consultant for R&D management programs, Denver, Colorado
- Mr. Raymond Kitchell, consultant for project evaluation methodologies, Alexandria, Virginia
- Mr. Roy Tidwell, Director, Washington Operations for Engineering R&D Services, SRI International
- Mr. Richard Wallbrecker, Director for International Programs, Battelle/Washington Office.

A joint report by Drs El-Halwagi and Abd El Salam on the study visits, seminars, and discussions is included in Annex B.

II. Other Projects

A. More and Better Food (MBF)

During this reporting period, the group in the Department of Family and Community Medicine, University of Arizona, has continued to assist the More and Better Food project of NRC/Cairo. Dr. Osman Galal who travelled to the U.S.A. in February on programs of the Nutrition Institute, spent several days in Tucson on the nutrition/health aspects of MBF. The major analysis and report on the impact of the MBF project on socioeconomic and nutritional characteristics of life in the study communities (See Quarterly Report 17, October-December 1985) is nearing completion. An overall report on MBF as a case study in S&T for Egyptian development is also in the final editing/production process and will be available from the National Academy Press in June 1986.

As a final activity for MBF, the Steering Committee will sponsor a discussion seminar (April 28-29, 1986) in Cairo to help define a role for NRC/Cairo in a more integrated and comprehensive rural development program for Egypt. A multi-disciplinary, multi-institutional group will be assembled to review MBF experience and other rural development inputs of Egyptian institutions. Participation is being invited from the Agricultural Research Centre, universities, Organization for the Development of the Egyptian Village, etc. One product of the seminar is to be a draft framework for an integrated rural development program which builds upon the experience of MBF and other agriculturally related development activities.

In preparation for the seminar, the Arizona group is preparing an in-depth literature review in bibliographic format of direct and indirect linkages among the topics food consumption, nutrition, and health; rural enterprises; and socioeconomic impacts on rural life with special attention to women's role in development. The literature review is Egypt-specific. The background document will be an information base of considerable utility for post-MBF project planning and design.

B. Technical and Socioeconomic Evaluation of Irrigation Systems in the New Lands of Egypt.

1. Technical Visit to Egypt

During January a project advisory team consisting of Dr. Melvin Skold, Department of Agricultural and Natural Resource Economics, Colorado State University, and Dr. Wesley Wallender, Department of Land, Air and Water Resources, University of California at Davis visited the three project sites in Egypt and the Water Distribution and Irrigation Systems Research Institute (WDISRI) in Cairo. Mr. Augustus Nasmith, NAS/NRC, and project officer in the Egypt program accompanied them. Their goal was to cooperate with the Egyptian team leaders in reviewing the interaction among technical, economic and social circumstances which shape experience and determine feasibility of New Land developments. Their report (Annex C) reviews the project in the context of its originial goals and analyzes results of the first year

of field activity. (Note: Although the Applied Science and Technology Research Program is providing significant inputs of materials, equipment and technical assistance to the New Lands Project, the major R&D resources over the period May 1985-May 1988 are those provided by the ASRT and WDISRI.)

Summary recommendations given by Professors Skold and Wallender include:

- Interdisciplinary research training for personnel at the three sites (Inshass, Nubaria and Salhiya) is an important priority to assure a better level of between-site analysis and comparison of results.

- Timely end-of-season and end-of-year reporting and cross comparisons are essential to remove any project design deficiencies that may arise and to assure closer examination of the more promising approaches to technical and socio-economic results.

- Any project of this magnitude benefits from a continuing external discussion and review of results and evaluation of progress.

- In-depth cooperation with the Statistics Department, Ministry of Agriculture, is urged as an assistance to analyzing and/or collecting economic and technical data on irrigation systems in the New Lands.

- Research objectives and procedures should be tailored to the advantage of existing conditions at the three experimental sites. A three layer system of: (a) form surveys, (b) satellite experimental plots under production agriculture, and (c) controlled experiments is one possible option.

- The process of irrigation system selection should give attention to drainage as estimated from irrigation system performance.

- Economic analysis should distinguish between financial and economic analysis from the prospectives of the farmer, the Ministry of Irrigation, and the Government of Egypt. Immediate priority should be directed to financial and economic analysis of alternative irrigation systems from the farmers' perspective and with the size economies inherent in the alternative technologies.

- Sociological research should (a) focus on a review of the general body of literature on the diffusion of technology, and

(b) recognize the different sociological problems posed by the public farm development schemes and the alternatives for private development.

2. Technical Visit to the USA

During February 1986 a six person team from WDISRI and the three field sites of the land reclamation studies project visited: (a) the University of California (Davis), (b) the USDA Water Management Research Laboratory at Fresno, California, (c) the Kearney Agricultural Field Station of the University of California, (d) irrigation projects on private farms in Colusa County, California, (e) the county farm advisor for Salinas, California area, (f) the USDA Salinity Laboratory at Riverside, California (g) arid land project at the University of Arizona near Tucson, (h) the U.S. Bureau of Reclamation, Denver, Colorado, and (i) arid land projects at Colorado State University in Fort Collins.

The Egyptian group consisted of the following persons:

	Field
• Dr. Farouk Abdel Al Water Distribution and Irrigation Systems Institute (WDISRI) Water Research Centre, Ministry of Irrigation, Cairo	Economics
• A.W.Abdel Wahed Vice President for Agricultural Projects Arab Contractors (Salhiya site)	Irrigation Engineering

• Abdel Hamid Abou-Sabe Chairman, Managing Board International Centre for Rural Development (Nubaria site)	Irrigation Mechanization
• Abdel Ati Allam WDISRI	Irrigation Systems
• Nadia Wahby WDISRI	Water Management
• Balaigh Shindi Zikri Director, Soil and Water Research Institute Ministry of Agriculture	Soil Science

C. End-of-Project Reports

Two final reports are in preparation. One is a case study of the More and Better Food Project of NRC/Cairo. MBF represents a major effort to mobilize the scientific manpower and institutional resources of the Centre to increase crop production in selected demonstration villages and study the impact of the increased productivity on the nutritional, health and socioeconomic status of villagers. Because of the magnitude and diversity of effort, MBF challenged NRC/Cairo's management and technical capabilities and opened new avenues of cooperation on multi-disciplinary and multi-institutional problems. Documentation of this experience is important as an example of a major rural development effort both for Egypt and other developing countries. The case study is not a collection of the technical project reports. It concentrates on aspects of planning, priority selection, management methods, and the lessons learned. As a contribution to the

literature of rural development in Egypt, the report includes a large introductory section on the status of agriculture, food and nutrition as well as a description of the R&D resources in those sectors. Annex D gives the table of contents for the report which is entitled More and Better Food: A Demonstration Project. The full report is to be available in June 1986.

The second of the final reports is an overview and analyses of the significant elements of the Applied Science and Technology Research Program including management and policy, demonstration and R&D sub-projects, and facilities development. Over 700 Egyptian scientists and engineers participated in these activities which took place in 14 governorates of the country. The mobilization of human and institutional resources over the period from 1978 through 1986 represents a major technical and socioeconomic development effort. The report is entitled Applied Science and Technology: An Egyptian-American Cooperative Program. It, too, is to be available in June 1986. Annex E gives the table of contents for that end-of-project report.

D. Projects Summary, (January-March 1986)

Project	Activity	Status/Remarks
1.0. Program Policy, Planning and Management		
1.1. JCC	• Report by U.S. JCC Panel Chairman to BOSTID	• Completed February 17, 1986
1.2. R&D Mgt.	• Background Reports on NRC/Cairo Programming and Marketing Offices	• Issued, Jan. '86
	• Study visits to USA and Turkey	• Completed, Feb-March 1986. Report issued (Annex B)
	• Planning for NRC/Cairo Marketing Seminar	• Seminar Scheduled April 20-24, 1986
	• Programming Activities, NRC/Cairo	• Activities begun, March 1986 (See Annex B)
1.3 End-of-Project Analytical Report	• Dr. El Nockrashy completed final draft	• February '86 (Cairo)
	• Editing, preparations for publication	• March '86 (Washington)
2.0 Demonstration/R&D Projects		
2.1 More & Better Foods	• Nutrition/health Impact report	• Completed draft, February '86
	o Case study MBF (El Nockrashy)	• Final draft March '86
	• Planning for seminar in Cairo and preparation NRC framework on rural development proj.	• Seminar scheduled (Cairo) 28-29 April '86
	• Review/Information Survey of Rural Development Programs	• In process/Arizona Jan-March '86 Completion date: April '86
2.2 Technoeconomic Evaluation/Irrigation New Lands	• U.S. Technical Panel Panel to Egypt	• January '86

	• Technical visits by 6 Egyptians, USA	• February '86
2.3 Pharmaceutical Chemicals	• Continuation of Pilot Pilot Plant Runs	• Jan-March '86
2.4 Bentonite Clays	• Final visit U.S. Advisor	• Scheduled for Feb '86 Postponed to May '86
2.5 Red Sea Fisheries	• Final Visit U.S. Advisor	• Still in Planning

Annex A

Applied Science and Technology Research Program
Academy of Scientific Research and Technology, Cairo, Egypt
U.S. National Academy of Sciences/National Research Council
Washington, D.C.

Contract NEB-0016-C-00-1058-00

SCOPE OF WORK STATEMENT
February 1 - June 30, 1986

The following activities should be completed by the contractor prior to contract termination:

1.0. R&D Management

1.1. With the assistance of the National Research Center (NRC), develop and submit a marketing plan and a program/evaluation plan for the R&D activities at NRC. This includes but is not limited to:

- Organizing for each of the head officers of marketing and programming evaluation, a study tour in the U.S. and Turkey. The study tours will not be initiated unless the two office heads have prepared an entire review of the marketing and programming evaluation experience in NRC for the ASRT program director's approval.

- Hiring, for each of the two plans, a qualified U.S. specialist to review with the office heads the necessary background documents, assist in drafting the plan, and follow up on its implementation.

- Ensuring that the draft plans are endorsed by the NRC President.

- Organizing and preparing a seminar in Egypt for each of the two plans to explain and prepare for implementation of each plan. This will take place after the plans receive written endorsement for implementation by the NRC president.

1.2. With the assistance of the ASRT program director, and after receiving inputs and comments from the four U.S. contractors who implemented the S&T Research project, draft and submit a summary analytical report of the Applied S&T Research project highlighting the achievements of all the activities and identifying effects upon Egyptian socioeconomic development. The draft report shall be submitted to USAID/Cairo for comments 45 days prior to the end of the contract.

2.0. More and Better Food (MBF)

2.1. Complete the analysis and interpretation of data collected from the two MBF villages on the impacts of increased agricultural resources upon nutrition and health, and issue a final report.

2.2. With the assistance of the U.S. and Egyptian specialists, review the different approaches to rural development in Egypt and design a framework for comprehensive rural development intervention based on the MBF experience. The framework will be the subject of a seminar that the contractor shall organize in Egypt in order to discuss the different plan elements and produce an action plan based on this framework.

2.3. Ensure the completion of the final MBF report due in June 1986.

3.0. Land Reclamation

3.1. Provide a 2-3 person advisory panel on technical, social and economic aspects of land reclamation and land development which shall meet with the appropriate counterpart group of the Water Distribution and Irrigation Systems Research Institute (WDISRI).

3.2. Complete study, observation, and training visits of five or six WDISRI staff to the U.S.A. on project purposes.

3.3. Ensure completion of an interim socio-economic study on irrigation in the new lands.

3.4. Provide guidance on economic studies of irrigation techniques of the project with the assistance of a U.S. specialist in this field.

4.0. R&D Projects

The Contractor shall provide the following services for the three R&D subprojects (a. Investigation and Evaluation of Egyptian Bentonites for Industrial Applications. b. Preparation of Selected Pharmaceutical Chemicals. c. Red Sea Fisheries):

- An advisor/consultant to complete a review and assessment of the subprojects.

- Completion of a final report by June 1986.

Annex B

TRIP REPORT
(Turkey and U.S.A.)

Research & Development Management Project

Academy of Scientific Research & Technology
Cairo, Egypt

National Research Centre
Cairo (Dokki), Egypt

By
Prof. Dr. M.M. El Halwagi, Director
Marketing and Techno-economic Studies Office
National Research Centre

and
Prof. Dr. M. El Hossieny Abd El Salam
Director, Programming Office
National Research Centre

March 1986

REPORT

Research and Development (R&D) Management Project

Study Visits to R&D Institutions and Laboratories
in Turkey and the United States
March 1986

I. Background: As part of the R&D Management project, assistance is being given to the National Research Centre (NRC/Cairo) to strengthen the functions of project management, project and program evaluation and R&D marketing. The project is jointly sponsored by the Egyptian Academy of Scientific Research and Technology (ASRT) and the U.S. Agency for International Development (AID) in Cairo, Egypt. The U.S. National Academy of Sciences/National Research Council (NAS/NRC), contractor to the U.S. AID, made arrangements for the study visits in cooperation with NRC/Cairo.

Prior to the initiation of the study visits, two background documents were prepared:

- "The National Research Centre: In-house Project System" by Prof. Dr. M. El Hossieny Abd El Salam, Director, Programming Office, NRC/Cairo.

- "Marketing of the National Research Centre Services: Background and Future Strategies" by Prof. Dr. M.M. El-Halwagi, Director, Marketing and Techno-economic Studies Office, NRC/Cairo.

During a four week period in February and March 1986 both Dr. Abd El Salam and Dr. El Halwagi visited the United States and Dr. El Halwagi also visited Turkey to observe current management practices, systems and trends in contract R&D organizations, university applied research centers, U.S. government R&D facilities, and with research sponsors.

The objective of the visits and consultations was to assist the NRC/Cairo R&D Management Committee in its current activities and to recommend to the Director (Dr. M.B.E. Fayez) actions which could strengthen procedures and methods to institute an expanded contract research system.

The current AID contract amendment with NAS/NRC outlines a scope of work for R&D management activities prior to 30 June 1986 as follows:

"With the assistance of the NRC/Cairo develop and submit a marketing plan and a program/evaluation plan for the R&D activities at the Centre." This includes but is not limited to:

- Organizing for each of the head officers of marketing and programming evaluation a study tour in the U.S. and Turkey. The study tours will not be initiated unless the two office heads have prepared an entire review of the marketing and programming evaluation experience in NRC/Cairo for the ASRT program director's approval.

- Hiring for each of the two plans, a qualified U.S. specialist to review with the office heads the necessary background documents, assist in drafting the plan and follow-up of its implementation.

- Ensuring that the draft plans are endorsed by the NRC President

- Organizing and preparing a seminar in Egypt for each of the two plans to explain and prepare for implementation of each plan. This will take place after the plan receive written endorsement for implementation by the NRC president.

II. The Role of the Programming Office in the NRC R&D Management System.

The Office of Research Programs (ORP) has been established to manage, monitor, and control the in-house research projects and programs according to priorities approved by the NRC/Cairo board of directors. In accordance with current NRC/Cairo policy, each internally-funded R&D project requires a contract between the Centre and the research teams. NRC/Cairo (client) provides the research team with necessary facilities; they, in turn, are required to submit semi-annual progress reports and a final project report. The main objectives of this policy are:

- Gradual re-orientation of research activities in NRC/Cairo from thesis-oriented to consumer (client) oriented research.

- Training researchers in the system of contract research projects.

- Creation of research teams with integrated specialities.

- Preparation for future contracts with end users

- Development of specialized technical capabilities and providing a basis for centers of excellence with NRC/Cairo.

III. The Role of the Marketing Techno-economics Office in the NRC R&D Management System.

The objectives of the Marketing and Techno-economic Office are to:

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- Provide assistance to the Centre's R&D System in marketing activities and in techno-economic studies related to ongoing and future research projects.

- Establish contact with relevant national organizations to disseminate information about the NRC/Cairo capabilities and facilities.

- Increase significantly the volume of R&D contracted by Egyptian public and private sector end-users.

IV. Topics Discussed During Visits

1. Project Management and Evaluation

- Differentiating evaluation methods and techniques. (NRC/Cairo presently has (internal projects, multi-disciplinary and/or multi-institutional projects, sponsored projects from ASRT, sponsored projects from Egyptian government ministries, sponsored projects from public sector/private sector enterprises, and international projects).

- Role of evaluation in improving R&D productivity and results.

- Role of a management information system (MIS) as a component in evaluation.

- Achieving internal acceptance of the evaluation function.

- Use of personal computers in project management.

2. Marketing

- Identification of actual needs of end users.

- Establishing priorities in a marketing effort.

- Techno-economic studies as a tool in marketing.

- Relative importance of technical services/training/R&D as "products" for NRC/Cairo.

- Marketing and the management information system.
- Strategies for marketing multi-disciplinary, multi-institutional projects.

V. Summary of Important Conclusions from Visits

1. Project Management and Evaluation

1.1 The importance of building an efficient data base as a management tool.

1.2 The importance of introducing the use of personal computers (PC's) in project management.

1.3 Developing a strategic (long range) operational plan and identifying priority areas in R&D for NRC/Cairo.

1.4 Maintaining a current inventory of skills and capabilities.

1.5 The importance of guidelines and quality-assurance measures to evaluate projects.

1.6 Giving emphasis to detailed and extensive evaluation of proposals submitted, and less attention to routine evaluations during the course of R&D for each approved project.

1.7 Emphasis upon peer review as the predominant method for proposal evaluation. (Usually 5-6 reviews per proposal).

1.8 Experience demonstrates that the probability of success in R&D projects largely dependent upon the careful identification and selection of problems under investigation and control of R&D schedule.

1.9 The extent of project evaluation is dependent on funds and resources allocated.

1.10 Recognition that no single system can be followed in evaluating different types of projects; however, all share the same principles and ideas.

B. Marketing

1.0 The Industrial Relations Unit of the Scientific and Technical Research Council of Turkey (TUBITAK), similar in function to ASRT, provides direct technical extension services to public and private enterprises. This leads to R&D problem identification of importance to end-users.

1.2 Marketing is the responsibility of department heads and senior researchers. At least 30% of their time is devoted to marketing. Almost every staff member should be engaged in marketing and should receive training in selling skills.

1.3 A central core marketing group (small size) is needed to facilitate and coordinate functions and minimize cross marketing.

1.4 Bulletins and brochures are extensively used to inform people of what is going on and to express opinions regarding contemporary issues.

1.5 Well-structured and frequent technical seminars and meetings, on a sectoral basis, are considered to be the most effective mechanisms for persuading client to use research institute services and to contract for R&D.

1.6 Multi-client projects (e.g., the Association of Cement Manufacturers and many SRI projects) is a very successful mechanism for attracting clients.

1.7 Established contacts can provide work to other groups.

1.8 A Skills Inventory Directory is important for internal as well as external use.

1.9 Good marketing requires:

- Quality human resources
- Integrity
- Image (in the marketplace)
- Ability to do something the client cannot do.
- Personal interaction with clients and development of trust. Getting to know the clients; their needs, organization and how they think.
- Do the job well.
- Choice of services the institute can provide in a competitive area.
- Utilize the image and facilities of the institute to impress clients.

1.10 New work is obtained through meetings, visits and personal contacts. But above all in the U.S.A. RFPs (request for proposals) advertised in government journals is a very important source. Institutes try to have advance information to get ready in the proper way.

1.11 For good marketing one should know very well what really are the client needs and who are the competitors.

1.12 Try to make basic, broad contracts with established clients on a continuing basis (similar to retainer services). This reduces the formalities, precontract time and enhances flexibility and fast response to client needs.

1.13 Be selective in marketing. Priority is for areas where an organization has a competitive edge and is able to offer a unique service, expertise, or product. Recognize the importance of "follow on" with existing clients.

1.14 Intensive planning sessions are basic to marketing. These should be oriented to answers:

- What is our product?
- How do we want our product to be used?
- How can we get there?

1.15 Every report is a <u>product</u> that must be very carefully edited.

1.16 Geographic presence and representation by efficient and technically knowledgeable people (general) and client needs and Institute resources.

1.17 The Institute Venture Approach, similar to the newly established NRC "Units of Special Character," is a good mechanism (as for example, a for-profit subsidiary) to commercialize "system technologies" or "on-the-shelf" or "orphan technologies" developed by the institute.

VI. Immediate Course of Action: April - June 1986

As a result of information provided relative to project management and marketing of R&D in the NRC, and the summary discussions related to these activities in Washington on 10 and 11 March 1986, three action tasks have been identified which can be completed by 30 June 1986. It is also important to recognize that these activities will continue over the long term.

Task 1 Upgrading Marketing Skills in NRC/Cairo

This task will involve briefing Department and Laboratory Heads on the proposed NRC/Cairo Marketing Strategy, an intensive 3-5 day workshop on methodologies for effective marketing, and the holding of an R&D Management Seminar (two weeks) for NRC/Cairo researchers which will include presentations and case studies on project management, evaluation, and marketing techniques (See Bar Chart).

Task 2 Improving the Programming Office Effectiveness through Use of Personal Computers as a Management Tool.

This task will involve the use of a personal computer (compatible with the Centre's main computer) to establish rapid access to project data bases for on-going projects, to create and expand the projects data file, and to manage a multi-disciplinary R&D project, evaluation of existing project management software programs, and preparing modifications in the software programs so as to be suitable for the needs of the Programming Office for control and project evaluation needs, with the ultimate objective of interlinking with a management information system. A series of meetings will be held with senior researchers and department heads to explain the revised functions of the Programming Office (see Bar Chart).

Task 3 Coordination and Interaction of the Functions of the Programming Office and the Marketing Office

This task will involve (as a demonstration project) conduct of 2-3 prioritized industry surveys, based on project and skills data from the Programming Office files and NRC/Cairo facilities and capabilities data from the Marketing Office, selection of research teams to conduct and analyze the results of the data, and prepare proposals for submission to the target industries. The objective will be to demonstrate the desirability and necessity for close interaction between the Programming Office and the Marketing Office in developing possible R&D projects for consideration by end-users and came up-through the specialized research staff - with proper situation analysis, future outlook and present and projected R&D needs for various industries. (See Bar Chart).

VII. Strategic Plans for the Future.

A. Programming Management Office

The short term plan for the Programming Office is:

1.0. Improve quality of project/program data

1.1. Initiate skills inventory

1.2. Initiate equipment/facilities inventory

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1.3. Improve monitoring and review of projects, meeting of goals, and follow-up

1.4. Identify appropriate R&D results for the marketing effort

1.5. Use of the PC as a management tool in R&D projects activities.

1.6. Evaluation of the Programming Office effectiveness.

The long-term plan for the Programming Office is:

1.0 Assist in re-direction of NRC/Cairo researchers to conduct applied R&D needed by end-users.

1.1 Coordinate, with and assist the Marketing Office with outputs of results of in-house R&D appropriate to end-users needs.

1.2 Continuing inventory and upgrading of skills.

1.3 Extend the concept of program management and evaluation to other R&D Centres.

1.4 Assist researchers in preparing effective proposals to meet competition.

1.5 Establish consistency of project/program data bases for inclusion in the NRC/Cairo central computer as component of MIS.

1.6 Strengthen Programming Office staff capability.

1.7 Provide leadership to R&D Management of in-house and external projects.

B. Marketing Office

The plan for the Marketing Office includes:

1.0 Establish a nucleus of 2-3 people to assist in marketing activities;

1.1 Appoint an advisory committee of 8-10 people from NRC/Cairo representing several departments and disciplines;

1.2 Renew and strengthen the NRC/Cairo-Industry R&D Committees;

1.3 Prepare brochures for the NRC/Cairo labs, which portray their experience, previous accomplishments, human resources, capabilities, facilities, and services available to end-users;

1.4 Conduct a self-evaluation of NRC/Cairo to determine actual saleable capabilities;

1.5 Initiate a quarterly newsletter, entitled "Science in Service of the Community": which will be, in effect, the bulletin of the NRC/Cairo Marketing Office, and which will include contemporary information on current R&D activities, new technologies, and an information answering service.

1.6 Schedule industry seminars every three months in specialized topics such as pulp and paper, textiles, etc.

1.7 Open channels of communication with the Ministry of Planning, other Egyptian planning entities, and other Ministries;

1.8 Identify potential customers and the services that these need;

1.9 Identify competitors (universities and other R&D centres) and learn what they do.

1.10 Strengthen weak areas especially through development of staff capabilities in the practical aspects of technology.

The long term plan for the Marketing Office is:

1.0 Coordinate and integrate with the Programming Office and other project offices in developing skills/facilities inventories, analysis of R&D projects appropriate to marketing.

1.1 Jointly with Programming Office and local projects unit, conduct selected industry surveys as demonstration project and compare of the survey results with NRC/Cairo competences and experience.

1.2 Develop multi-client strategies for R&D contract support.

1.3 The Marketing Office goal, 3-5 years is to increase contracted R&D volume in NRC/Cairo from LE 2 million to LE 10 million.

1.4 Review NRC/Cairo "shelf" R&D results for applicability to venture support and consideration by the Units of Special Character.

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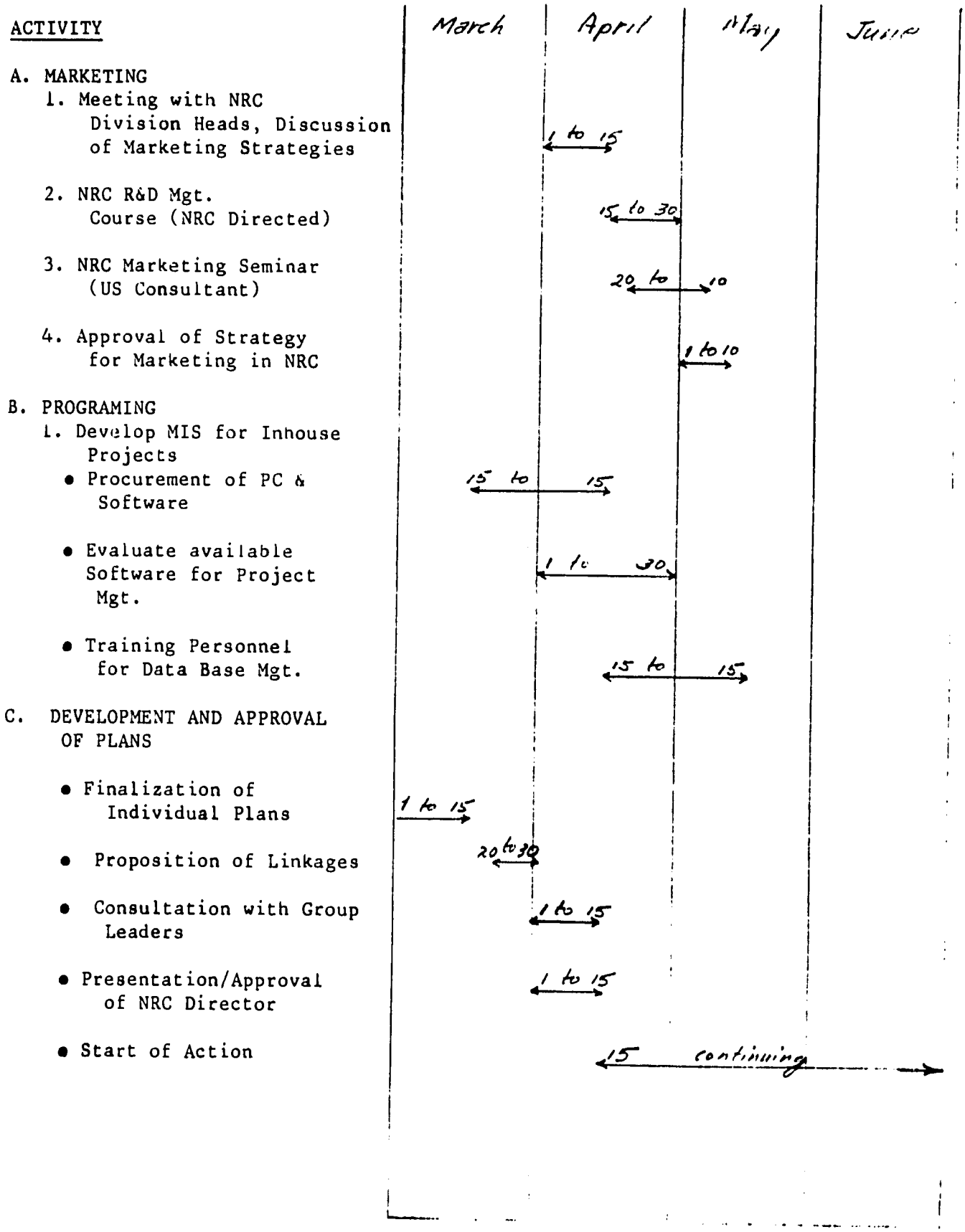
Bar Chart
R&D Management Project
Schedule of Activities, April-June 1986



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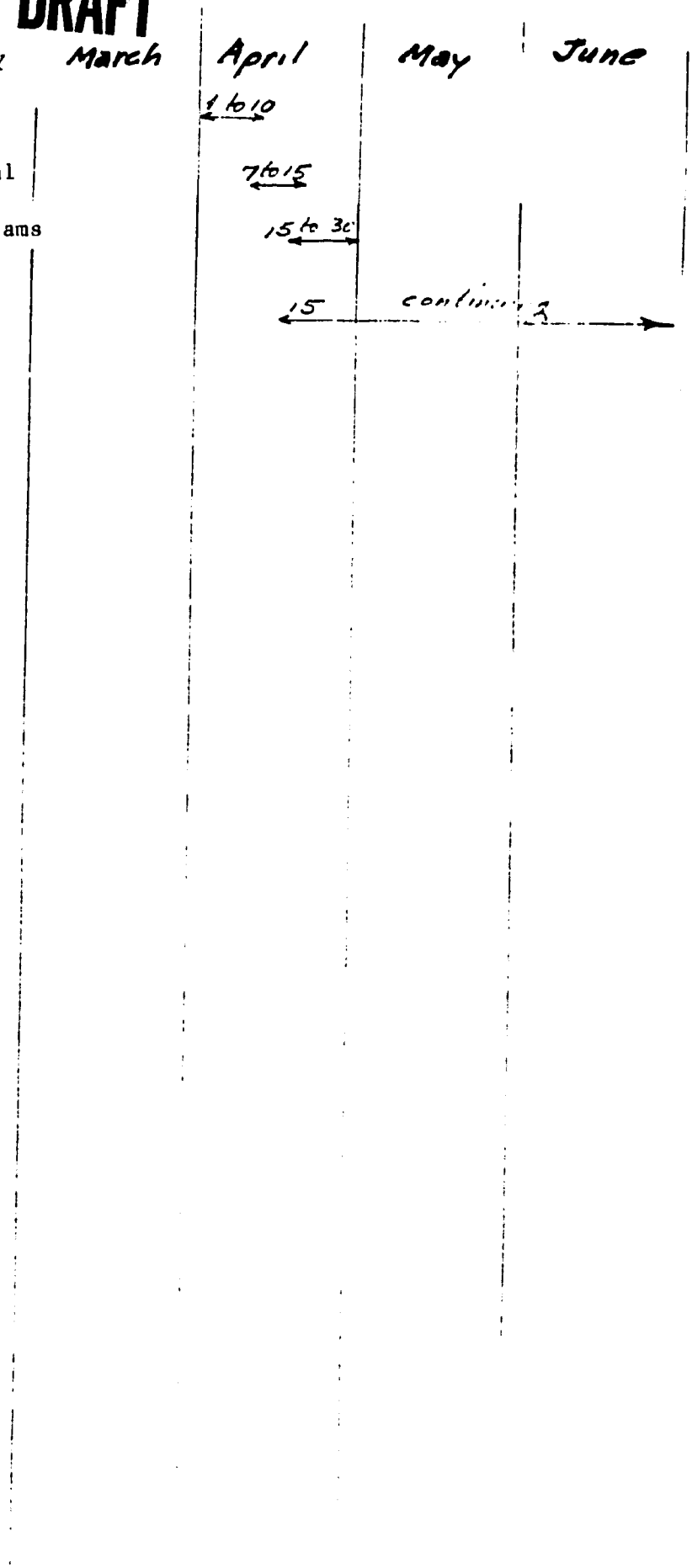
D. PILOT STUDY ON MARKET SURVEY

- Working Paper Prepared
- Group Meeting and Approval
- Sectors Definition and Teams Assignment
- Preparation of Plans



Annex C

APPLIED SCIENCE AND TECHNOLOGY RESEARCH PROGRAM IN EGYPT

Report on an Advisory Mission to the Project
Technical and Socio-Economic Evaluation of the Irrigation Systems
in the New Lands of Egypt

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January 1986

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ACKNOWLEDGEMENT

This is a report of an advisory visit to Egypt (January 11-16, 1986) by Melvin Skold, Department of Agricultural and Natural Resource Economics, Colorado State University, and Wesley Wallender, Department of Land, Air and Water Resources, University of California at Davis, on behalf of the Board on Science and Technology for International Development, U.S. National Research Council. It is submitted for consideration of the Egyptian project team under the leadership of Dr. Abdel Hady Rady, with the acknowledgement by the authors that in a brief visit the full scope of the Egyptian team's efforts could not be covered. Dr. Skold and Dr. Wallender appreciate the time, courtesies, enthusiasm and candor which were extended by their Egyptian hosts. It is in the spirit of collegial undertaking which characterized their visit that they offer the following observations.

SUMMARY RECOMMENDATIONS

1. As stressed in James Fitch's report on the project (August 1985), immediate attention should be given to intrasite and intersite interdisciplinary research training. The interdisciplinary skills of the project leaders must be imparted to the researchers at each site. Unless this is accomplished, between-site comparisons will not be possible, and within-site analyses will not provide their full potential contributions to knowledge.

2. Again, as with the Fitch report, the current reporting of results (end of season, end of year) should be given priority. With this, researchers can adjust experiments and observations to remove deficiencies in design and to proceed toward closer examination of the more promising alternatives.

3. The project would benefit from continued outside review and evaluation. While the need for technical assistance is not apparent at this time, this research, as any research, will benefit from continued review and evaluation.

4. In-depth cooperation with the Ministry of Agriculture Statistics Department is urged as an assistance to analyzing and/or collecting economic and technical data on irrigation systems in the New Lands.

5. Research objectives and procedures should be tailored to the advantage of existing conditions at the three experimental sites. A three layer system of (1) farm surveys, (2) satellite experimental plots under production agriculture, and (3) controlled experiments is one possible option.

6. The process of irrigation system selection should give attention to drainage, as estimated from irrigation system performance.

7. Economic analysis should distinguish between financial and economic analysis from the perspectives of the farmer, the Ministry, and the Government of Egypt. Immediate priority should be directed to financial and economic analyses of alternative irrigation systems from the farmers' perspective and with the size economies inherent in the alternative technologies.

8. Sociological research should (a) focus on a review of the general body of literature on the diffusion of technology, and (b) recognize the different sociological problems posed by the public farm development schemes and the alternative schemes for private development.

INTRODUCTION

Interest on the part of the Government of Egypt in the development of New Lands is based on a number of pressing problems. A rapidly expanding population is placing an ever-increasing pressure on food production. Egypt is becoming more and more dependent on imports of food to sustain its population. As population expands, it tends to settle in the fertile Nile Valley, thus causing a gradual erosion of the agricultural land base. Reclamation offers the hope of increasing Egypt's agricultural land base and its food production potential. It can also contribute to a more desirable dispersion of the population and slow the necessity to convert agricultural lands in the Nile Valley to urban-industrial uses. Successful agricultural and associated infrastructural development on New Lands can also contribute to providing employment for the growing population.

Experience has shown that success in New Land developments depends on a variety of technical, economic, and social circumstances. Irrigation systems must be identified that provide an efficient use of water because of limited supplies of water, the costs of lifting and distributing the water on farms, and the water management capabilities of those operating the irrigation system. The appropriate crops and cultivation techniques are also important, as direct transfer of cropping patterns and cultivation methods from old lands are not necessarily appropriate. The financial and economic conditions associated with alternative irrigation systems, crops, and cropping practices must be reconciled from the viewpoint of the farmer, the ministries associated with implementation of New Land developments, and the Government of Egypt. And, depending on the particular New Land settlement strategy to be implemented (as defined by the technical and economic considerations), a variety of sociological problems must be solved if sound technical and economic New Land developments are to succeed.

This report reviews and offers specific contributions to finding solutions to the technical, economic, and social problems of New Land developments. The project, "Technical and Socio-economic Evaluation of the Irrigation Systems in the New Lands and Their Impact on Crop Production, Soil Properties, and Water Requirements," is being conducted by the Water Distribution and Irrigation Systems Research Institute, Water Research Center, Ministry of Irrigation. The project is sponsored by the Academy of Scientific Research and Technology in Egypt. Cooperating with the Egyptian Academy, the U.S. National Research Council's Board on Science and Technology for International Development, under funding from USAID, provided for the scientific interchange between Egyptian and United States scientists.

An earlier review was completed by James B. Fitch (August, 1985). The Fitch report recommended (1) that the project scientists conduct a thorough review of previous research and that these materials be made

readily accessible in a project library, (2) that interdisciplinary communications within the project be improved, and (3) that project scientists be encouraged to publish interim findings and reports.

This review, while observing many of the same matters as the Fitch report, focuses primarily on the specific technical and socio-economic research methods and tools appropriate for comparisons among alternative irrigation systems. The research proposal prepared by the Water Distribution and Irrigation Systems Research Institute is outstanding in that it (a) clearly identifies objectives, (b) focuses on a researchable issue, that of alternative irrigation (water distribution) systems, and (c) recognizes that technical as well as socioeconomic problems are present. The necessity for an interdisciplinary approach is evident in the project design and in the spirit of the disciplinary team leaders.

This report includes a section on methods of technical evaluation, methods of economic evaluation, and perspectives about sociological evaluation. Due to the limits of time for this review, separate sections for technical and socio-economic analyses are maintained. The authors do not imply that these analyses are independent. Rather, as with the project design, an integrated interdisciplinary analysis of data at each site is favored. The report does not include an equal amount of discussion for each site. This does not in any way reflect the authors' perceptions of the importance of each site. Rather, comments or discussions about each site tend to be proportional to the opportunities to visit and engage in in-depth discussion with the scientific personnel at the various sites.

The three sites on which investigations are proceeding provide an excellent opportunity to conduct research necessary to accomplish the stated objectives. The experiment station at Inshass offers a laboratory on which controlled experiments can be used to study the differences and potentials among alternative irrigation systems. The Salhiya site provides the researchers an opportunity to observe how these systems perform under scientific management applied by the managers of a large public farm. At Nubaria, researchers may observe how alternative systems perform under settlement systems of large private investors, smaller investors, and government-sponsored schemes for small settlers. In addition, the reclamation development by the Army near the Nubariya site provides another observation of the implementation of reclamation as a public undertaking.

It is always a problem for researchers to transfer the results from an experiment station to the field. In this project, the results at Inshass can be observed for their adaptability and applicability at a spectrum of sites with different physical and institutional characteristics.

IRRIGATION SYSTEM EVALUATION

One of the most challenging tasks of irrigation engineers and agronomists is the evaluation of irrigation systems. Discussions continue on the best method of evaluation, and these discussions often distract from the purpose of evaluation. The evaluator should remember that good scientific and engineering principles are the most important factor and the most popular method is not necessarily the best for a particular situation. As part of a sound approach, consistency through time and location is important. Further, the results of an evaluation are only as reliable as the information collected and used to make the calculations. In what the follows, challenging aspects of trickle, sprinkle, and surface irrigation evaluation are discussed in general, and then the programs at the three sites are considered specifically.

Under trickle irrigation, uniformity and amount of application are important management and design considerations. Because uniformity between the flow rates of emitters is critical, careful measurements over time and space are needed. Procedures, recommended by Merriam and Keller in their text on farm irrigation system evaluation, describe the measurements and calculations*. The more challenging aspect of evaluation and design, however, is determining the average volume of water to apply at each emitter in order to satisfy the evapotranspiration needs of the crop and to enable leaching without overirrigating. One approach is to integrate changes in water content over volume of soil wetted by the emitters and equate this to daily ET. Although this procedure seems straightforward, it is very difficult to measure the volume of soil wetted. The preferred method is to add varying amounts of water and determine at which level plant water stress is eliminated. In summary, the issue of trickle irrigation system performance, as estimated by uniformity, can be treated separately from the water management issue of determining average volume of application. Water management is the more challenging from the viewpoint of field measurements and interpretation.

As mentioned above, it is nearly impossible to estimate ET by integrating changes in soil water content because the wetted soil volume is poorly defined. To circumvent this problem, one approach suggests establishing treatments which receive a percentage of reference ET (for example, 2/3 ET, ET 4/3 ET added each day). Reference ET calculated from Blaney-Criddle must be adjusted for percentage ground cover.

Uniformity can also be judged independently of water management under sprinkle irrigation. The estimation of actual uniformity is more challenging under sprinkle irrigation because, as water travels from the sprinkler through the air on its way to the soil surface, wind

* John L. Merriam and Jack Keller, Farm Irrigation System Evaluation: A Guide for Management (Utah State University, 1978)

can distort the water application pattern. Measurements of uniformity under no wind conditions can not be easily and reliably adjusted for wind with current evaluation technology. The ultimate uniformity is further complicated by soil moisture redistribution. However, redistribution generally improves uniformity, and thus uniformity calculated from catchcan measurements is underestimated. Evaporation and spray losses can account for a large portion of water applied via sprinkling. Total volume applied is usually adjusted upward to compensate for the losses. As in the case of trickle, total applied water is also increased above that needed for ET, to adjust for nonuniformity of application. Estimating the irrigation amount and timing (ET) is slightly less difficult for sprinkle than trickle irrigation. The entire surface area is wetted under sprinkling and therefore the earlier problem of defining the root zone wetted volume is reduced. However, a large number of soil samples are required to determine the amount of water extracted by the plant and evaporated from the soil surface. It is advisable to measure soil moisture changes at the same location each time to limit spatial variability of soil moisture retention and of redistribution properties. Thus ET can be estimated by integrating changes in soil moisture with depth at a number of locations over a field. The required number of samples increases with the spatial variability of soil properties.

Nonuniformity of water application under surface irrigation is the result of variability in intake opportunity time and soil infiltration characteristics. Intake opportunity time distribution can be estimated from advance and recession trajectories, and infiltration with time is measured with water ponded in rings or blocked furrows. Intake opportunity is substituted into the infiltration function to estimate infiltration. Unfortunately it is very challenging to reliably measure infiltration.

An alternative water distribution measurement method is to measure changes in soil moisture as the result of irrigation. This is similar to estimating ET, but in this case soil moisture increases rather than decreases. Again, soil moisture samples should be taken before and after irrigation at the same site to limit soil variability. Irrigation timing and amount can be determined by changes in soil moisture.

Spatial variability of water content profiles makes it difficult to have sufficient samples to accurately schedule irrigation (measure ET). Soil samples should be taken at regular intervals over the area, and samples should be taken near the same site each time in an effort to limit the variability. Currently in the soils literature, the preferred sampling methods do not suggest randomizing sampling sites within a field; rather a grid is established, and samples are taken at each grid point. This strategy is also rational for evaluating the uniformity of water application under furrow irrigation, where application decreases with the distance from the water source.

The measurement of water content over depth, area, and time gives information used to estimate water use, but it also can be used to calculate water application uniformity, an irrigation system characteristic. Non-uniformity of applied water forces actual water application volume to be greater than that calculated as ET. For example, in surface irrigation the upstream end of the field is often overirrigated in the process of adequately irrigating the downstream end because intake opportunity time is greater. The degree of overirrigation is a measure of irrigation performance and, if performance is low, water may be wasted if it percolates into a saline sink. The cost of this drainage can be estimated and included in the financial and economic analysis.

Although uniformity of sprinkle and trickle irrigation systems is relatively constant over the season, uniformity can change as the depth of application increases under surface irrigation. Application depth per irrigation increases for annual crops as the root zone deepens, and uniformity can thus improve.

In all the above cases, water measurement is critical to the accuracy of uniformity and irrigation timing and amount decisions.

The Inshass station provides a unique opportunity to compare trickle, sprinkle, and surface irrigation technology under controlled conditions. In selecting irrigation experiments at Inshass, two important issues are being addressed: one is the determination of crop water use, and the other is irrigation system performance as measured by water application uniformity. Although the estimation and measurement of crop water use is critical for the management of irrigation water on the New Lands, the greater emphasis should be placed on evaluating irrigation system performance. Further justification is the existing body of knowledge already accumulated at the station on water use. Perhaps limiting the water use study to scheduling irrigation based on changes in water content, through the entire root zone, over time would be appropriate. In conjunction with this study, climatic variables could be measured as input to estimating ET using the Blaney-Criddle or other equation. Thus, following local calibration, water use could be estimated by equation and checked occasionally against soil moisture changes.

Water measurement at the Inshass station is critical. Both water use and uniformity measurements are dependent on accurate metering of water onto and off the field. The meters should be serviced and calibrated regularly. It might be possible to focus all meter maintenance on meters installed at the pump house and eliminate others (assuming only one treatment replicate is irrigated at one time.)

Finally, planting, fertilization, and other agronomic practices should be uniformly applied to all treatments. If not, they override the effect of changing irrigation systems. It is possible that these

practices might be more important than irrigation systems in improving productivity on the new lands.

Nubaria and Salhiya offer different research and extension opportunities than does Inshass. Current conditions are being evaluated, and the proposal is to help growers make adjustments to improve irrigation system performance and productivity. Research procedures at these sites are not and should not be the same as at Inshass because more specific examples are studied in less detail. Challenges in Nubaria include irrigation system selection on calcareous soils, drainage in West Nubaria, and salinity in the irrigation water from mixing drain with fresh water. Maintaining and managing a large number of center pivots for maximum production or profit is unique to Salniya. Unfortunately we did not visit a site where surface irrigation was being compared to sprinkle or trickle irrigation. Although not advocating gated pipe for furrows or flooded basin irrigation, these technologies should be included in the example areas.

In summary, the three site concept is good and should continue. However, some changes in emphasis would improve results. These are suggested in the recommendations section.

FINANCIAL AND ECONOMIC ANALYSIS

From the economists providing leadership in planning the analysis, and from visits with those conducting the analyses, it was learned that all of the data which can be anticipated to be needed for such analyses are being collected. In addition, it appears that at the planning level the economic data collection is being well coordinated with that of the other disciplines and that data relevant to analyses for each discipline is being developed in a comprehensive manner. It is gratifying to see such careful planning and coordination among the disciplines represented. Immediate attention should be given to developing interdisciplinary methods and research programs at the project sites.

Observations about the economic aspects of the alternative irrigation systems are being directed toward being able to make effective comparisons of the costs of establishing and operating each system under varying physical environments and under different cropping systems. Further, project personnel are aware of the size economies associated with alternative irrigation systems and are correctly focusing on the trade-off between labor use, energy use, and capital investments as irrigation systems with different potentials for physical water distribution efficiencies are evaluated.

While the data needs necessary for effective economic analysis have been anticipated, the analyses which will have to be performed are diverse and complex. The diversity comes from the necessity to evaluate the alternative irrigation technologies from a variety of perspectives. Each system must be evaluated in terms of how it will appear to the farmer faced with the decision about irrigation systems and cropping patterns. The systems must also be compared from the viewpoint of agencies, such as the Ministries of Irrigation, Agriculture, or Land Reclamation, charged with the implementation of new land irrigation development schemes. And, finally, evaluations should be made to include the national perspective and the policy goals of food production, food price and procurement policies, employment, population dispersion, and other social/political considerations. Complexities arise due to the alternative procedures and assumptions necessary to assign values to certain inputs used in New Land irrigation projects, which are often set in conjunction with a particular policy goal. Especially important will be values imputed or assigned to water, labor, energy, and land as well as the rate at which values of future production are discounted.

J. Price Gittinger in his book, Economic Analysis of Agricultural Projects (Second Edition, World Bank), makes a useful distinction between financial and economic analysis. Given the diverse perspectives under which evaluations of irrigation systems on new lands must be viewed, the distinction between these two analytical approaches

is especially relevant. Those who are to conduct the analyses are should study Gittinger's book for proper insight into his perspective and method; an attempt is made here to communicate the general idea and rationale of his approach to financial and economic evaluations.

Financial Analysis

Financial Analysis -- Farmer

Financial analysis takes the perspective of cash flows. Such analyses can be conducted from the perspective of the farmer operating an irrigation system, the government ministry charged with implementing a system, or from the perspective of the national economy. Regardless of the perspective, distinction is made between those items of cost which require budget expenditure as opposed to those which do not. Costs of items which are assigned or imputed values based on the economic concepts of opportunity costs, shadow prices, or residual imputation are not considered.

The rationale for financial analysis from the farmer's perspective is as follows. Farmers choose between alternative enterprises, alternative production techniques, and alternative irrigation systems on the basis of comparisons between the "financial gross margins" of the alternatives. Take for example the costs and returns from a feddan of a particular crop. From the gross market values of the primary and secondary products from that crop, some deductions may also be made for the amounts of the crop consumed in the farm household or by livestock on the farm. This "adjusted gross value," is that which makes it a cash crop, and is estimated first.

From the "adjusted gross value" per feddan, deductions are made for the costs of purchased inputs and other cash expenses incurred in the production of that crop with the cropping practices and irrigation system under consideration. Thus, the cost of expenditures incurred for purchases of seed (if purchased), fertilizers (if purchased), tractor and machines services, hired labor, chemical pesticide, water pumping, repairs of machinery and equipment, taxes, cash or share rents, and other items of costs which must be paid during or at the end of the production period are itemized and deducted from the adjusted gross value per feddan. These are termed the "direct cash costs." The difference, the "gross financial margin," is calculated.

Next, it is recognized that some inputs are not entirely consumed by the production process. Particularly, in more capital-intensive farming systems, tractors, machinery, and equipment are only partially consumed by the production process; the services of these durable inputs are used over several production periods. They, too, represent cash costs because these capital inputs must eventually be replaced, if that level of technology is to continue. They are not annual cash costs, like those for seed, fertilizer, etc., since they do not have to

be purchased each year or each production period. Nevertheless, they are cash costs which must be met sometime during the life of the asset. We term this the capital replacement allowance. Cash costs for capital replacement are often termed property and ownership costs, or even depreciation. Care should be taken, however, to properly reflect the actual use depreciation. Economists have been prone to adopt accounting concepts for estimates of depreciation costs. There are several techniques applied to estimating depreciation. But what is required here is the actual use depreciation, not accounting write-offs allowed by taxing authorities in developed economies. Use depreciation would consider the acquisition price for the asset, its salvage value at the end of the asset's life, and the number of years (hours) of expected life of the asset.

The estimated capital replacement allowances are then deducted from the "gross financial margin" to obtain the "financial margin above cash costs." This calculation ends the immediate financial analysis picture from the point of view of the farmer. A variety of subsequent analyses using the "gross financial margin" and the "financial margin above cash costs" can be performed, and a few of these will be suggested below.

The "financial margin above cash costs" represents the return to a number of unpaid or nonpurchased production inputs. The residual, the difference between the "adjusted gross value" less "direct cash costs" and "capital replacement allowances" ("direct cash costs" plus "capital replacement allowances" equals "total cash costs") is subjectively, and perhaps uniquely, allocated by each producer to the unpaid items of production. Some may allocate it subjectively between operator and unpaid family labor, management, return on investment in land, and return on investment in machinery and equipment. It is futile for the economist to make such allocations, and it is also unnecesary.

Financial ratio analyses

Observations of farmer behavior in developed as well as developing countries would indicate that farmers' decisions about choices between enterprises, between production technologies, and between alternative irrigation systems are primarily decided by comparisons between the relative values of "financial margins above cash costs". If farmer behavior is not explained by these direct comparisons, the subsequent analyses may provide additional insight.

When "financial margins above cash costs" are calculated, as described above, the direct comparisons are formed on the basis of a unit of land. But land, in the mind of a farmer, may not be the most limiting resource. Thus, analysis of "financial margins above cash costs" relative to other important inputs is also suggested.

Ratios of "financial margins above cash costs" to amount of operator and operator family labor, and the ratio of the financial margins to cubic meters of water applied may be important

calculations. Further, since different crops require use of the land for varied periods, analyses of returns per unit of land (labor, water) per month can also be useful comparisons.

Financial Analysis -- the Ministry.

Financial analyses from the viewpoint of the ministry consider its goals to facilitate a certain amount of land, irrigation system or settlement development given constraints of budget, arable land, water supplies, and other physical characteristics. Development policy may require the ministry to establish distributory canals and complete irrigation and settlement infrastructure as for the small-holder settlement schemes in Nubaria, or as only a portion of these investments as for the investor settlement in the same region.

As with financial analysis from the farmer viewpoint, only those items which make claim on the budget expenditures of the ministries would be considered in financial evaluations. Comparisons between developments of alternative irrigation systems, including water delivery as well as field distribution systems, will reveal trade-offs faced by the ministries as to the extent of development possible, per unit of time, under the alternative. Such comparisons will be useful in appraisals of the rate and extent of new land development possible under the budget of the ministry, and these, in turn, can be evaluated relative to the established policy goals (e.g., food production vs population dispersion, employment) for which the ministry is expected to make a contribution.

Financial Analysis -- the Nation

Public sector resources are always limiting, and allocations must be made between sectors and within sectors. That is, the Ministry of Irrigation must be able to justify (1) its overall allocations between new lands and old lands and (2) its expenditures between alternative new lands projects. The ministry must be in a position to have its policies and strategies rationalized with expenditures for development of agriculture or industry. The financial analyses from the national viewpoint would seek to develop information about the relative amounts of increases in food production, extent of settlement, amount of employment, increase in personal income, etc. from the programs of alternative ministries to the national development goals. It can be expected that each ministry will have to justify its share of the national budget, in part, according to these financial criteria.

Economic Analysis

While financial analysis focuses on cash flows and use of resources relative to budget expenditures, economic analysis seeks to provide a more thorough evaluation of the full costs of development alternatives. It is more complete in the sense of examining all of the economic trade-offs between development alternatives, as between choices of irrigation systems, farming practices, and settlement plans. The more complete recognition of costs is not necessarily more

revealing of the incentives of farmers, ministry officials, or the government towards specific courses of action. Farmers may prefer one alternative irrigation system to another because it provides a greater financial return even though economic evaluation may reveal it to have less economic potential.

Economic Analysis -- Farmer

In Egypt, as in many other countries, many of the resources used in production are not fully accounted for in a financial analysis. The prices of certain commodities are established by the government, and these prices may or may not reflect the true econonomic value of the commodities. Prices of inputs may be subsidized or taxed as a part of policies to affect the use and employment of these resources in the context of broader development strategies. And many of the inputs to production are supplied by the farmer and involve no financial transations for their employment. These resources, necessary and important to production, make claim on the "financial margins above cash costs" discussed above. Economic analysis seeks to provide an economic cost of all products and resources in a production process. To the farmer, an economic evaluation of the contributions of resources supplied by the farm are important.

Farm families in Egypt provide great amounts of unpaid labor to the farming operations. There is much variation between commodities in the amounts of labor required. And there will be much variation between irrigation systems and practices in the amounts of labor required. Economic evaluation is difficult because of the subjective means by which values are placed on the use of this labor. Economists often apply opportunity cost concepts in the valuation of operator supplied inputs. That is, if the farmer hired labor which he or his family contributes, the cost of hiring that labor would represent an opportunity cost. Or, if the farmer were to work off the farm rather than contributing his time and effort to farming, the value of off-farm earnings may be counted as an opportunity cost. Problems arise because the opportunity costs vary from individual to individual; a university graduate will have different off-farm earning potential than an uneducated peasant.

Returning to the concept of an enterprise cost and returns estimate, we shall seek to discuss the adjustments necessary to convert those estimates from a financial to an economic evaluation.

Earlier we set aside from total product that amount of production which was (a) used on the farm (e.g., fed to livestock) or (b) used for home consumption. Economic analysis places a value on total production. If crop residues are fed to livestock, they replace forages which would otherwise be purchased. If products are consumed in the household, those products do not have to be purchased. The appropriate opportunity costs are the value of feed not purchased and the value of household commodities which do not have to be purchased.

Proceeding to costs of production, in addition to the expenditures for purchased inputs, farmers and their families provide most of the labor to the farming operations. So, in addition to hired labor recognized in the financial analysis, values are placed on the labor supplied by the farmer and members of the farm household. The opportunity cost of each contributor's labor will vary depending on his/her true opportunities, education and training.

In addition, some fertilizers important to crop production may be from manure supplied by farm animals. While no financial expenditure is made for farm-supplied fertilizer, it may have an opportunity cost (it could, perhaps, be sold to a neighboring farm). Seeds for certain crops may be from that crop grown in the previous season. Again, while no financial cost is incurred for the use of that seed, its opportunity cost becomes the income foregone if it had been sold rather than used as seed.

Irrigation systems will vary in the amount of farmer and farm family labor required to operate them. For example, the traditional saggia requires a relatively small financial investment. It uses farm-supplied power and can be maintained and operated by farm-supplied labor and animal power. It may appear to have considerable financial advantage over, say, a sprinkler system. The sprinkler system may require more purchased inputs for its operation, e.g., energy costs, repairs of sprinkler heads. While the saggia is more labor intensive, an economic evaluation, placing an opportunity cost on the value of labor, may show it is more costly to operate under certain circumstances than the sprinkler system. Thus, the differences which can arise between financial and economic evaluations become apparent. Finally, farmers own equipment and land used in production. If investments were not made in such, those investments could be earning returns in other uses. The opportunity cost of investments in equipment, or opportunity returns of the value of equity in land must also be considered in an economic analysis at the farm level.

Economic Analysis -- Ministry.

The ministries initiating irrigation development and settlement on new lands use many of their permanent personnel to implement these schemes. Economic analysis from the ministries' viewpoint considers the time, effort, and operating costs for these personnel assigned to the new lands development efforts. Personnel must be trained to construct the infrastructure for the irrigation system. They must also be trained in the proper operation and maintenance of new irrigation systems. Infrastructural development in the new lands extends well beyond the irrigation system. Communities are planned; housing, schools, hospitals and other facilities for community services are built. Education and training classes are presented to settlers on new lands, relating to adjustments to the new technologies and community structures. The economic analysis includes accounting for the costs of the personnel required to execute these programs, which are necessary to ensure the success of the new lands development project.

Economic Analysis -- National

Because of national economic policies, many of the prices used in the financial analysis for the farmer and for the ministries do not represent the true costs or values. It is a national policy to not charge farmers for water, yet water has value in alternative uses. National agricultural prices and procurement policies set prices for certain commodities at levels below what those commodities would receive in international markets. Prices of inputs such as fertilizers, seeds, chemicals and energy are often subsidized to farmers. Economic analysis from the national viewpoint reflects as accurately and completely as possible the true economic costs of inputs and products. Prices and values which are free from distortions of administered pricing systems form the basis for national economic evaluation.

One of the most difficult aspects of this type of economic analysis is the assumption about whether or not resources would be used in the same manner in the absence of administered price distortions. If commodity prices were market prices, differences in the mix of commodities may well result. If fertilizer, energy, and other inputs were priced at their nonsubsidized values, different levels of use may result.

Economies of Size.

In addition to the financial and economic analyses with enterprise cost and return studies, along with the comparative ratio analyses which can be directly made with data from enterprise cost and returns, it is also important to consider the size or scaling of alternative irrigation systems. Irrigation systems differ in their initial investment costs, the lumpiness of their designs with respect to land area, potentials for water application efficiency, and energy, labor, and management requirements. Studies of the economies of size for each irrigation system should be conducted. Within economies of size comparisons, distinction is made between (a) investment costs and (b) operating costs. It would be well to separate investment costs between (i) those costs associated with the project and (ii) those associated with the on-farm infrastructure. Project investments include those of the pumping station and major distribution canals. The on-farm infrastructure costs are those associated with the irrigation systems as they exist.

Cost relationships can be expressed per unit of area or per volume of water. It will also be useful to maintain the financial versus economic cost concepts in developing the economies of size comparisons.

SOCIOLOGICAL STUDIES

Because of the lack of sociological analyses expertise by this reviewer and the diversity of the three sites, suggestions for uniform sociological studies will not be specific. The objectives for sociological analyses (Objectives 7 and 8)* are well-developed and will result in knowledge of great use to the study team. Differences in the three sites will make sociological investigations difficult.

Inshass is an experiment station; direct extrapolations to farmers can only be observed when the alternative irrigation systems are applied on farms. There is a body of literature that suggests how results from the kinds of studies which are being conducted can best be disseminated from experiments to farmers. It would seem that sociological analyses at Inshass should be initially addressed to review of this technology diffusion literature. The sociological analyses in this regard could be linked to the economic analysis that distinguishes between financial and economic costs. The underlying hypothesis here is that acceptance of a technology by farmers may be related to the cost structure (how much money is at risk) as well as to important sociological variables.

Conversations with the economist and sociologist at one site would indicate that they are progressing well in their plans for data collection and analyses. It is important that data collection and analytical techniques be similar at each of sites. It may be well to have the sociologist associated with the Inshass site assume a liaison role between Salhiya and Nubaria. This is suggested because of the great differences between the two sites in their development strategy. The large state farm at Salhiya poses different sociological problems than are presented by the private settlement schemes at Nubaria. At Salhiya, where all employees are hired, factors of employee satisfaction, productivity, performance, and incentives are important. Sociological investigations should focus on these factors.

On the other hand, at Nubaria, development includes large private schemes, smaller investors, and planned settlements of small-holders. Each implies different sociological investigations. Studies of technology acceptance, rates of discovery of alternative crops and cropping systems, adjustments to new irrigation systems, and other factors relating to success in settlement will be important. In addition to adjustments to the new farming and irrigation systems, individual families' continuation in new settlement schemes will depend on their ability to establish themselves in new communities, on

*Objective 7

To evaluate the effect of each of the three techniques on the social network in each area.

Objective 8

To examine the issue of the resettlement of groups of people in reclaimed land areas.

the extent of community services, and on the efficacy of new institutions, public and private, in meeting the needs of farmer-settlers and their families.

Priorities in Financial, Economic and Sociological Analyses

Given the funding limitations of the project, researchers may have difficulty accomplishing all of the socioeconomic analyses suggested. Thus two top priorities are suggested:

1. Give emphasis to farmer-level analyses. The immediate acceptance of irrigation practices must first occur on farms. Not only must these practices result in economically sustainable farms, they must provide desirable and satisfying social environments.

2. Analyses should be kept up to date. Unless analyses are completed at the end of each cropping season and reported at least annually, the project will not benefit from internal correction. Data gaps will be discovered, weaknesses in methods will be identified, and changes in annual work plans can be made only with the benefit of completed analyses.

3. While some attention to ministry level and national level analyses should be given throughout the project, it is especially important that these analyses be conducted in the final project report.

CONCLUSION

The project has the potential to provide information for important policy decisions faced by the Government of Egypt. The most appropriate irrigation systems will likely be determined by water availability, energy costs, soil types and crop selection. Results of research on this project will help researchers understand the conditions under which alternative irrigation systems can be adapted to different physical and biological environments as well as the financial, economic, and sociological dimensions of these alternative irrigation systems.

Annex D

More and Better Food: A Demonstration Project

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TRAVEL TO EGYPT

January 1 - March 31, 1986

NAME	DATE	PURPOSE
TECHNICAL & SOCIOECONOMIC EVALUATION OF IRRIGATION SYSTEMS IN THE NEW LANDS		
1. Melvin Skold Dept. of Agricultural Economics & Natural Resource Economics Colorado State University	January 9-16	Review project, advise on project implementation during next two years, advise on planning of study/observation visits to U.S. by Egyptian project personnel
2. Wesley W. Wallender Dept. of Land, Air and Water Resources University of California Davis, California	January 9-16	
3. Augustus Nasmith Jr. Staff Officer, BOSTID	January 7-22	Coordinate U.S. team's activities, in addition to overall program management responsibilities
MORE AND BETTER FOOD		
4. Andrew W. Nichols Dept. of Family and Community Medicine University of Arizona	February 5-12	Analysis of data on health interventions in demonstration villages; assist in preparation of guidelines for future activities in rural development; participate in discussion seminar to brief USAID/Cairo on impact of MBF on village health and nutrition

TRAVEL FROM EGYPT

January 1 - March 31, 1986

NAME	DATE	PURPOSE	PLACES VISITED
TECHNICAL & SOCIOECONOMIC EVALUATION OF IRRIGATION SYSTEMS IN THE NEW LANDS			
1. Farouk Abdel Al Water Distribution & Irrigation Systems Research Institute (WDISRI)	Feb. 8-27	Study current technologies in irrigation and water management, sprinkler and drip irrigation systems, system maintenance and repair; review latest R&D on soil salinity; observe on-farm water conservation and water harvesting methods; strengthen links with U.S. institutions active in arid land studies	University of California, Davis USDA Water Mgt Research Lab, Fresno, Calif. Univ. of Calif. Kearney Agricultural Field Station Farms in Colusa County, Calif. County Farm Advisor, Salinas, Calif. U.S. Salinity Lab, Riverside, Calif. University of Arizona, Tucson Colorado State University, Fort Collins U.S. Bureau of Reclamation, Denver, Colo.
2. A. W. Abdel Wahed Vice Director for Agricultural Projects, Arab Contractors			
3. Abdel Hamid Abou-Sabe Chairman, Managing Board International Center for Rural Development			
4. Abdel Ati Allam WDISRI			
5. Nadia Wahby WDISRI			
6. Balaigh Shindi Zikri Director, Soil and Water Research Institute Ministry of Agriculture			
MORE AND BETTER FOOD			
7. Osman Galal*	March 2-11	Continue work on analysis of nutrition interventions and completion of final report	University of Arizona, Dept. of Family and Community Medicine, Tucson NAS, Washington, D.C.

TRAVEL FROM EGYPT (cont.)
January 1 - March 31, 1986

NAME	DATE	PURPOSE	PLACES VISITED
R&D MANAGEMENT SYSTEMS			
8. Mohamed El Hossieny Head, Programming Office National Research Centre (NRC)	Feb. 14-March 13	Study management control and evaluation systems in U.S. institutions; prepare draft plan for strengthening NRC management control and evaluation functions	AID Office of Evaluation, Washington National Science Foundation, Washington USDA Agricultural Research Center, Beltsville, Maryland Battelle Memorial Institute, Columbus, Ohio Ohio Agriculture R&D Center, Wooster, Ohio University of Wisconsin, College of Engineering, Madison USDA Northern Regional Research Center, Peoria, Illinois Washington University, Dept. of Technology and Human Affairs, St. Louis, Missouri Midwest Research Institute, Kansas City,Mo.
9. M. M. El Halwagi Head, Pilot Plant Lab NRC	Feb. 23-March 18	Study marketing methods in selected R&D institutes; Review waste water treatment for seaport cities	TUBITAK (Scientific & Technical Research Council of Turkey), Ankara and Istanbul City of Los Angeles Bureau of Sanitation, Hyperion Treatment Facility SRI International, Menlo Park, Calif. Midwest Research Institute, Kansas City,Mo. Metropolitan Sanitary District of Greater Chicago American Clean Water Assn, Washington,D.C. World Bank, Washington, D.C. U.S. Environmental Protection Agency, Washington, D.C. Tams Pirnie Inc., New York, N. Y.
PROGRAM MANAGEMENT			
10. A. S. El Nockrashy ASRT Program Coordinator	March 7-28	Completion of analytical report on program and final MBF report	NAS, Washington, D.C.

*Airfare provided by AID/CRSP program