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TRINATIONAL

AGRICULTURAL TECHNOLOGY EXCHANGE and COOPERATION (TATEC) PROJECT:

PATTERNS OF TECHNOLOGY EXCHANGE & COOPERATION IN AGRICULTURE

A.I.D. Project #398-0158-05

FINAL EXTERNAL EVALUATION REPORT

Prepared for
U.S. Agency for International Development
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E R R A T A

The last sentence on page 44 (continuing to page 45) should read:

> There is a high risk factor in using a relatively new technology such as solarization without a lot of testing to show the farmers that pest control can be achieved.

PROJECT IDENTIFICATION DATA SHEET

1. Country: Egypt, Israel (Middle East Regional Cooperation Program)

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7. Project Designers:

   Ministry of Agriculture, Egypt

   Hebrew University of Jerusalem (Faculty of Agriculture) and Ministry of Agriculture, Israel

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   NE/Egyptian and North African Affairs
   NE/Technical Resources/Agriculture & Rural Development

9. Previous Evaluations: January 1987

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EXECUTIVE SUMMARY

Between 1984 and 1991, the Trinational Agricultural Technology Exchange and Cooperation (TATEC) Project has accomplished varying degrees of success in its individual sub-projects. Significant achievements have been made in both the scientific and in the political aspects of the project. A substantial body of useful research has been completed and many good scientific papers have been published in international journals. Furthermore, a wide range of professional relationships and personal friendships have been established, despite the political intransigence and violence in the region throughout the life span of the project.

1. Features of the Project

The project was planned to focus on an interdisciplinary approach to promote, screen, select and adopt appropriate new agricultural technology in Egypt and Israel. Thus it comprised various activities, ranging from water use through crop production to crop protection, animal production, and medicinal plants, as well as their economic feasibility. However, the project was implemented in the form of individual sub-projects, in which each had its specific objectives. The needed careful coordination among the various sub-projects was planned in a loose manner which made them appear as unrelated subjects. The collective scope of the project as a whole was not equally well defined among the involved scientists.

2. Project Productivity

In both its phases (1984-87 and 1988-91), the TATEC project was aimed primarily at:

a.) better interaction, cooperation and understanding between Egyptian and Israeli scientists (i.e., a political goal)

b.) selection of innovative agricultural technologies in Egypt and Israel and promotion of their adoption (i.e. a scientific goal)

The success of the political goal is evident and documented for each sub-project in its specific section of this evaluation. There is clear constructive cooperation that is well-demonstrated by some of the jointly published papers. The warmth and depth of the personal relationships between Egyptian and Israeli researchers is indicative of the great success of the project in

promoting cooperation and understanding among the scientists of both countries. The success of the scientific goal is well expressed by the various ways of dissemination of data within the scientific community, i.e. journals, proceedings of symposia, books and presentations at national and international meetings. The quality of the published work is quite variable among the various sub-projects.

Some appropriate technologies have been selected and tested under controlled conditions in both countries. Adoption of these technologies by the farmers is generally less apparent. Although tested innovative technologies need to be transferred to the farmer, demonstrations of these selected technologies on farms have been very limited. Only on-farm experiments can identify barriers to adoption of new innovative technologies.

3. Problems Encountered

- The duration of the TATEC project has witnessed numerous political tensions in the region and the situation was made more difficult since the objectives were basically broad and undefined, i.e., hopes were set as goals.

- On the Egyptian side, the unfortunate frequent changes of the coordinator of the project made supervision and communication between and among the various sub-projects difficult at best.

- The administrative structure specially at the coordinator level in Egypt made it difficult for the Principal Investigators (PIs) to spend their allocated budget.

- Israeli scientists expressed dissatisfaction with the degree of professional technical involvement by the USDA during the second phase of the project.

- Funding in the second phase was considered low and inadequate.

- The delay in funding for the second phase and the shift of emphasis have contributed to some confusion and interruption for the project.

- Periodic and annual reports were not widely and consistently distributed among and between the scientists and administrators of both countries. This resulted in less communication within and between countries than would have been desirable, given the collaboration and cooperative exchange objectives of the TATEC.

4. Recommendations

Each of the reviewers for the various sub-projects list specific conclusions and recommendations. In this summary, only overall recommendations concerning the project as a whole are listed:

- Overall observations of the evaluation team suggest that consideration of an extension of some components of TATEC could provide a productive contribution to the original objectives of the project.

- If an extension is not possible for any reason, the team strongly recommends that an umbrella format should be provided to insure the continuation of the warm, friendly and professional relationships among the scientists of both countries.

- Any form of extension must emphasize the link between research, demonstration and practice under farm conditions.

- Scientists of both countries recommend that any form of an extension should include more involvement by American scientists without them being directly involved in research engagement.

- Participation of additional scientists and research institutes <u>in any extension of this project</u> should be encouraged.

- Initiation of any new or continued research activity must emphasize the association among equals throughout the planning and implementation phase and in the dissemination of information.

- The economic evaluation of the selected technologies concentrated on the analysis of technical experiments. Such analysis is necessary and appropriate, but it is not sufficient to answer questions about the worth of a particular technology. The suggested approach is to conduct the analysis at the farm level where the new technology must compete with other investment choices for the use of farm resources.

- Future trinational projects need to have more specific and focused research objectives.

- Periodic and annual reports should follow a structured format of suitable detail, i.e. statement of purpose, specific objectives, detailed methods, and well-thought-out results and discussion. Reports should be widely disseminated among the various project components within countries and between countries. In the latter case, a significant role could be played by the Coordinating Committee and OICD, the implementing agents of the project.

Introduction:

Background
Goals
Scope of Review and Procedure

1. Background

The Trinational Agricultural Technology Exchange and Cooperation (TATEC) research project started its activity in 1984. Its goal is the promotion of agricultural technology innovations in Egypt and Israel by combined activities of agricultural scientists in both countries.

This project had a long genesis: its conception was made possible by the signing of the peace treaty between Egypt and Israel in May 1979, followed by the agreement in May 1980 of the Egyptian and Israeli Ministries of Agriculture to cooperate in research and other areas, which marked Regional Cooperation as an area of joint effort. The first draft of the TATEC project's proposal was set in 1981 and reached final form in early 1984. The proposal was approved in summer 1984, and the research program started in the fall of the same year.

After such a prolonged gestation, the project started building with the eagerness of both sides to join efforts for attaining the goals of the project.

This project grew from the recognition that progress in the Middle East region is largely dependent upon cooperation between countries. In spite of apparent differences in socio-economic structures, Egypt and Israel have many basic characteristics in common: similar climates and soil types, limited water availability, and the urgent need to increase agricultural productivity in specific areas. Along with these factors, scientists in the two countries have reached a high degree of technical competence. As a result, they are able to complement each other for the mutual benefit of both countries.

The socio-economic situations in Egypt and Israel are such that regional cooperation can promote mutual advantages, with little risk of generating competition between the two countries that would limit the advantages of cooperation. Therefore it seems that promotion of regional cooperation, freed from political limitations, should be seen as the heart of future progress in the region.

The agricultural system is a complex one. It comprises various activities, ranging from water use through crop production to crop protection, animal production, and medicinal plants. Principally by adopting an integrative approach that addresses these varied agricultural activities can the rate of progress of the whole agricultural system be enhanced. The TATEC project has adopted such an approach, by emphasizing selected activities in the main components of the agricultural system and was carried out in two different phases.

In Phase I of the TATEC project (project years 1-3, FY 1984-87), five interdependent but autonomous sub-projects were carried out:

- The intensification of agricultural system production:
  cropping systems and water use
  dairy cattle productivity
  solar heating of soil for pest and weed control

- Developing new resources: medicinal uses of desert flora

- Economic evaluation of technologies selected for exchange

The TATEC project was evaluated in January 1987 by a Scientific Evaluation Committee, whose members were nominated by AID. This evaluation, which was accomplished during a 3-week visit to sites in both countries, found that: "The project has been impressively successful. It is enthusiastically recommended that the project be extended. Much of the work is still in gestation and should not be cut off in a short period of time. Thus providing an extension for a multi-year period is extremely important."

The external evaluation report further recommended: "If increased funding is feasible, it is desirable to make plans for expanded activities."

In Phase II, certain shifts in emphasis took place relative to Phase I:

- First, following the request of the Egyptian cooperating party, the Medicinal Desert Plants and the Soil Solarization (Solar Heating) sub-projects were due to phase down in Egypt to minimal levels of activity, for reasons particular to each sub-project.

With respect to the Soil Solarization sub-project, it had an earlier start than other sub-projects, due to Germany-Israel GIFRID Foundation support 1981-84. It was most successful in terms of scientific achievements, spirit of cooperation, publication of joint papers, and testing/demonstration of a new technology for control of soilborne pests, one which also has considerable potential for increasing the profitability of certain crops. This sub-project has reached the stage at which on-farm experimentation is required, to test its commercial feasibility in the Egyptian agricultural system. However, the budget allocated by AID for TATEC's Phase II was too small to allow for such activity, although on-farm experimentation and demonstrations were initially planned for technologies stemming from all sub-projects. It was hoped that financial support for this in Egypt will come from other sources.

- In accordance with the request of the Egyptian cooperating party, Water Use/Cropping Systems activity at Gemeiza (in the Nile Delta) was discontinued. Instead, the activity was shifted to a site in the newly reclaimed lands (Nubaria). Also, in this new area, problems of irrigation and soils were emphasized, rather than those of particular crops. This was reflected in the organization of the "Integrated Water Use and Cropping Systems" sub-project. This shift in emphasis was also reflected in the share of the available budget that is allocated to this sub-project.

- In the Dairy Production sub-project, emphasis was given to the development of a dairy herd recording system and data analysis in Egypt, and in Israel, to the extensive testing of a heat-stress relief method, which was developed and initially tested in Phase I.

2. Goals

The overall goal of the project was to promote progress in the agriculture of Egypt and Israel through development and exchange of innovative technologies suitable to the agro-economic environment. This goal was to be achieved by:

- selection of technologies that would be good candidates for exchange and promotion through agro-technical research (surveys, studies, experiments) by participating agro-technology experts

- a study of farm types of greatest potential for practical implementation of the selected technologies

- A study of factors promoting or inhibiting adoption and diffusion of the selected technologies and of measures to overcome inhibiting factors.

3. Scope of Review and Procedure

The scope of the final external evaluation of TATEC can be summarized as follows:

- review the various components of the project and how they have contributed to the transfer of technology between Egypt and Israel, and

- consider the successes and problems which have arisen in the process of coordination and cooperation among agencies and individuals of both countries.

The evaluation team visited Egypt and Israel between October 4 and October 18, 1991. The team members were: Dr. Mohamed Yousef (team leader), University of Nevada, Las Vegas; Dr. James

Duke, USDA; Dr. Clyde Elmore, University of California, Davis; Dr. Stephen Grattan, University of California, Davis; and Dr. Fletcher Riggs, retired from the USAID.

During the team's overseas activities, each one took the responsibility of writing a rough draft entailing his observations. The team leader edited and collated the reports to synthesize the final report.

INTEGRATED WATER USE & CROPPING SYSTEMS

I. INTRODUCTION

The Trinational Agricultural Technology Exchange and Cooperation (TATEC) Project was initiated in 1984, not only to develop or adapt new agricultural technologies in Egypt and Israel suitable to their agro-economic environments, but to establish positive working relationships among agricultural scientists in each country through collaborative research activities. A project of this nature has considerable potential of success since both countries have similar climates and soil types, have a limited supply of good quality water for irrigation, and are interested in improving crop production practices. Therefore any innovative technologies developed and/or adopted in one country could have direct or indirect benefits in the other.

The TATEC sub-project "cropping systems and water use" has been structured into two phases. The first phase (1984-1987) concentrated on field oriented research with wheat and maize. The research in Egypt was conducted at the Gemezia Agricultural Research Station (in the Nile Delta) and emphasized plant response to fertilizer applications, soil-water depletions, irrigation methods and irrigation timing. In Israel, research was conducted at the Lakhish Station and emphasized plant response to crop rotations, to growth regulators, seed-planting (diversity and timing) and certain irrigation practices.

In Phase II (1988-1990) investigators in both countries were interested in expanding their research to include high-value vegetable crops. In Egypt, investigators discontinued their research activity at Gemezia to conduct experiments in the newly reclaimed lands (Nubaria) with a stronger emphasis on crop response to applied water and their performance and feasibility under different irrigation methods (e.g., furrow, drip, mini-sprinklers, etc.). In Israel, not only did work continue at the Lakhish Experimental Farm but other research was conducted in the Negev area under soil and climate conditions similar to those of Nubaria in Egypt. Furthermore research in Israel continued in double cropping but expanded to include 1) an on-farm economic evaluation of different irrigation systems with particular emphasis on non-uniformity at the applied water and 2) experiments to improve tomato fruit set, understand the mechanisms involved with sunscald, and prevent such injury under field conditions.

The evaluation here identifies the technologies developed or adopted in each country; their importance and significance related to crop water use and cropping systems; the extent or potential by which these technologies were (are) adapted (adaptable) by growers; and describes the quality and level of cooperation among scientists.

II. SUMMARY OF RESEARCH PROGRAM

As one might expect, the "cropping systems and water use" section of the TATEC project is a very broad area and there are a multitude of potential technologies or management practices that can be developed or adapted that would fall within this section. From this perspective, the category was too broad and allowed research groups in each country to conduct work independent from one another. Therefore the collaboration and interactions among scientists in each country potentially would have been greater with more focused objectives presented in the "Plan of Work".

Overall objectives:

The following are the combined objectives of all work in both Phases (I and II) that were set-out to be accomplished by experimentation in either Egypt or Israel within the "Cropping system and water use section".

1) To develop improved technologies for double cropping wheat and maize that will increase production.

2) To investigate different cultural (plant spacing and density) and management (irrigation, fertilization, etc.) practices and varieties in the production of certain agronomic and vegetable crops.

3) To determine the relationship between water-application uniformity produced under different irrigation methods and crop-yield water-production functions.

4) To establish a standard procedure for tomato fruit set induction with auxin-like compounds.

5) To study the factors leading to the development of sunscald of certain vegetables and to develop procedures to minimize the damages caused by this physiological disease under field conditions.

Methodology:

Investigators in both countries satisfied most of the objectives above by conducting replicated field experiments (e.g., objectives 1 and 2). These experiments were carried out with treatments and practices selected for the local conditions (e.g., sowing dates, varieties, fertilizer rates, irrigation practices, system type and crop water requirements, etc.). Data were collected on crop yield and other crop parameters, soil-water content and other soil parameters, and plant susceptibility to disease. Additional objectives (e.g. 4 and 5) were satisfied, in part, by greenhouse and laboratory

experiments. Other work involved the development of an economic optimization model (objective 3).

Reported scientific findings:

The following is a summary of the important scientific findings that were reported by the various principle investigators in the annual reports under both phases of the "cropping system and water-use section". The numerical value assigned to each "finding" is not related to the significance of the finding or its relative contribution to the program goals.

Egypt:

1) Increasing the applied water and applied fertilizer (both nitrogen and phosphorus) increased wheat yield. However, in one year, applied water did not improve wheat and barley yields.

2) Onion seeds can be produced effectively under drip and micro-sprinklers. In one year, yields were the same under both irrigation practices while drip irrigated plots out-yielded sprinkler irrigated plots the following year. It is believed that drip irrigation is better for seed production than mini-sprinklers where the opposite is believed to be true for bulb production (Dr. Ihsan El-Mofty, personal communication).

3) Large onion bulbs (5-6 cm in diameter) produced higher seed yields than smaller bulbs (4-5 cm in diameter). Furthermore, bulbs spaced 10 cm apart produced higher yield than those spaced 20 or 30 cm apart. Also applying differential quantities of N-fertilizers did not influence seed yields.

4) Tomato breeding trails indicate that two cultivars (BB234 and BB325) have potential for resistance to stresses imposed by heat, nematodes and salinity.

5) Splitting N-fertilizer into three applications was more effective than splitting them into four.

6) Tillage practices increased grain yield.

7) The 15th of June was a better date for planting maize than one month earlier or later.

8) Optional plant density was 20,000 maize plants per feddan using one drip line per row and 24,000 plants per feddan using one drip line per two plant rows.

9) Maize yield under drip irrigation decreased as the available soil-water depletion increased from 25 to 75%; indicating that more frequent irrigations with less amounts of water produces higher yields.

10) In Gemezia, maize yields under surface irrigation (i.e. flood) was higher than under drip irrigation.

11) At the Nubaria site, only one irrigation was needed to produce successful wheat and barley crops and may be related to preseason rainfall (i.e. 130 mm) and distribution.

12) Optimum grain crop response to fertilizers in Nubaria were obtained from applying 90 and 15 Kg/Feddan N and P_2O_5, respectively.

13) In Nubaria, the wheat variety "Giza 155" and the barley variety "California Mar." produced higher grain yield under the lowest applied water treatment as compared to the other varieties tested. These varieties increased their harvest index under water-stressed conditions.

14) The foliar application of the growth regulator "ccc" (chloromequat) reduced the amount of irrigation water required to produce a given quantity of wheat grain.

15) Sprinkler irrigation could be successfully used to grow wheat in heavy clay soils of the delta.

Israel:

1) Controlling irrigation uniformity can be as important as controlling irrigation water quantities (i.e. lower uniformity is related to lower expected average yield).

2) It is not appropriate to use a predetermined arbitrary measure of application uniformity as a criterion for planning and operating sprinkler or drip irrigation systems.

3) Stochastic economic optimization models were developed to determine both the optional levels of applied water and the optional application uniformity.

4) Using one drip line per two rows of maize yielded higher than one drip line per row.

5) Terminating the drip irrigation at the end of September (for maize planted early June) produced higher yields than when the final irrigation was the beginning of September.

6) Maize yields were reduced when planted later than the middle of June at Lakhish and later than the beginning of July in the Negev area.

7) Heat-resistant processing tomato cultivars that were planted in June after wheat produced more marketable fruit than the standard cultivars.

8) Applying the growth regulator "ccc" on short-strawed wheats is not justified if they are grown under conditions where lodging is not likely to occur.

9) Applying additional nitrogen to chickpeas during seed development does not increase yields, but does increase protein content.

10) A larger percentage of the dry matter produced up to maturity in wheat (a determinate crop) goes to grain rather than vegetative growth as compared to chickpeas (an indeterminate crop).

11) Different wheats were selected that excel both in grain production as well as straw production (a characteristic particularly attractive to Egyptian farmers).

12) Maize had certain beneficial effects on the subsequent wheat crop.

13) A single, full coverage of the auxin-like material P-CPA improved tomato fruit set under summer conditions and improved yield. The magnitude of this effect varied among genotypes.

14) Adoption of agrotechniques (e.g., white washing, ZnO, sprinkling, etc.) that maintain fruit tissue temperature below 40°C substantially reduces sunscald.

15) The mature green growth stage of tomato fruit was particularly susceptible to sunscald and the development of this physiological disorder is dependent upon fruit temperature, light, chlorophyll and oxygen.

Contribution of research findings to program goals:

All the research findings presented here can benefit irrigation practices and crop production in both Egypt and Israel. The magnitude of the benefits varies from experiment to experiment. The field projects that were conducted in both countries were very applied and fundamental, but necessary to establish site or region specific guidelines on irrigation practices, fertilizer practices, seeding rates, plant spacing, and feasibility of different crop rotations. Although results may not be directly applicable from region to region or country to country, various concepts and experimented techniques use can be applicable. In Egypt, future irrigation experiments should be redesigned to replicate irrigation methods over space. This will allow for direct comparison among irrigation systems. In both countries, work should be done to avoid simultaneous use of two capital intensive irrigation systems (drip and sprinkler). Establishing a uniform maize stand with sprinkler irrigation then switching to drip is economically infeasible.

The reporting system, particularly in Egypt, needs substantial improvement. Very often units are wrong or missing, pertinent information is inadvertently omitted, abbreviations are not defined, and objectives and methodology insufficiently described. Spending more time on reports will improve their scientific credibility.

Furthermore, all reports that are sent to USDA should be distributed to all principle investigators. There were concerns by certain scientists that this process was not too effective in Phase II.

In the tomato fruit set and sunscalding experiments conducted in Israel, important information was developed that can have direct benefits to tomato growers in both countries. The agro-technologies developed here are ready for grower adoption. Both Drs. Rylski and Rabinowitch should be acknowledged for their efforts in developing educational material in Arabic and English as well as Hebrew.

As initiated earlier, the "cropping systems and water use" section was too large. The scientist in a particular sub-discipline in one country may be working at an entirely different level or in a different subject area from his peer in the other country. For example, Dr. Hakeen, a tomato breeder in Israel is interested in developing new tomato lines with disease resistance whereas the Israeli scientists are studying ways to improve fruit set and avoid sunscald. Dr. Abdel-Shafi and his soil and irrigation colleagues are interested in very applied site-specific field experiments with direct application for improving crop production in New Lands whereas Drs. Bresler and Feinerman have demonstrated the economic importance of spatial variability in irrigated agriculture. Although findings reported by all are important, subject matter differences discourage cooperation and interactions, the most important goal of the TATEC project.

III. COOPERATION AND EXCHANGE

The cropping systems and water use sub-section of TATEC has been successful in enhancing the understanding of similarities and differences between Egyptian and Israeli colleagues and by establishing linkages between the two countries. Effective working relationships were developed, despite difficulties in the beginning of the project. Although the cooperative aspect has been successful, the level and extent of cooperation could have been more.

Perhaps the strongest cooperation and interaction between Israeli and Egyptian scientists were among Drs. M. Pinthus, Marani, Abdel-Shafi and their colleagues. As indicated below,

each have made visits to each others countries, visited research sites, planned projects and discussed results. Drs. Pinthus and Abdel-Shafi have also interacted socially at each others homes. No joint papers have been published among scientists yet, but it is our understanding that three joint papers have been planned between Drs. Pinthus and Abdel-Shafi and their colleagues. The strength of this relationship is also reflected in their interactions outside this project. In one instance, Dr. Pinthus wanted to conduct a chickpea experiment by varying the soil water supply at different growth stages. The experiment needed to be conducted in Egypt to reduce the probability of late season rains adversely affecting the experiment. After a phone call between Drs. Pinthus and Abdel-Shafi, the experiment was designed and conducted in Egypt and results were sent to Dr. Pinthus in Israel.

It is clear that contact between Egyptian and Israeli colleagues is usually initiated by the Israeli scientists.

One should not infer that the desire for collaboration is greater on the Israeli side. Egyptian scientists that were interviewed indicate that it is administratively difficult for Egyptians to make phone calls, send materials or information, and make visits to Israel. Superimposed on this factor is the discomfort among Egyptian scientists to have "documented" contacts with Israel that can create unwanted tensions among certain Egyptian colleagues, affect professional advancement or affect future activities with other Arab countries.

Despite successes in cooperation between countries, there were disappointments as well. In one instance Drs. Pinthus, Marani, and colleagues planned on redirecting 10% of their budget to fund an Israeli extension agent to assist in the development of an on-farm demonstration project in Egypt. Although all plans were made, the project did not materialize on the Egyptian side. Some feel that it was Egyptian bureaucracy that prevented its development.

As indicated earlier, the cropping system and water use section was so broad it encouraged independent rather than cooperative work. Israeli Drs. Rabinowitch and Rylski conducted excellent research on sunscald and tomato fruit set that would have direct applicability in vegetable production in Egypt. They made visits to Egypt but had extreme difficulties finding a specialist or colleague in Egypt. Part of this problem may be due to the lack of Egyptian expertise in this area or the lack of desire among Egyptian administrators to look for such an Egyptian colleague. Drs. Feinerman and Bresler conducted excellent research on the development of a stochastic economic optimization model to determine optional quantities of applied water and uniformity, but there are no colleagues in Egypt in this field. It is important, therefore, that future AID funded projects have

well-defined objectives and work plans where colleagues in both countries are interested and qualified to work in such an area. This will create an environment that will encourage maximum collaboration and facilitate the production of joint publications.

Many laboratories in Egypt do not have state-of-the-art equipment or adequate facilities to address the research objectives. It is possible that student exchanges, particularly for Egyptian students to study in Israel and the US could be beneficial in future programs. However, courses in Israel are taught in Hebrew.

Without a narrower focus on objectives of mutual interests, professional relationships will remain superficial. For example, Dr. Bresler made several visits to Egypt and met with Drs. Abdel-Shafi, Badawi, Menoufi, et al. but their research interests were too different to develop a long-lasting collaborative relationship.

It was also felt among the Egyptian and Israeli scientists that future AID funded work encourage interactions among young scientists in each country. This may be more effective at establishing long-term personal relationships. There was concern, however, that this may be difficult in Egypt.

Scientists from both countries believe that TATEC or any AID related project with US cooperation is necessary structurally, for maintaining long-term relationships among Egyptian and Israeli scientists. The desire for interaction exists but the "umbrella" structure facilitates collaboration.

Cooperation of scientists between different disciplines differed in both countries. In Israel, most cooperation involved only two or three scientists within a group and not much interaction occurred among disciplines. In Egypt, the field oriental projects appeared to be much more interdisciplinary in nature. This was important since they were stressing management of new farming systems. At the experimental site at Gemezia, soil scientists, irrigation scientists, entomologists, weed scientists and agronomists worked together at the same experimental site. The bilateral project between Egypt and Israel helped in the experimental success of the TATEC project since equipment and labor were shared. In both countries, however, interactions with economists was minimal.

IV. ACCOMPLISHMENTS

All principle investigators interviewed strongly believed that the TATEC project was successful in a) improving the interaction and understanding between Egyptian and Israeli

scientists in agricultural water use and cropping systems and b) in developing long-term channels of cooperation between countries. However, there was potential for greater success in the field of cooperation and collaboration that did not occur. For example, no joint publications in this general subject were produced and there was no long-term exchange among scientists in the form of fellowships. Nevertheless, important information was obtained in each country and much of this information has been published.

Below is a list of abstracts, journal articles, graduate students supported under the TATEC project, workshops, and general educational material that have been generated and are related, at least in part, to the TATEC project.

Abstracts, Presentations, Published Papers & Graduate Education

Israel:

1. Pinthus, N. and A. Marani. 1991. Paper presented at the International Symposium on Physiology and Determination of Crop Yield. Gainesville, FL (10-14 June).

2. Steinberg, Miriam and H.D. Rabinowitch. 1989. The role of oxygen in thermo-photodynamic processes leading to sunscald-like damage in green tissues. Fifth DOF Meeting. Jerusalem, Sept. (abstr.)

Scientific Journals

1. Rabinowitch, H.D. and U. Zig. 1989. Leaf and root degeneration in early maturing onions: A physiological disorder. Ann. Appl. Biol. 115:533-540.

2. Steinberg, Miriam and H.D. Rabinowitch. 1991. The role of oxygen in thermo-photodynamic processes leading to sunscald-like damage in green tissues. Free Radical Res. Commun. (in press).

3. Feinerman, E., E. Bresler and H. Achvish. 1989. Economics of irrigation technology under conditions of spatially variable soils and nonuniform water distribution. Agronomie 9:819-826.

4. Feinerman, E., E. Bresler and G. Dagan. 1989. Optimization of inputs in a spatially variable natural resource: unconditional vs. conditional analysis. J. Environ. Econ. and Mgt. 17:140-154.

5. Feinerman, E., Y. Shani and E. Bresler. 1989. Economic optimization of sprinkler irrigation considering uncertainty of spatial water distribution. Aust. J. Ag. Econ. 33(2):88-107.

6. Dinar, A. and D. Yaron. Adoption and abandonment of irrigation technologies. Ag. Econ. (in press).

7. Feinerman, E. and D. Yaron. 1990. Adoption of drip irrigation in cotton-growers in Israel. Oxford-Agrarian Studies 18:43-52.

Workshops

TATEC Workshop: Alexandria, December 4-7, 1989 (P.I.s from all aspects of the cropping system-water use participated).

General Materials

1. Rabinowitch, H.D. Sunscald damage in tomatoes, peppers and cucumbers under field and controlled conditions: Physiology and possible remedies.

2. Rylski. Fruit set and fruit growth improvement of some solanaceae (video-tape). In Hebrew, Arabic and English, describes agro-technique and as flower vibration to improve fruit set.

Graduate Students (M. Sc. Degree)

1.	Miriam Steinberg	Work on various aspects of sunscald
2.	Barak Ben David	
3.	Michael Friedman	
4.	David Bonfil	"Physiological and agronomic aspects of the potential yield of chickpea", June 1989.

Egypt:

Articles in Conference Proceedings

1. El-Refaie, M.M.A., H.H. Abdel-Maksoud and M.M.A. El-Menoufi. 1988. Effect of soil moisture levels on wheat-water relations under trickle irrigation method in the Delta soils. Proceedings of the Conference of Field Irrigation and Agroclimatology (June 20-23, 1988).

2. Abdel-Maksoud, H.H., M.M.A. El-Refaie, A.Y. Badawy and A.A. Abdel-Shafi. 1988. Effect of tillage practices under sprinkler irrigation on water use efficiency by wheat crop. Proceedings of the Conference of Field Irrigation and Agroclimatology (June 20-23, 1988).

3. El-Refaie, M.M.A., H.H. Abdel-Maksoud and A.A. Abdel-Shafi. 1988. Comparison of basin, sprinkler, and drip irrigation methods for wheat crop. Proceedings of the Conference of Field Irrigation and Agroclimatology (June 20-23, 1988).

4. El-Razek, A.A.A., A.A. Wahdan, E.E. Raoud and A.M. Abdel-Shafi. Soil moisture and soil distribution patterns in clayey soils as affected by different irrigation systems.

5. El-Refaie, M.M.A., A.Y. Badawi, A.H. Awad and M.A. Khalifa. Comparison of trickle, furrow, and sprinkler irrigation methods for maize crop.

Disseminating information to growers

Dissemination of pertinent research knowledge and adoption of this information by growers in both countries is, of course, the overall goal of applied research. However, dissemination of information does not necessarily imply adoption. For growers to adopt technologies, they must be capable of change (both socially and scientifically) and the new technology must be economically feasible and profitable. There are large differences in adoption of new technologies by growers in each country. This, however, should not reflect on differences in attempts to disseminate information to growers by the principle investigators or collaborating or extension personnel. In Israel, adoption is very rapid and in some cases perhaps too rapid (Dr. Rabinowitch, personal communication). Growers in Israel are generally very well-educated and easily learn new ideas. In Egypt, there is a large gap in the understanding of agricultural science between the growers and scientists. Furthermore, many growers in Egypt are very poor (particularly those in the Delta) and adoption of new irrigation technologies is currently unfeasible (both economically and perhaps socially).

Nevertheless, Egyptian scientists interact directly with growers or agricultural industries. For example, Drs. Ahmed and Mofty from the onion department act as consultants with Nubaseed. Data obtained on onions from the TATEC project however are still preliminary and are not yet ready for dissemination. At the Gemezia Research Station growers' meetings are held at least twice monthly and demonstration plots are shown.

The goals and objectives of this project were too ambitious and no investigator in either country developed on-farm demonstration projects that were directly funded under TATEC. Irrigation demonstration projects are often costly and time consuming. Should more money and time have been allocated to this phase of the project, it may have been more successful.

There is, however, a substantial amount of information developed under TATEC that has potential for future adoption. Adoption, particularly in the area of water management, is a painfully slow process that takes years and in some cases decades to occur. Because of the relatively short time period of Phase II, it would be unfair to judge the success of this objective by looking only at the present level of adoption.

Log of Visits & Meetings

Date	Activity
October 1984	Drs. Pinthus and Marani visited Egyptian principle investigators in Egypt to plan field experiments.
January 1985	Drs. Pinthus and Marani visited Egypt to plan experiments with Egyptian P.I.s.
January 1986	Drs. Pinthus and Marani visited Egypt to discuss results and plan future experiments with Egyptian P.I.s.
September 1986	Drs. Abdel-Shafi and Mostafa visited Israel to discuss results and future projects with Israeli P.I.s.
December 1986	Dr. Pinthus met with Dr. Abdel--Shafi in Cairo to discuss future plans and previous results.
August-September 1987	Drs. Abdel-Shafi, Badawi, Moustafa and El-Menoufi visited Israel to evaluate results from field research trials, and to plan future work with Israeli scientists. Visited experimental sites.
January-February 1988	Drs. Rabinowitch and Rylski visited Egyptian colleagues (Dr. Rylski made several more visits and Dr. Rabinowitch made one additional visit; dates not given).
February 1989	Drs. Pinthus and Marani met with Dr. Abdel-Shafi and others in Egypt to discuss results.
February 1989	Dr. E. Bresler visited Egypt for discussion with Egyptian scientists and visits to field sites.
December 1989	Egyptian and Israeli scientists (Drs. Marani and Pinthus, and D.
February 1990	

CONTINUOUS: Frequent phone calls (often bi-weekly) were also made by Dr. Pinthus to Dr. Abdel-Shafi.

Bonfil) met at TATEC workshop in Alexandria.

Drs. Pinthus and Bresler visited Egyptian colleagues in Egypt. They visited field experiments in Nubaria.

V. PROBLEMS ENCOUNTERED

There were technical, administrative and cooperative problems that prevented the TATEC project from achieving its goals in its fullest potential.

Technical problems:

Perhaps the largest problem related to the technical aspect of the project is the differences in both levels and areas of research. The Egyptian scientists were interested in conducting very applied field research that would develop site-specific management information on fertilizer needs, basic agronomic practices, and crop performance under different irrigation systems with different levels of applied water. The Israeli scientists were interested in conducting research (from practical to theoretical) that will produce publications in high quality journals.

Field trips to experimental sites in Egypt, particularly the Gemezia, indicated that data collected are more substantial than the reports indicate. For example important information was collected on soil-water contents that are necessary to compare actual soil-water depletion values to predicted values, but a detailed description is not given in the report.

In Nubaria, the experimental site encountered high water table problems that undoubtedly influenced crop performance. Therefore the investigators are cautioned not to make general conclusions regarding maize or wheat performance under different levels of applied water. Furthermore certain cultivars that performed better under low amounts of applied water may not perform as well at other sites without a high water table. Caution is also advised not to compare data from different irrigation methods since the irrigation systems were not replicated. Investigators are currently interested in relocating the site at Nubaria. However, if this is done, it is important that they purchase a reservoir with sufficient capacity to irrigate all drip-plots. A reservoir is needed since water is delivered only every other week.

Administrative problems:

A standardized procedure needs to be developed for reporting which would assure that reports are complete with research justification, objectives, methodology (on all data collected), and results and discussion. The USDA should be responsible for getting the reports and distributing them to all principle investigators.

There were complaints among several Egyptian scientists that money was either not available or that the administrative process

for using the money was too difficult. Many felt the 50 L.E. limit for spending should be raised one or two orders of magnitude. To spend in excess of 50 L.E. apparently requires additional signatures and permission. Another principle investigator was upset that the money arrived "too late" but was not sure if the problems were from US administration or Egyptian administration. These problems must be investigated, understood and resolved before any future AID project is funded. Input by Egyptian scientists is important if Egyptian administrative procedures are to be changed to facilitate the process.

Cooperation:

Clearly under TATEC there were more visits and contacts initiated by Israelis than Egyptians. Personal interviews suggest that Egyptians want to collaborate more but are under constraints within their country. There are not only administrative channels that need to be followed if an Egyptian scientist visits, calls or sends information to Israel, but here are concerns such interactions may be made public. Two Egyptian investigators said that "extremists" within the country published an article in a newspaper several years ago describing the interactions of certain Egyptian scientists with Israelis in reference to the project.

Both Israelis and Egyptians had comments about involvement of US scientists in the project. It appears that many would like to see US scientific involvement increase beyond that of the present.

VI. CONCLUSIONS

The cropping systems-water use section of the TATEC project was successful not only in the production or adoption of important agro-technologies, but the development of positive working relationships among Egyptian and Israeli scientists. It is therefore recommended that projects of such nature continue in the future.

Future A.I.D. projects, however, need to be changed so that they will encourage more interactions among colleagues in both countries. In TATEC there were good interactions in many cases, but there were also situations in which cooperation could have been better. To improve the situation, more focused research objectives need to be developed in which specific scientists in each country have identical interests and are willing to conduct joint projects in each country. In the cropping systems-water use section, the category was too broad allowing scientists in each country to conduct work independently.

Annual reports should follow a structured format of suitable detail. Each report needs a statement of purpose, a clear list of objectives, detailed methodology of experimentation, and well-thought-out results and discussion. USDA should then be responsible for distributing reports to all P.I.s.

Administrative structures in Egypt must be changed to allow P.I.s easier access to funds. Having funds directly available to P.I.s rather than channeling money through the Ministry of Agriculture may be necessary.

It is recommended that future field experiments have statisticians review experimental design before the experiments are initiated. This will avoid any problems of publication of the results in journals.

Finally, there should be a better mechanism for Egyptians to send information or contact their colleagues in Israel.

DAIRY PRODUCTIVITY:

Husbandry, Breeding and Improvement

I. INTRODUCTION

A major scientific objective of the TATEC project was to sort out a few simple and promising innovative technologies suitable for exchange between Egypt and Israel. For the dairy sub-project, both the Egyptian and Israeli scientists recognized that their countries' immediate goals and needs for improvement of dairy production require different strategies in approach. For example, in Egypt the national priority is to increase milk production to reach the level of self-sufficiency in the shortest possible time. On the other hand, in Israel the question is not how to increase national total milk production but rather how to increase the dairy farmer's income through eliciting the maximum efficiency of each individual animal. Therefore, the research activities in both countries were not in the form of parallel experiments.

In Egypt, the scientists emphasized 1) appropriate calf rearing systems, 2) the use of non-conventional resources as a primary source for formation of economic rations, 3) development of a modern recording system for the dairy animals and 4) examining ways to reduce the climatic impact on milk production.

In Israel, experimental work was focused on: 1) feeding system for young calves to replace milk by relatively cheap feeds and 2) developing an appropriate simple technology to reduce the level of heat stress during the summer months, i.e. a cooling system.

II. SUMMARY OF RESEARCH PROGRAM

A. Israel

- Objectives

The primary objective was to assess the extent to which nutrition and management limit productivity in dairy farms. More specifically, 1) to assess the feasibility of reducing the amount of milk required for rearing calves, and 2) to develop a cooling system for dairy cows.

- Methods and important findings

1. Nutrition studies:

The study was carried out at the Agricultural Research Organization at Bet Dagan. Twenty-three calves were used (12 as the treatment group and 11 as a control group). The control group was fed milk and freely available concentrate from the age of 3 days. Whereas, the treatment group was fed, from the age of 4 days, increasing amounts of feed in liquid form to the age of 8 weeks. Their feed consisted of a complete concentrate: chopped

roughage ration of the high producing dairy cows. Body gain was measured weekly. The results were not conclusive and therefore, feeding calves a liquid diet containing cheaper feeds than milk was found to be economically unjustified.

2. Development of a cooling system:

The principle of the cooling system chosen was: to sprinkle the animals with relatively large sized water droplets, thus the water impinged upon the skin with an adequate force to penetrate the hair coat; and to use forced ventilation for evaporation of the water contained in the coat. This procedure was repeated for the time needed to reduce body temperature to the required level.

The development of the cooling system has been completed in two stages. In the first stage, the cooling system was installed in the holding area (20 x 5.2 m) of the milking parlor. It was comprised of an array of static garden sprinklers (Model 943, Naan, Israel) spraying .76 m^3/h at 2 atm pressure. These were installed upside down 1.5 m over the cows and located 1.5 m of each other. This arrangement of the sprinklers completely covered the holding area with a spray of droplets large enough to thoroughly penetrate the coat of all cows in the holding area. The holding area was force-ventilated by 4 fans (Model DDQ-632-6, free flow 12200 m^3/h, Ziehl-ABEGG, 7118 Kunzelsau FDR) which were so located around the area that air velocity over it was at least 1.5 m/s at the height of the cow's main body. Both fans and water flow to sprinklers were under automatic control. This enabled researchers to independently vary duration of wetting and of forced ventilation periods. Fans and sprinklers were sequentially activated to form repeated cycles of wetting for periods of seconds, followed by forced ventilation only for 4.5 minutes. This duration of forced ventilation period was found in previous observations to be needed for evaporation of most of water retained in the coat.

In the following experiments: 1) effects of various durations of wetting period and of cooling period as well as effect of density of cows in holding area on rectal temperature (Tr) were examined, 2) whether this cooling method could prevent the diurnal increase in Tr in the summer was examined. All experiments were carried out on Israeli-Holstein cows, in their 2 to 3rd lactation and 2 to 3rd month postpartum, whose mean milk yield was 32.2+1.2 SE kg FCM/day.

In these experiments daily routine commenced at 0700 h when experimental cows were tied to stanchions in an open shed and were offered food an 8 water ad libitum. At 0830 h Tr was measured to nearest .1°C at a depth of 12 cm using a thermistor system. Between 1030 and 1100 h the cows were moved to the nearby shaded holding area of the milking parlor in which they were exposed to the experimental treatments. All cooling treatments began and ended with wetting of the animals. Duration

of forced ventilation periods was always 4.5 minutes. After completion of treatment the cows were returned to the open shed, tied in stanchions with food and water ad libitum, and Tr were sequentially measured at 15 minute intervals over the next 2 hours. Air temperatures (Ta) were measured at .5h intervals.

In the second stage, a new approach for cooling was developed since the described technique was limited. To overcome these limitations, an alternative approach was examined. It consisted in using the drive of the heat stressed animal to seek relief from this stress. A cooling system, similar to that in the holding area of the milking parlor, was installed along the feed mangers. It was set to operated for .5 h periods 5 times a day. As it uses the combination of repeated wetting (30 sec) and forced ventilation (4.5 min), this cooling system was a strong cooling stimulus, which was thought to be attractive to heat stressed animals. Whenever water started flowing, a strong whistling sound was produced, which created an additional acoustic cue. The main modification in the new cooling approach was in the water delivery system, so that water output could be modified, without affecting water droplets size, which are so critical for penetration and thorough wetting of the hair coat. By varying the combination of nozzles diameter and water volume flow restrictors of a certain type of garden sprinklers it was possible to reach a range water output of 67 to 250 l/h while maintaining droplets size almost constant. This compares to the 600 to 700 l/h of the previously tested Model Naan 643 inverted static garden sprinklers. Also, it proved possible to limit the sprinkling of water to 180 degrees, a considerable advantage, which allows the sprinklers line to be set along and over the stanchions line.

These modifications permitted the testing of another cooling system. It was based on water being sprayed from the sprinklers for 1 minute every 4 minutes from morning to evening, with only part of the stanchions line being provided with fans to supplement forced ventilation. The water output could be set according to local water runoff control conditions and to ambient heat stress. This approach appears to be advantageous over the previous one, as it makes possible heat stress relief at practically any time, not just for a half hour every 2 to 3 hours.

During the past summer, this approach has been tested for its efficiency to maintain body temperature stability; also, a preliminary study of cow's utilization of the two different cooling systems has been carried out. The data set, consisting of about 32000 behavior records has been analyzed.

Two cooling systems were developed to reduce the climatic impact on both milk production and fertility irrespective of ambient humidity conditions. Both systems are cost effective and simple to use in most conditions. Cooling dairy cows

successfully prevented a sharp rise in Tr and lessened the typical diurnal increase in Tr during the summer. Milk production of cooled cows was higher than in the non-cooled cows. Although more cooled cows exhibited estrus as compared to non-cooled cows, fertility was not improved by cooling probably as a result of the short duration of the cooling period.

The supportive data to prove the success of both cooling systems have been reported in several international scientific journals (see Sec. IV, Accomplishments). Furthermore, the Israeli P.I. of this sub-project, Dr. A. Berman, informed me during the field site visits that the first cooling method, i.e. cooling in the milking parlor, is already in use in about 50% of Israel's dairy farms. The alternative cooling method, i.e. cooling along the manger, although developed only in the past two years has been adopted by about 20% of the Israeli dairy farms.

B. Egypt

- Objectives

Emphasis of the Egyptian scientists was placed on using nontraditional crop residues in feeding dairy animals and on development or adoption of a modern simple technique for dairy recording systems. Additionally, the feasibility of adopting the new technology of cooling cows under the Egyptian farming system was assessed.

- Methods and important scientific findings

1. Nutrition studies:

Calf rearing studies were designed to assess the effectiveness of early weaning and the use of milk replacers on growth rate (average daily gain) of calves. The data showed that the use of milk replacers yielded about equal average daily gain to the traditional method of using whole milk. The Egyptian scientists stated that the use of milk replacers can save about 400 kg of fresh milk/calf, i.e., about 10% of the total annual milk yield/per cow. Furthermore, based on these data the Ministry of Agriculture has published an extension service bulletin to farmers explaining the benefits of using milk replacers in rearing calves.

Traditional feed resources to ruminants and specially cattle and water buffaloes in Egypt include berseem in winter and wheat straw plus concentrate mixture in the summer. These feed resources are limited, in short supply and expensive, thus an important limitation for improvement of livestock industry and dairy production in particular. Therefore, a major component of this sub-project was directed to assess the potential use of abundant nontraditional crop residues in feeding ruminants and

the possibility of increasing their feeding quality and nutritive value.

Studies were conducted on using some of the most common unused crop residues, i.e. corn stover, corn cobs and rice straw and nontraditional by-products such as molasses and urea. Feeding trials using calves, cows, and sheep were conducted at Gemezia and Karada (Sakha) Experimental Stations. Molasses, urea, chopped corn stover, ground corn cobs and rice straw were incorporated in various complete rations with and without treatment by anhydrous ammonia. These rations were compared to the known available traditional rations.

Analysis of the data provided strong evidence to support the inclusion of nontraditional and crop residues in feeding ruminants since feeding these by-products resulted in similar average daily weight gains, feed conversions and milk yield as compared to the traditional feeding rations. Additionally, the use of the crop residue reduced feed costs and helped save the needed concentrates which have a limited local production. Some of these data have been published (see Sec. IV, Accomplishments). Additionally, the authors, Drs. Hathout and El-Nouby, prepared two well-illustrated bulletins for extension service entitled, "Feeding crop residues" (Bull. #111, 1990/91) and "Feeding non-traditional farm by-products" (Bull. #112, 1990/91) as a significant step to solve the feed shortage problem in Egypt.

2. Adoption of a cooling system:

In collaboration with the Israeli counterpart, a cooling system was designed in Sakha Experiment Station to study the effects of cooling during the heat stress period on milk yield, female reproductive performance, semen quality and some related physiological responses.

A series of experiments were conducted on cows, bulls and heifers to compare the effects of cooling, exposure to solar radiation and shading. The results of the experimental work carried out in Egypt on relieving heat stress by a combination of sprinkling and forced ventilation on milk yield and fertility are quite similar to those attained in Israel. Additionally, cooling bulls caused an increase in semen volume, percentage of motility and concentration.

In 1988-89, the cooling system was installed in a private dairy farm in Menoufia in an attempt to transfer this technology through extension service similar to that in the dairy farms of Israel. I have visited the farm and discussed with the owner his opinion of the system. He stated that the system was used for only one season, i.e. the past summer, and he has not analyzed the yield records to make a judgement at this time.

3. Development of a modern computerized dairy recording system:

The objective of this component of the project was to modernize and upgrade the dairy recording system used in the Experiment Stations of the Ministry of Agriculture. With computerization of available records, a more effective breeding program for selection of bulls and cows can be established. Registration cards have been designed to include information on various traits, i.e. milk yield and composition, body weight gain, reproduction efficiency, etc. Records for the dairy animals at Sakha and Gemezia Experiment Stations for the past 30 years have been entered in a computer (IBM PC-XT), and a training program on data entry and analysis for research personnel was conducted.

A total of 3612 lactation records, covering the period from 1969-1986, were analyzed to study some productive and reproductive traits of the two Friesian herds in Sakha and El-Karada Experiment Stations. Additionally records on 2531 daughters of 109 Friesian sires and 868 Friesian cows were analyzed to estimate different phenotypic and genetic parameters of lifetime production traits. Heritabilities and phenotypic and genetic correlations were estimated. These estimates indicate that selection of dairy animals on milk yield at first lactation can be an effective method for improving lifetime milk production and daily milk yield over the total productive life of the cow.

A modern efficient recording system for the dairy herds has been developed. Data entry from both Sakha and Gemezia Experiment Stations is completed. Data analysis remains at too early a stage to play a major role in the decision making process of selection of an appropriate breeding program in Egypt. Complete analysis of these data should provide a scientifically valid foundation for any breeding program in Egypt since strain differences in adaptability to environmental conditions can be assessed statistically.

III. COOPERATION AND EXCHANGE

Egyptian and Israeli teams exchanged visits and have moved from a stage of just getting to know each other with perhaps reservations of a psychological barrier at the beginning of the project to a stage of trust, respect and friendship. During these exchanges, they discussed their research plans, data and visited each other's research sites. Both groups have told me that they have benefitted from each other's association. The fact that both groups did not follow parallel experimental plans was the major reason that they did not co-author any research papers.

IV. ACCOMPLISHMENTS

A. Publications

Egypt:

1. Gallab, Z.R.A., S.A. Fawzy and F. El-Keraby. 1988. Effect of exposure to solar radiation wetting on some physiological and productive traits in Friesian cows and heifers. J. Agri. Sci., Mansoura Univ. 13:1572.

2. Hathout, M.K., H.M. Ghanem, H. El-Nouby and A.A. Abdel-Aziz. 1989. Incorporation of treated corn cobs in complete rations for sheep. in: third Egyptian-British Conference on Animal, Fish and Poultry Production. p. 281, Fac. Agri., Alex. Univ., Alexandria.

3. Gallab, Z.R.A., S. A. Fawzy and F. El-Keraby. 1989. Effect of exposure to solar radiation and wetting on thyroxine and cortisol in Friesian cows and heifers. Communications in Sci. & Develop. Res. 25:107.

4. El-Keraby, F., A.K. Kirrella, S.A. Fawzy and E.A. Omer. 1991. Effect of water spray cooling on some physiological performances and milk production of pregnant Friesian cows. Agric. Res. Rev. (in press).

Israel:

1. Flamenbaum, I., D. Wolfenson, M. Mamen and A. Berman. 1986. Cooling dairy cattle by a combination of sprinkling and forced ventilation and its implementation in the shelter system. J. Dairy Sci. 69:31.

2. Her, E., D. Wolfenson, I. Flamenbaum, Y. Folman, M. Kaim and A. Berman. 1988a. Thermal, productive, and reproductive responses of high yielding cows exposed to short-term cooling in summer. J. Dairy Sci. 71:1085.

3. Wolfenson, D., I. Flamenbaum and A. Berman. 1988b. Hyperthermia and body energy store effects on estrus behavior, conception rate, and Corpus Luteum function in dairy cows. J. Dairy Sci. 71:3497.

4. Wolfenson, D., I. Flamenbaum and A. Berman. 1988c. Dry period heat stress relief effects on prepartum progesterone, calf birth weight and milk production. J. Dairy Sci. 71:809.

5. Kimmel, E., H. Arkin, D. Broday and A. Berman. 1991. A model of evaporative cooling in a wetted hide. J. Agric. Engng. Res. 49:227.

B. Graduate Students

Egypt:

1. Abdel-Glil, M.F. 1990. Sire differences for milk production traits in Friesian cattle. Ph.D. Thesis.

2. Hosny, A. 1991. Studies on the effect of cooling on productive and reproductive performance on Friesian cattle in sub-tropical area. M.Sc. Thesis.

3. El-Bazze, M. 1991. Effect of cooling on semen production. M.Sc. Thesis.

Israel:

1. Lublin, A. 1990. The relationship between thermal state and the distribution of cardiac output in the rabbit. Ph.D. Thesis.

2. Flamenbaum, I. 1990. Hyperthermal and nutritional effects on production and reproduction of the dairy cow. Ph.D. Thesis.

3. Blum, O. Embryo development and ovarian function as effected by heat stress imposed before or after implantation. M.Sc. Thesis.

4. Gordin, D. Induced corpus luteum function as affected by heat stress applied at different stages of its formation in the rabbit. M.Sc. Thesis.

5. Luft, A. Heat stress effects on luteal function at different stages of corpus luteum development in the dairy cow. M.Sc. Thesis.

6. Gilad, E. Heat stress effects on ovulatory follicle function. M.Sc. Thesis.

C. Dissemination of Information to Farmers

Egypt:

Highlights of the data on calf rearing with special reference to milk replacers and on feeding of crop residues and nontraditional resources have been translated into layman's language and written in bulletins for the Extension Service Division of the Institute of Animal Production in the Ministry of Agriculture. The bulletins are simple, and well-illustrated and could make a significant impact on the serious shortage of animal feeds in Egypt. In fact I was told that the use of corn cobs, corn stover and molasses has been a common practice on the small farms of Egypt.

The cooling system has been adopted by only one of the relatively large dairy farms about one year ago. This technology may not become common in Egypt because of the few farms that can economically afford it.

Israel:

Dissemination of scientific data on cooling in Israel is relatively much easier than in many other nations since the research started on a non-government farm, i.e. kibbutz. Additionally some of the personnel involved in the research are also Extension Service agents. Thus they fully understand the data and are able to spread the information through word of mouth and actual demonstrations on large farms. I was told that 50% of the dairy farms have adopted the milk parlor cooling system and about 20% have adopted the manger system.

V. PROBLEMS ENCOUNTERED

The changing nature of the political situation in the region has affected the exchange visits specially during Phase II (1988-91). This is evident from the lack of visits by the Egyptian scientists and the relatively fewer visits by the Israeli scientists.

On the Egyptian side the unfortunate rather frequent changes in the leadership of the project (i.e. four coordinators in the period, 1984-91) have contributed to administrative problems that was evident in the inability of the sub-projects' P.I.s to purchase needed equipment and other supplies. Thus the budget remained partially unspent.

Both Egyptian and Israeli scientists felt that if American colleagues were involved beyond their ad hock role perhaps some of the problems encountered at the administrative, periodic reporting and visit exchanges levels would have been minimized.

VI. CONCLUSIONS

The dairy sub-project has met varying successes in fulfilling its goals. In Egypt, the data on using local non-conventional crop residues in feeding ruminants were expressed in simple and illustrative bulletins for extension service. If the extension agents are successful in getting this information to the Egyptian farmers, the benefits to development of animal production in the country would be sustainable. Development of a modern system for dairy recording has been accomplished only for three of the Government (Ministry of Agriculture) farms. The common use of the developed system in other government and private farms would provide the backbone

information for an efficient system for genetic breeding and selection.

In Israel, the development, modification and adoption of two simple technologies for cooling high producing cows is a significant accomplishment. The success of the cooling systems is expressed in the relative wide spread adoption among Israeli dairy farms. The benefit of this technology in development of dairy production in arid land regions in general should be felt in future years.

SOLARIZATION (SOLAR HEATING) OF SOILS FOR DISEASE & PEST CONTROL

I. INTRODUCTION

Soil solarization (soil pasteurization, solar tarping) is a non-pesticide method for controlling soilborne pests (pathogens, weeds and nematodes). The principle is to cover moistened soil with thin transparent polyethylene during the highest radiation season (June to August in northern hemisphere) for 4-8 weeks. This technology can provide control of pests not controlled with other cultural or chemical means. It can be used to control diseases caused by soil pathogens, many weed species, and some nematodes. The process is non-pesticidal, thus there is no concern with pesticide residues on crops, residual of pesticides in the soil, or hazard to humans or animals from application. It does have the environmental undesirability of plastic disposal until recycling occurs. After planting, there is an enhanced growth that is observed in most crops. Crop quality is often improved.

Research has been conducted in several countries with heating of soils for pest control. However, using polyethylene and heating soil for soil pathogen control started in Israel with subsequent research and development in much of the high radiation areas of the world. Since the climatic conditions in Israel and Egypt are correct for the technology to gain significant use it was appropriate to include this sub-project.

Soil solarization is a tool for small farms as well as large agricultural lands. In small parcels the polyethylene can be applied by hand with available labor or it can be applied by machine on larger parcels. It will be used more in high value crops because they can justify the increased costs of production. The process requires a rather high management knowledge to be successful, thus it is difficult to replace existing technology. For specific pest problems, without adequate, safe, control measures it may find wide acceptance. Farmers in both countries have need for the process and it can be cost effective in some crop management systems.

The soil solarization technology should not be viewed as another "quick fix" as is often thought with most pesticides, but as a crop management or plant protection tool to control pests and increase crop growth and yield.

II. SUMMARY OF RESEARCH PROGRAM

<u>Objectives</u>:

1) Explore the feasibility of solar heating in Egypt and Israel for the control of soilborne pests (including pathogens, weeds and nematodes with the implied interest in control of insects.

2) Evaluate the technology in agricultural regions of the two countries, including furrow and sprinkler irrigation, different soil types, and different crops and pests.

3) Conduct economic evaluations of the technology under the systems indicated in objective 2.

Methods:

Extensive field experiments were conducted in both countries. Tests varied in number from 4 to more than 20 per year. Some of the experiments continued at the same location for two years in both countries to evaluate residual control on crop yields. Economic evaluations were conducted on these sites. Multiple crops were evaluated (Table 1). Various soil types (from sandy to heavy clay) were treated. Solarization was conducted using flood, furrow, sprinkler and drip irrigation. Timing of irrigation before or during treatment was compared. Various plastics, plastic thickness and new or used plastics were evaluated. Evaluations on control were measured on 11 pathogen species, 14 weed species and seven species of nematodes (Table 2).

Laboratory and growth chamber studies were conducted on the effects of solarization on soil pathogens, and the cause of the improved growth rate (IGR) of plants in solarized soil.

Evaluations were taken on crop growth characteristics, yield, incidence of soilborne pests in the soil, infection of the crops, percent weed and nematode reduction, soil salinity and the effects of some of these factors on the economics of solarization for the crop.

Important scientific findings:

1) A wide adaptation of an alternative non-pesticide method of control, that is safe to apply for the control of many pests common to the region, but found in many parts of the world.

2) Definition of soil, water, plastic (thickness and age), duration of exposure requirements for effective solarization.

3) Determination of control for many soilborne pathogens, some weeds and some nematodes.

4) Mechanisms of pathogen control in solarized soil.

5) The common increase in growth and yield of crops (field, vegetable and flower) after solarization and partial characterization of the causes of increased growth rate.

6) Control of pathogens by solarization in fields destined for seed or propagule production for planting elsewhere will produce "healthy" plants for new sites with best production using solarized-clean plant material and a solarized planting site.

7) In certain sites in Egypt with a high water table, soil salinity at the surface was reduced.

8) Utilization of solarization in combination with pesticide treatments to enhance control of organisms.

9) Costs and income studies of experiments and field tests have shown increased net gain with high value crops following solarization.

These important findings went well beyond the goals of the project. They led to additional basic research projects on effects of microorganisms on propagules under sub-lethal temperatures, investigations of causes of increased crop growth in the absence of soil pathogens, development of simulation models to predict temperatures under solarization, and evaluations of using the soil solarization process to reduce salinity.

This work produced results applicable to Egypt and Israel in furrow, flood, sprinkler and drip irrigation. These findings will contribute to solarization use in other middle east countries and has been found in Lebanon, Syria, Jordan, and Morocco.

1) Adoption of soil solarization by farmers was not as great as researchers had hoped. Expectations however, were probably too high for the adoption of a new technology in a short period of time. Certain segments of agriculture have had a high adoption rate: 98% of onion farmers in parts of Israel use solarization. In the South Arava area it is the only effective method of control for pink root disease of onion. In a preliminary survey of adoption in Egypt, in the area of protected agriculture, about 50% of the 6000 plastic houses are treated with solarization before planting. In open field agriculture in Egypt, only 50 feddans may be treated annually. High value crops such as onions grown for off-farm use (not local), strawberries, and tomatoes have shown a steady economic benefit from solarization. Some agronomic crops (lower value) such as broadbean and maize, though showing increased yields do not show an economic profit. Solarization could be adapted and utilized for other crops such as other vegetables, herbs, spices, floricultural crops and nursery crops. There is a problem that must be overcome for solarization to be used in these high value crops. Methyl bromide fumigation is used in some of these crops and is a reliable and understood pest control method. There is a high risk factor in using a r

solarization without a lot of testing to show the farmers that

pest control can be achieved. When field demonstration plots are established there must be a "current" practice plot and an untreated plot to convince the farmer to change.

2) Conditions necessary for optimum control with solarization have been researched and recommendations formulated.

a) Optimum soil pathogen and nematode control with polyethylene requires continuous plastic. A process using heat and a teflon roller to seal edges was developed. Bed treatment with polyethylene (beds greater than 55cm in width) will give effective heating for weeds.

b) Furrow or sprinkler irrigation before solarization can be used to achieve effective control.

c) The time during the year and duration of leaving the polyethylene on the soil was determined.

d) Optimum soil moisture at the beginning of the solarization treatment is essential, however drip irrigation during the treatment can be done.

e) The polyethylene must remain intact during the solarization period.

f) Thin films (15m (micron)) are effective and increase temperature in the soil. Thicker films (100m) are more durable and have been used more than one year. After the second year the effectiveness is decreased due to holes, tears and/or degradation of the polyethylene.

3) Many soilborne pathogens, nematodes and weeds were evaluated (Table 2) for efficacy. Most species are effectively reduced below crop damage levels. Many are reduced to levels where more than one sensitive crop can be grown economically. Populations of nematodes, though reduced, increase again during a cropping sequence. The weed species, Cyperus rotundus is only partially reduced and Melilotus sp., and the pathogen Macrophomina phaseolina are not controlled and may increase after solarization.

4) Some soilborne pathogens such as Verticillium wilts are very heat sensitive. Others such as some subspecies of Fusarium oxysporum are weakened with sub-lethal levels of heating (38-42C) and show delayed germination and mycelial growth. This allows additional exposure to other antagonistic agents that reduce the organisms.

5) Most studies of the crops planted after solarization have shown increased growth and yields. Yield increases vary considerably but may be up to 800% at sites where severe pest problems limit production.

Gypsophila flower number and weight were increased after solarization compared to metham (vapam) or untreated areas over two crop cycles. At another location with Gypsophila it was not as effective as methyl bromide but more effective than the untreated control for increased flowers. Note: In none of the

studies do the investigators indicate where weeds or nematodes were present even at low levels in the untreated plots to cause reduced growth. It must be assumed that these pests were taken into consideration and were eliminated.

The causes of increased plant response to solarization has not been totally researched and needs additional effort to determine the cause(s) for promotion of growth.

6) Solarization when applied for pest control in site preparation for nursery material or seed crops enhance the opportunity of high yields of clean propagation (vegetative or seed) material. When these clean plant materials are again used in solarized soil there is potential for optimizing plant growth due to release from soilborne pathogens. This was demonstrated using onions in both Egypt and Israel.

7) Soil salinity is a major problem in many parts of the world. In experiments in Egypt, with sandy or loamy sand soil and a high water table (80-120 cm depth), there were decreases in surface salinity after solarization. This phenomenon was only shown in Egypt. A simulation system was built in Israel to reproduce the "desalination" effect of solarization under controlled conditions in the laboratory.

8) When solarization was combined with certain pesticides they found that enhanced control of organisms could be obtained. The thermophilic fungi (Macrophomina phaseolis) was controlled using solarization with low rates of the fungicide Benomyl whereas, it was increased when solarization was used alone. Improvement of solarization for the control of other pests (nematodes, weeds and Fusarium) was achieved by combining it with other methods. Additional research is required in this area to possibly show that reduced rates of pesticides may be used, or increased degradation of pesticides may be enhanced with solarization.

9) Various cost and income studies of solarization have been conducted on field and vegetable crops, and one floricultural crop. Early work in Egypt evaluated Faba bean. Yields were increased but did not offset the cost of materials and labor. The most work has been accomplished on onion, strawberry and tomato; crops that can be exported or demand higher prices. Limited work was conducted on crops in rotation from a single initial solarization. In studies dealing with major pest problems (white rot or pink root in onions, rhizoctonia in strawberry, major mixture of annual weeds, or nematodes) yield increases are common and showed a positive economic return to farmers from adoption of solarization.

Economic analyses have not been conducted looking at which crops should be treated with solarization, combinations of solarization and pesticides, the potential of marketing pesticide

free products to organic markets, or the environmental tradeoffs with solarization versus pesticides.

On-farm use of the technology

In Israel, on-farm use varies considerably by location, whether other methods of control are available for a particular pest, and at what cost for the technology. In the high value crops such as onion, strawberry and tomato there is some current use. With time and further demonstration of the technique additional sites and crops will be treated. Soil solarization has become established as a technology in Israel that will answer certain pest problems and has become a part of crop production.

In Egypt, use by farmers has been primarily in the area of protective agriculture (greenhouses). This is because of the cost factor favoring solarization, the availability of plastic and the interest in the reduction of treatment with methyl bromide. Part of the reason is that it has been introduced only to farmers working directly as cooperators in field testing. This makes plastic available to them and they can use and reuse the film. There is need for the further teaching of the benefits of solarization and demonstration of the technique to farmers in Egypt.

III. COOPERATION AND EXCHANGE

There has been a high level of exchange between scientists in Egypt and Israel. Drs. Satour, Katan, and Grinstein visited each other in both countries. Dr. M. Abdel Rahim also visited Israel. More trips were made from Israel to Egypt by scientists. There was a sharing of data, joint evaluation of field tests in the field and laboratory, and joint planning of experiments. Joint papers have been presented at meetings and joint papers have been published in refereed journals. Many reports and joint papers for proceedings were finished. There are additional data and papers that are in some form of preparation but not ready for publication.

It was found that individuals involved in the project from nematology, and weed science also have data on solarization but one paper was found in print.

IV. ACCOMPLISHMENTS

Publications:

1. Abdel Rahim, M.F., M.M. Satour, K.Y. Mickhail, A. Grinstein, H.D. Rabinowitch, and J. Katan. 1987. Long-term effects of soil solarization in furrow and sprinkler irrigated

soils in Egypt and Israel. Proc. 7th Congress Mediter. Phytopath. Union. pp.59-60.

2. Gamliel, A., E. Hadar, and J. Katan. 1987. Microbial phenomena related to increased growth response in solarized soils and to monoculture systems. Ibid. pp.72-73.

3. Abdel Rahim, M.F., M.M. Satour, S.A. El-Eraki, H.R. El Wakil, A. Grinstein, Y. Chen, and J. Katan. 1987. Soil solarization for controlling soilborne pathogens and weeds in furrow-irrigated Egyptian soils. Ibid. pp.76-77.

4. Freeman, S. and J. Katan. 1988. Weakening effect on propagules of Fusarium by sublethal heating. Phytopathology 78:1656-1661.

5. Satour, M.M., M.F. Abdel Rahim, T. El-Yamani, A. Radwan, A. Grinstein, H.D. Rabinowitch and J. Katan. 1989. Soil solarization in onion fields in Egypt and Israel: short and long-term effects. Acta Horticulturae 255:151-159.

6. Abdel Rahim, M.F., M.M. Satour, K.Y. Mickhail, S.A. El-Eraki, A. Grinstein, Y. Chen and J. Katan. 1988. Effectiveness of soil solarization in furrow-irrigated Egyptian soils. Plant Disease 72:143-146.

7. Katan, J., A. Grinstein, A. Greenberger, O. Yarden and J.E. DeVay. 1987. The first decade (1976-1986) of soil solarization (soil heating): a chronological bibliography. Phytoparasitica 15:229-255.

8. Freeman, S., C. Ginzburg and J. Katan. 1988. Heat shock protein synthesis in propagules of Fusarium oxysporum f. sp. niveum. Phytopathology 78:1656-1661.

9. Hetzroni, A. and A. Grinstein, 1989. Technology of soil solarization. Acta Horticulturae 255:189-196.

10. Gamliel, A. and J. Katan. 1991. Involvement of fluorescent pseudomonad and other microorganisms in increased growth response of plants in solarized soils. Phytopathology 81:494-502.

11. Katan, J. Soil solarization, in: Innovative Approaches to Plant Disease Control, Chet, I., ed., Wiley and Sons, New York, 1987. 77p.

12. Greenberger, A., A. Yogev, and J. Katan. 1987. Induced suppressiveness in solarized soils. Phytopathology 77:1663-1667.

13. Satour, M.M., F.W. Riad and A.S. Abdel-Hamied. Soil solarization and control of plant parasitic nematodes. in: Soil Solarization. FAO Plant Production and Protection Paper No. 109. pp.173-182. 1991.

14. Mansour, M. and M. Sultan. Economic assessment of the long-term effects of the soil heating technology in Beni Suef Governorate. Ibid. pp.367-382.

15. Yaron, D., Y. Wijler, A. Avizohar, A. Dinar, J. Katan and A. Grinstein. An economic analysis of soil disinfection for controlling soilborne diseases. Res. Progress Report, Hebrew University, Dept. of Agri. Economics, Rehovot, Israel. 1986.

16. Basheer, A.M., D. Yaron, Y. Wijler, A. Avizohar, A. Dinar, M.F. Abdel Rahim, M. Satour, J. Katan and A. Grinstein. An economic analysis of soil disinfection for controlling soilborne diseases. Res. Progress Report, Hebrew University, Dept. of Agri. Economics. Rehovot, Israel. 1986.

17. Katan, J. and J.E. DeVay (eds.) 1991. Soil Solarization. CRC Press, Boca Raton, Fl. (In press).

18. Satour, M.M., E.M. El-Sherif, L. El-Ghareeb, S.A. El-Hadad and H.R. El-Wakil. Achievements of soil solarization in Egypt. in: Soil Solarization. FAO Plant Production and Protection Paper No.109. pp 200-211.

Additional summaries, reports and unpublished data were viewed during the review process. Most reports will not be published. However, data is still being prepared for publication. Following are 13 economic reports from Egypt on various crops and at different sites, 1987-1991.

Economic assessment of solar heating in Egypt

1. A financial analysis of onions solarization experimental trials at Biba District of Beni Suef Governorate, 1987.

2. A financial analysis of the faba beans solarization experimental trials, Giza Governorate, 1987.

3. Agricultural production of potatoes by using the technology of soil solarization, Gemmeiza Research Station, Gharbia Governorate, 1987.

4. An evaluation of winter bulb onion solarization experimental trials at Tamiya Experiment Station, Fayoum Governorate, 1987.

5. Estimation of the effect of soil solarization on the profitability of the second crop--maize, 1984.

6. Estimation of the effect of soil solarization on the profitability of the third crop--faba bean, 1988.

7. Economic assessment of the long-term effects of soil heating technology, 1988.

8. Economic assessment of the long-term effects of the soil heating technology at Beni Suef Governorate, 1989.

9. An evaluation of winter onions solarization experimental trials, Somsta District, Beni Suef Governorate, 1989.

10. Estimation of the effect of plastic types on solarization profitability of faba bean crop, 1990.

11. Estimation of the effect of plastic types on solarization profitability of soybean (second crop), 1990.

12. Estimation of plastic types effect on solarization profitability of faba bean (third crop), 1990.

13. Estimation of the effect of soil-heating on profitability of strawberry crops, 1991.

Dissemination of information to farmers:

Israel:

In Israel there is a single faculty of agriculture at the Hebrew University at Rehovot with additional scientists cooperating at the Volcani Institute and the Weizmann Institute. Many of the personnel are graduates from these institutions and are students of current professors. In the solarization project there was close cooperation with extension members to evaluate solarization in fields throughout the country. Thus there is a system of information transfer between researchers, extension and farmers. There is an informal link that allows farmers or extension members to seek counsel and cooperation from the on-campus faculty thus not requiring planned extensive training courses for extension. This system works: example, after asking one of the researchers about adoption an informal survey (phone) was made during the site visit and results were reported before leaving.

Egypt:

Dissemination of information to farmers has been very limited. The number of farmers is large and the size of extension is also large. Use in Egypt of the solarization technique was estimated to be 50 feddans of open fields and approximately one-half of the protective agriculture greenhouses. With 8000 houses and an average of 0.25 feddan per house, this would equal about 1000 feddan treated in houses, a significant amount.

Movement of the technology in the open field agriculture has been limited to the sites where experimentation occurred. Polyethylene is either too expensive or not available to growers in most areas. Since there is excellent control of white rot in onions, these growers are using thick (100u) plastics that would normally be used on plastic houses for annual solarization. It is relatively ineffective during the third year depending upon the care and use of the plastic. Since the farmers with plastic houses have the material available to them they also choose to use it for solarization as well.

Support to graduate students:

Israel:

1. Stanley Freeman (Ph.D.)
2. Abraham Gamliel (Ph.D.)
3. Anat Yogev (M.Sc.)
4. Mohamed Abdel Rahman (M.Sc.)
5. Zvi Ravinovich (M.Sc.)
6. Hilel Manor (M.Sc.)
7. Amihai Lustig M.Sc.)

Egypt:

1. Raouf Saad (Ph.D.)
2. Safwat El-Hadad (M.Sc., currently on Ph.D. program)
3. Fathy H. Mohamed (graduated during project)

Table 1: Crops evaluated with solarization

Egypt

Tomato, onion, cucumber, broadbean, corn, potato, pepper, strawberry, peanut, cantaloupe, sunflower, beseem

Israel

Avocado, onion, watermelon, tomato, lettuce, peanut, pear, vineyards, Gypsophila, carrot*, cotton, cucumber, squash, vegetables*

* organic farming

Table 2: Organisms evaluated and extent of control in soil solarization studies (Egypt & Israel)

		Effectiveness of Control
A.	Soil Pathogens	
	Fusarium sp.	C
	Botrytis sp.	C
	Helminthosporium sp.	-
	Epicocum sp.	-
	Verticillium sp.	C
	Pythium sp.	C
	Pyrenochaeta terrestris	C
	Phytophtora parasitica	C
	Sclerotium cepivorum	C
	Rhizoctonia solani	C
	Macrophomina phasealenia	N
B.	Weeds	
	Amaranthus sp.	C
	Plantago sp.	P
	Portulaca oleraceae	C
	Chenopodium murale	C
	Cyperus rotundus	P-N
	Melilotus indicus	N
	Solanum nigrum	C
	Rumex sp.	C
	Vicia sp.	P
	Cynodon dactylon	P
	Convolvulus arvensis	P-N
	Malva sp.	P-N
	Setaria viridis	C
	Sonchus oleraceus	C
C.	Nematodes	
	Helicotylenchus sp.	C
	Pratylenchus sp.	P
	Tylenchorhynchus sp.	C
	Rotylenchus reniformis	P
	Longidorus sp.	C
	Hoplolaimus sp.	C
	Meloidogyne incognita	P

V. PROBLEMS ENCOUNTERED

Soil solarization is a technology that can be transferred from researchers to researchers or to farmers. The process requires good technical understanding of the method to make it work successfully. If the plastic is torn, the soil rough and

cloddy, lack of good moisture, poor application and stabilization of the plastic, or any other factor that does not give optimum conditions the technique may be less than satisfactory. Though it is a simple process, it is easy to make it "not work." There may be some of this in Israel with extension advisors. It is imperative that extension advisors be involved in well-conducted demonstrations or experiments so they will receive the correct information. Other methods such as methyl bromide fumigation is less risky to failure because it is more familiar. Farmers will not accept this risk and use solarization unless it consistently controls the organism. To resolve this concern there will need to be many positive experiences through demonstration to make the process acceptable. In areas where pest problems cannot be solved by other means, then adoption has been rapid.

Many plots in the studies in Egypt were not replicated. This is difficult to accomplish with furrow and flood irrigation because of the great potential of contamination between replicates or treatments. This can be corrected by conducting a few controlled experiments on research stations. It greatly enhances the accuracy of the information and is imperative to achieving publication in refereed journals.

The lack of moving the technology to the open farm in Egypt has been discussed. Many farmers in Egypt are so poor that they cannot purchase the plastic even if it were available. They also cannot afford leaving the soil out of production for the 4-8 weeks during the middle of the summer for solarization. There is not enough land in their holdings to rotate to solarize one parcel. Therefore, currently many farmers in Egypt will not use this technology.

In Egypt, there was little effort to move the technology to the farmers field on a large scale. Therefore, this process should be a major emphasis in any follow up project. Since the technology has been developed it should not be allowed to die.

VI. CONCLUSIONS

1) Scientists in Egypt and Israel have cooperatively developed a technology at the academic level.

2) There have been visits, joint discussions, cooperation in field experiments, joint presentations, and joint papers from the project.

3) Findings from the cooperation are being used in other countries in the area and in other parts of the world.

4) Because of major emphasis on the technology, there was a 1st International Conference at Amman, Jordan with FAO with a

published proceedings and a book to be published in November 1991.

5) The research has led to results that have spawned additional research and helped train graduate students.

6) The technology developed has increased some farmers' ability to make a profit, grow crops that they could not grow because of pests, and improved crop quality and yields.

7) The technology will not be profitable for many large area, low value crops.

Recommendations:

1) The researchers should be commended for aggressively achieving cooperation and a furthering of working together as scientists and individuals. The soil solarization team worked well together.

2) There are additional facets of solarization that need research.

3) The greatest need currently is to promote the further maturing of the technique by extension in Israel and to train extension advisors by working together on demonstration of solarization on farms with situations that are most likely to succeed. The technology needs to be transferred to the farmer.

4) There is need to further develop plastics that are cheaper, easier to supply, and that can be biologically degraded. Recycling of the plastic should be encouraged.

5) Additional research is needed to evaluate the use of solarization to enhance pesticide efficacy at low rates, and to degrade pesticides in soils.

6) A continuation of this sub-project (soil solarization) should be funded and encouraged with the same participants. Work from other disciplines should be encouraged.

MEDICINAL DESERT PLANTS

I. INTRODUCTION

A. Egypt

Background:

Since before the times of Christ and Mohammed, the Egyptian traditional medicine system has been one of the better documented traditions. There are Biblical references to many of the species I saw at El Kanater, Maryut Center and Nubaria, e.g., chicory, cinnamon dandelion, garlic, melon mint, onion, rosemary, wheat.

The corn, potatoes, string beans, and tomatoes, e.g., result from the so-called Colombian exchange.

The Medicinal and Aromatic Plants Research Center, Horticulture Section, ARC, is actively involved in research on aromatics like coriander, cumin, dill, fennel, jasmine, mint, neroli, nigella, and medicinals like Catharanthus, Chenopodium, Marrubium, Pancratium, Peganum, Plantago, Rosmarinus, Senna, Urginea.

Importance of project:

Project could potentially lead to new drug plants for arid-land agriculture, and might contribute to the salvation of the somewhat endangered Pancratium (of which Dr. El Gamal reports five species in Egypt. Strangely this same Pancratium species, P. maritium, was one of the final candidates in Israel, where it is now illegal to harvest from the wild.

B. Israel

Background:

With a long history of publishing on extension-like studies of several vegetables under desert conditions (broccoli, Brussels sprouts, celery, corn, cucumber, evening primrose, paprika, sesame, string bean, tomato), Palevitch could anticipate extension results from studies of the cultivation of medicinal plants. There is evidence of the use of medicinal plants in the Middle East long before the arrival of Christ or Mohammed. One recent book even details medicinal uses of over 100 plants mentioned in the Bible. Three such Biblical plants, aloe, castorbean, and hyssop, are now being studied as potential remedies, and one Israeli plant (Hypericum) contains two antiretroviral compounds, hypericin and pseudohypericin, and one Egyptian plant (Ammi) contains psoralen, being used photophoretically to treat the AIDS virus and lymphoma. Clearly the Biblical region of the world is well-endowed with traditional medicines, many of which might alleviate the sufferings of that portion of humanity unable to afford modern prescription drugs.

Importance of the project:

Proving out Bedouin medicinal plants in itself can improve the health and livelihood of arid-land citizenry. Taking such proof through clinical trials, and mastering could lead to new economic crops for Egypt and Israel as well as other arid lands.

More specifically (and remotely), identification of arid-land antidiabetic plants might help solve the diabetic problems of American Indians of the Southwest, who have one of the highest incidences of the disease in the world.

II. SUMMARY OF RESEARCH PROGRAM

A. Egypt

Objectives-Methods:

Identification of some desert plants, used in traditional medicine, in both Egypt and Israel, which might be grown economically as medicinal plants, for internal and/or external markets, as crude drugs or processed to finished pharmaceuticals. El Gamal selected three of the more promising species from a field of nearly 150.

Important Scientific Findings:

One gets more alkaloid by sowing *Pancratium maritimum* in September and harvesting in the following August.

One gets more harmal (*Peganum harmala*) sowing in September rather than October or November, and harvesting in July rather than June or August.

Contributions to program goals:

Some desert medicinals were identified and cultivation studies on three of them improve our ability to raise them. The farmers do not yet have or need this information. It is still academic.

Technology selected/adopted:

A bibliographic survey of the flora of 148 species narrowed the field to some 30-50 "album" species suggested to have greatest use among the Bedouins, among the Egyptians at large, among Middle-Easterners, and in the world at large.

Extension efforts:

Not started yet. Reserved for the next phase. The timing of planting and fertilization studies will strengthen extension

efforts, when and if they begin. (Note that El Kanater is actively engaged in extension with other species.)

On-farm applications:

None to date. Experiments may be amplified with drip irrigation in newly reclaimed land.

Possible pitfalls:

There seems to be little internal and no external market for these folk medicinals selected. Granted *Marrubium* (horehound) is found in herbal antitussives in the United States, *Marrubium* is also a weed in Western United States, as is *Peganum harmala*. While the *Pancratium* (sea daffodil) is more endangered than weed, there are many sources of the Amaryllidaceous alkaloids, for which there are also no huge markets.

B. Israel

Objectives-methods:

Identification of some desert plants that are used in traditional medicine in both Egypt and Israel, which can be used economically as medicinal plants in modern medicine.

An ethnobotanical survey will uncover the most promising species.

Important scientific findings:

Potential antidiabetic and/or antiobesity drug plants, native to middle eastern desert, and capable of being cultivated by Israeli and Egyptian farmers, should they prove out clinically.

Contribution to program goals:

There were Egyptian-Israeli exchanges of visits and scientific data, but collaborative field experimentation did not materialize.

Technology selected/adopted:

Both countries screened potential medicinal plants bibliographically after selecting more promising folkloric medicine.

Extension efforts:

One agronomist is and has been involved in desert extension of the Bet Dagan Research Station, where 1,000 acres of paprika is grown as part of his previous research. Experimental efforts

on medicinal plants were not moved to the field in Israel or Egypt.

On-farm applications:

Strictly potential. So far, there are no real farm applications. All of the experimental plants could be grown on irrigated farms in desert, or rain-fed farms in wetter areas.

Possible pitfalls:

Drugs may never be clinically approved. Hence drugs may not move out of the folklore arena into pharmaceutical arena.

III. COOPERATION AND EXCHANGE

A. Egypt

Level of cooperation achieved in planning and executing research:

All three professionals travelled to Israel and were permitted to make observations in the field.

Only one graduate student (Yasser), who is beginning now on his Master's thesis on Pancratium. I did not meet Yasser.

My primary contacts in Egypt were Dr. El Gamal, Ms. Suhir (like 'Sue Hear'), and Dr. Martada Khater, Asst. Professor of Medicinal Plants, in Cairo. At El Kanater el Khairia, we were joined by Dr. Mohamed Abd El Fattah, Director of the Station, and Dr. Ibrahim M. Harridy, along with several technicians, field bosses, and laborers. It was not clear that any of these, except Harridy, had been involved in TATEC, but it was clear that Harridy knew the Marrubum and Peganum plots better than did Dr. El Gamal or Ms. Suhir. It seemed obvious that the TATEC plots would have been managed by the general farm labor here. I must confess that I saw as many feddans devoted to TATEC here as I had seen devoted to TATEC in Israel.

Interactions between scientists:

Dr. Palevitch and associates have visited Egypt and Dr. El Gamal and associates visited Palevitch's plots in Israel.

While I cannot overendorse renewal of this project, I think the project might attain more political goals if two of Palevitch species, two of El Gamal species, and two Arizona/California medicinal species, were all tried in at least three sites in each country under similar experimental protocols, with counterparts from each country getting his/her hands dirty in both the other countries. At Maryut Center we heard the plea for technical expertise from similar ecological zones in the United States,

over and beyond the call for money. Since all three deserts (Arizonan, Egyptian, and Israeli) have poor inhabitants with a tendency towards diabetes, emphasis on diabetes should continue.

B. Israel

Level of cooperation achieved in planning and executing research:

Apparently the planning objectives of the Israelis, namely to survey jointly the Egyptian Sinai and the Israeli Negev deserts for promising phytomedicinals, was thwarted by political and vehicular obstacles in Egypt. Nonetheless, there was reciprocal travel by the P.I.s and some of their collaborators and amicable relations developed at the personal level, which could not overcome specific logistical and/or program development obstacles at a political level.

IV. ACCOMPLISHMENTS

A. Egypt

Publications extant:

El Gamal, E.A., E.M. El Zahwey, M. Abd El Fattah and I.M. Haridy. 1990. Effect of sowing date on growth, yield, and alkaloid content of *Peganum harmala L.*

Publications in preparation (Reportedly accepted for publication in Egyptian Journal of Agriculture):

1. El Gamal, E.A., A.A. Zaied and S.M. Mahmoud in ed. Effects of some micronutrients on the yield and alkaloids content of Harmal cultivated plant (*Peganum harmala L.*).

2. El Gamal, E.A., E.M. El Zahwey and I.M. Haridy. Effect of sowing date on growth and alkaloid production of *Pancratium maritimum L.*

Dissemination to farmers:

When asked about extension efforts to farmers, El Gamal said that was for the "next" phase of the project. This leads me to conclude that there has been little or, more probably, no benefit yet to Egyptian farmers.

On Wednesday, while at El Kanater el Khairia with Dr. Gamal, Ms. Suhir (who ended up being my driver for the day), and Dr. Ibrahim M. Harridy, I accidentally learned quite a bit about extension from this station, though not extension from TATEC. For example, they had imported American basil, which they were increasing for several years now, to give seed to the farmers,

who preferred this American variety, which yielded more biomass, more essential oil, and more money. They were also distributing improved varieties of roselle (Kharkadi), citrus, fennel, jasmine, etc. to farmers though it was probably sold to the farmers at low price.

B. Israel

Publications:

1. Yaniv, Z., A. Dafni, J. Friedman and D. Palevitch. 1987. Plants used for the treatment of diabetes in Israel. J. Ethnopharmacology 19:145-151.

2. Freedman, J., Z. Yaniv, A. Dafni and D. Palevitch. 1987. A preliminary classification of the healing potential of medicinal plants based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. J. Ethnopharmacology 16:275-287.

3. Palevitch, D., Z. Yaniv, A. Dafni and J. Friedman. 1986. Medicinal plants of Israel: an ethnobotanical survey. Herbs, Spices, and Medicinal Plants 1:281-345.

(plus many other pertinent publications)

In preparation:

1. Palevitch, D. 1991. Identification of desert plants with hypoglycemic activity by observations on desert inhabitants: Man and sand rat. Ethnobotany Today, R.E. Schultes, ed. (in press).

Dissemination to farmers:

Working with Negev Bedouins, scientists learn from locals and vice-versa. Objectives included learning to cultivate potential medicinals, especially rarer or endangered species. Palevitch hoped to work with Egyptian Bedouins in the Sinai, but this did not materialize. Palevitch is involved with extension.

Support to graduate students:

Minimal support led to little graduate work. Working on her masters in agriculture, Ms. El Netza did travel on the program. Three Egyptian students did get to the field, with Dr. Gamal.

V. PROBLEMS ENCOUNTERED

A. Egypt

The slow start is attributed to inability to procure a

4-wheel-drive car. The field to be covered was from Alexandria to Borg el Arab, where El Gamal reported a flora of 148 species and prepared his "album" of the more important medicinal species. I can see how the "album" might represent an effort to produce something in spite of the budgetary, personnel, and vehicular constraints.

In spite of this, and in spite of many changes in personnel, I feel that the products I have seen do not exceed in quality the low level of expenditures nor the speed of vehicle procurement.

B. Israel

Palevitch naturally lamented the slow development of plans and personnel by his counterparts, which later led to curtailment of Israeli funding, due to lack of Egyptian progress. In recent years, his funding was:

1988	$32,000 (US)
1989	5,000 (US)
1990	4,000 (US)

Palevitch had hoped to work on the Sinai Desert of Egypt but Egyptians suggested the Libyan Desert, probably for political reasons. Then Egyptians foundered ostensibly for lack of transportation (special vehicle or research trailer).

Technical problem:

The most promising species, *Cleome*, failed in cultivation trials back at Bet Dagan, while the other species succeeded. Discontinuation of funding led to curtailment of program to cultivate the *Cleome*.

Phenological studies were not performed to determine how biological activities varied with time of day, or time of year (lack of funds).

Many of these failures or "lack of success" will probably be resolved through further research (the so-called "mistress" or hidden favorite research). Israeli doctors frequently come to Palevitch seeking herbs promising for clinical trials (e.g., *opuntia* for prostatitis, *hypericum* for AIDS, *polygonum* for herpes, aloe (especially among new Russian immigrants) for cancer.

VI. CONCLUSIONS

A. Egypt

Political:

Regrettably, the medicinal plant program, in Israel and Egypt, does not have as much to show politically and scientifically as other TATEC programs or as CALAR. Amicable relations were made between P.I.s and trips exchanged. We need something like we saw at Nubaria which seemed to show technology exchange between Israel and Egypt, if not vice-versa, in vegetable and fruit production. I saw no evidence of major political benefit at the public or graduate level, only at the Principle Investigator level.

I was surprised to hear stress on medicinal plants at our meeting at Maryut Center and to hear Mohamed Dessouki stress need for American expertise (in addition to money) for the "extension" they seemed to anticipate. Seeing some political potential in an extension, if well supported, I would recommend incorporation of United States Agencies, like the Arid Land Studies, University of Arizona (contact Barbara Timmerman), and/or the New Crops Branch, USDA, Arizona (contact Anson Thomas), with reciprocal transplants of plants and technology, requiring visits (prolonged) by all P.I.s and some graduate students from each country to each of the other countries, getting involved in field work.

Scientific:

Except for pedestrian data on best planting, fertilization, and harvesting regimes for three medicinal plants, harmal (Peganum harmala), horehound (Marrubium vulgare), and sea daffodil (Pancratium maritimum), there are few scientific conclusions to be drawn from the Egyptian work, at least in the papers and oral reports presented to me. Other work at the one (of six) station I visited, El Kanater el Khairiya, described as by far the best of the six facilities, clearly has extension ramifications. Readily providing germplasm of basil, citrus, jasmine, etc., to Egyptian farmers. El Kanater would be in good position to provide medicinal plants to farmers, if the local interest and medicinal applications merit. For example, if they develop superior methods of growing horehound and convince Egyptian peasantry that horehound alleviates coughs and sore throats, there could be much demand for this medicinal plant, now growing wild on the desert.

B. Israel

Political:

Palevitch, a competent, well-published scientist will continue to publish on data generated in his wing (clipped though it be) of the project. The major publication, "Identification of Desert Plants with Hypoglycemic Activity by Observations on Desert Inhabitants: Man and Sand Rat (Psammoys obesus)", acknowledges support by AID and USDA (OICD).

One Israeli collaborator professes to have established friendly cooperation with the late-arriving Egyptian collaborator, in spite of political intransigence.

On my last day in Israel I read a nice article on the Israeli-Egyptian efforts in CALAR as, for example, at Nubaria and Maryut. TATEC, with less political and economic push than CALAR, has not been as effective and visible, politically or scientifically. A copy of the newspaper article was delivered to Mark Abbott, who reported it to be politically useful.

Scientific:

Plants with significant antidiabetic and antiobesity principles were identified during the project. Such work, while potentially leading to new pharmaceuticals of importance to the developed countries, could also identify "proven" folk remedies for inhabitants of many arid countries, including many in the 75% of modern man unable to afford modern pharmaceuticals.

ECONOMIC EVALUATIONS

I. INTRODUCTION

The overall objectives of the TATEC project were twofold:

1) to develop, modify and adapt agricultural technologies which may promote agricultural progress in the cooperating countries; and

2) to analyze the factors which promote or inhibit the adoption of new technologies.

The underlying philosophy of the project is that strong linkages among applied research, economic evaluation, on-farm implementation, and agricultural extension are required for effective programs of adoption of new technologies. Another part of this philosophy is the necessity for an interdisciplinary approach involving the relevant agricultural and supporting disciplines in a comprehensive implementation framework.

II. SUMMARY OF ECONOMIC RESEARCH PROGRAM

Israel:

The Israeli economics sub-project, based on the above philosophy, was designed to carry out two lines of investigations:

1) economic analysis of improved agricultural technical innovations that have potential for adoption in the participating countries; and

2) economic and statistical analyses of the factors promoting the adoption of such innovations.

These two lines of investigation are summarized below in Section A - the technologies; and Section B - their adoption.

A. Economic Analysis of Improved Agricultural Technologies

A number of technologies emerged as having some potential and, therefore, requiring economic analysis. The objectives of these studies were to assess the economic worth of the various technologies selected; and to suggest modifications in the technologies and new directions for the technical research and the technical researchers. Close collaboration between the technicians and economists was an operating fact in Israel. This could relate both to wisdom and to the fact that the Project Director is an economist.

Of the possible technologies, emphasis was placed on 1) intensive cropping systems and water use, including modernization of traditional irrigation systems and on-farm irrigation technologies; and 2) soil solarization and disinfestation.

Others included double cropping systems and improving livestock production systems.

1. Intensive cropping systems and water use

There are a number of studies that fall under this category but not all of them were subjected to economic analysis. Only a) modernization of a traditional irrigation system, b) drip irrigation on cotton, c) new technology in citrus, and d) uniformity in water application will be discussed.

a. Economic analysis of the modernization of a traditional irrigation system

- Objectives/methods

The objective was to determine the economic consequences of a transition to a capital intensive and water saving irrigation system; including consideration of cropping mix changes and crop production technology.

The methodology employed was benefit-cost analysis of various physical and biological development combinations. The worth of these various choices was presented in the form of an internal rate of return (IRR). Each of the choices represented a comprehensive development package.

- Important scientific findings

The main findings as reported by the researchers included:

1) a modern irrigation system employing drip irrigation, and using high value cash crops, attains a high IRR on capital invested;

2) a modern irrigation system employing drip irrigation, but using a traditional crop mix, is not economically justified;

3) under conditions of capital shortage, the selection of only particular parts of the modernization package may be the most appropriate choice. One such example was limiting the modernization investment to only concrete lining of canals; and

4) there was a significant (50-60%) saving of water from the modernized drip irrigation system.

- Contributions of findings to program goals

These findings contribute to the overall objective of identifying and analyzing modern technological changes. The

results are applicable to considerations of development budget allocations in participating countries and in the choices of appropriate technology to be analyzed in particular situations dealing with the modernization of irrigation, a major emphasis in the technology packages considered by TATEC.

- What technology was selected/adopted?

Not applicable since the study was of a project already implemented, i.e. the technology was pre-selected. The analysis is of potential modifications to the original technology if it is to be applied elsewhere.

- Use of the technology on farms

The technology and its analysis is at an aggregate level that does not involve direct decisions by farmers, although farmers are the end-users of any irrigation system that is created. Since this is an on-going project it is assumed that farmers are applying the design technology. The documentation does not report on this aspect.

- Conclusion

This piece of research was well done and should be useful for government decision makers going through the design and selection process for new irrigation investments. Studies in the future should look at the effects of reduced availability of water since this is apparently the trend of the future. The report talks about water savings but the data show that total water use increased in the modernized system.

The analysis does not try to allocate benefits to improved irrigation or new crop mix, the primary sources of benefits. Since new crop mix was such an important factor in justification of the modern system, it might have been instructive to apply the new crop mix, as much as would be appropriate, to the traditional physical system. Even the modern system was not profitable with the traditional crop mix.

b. On-farm irrigation technologies

- Adoption of drip irrigation in cotton: the case of Kibbutz cotton-growers in Israel

The objective of this study was to identify, estimate and explain the parameters which promote the adoption and speed the rate of diffusion of drip irrigation technology in cotton-growing.

The methodology employed involved using cross-section time series regression models. The analysis was applied to a sample of 38 kibbutz cotton-growers in two regions of Israel.

The findings showed that profitability was the major motive for adoption of drip irrigation in cotton by a profit-maximizer kibbutz farms. Additional significant explanatory variables which affected the rate of adoption are water scarcity, experience gained in drip irrigation of cotton and when cotton is being expanded to new plots.

- Economics of irrigation with non-uniform water application

The objective of this analysis was to determine the optimal level of applied irrigation water under variable soil conditions and non-uniform water distribution, which maximizes the expected profits of a (risk-neutral) farmer. Subsequently, the model results have been used to evaluate and compare the profitability of distinct irrigation methods for cotton, taking into account their uniformity of performance and their associated investment and operation costs.

The methodology employed focused on the development and the application of an econometric optimization model.

The principle findings and conclusions were that lower uniformity of water application is associated with a lower expected average yield (and obviously with lower expected profits) and, generally, with a higher requirement for water at optimal application levels. The increase in the expected average yield under the more uniform irrigation method is higher when the uniformity of water infiltration is affected by the spatial variability of soil properties. This occurs in soils with a long water application rate, with low variability of hydraulic conductivity or both. In this case, the relative profitability of the more uniform irrigation (a) as compared to the less uniform (b) is increased.

Sensitivity analyses of water prices showed that an increase in water prices implied a decrease in optimal water application level as well as on expected profits. It was found that the difference between the expected profits from the two irrigation methods are relatively unaffected by water prices.

The results are, however, very sensitive to the technical nature of the yield function. Two cotton yield functions were examined and compared. It was found, as expected, that the sensitivity of the average yield to non-uniformity in water infiltration is higher the more concave the function. Under the more concave yield function, irrigation method (a) is more profitable than (b); whereas under a more linear function, the opposite is the case.

Conclusions: The methodology employed in this research was, by its nature, highly mathematical and theoretical. The uniformity of water application technology that was explored appears to have potential for on-farm applicability, but such was

not reported. The role of this type of research in the collaborative program is not clear. Such research, that seems to stretch the limits set by practicality, is particularly important to Israel, faced with current severe water shortages, at this time and will become more relevant to Egypt as time passes.

2. Soil solarization and disinfestation

The study deals with the assessment of solarization from the farm management point of view and from the environmental quality perspective.

The findings suggest that solarization is technically effective and economically profitable when applied to high income crops both in Egypt and Israel. It works in open fields, greenhouses, and fields infested with weeds. A major attribute of solarization is its contribution to the environment as an effective alternative to chemical treatment of infested soils.

The experiments and analyses carried out thus far raise several questions and suggest directions for further research, specifically:

a) which farm types and crop rotations are suitable (or unsuitable) for this technology.

b) what is the value of solarization as an alternative to the use of toxic chemicals from the point of view of the farmer, the ecologists and health workers concerned with the hazard involved in their use.

c) what is the value of solarization from the point of view of reducing the contamination of ground water and return flows.

3. Other technologies

a. Cooling systems for increased milk production

The kind of economic analysis of cooling systems for dairy cattle that was carried out does not determine the economic worth of the technology. It only determines how much additional milk production is required to cover cooling costs. An appropriate analytical tool would have been to take the dairy farm business as a base and to consider the cooling technology and its effects along with other dairy farm investment options.

This approach would also have avoided the error of assuming no costs for concrete floors already in place, even though two of the technologies tested required such floors. In both Israel and Egypt, the economists tended to limit their considerations to evaluation of the experimental trials rather than an economic analysis of the technology under consideration and how that technology fit into the farm operation.

B. Economic and Statistical Analyses of Technology Adoption

A number of investigations were carried out to assist the Israeli Team in understanding their Egyptian counterparts and to facilitate attainment of the collaboration objective. The only Arab "laboratory" available was Arab territories in Israel, primarily the Nazareth area (Jezreel Valley) and the Gaza area. Therefore, a number of studies were carried out in these areas.

- Arab farming system

Economic growth and the adoption of innovations on family farms under the Arab social and institutional systems were studied in the Nazareth and Gaza areas.

Arab family farms in the Nazareth region in the north of Israel have exhibited substantial economic growth over the last two decades by a shift from a traditional dry farming system to modern farming based in part on advanced technologies. The structural factors and the role of extension were studied subsequently. The extension system and its modes of operation were reviewed and analyzed and found to be very important in the development process.

An analytical econometric study of the factors promoting innovativeness was carried out in the Nazareth region. Data were collected from a sample of farms and the factors promoting innovativeness were analyzed within a simultaneous equation system. Innovativeness was found to be affected positively by risk tolerance, extension, water quota allotment and affected negatively by the farm's land area. The latter result supports the hypothesis that a small land area provides an incentive to adopt high payoff input intensive innovations. Another interesting finding is that innovativeness is affected by extension, but not necessarily by education. This result implies that farmers with elementary school education are capable of adopting complex technologies if proper extension services are provided.

A study of factors promoting innovations by family farms with Arab operators was conducted in a Gaza area south of Rehovot, which too underwent a remarkable modernization process. Data were collected pertinent to the adoption of new crops and methods of irrigation. Innovativeness was found to be positively affected by frequent contact with extension officers and by risk-tolerance, and negatively affected by water quota per land unit area. The effect of schooling was positive up to a certain level and thereafter negative.

The results of this study also emphasize the importance of extension, and not necessarily education above the elementary school level. They also support the hypothesis that smallness in

terms of land area is an incentive for adopting input intensive innovations.

Conclusions (or more appropriately, observations): 1) These studies are very instructive for understanding elements of Israeli agriculture. However, the chasm to be bridged to current Egyptian agriculture is, for the most part, too wide. 2) The role of extension in agricultural development has aspects that appear to be unique to Israeli cultural as well as economic circumstances and are therefore probably not very exportable, to Egypt or anywhere else--the collective aspects of the kibbutz and moshav socioeconomic organization; the unitary control imposed by the centralized water control authority; the lack of normal capital constraints on development; and other factors that enhance/support the role of extension. 3) Nevertheless, it is important for the Israelis to continue such investigations.

- Specific studies

1. Influence of quality and scarcity of inputs on the adoption of modern irrigation technologies

- Objectives/methods

The objectives were to analyze the influence of input quality and scarcity, environmental conditions, human capital, water price, and other variables on adoption rates for modern irrigation technologies in terms of both speed and extent of application.

The methodology involved development of an empirical model to apply these relationships to citrus groves in Israel.

- Important scientific findings

Findings show that modern irrigation technologies tend to be adopted sooner and to a greater extent (a) on groves located on relatively low quality land, (b) in regions with higher evaporation rates, (c) on groves planted with more sensitive rootstock, and (d) on groves grown under conditions of restricted water allotments and higher water prices. Management, human capital, and scale of operation also affect the level and speed of adoption. It is suggested that water prices and quotas can be used to increase adoption.

2. Adoption and abandonment of irrigation technologies

The objectives were to analyze adoption and abandonment processes for seven irrigation technologies.

A procedure is developed to estimate the technology cycle and is applied to data available for citrus groves in several regions of Israel and Gaza. The technology cycle was used to

estimate diffusion-abandonment patterns for several irrigation technologies that have been abandoned.

Findings suggest that the technology cycle is unique to each technology and similar in length for all regions. Results predict the year of full abandonment of each technology.

For modern technologies still in the diffusion phase, a logistic equation was fitted to the aggregated data.

Findings suggest that diffusion is significantly affected by economic variables such as water price, crop yield price and subsidy for irrigation equipment. Use of the estimated equations for policy purposes suggests that water price and subsidy for irrigation equipment can be used to control the diffusion process (speed and ceiling) of the irrigation technologies.

3. Other economic analyses of irrigation

Economic analysis was performed using evidence based mainly on conditions prevailing in Israel; regression analysis was carried out for the relatively modern irrigation technologies (drip, micro-sprinkler, moving machine, dragged line sprinkler and solid set sprinkler) in order to estimate the role of several factors influencing the capital investment for these irrigation systems.

Several conclusions can be drawn based on these analyses: Investment costs per unit area are dependent on crop, field scale, and quality of water and soil. The last variable dictates also the density of the irrigation equipment in a given field. Different definitions of the regression equations has resulted in the same conclusion that per unit area investment in irrigation technologies decreases over time. This of course has a major implication on the rate of adoption of capital intensive irrigation systems in poor environments or low-profit crops.

The field level analyses for cotton, citrus and tomatoes irrigated with several irrigation technologies has shown that the net benefit related to a specific irrigation technology is heavily related also on the crop price level.

The bottom line derived from the analyses, similar to findings in previous studies, is that the selection of irrigation methods will often be influenced by water supply, land topography, climate, crop, labor availability, energy and the relative cost of each resource. Initial investment, operation and maintenance costs, and irrigation equipment during the year cycle - like multi cropping system, can increase the economic performance of capital intensive irrigation systems.

C. Economic Evaluation of Solarization

- Conclusions

Thirteen different economic studies of solarization were reported on. These studies have concentrated on the analysis of technical experiments. Such analysis is necessary and appropriate, but it is not sufficient to answer questions about the worth of a particular technology. The suggested approach is to conduct the analysis from the point of view of the farmer operator where solarization must compete with other investment choices for the use of farm resources.

D. Economic Evaluation of Irrigation and Water Use

The research program is divided into three parts depending on the methodology employed. First is analysis of experimental trials; second is farmer surveys, primarily in the New Lands; and third, case studies of particular technologies.

1. Economic analysis of experimental trials

a. Economic evaluation of irrigation systems and shadow pricing of irrigation water

Objectives of the study were: 1) determining costs of irrigation water under different irrigation systems 2) determining shadow price of water using the residual method and the production function method 3) determining the best system of irrigation from an economic point of view for crops concerned in the study and in the light of the value of water saved under irrigation systems.

- Cost and value of irrigation water under different irrigation systems

The economic value of irrigation water varies with cropping pattern, soil types, irrigation system and all other factors affecting agricultural productivity. In Egypt, surface irrigation is the classical method particularly in the Old Lands. Sprinkler and drip irrigation are considered the modern irrigation methods, and are primarily in the New Lands.

Water use efficiency differs in various irrigation systems. It is calculated as a percentage of the quantities of water beneficially used over water delivered to the farm. Modern systems like sprinkler and drip irrigation are more capital intensive than surface irrigation but more efficient. The calculation of water use efficiency for different irrigation systems in Egypt has shown 88%, 75%, 63%, for drip, sprinkler and surface irrigation, respectively.

Total annual irrigation cost amounted to L.E. 204, 402, 597 per feddan under surface, sprinkler and drip irrigation respectively, regardless of water use efficiency. The higher costs for sprinkler and drip irrigation were major factors explaining their lower values of water as compared to surface irrigation.

- Residual method for estimating value of water

The residual procedure was employed in assigning values to irrigation water using a farm budget approach. According to this approach the value of water used in wheat production, including its by-products, was estimated at the average quantity of water applied.

A wheat production function was used to estimate the quantity of production equivalent to the average rate of water applied under surface and sprinkler irrigation. Dividing the costs by the quantity of water used results in a value of L.E. 485/1000 cubic meters of irrigation water, i.e. a decrease/increase in water applied of 1000 cubic meters will reduce/increase revenue by L.E. 485. In the case of sprinkler irrigation the figure is L.E. 193.

Using a Cobb-Douglas production function to estimate the quantity of wheat production under surface and sprinkler irrigation systems resulted in a similar value of water for surface irrigation - L.E. 461 per 1000 cubic meter but only L.E. 38 per cubic meter for sprinkler irrigation. The rationale for such differences is not discussed.

The same approach was adopted for maize, yielding a value for irrigation water of L.E. 233 for surface irrigation, while under drip irrigation it was L.E. 123. When using Cobb-Douglas in estimating production, the shadow price of water was L.E. 234 and 135 for surface and drip irrigation, respectively.

Although the value of irrigation water for maize under surface irrigation is higher than under drip irrigation, a substantial saving of water under drip irrigation is reported. However, consideration of the value of water saved with sprinkler and drip irrigation did not significantly alter the essentials presented above.

To estimate value of water, the residual method was applied, all costs of inputs except water costs were deducted from gross return per feddan and divided by quantity of water needed per feddan to get the return per 1000 cubic meter. The results showed that value of water using surface irrigation amounted to L.E. 552 per 1000 cubic meter while in case of drip irrigation it amounted to L.E. 212 per 1000 cubic meter in case of wheat cultivation. These values for maize amounted to L.E. 234 and 167

per 1000 cubic meter under surface and drip irrigation, respectively.

A quadratic production function was used to estimate value of marginal product of water resource under wheat and maize. In wheat it was found that VMP amounted to L.E. 305/1000 cubic meter and L.E. 67/1000 cubic meter under surface and sprinkler irrigation, respectively. In the case of maize VMP was L.E. 73/1000 cubic meter and L.E. 71/1000 cubic meter under surface and drip irrigation, respectively.

- Conclusion

The methodology employed was appropriate for the objectives of the research. The residual farm budget analysis as well as the use of Cobb-Douglas and quadratic production functions yielded useful results. The rather significant differences in the returns under surface and drip irrigation and variations in results under the two production function models could have been usefully discussed in more detail.

b. Fertilizer production function for maize under surface and sprinkler irrigation

- Objectives/methods

The objective of the research was to determine optimum rates of nitrogenous fertilization. The experiment involved adding varying amounts of nitrogen fertilizer in synchronization with water applications on maize under surface and sprinkler irrigation.

The methodology used quadratic production functions.

- Important scientific findings

The findings show that optimum fertilizer application differs between surface and sprinkler irrigation and that optimum economic returns are under sprinklers.

c. Economic analysis of maize under drip and sprinkler irrigation in Old Lands

- Objectives/methodology

The objective of the analysis was to test varieties, planting dates, plant population, and variations in the water delivery system. The experimental design was not included in the summary.

- Important scientific findings

The findings identified the best variety (DO 204), the best planting date (June 15), and plant population (20,000), and a drip set-up with one line between two rows of maize.

d. Soil moisture control at various levels

The experiment permitted soils to dry by 25, 50, and 75 per cent of their water holding capacity before additional water was applied. The objective was to determine optimum levels of water application. The 25% depletion level gave the highest return but used the most water. The analysis does not deal with this tradeoff.

2. Farmer survey analysis

a. Economic indicators of the cropping patterns in New Lands and impact of the irrigation system

- Objectives/methodology

The objective of this study was estimating costs and revenues of producing selected crops in both East Nubaria and South Tahrir under different systems of irrigation and to evaluate the economics of producing those crops under prevailing conditions in the two areas. Only the Nubaria work will be discussed.

The study relies upon data collected from three private sector companies and 125 individual farmers during the years 1985-1988.

The East Nubaria area under investigation included about 9230 feddans, which was irrigated by sprinkler (21%), drip (13%) and surface (67%) irrigation. The sprinkler irrigated area of 1900 feddans had 94% devoted to field crops, 5% to vegetables and about 0.2% to fruits.

The drip irrigated area was 1170 feddans, with 15% cultivated to vegetables and 85% cultivated to fruits.

The area under surface irrigation was estimated at 6161 feddans of which 58% was in field crops and 32% and 10% of the area were devoted to vegetables and fruits, respectively.

b. Cropping patterns in East Nubaria

Clover crops, especially permanent and winter berseem are the main field crops which represent 60% of total field crops area, followed by barley, water melon and vegetables. Green peas are cultivated under both surface and sprinkler irrigation. Cantaloupe has been cultivated under drip irrigation on 180 feddans representing about 18% of total vegetable area.

c. Costs and benefits under different irrigation systems

Total costs, total returns, gross returns and benefit/cost ratios were presented for the main crops in the area. Benefit/cost ratios were higher under surface irrigation compared to sprinkler irrigation for berseem, water melon (seeds) and green peas. The ratio was higher under sprinkler irrigation compared to surface irrigation for barley and peanuts. Barley resulted in losses whether under surface or sprinkler irrigation. Berseem under surface irrigation and peanuts under sprinkler irrigation gave the highest return per each invested pound. Cantaloupe has a very high cost per feddans. However, it achieved the highest net return per feddan. Peanuts realized the highest return per invested pound under sprinkler irrigation.

d. East Nubaria economic problems

For new technology to have an opportunity to exhibit its worth the economic environment must provide the necessary services - markets, transportation, inputs, credit, water, electricity, and so on. Below are the major economic problems identified by researchers.

1) Lack of inputs at the proper time which creates a black market especially for fertilizers. Actual fertilizer application to some crops such as berseem and water melon ranged between 190% - 458% above the official quota. In addition, transportation costs of inputs are high because of the long distance between crop production locations and input distribution centers.

2) Irrigation problems were divided into economic and technical problems as follows:

a) high investment, maintenance, and energy costs for sprinkler and drip irrigation compared with surface irrigation

b) technical problems include electricity failure, the increase in land salinity, the increase in irrigation water salinity, the spread of crop diseases and the spread of weeds

c) higher wage rate for labor by L.E. 2 than neighboring Old Land because of lack of transportation

d) lack of finance for about 95% of the farmers reflected in lack of loans and high interest rates

e) the absence of a proper marketing system

f) the absence of extension services

- Conclusions

Some of the above conclusions and observations should represent key items in the future research agenda. It also became clear from discussions in the area that major efforts will be required to deal with the lack of markets and with marketing problems.

3. Case studies

a. Water pricing in New Lands

- Objectives/methods

The objective was to determine the price of water under drip and sprinkler irrigation for winter and summer crop rotations.

The methodology used was linear programming which is ideally suited to this type of problem.

- Important scientific findings

The findings gave net returns for each crop; the shadow price of water by months for drip and for sprinkler; the optimum rotation for winter and summer seasons under drip and under sprinkler; and showed that the highest returns came under drip irrigation.

4. Concluding comments

This set of irrigation studies should be very useful to the Egyptian agricultural system. They are not sophisticated, methodologically, but are appropriate to the problems addressed. The presentation probably did not do justice to the research performed.

In contrast to the livestock and solarization work, this research drew on other work and other data as appropriate for the economic analyses, in addition to using the current subject matter experimental results.

E. Economic Evaluation of Livestock Experiments

Two lines of investigation are reported on. One line deals with various livestock rations with the objective of studying the effect of feed substitutions - using ground corn-cob meal treated by ammonia and by urea in feeding sheep and dairy cows, or corn stover as a substitute for normal concentrates; and various substitutes for berseem. The other line deals with modern technology involving cooling of dairy cattle.

1. Feed substitutions

a. Concentrate feed substitutions

Demand for feed, and specially concentrate feed, increased in recent years as a result of the large expansion which occurred in the livestock investment projects. But the available amounts of ingredients required for concentrated feed whether produced locally or imported are limited. Therefore, research was directed to find the possibility of utilizing locally available farm residues in, formulating nutritionally balanced animal feed.

Several experiments and studies are undertaken by technicians to find out the technical possibilities of using these nontraditional types of feed in feeding various farm livestock. Two classes of livestock were selected for investigation - dairy cows and sheep.

- Dairy

The dairy study analyzed the results of feeding cows on the three different types of rations. All three included the standard concentrate mixture and hay. The control used rice straw (A); B and C used corn stover and molasses, and varying amounts of poultry droppings. Statistical analysis did not detect any significant differences between the amounts consumed of the three types of feed. Also, no significant differences were detected between amounts of milk produced among the three types of feed.

Financial analysis indicated that net return per head in case of feed B was higher than that accruing in case of feed C, and only slightly higher than the control feed (A). Economic analysis of the data also exhibited a preference for feed B.

- Sheep

The sheep study compared three different types of nontraditional feed. These were standard concentrates plus corn-cob meal - untreated for A, ammonia and urea for B, and urea only for C. Results indicated no statistical significance in the relation between changes in live body weights and amounts of feed consumed. Moreover, there were no significant differences in live weight gains among the three rations. These results suggest

that there is not a significant biological difference in the three rations.

Financial analysis showed that net return per head was higher in case of using the untreated feed although costs of the treated ones are less. Economic analysis indicated no evidence of economic feasibility for using any of the three types of feed at domestic market prices. A positive net economic return could be obtained however, by applying higher export prices. (There was no export market analysis.)

As a principle, the most profitable feed choice depends on which resources are limiting and the possibility of changing the size of the flock. (No analysis of flock size is presented.)

2. Dairy cattle cooling

The economic analysis assesses the results of technical experiments designed to increase milk yields of dairy cows through cooling.

Analysis of variance was used to test the significance of differences in milk production between the treated and the control groups.

Economic evaluation of the results was based on the investment and variable costs and the net returns in both cases (cooling and without cooling). Analysis of the 1988 results indicated the existence of significant differences in milk production as a result of cooling the cows. Economic analysis, however, showed that the increase in costs due to using the cooling technology was greater than the value of the increased milk production, except for cows in the third stage of lactation.

On the other hand, results of the 1989 experiment indicated the existence of significant differences in milk production between the cooled group of cows and the uncooled group. Moreover, economic analysis indicated the financial feasibility of the cooling technology in increasing yield of milk, the test being the increase in the value to milk production in relation to cooling costs.

- Conclusions

The animal production economics research has concentrated on the analysis of technical experiments, which is necessary but not sufficient to answer questions about the worth of a particular technology.

The suggested approach is to conduct the analysis at the farm level where the new technology must compete with other investment choices for the use of farm resources. Economists

should not confine their sources of data to only the particular experiment that is under investigation.

F. Economic Evaluation of Medicinal and Aromatic Plants

No economic analysis reported.

III. COOPERATION AND EXCHANGE

Israel

From the Israeli side it appears that the possible levels of exchange with Egyptian scientists was maximized. Constraints to cooperation do not appear to have originated from the Israeli scientists. Having said that, however, the magnitude and intensity of exchange was far from that hoped for in the project design. The collaboration that existed in the soil solarization work, which was outstanding, is the exception that vindicates the original project concept of the benefits to be gained on both sides through intensive and effective collaboration.

The reasons for the patterns of collaboration that actually transpired should be analyzed and corrective measures taken before initiating any additional work. The review group of Ambassador Kontos should have answered this question but did not.

From the point of view of individual research activities, there are greater or lesser opportunities for useful collaboration. For example, the economic analysis of the modernization of a traditional irrigation system did not directly involve the participation or cooperation of scientists from Egypt or the United States. However, the results of the analysis are equally applicable to irrigation development in Egypt, Israel or the US.

Egypt

Egyptian P.I.s are very sensitive relative to collaboration. Dr. Mansour emphasized that future collaboration should focus on "real problems for Egypt." Some examples were solarization of onions, New Lands reclamation, and seed technology.

Any collaboration with Israel must result in a positive output, one thought to be important by the general public. A negative example was tomato problems in Fayoum that were blamed on the fact that the tomato seeds came from Israel.

Dr. Habashey emphasized that there should be more seminars, workshops and exchange of papers, and more joint papers. He also suggested regular meetings between collaborators, as often as

once a month. A formal umbrella like TATEC, is necessary to effectuate meaningful collaboration.

Exchange between P.I.s is through the overall TATEC project management rather than direct between principle investigators. Direct communications between P.I.s in the two countries would be more productive.

IV. ACCOMPLISHMENTS

A. Publications

Israel

1. Refereed journal papers and chapters in books

1) Dinar, A. and D. Yaron. Influence of quality and scarcity of inputs on the adoption of modern irrigation technologies. Western J. of Agri. Econ. 15:224-233. 1990

2) Dinar, A. and D. Yaron. Adoption and abandonment of irrigation technologies. Agri. Econ. (in press).

3) Feinerman, E. and D. Yaron. Adoption of drip irrigation in cotton - the case of kibbutz cotton growers in Israel. Oxford-Agrarian Studies 18:43-52. 1990.

4) Regev, A., A. Jaber, R. Spector and D. Yaron. Economic evaluation of the transition from a traditional to a modern irrigation project. Agri. Water Man. 18:347-363. 1990.

5) Feinerman, E., E. Bresler and G. Dagan. Optimization of inputs in a spatially variable natural resource: unconditional vs conditional analysis. J. of Envirn. Econ. and Man. 17:140-154. 1989.

6) Feinerman, E., E. Bresler and H. Achrish. Economics of irrigation technology under conditions of spatially variable soils and non-uniform water distribution. Agronomie. 9:819-826. 1989.

7) Blum, A. Use of different information sources for decision making by traditional farmers in a progressive knowledge system. J. of Ext. Syst. 5(1):60-73. 1989.

8) Blum, A. Extension strategies used to develop a traditional farming sector in an advanced agricultural surrounding. Quart. J. of Inter. Agric. 27(3-4):299-313. 1988.

9) Blum, A. Use of extension by traditional Arab farmers in Israel and in the Gaza Strip. Quart. J. of Inter. Agric. 27(3-4):314-326. 1988.

10) Yaron, D., A. Dinar and H. Voet. Innovations on family farms: the case of the Nazareth Region in Israel. Accepted by Am. J. of Agric. Econ.

11) Yaron, D. and A. Regev. Is modernization of traditional irrigation systems in arid zones economically justified? in: Rydzewski, J.R. and C.F. Ward, eds., Irrigation - Theory and Practice. Pro. of Intl. Conference, Southampton, Pentech Pr., London. 1989. (Presented also at the TATEC Workshop, Alexandria, Dec. 1989.)

12) Yaron, D., A. Regev and R. Spector. Economic evaluation of soil solarization and disinfestation. in: Katan, J. and De Vay, J., eds. Soil Solarization, CRC Press, Inc. (in press).

13) Basheer, A.M., D. Yaron, Y. Wijler, A. Avizohar, A. Dinar, H.F. Abdel Rahim, M. Satour, J. Katan and A. Grinstein. On soilborne diseases. Res. Report. TATEC - A Trinational Egypt-Israel-U.S.A. Project. The Hebrew Univ. of Jerusalem. 1988.

14) Blum, A. The development of agricultural extension in the Arab Sector of Israel and in the Gaza Strip. Res. Report. TATEC - A Trinational Egypt-Israel-U.S.A. Project, The Hebrew Univ. of Jerusalem. 1988.

15) Blum, A. Arab farmers' contracts with extension and their use of information sources in decision making. Res. Report. TATEC - A Trinational Egypt-Israel-U.S.A. Project. The Hebrew Univ. of Jerusalem. 1988.

16) Dinar, A. Economic evaluation of methods to reduce heat losses and increase milk yield in dairy cattle in warm climates. Res. Report. TATEC - A Trinational Egypt-Israel-U.S.A. Project. The Hebrew Univ. of Jerusalem. 1988.

17) Dinar, A. and A. Baruchin. Economic evaluation of double cropping systems. Res. Report, TATEC - A Trinational Egypt-Israel-U.S.A. Project. The Hebrew Univ. of Jerusalem. 1988.

18) Dinar, A. and D. Yaron. Economic evaluation of irrigation technologies. Res. Report, TATEC - A Trinational Egypt-Israel-U.S.A. Project. The Hebrew Univ. of Jerusalem. 1988.

19) Dinar, A. and D. Yaron. Adoption of new irrigation technologies in citrus: Process description and the influence of inputs scarcity and quality. Res. Report. TATEC - A Trinational Egypt-Israel-U.S.A. Project. The Hebrew Univ. of Jerusalem. 1988.

20) Szeskin, A. and R. Sternlicht. Agricultural development of family farms in the Nazareth Region. Res. Report. TATEC - A Trinational Egypt-Israel-U.S.A. Project. The Hebrew Univ. of Jerusalem. 1988.

2. Papers submitted or in process

21) Yaron, D., H. Voet and A. Dinar. Adoption of innovations by family farms under Arab social systems in a southern region - Region B. (in prep.)

22) Yunis, H. Agricultural development in the Nazareth Region - twenty-five years. Nazareth Ext. Serv., Israel Ministry of Agric. (submitted)

3. Workshop papers

23) Pohoryles, B. The impact of agricultural technology exchange. Paper presented at the TATEC Workshop, Alexandria, Dec. 1989, The Israeli Team, The Hebrew Univ., P.O. Box 12, Rehovot, Israel.

24) Voet, H. Adoption of innovations on private Arab farms. Paper presented at the TATEC Workshop, Alexandria, Dec. 1989, The Israeli Team, The Hebrew Univ., P.O. Box 12, Rehovot, Israel.

25) Yaron, D., H. Voet and A. Dinar. Adoption of innovations by family in the Nazareth Region in Israel. Paper presented at the development Workshop. Dept. of Agric. and Applied Econ., Univ. of MN, May 1990.

Egypt

1) Sharaf, M.F., M.F. Sabaa and A.A. Sheneshin. Financial and economic evaluation of feeding sheep on nontraditional feed. AERI, Ministry of Agric., Cairo, 1989.

2) Sharaf, M.F., M.F. Sabaa, H.A. Mohsen and A.A. Sheneshin. Financial and economic evaluation of feeding dairy cows on nontraditional feed. AERI, Ministry of Agric., Cairo, 1989.

3) Sabaa, M.F., H.A. Mohsen and M.F. Sharaf. Economic evaluation of using cooling technology for increasing milk yield of dairy cows. AERI, Ministry of Agric., Cairo, 1991.

4) Habashy, N.T., S. Darwish and F. Aziz. Fertilizer production function for maize under surface and sprinkler irrigation. AERI, Ministry of Agric., Cairo, 1991.

5) Habashy, N.T., S. Darwish and F. Aziz. Economic evaluation of irrigation systems and shadow pricing of irrigation water. Agric. Res. Rev., 1990.

6) Habashy, N.T., S.A. Motalb and F. Azia. Economic indicators of cropping patterns in the New Lands and the impact of the irrigation systems. AERI, Ministry of Agric., Cairo, 1989.

7) Sultan, M.Y. Application of binary choice models in assessment of factors affecting farmer decisions in adopting improved wheat seeds. AERI, Ministry of Agric., Cairo, 1989/90.

B. Training of Graduate Students and Research Assistants

Israel

- M.Sc. Theses

A. Regev - Modernization of a traditional irrigation project, with D. Yaron

H. Efrat - Economics of irrigation, salinity and drainage in the Jezreel Valley, with D. Yaron

H. Ackrisch - Evaluation of irrigation systems with emphasis on spatial variability, with E. Feinerman

T. Sadeh - Adoption of modern irrigation technologies, with A. Dinar and D. Yaron, (incomplete)

- Research assistants (Graduate students only)

Nimer Abdel Hadi (Phytopathology), survey of Region B

Mahmoud Sror (Citriculture), survey of Region B

Hana Savir (Ag. Econ.), data processing

Ibrahim Zaidan (Phytopathology), survey of Nazareth Region

V. CONCLUSIONS

A. TATEC Extension

The information received and the observations of the Team suggest that an extension of TATEC could provide a productive contribution to the original objectives of the Congress in funding an overall Middle East Regional Cooperation Program.

Both Israeli and Egyptian senior policy makers and all of the P.I.s requested an extension. To make such an extension productive, certain changes need to be made and issues dealt with.

1. Collaboration can be enhanced with more formal contacts built in at the design stage. Have at least one joint workshop

per year, rotated among the three countries. Make sure there are no budgetary constraints to travel.

The reasons for the patterns of collaboration that actually transpired should be analyzed and corrective measures taken before initiating any additional work. The Kontos review group might have answered this question but did not.

2. Research efficiency can be enhanced in Egypt by making separate grants to each P.I. responsible for a particular research area, rather than one grant to the Ministry which then must involve a program coordinator who controls and allocates funds to the P.I.s.

3. The amount of technical involvement by American scientists should increase. The need is not for P.I.s directly involved in the research, but for consultation and review by colleagues. There could be more US researchers involved in the expanded workshop program.

4. The Israelis expressed dissatisfaction with the degree of professional technical involvement by OICD, the implementing agent, particularly during Phase II. Any extension should make clear the nature and extent of professional involvement and participation by the implementing agent and one selected that can deliver the services required.

B. Egyptian Animal Production and Solarization Research

These research investigations need to focus on an analysis at the farm level where any new technology must compete with other investment choices for the use of farm resources.

The mid-term evaluation recommended that economists and physical and biological scientists jointly plan and design the experiments. This has not happened to a sufficient degree to make the economists comfortable about the level of joint participation. It is re-recommended that joint design of experiments be established as a criterion for funding.

C. Egyptian Irrigation Research

The methodology employed for evaluating irrigation techniques and shadow pricing water was appropriate for the objectives of the research. The residual farm budget analysis as well as the use of Cobb-Douglas and quadratic production functions yielded useful results. The rather significant differences in the returns under surface and drip irrigation and variations in results under the two production function models could have been usefully discussed in more detail.

Some of the conclusions and observations in the analysis of cropping patterns in New Lands should represent key items in the

future research agenda. It also became clear from discussions in the area that major efforts will be required to deal with the lack of markets and with marketing problems.

The complete set of irrigation studies should be very useful to the Government of Egypt. They are not sophisticated, methodologically, but are appropriate to the problems addressed. The presentations probably did not do justice to the research performed.

In contrast to the livestock and solarization work, this research drew on other work and other data as appropriate for the economic analyses, in addition to using the current subject matter experimental results.

Overall, the P.I. recommended expanding the number of crops being researched; using demonstration areas more instead of plots; more cropping pattern research in New Lands; and more work on marketing constraints.

As a strictly domestic suggestion, economic analysis should be introduced into the irrigation and drainage water allocations by the Ministry of Public Works and Water Resources (MPWWR).

D. Arab Farming in Israel

Conclusions, or more appropriately, observations regarding Israeli studies of Arab farming in Israel: 1) These studies are very instructive for understanding elements of Israeli agriculture. However, the chasm to be bridged to current Egyptian agriculture is, for the most part, too wide. 2) The role of extension in agricultural development has aspects that appear to be unique to Israeli cultural as well as economic circumstances and are therefore probably not very exportable, to Egypt or anywhere else - the unitary control imposed by the centralized water control authority; the lack of normal capital constraints on development; and other factors that enhance/support the role of extension. 3) Nevertheless, it is important for the Israelis to continue such investigations.

E. Israeli Irrigation Research

The research on transition from traditional to modern irrigation systems was well done and should be useful for government decision makers going through the design and selection process for new irrigation investments. Studies in the future should look at the effects of reduced availability of water since this is apparently the trend of the future. The report talks about water savings, but the data show that total water use increased in the modernized system.

The analysis does not try to allocate benefits to improved irrigation or new crop mix, the primary sources of benefits.

Since new crop mix was such an important factor in justification of the modern system, it might have been instructive to apply the new crop mix, as much as would be appropriate, to the traditional physical system. Even the modern system was not profitable with the traditional crop mix.

The methodology employed in the analysis of uneven water applications was, by its nature, highly mathematical and theoretical. The uniformity of water application technology that was explored appears to have potential for on-farm applicability, but such was not reported.

The role of this type of research in the collaborative program is not clear. Such research, that seems to stretch the limits set by practicality, is particularly important to Israel, faced with current severe water shortages, at this time and will become more relevant to Egypt as time passes.

F. Economic Evaluation of Solarization

The economics research on solarization has concentrated on the analysis of technical experiments. Such analysis is necessary and appropriate but it is no sufficient to answer questions about the worth of a particular technology.

The suggested approach is to conduct the analysis from the point of view of the farm operator where the new technology must compete with other investment choices for the use of farm resources. Economists should not confine their sources of data to only the particular experiment that is of interest.

The mid-term evaluation recommended that economists and physical and biological scientists jointly plan and design the experiments. This has not happened to a sufficient degree to make the economists comfortable about the level of joint participation. It is re-recommended that joint design of physical and biological experiments be established as a criterion for funding.

A N N E X E S :

A. Individuals Interviewed

B. TATEC Project's Logical Framework

C. Evaluation Team's Scope of Work

D. Comparison of Achievements with Previously Stated Goals

E. Highlights of TATEC "outright" Accomplishments

F. Numbers of Publications, Papers, other Documentation, and Visitors - Egypt and Israel

G. Reference Material

ANNEX A.

A. INDIVIDUALS INTERVIEWED

Egypt

Administrative Personnel

Mr. Fouad Abu-Hadab
Mr. Mohammed Dessouky
Mrs. Attiat El-Menshawy

Principal Investigators and Colleagues

Dr. Abdel Maaboud Abdel-Shafi
Dr. Mahmoud Mansour
Dr. Nabil Habashey
Dr. Hussein El-Nouby
Dr. Fikry El-Keraby
Dr. El-Sayed El-Gamal
Dr. Sohir El-Deeb
Dr. Mokhtar M. Satour

Israel

Principal Investigators and Colleagues

Dr. Haim Rabinowitch
Dr. Irena Rylska
Dr. Eshel Bresler
Dr. Moshe Pinthus
Dr. Dan Yaron
Dr. Amiel Berman
Dr. Dan Palevitch

ANNEX B.

B. TATEC PROJECT'S LOGICAL FRAMEWORK

PROJECT DESIGN SUMMARY - LOGICAL FRAMEWORK
Traditional Agricultural Technology Exchange & Cooperation (TATEC) Project

Project Title: PATTERNS OF AGRICULTURAL TECHNOLOGY EXCHANGE IN SIMILAR ECOSYSTEMS

Narrative Summary	Obj. Verifiable Indicators	Means of Verification	Important Assumptions
Program or Sector Goal:	Measures of Goal Achievement:		Assumptions for achieving Goal targets:
To promote agricultural cooperation between Israel & Egypt, and to accelerate agricultural development in both countries, with the technical support of USDA and the financial assistance of AID.	Increased agricultural productivity and farm income	Quantitative evaluation of likely changes in agricultural productivity and income in areas where technologies are diffused	--Adoptability of innovative technologies exchanged between different farming systems --Improved means of agricultural production result in higher productivity and income --Existing farming systems have flexibility to absorb new technologies and can profit from adjusting to new elements
Project Purpose:	Conditions that will indicate purpose has been achieved (end-of-project status:		Assumptions for achieving Purpose:
Generation, exchange, & adoption of innovative technologies suitable to the ecological and socio-economic patterns of farming systems in Egypt and Israel.	Diffusion of selected technologies in chosen areas, & necessary adjustments made in the related supporting system	Increase of yields & income, as compared to traditional or previous patterns of production	Adaptability of new technologies to organizational and socio-economic patterns with minimal disruption

Narrative Summary	Obj. Verifiable Indicators	Means of Verification	Important Assumptions
Outputs: Selection of appropriate technologies for exchange, adaptation, & adoption and identification of adequate projects and supporting systems	**Magnitude of Outputs:** --4 to 5 general categories of technologies (e.g. dairy productivity, cropping systems/irrigation, soil solarization, medicinal plants) with several new techniques/technologies in each. --Conclusions re: desirability for general dissemination --Results of experiments	--Products resulting from agricultural experiments & product analyses showing adequate benefit-cost ratio or internal rate of return --Progress reports --Publications, papers --Seminars	**Assumptions for achieving Outputs:** --Positive results of economic analyses will start the process of adoption & diffusion --Research & extension personnel will collaborate fully in adaptation and adoption processes
Inputs: Field experiments, surveys, and economic analyses with reference to selected technologies	**Implementation Target** (Type and Quantity): 5 subjects areas, each with several statistical surveys, field experiments, & technical and economic assessments & analyses	--Progress reports --Site Visits by reviewers & evaluators --Publications, presentation of papers at professional meetings	**Assumptions for providing Inputs:** --Successful technologies can be attained --Funds can be made available through the assistance of AID --Willingness of administrators, researchers, etc. to cooperate

ANNEX C.

C. EVALUATION TEAM'S SCOPE OF WORK

TRINATIONAL (EGYPT-ISRAEL-U.S.) AGRICULTURAL
TECHNOLOGY EXCHANGE & COOPERATION
(T.A.T.E.C.) PROJECT

AID-USDA PASA # BNE-0192-P-AG-4221
AID Project # 398-0158.05, "Patterns of Technology
Exchange & Cooperation in Agriculture"

-- FINAL EXTERNAL EVALUATION --

S C O P E O F W O R K

Activity to be Evaluated: Trinational (Egypt-Israel-U.S.) Agricultural Technology Exchange & Cooperation (TATEC) project (see heading above for AID # and formal title).

Life of Project: six years outlined in project workplan, extended to 6.5 years due to delays in funding (FY 1988) 10/1/84-3/31/91, with 1-year no-cost extension to 3/31/92 (to accomplish final evaluation).

Cost: $3,671,646

Purpose of the Evaluation:

1) review the various components of the project and how they have contributed to the transfer of technology between Egypt and Israel, and

2) consider the successes and problems which have arisen in the process of coordination and cooperation among agencies and individuals of both countries.

Background: Outline Chronology of the TATEC Project.

June 1981 - June 1982: Project conceived and scoped at tri-national meetings in USA and in bilateral Egypt-Israel meetings in the Middle East. Full proposal sent to AID for consideration in September 1982.

1983: Revisions and drafts, in response to AID comments, are accomplished by correspon-

dence, as continuing Lebanon crisis prevents direct meetings of Egyptian-Israeli project design teams.

February - May 1984:	AID review and processing of project proposal.
July 1984:	AID-USDA project agreement (PASA) signed
October 1984:	Grants to Egyptian and Israeli institutions start
May 1986:	Regional Cooperation Conference in Washington; TATEC Project scientists and officials from all three nations participate.
January-February 1987:	interim external evaluation
March-November 1987:	Project scope of work for Years 4-6 first outlined, for discussion with AID; severe AID budget cuts postpone funding decision until FY 1988 AID appropriation is known
June-July 1988:	Project Scope of Work, Years 4-6 4/88-3/91) is finalized at project meeting in Italy, and approved and funded by AID
December 1989:	TATEC Project Workshop held in Cairo and Alexandria, Egypt

Statement of Work: See section II. below for questions that are to be asked by the evaluation team.

I. OVERALL PROJECT VIEW

A. SCIENTIFIC & TECHNICAL COMPONENT.

1. Goals.

The overall goal of the project is to promote progress in the agriculture of Egypt and Israel through development and exchange of innovative technologies suitable to the agro-economic environment. This goal will be achieved by:

-- selection of technologies that are good candidates for exchange and promotion through agro-technical research (surveys, studies, experiments) by participating agro-technology experts

-- a study of farm types of greatest potential for practical implementation of the selected technologies

-- a study of factors promoting or inhibiting adoption and diffusion of the selected technologies and of measures to overcome inhibiting factors.

2. Assumptions.

Transfer of technology has been widely analyzed in development studies and has become one of the basic elements of various theories concerning economic growth and development. Analyses of this subject lay a particular emphasis on three major obstacles which hamper the exchange of technology and innovations:

-- Lack of biological/ecological suitability,
-- Lack of economic capacity to assimilate a new technology, and
-- Lack of socio-institutional adaptability.

On the other hand, diffusion of technology can be facilitated by its suitability to the ecological, economic, and socio-institutional conditions. In order to promote the exchange of technology, a comprehensive approach involving the technical, economic, and socio-institutional issues should be undertaken.

3. Project Purposes.

A major purpose of the project is to sort out a few promising innovative technologies suitable for exchange between Egypt and Israel, to evaluate the agro-economic factors affecting their adaptability, and to formulate recommendations for implementation of the exchange.

The subjects / technologies investigated were:

-- integrated water use and cropping systems

-- dairy cattle productivity

-- solar heating of soil for pest and weed control

-- medicinal uses of desert flora

-- economic evaluation of technologies (listed above) selected for exchange, and economic evaluation of the methods for technology exchange in agriculture

The basic concepts underlying the research are as follows:

a. The background for the search, development, and testing of new technologies will be the farm system and its environment on the one hand, and national priorities, on the other.

b. A comprehensive system approach is needed to promote the diffusion of new technologies, taking into account the farm production system and its supporting system(s).

c. The central feature of the project is an implementation-oriented R & D study, concentrated on a few agricultural technologies on selected farm types.

During the course of the project, a new goal has emerged: preparation of the technological building blocks and the technological background for new development projects in the region.

4. Outputs.

The end product of the project will be:

a) A thorough evaluation of several agro-technologies and of their adaptability to selected Egyptian and Israeli farming systems.

b) Actual implementation of several technologies on farms in Egypt (both large/medium- and small-scale farms) and kibbutz and moshav farms in Israel.

c) Improved understanding regarding exchange, adoption, and diffusion of existing technologies, as well as development of new technologies.

d) Recommendations for future promotion of exchange, adoption, and diffusion of existing technologies and development of new technologies.

e) As an important by-product, promotion of interaction and understanding between Egyptian and Israeli agricultural scientists and administrators.

5. Inputs.

-- compilation of existing information

-- technological research and testing with full formal statistical designs

-- small-scale on-farm experiments

-- demonstration plots

-- economic analysis of technologies and supporting systems needed for adoption of the technologies

B. MEANS OF VERIFICATION: OBJECTIVELY VERIFIABLE INDICATORS OF SCIENTIFIC & TECHNICAL COMPONENT.

1. Evaluation of Outputs.

a) Conditions Indicating Project Achievements.

The following considerations should be addressed:

-- were the selected agro-technologies properly assessed in each country for their applicability in the new farming system?

-- were the inputs of a scale and quality likely to produce the outputs expected?

-- what was the progress toward achieving both scientific and cooperative outputs (see above, sec. I.A.4.), as compared to inputs devoted and time elapsed?

b) Magnitude of Outputs.

Not all scientific outputs will have precisely measurable indicators of achievement and/or progress. However, some of the measurable indicators are:

-- increases in yield on experimental sites (vs. controls)
-- on-farm experiments and demonstration plots set up and executed
-- extent of actual activity at implementation sites
-- development/refinement of technology selection testing process
-- selection of several technologies
-- field testing
-- interest in adoption by farmers

NOTE: This evaluation is final; an interim evaluation in January 1987 assessed progress toward achieving outputs. Thus this evaluation should emphasize outright accomplishments (achievement of outputs), rather than progress toward these ends.

2. Comparison of Achievements with Previously Stated Goals.

Using the Project Plan of Work (both the original 1984 document for Project Years 1-3 [FY 1985-1987] and the 1988 "Phase II" document for Project Years 4-6 [FY 1988-1990]) as the benchmark document, the evaluation

team will formulate conclusions on the technical progress achieved to date and the prospects for sustainability of cooperation after the end of AID support, by reviewing semi-annual and annual progress reports, interviewing principal investigators and other Egyptian and Israeli officials responsible for executing the project, and contacting U.S. Cooperating Scientists.

C. FUNDING.

Adequacy of funding provided, vis-a-vis the scale of activities envisioned and implemented, should be assessed.

D. COOPERATIVE COMPONENT: GOALS.

-- promotion of understanding between people of Egypt and Israel via scientific exchange and cooperation.

-- contribution to development of agriculture in Egypt and Israel.

-- creation of scientific and institutional linkages between Egypt and Israel.

E. COOPERATIVE COMPONENT: INDICATORS OF COOPERATION.

-- regularity of Project Coordinating Committee meetings, and level of participation at these meetings.

-- quality of inter-personal relationships.

-- visits of scientists between Egypt and Israel.

-- joint and/or parallel planning of research steps and evaluation of results.

-- joint and/or parallel execution of research.

-- joint publications produced and workshops held.

-- scientific relationships that have developed outside those directly funded by the project (i.e. the spread effects).

II. SPECIFIC QUESTIONS TO BE ADDRESSED BY EVALUATION TEAM.

A. GENERAL.

1. Have the selected agro-technologies been properly assessed in each country for their applicability in farming systems?

2. Were the inputs of a scale and quality likely to produce the outputs expected? This should include an analysis of the project's logical framework.

3. Has funding been adequate to initiate and implement research to achieve progress toward objectives?

4. Has there been sufficient contact between the researchers to ensure adequate planning and implementation toward project objectives?

5. Has sufficient analysis of research data and information been undertaken to ensure that researchers and others are aware of progress and problems so that decisions regarding that research can be made? For example, to what extent has the solarization activity been analyzed to determine the cost/benefit to farmers (potential users of solarization)?

6. Have there been sufficient coordination meetings and reporting of activities to facilitate cooperation and understanding between the two countries? What actions or changes in project implementation have occurred following these meetings?

7. Has the exchange of information been equally beneficial to researchers from both countries? What form have these benefits taken?

8. In reviewing project outputs, was there an adequate balance between planning for research and reporting results? What uses were made of results?

9. Was the process of planning for research cooperative, or to what extent did researchers in each country do this on their own?

10. Was the administration of the project by responsible agencies of both countries adequate to support implementation toward project goals and objectives? What were some of the major problems that might have impeded project implementation?

11. Was there an adequate review of literature and prior research to ensure that new ground was broken in the project and that it had a regional (two country) perspective?

12. What methods are being employed to ensure that farmers, extension agents, and other researchers have access to the project's results? Please identify and list publications resulting from the

project, especially those in the international professional literature.

13. Were the activities in general properly designed to meet the project's stated goals? Please comment on the vertical, integrated structure of the project (i.e. research on specific technologies, providing data for evaluations of economic feasibility on these technologies, which in turn feeds into demonstration-plot and on-farm experiments that provide an important database for the overall economic evaluation of technology exchange methods).

14. How successful were the processes of identifying scientifically viable technologies for transfer to farmers?

15. Do you have any recommendations on the emphasis among technological subjects, specific issues, or topics to be pursued in future investigations or demonstrations, beyond those suggested by the Principal Investigators (Pis)?

16. What are your impressions concerning the cooperation between the Egyptian and Israeli team on each subproject? Among the various disciplines (within and among subprojects and between the two nations' teams)? Between the Egyptian and Israeli teams overall?

17. What actual and potential contributions to scientific cooperation between Egypt and Israel have been made possible by this project? What is the project's actual/potential impact on bilateral scientific cooperation between each major party (Egypt, Israel) and other countries?

B. ECONOMICS.

1. Within the irrigation component, please comment on the identification of water pricing as a question for investigation, and its significance to farm production in different areas (e.g. Old vs. New Lands in Egypt).

   a. What degree of adaptation seems likely? How selectively should a given system be applied to specific crops, farming systems, etc.

   b. How does the economic evaluation of the several irrigations methods (furrow, sprinkler, drip/trickle) contribute to the overall evaluation of technology exchange methods?

c. Should salinity aspects have been incorporated into this study?

2. How appropriate were the several main topics for the Evaluation of Technology Exchange Methods subproject? Which were continued in Years 4-6 (Phase II) of the project, and how significant were the results?

3. Please comment on the overall concept of the Economic Evaluation subprojects (i.e. their comprehensive, integrated approach that included technical experiments, compilation of data, on-farm testing and demonstration, etc.). What were the results of these subprojects, i.e. technological recommendations, and how have they been followed up?

C. DAIRY PRODUCTIVITY

1. Has the research on dairy production fit in with individual country goals for this particular sector? Were the specific topics chosen suitable for cooperation, considering the dairy husbandry problems common to Egypt and Israel?

2. Were the research activities chosen well suited to the facilities available to the cooperating investigators? Were the inputs and outputs of this component in line with design input and output goals? An analysis of the project logical framework for this component should be included.

3. What are the reasons for either project progress or failure in achieving those input and output goals?

4. What were the results? What economic and production impacts are they likely to have?

D. CROPPING SYSTEMS / IRRIGATION

1. Please comment on the selection of crops. Were they appropriate choices in relations to the goals of this subproject?

   a. Were the field sites selected for experimentation and demonstrations suitable for studying the crops and agronomic variable selected?

2. Please comment on the multifactorial agronomic design of the subproject (i.e. the agronomic practices used, the several irrigation methods incorporated, variant timing and dosage of fertilizers, etc.) Did the design and execution advance the research toward its stated goals?

E. MEDICINAL DESERT FLORA

1. Were the basic approach, the criteria used for selecting the investigated species, and the methodology soundly conceived?

2. How significant are the results? What potential exists for the exchange of medicinal plant knowledge/technology between Egypt and Israel?

F. SOIL SOLARIZATION

1. To what extent were the working hypotheses and basic assumptions verified?

2. Which are the most important new findings developed during this project?

3. What are the actual ("in-use") and potential advantages of solarization as compared to other existing techniques for disease and pest control? What contributions has this research made in developing other new techniques?

4. How has this research promoted interdisciplinary cooperation in the overall project?

<u>Methods and procedures:</u>

a) **Preparatory/Initial Evaluation Activities.**

Before departure for Egypt and Israel, the evaluation team should review all project progress reports and publications resulting from the project, as well as the project's Scope of Work (Feb. 1984, as amended in June 1988) and the interim external evaluation of Jan.-Feb. 1987. The team will meet

with AID officials responsible for administering the project, to clarify their charge and obtain additional information. Estimated timeframe: 2-3 working days.

b) **Overseas Activities.**

In Egypt and Israel, the evaluation team will meet with each nation's Project Coordinator(s), Principal Investigators, and administrative officials, who likely will provide additional written materials, answer technical questions, and arrange visits to any field sites that may still be active. Following meetings and field work in both nations, the team will prepare draft reports and conduct a debriefing for Egyptian and Israeli scientists. Estimated timeframe: 3 weeks. (Six-day work weeks are authorized.)

While in Egypt and Israel, the evaluation team will fall under the guidance of the Science Officer, U.S. Embassy/Tel Aviv and the Political Officer, U.S. Embassy/Cairo, who should also be debriefed before departure from the region.

The key TATEC Project contacts (and locations of central project records) are:

EGYPT: Prof. Adel El-Beltagy, First Undersecretary for Land Reclamation and Foreign Relations, Ministry of Agriculture, Cairo (tel. 011-20-2-702-442)

Mrs. Atiat El-Menshawy; Director, Technical Office; Foreign Agricultural Relations Dept., Ministry of Agriculture, Cairo (tel. 011-20-2-712-937).

Prof. Osman El-Kholei (TATEC Project Technical Coordinator), Agricultural Economics Research Institute, Ministry of Agriculture, Cairo (tel. 011-20-2-702-618)

Working hours: Sun.-Thurs., 8:30 a.m. to 3:00 p.m. GMT+2

ISRAEL: Prof. Samuel Pohoryles, Director-General, Rural Planning & Development Authority, Ministry of Agriculture, Tel Aviv (tel. 011-972-3-269-102)

Dr. Yehuda Haas, Vice President for Research & Development, Hebrew University of Jerusalem, Jerusalem (tel. 011-972-2-585-425/426)

Dr. Shabtay Dover, Director, Authority for Research & Development, Hebrew University of Jerusalem, Jerusalem (tel. 011-972-2-630-241)

Prof. Dan Yaron (TATEC Project Technical Coordinator), Dept. of Economics, Faculty of Agriculture,

Hebrew University, Rehovot (tel. 011-972-8-481-227)

Working hours: Sun.-Thurs., 8:00 a.m. to 4:30 p.m. GMT+2

U.S.A.: A.I.D.:
Mr. Bert Porter (ENE/MENA Regional Cooperation Program Officer, tel. 202-647-9000); Mr. Leland Voth, (ENE/TR/ARD Regional Cooperation Program, technical resources / monitoring officer, tel. 202-647-7061).

USDA:
Dr. Jerry S. Walker (OICD/RSED Program Leader, tel. 202-245-5877); Mr. Mark C. Abbott (OICD/RSED Research Administrator) and Ms. Eileen Herrera (OICD/RSED International Affairs Specialist) (tel. 202-245-5868 or -5869)

c) **General Methodology.**

Each evaluator will prepare a list of activities undertaken in each component, who are the principal researchers involved, a list of reports produced by each component, and a list of meetings and visits which have taken place. A brief assessment should be made by each evaluator as to the success and usefulness of those activities, major problems encountered, and if/how the problems were resolved.

The individual evaluator reports should include statements of findings based on answers to the questions in section II., Statement of Work above. These should then lead to a series of conclusions for each project component. These will be synthesized by the team leader in the main body of the final report. A suggested reporting format is outlined in the Reporting Requirements section below.

d) **Evaluation Team Relationships and Responsibilities.**

1) The evaluation will be conducted by a five-person team, including a team leader. The team leader will be responsible for writing the final report, based on draft reports prepared by the other team members.

2) The team leader and team members will be responsible to the AID Project Officer (AID/Washington); while overseas they will fall under the guidance of the Science Officer, U.S. Embassy/Tel Aviv and the Political Officer, U.S. Embassy/Cairo.

3) In addition, the USDA/OICD Project Officer will assist in facilitating the administration, logistics, and execution of the evaluation.

4) The evaluation team will coordinate their activities with the Technical Coordinators/Principal Investigators (PIs) of each country. The PIs will provide, through their respective agencies, project documentation as required, and logistical support for field trips. The PIs will also arrange for meetings as requested by the evaluation team.

5) The PIs of each country will provide, to the extent possible, office space, office equipment, and secretarial assistance. The PIs of each country will also provide vehicle support for the evaluation team for field trips and transportation to meetings as necessary.

e) **Conclusion of Evaluation.**

The evaluation team will be authorized three days in Washington D.C. following return from overseas to meet with USDA officials responsible for the project and to finalize their reports. The team leader will be authorized two additional days in the United States to complete a comprehensive draft report for AID, which is due to the AID Project Officer within 10 working days after return from overseas.

f) **Illustrative Schedule:**

Begin on/about October 1, 1991

[July-August not possible, due to vacation schedules of Egyptian, Israeli staff and prospective American evaluators. September not possible, due to Rosh HaShana-Yom Kippur-Simchat Torah holidays Sept. 8-Oct. 1, 1991]

Proceed to Israel on/about Oct. 4

Travel to Egypt on/about Oct. 11

Return to USA, on/about Oct. 18

Comprehensive draft report due to AID, on/about Nov. 1

Final report due to AID, on/about Nov. 15

<u>Evaluation Team Composition:</u>

Language proficiency in Arabic or Hebrew is desirable but not required, as all project participants speak adequate-to-excellent English and all relevant project information is available in English.

Previous in-country work (in either Egypt or Israel): Familiarity with semi-arid or arid zone agricultural operations is essential, as is familiarity with the societies and economies of the

Middle East (due to the cooperative goals of the project). Work in another Middle Eastern nation or as a professional associate of its nationals is an acceptable substitute for experience directly in Egypt or Israel or with Egyptians or Israelis.

Technical competency: PhD and several years experience in laboratory or field work in an agricultural discipline closely allied to the several subjects investigated in this project, i.e.:

- -- Cropping Systems/Water Use: agronomy of field crops and vegetables, irrigation
- -- Dairy Productivity: dairy husbandry, dairy breeding and improvement, veterinary medicine
- -- Solar Heating: plant pathology, weed science, agronomy
- -- Medicinal Desert Plants: botany, agronomy, biochemistry
- -- Economic Evaluation: agricultural economics, technology transfer, agronomy

Reporting Requirements:

The final written report (15 bound copies and one unbound copy) will be due to the AID Project Officer within one month (20 working days) of return from Egypt and Israel and shall be accompanied by a copy of the report on a computer diskette utilizing WordPerfect 5.1 software.

Report format:

- -- Executive Summary (1-3 pages) citing the key findings, conclusions, and recommendations of the review
- -- Project Identification Data Sheet (see Appendix A, AID Evaluation Handbook)
- -- Table of Contents
- -- Main Body of the Report (no more than 40-50 pages)
- -- Annexes including a copy of the scope of work, individuals interviewed, reference materials, and a list of basic project outputs.

A portable computer with software may be leased for use by the team in fulfilling this assignment.

ANNEX D.

D. COMPARISON OF ACHIEVEMENTS WITH PREVIOUSLY STATED GOALS

The evaluation Scope of Work calls for using the stated goals in the Project Plans of Work as benchmarks for the Team to formulate conclusions on the technical progress to date and the prospects for sustainability of cooperation after the end of AID support.

The stated goal in the combined Plan of Work is:

The overall goal of the project is to promote progress in the agriculture of Egypt and Israel through development and exchange of innovative technologies suitable to the agro-economic environment. This goal will be achieved by:

a) selection of technologies that are good candidates for exchange and promotion through agro-technical research (surveys, studies, experiments) by participating agro-technology experts

The technology categories selected are listed below:

1) Integrated water use and cropping systems

2) Dairy cattle productivity

3) Solar heating of soil for pest and weed control

4) Medicinal uses of desert flora

5) Economic evaluation of technologies (listed above) selected for exchange, and economic evaluation of the methods for technology exchange in agriculture

These are the technological categories that have been the focus since TATEC I started. Progress under each category is documented throughout the text of this Report. Refer to Appendix E. for highlights and Appendix F. for more detail.

b) a study of farm types of greatest potential for practical implementation of the selected technologies

No serious research was focussed on the study of farm types, as such. However, the relevance of certain farm types became obvious from some of the research. For example, it was concluded from the dairy cow cooling research in Egypt that this technology would be relevant only for large farms. In Israel, however, two different kinds of cooling were used by 70 per cent of the dairy farmers. Farm size was not reported.

A controlling factor in practical implementation of the selected technologies was the availability of capital, since many of them are capital intensive. High capital requirements are reported for dairy cattle cooling, solarization, and some of the water use/ irrigation technologies.

c) a study of factors promoting or inhibiting adoption and diffusion of the selected technologies and of measures to overcome inhibiting factors.

Israel conducted research on adoption practices by Arab farmers in Israel with the expectation that the results would be applicable to Egypt. The only Arab "laboratory" available was Arab territories, primarily the Nazareth area (Jezreel Valley) and the Gaza area, where the adoption of innovations on family farms under the Arab social and institutional systems were studied.

Arab family farms in both the Nazareth region in the north of Israel and in the Gaza area have exhibited substantial economic growth over the last two decades by a shift from a traditional dry farming system to modern farming based in part on advanced technologies. The most significant findings related to the extension system and its modes of operation which were analyzed and found to be very important in the development process, which could be a lesson for Egyptian agricultural administrators. However, because of significant differences in socio-cultural variables, as well as major economic factors, the research will have limited applicability to exchange of technology between countries.

There were no adoption studies, as such, in Egypt.

ANNEX E.

E. HIGHLIGHTS OF TATEC "OUTRIGHT" ACCOMPLISHMENTS AND LESSONS LEARNED

The Scope of Work notes that this final evaluation "... should emphasize outright accomplishments (achievement of outputs), rather than progress toward these ends." Achievement of the proposed project outputs varied from one subject category to the next and in some cases, for example, 4) "... future promotion of exchange", accomplishment and understanding were a by-product of other activities. The five proposed outputs were:

1) A thorough evaluation of several agro-technologies and of their adaptability to selected Egyptian and Israeli farming systems.

This was the focus of most project activity and extensive results are reported in the text. In the case of Water Use and Cropping Systems, the field projects that were conducted in both countries were very applied and fundamental, but necessary to establish site or region specific guidelines on irrigation practices, fertilizer practices, seeding rates, plant spacing, and feasibility of different crop rotations.

Dairy nutrition studies provided useable results in both countries. Cooling dairy cows was established as a viable technology in Israel, with 70% of dairies using it, but has not been successfully transferred to Egypt, in spite of the research efforts.

Solar heating of soils, itself a new technology for control of soilborne pests, was thoroughly investigated in both countries with resulting recommendations for its use. There are few scientific conclusions to be drawn from the medicinal desert plant work in Egypt and only a few plants were identified in Israel with medicinal/commercial potential, perhaps in the distant future.

Useful economic evaluations were accomplished for various aspects of irrigation in both countries, with the Egyptian research being practical on-farm work. Whereas in Israel the research was highly technical and theoretical. Dairy and solarization economic studies were confined to enterprise analysis instead of being incorporated into farm management studies where useful recommendations could result. There was no economic analysis of desert plants.

2) Actual implementation of several technologies on farms in Egypt (both large/medium- and small-scale farms) and kibbutz and moshav farms in Israel.	Implementation of the various technologies on farms was variable from one technology to another with more farmer involvement in Israel than in Egypt. Cropping systems investigations in both Egypt and Israel made useful contributions to the bank of farmer oriented information. In the case of water use investigations, however, there was not extensive focus on getting the technology used on farms.

Dairy nutrition results were extended to farmers in both countries but the cow-cooling work was extended only in Israel. In Egypt, solarization use by farmers has been primarily in the area of protective agriculture (greenhouses). In Israel, on-farm use of solarization varies considerably by 1) location, 2) whether other methods of control are available for a particular pest, and 3) at what cost for the technology. No on-farm work was done with desert plants.

3) Improved understanding regarding exchange, adoption, and diffusion of existing technologies, as well as development of new technologies. **4) Recommendations for future promotion of exchange, adoption, and diffusion of existing technologies and development of new technologies.**	Both of these outputs deal with exchange, adoption, and diffusion; for which only Israel conducted direct research on factors affecting adoption - not exchange or diffusion. However, execution of the project has resulted in a number of recommendations affecting, particularly, exchange and collaboration between scientists in the two countries. It is recommended that research be narrowly enough focussed that researchers from both countries are working on the same subject. In the case of water use/ cropping systems Israeli scientists were investigating highly technical aspects while

their Egyptian colleagues were focussing on farm oriented research, thus giving them little to share with one another. Working on the same research problem will facilitate collaboration among scientists and make creating transferable technology between countries more likely.

Communication between scientists in the two countries is constrained by bureaucratic and political considerations. Much of this could be bypassed by the executing agent (the USDA or whomever, or AID for that matter) taking a more active role in getting research reports and other documentation from one country distributed to participants in the other country. This was not done in either TATEC I or II.

5) As an important by-product, promotion of interaction and understanding between Egyptian and Israeli agricultural scientists and administrators.

Promotion of interaction and understanding has shown important positive results, particularly among scientists, even though political tensions have dampened relations in some cases at the administrative/ political level.

Not really a by-product, but a critical and decisive role is played by the US, under TATEC or other sponsorship, by providing the structural arrangement which is necessary for maintaining long-term relationships among Egyptian and Israeli scientists. The desire for interaction exists on both sides but the "umbrella" structure facilitates collaboration. It is clear from the evaluation that, without this umbrella, there is little likelihood of sustained collaboration.

ANNEX F.

F. NUMBERS OF PUBLICATIONS, PAPERS, OTHER DOCUMENTATION, AND VISITORS - EGYPT AND ISRAEL[1]

CATEGORIES	EGYPT	ISRAEL	JOINT
I. Integrated Water Use & Cropping Systems			
A. Publications[2]		9	
B. Papers Presented, Workshops, & general materials	5	3	
C. Visitors to Other Country	6	21	
D. Academic & other training[3]		4	
E. Dissemination to Farmers	Yes, extension releases.	Yes, researcher/farmer interaction	
II. Dairy Productivity			
A. Publications	4	5	
B. Papers Presented, Workshops, & general materials			
C. Visitors to Other Country	4	3	
D. Academic & other training	3	6	
E. Dissemination to Farmers	Feeding-yes Cooling-one	Cooling-70% of dairies	
III. Solarization			
A. Publications	3	10	5
B. Papers Presented, Workshops, & general materials	5	7	3
C. Visitors to Other Country	5	9	
D. Academic & other training	3	7	
E. Dissemination to Farmers	Limited	Yes	

[1]These numbers are abstracted from the text. Please refer to the text for substance related to publications, visits, training, etc.

[2]Journal articles, chapters in books, and other published material.

[3]Numbers of trainees.

ANNEX F.

NUMBERS OF PUBLICATIONS, PAPERS, OTHER DOCUMENTATION, AND VISITORS - EGYPT AND ISRAEL (continued)

CATEGORIES	EGYPT	ISRAEL	JOINT
IV. Medicinal Desert Plants			
A. Publications	3	4	
B. Papers Presented, Workshops, & general materials		7	
C. Visitors to Other Country	6	8	
D. Academic & other training	3	1	
E. Dissemination to Farmers	Limited	Yes	
V. Economic Analysis			
A. Publications	7	21	1
B. Papers Presented, Workshops, & general materials	13	3	
C. Visitors to Other Country	5	9	
D. Academic & other training		8	

ANNEX G.

G. LIST OF REFERENCE MATERIALS

I. ADMINISTRATIVE DOCUMENTATION

These materials were provided to the Team prior to departure from the US. Along with the SOW, they provide the basic setting for the Project and the starting point for the Team.

ORIGINAL PROJECT PLAN OF WORK & BUDGETS
FOR PROJECT YEARS 1 - 4 (fiscal years '84-87), dated Feb. 1984 - Aug. 1985

INTERIM (FEB. 1987) TECHNICAL EVALUATION REPORT

ANNUAL TECHNICAL / FISCAL PROGRESS REPORT,
Year 3 (Oct. 1986 - Sept. 1987)

REVISED ("PHASE-II") SCOPE OF WORK (WITH BUDGETS)
FOR PROJECT YEARS 4 - 6 (fiscal years '88 - '90),
dated Aug. 1988

ANNUAL TECHNICAL / FISCAL PROGRESS REPORT,
Year 4 (Oct. 1987 - Sept. 1988)

SEMI-ANNUAL TECHNICAL / FISCAL PROGRESS REPORT,
Year 5 (Oct. 1988 - March 1989)

ANNUAL TECHNICAL / FISCAL PROGRESS REPORT
Year 5, (April 1989 - Sept. 1989)

FINAL TECHNICAL PROGRESS REPORTS
OF EACH SUB-PROJECT / SUBJECT (Oct. 1989 - Sept. 1990)

REPORT OF EVALUATION TEAM: OCT.-NOV. 1990 REVIEW OF
THE COOPERATIVE ASPECTS (& RELEVANT TECHNICAL POINTS) OF ALL PROJECTS IN THE A.I.D.-FUNDED EGYPT-ISRAEL REGIONAL COOPERATION PROGRAM (by DEVRES, Inc. - Ambassador Kontos et al., dated Feb. 1991)

II. FIELD DOCUMENTATION

These documents and studies were provided to the various Team members by the collaborating scholars. They, along with interviews and observation, provide the grist for evaluation and form the substantive basis for the conclusions reached by the Team.

A. WATER USE AND CROPPING SYSTEMS

Abstracts, Presentations, Published Papers & Graduate Education

Israel:

Presentations

1. Pinthus, N. and A. Marani. 1991. Paper presented at the International Symposium on Physiology and Determination of Crop Yield. Gainesville, FL (10-14 June).

2. Steinberg, Miriam and H.D. Rabinowitch. 1989. The role of oxygen in thermo-photodynamic processes leading to sunscald-like damage in green tissues. Fifth DOF Meeting. Jerusalem, Sept. (abstr.)

Scientific Journals

1. Rabinowitch, H.D. and U. Zig. 1989. Leaf and root degeneration in early maturing onions: A physiological disorder. Ann. Appl. Biol. 115:533-540.

2. Steinberg, Miriam and H.D. Rabinowitch. 1991. The role of oxygen in thermo-photodynamic processes leading to sunscald-like damage in green tissues. Free Radical Res. Commun. (in press).

3. Feinerman, E., E. Bresler and H. Achvish. 1989. Economics of irrigation technology under conditions of spatially variable soils and nonuniform water distribution. Agronomie 9:819-826.

4. Feinerman, E., E. Bresler and G. Dagan. 1989. Optimization of inputs in a spatially variable natural resource: unconditional vs. conditional analysis. J. Environ. Econ. and Mgt. 17:140-154.

5. Feinerman, E., Y. Shani and E. Bresler. 1989. Economic optimization of sprinkler irrigation considering uncertainty of spatial water distribution. Aust. J. Ag. Econ. 33(2):88-107.

6. Dinar, A. and D. Yaron. Adoption and abandonment of irrigation technologies. Ag. Econ. (in press).

7. Feinerman, E. and D. Yaron. 1990. Adoption of drip irrigation in cotton-growers in Israel. Oxford-Agrarian Studies 18:43-52.

Workshops

TATEC Workshop: Alexandria, December 4-7, 1989 (P.I.s from all aspects of the cropping system-water use participated).

General Materials

1. Rabinowitch, H.D. Sunscald damage in tomatoes, peppers and cucumbers under field and controlled conditions: Physiology and possible remedies.

2. Rylski. Fruit set and fruit growth improvement of some solanaceae (video-tape). In Hebrew, Arabic and English, describes agro-technique and as flower vibration to improve fruit set.

B. DAIRY PRODUCTIVITY

Egypt:

1. Gallab, Z.R.A., S.A. Fawzy and F. El-Keraby. 1988. Effect of exposure to solar radiation wetting on some physiological and productive traits in Friesian cows and heifers. J. Agri. Sci., Mansoura Univ. 13:1572.

2. Hathout, M.K., H.M. Ghanem, H. El-Nouby and A.A. Abdel-Aziz. 1989. Incorporation of treated corn cobs in complete rations for sheep. in: third Egyptian-British Conference on Animal, Fish and Poultry Production. p. 281, Fac. Agri., Alex. Univ., Alexandria.

3. Gallab, Z.R.A., S. A. Fawzy and F. El-Keraby. 1989. Effect of exposure to solar radiation and wetting on thyroxine and cortisol in Friesian cows and heifers. Communications in Sci. & Develop. Res. 25:107.

4. El-Keraby, F., A.K. Kirrella, S.A. Fawzy and E.A. Omer. 1991. Effect of water spray cooling on some physiological performances and milk production of pregnant Friesian cows. Agric. Res. Rev. (in press).

Israel:

1. Flamenbaum, I., D. Wolfenson, M. Mamen and A. Berman. 1986. Cooling dairy cattle by a combination of sprinkling and forced ventilation and its implementation in the shelter system. J. Dairy Sci. 69:31.

2. Her, E., D. Wolfenson, I. Flamenbaum, Y. Folman, M. Kaim and A. Berman. 1988a. Thermal, productive, and reproductive responses of high yielding cows exposed to short-term cooling in summer. J. Dairy Sci. 71:1085.

3. Wolfenson, D., I. Flamenbaum and A. Berman. 1988b. Hyperthermia and body energy store effects on estrus behavior, conception

rate, and Corpus Luteum function in dairy cows. J. Dairy Sci. 71:3497.

4. Wolfenson, D., I. Flamenbaum and A. Berman. 1988c. Dry period heat stress relief effects on prepartum progesterone, calf birth weight and milk production. J. Dairy Sci. 71:809.

5. Kimmel, E., H. Arkin, D. Broday and A. Berman. 1991. A model of evaporative cooling in a wetted hide. J. Agric. Engng. Res. 49:227.

C. SOLARIZATION

1. Abdel Rahim, M.F., M.M. Satour, K.Y. Mickhail, A. Grinstein, H.D. Rabinowitch, and J. Katan. 1987. Long-term effects of soil solarization in furrow and sprinkler irrigated soils in Egypt and Israel. Proc. 7th Congress Mediter. Phytopath. Union. pp.59-60.

2. Gamliel, A., E. Hadar, and J. Katan. 1987. Microbial phenomena related to increased growth response in solarized soils and to monoculture systems. Ibid. pp.72-73.

3. Abdel Rahim, M.F., M.M. Satour, S.A. El-Eraki, H.R. El Wakil, A. Grinstein, Y. Chen, and J. Katan. 1987. Soil solarization for controlling soilborne pathogens and weeds in furrow-irrigated Egyptian soils. Ibid. pp.76-77.

4. Freeman, S. and J. Katan. 1988. Weakening effect on propagules of Fusarium by sublethal heating. Phytopathology 78:1656-1661.

5. Satour, M.M., M.F. Abdel Rahim, T. El-Yamani, A. Radwan, A. Grinstein, H.D. Rabinowitch and J. Katan. 1989. Soil solarization in onion fields in Egypt and Israel: short and long-term effects. Acta Horticulturae 255:151-159.

6. Abdel Rahim, M.F., M.M. Satour, K.Y. Mickhail, S.A. El-Eraki, A. Grinstein, Y. Chen and J. Katan. 1988. Effectiveness of soil solarization in furrow-irrigated Egyptian soils. Plant Disease 72:143-146.

7. Katan, J., A. Grinstein, A. Greenberger, O. Yarden and J.E. DeVay. 1987. The first decade (1976-1986) of soil solarization (soil heating): a chronological bibliography. Phytoparasitica 15:229-255.

8. Freeman, S., C. Ginzburg and J. Katan. 1988. Heat shock protein synthesis in propagules of Fusarium oxysporum f. sp. niveum. Phytopathology 78:1656-1661.

9. Hetzroni, A. and A. Grinstein, 1989. Technology of soil solarization. Acta Horticulturae 255:189-196.

10. Gamliel, A. and J. Katan. 1991. Involvement of fluorescent pseudomonad and other microorganisms in increased growth response of plants in solarized soils. Phytopathology 81:494-502.

11. Katan, J. Soil solarization, in: Innovative Approaches to Plant Disease Control, Chet, I., ed., Wiley and Sons, New York, 1987. 77p.

12. Greenberger, A., A. Yogev, and J. Katan. 1987. Induced suppressiveness in solarized soils. Phytopathology 77:1663-1667.

13. Satour, M.M., F.W. Riad and A.S. Abdel-Hamied. Soil solarization and control of plant parasitic nematodes. in: Soil Solarization. FAO Plant Production and Protection Paper No. 109. pp.173-182. 1991.

14. Mansour, M. and M. Sultan. Economic assessment of the long-term effects of the soil heating technology in Beni Suef Governorate. Ibid. pp.367-382.

15. Yaron, D., Y. Wijler, A. Avizohar, A. Dinar, J. Katan and A. Grinstein. An economic analysis of soil disinfection for controlling soilborne diseases. Res. Progress Report, Hebrew University, Dept. of Agri. Economics, Rehovot, Israel. 1986.

16. Basheer, A.M., D. Yaron, Y. Wijler, A. Avizohar, A. Dinar, M.F. Abdel Rahim, M. Satour, J. Katan and A. Grinstein. An economic analysis of soil disinfection for controlling soilborne diseases. Res. Progress Report, Hebrew University, Dept. of Agri. Economics. Rehovot, Israel. 1986.

17. Katan, J. and J.E. DeVay (eds.) 1991. Soil Solarization. CRC Press, Boca Raton, Fl. (In press).

18. Satour, M.M., E.M. El-Sherif, L. El-Ghareeb, S.A. El-Hadad and H.R. El-Wakil. Achievements of soil solarization in Egypt. in: Soil Solarization. FAO Plant Production and Protection Paper No.109. pp.200-211.

Additional summaries, reports and unpublished data were viewed during the review process. Most reports will not be published. However, data is still being prepared for publication.

Following are 13 reports from Egypt on the financial results of solarization of various crops and at different sites, 1987-1991.

1. A financial analysis of onions solarization experimental trials at Biba District of Beni Suef Governorate, 1987.

2. A financial analysis of the faba beans solarization experimental trials, Giza Governorate, 1987.

3. Agricultural production of potatoes by using the technology of soil solarization, Gemmeiza Research Station, Gharbia Governorate, 1987.

4. An evaluation of winter bulb onion solarization experimental trials at Tamiya Experiment Station, Fayoum Governorate, 1987.

5. Estimation of the effect of soil solarization on the profitability of the second crop--maize, 1984.

6. Estimation of the effect of soil solarization on the profitability of the third crop--faba bean, 1988.

7. Economic assessment of the long-term effects of soil heating technology, 1988.

8. Economic assessment of the long-term effects of the soil heating technology at Beni Suef Governorate, 1989.

9. An evaluation of winter onions solarization experimental trials, Somsta District, Beni Suef Governorate, 1989.

10. Estimation of the effect of plastic types on solarization profitability of faba bean crop, 1990.

11. Estimation of the effect of plastic types on solarization profitability of soybean (second crop), 1990.

12. Estimation of plastic types effect on solarization profitability of faba bean (third crop), 1990.

13. Estimation of the effect of soil-heating on profitability of strawberry crops, 1991.

D. MEDICINAL PLANTS

1. Yaniv, Z., A. Dafni, J. Friedman and D. Palevitch. 1987. Plants used for the treatment of diabetes in Israel. J. Ethnopharmacology 19:145-151.

2. Freedman, J., Z. Yaniv, A. Dafni and D. Palevitch. 1987. A preliminary classification of the healing potential of medicinal plants based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. J. Ethnopharmacology 16:275-287.

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3) Feinerman, E. and D. Yaron. Adoption of drip irrigation in cotton - the case of kibbutz cotton growers in Israel. Oxford-Agrarian Studies 18:43-52. 1990.

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7) Blum, A. Use of different information sources for decision making by traditional farmers in a progressive knowledge system. J. of Ext. Syst. 5(1):60-73. 1989.

8) Blum, A. Extension strategies used to develop a traditional farming sector in an advanced agricultural surrounding. Quart. J. of Inter. Agric. 27(3-4):299-313. 1988.

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16) Dinar, A. Economic evaluation of methods to reduce heat losses and increase milk yield in dairy cattle in warm climates. Res. Report. TATEC - A Trinational Egypt-Israel-U.S.A. Project. The Hebrew Univ. of Jerusalem. 1988.

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19) Dinar, A. and D. Yaron. Adoption of new irrigation technologies in citrus: Process description and the influence of inputs scarcity and quality. Res. Report. TATEC - A Trinational Egypt-Israel-U.S.A. Project. The Hebrew Univ. of Jerusalem. 1988.

20) Szeskin, A. and R. Sternlicht. Agricultural development of family farms in the Nazareth Region. Res. Report. TATEC - A Trinational Egypt-Israel-U.S.A. Project. The Hebrew Univ. of Jerusalem. 1988.

2. Papers submitted or in process

21) Yaron, D., H. Voet and A. Dinar. Adoption of innovations by family farms under Arab social systems in a southern region - Region B. (in prep.)

22) Yunis, H. Agricultural development in the Nazareth Region - twenty-five years. Nazareth Ext. Serv., Israel Ministry of Agric. (submitted)

3. Workshop papers

23) Pohoryles, B. The impact of agricultural technology exchange. Paper presented at the TATEC Workshop, Alexandria, Dec. 1989, The Israeli Team, The Hebrew Univ., P.O. Box 12, Rehovot, Israel.

24) Voet, H. Adoption of innovations on private Arab farms. Paper presented at the TATEC Workshop, Alexandria, Dec. 1989, The Israeli Team, The Hebrew Univ., P.O. Box 12, Rehovot, Israel.

25) Yaron, D., H. Voet and A. Dinar. Adoption of innovations by family in the Nazareth Region in Israel. Paper presented at the development Workshop. Dept. of Agric. and Applied Econ., Univ. of MN, May 1990.

Egypt

1) Sharaf, M.F., M.F. Sabaa and A.A. Sheneshin. Financial and economic evaluation of feeding sheep on nontraditional feed. AERI, Ministry of Agric., Cairo, 1989.

2) Sharaf, M.F., M.F. Sabaa, H.A. Mohsen and A.A. Sheneshin. Financial and economic evaluation of feeding dairy cows on nontraditional feed. AERI, Ministry of Agric., Cairo, 1989.

3) Sabaa, M.F., H.A. Mohsen and M.F. Sharaf. Economic evaluation of using cooling technology for increasing milk yield of dairy cows. AERI, Ministry of Agric., Cairo, 1991.

4) Habashy, N.T., S. Darwish and F. Aziz. Fertilizer production function for maize under surface and sprinkler irrigation. AERI, Ministry of Agric., Cairo, 1991.

5) Habashy, N.T., S. Darwish and F. Aziz. Economic evaluation of irrigation systems and shadow pricing of irrigation water. Agric. Res. Rev., 1990.

6) Habashy, N.T., S.A. Motalb and F. Azia. Economic indicators of cropping patterns in the New Lands and the impact of the irrigation systems. AERI, Ministry of Agric., Cairo, 1989.

7) Sultan, M.Y. Application of binary choice models in assessment of factors affecting farmer decisions in adopting improved wheat seeds. AERI, Ministry of Agric., Cairo, 1989/90.

ANNEX H.

H. TATEC EVALUATION TEAM

Current Location/Tel/Fax:	Home Institution Address/tel:
TEAM LEADER and DAIRY: Mohamed K. YOUSEF, PhD Dean, Faculty of Science United Arab Emirates University P.O. Box 15551 El Ain, U.A.E. tel. 011-971-3-677-280 (w), fax. 011-971-3-671-291	Desert Biology Research Center, Univ. of Nevada / Las Vegas 4505 Maryland Parkway Las Vegas NV 89154 tel. 702-739-3399 (w), fax 702-739-3956
CROPPING SYS./WATER USE: Stephen R. GRATTAN, PhD THRU 9/18/91: c/o Servicio de Investigación Agraria Unidad de Suelos y Riegos Carretera de Montañana, 176 (Apartado 727) 50080 Zaragoza, ESPAÑA tel. 011-34-76-576411 (w), fax. 011-34-76-575501	Dept. of Land, Air, & Water Resources, Viehmeyer Hall Univ. of California Davis, CA 95616 tel. 916-752-1130 (w), fax. 916-752-1552
MEDICINAL DESERT PLANTS: James A. DUKE, PhD USDA/ARS/National Germplasm Resources Laboratory Bldg 001, Room 133 - BARC-W 10300 Baltimore Ave. Beltsville MD 20705-2350	<--ditto
SOIL SOLARIZATION: Clyde L. ELMORE, PhD Dept. of Botany Univ of California/Davis Davis CA 95616 tel. 916-752-0612 fax 916 752 4754	<--ditto
ECONOMICS: Fletcher E. RIGGS, PhD 12005 Rosiers Branch Dr. Herndon, VA 22070 tel 703-243-7911 (ISPAN), 703-481-8820 (Isl. Ent.) fax 703-742-0744 (Isl. Ent.)	Island Enterprises, Inc. <--ditto [alternate contact: ISPAN: 1611 N. Kent St., # 1001 Arlington VA 22209]