The National Agricultural Research Project's Contributions to Significant Advances in Egyptian Agriculture

Submitted to
USAID/Cairo
Ministry of Agriculture and Land Reclamation
Cairo, Egypt
under contract number LAG-4200-I-00-3056

Submitted by
Tropical Research & Development, Inc.
Gainesville, Florida, U.S.A.
June 1994

The National Agricultural Research Project's Contributions to Significant Advances in Egyptian Agriculture

Report of a 1994 USAID-sponsored mission to evaluate the National Agricultural Research Project in Egypt

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Preface

In early 1994, Tropical Research and Development, Gainesville, Florida, was asked by USAID Egypt to organize and provide logistical support for a team of U.S. specialists to go to Egypt and assess the National Agricultural Research Project (NARP). The assessment team was involved in the task from March 15 to April 25. The team members and their Egyptian counterparts are listed at the end of this preface.

Much of the effort of the team involved work with officials of the Ministry of Agriculture and Land Reform, with leaders of the NARP program and the Agricultural Research Center, members of the staff of USAID/Cairo, and members of the CID team in Cairo. We also met with members of the Board of Directors of the Agricultural Research Center, private-sector leaders, research personnel at Sahka and at research locations near Alexandria, extension personnel in Ismailia and elsewhere, deans of the Egyptian university faculties of agriculture, former members of the USAID-sponsored teams involved in a special horticultural marketing study, the USDA agricultural counselor for Egypt, and others. We are very grateful for all of the assistance and input from these various individuals and groups.

We especially wish to acknowledge and express our gratitude to the following persons for their generous assistance and wise counsel during the review:

- Dr. Youssef Wally, Deputy Prime Minister, Agriculture and Land Reform
- Professor Dr. Adel El-Beltagy, Director General of NARP
- Mr. David Delgado, Director-Office of Agriculture, USAID Egypt
- Dr. Mohamed El-Beltagy, Director of the Technology Transfer Component of NARP, and his staff
- Members of our counterpart team
- Dr. Fenton Sands, Mr. Blair Cooper, and other members of the USAID/Cairo staff
- Dr. Lowell Lewis and members of the CID team in Cairo
- The staff of Tropical Research and Development

The assessment team also wishes to express its gratitude for the opportunity to review a truly exciting USAID-supported project, which is enjoying remarkable success in contributing to substantial improvements in Egyptian agriculture.

U.S. Members of Assessment Team

Dr. Donald Plucknett—former Science Advisor for the CGIAR System, located in the World Bank. Former Professor of Agronomy/Soil at the University of Hawaii. Formerly with AID/Washington in the Development Support Bureau. Has extensive experience with IARCs.

Dr. Jim Ross—formerly with Foreign Agricultural Service in USDA; assignment included services as agricultural counselor to Egypt, 1978–81, and to FAO in 1984–87. Former assistant dean for extension, University of Florida. Currently adjunct professor in Food and Resource Economics at the University of Florida.

Dr. Harold Youngberg—for 29 years served as professor and extension seed specialist with Oregon State University. In recent years has held a number of international assignments in Yugoslavia, China, India, and two years in Bangladesh.

Dr. E.T. York, Jr.—Chancellor Emeritus of the State University System of Florida. Former vice-president for agriculture at University of Florida. Served as member and chairman of the Board for International Food and Agricultural Development, USAID, 1980–86. Member of the Technical Advisory Committee of CGIAR System, 1982–88. Currently distinguished service professor, University of Florida. Team leader for the NARP evaluation.

Ms. Leticia Solaún—Project coordinator for Tropical Research and Development, an international consulting firm in Gainesville, Florida, which is contracting with USAID for the NARP evaluation.

Egyptian Counterpart Team

Dr. Abdrabboh A. Ismail—Deputy director of Field Crops Research Institute. Coordinator of the National Maize Program.

Dr. Mohsen A. El-Guindy—Deputy director of Plant Protection Research Institute.

Dr. Abd El-Wahab Allam—Director of Sugar Crops Research Institute

Dr. Mohamed Abd El-Salam—Deputy Director of Cotton Research Institute

Professor Dr. Fawzi El-Shaarawy—Former Vice-President and Dean of Faculty of Agriculture of Ain-Shams University. Member of ARC Board of Directors.

Acronyms

ADS	Agricultural Development Systems
AEnRI	Agricultural Engineering Research Institute
AERDRI	Agricultural Extension and Rural Development Research Institute
AERI	Agricultural Economics Research Institute
AGERI	Agricultural Genetic Engineering Research Institute
AHRI	Animal Health Research Institute
APAC	Agricultural Policy Analysis Component
APCP	Agricultural Production Credit Project
APRI	Animal Production Research Institute
ARC	Agricultural Research Center
ARRI	Animal Reproduction Research Institute
ASRT	Academy of Scientific Research and Technology
CAAES	Central Administration for Agricultural Extension Service
CAPL	Central Agricultural Pesticides Laboratory
CASC	Central Administration for Seed Certification
CGIAR	Consultative Group for International Agriculture
CID	Consortium for International Development
CLAC	Central Laboratory for Aquaculture
CLAES	Central Laboratory for Agricultural Expert Systems
CLDSA	Central Laboratory for Design and Statistical Analysis
CLFF	Central Laboratory for Food and Feed
CRI	Cotton Research Institute
DG	Director General for NARP
DIS	Data Information
EEC	European Economic Community
EMCIP	Egyptian Major Cereals Improvement Project
ENAL	Egyptian National Agricultural Library
ENAL	Egyptian National Agricultural Library
FAO	Food and Agricultural Organization, United Nations
FCRI	Field Crop Research Institute
FRTI	Food Technology Research Institute
FTRI	Food Technology Research Institute
GOE	Government of Egypt
GTZ	Duetsche Gessellschaft fur Technische Zusammenarbeit
HRI	Horticultural Research Institute
IARC	International Agricultural Research Center
IG	Inspector General
IRI	Water Distribution and Irrigation Systems Research Institute
MALR	Ministry of Agriculture and Land Reclamation
MOA	Ministry of Agriculture
NARP	National Agricultural Research Project
NRC	National Research Center

PBDAC	Principal Bank of Development and Agricultural Credit
PEI	Production Efficiency Institute
PMADE	Presidental Mission on Agricultural Development in Egypt
PPaRI	Plant Pathology Research Institute
PPrRI	Plant Protection Research Institute
RSP	Research Support Program
SAAD	Strategies for Accelerating Agricultural Development
SRI	Sugar Research Institute
SWRI	Soils and Water Research Institute
TTC	Technology transfer component
TTS	Technology transfer specialist
TYLCV-E	Tomato yellow leaf curl virus
VSVRI	Veterinary Serum and Vaccine Research Institute
WRC	Water Research Center

Executive Summary

Egypt is in the midst of a dynamic agricultural transformation, highlighted by unprecedented yield gains and production of its major crops. For a country that has limited arable lands and water supplies and that already enjoys high crop yields, this is a tremendous accomplishment. This progress has resulted, primarily, from effective research programs and significant policy reform during the past 10- to 15-year period.

The case for research in Egypt is easy to make. Limited land, limited water, rapidly growing population, food needs outstripping production—these require continuing intensification of production on a limited natural resource base. Such intensification requires increasingly higher yields, greater input efficiencies, reduced negative environmental effects, a greater knowledge base, and superior management. But this picture, while daunting, is not all bleak, for the Egyptian farmer is one of the best in the world. Egyptian farmers know much about the land and the soil and water to be managed; they also possess an abundance of knowledge and experience concerning the art and craft of farming.

While the Egyptian farmer is exceptional in skills and acumen, to continue to be successful, each farmer also needs a continuous flow of new technologies. Only a productive, problem-solving research system can fulfill that need. We are convinced that Egypt is building an effective research system to help solve its agricultural and natural resource management problems, and that such a research system is essential to Egypt's future. The National Agricultural Research Project and its predecessor projects have played a key role in the changes and improvements that have taken place, and the work that the project has begun or stimulated will become even more valuable in the future. What is important now is to build on the base that has been established in order to ensure that Egyptian agricultural science can be vibrant and innovative in solving the great problems faced.

Yield growth in major Egyptian crops can only be described as phenomenal over the past decade. Productivity gains for many crops have been exceptionally great since the early 1980s. Moreover, since 1981 Egypt's agricultural performance far exceeds the average for the rest of the world in rate of gain in the indices of total agricultural production, agricultural production per capita, total food production, and food production per capita. It should be noted, as well, that with 31 of 32 major crops Egypt exceeded world average yields. With two crops, Egyptian yields were the highest in the world. For several other crops, Egypt ranked second or third in the world in average yield.

In the performance of animal-based agriculture, Egypt has not done as well as with crops—except, perhaps, with poultry. For example, Egypt's production of milk per cow equals only one-third of the world average.

Contributions of NARP and other USAID-supported efforts

Significant advances have been made in Egyptian agriculture since 1985 during the period of the NARP's existence. It cannot be said, however, that the National Agricultural Research Project was by any means totally responsible for such improvements. We believe these improvements can be attributed to three major factors (not in any priority order):

- *The major policy reforms implemented during the past 12 years under the dedicated and enlightened leadership of Deputy Prime Minister Youssef Wally.* Many of these reforms have removed significant disincentives that were holding back agricultural development, providing a policy atmosphere that is much more supportive of such development.

- *The improvement in agricultural research programs made possible, in part, by the USAID-sponsored projects in the late 1970s to mid-1980s.* These projects helped to provide the technology and demonstrated the capacity to increase agricultural output significantly. We would note that this significant progress would likely not have been realized in the absence of either the policy reforms or the improved research programs. Each was, in some respects, dependent on the other for its full impact to be realized.

- *Contributions by NARP, building on the foundation established by the earlier USAID-supported research projects, including a major policy project.* The NARP has not only built on that foundation but also has supported other research areas not covered by the earlier projects. The results of these efforts will likely be felt primarily in later years.

NARP has also supported extension and technology transfer activities that are vital to help the farmers apply the technologies generated through research. These programs are beginning to contribute to more rapid adoption of new technologies and the further strengthening of the agricultural sector.

Improvements in the seed industry in recent years—also a major objective of NARP—are beginning to contribute to the improvement of the agricultural sector.

The new initiatives component of the NARP has provided an excellent vehicle to address emerging problems or opportunities that could not be anticipated when the project was originally designed. The benefits of most of these efforts will be realized after the National Agricultural Research Project has been completed.

Some of the specific improvements growing out of these efforts are these: With 21 major crops there was a modest increase in the crop production index from 1980 to 1983 (1 percent annual increase)—but a substantially higher rate of 36 percent from 1983 to 1990, reflecting a 4.5 percent annual growth rate. These data indicate that improvements in crop production have not been limited to cereals only but significant improvement have been made in a broad spectrum of other crops as well. Such advances with the 21 crops are even more dramatic

when changes in the *current* or *nominal value* of these crops during this period are examined. These data indicate a growth rate in nominal values of these crops of some 19 percent annually since 1980— with growth much more rapid since 1984.

Such improvement in value reflect not only greater production but also significant improvements in prices of the commodities resulting from the major policy changes of the 1980s and early 1990s.

These rapid gains in current value since 1980 reflect inflationary price increases as well. However, there were also significant improvements in the *real value* of this production. In fact, in the period from 1980 to 1990 the real crop production value increased 89 percent with an annual growth rate of 6.6 percent. Such improvement in the real value of such improvements in production, we believe, have been reflected in significant advances in income to the farmer.

Perhaps the significance of these improvements is best reflected in the fact that wheat production increased more in Egypt since 1987 than in all of Egypt's history prior to that date.

But the greatest impact of the NARP, we believe, is yet to come. The National Agricultural Library is yet to be equipped and stocked. Laboratory equipment, vehicles, and many other commodities are ordered and are yet to arrive. Buildings and laboratories are still being renovated, and improvements continue to be made in upgrading the land and other infrastructure at the research centers.

Important improvements are being made through the technology transfer program in upgrading facilities for extension workers. At some nine locations, management information systems for use by extension are being installed through the technology transfer component.

Four regional research and extension councils have just been formed for the major regions of Egypt. When fully activated they should serve a very useful function in helping to coordinate more effectively the total research effort of the country and in focusing attention on continuing needs for research and extension as new problems emerge.

The extensive training program, which is still in progress, should continue to pay dividends for many years to come. Significant improvements have been made in the seed industry, which should contribute to further improvements in the agricultural sector.

Measuring capacity for effective research is very difficult and, at least, somewhat subjective. However, we have identified several indicators that we believe are important in assessing the development and effectiveness of a national agricultural research system. There is strong and unmistakable evidence that NARP is greatly enhancing Egypt's capacity to do excellent agricultural research. All of the capacity-building indicators discussed in our report point strongly to such enhancement—which should contribute to enhancing Egyptian agriculture well into the twenty-first century.

Closing the food security gap

In the report of the U.S. Presidential Mission on Agricultural Development in 1982, major attention was devoted to the "food gap" in Egypt.[1] The gap had been increasing since 1960 when Egypt was essentially self-sufficient in food. Food production increased at a steady but slow pace from 1960 to 1980. However, utilization of the 10 primary food products—wheat (and flour), maize, groundnuts, lentils, sugar, cooking oil, red meat, white meat, dairy products, and fish— was increasing at a much faster rate than production, especially from 1974 to 1980. If nothing had been done to modify these two trend lines, the food gap would have grown from approximately one million tons in 1960 to nine million tons in 1980 and 26 million tons in 2000 (see figure 5-5).

From 1980 to 1992, however, there was a sharp increase in production, primarily since 1985, with a distinct slowing down in the rate of increase in food utilization. These changes in the slopes of the two curves since 1980, when projected to the year 2000, show a potential food gap in 2000 of some 4.5 million tons. This gap is about 17 percent of the projected gap that would have occurred in 2000 based on extrapolations of the trends in 1980 (see figure 5-6).

Most of this narrowing of the gap has resulted from the sharp upturn in production since 1985. It is obvious, however, that the rate of utilization is beginning to slow down as well.

These changes were also reflected in wheat imports, which reached a maximum level of around 7.4 million tons in 1987 and dropped to around 5.3 million tons by 1993.

Data indicate that little progress has been made since 1980 in improving the self-sufficiency level in vegetable oil, fish, and red meat. This would suggest that there is significant need to produce more of these products for domestic consumption.

There is considerable evidence that technology is available to facilitate significantly higher crop yields than are currently realized. Despite this, perhaps Egypt should never be expected to fully close the food gap or to become totally self-sufficient. It would be desirable, however, for Egypt to become *self-reliant* or *economically self-sufficient* in food production. This would entail exporting sufficient products from agriculture to cover the costs of importing the agricultural commodities that were not produced domestically.

There would appear to be excellent opportunities for such exports, especially of higher-valued horticultural products. Several factors make this feasible: the nearness to large markets in Europe and the Gulf States; the ability to supply these markets during winter months when needs in Europe, especially, are greatest; unusually favorable weather conditions, including an almost totally frost-free climate; the ability to control water supplies; the absence of major,

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1. E.T. York, Jr., et al., "Strategies for Accelerating Agricultural Development," Report of the Presidential Mission on Agricultural Development in Egypt, USAID/Cairo, July 1982.

damaging storms, etc. In fact, Egypt has been likened to a large greenhouse in which environmental conditions, can, in large measure, be controlled.

Egypt has thus far developed only a modest export market for horticultural crops, and these markets are not stable. They fluctuate greatly from one year to the next. If Egyptian farmers are producing enough to supply the high levels of demand in some years, they are undoubtedly producing too much in other years when exports are significantly lower. We saw evidence of this in Ismailia in talking with several growers who said they had great difficulty some years in selling their strawberries and other crops for export.

Obviously, to be truly competitive in export markets, any country must consistently have available a high-quality product. This requires the development of a good system of grades and standards, handling procedures which do not damage the product needlessly, refrigeration facilities for storage and transportation, etc. To date, Egypt has done little in these areas. There is urgent need to take advantage of what would appear to be excellent opportunities in this area.

With the move toward privatization of agricultural operations, there is also a great need to develop effective storage and marketing procedures for commodities to meet domestic market needs. Officials point out that at harvest time, farmers flood the market with their product because they have no storage facilities and they need income as soon as possible. With farmers all over the country doing this at about the same time, prices drop precipitously. However, prices quickly come back up once the glut is gone.

We strongly recommend that steps be taken to improve and further develop both domestic and export markets for agricultural commodities to take better advantage of excellent production capacities.

Criticism of NARP and response thereto

NARP has received rather severe criticism from some sources, including a critical audit by the Regional Inspector General Cairo. This audit resulted in a prominent U.S. senator in 1989 criticizing the project and expressing serious concern about the effort. This episode, and perhaps other incidents, caused AID/Washington and USAID Egypt to focus much attention on NARP, leading to serious questioning of whether the project should even be continued. There was, in fact, a major reduction in AID funding and a total cancellation of important parts of NARP. About this time, serious questions were raised about the administrative management of the project.

In 1992, USAID reduced its authorization for NARP from $300 million to $205 million. A further reduction to $194 million has been proposed.

We were told by a senior USAID official that "many USAID and Government of Egypt actions, reactions, and responses that hindered the project can be traced back to the early negative history." There were also changes in leadership on both sides of the project (three USAID Mission directors, for example) as well as "changes in direction as natural responses to different leadership management styles and visions."

The assessment team feels that the problems and delays were apparently contributed to by both sides, and the burden of responsibility for these problems and delays does not reside with one party alone; both must share some of the burden.

We should add that the major items serving as the primary basis for the negative Inspector General's report in 1989 have apparently been addressed in a positive fashion. In response to management difficulties that apparently occurred in the early years of the project, a new leader of NARP was appointed in 1990, and apparently there have been no major management problems since.

While there have continued to be implementation delays and other less serious administrative difficulties, which are undoubtedly irritating and frustrating to both parties, *we believe minor difficulties should not be the source of undue concern and must be weighed against the overall outstanding accomplishments of the project.*

The other principal issue raised by the Inspector General—the failure of the Government of Egypt to provide its share of the National Agricultural Research Project funding—has also apparently been resolved. In fact, on March 17, 1993, the NARP director general reported to USAID that the total length-of-project contribution to NARP would exceed £E 240 million, an amount in excess of what the agreement called for.

We do not wish to dwell on this point because problems of this nature frequently occur with USAID-supported efforts in many developing countries. Given the magnitude of the project, it would have been unusual if there had *not* been administrative difficulties and delays in implementation. Poor management should certainly not be condoned. However, it would appear that when serious questions were raised, Minister Wally responded promptly and changed the leadership of the project. The new director general initiated major changes, including the establishment of an Executive Management Program.

Perhaps some of the earlier management difficulties grew out of the fact that the NARP administering unit was not established until some two years after initiation of the project. The Executive Office, which reports directly to the NARP's director general, has established an impressive MIS system, trained staff, and implemented an inventory system for all ot the project's units. Improved communications and reports from this system have helped NARP management and apparently have improved relationships with USAID.

We have also been quite impressed with the scope and content of the NARP program. Its various components and subcomponents, we believe, were very effectively and meaningfully formulated to address some of the major constraints and needs of the agricultural research systems in Egypt.

Future USAID support

The assessment team generally concurs that much of USAID's future support should be more sharply focused—although the broad-based support through NARP has been appropriate for existing circumstances. Indeed some continued broad-based support may be warranted to complete some aspects of the NARP program.

We are fully in accord with the Government of Egypt's Ministry of Agriculture's major strategic goals for the agricultural sector, namely, to optimize crop returns per unit of land and water, to enhance sustainability of resource patterns and protection of the environment, to bridge the food gap and achieve self-reliance in agriculture, and to expand foreign exchange earnings from agricultural exports.

Future USAID support in agriculture should be consistent with these strategic goals.

During the assessment team's visit to Egypt, we were asked a very pertinent question by a USAID official: "If Egypt is making all these advances in agricultural production, why is there need to continue support for further research-related activities in agriculture. Isn't this task now done so that we can move on to address other needs?" The simple answer to that question is that research to improve efficiency and productivity in agriculture is never done—never finished. As long as there are more human mouths to feed, there is continuing need for such research.

In fact, a significant amount of such research would be needed merely to accommodate the food needs of a stable human population. But neither Egyptian nor global population is stable. In fact, over 90 million additional people are added to the world's population annually, and Egypt's rate of population growth of some 2.3–2.5 percent is above the world average of 1.6 to 1.8 percent.

Such constantly growing need resulting from population growth demands increasing levels of research—especially in situations like those found in Egypt where yield levels are already high. When a country reaches a very high level on the crop yield curve, as Egypt has, each additional increment of production may become more difficult to achieve.

But Egypt, because of its very limited arable land and water resources, is probably more dependent on research to expand food production that any other country in the world. Moreover, the primary beneficiary of such research is the consumer, who is served by having not only an adequate supply of food, but also higher quality and less expensive food as well.

Therefore, the need for a high-quality, productive agricultural research program is *vital to a sound economy and a stable political future.* While much has been achieved through past support of agricultural research, much more effort is needed.

USAID projects have contributed immensely to improving the productivity of Egyptian agriculture for some fifteen years through their support of research, policy reform, and other programs. NARP, we believe, has been a vital part of that effort for the past eight to nine years. However, because of the significant delays in the implementation of the project, along with major reductions of USAID financial commitments, there is still much to be done.

Although USAID is considering a successor project to NARP, it is obvious that it would be impossible to have such a successor project in place by the time of the planned termination of the project. If a major part of the project is terminated September 30, 1994, as now planned, much of the NARP structure could, and possibly will, be dismantled and key personnel in NARP will move on to other things. We believe it would not be in either Egypt's or USAID's best interest for this to happen. There would be a tremendous loss of time, resources, and effectiveness of future effort if this were to happen.

The assessment team strongly recommends that NARP be continued intact until a USAID-successor project has been designed and can be ready for implementation, and that much if not all the support committed to NARP by USAID in 1988 but decommitted in 1992 now be restored. Some of these resources should, undoubtedly, be used for those purposes for which the funds were originally intended. We believe, however, that there should be some flexibility in the use of such funds at this time to address high-priority needs that have developed since these additional funds were originally committed. Frankly our team has had difficulty understanding why USAID's commitments were drastically cut in the first place, given NARP's obvious successes.

We also recommend that USAID and the Government of Egypt begin—immediately—to plan a successor project to NARP so it can be ready to be implemented as soon as NARP is finished. The task to which the project was committed in 1985 is by no means over. Indeed it may be no more than half done.

We make a number of observations and recommendations concerning future efforts of NARP (assuming the project is continued) along with the nature of the efforts to be covered by the project's successor project. They are as follows:

- Expand research collaboration both internationally and domestically;
- Research on New Lands;
- Research activities for maintaining a sustainable agriculture;
- Breeding to reduce need for pesticides;
- Development of cultivars more tolerant to environmental stresses;
- Research aimed at producing more per unit of land and water;
- Public policy and data analysis;

- Market research and development--for both export and domestic markets;
- Further improve research infrastructure;
- Build on the experience of the Technology Transfer Component and continue the improvement of extension;
- Restore cotton ginning capabilities for breeding work;
- Greater emphasis on research dealing with food animals;
- Greater effort on improvement of vegetable oil production;
- Continued support in genetic engineering and other areas of modern biotechnology research;
- Further development of the "Expert Systems" Program to be used by both extension and the private sector in technology transfer;
- Continued emphasis on human resource development;
- Consolidate and emphasize on-farm water management;
- Research to address long-term strategic goals;

Need for additional sources of support to complement Government of Egypt funding

The team firmly believes that while great progress has been made over the past fifteen years or so through USAID assistance, there is continuing need to develop strong and sustainable capacity to accommodate further support for agricultural research and related efforts. This is especially true until there can be developed means for assuring adequate financial support from local sources—Government of Egypt and otherwise.

At some point USAID support will likely be greatly reduced or cease. Hopefully that will not occur until a much strengthened research capacity is developed *and* until there is better assurance that there is adequate support to maintain the capacity of such enhanced programs.

The national research effort in agriculture will likely be primarily dependent on future Government of Egypt funding. *We firmly believe that agricultural research and related efforts should receive higher priority in such funding.* Given past experience, however, there is little assurance that this will be adequate to maintain a vigorous research program. Therefore, we suggest two possible approaches through which funds could be generated to complement Government of Egypt funding.

We recommend that consideration be given to the development of programs to generate research funds through farmer assessments or contributions. For example, a possible approach could be one in which each ton of fertilizer or feed purchased and/or each ton of product a farmer sells is assessed a very small percentage of the value, with the funds so generated being put into a special fund—to be used *only* for supporting *research-related activities.* The amount of the assessment would likely be no greater than one-tenth of one percent per ton—although different rates could be established for different items.

A "Piasters-for-Pounds" program or something similar could be effective, with farmers realizing that they are investing very modestly in programs that will pay them great dividends in terms of enhanced incomes resulting from the application of research results.

In addition to direct funding for current programs, we recommend that while the United States is committing large sums of money to Egypt, consideration be given to using some of these funds to establish an endowment, the proceeds from which could be used to provide continuing support for research-related activities.

Funds put into the endowment could either be in the form of U.S. dollars from ESF commitments or from local currency generated through Public Law 480, Section 416, or other U.S. programs. Funds from these sources could be put into a "special," nongovernmental foundation annually for several years through which an endowment could build up sufficiently to help assure that the progress made through current U.S. assistance could be sustained. The foundation into which such funds would be placed could be governed by a joint Egyptian-U.S. board, if desirable.

The U.S. government provides at least $815 million annually to Government of Egypt in economic support funding as the result of a program that grew out of the Camp David Accord in the late 1970s. It was primarily these funds that were used to support the research programs discussed in this report. The continuing question is "how can these funds be used most effectively?"

A very strong case can be developed for putting significant amounts of these funds into the agricultural sector. Agriculture continues to be one of the three most important segments of the economy. Over half the Egyptian people are engaged in farming or agriculturally related business/ industry. Moreover, the agriculture sector has already enacted more reforms and has moved farther toward privatization than any other sector and is therefore better positioned to use U.S. assistance more productively than any other sector.

We believe that high priority should be given by the United States to supporting the agricultural sector. We further believe that, at this juncture, support for functions and needs we have addressed herein should receive highest priority in terms of future U.S. support.

1.0. Agriculture in Egypt and the Impact of Changing Agricultural Policies

1.1. General conditions

A combination of fertile soil, a supply of currently abundant water, a mild climate, and industrious farmers make Egyptian agriculture one of the most productive in the world—despite the fact that only about 3 to 3.7 percent of Egypt's land is arable.

Moreover, the nation's agriculture is almost totally dependent upon irrigation. The only effective rainfall is found along the northern coastal area and amounts to only about 80 mm annually. Consequently, agricultural development is closely linked to the water resources of the Nile River. In fact, more than two millennia ago the Greek historian Herodotus visited Egypt and concluded that "Egypt is a gift of the Nile."[1] This was a reasonable assessment because life in Egypt would be essentially impossible without the water of the Nile.

Total agricultural land in Egypt is about 7.5 million feddans,[2] distributed as follows:

5,400,000	"Old Lands" in the Nile basin and Delta
1,900,000	New (reclaimed) lands
200,000	Rainfed areas and the oases (some references indicate 500,000 feddans in this category)

Soils in the Nile River and Delta are silt-clay mixtures of excellent quality, deposited during thousands of years of Nile flooding.

Total cropped area in 1990 was estimated to be some 12,143,000 feddans (5.1 million hectares) with a cropping intensity of 180 percent. Most of the newly reclaimed desert areas use modern irrigation such as drip and sprinkler systems.[3]

An estimated 3.5 million farmers cultivate holdings that average about 2 feddans. Approximately half the farms are less than 1.0 feddan. Production is intensive, and yields are some of the highest in the world.

The major crops are cotton, rice, and corn in the summer and wheat, berseem clover, and beans in the winter. Sugarcane is grown on about 15 percent of the cultivated land in Upper Egypt throughout the year. Citrus and vegetables are also important crops and are produced in sufficient quantities to meet domestic demands and provide some surplus for export.[3] Considerable quantities of meat animals, poultry, and animal products are produced, primarily for domestic consumption; limited amounts are exported.

Perhaps the most impressive advances in the agricultural sector in recent years are reflected in the gains in cereal production. With total cereal production in 1981 of 8 million tons, output increased to 11 million tons in 1987, 14 million tons in 1991, and 15 million tons in 1992. These large increases are attributed to

- development and use of high-yielding varieties and other improved technology;
- liberalization of commodity prices;
- phase-out of mandatory planting requirements for cereals;
- privatization of newly reclaimed government owned and public-sector owned lands;
- development and use of new production practices (fertilizer, irrigation practices, planting dates, seeding rates, and weed control), and
- major production campaigns conducted by extension and other agencies.[3]

These increases in production have had a significant impact upon cereal imports and exports. For example, with increases in wheat production from 2.4 million tons in 1987 to 3.4 million tons in 1991, wheat imports declined from 6.6 million tons to 5.7 million tons during the same period.[3]

Rice production progressed from 2.4 million tons in 1987 to 3.4 million tons in 1991, facilitating increases in rice exports from 70,000 tons to 200,000 tons in the same period.[3] Increased productivity contributed significantly to these increases in total production during this four-year period when yields of rice went up 28.8 percent, wheat 19.5 percent, barley 30.7 percent, maize 27.5 percent, and sorghum 27.4 percent.[5]

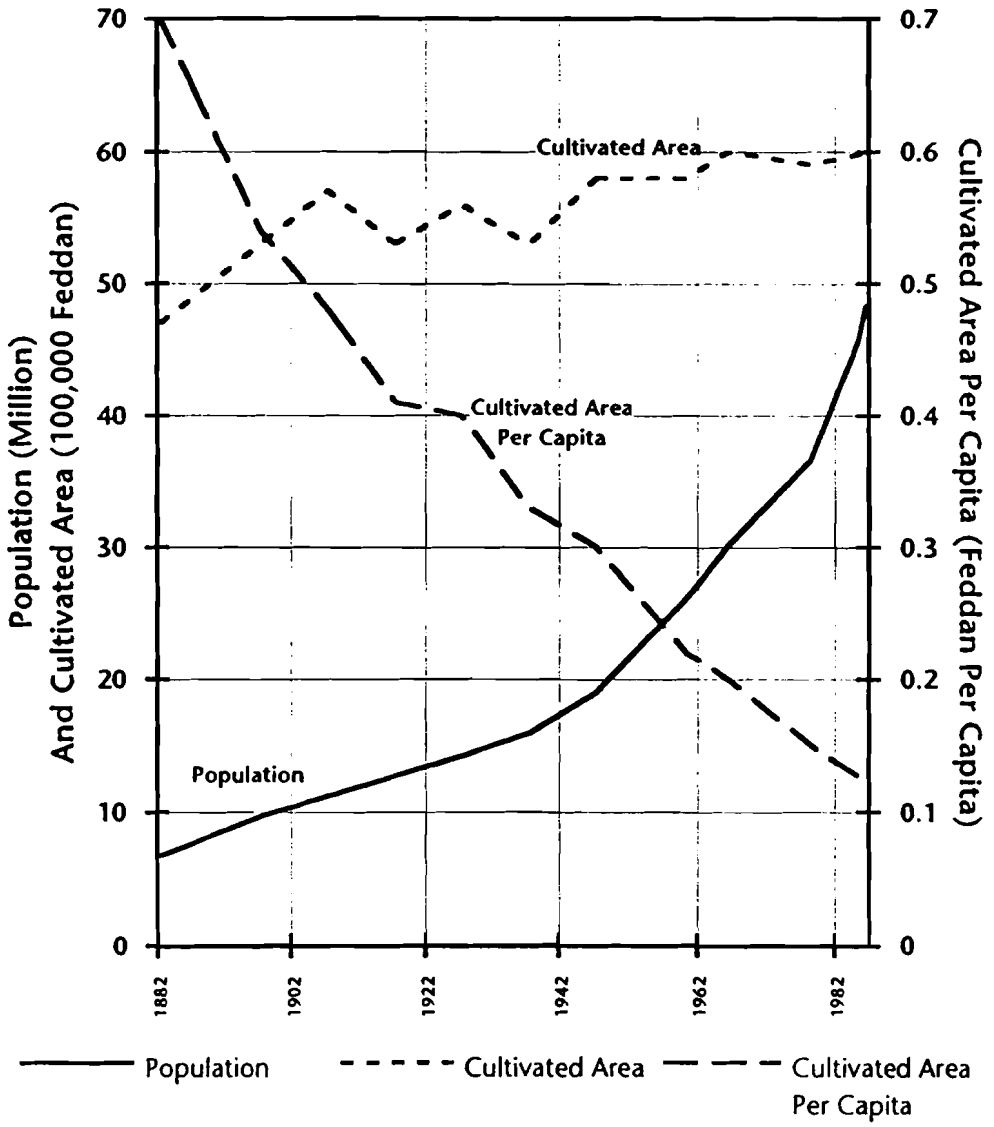
USDA/Cairo estimates that 1992 agricultural output was about 5 percent above the 1991 level. The production of rice, wheat, and citrus was estimated to be at record levels, and cotton and maize output was also strong. Yields of the 1993 wheat crop are thought to have been even more impressive than those in 1992.[4]

"The major progress in cereal production indicates the Egyptian farmers are responding rationally to agricultural reforms and advanced technology. However, the food gap will widen dramatically in the next decades—assuming that current trends in production and consumption persist—unless major changes in both the economy and the agricultural sector are effected."[3]

Perhaps the greatest factor influencing the demand for agricultural products is the continued high rate of population growth, which is now estimated to be around 2.4–2.5 percent. In 1970, population growth rate was 2.0 percent, rising to about 3.0 percent in 1980. Such a rapid rate of population growth along with limited expansion in arable land has resulted in a dramatic reduction in the amount of arable land per capita (see figure 1-1). In fact, Egypt has the lowest area of arable land per capita in Africa and one of the lowest of any country in the world.

The relative share of the Egyptian economy represented by agriculture has declined over time —not because of a diminution in importance of agriculture but because of the rapid growth in other sectors. Still, agriculture accounts for about 36 percent of employment and for some 20 percent of the gross domestic product.

Figure 1.1. Total population, arable land, and cultivated area per capita, Egypt: 1882–1986



MIS The M.I.S. Unit - NARP Executive Office

Source: Agricultural Economic Bulletin, Various Volumes

1.2. Evolution of government policies affecting agriculture

To understand better the current policy environment in agriculture, it is helpful to consider briefly the evolution of governmental policies affecting agriculture over the past 40 years. These policies have had a major impact on the performance of the agricultural sector during this period.

Dr. Ahmed Goueli, governor of Ismailia, has provided an excellent summary of the changes occurring during this period in the paper entitled "Egyptian Agricultural Policy and Challenges for the 1990s."[6] The following information is, in part, from his paper.

Dr. Goueli divides this 40-year period into five phases:

1.2.1. "Nationalism" (1952–61)

The Land Reform Law of 1952 was the first major intervention of government into agriculture. The law imposed a ceiling on ownership of agricultural land, with distribution of excess land to the landless. It also gave farm tenants rights of inheritance which, in effect, gave tenants quasi-ownership. Agricultural rent was established at a level seven times the tax rate on the land. Furthermore, the land subject to the law was organized into cooperatives known as "land reform cooperatives" and was administrated by village and district offices and a central agency. Many of these regulations and institutions are still in existence.

During this period, both domestic and foreign trade in cotton was nationalized and brought under control of the government. This system of agricultural cooperatives was expanded to include "new reform" land.

The government program for land reclamation began in this phase with about 78,000 feddans being reclaimed. The land reclamation policy was based on small-farmer ownership of the reclaimed land.

1.2.2. "Socialism" (1961–74)

Between 1961 and 1974, agricultural policy changed dramatically, reaching the ultimate in governmental intervention and control. A policy of low agricultural prices was adopted to transfer the surplus of the agricultural sector to the urban and industrial sectors. Public agencies were contracted to run agricultural activities—from the farm gate to domestic consumption and exports. Land reclamation and cultivation of new lands was organized around state farms. The Aswan New High Dam was constructed. With the additional water resources, a large land reclamation program was implemented involving some 500,000 feddans.

The rate of growth in agricultural production was high, reaching almost 4 percent annually due to the transformation of basin irrigation land to permanent irrigation and the shifting of the growing season for maize and rice.

The late 1960s and early 1970s saw a stagnation of public investment in the economy in general and agriculture in particular.

1.2.3. "Open Door" (1974–82)

After the Sixth of October War in 1973, Egypt adopted an open-door policy to attract foreign investment. In agriculture, slogans such as "food security" and "green revolution" emerged. The private sector was allowed, in a very unorganized fashion, to reclaim desert land for agricultural use or speculation. With large amounts of workers' remittance from foreign employment, urban encroachment on agricultural land expanded greatly.

The same price policies as in 1960s for agricultural commodities continued to prevail. Due to these policies and a low rate of government investment in the agricultural sector, the high rate of growth in the agricultural sector that prevailed in the 1960s was not sustained.

The most important institutional change was the creation of a village-based system (1972), which took over all the functions of the village credit cooperatives. There was also a huge expansion in "food security" loans to farmers at highly subsidized rates, which was responsible for a large expansion in the poultry industry. Poultry and livestock feeds were subsidized, which further stimulated the expansion in the production of animal products.

"The only positive change that occurred during this period" was the beginning of foreign aid in agricultural research and technology transfer, particularly by USAID.[6]

1.2.4. Revitalization (1982–90)

In earlier years, the food gap (the gap between domestic production and consumption) had widened significantly. This was highlighted in the 1982 Presidential Mission report.[7]

In 1960, for example, Egypt was almost self-sufficient in wheat production. By 1980, the country was importing about three-fourths of its wheat needs. This alarming gap—due in part to a stagnant agriculture in the 1970s and early 1980s—resulted in increased attention being devoted to agriculture.

In fact, within two months after President Mubarek assumed the presidency in 1981, he visited Washington, D.C., and asked U.S. President Reagan for assistance in efforts to revitalize the agricultural sector. A part of the U.S. response to this request was to send to Egypt in early 1982 a high-level "Presidential Mission on Agricultural Development" to comprised of experts in agricultural research, extension, administration, production, policy, irrigation, etc., to analyze the problems constraining the development of the agricultural sector and recommend actions to overcome these constraints and accelerate development.

In its report entitled "Strategies for Accelerating Agricultural Development" (SAAD), the Presidential Mission addressed many policy issues. For example, the report emphasized that

governmental policies were acting to seriously constrain the growth of Egypt's agricultural sector and recommended that the Government of Egypt "permit agricultural output and input prices to move toward world price levels." The report emphasized that "correcting distortions in relative prices received and paid by farmers is central to using resources in the agricultural sector more efficiently and reducing Egypt's growing dependence on imported food."

Many governmental policies and other factors constraining agricultural development were recognized by Dr. Youssef Wally and associates in an excellent report entitled *Strategies for Agricultural Development in the 1980s for the Arab Republic of Egypt,* published in June 1983. This document proposed various strategies for addressing the constraints.[8] In fact, when the Presidential Mission's report was presented to Minister of Agriculture Dr. Wally, he indicated that he was firmly committed to modifying a wide range of government policies constraining agricultural development but that these modifications would have to be made in a gradual, stepwise fashion.

Another related policy problem of the early 1980s highlighted in the Presidential Mission's report was the heavy subsidy for bread prices. In 1980, a loaf of balady bread sold for one piaster—a price that had not been increased in many years despite high inflation rates. In real terms, prices paid by consumers for bread declined significantly from 1965–87, causing bread subsidy costs to approach $1 billion annually, representing more than half the total food subsidy in some years.[9] Even with the low fixed prices paid to the farmer for wheat, the government was still spending enormous sums to subsidize the cost of bread. This situation was encouraging to the government's efforts to keep the prices paid to the farmer for wheat low.

Dr. Wally was appointed minister of agriculture a few weeks before the Presidential Mission arrived in early 1982. He worked very closely with the Presidential Mission and began immediately to take steps to address the problems that it identified. In late 1982, the price of bread was increased 100 percent to 2 piasters, and the size of the loaf was simultaneously reduced almost 8 percent. There was another slight reduction in loaf size in 1986. Then in 1989 the price of balady bread was raised to 5 piasters, and the size of the loaf was reduced another 18 percent.[9] Better quality breads are priced at even higher levels. These adjustments resulted in significant reductions in the Government of Egypt's expenditure for bread subsidies and made it easier to raise the prices paid to farmers for wheat.

In 1986, major economic policy reforms were initiated to address problems that were limiting the development of the agriculture sector.[10] They included the following actions:

- government controls on commodity prices received by farmers and procurement quotas on all crops except cotton and sugarcane were removed;
- farm gate prices of sugarcane and cotton were increased;
- farm input subsidies were removed;
- government constraints on private-sector importing, exporting, and distribution of farm inputs were removed, allowing the private sector to compete with the Principal Bank of Development and Agricultural Credit (PBDAC);

- government constraints were removed to allow the private sector to import and export agricultural crops;

- the PBDAC was gradually limited in its role to providing financial services;

- limitations on state ownership of land were imposed and the sale of new lands to the private sector was facilitated;

- the role of the Ministry of Agriculture was proposed to be limited to agricultural research, extension, and legislative policies, along with a program to facilitate the development and implementation of economic policies;

- adjustments were made in the land tenancy system;

- interest rates were adjusted to reflect commercial rates;

- foreign exchange rates were adjusted to reflect the real value of local currency.

In summary, the economic reform program initiated by the minister of agriculture had these objectives: removing restrictions and distortions from the agricultural sector; encouraging the private sector; improving agricultural terms of trade; encouraging farmers to use modern technology; increasing cultivatible areas, productivity, and farm income; improving the standard of living for farmers while providing food for citizens at reasonable prices; and increasing exports and raising the share of the agricultural sector in the social and economic development of the country.

In the areas of land reclamation, the private sector was encouraged and a new program for graduates of technical high schools and universities were encouraged to own and manage small areas of reclaimed lands. The policy of the government was to develop these new lands, with the private sector being responsible for its utilization.

By the end of the 1980s, productivity of major crops, including wheat, maize, rice, fruits, and vegetables increased substantially over the levels of the 1970s. This was attributed to two major factors: (1) the major policy reforms involving the removal of controls on commodity prices and mandated production of certain crops, and (2) major improvements in the development and application of improved agricultural technology, including high-yielding varieties.[5]

1.2.5. Economic reform

In 1991, the Government of Egypt began to implement an aggressive and comprehensive economic reform program around the theme of further liberalization and structural adjustment. In agriculture, the process of liberalization and privatization that began under Minister Wally's leadership in the early 1980s, has resulted in agriculture today being the most privatized sector in the Egyptian economy: 97 percent of agricultural lands are now in the private sector.

Economic reforms have impacted agriculture in the following areas:

- interest rates rose from a subsidized level of 6 percent to a market rate of some 20 percent (now around 12 percent);

- there is now active participation of the private sector in trade and distribution of agricultural imports, especially fertilizer;

- state managed production enterprises have been transferred to a system of holding companies while they await privatization;

- state marketing systems have been privatized for all crops except cotton;

- the amount and scope of agricultural subsidies have been limited.

1.3. Impact of policy changes

These numerous policy changes since 1980 and further anticipated adjustments should greatly impact the agricultural and rural sectors of the nation, both economically and socially. They are already having a very positive effect on agricultural output and income—an impact that could be significantly accelerated when the entire sector adjusts more fully to the policy changes. A continuing flow of improved agricultural technology will be essential for the agricultural sector to take full advantage of these significant policy reforms.

The impacts of these policy changes were considered in some detail in the IFPRI-sponsored symposium held in Cairo in November 1993.[10]

1.4. The food production gap in Egypt

The 1982 U.S. Presidential Mission on Agricultural Development in Egypt (PMADE) focused major attention on the rapidly widening food gap in Egypt—for example, the spread between the amount of food produced and consumed.[7]

In 1980, this gap was increasing at an alarming rate (figure 5-5), and the Presidential Mission recommended a number of specific actions to deal with the problem. Specifically, recommendations were made for significant policy reform (as discussed above, §1.2.4). It was believed that such reform could have an impact on the problem by (1) making conditions more favorable for enhanced food production, and (2) slowing down the rate of increase in demand for food. It was pointed out that cheap food, made possible by extensive government subsidies, was in part responsible for increasing per capita food utilization by contributing to excessive waste. For example, farmers often found it desirable to buy cheap, heavily subsidized bread and feed it to their chickens and livestock. Some farmers, moveover, were feeding their own government controlled and underpriced wheat to livestock and buying subsidized bread for their own consumption. Both actions were resulting in increasing demand for imported wheat.

Furthermore, the Presidential Missing recognized the need for the establishment of effective programs of family planning to reduce the rate of population growth—the primary means of reducing the rate of increase in demand for food.

The Presidential Mission also emphasized a number of actions needed to increase food production—above and beyond recommended policy changes. Major emphasis was placed upon the need for strengthened research and extension programs aimed at increasing agricultural output. The NARP program was established as a means of responding to this recognized need for enhanced production.

1.5. Current strategic goals for the agricultural sector, 1994

Currently, the Government of Egypt has the following major strategic goals for the agricultural sector:

- optimize crop returns per unit of land and water consumed;
- enhance sustainability of resource use patterns and protection of the environment;
- bridge the food gap and achieve self-reliance in agriculture;
- expand foreign exchange earnings from agricultural exports.[2]

In 1993, a World Bank mission team suggested that the underlying drive for Egyptian agricultural strategy should be the momentum already created by the reforms initiated by the Ministry of Agriculture and Land Reclamation for the agricultural sector and by the comprehensive economic reform program adopted by the Governmnent of Egypt. "This would need to be complemented by strong national population policies aimed at reducing the overall rate of population growth."[11]

The World Bank mission team suggested that a process of change had been initiated over the last few years "which needs to be fostered and reinforced through a combination of policy and institutional reforms—the principal ones include the following:

- "need for measures aimed at ensuring efficiency and environmental sustainability in the management of the most important natural resources of the country, i.e. water and arable land;
- "emphasis on using free market considerations, in particular the promotion of the private sector, in resource allocations;
- "the need for implementing an agriculture sector strategy within the context of overall rural development, which should encompass within it better involvement of rural women in the development process, diversification of rural activities, and provision of essential

social programs for health and education;

- "recognition of the social and political issues, and the need for social safety nets to assist in absorbing some of the potential dislocations which will inevitably accrue through the implementation of the comprehensive reform program; and

- "initiating a program of institutional reforms, so as to streamline the array of institutions presently serving the agriculture sector, and make them more responsive to its needs."[11]

Those strategic goals will have a major impact on the nature of future research efforts.

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2.0. Agricultural Research and Extension in Egypt

To put the NARP program in better historical perspective, a brief account of the evolution of agricultural research and extension in Egypt should be helpful.

2.1. Research

Agricultural research in Egypt began in the late nineteenth century—about the same time as it did in the United States. An excellent account of its beginning and evolution is found in the introduction to the publication "Highlights of ARC Activities, 1980–1990."[1]

> Egypt initiated agricultural research on a modest scale at Giza, as early as 1897 in what was known as the Royal Agricultural Society. Experimental sites were established at Giza (1900), Meet El-Deeba in North Delta (1901), and Bahteem (15 kilometers from Cairo) in 1909. Simultaneously, several research branches and sections were organized in 1903 to carry out research in plant breeding, animal breeding, entomology, agricultural chemistry, and seed production. A veterinary pathology laboratory was established the following year to produce vaccine for poultry cholera and perform related diagnostic activities.
>
> In 1910, the Egyptian Government, convinced of the importance and benefit of research in agriculture, issued the Decree No. 34 to establish the Department of Agriculture under the Ministry of Public Works to perform the following duties: agricultural research, seed production, extension in crop production with emphasis on cotton, soil and fertilizer analysis, and pest control.
>
> Only three years later, a separate Ministry of Agriculture (MOA) was established. During the following decades, several decrees were issued to further organize the Ministry of Agriculture in the years 1944, 1949, 1950, 1957, and 1958. The Agricultural Production Sector was established within the Ministry of Agriculture in 1963. It included the Departments of Agriculture, Horticulture, Plant Protection, Soils, Animal Production, Veterinary Laboratories and Seed Production. In 1971, Presidential Decree No. 2425 was issued establishing the General Authority for Agricultural Research. This unified all research functions within the MOA under one administration.
>
> The Agricultural Research Center (ARC) was formulated as a semi-autonomous organization with the Minister of Agriculture as chairman of the board. More recently, the ARC has undergone extensive reorganization resulting directly from Presidential Decree No. 19 of 1983. This decree established the ARC as a scientific research and extension institution and gave it broad general authority for agricultural research and extension activities in Egypt. Earlier, Decree No. 483 (1982) gave the ARC responsibility for the production farms, known as state farms which were under the General Authority for Agricultural Production. These have since been amalgamated into the ARC. A total land area of 27,000 acres is devoted to foundation seed production for field crops.
>
> After the promulgation of Presidential Decree No. 19 of 1983 authorizing the Agricultural Research Center, it became more qualified to play the major role in realizing the technological advances needed for agricultural development in Egypt. Accordingly, the ARC assumed a two-fold mission:

(a) Generate a flow of research results to formulate appropriate agricultural technology needed to ensure the continuous development of agricultural production.

(b) Ensure the transfer and extension of such technology, as far as possible, among farmers, to achieve higher yields and better income and follow up the economic effects of those new technologies and devise solutions to perceived problems of application.

The ARC is governed by a Board of Directors chaired by the Minister of Agriculture and consists of the Director of ARC, who is responsible for the day-to-day operations and the supervision of technical, financial, and administrative matters; the two deputies, one for Research, and one for Extension; the fifteen research Institute Directors; a representative of the Academy of Scientific Research and Technology, five consultants versed in agriculture and selected by the Minister of Agriculture, and a representative from the MPWWR. The main functions of the ARC Board are to organize, plan, coordinate, promote and review agricultural research and policy; to utilize the results of research; to identify problems and develop closely coordinated research programs; to plan and develop extensions programs; to administer agricultural research stations; to publish or otherwise disseminate research results and agricultural information; and to foster relations with national and foreign scientific institutions. The Board may establish subject matter committees to review research projects and report on matters that may be referred to them.

The objective of the ARC is to enable Egypt to become self reliant in food, assure food security and achieve economic growth for her people. This is being accomplished by improving the technologies and services available to Egyptian agriculture through research and extension.[1]

2.1.1. The Agricultural Research Center

Today the Agricultural Research Center has 16 institutes and 5 central laboratories. A brief description of the functions along with information concerning numbers of professional personnel in each unit is found in Annex §2.1.1.

Although Presidential Decree 19 of 1983 gave the Agricultural Research Center broad general authority for both research and extension, the center continues to be primarily concerned with research. Extension responsibilities in ARC will be discussed in greater detail in the this report in §2.1.2.

As a result of the Camp David Accord between Egypt and Israel in the late 1970s, the United States greatly increased its support of the Government of Egypt, facilitating the initiation of major development assistance projects in agriculture. Work was especially focused on research programs to improve the production of cereals (maize, wheat, sorghum, and rice) through the EMCIP and Rice Projects, as well as tomatoes and other horticultural crops through the Agricultural Development Systems—Egypt (ADS) project. Special attention was focused, as well, on agricultural policy through the ADS project and through other programs. And there were major projects on mechanization.

Many of these projects were very effective, particularly in strengthening the research capabilities within the Agricultural Research Center, developing improved technology, and improving the policy environment.

The 1982 report of the U.S. Presidential Mission documented the dramatic yield increases made possible through improved technologies. For example, in large-scale demonstrations, by using the best varieties and applying other improved technologies, the following average yield increases above national average yields were obtained: rice, 54 percent; wheat, 65 percent; maize, 74 percent; sorghum, 63 percent; and tomatoes, 252 percent.[2]

Those USAID-supported research efforts not only resulted in the development of improved technologies, but the related demonstrations also dramatically illustrated that the available technologies could provide the basis for significantly improving the production of many of Egypt's most important crops.

While the Presidential Mission was impressed by the impact of these USAID-supported research projects, concern was expressed over the fact that they were functioning somewhat apart from the institutes within the Agricultural Research Center having responsibility for these commodities. The Presidential Mission, therefore, recommended that these projects "be institutionalized as a part of the revitalized research and extension programs."

USAID responded to this recommendation by beginning a major new initiative in support of research and extension in Egypt—as a successor project to the individual commodity projects discussed above. To assist in the planning of such an effort, USAID commissioned another, smaller team, including the leader and some other members of the Presidential Mission, to provide such assistance. This effort resulted in a 1984 report entitled "Increasing Egyptian Agricultural Production through Strengthened Agricultural Research and Extension Programs."[3]

This report includes a wide range of recommendations, many of which were to be addressed in a single, comprehensive, successor project to the individual commodity projects of the late 1970s and early 1980s (EMCIP, Rice, and ADS). The successor program became the National Agricultural Research Project (NARP), which was agreed to by USAID and the Government of Egypt in 1985. (NARP will be considered in detail in §3.0 of this report.)

2.1.2. Other organizations doing agricultural research

Although the principal agricultural research organization in Egypt is the Agricultural Research Center, 14 universities in Egypt have agriculture faculties (colleges of agriculture), each engaged in some research activities. Some of the larger, older universities such as those in Cairo and Alexandria have major agricultural research programs. A description of each is found in Annex §2.2.

Agricultural research is also conducted by the National Research Center (NRC) (Annex §2.1.2), an arm of the Academy of Scientific Research and Technology (Annex §2.1). Moreover, water-related agricultural research is conducted in the Water Research Center, which was in the Ministry of Irrigation. Irrigation responsibilities are now found in the Ministry of Public Works and Water Resources (in Annex §2.4). A Desert Research Center was until recently in the Ministry of Land Reclamation. With the merging of the Land

Reclamation and the Agriculture Ministries, the Desert Research Center is now in the Ministry of Agriculture and Land Reclamation but is not directly affiliated with the ARC. American University of Cairo has a Desert Development Center, which has engaged in some research dealing with desert-related ecological issues.

2.2. Extension

2.2.1. Evolution of extension in Egypt

A history of the evolution of extension in Egypt has been prepared within the technology transfer (TT) component of the National Agricultural Research Project. The following brief summary has been extracted from this document.[4]

Extension activities, as such, have a much more recent history in Egypt than those of research. The extension system was introduced as a formal service of the Ministry of Agriculture in 1953. This was apparently the result of FAO efforts directed to all Arab countries in 1952.

Extension work was formally launched in November 1953 as a Ministry of Agriculture service and organized as a part of the Cultural Agricultural Association. It functioned as a part of such a structure until 1958. At that time, the extension function was transferred to the General Administration for Regional Services in the Ministry of Agriculture with three major sections: extension programs, agriculture units and demonstration fields, and teaching methods.

In the 1963–64 period, extension was reorganized with some modification of its internal structure. In the 1964–69 period, there was further reorganization internally and extension units were added at the governorate and district levels.

In 1968, Ministerial Decree No. 251 was issued to establish a High Extension Council made up of representatives from universities, "high" agricultural institutes, cooperative associations, research divisions of MOA, the Rural Services Division of MOA, two agricultural directors at the governorate level, along with the Extension director general, his deputy, and his program planning director. The Council was chaired by the undersecretary of the Ministry of Agriculture for Extension.

The primary responsibilities of the Council involved reviewing extension programs, supporting linkages between extension, agricultural universities and rural associations, and proposing solutions for production constraints. In 1968, another ministerial decree was issued to reorganize the Extension program so that it would be directly under the Ministry of Agriculture undersecretary and include the following units: extension programs, teaching methods, agriculture and demonstration fields, rural development and extension research.

In 1976, Ministerial Decree 3409 was issued to assign an extension director to each governorate, plus one extension inspector for each two districts. At the district level, one

extension inspector and one extension specialist were assigned for each ten villages. For the first time a village extension worker (VEW) was assigned to each village, with counsel and guidance from an advisory group of 8 to 12 local leaders.

In 1979, Ministerial Decree 151 was issued to broaden the scope of activities, providing for sections dealing with production of agricultural crops, production of agricultural animals, extension teaching methods, mechanization, foreign projects, and extension programs.

As a result of recommendations of the 1982 Presidential Mission,[2] Ministerial Decree 744 was issued to transfer the Central Administration for Agricultural Extension Service (CAAES) from the Ministry of Agriculture to the Agricultural Research Center with responsibility for (1) "applied extension" and (2) "specialized" extension. To implement the new structure, Ministerial Decree 149 was issued in 1983 to organize ARC under three deputy directors, one each for research, extension, and production.

Ministerial Decree 211 was also issued in 1983 to organize the extension in ARC into three major components:

- general extension to include training program development and monitoring;
- specialized extension to include technical information for plant and animal production, along with mass media and audio/visual functions;
- extension research.

Ministerial Decree 845 was issued in 1988 to establish the Central Administration for Agricultural Extension Services (CAAES)—with three components: extension administration at the Central Level, the Delta, and the Upper Egypt region.[4]

2.2.1.1. Recommendations regarding extension by earlier USAID-sponsored missions

It should be noted that three earlier USAID-supported evaluation missions in the early 1980s specifically addressed agricultural extension programs, making a number of recommendations for reform. The first of these missions, in November 1981, produced a report entitled "Increasing Agricultural Production in Egypt through More Effective Use of Technology."[5] This report included a series of recommendations, some of which are summarized as follows:

- That the agricultural research and extension functions be brought together and placed under the leadership of a single administrator charged with the responsibility for developing strong linkages between these two highly complementary functions.
- That major emphasis be placed on its development of a corps of well-trained (subject matter) specialists.
- That the agricultural colleges be better integrated into a national system of agricultural

research and extension. [These] colleges are significant resources and we recommend that their efforts be coordinated with MOA research and extension programs.

- That there be a major, continuing training program to upgrade the capabilities of extension workers.

- That extension personnel be relieved of regulatory and service functions which detract from their educational missions.

- That foreign donors, including USAID, be encouraged to give major emphasis to strengthening research and extension institutions so that they might become more effective and, ultimately, self-sustaining—rather than focus on a number of small projects which may have impacts of short duration but not contribute to the long-term improvement of basic institutions.

A few months following the 1981 evaluation mission, the Presidential Mission completed its efforts and made a number of recommendations that supported and reinforced the earlier work.[2] Following are excerpts from the Presidential Mission's report.

- "Egypt's future in agriculture depends on a continuing stream of improved technology. Because the relatively high levels of productivity already achieved, the technological constraints on Egyptian agriculture are greater and more sophisticated that those operating in most other developing countries. Indeed, because of its unique circumstances, Egypt is perhaps more dependent on improved agricultural technology than any other country in the world."

- "It is obvious that there is much available but unused technology in Egypt which could readily be applied by Egyptian farmers. This emphasizes the need for strong and effective extension programs."

President Mubarek's Decree No. 19 of 1983 called for extension to be integrated with research in ARC as was recommended in the 1981 report.

The 1984 evaluation mission dealing with research and extension[3] made a number of very specific recommendations supporting and augmenting those of the two earlier efforts. Some of these are summarized as follows:

- Building on the incorporation of extension into ARC through the President's Decree, the 1984 evaluation mission recommended that there be one deputy director of ARC for each of the three major functions: research, extension, and production. Shortly afterwards, this recommendation was implemented.

- It was recognized that Presidential Decree No. 19 provides the basis for a strong corps of extension leaders and subject matter specialists. The 1984 evaluation mission suggested that "in view of the large number of research personnel now in ARC and the virtual absence of program leaders and subject matter specialists in extension, we believe

it is most appropriate for a significant portion of the current research personnel to reorient their efforts toward extension, as the Presidential Decree mandates ... women specialists, who can work closely with women (extension personnel), are needed, particularly, in fields which relate to tasks involving important inputs by women. Specifically, they include livestock, poultry, beekeeping, sericulture, postharvest technologies and marketing, human nutrition, household and farm management."

- The 1984 evaluation mission recommended that priority be given to training and upgrading the support of the large number of currently employed agents before large numbers of additional agents are employed.

- The 1984 evaluation mission provided detailed recommendations for major production campaigns, throughout the country, which would be heavily dependent on effective leadership by extension.

2.2.1.2. Implementation of recommendations concerning extension

In §2.1.1 it was pointed out that in 1984–85 USAID began to plan and implement a major new project that would consolidate the work of several of the earlier projects and address many of the recommendations for strengthening research and extension made by the three earlier missions.[2,3,5]

The NARP assessment team understands that the original plan was to incorporate all of this in a National Agricultural Project. However, a newly appointed USAID Mission director was apparently strongly opposed to supporting any extension activity—despite the strong recommendations of the three earlier missions, recommendations that were in large measure accepted by both USAID personnel at the time and by Government of Egypt leaders. Because of this opposition, any work with extension was eliminated from the new project, which became the National Agricultural Research Project (NARP).

It should be recognized, however, that after this USAID Mission director left, the need for such efforts was recognized and a technology transfer component was added to NARP.

2.3. Regional Research and Extension Councils

Ministerial Decrees Nos. 1523/1993 and 148/1994 authorized the establishment of Research/ Extension Councils for the following four regions:

- *Delta,* with responsibility for six governorates: Damietta, Dakahlia, Kafr El-Shiekh, Gharbia, Menoufia, and Qualiobia;

- *West Delta and North Coast,* with responsibility for three governorates: Alexandria, Behairah, and Marsa Matrouh;

- *Middle and Upper Egypt,* with responsibility for nine governorates: Giza, Fayoum, Beni Sueif, Menia, Assuit, Sohag, Qena, Aswan, and the New Valley;

- *East Delta and Sinai,* with responsibility for six governorates: Ismailia, Sharkia, Suez, Port Said, North Sinai, and South Sinai.

The goal of these councils is to help strengthen linkages between researchers in the academic community (universities), researchers in established research centers, extensionists, the private sector, and allied resources in other ministries.

The councils have the following officers:

- *Chairman:* the chairman of Board of Directors, ARC (by delegation)

- *Vice Chairman:* the deputy director for research, ARC

- *Vice Chairman:* the deputy director for extension and training, ARC

- *Coordinator:* the director of the Core Regional Research/Extension Station.

Each council includes the following members:

- Deans of agricultural faculties in the region

- Directors of regional research/extension stations

- Three directors of specific research stations (Field Crops, Animal Production, and Horticulture)

- Chancellors of regional NRCs

- Directors of agricultural sectors and undersecretaries in the governorates

- Chairman of the Principal Bank for Development Agricultural Credit in the core governorate

- Two from the Extension Directorate in the governorate (periodically replaced)

- Director of Seed Directorate in the core governorate

- Director of Veterinary Affairs in the core governorate

- Director of Irrigation and Drainage in the core governorate

- Two representatives from the private sector

- Two farmers as representatives from the region

The Councils are expected to perform the following functions: (a) to discuss constraints of agricultural production and suggest solutions, (b) to discuss and approve research and extension programs, (c) to coordinate and integrate programs needed by different universities and research centers, (d) to suggest ways to support research and extension program, and (e) follow up and evaluate research and extension activities.

The four Regional Councils are funded by NARP until September 30, 1994, but their activities are being continued through the use of Ministry of Agriculture and Land Reclamation special funds.

Although the Councils have not been functioning long enough to measure their effectiveness, they could, when they are fully functional, serve a very useful purpose in terms of addressing problems constraining agricultural development in the four regions and exploring ways in which research and extension organizations can most effectively address these problems.

We applaud the concept of these Regional Councils but suggest that consideration be given to expanding their private-sector/farmer representation. Ultimately, consideration might be given to having appropriate private-sector commodity representation on the Councils.

2.4. References

1. "Highlights of ARC Activities, 1980–1990." The Agricultural Research Center of the Egyptian Ministry of Agriculture. Giza, Egypt.

2. York, E.T., et al. "Strategies for Accelerating Agricultural Development." Report of the Presidential Mission on Agricultural Development in Egypt. USAID/Cairo. July 1982.

3. York, E.T., et al. "Increasing Egyptian Agricultural Production through Strengthened Research and Extension Programs." USAID/Cairo. 1984.

4. Sileem, Fouad. Paper prepared for the 1994 assessment team on major decrees affecting Egypt's Extension Service. Technology Transfer Component, NARP. 1994.

5. York, E.T., et al. "Increasing Agricultural Production in Egypt through More Effective Use of Technology." USAID/Cairo. 1981.

3.0. The National Agricultural Research Project (NARP)

3.1. NARP original plans and subsequent changes

The USAID Mission Director signed the Project authorization document for NARP July 30, 1985. The stated purpose of the project was to develop the capability of the Egyptian agricultural community to provide farmers a continuous flow of improved and appropriate agricultural technology. It was further stated that this purpose would be achieved by focusing USAID and Government of Egypt resources on improved management and on strengthening priority research areas. It was proposed that USAID assistance in the form of training, technical assistance, commodities, construction, and support services would assist the Government of Egypt under a host-country contract in accomplishing the Project's purpose.[1]

The Project was intended to unify under one cohesive unit the bulk of research activities begun with USAID's original investment in agricultural research in the late 1970s. In fact, NARP was intended to absorb these earlier projects (EMCIP, Rice, ADS, Mechanization, and other ongoing research-related projects). It was pointed out that this initial USAID support worked with discrete sections in the ARC but did not focus on its overall institutions or management.

The NARP Project was intended to focus on improved research management while also integrating ongoing research activities—very much in accordance with recommendations made by USAID-sponsored missions in 1982[2] and 1984.[3]

Specifically, the Project called for:

- extensive training, both in-country and abroad, to upgrade the technical skills of Agriculture Research Center and Ministry of Agriculture staff;
- strengthening of data collection and analysis capabilities to facilitate improved policy decisions;
- long-term technical assistance, focused on improving the management and coordination of research—as well as short-term specialists to provide expertise for the upgrading of specific priority research activities;
- support for construction and commodity procurement to improve the physical plant for research;
- establishment and stocking of a national agricultural library;
- research grants to provide support and further coordinate activities among the different organizations doing agricultural research in Egypt, such as universities, NRC, etc.;

- efforts to develop further and privatize the seed industry;

- establishment of a National Agricultural Council to ensure coordination and determine priorities of the national agricultural research effort (it was noted that research would focus on these priority activities to generate technologies appropriate to farmers, and it was further suggested that technologies generated by the Project would be transferred to farmers through "on farm demonstrations, media, and person-to-person word of mouth").[1]

The Project authorization document called for a commitment of $130 million over a five-year period from the date of authorization—with an initial obligation of $30 million (USAID Section 3.1). The planned life of the Project was to be seven years from the date of initial obligation.

Although the original Project authorization document did not specify monetary contribution to the Project by the Government of Egypt, the original grant agreement called for a life-of-project contribution from the Government of Egypt of £E 66.5 million (based on a $US to £E conversion rate of 0.83168 to 1)—with £E 10 million to be obligated the first year. The terms set forth in the original Project authorization document called for the U.S. contribution to be in the form of a grant.

The original Project authorization document did call for the GOE to make available sufficient resources after the termination of the Project to support the research and information dissemination activities supported by the Project.

The First Amendment to the Project grant agreement was made September 21, 1986, by changing the USAID Section 3.1 obligation from $30 million to $45 million and the Government of Egypt obligation from £E 10 to £E 20 million including "costs borne on an in-kind basis."

The Second Amendment to the grant agreement was signed June 15, 1988, increasing the USAID Section 3.1 obligation from $45 million to $60 million and the Government of Egypt obligation from £E 20 million to £E 25 million.

The First Amendment of the document was signed August 22, 1988, indicating a planned U.S. authorization for the project of $300 million over an eight-year period from the date of the original authorization.

On September 29, 1988, the Third Amendment to the grant agreement was signed to expand the Project significantly from one component, research, to four additional components technology transfer, policy analysis, seed technology, and new initiatives. Furthermore, the research component was expanded to add funding for land improvement, international collaborative research, and maintenance activities. Earlier figures for U.S. commitments to the Project were changed from a life-of-project amount of $130 million to $300 million and the Government of Egypt contribution from £E 66.5 million to £E 219 million—the equivalent of

$75 million after devaluation of the Egyptian pound. The U.S. obligation under Section 3.1 was changed from $60 to $100 million.

The Fourth Amendment to the grant agreement, signed September 30, 1991, changed the USAID Section 3.1 obligation from $100 million to $142 million.

The Fifth Amendment to the grant agreement, signed May 19, 1992, changed the USAID Section 3.1 obligation from $142 million to $177 million.

The Sixth Amendment to the grant agreement, signed June 30, 1992, called for decreasing the U.S. authorization for the Project from $300 million to $205 million. The Section 3.1 obligation was changed from $177 million to $194 million.

A Project Paper amendment was signed on May 20, 1993, keeping the U.S. authorization at $205 million and the Government of Egypt contribution at £E 219 million. It was indicated that the research component will be scaled back from a broad institutional and budget support activity for Agriculture Research Council to a component that "focuses on substantive research priority topics." The Collaborative Research Program was to be oriented toward a set of priorities that includes integrated pest management, genetic engineering, postharvest losses, aquaculture, animal production, animal health, agro-management techniques related to newly reclaimed lands, computer expert systems in agro-management, socioeconomic aspects of agriculture, food consumption patterns, remote sensing, and export oriented systems.

It was proposed that the research grant program would focus on 10 research priority projects, including biotechnology, recycling agricultural wastes, soil and water management and management of new lands, postharvest losses, aquaculture, appropriate technology in agricultural mechanization, animal production, animal health, agro-management techniques related to newly reclaimed lands, and socioeconomic aspects of agriculture.

It was proposed that the Research Support Program be narrowed to focus on five key research areas: fruits, vegetables, cereals, small animals, and postharvest handling. It was indicated that USAID would shift its support as much as possible to only the units engaged in research in these five areas.

Tables 3.1 and 3.2 indicate the financial status of NARP as of March 10, 1994.

3.2. Other U.S.-funded programs in support of Egyptian agricultural research

Before discussing the specifics of the NARP program, it is well to recall some of the earlier U.S.-supported efforts, primarily by USAID, to help improve Egyptian agricultural research capabilities and productivity. In fact, it is apparent that these earlier collaborative efforts were beginning to have a positive influence on agricultural production before NARP was initiated. At the same time, it is also readily apparent that NARP has been able to build on these earlier efforts and to accelerate the movement toward an improved Egyptian agricultural sector that was becoming evident in the early to mid-1980s.

Table 3.1. NARP financial status—detail summary (March 10, 1994)

Budget Elements	AUTHORIZED TOTAL	Projection OBLIGATED	EARMARKED	COMMITTED	EXPENDED.	PIPELINE
Technical Assistance						
C.I.D.	0	21,389,000	20,800,000	20,800,000	16,670,322	4,718,678
SCI	0	2,500,000	2,031,272	2,031,272	2,031,272	468,728
Completed Activities	0	1,807,281	1,828,342	1,828,342	1,826,936	-19,655
PSC	0	80,000	80,000	80,000	67,257	12,743
USDA - PASA	0	2,093,985	1,943,985	1,928,093	1,928,093	165,892
Chemonics	0	2,688,733	2,593,713	2,593,713	2,046,785	641,948
SUB-TOTAL	31,084	30,558,999	29,277,312	29,261,420	24,570,665	5,988,334
Training						
SDSUF	0	16,983,088	17,625,738	17,625,738	16,447,718	535,370
MSU	0	500,519	500,519	500,519	389,526	110,993
In-Country	0	10,246,637	9,529,336	9,524,131	8,411,846	1,834,791
PIO/P's	0	2,015,794	2,027,565	2,032,770	2,032,770	-16,976
SUB-TOTAL	32,828	29,746,038	29,683,158	29,683,158	27,281,860	2,464,178
Commodities						
Off Equipment	0	0	0	0	0	0
Vehicles-Motor cycle	0	8,322,877	716,526	716,526	716,526	7,606,351
Motorcycles	0	0	0	0	0	0
Media	0	386,000	386,000	384,190	289,552	96,448
Library	0	462,498	462,498	462,498	462,498	0
Local Procurement	0	2,401,371	2,483,876	2,483,876	1,494,727	906,644
Farm	0	2,371,053	2,371,053	2,371,053	2,371,053	0
Lab	0	3,507,297	3,507,297	3,507,297	3,507,297	0
PSA	0	21,175,223	21,221,752	6,514,225	0	21,175,223
Cotton Gin	0	2,343,449	0	0	0	2,343,449
Davy Mckee Contract	0	3,922,233	3,922,233	3,922,233	3,269,611	652,622
SUB-TOTAL	44,953	44,892,001	35,071,235	20,361,898	12,111,264	32,780,737
Services						
Component Office	0	9,102,807	8,792,074	8,792,074	6,408,017	2,694,790
PSA	0	1,385,000	2,779,800	1,385,000	1,357,558	27,442
Renovation	0	6,982,968	6,689,529	6,689,529	4,771,938	2,211,030
Land Improvement	0	1,818,000	1,817,532	1,817,532	269,591	1,548,409
IRRI	0	4,000,000	4,000,000	4,000,000	3,256,828	743,172
ICARDA & CIMMYT	0	2,900,000	2,109,459	2,109,459	1,478,334	1,421,666
Research Suport Prog.	0	12,132,000	12,117,581	12,117,581	11,760,886	371,114
Research Grants Prog.	0	10,200,000	7,442,235	7,477,835	7,102,038	3,097,962
TT Grants	0	0	0	0	0	0
Collaborative Research	0	6,500,000	6,210,839	6,175,239	4,823,889	1,676,111
Demonstrations	0	0	0	0	0	0
USDA PASA	0	15,158,558	15,158,908	15,120,367	8,954,437	6,204,121
New Initiatives	0	16,641,000	15,069,448	13,857,866	7,118,337	9,522,663
Audit/Assmt.	0	414,670	214,670	0	0	414,670
Completed Activities	0	1,567,960	1,076,868	1,076,868	1,076,868	491,092
SUB-TOTAL	89,565	88,802,963	83,478,943	80,619,350	58,378,721	30,424,242
Contingency	6,570					
TOTAL	205,000	194,000,001	177,510,648	159,925,826	122,342,510	71,657,491

Table 3.2. NARP financial status—summary, life of project, obligations, earmarked, commitments (March 10, 1994)

SUMMARY — As of 10 March, 1994

Budget Elements	LOP	OBLIGATED	EARMARKED	COMMITTED	EXPENDITURES	PIPELINE
Technical Assistance	31,084	30,558,999	29,277,312	29,261,420	24,570,665	5,988,334
Training	32,828	29,746,038	29,683,158	29,683,158	27,281,860	2,464,178
Commodities	44,953	44,892,001	35,071,235	20,361,898	12,111,264	32,780,737
Services	89,565	88,802,963	83,478,943	80,619,350	58,378,721	30,424,242
Contingency	6,570	0	0	0	0	0
TOTAL	205,000	194,000,001	177,510,648	159,925,826	122,342,510	71,657,491

LIFE OF PROJECT (Per Grant Agreement)

Budget Elements	EO & NI	POLICY	SEED	TT	RESEARCH	AUTHORIZED TOTAL
Technical Assistance	3,638	5,525	2,496	4,500	14,925	31,084
Training	57	382	2,098	7,700	22,591	32,828
Commodities	560	261	11,521	6,100	26,511	44,953
Services	19,845	1,962	1,385	5,400	60,973	89,565
Contingency						6,570
TOTAL	24,100	8,130	17,500	23,700	125,000	205,000

OBLIGATIONS

Budget Elements	EO & NI	POLICY	SEED	TT	RESEARCH	TOTAL
Technical Assistance	3,637,999	5,525,000	2,496,000	4,500,000	14,400,000	30,558,999
Training	57,038	382,000	2,098,000	7,700,000	19,509,000	29,746,038
Commodities	560,000	261,000	11,521,000	6,100,000	26,450,001	44,892,001
Services	19,744,963	1,962,000	1,385,000	5,400,000	60,311,000	88,802,963
Contingency						
TOTAL	24,000,000	8,130,000	17,500,000	23,700,000	120,670,001	194,000,001

EARMARKED

Budget Elements	EO & NI	POLICY	SEED	TT	RESEARCH	TOTAL
Technical Assistance	3,019,271	5,451,499	2,172,249	4,234,293	14,400,000	29,277,312
Training	57,039	371,249	2,098,000	7,648,870	19,508,000	29,683,158
Commodities	539,375	223,506	9,177,551	2,946,529	22,184,274	35,071,235
Services	18,488,118	1,375,580	1,385,000	5,400,000	56,830,245	83,478,943
Contingency						
TOTAL	22,103,803	7,421,834	14,832,800	20,229,692	112,922,519	177,510,648

COMMITMENTS

Budget Elements	EO & NI	POLICY	SEED	TT	RESEARCH	TOTAL
Technical Assistance	3,019,271	5,435,607	2,172,249	4,234,293	14,400,000	29,261,420
Training	57,039	371,249	2,098,000	7,648,870	19,508,000	29,683,158
Commodities	539,375	223,506	8,983,652	2,835,806	7,779,559	20,361,898
Services	17,061,866	1,374,262	1,385,000	5,362,778	55,435,444	80,619,350
Contingency						
TOTAL	20,677,551	7,404,624	14,638,901	20,081,747	97,123,003	159,925,826

Certainly U.S. support for these earlier efforts was significant, but it is abundantly clear that the improvements would not have occurred without the dedicated work of talented Egyptian scientists and other professionals plus the industriousness of millions of skilled Egyptian farmers and their families. Following is a brief summary of some of these earlier, pre-NARP efforts.

3.2.1. International agricultural research centers

For many years USAID was the single largest contributor to the international agricultural research centers through the Consultative Group on International Agricultural Research. This support was crucial to the development and growth in effectiveness of the international agricultural research centers in helping developing countries to improve their agriculture through more effective agricultural research. USAID perhaps has not always appreciated the importance of its support and intellectual leadership in the development of this unique set of institutions and the global agricultural research system that emerged as a result of their existence and contributions.

The international agricultural research centers hold major global collections of germ plasm for the benefit of the world, provide training in research and its management, collaborate with developing countries to solve pressing international problems, provide publications and communications on many topics, and conduct strategic and applied research addressing a wide range of international problems and constraints facing agricultural production and development. Egypt has benefited greatly from the continuing contribution of the international agricultural research centers, especially IRRI, International Maize and Wheat Improvement Center (CIMMYT), and ICARDA.

3.2.2. Public Law 480 research projects

Considerable agricultural research was carried out in Egypt with support from funds generated under the U.S. Public Law 480 programs. Most of this research was carried out by Egyptian researchers with the support and collaboration of scientists from USDA/ARS. We were told that Public Law 480 projects created the concept of the team approach to solving problems. The value of this collaboration is still appreciated by Egyptian scientists, many of them staff members of Egyptian universities. Such support was more common in the 1970s and 1980s. Today there are limited Public Law 480–generated funds for such support.

3.2.3. The Rice Improvement Program

Many significant advances were made in rice research through the Rice Improvement Program. For example, some excellent modern laboratories and other facilities were con-

structed under this program at Sakha Research Center, where the Egyptian Rice Research and Training Center is located. Today Egypt is well equipped and well placed to conduct modern rice research. The benefits to Egypt have been dramatic in that average yields are fast approaching eight tons per hectare. While many individuals and institutions contributed to the success of the rice project, IRRI has played an important role in this effort. With support from USAID, IRRI has had a long involvement in collaborative research in Egypt. The direct posting of IRRI staff in Egypt is scheduled to end in June, 1994. The relationship with IRRI has been productive and effective, providing Egypt with a wide array of rice germ plasm from the Global Rice Genetic Resources Center at IRRI and other rice research programs. New high-yielding, robust, varietal materials have been developed as a result of this collaboration.

3.2.4. The Agricultural Development Systems—Egypt Project, 1979–83

The Agricultural Development Systems—Egypt project (ADS), with funding from USAID, was aimed at "improving the performance of the agricultural sector in Egypt" by concentrating on "research and training as a means of introducing and developing new technologies relevant to Egypt's needs, and ... on improving the research capacity of the Ministry of Agricultural and universities."[1] The project focused on two areas: horticulture and agricultural economics. In agricultural economics the emphasis was on policy research; in horticulture it focused on improving research capability, introducing and developing new technology for important crops, and introducing improved germ plasm of important crops. ADS was a collaborative effort between Egyptian and American scientists. The program was guided by a Joint Policy and Planning Board comprised of Egyptians and Americans and each research project was under joint leadership and joint scientific staffing.

Capacity building was enhanced through collaborative research activities between Egyptian and American scientists. Through this mechanism Egyptian scientists improved their capacity to plan, conduct, and extend horticultural research and technology. Success in productivity or crop improvement was gained in tomatoes, garlic, cucurbits (enhanced resistance to fungal and viral diseases), citrus (rootstocks, limiting factors, introducing new germ plasm), deciduous fruits (introduction of new cultivars), and mango (overcoming inflorescence malformation disorder). Horticultural research in Egypt was enhanced by this effort, and recent yield gains in horticultural crops appear to have resulted in part because of this concentrated collaborative research.

In policy analysis, the emphasis was to "improve the ability of the Ministry of Agriculture to plan, implement, and evaluate programs to promote the development of the agricultural sector in Egypt." Six policy areas were emphasized in research: price policy, agricultural marketing and distribution, human capital and social institutions, food security policy, allocation of development resources, and land and water resource use.[4]

One of the products of the ADS project was a very interesting book by Alan Richards, entitled, *Egypt's Agricultural Development, 1800–1980,* which has proved very helpful in understanding agricultural development in this ancient and fascinating land.[5]

3.2.5. Egyptian Major Cereals Improvement Program

The Egyptian Major Cereals Improvement Program (EMCIP) began in 1979 to improve cereal production research in Egypt. Later, work on forages and grain legumes were added. The program emphasized close linkages between research and extension. It built a major headquarters and research facility at the Giza headquarters of the Agriculture Research Center, and four research and extension facilities at the Sakha, Shandaweel, Sids, and Gemmeiza research stations. Besides the laboratory and office facilities, buildings for mechanization, stores and extension, chemical fertilizer storage, seed storage, machinery sheds, seed cleaning plants, electrical distribution, and a pump were provided at each of the four research and extension stations. The research and extension stations are being used as the key sites for regional NARP technology transfer efforts. In the words of one Egyptian scientist, "EMCIP was a major factor in improving research stations in Egypt."

The program also helped to renovate and equip laboratories and other buildings and facilities to serve the needs of the research projects that it supported. Vehicles and equipment purchased by the program are still in service and comprise a considerable scientific support base for NARP.

For further information on the work of EMCIP and its contributions, see *Proceedings of the Second EMCIP Symposium.*[6]

3.3. Research component

The *goal* of NARP is "to increase agricultural productivity by improving the quality of technologies available to farmers." The assessment team has taken as its responsibility the evaluation of both agricultural productivity and the building of capacity in Egyptian agricultural research as a result of NARP and its predecessor projects.

3.3.1. Agricultural Research Center (ARC) support and enhancement

The Agricultural Research Center is the main agency in Egypt having responsibility for agricultural research and development. The primary research entity supported by NARP, the Agriculture Research Center has operated since 1982–83 under three five-year research plans. It has 16 research institutes, six central laboratories, and 38 research stations located in selected agroecological zones representing various agricultural production conditions in the country. (Research institutes, central laboratories, and research stations are listed and described in Annex §§2.1.1, 2.1.2.)

Although not a formal part of the agricultural research system, the Faculties of Agriculture and Veterinary Medicine in the Egyptian universities and the National Research Center of the Ministry of Scientific Research and Technology also comprise a considerable body of scientific knowledge and capability for agricultural research in Egypt. Also, the Ministry of Public

Works and Water Resources has under its control a Water Resources Center that administers 11 research institutes. Egypt thus has considerable and various research capabilities in agriculture, but capabilities that still need better coordination, particularly more cooperation between ministries. (More complete descriptions of these other research entities are found in Annex §§2.2–2.5.)

Many of the Agriculture Research Center institutes and laboratories have done excellent work, including developing superior high-yielding cultivars of crops resistant to pests and diseases that have contributed materially to increased production. (Annex §3.3 lists new varities and hybrids developed by the Agriculture Research Center since the beginning of NARP.) New crops have been introduced, improved management and irrigation practices have been developed, soil and water practices have been developed and refined, fertilizer and pesticide use has increased, and now efforts are being made to reduce pesticide use through integrated pest management and other means.

In the Agriculture Research Center, research has the following objectives: identifying opportunities for sustained advances in agricultural productivity; developing improved farming systems for each crop and animal region; developing integrated pest management systems for crops; developing systems and technologies for the all-out modernization of Egyptian agriculture; encouraging the involvement of women in development and monitoring and testing advances elsewhere in the world that might help improve Egyptian agriculture.

NARP has helped to organize research in the ARC into the following 18 multidisciplinary crop and disciplinary research programs:

- Fiber crops
- Cereals
- Vegetable oil crops
- Food legumes
- Forage crops
- Sugar crops
- Fruit crops
- Vegetable crops and other plants
- Fish
- Soils and water
- Agricultural mechanization
- Plant protection
- Food and feed technology
- Agricultural economics and statistical analyses
- Experimental systems
- Agricultural extension and rural development
- Genetic engineering
- Animal production

Crops research gives special emphasis to (1) breeding improved varieties having higher yield potential, early maturity, and host plant resistance to pests and diseases and (2) improved production management. Animal production research (including fish) aims at improving production through genetic improvement, animal husbandry, and veterinary research. The work of the disciplinary programs is, primarily, aimed at supporting the work of crop research. Priority of the genetic engineering program is given to such areas as wheat tolerance to salinity, resistance to virus diseases in potato, cotton resistance to bollworms, and various work on cucurbits, maize, and tomatoes.

3.3.1.1. Research support activities and their impact

The research component of NARP has included a number of activities, the objectives of which have been to enhance the capabilities and capacities of agricultural research institutions in Egypt. These efforts have been focused primarily on the Agriculture Research Center but have gone far beyond ARC in helping to strengthen other research entities.

- There have been extensive training programs, both in country and abroad, to upgrade the knowledge and skill of research personnel (primarily those in ARC).

- Long-term technical assistance, through CID and other sources, has been helpful in improving the management and coordination of research.

- Short-term technical assistance has been effective in providing expertise for addressing special problems or upgrading specific research activities.

- Old research facilities have been renovated and new buildings have been constructed both at ARC headquarters in Cairo and at many of the research and extension centers throughout the country.

- The procurement of "commodities," including modern scientific equipment, farm machinery, etc., has been nearly competed and will contribute significantly to the improvement of research capacity and effectiveness.

- A very impressive National Agricultural Library has been constructed and is now in being stocked with books, periodicals, and other reference materials and equipped with the most modern systems for management and operations.

- Numerous research grants have been made to provide support and to coordinate activities among the different organizations doing agricultural research in Egypt, such as universities, NRC, etc.

- A cooperative research program has been developed to facilitate collaboration among Egyptian agricultural scientists and scientists in international agricultural research centers and U.S. universities, the U.S. Department of Agriculture, and other research institutions. Such collaboration has enabled Egypt to establish contact with and involve some of the top agricultural scientists in the world in working on problems of importance to Egypt.

- Significant land improvement efforts have been undertaken at the research stations, including tile drainage, land leveling, construction of waterways for more efficient use of irrigation water, etc.

- Farm mechanization research has focused on the development and improvement of farm machinery better suited to Egyptian farmers' needs.

The new initiatives component has provided the mechanism for quickly mobilizing research efforts to respond to serious problems such as the whitefly infestation of tomatoes and the screwworm threat—as well as to explore promising development opportunities. (Annex §3.3.2 includes a more complete description of these activities supported by NARP, which have contributed and are contributing to the objectives of the research component.)

3.3.1.2. Specific accomplishments in production through enhanced agricultural research

All institutions involved in agriculture-related research in Egypt have undoubtedly contributed to the progress in agricultural production in recent years reported in this document. The Agriculture Research Center, however, as the entity primarily responsible for agricultural research in Egypt, has been the focal point of the NARP effort and can be credited with a significant part of the success.

The following sections summarize some of the achievements with cereal crops in recent years. Though treated here as part of the research component of NARP, it is apparent that the other components of NARP, especially the technology transfer and seed improvement components, have contributed to these improvements. Universities and other institutions doing research in agriculture have also contributed to improved production, and major policy changes that have occurred during this period have resulted in some of the improvements. Little improvement would have been possible, however, had there not been significant advances in improved technology through research, primarily that carried out by the Agriculture Research Center.

Wheat. Egypt's wheat production has increased more in the past six to seven years than it did in the previous history of the country. New high-yielding varieties that respond to irrigation and fertilizers have triggered this rapid growth. Total wheat production more than doubled from 1986 to 1992 as a result of a 38 percent growth in yields and a dramatic increase in acreage (from 600,000 ha in 1987 to 900,000 ha in 1992). Increased production of wheat, a strategic food, represents a major development. The greater production allowed the country to cut its wheat imports from 7.2 million tons in 1987 to 5.7 million tons in 1993.

The new wheat varieties combine high yield with tolerance or resistance to important biotic and abiotic stresses. Wheat scientists have also benefited from effective linkages and collaboration with wheat scientists working elsewhere, including CIMMYT, ICARDA, the United States, and other countries. Such collaboration has provided a means to test promising genetic materials in national and international wheat research networks and nurseries for their adaptation to different agroecological and biotic stresses.

Wheat research is based on a multidisciplinary team approach. Thousands of new accessions have been introduced from CIMMYT and ICARDA. These are screened for adaptation to Egyptian conditions and to identify promising traits, such as yield and disease or insect resistance. Tolerance to heat stress is receiving considerable attention now, especially for

Upper Egypt and the new lands in the desert. During the period 1987–90, seven new lines were released, which have helped propel yields and production to new heights. These new lines are not only high yielding but also possess great yield stability.

The wheat program grew considerably as a result of research support provided by the EMCIP project. New research facilities, laboratories, greenhouses, field equipment, research station improvements, and effective linkages with U.S. universities, IARCs, and other scientific organizations, made possible by EMCIP, stimulated and improved Egyptian wheat research. The NARP, building as it did on the successful EMCIP effort, took that effort much further and accelerated it, with outstanding results. Increased wheat yields now being enjoyed are at least partly an outgrowth of earlier EMCIP research, but the benefits from that would likely not be as great if the NARP investment had not been made, thus allowing further improvements in the total wheat research effort.

We believe present NARP-supported research and development will be paying further large dividends by the year 2000 or before. At that time Egypt should be growing the new, long-spike wheats that are now being tested as advanced lines at Sakha and elsewhere. These new wheats promise to increase wheat yields even further, as much as 40 percent or more. Indeed, we consider the long-spike wheats to represent a new avenue for wheat yield improvement. This is an Egyptian innovation, using genetic materials from CIMMYT that produced many flowers per spikelet but had a high incidence of sterility. Egyptian breeders, through back-crossing, have obtained higher fertility and, therefore, more grains per spikelet. Since the spikes are longer, they produce more spikelets per spike, with consequently higher grain yields.

Rice. Rice is another of Egypt's great success stories. The Rice Research and Training Center at Sakha was established as part of the Field Crops Research Institute with strong support from the Ministry of Agriculture and Land Reclamation, USAID, and IRRI. Modern laboratory, greenhouse, glasshouse, growth chambers, seed handling and cleaning, and field research facilities were established prior to the initiation of NARP. The fine facilities and research support provided by USAID through the Rice Project have proved to be an important base for further research and development by NARP. Also, the relationship with IRRI in providing new germ plasm materials, research collaboration on important problems, and training of Egyptian scientists has been very productive. Egypt today has a modern and effective research capability in rice; with its modern laboratories and other research facilities, the nation is well placed to continue excellent multidisciplinary rice research.

Productivity growth in rice has been outstanding. Production has almost doubled since 1980, and yields have increased dramatically, beginning in 1988 from 5830 kg/ha in 1987 to 7710 kg/ha in 1993, an annual average increase of 313 kg/ha/yr, a phenomenal rate and certainly the highest rate of growth in yield for rice in the world for that period. By contrast, of the major producers, China, gained an average 125 kg/ha/yr over the past decade (1979–81 to 1989–91).

The rice program has had a number of signal achievements, including release and spread of

short stature, early maturing high-yielding varieties (e.g. Giza 181, Giza 175, Giza 176); better nutrient management for the crop; spread of chemical weed control from about 12 percent of the total rice area to about 60 percent in 1990; employment of integrated pest management, rice blast disease control using genetic resistance, and improved cultural practices. An effective National Rice Production Campaign has strengthened relationships between researchers, extension workers, and farmers. The National Rice Production Campaign helped identify production constraints and farmer problems and use feedback mechanisms to ensure their solution.

Potential rice yields have been shown in demonstration fields to be from 7.7 to 13.0 t/ha. The "yield gaps" so identified between potential and farmer yields were attributed to soil salinity and alkalinity, inappropriate water management, blast disease, inappropriate pest management, and postharvest losses.

Rice research has been a resounding success, but much remains to be done. Continuing intensification of production, cultivation of salt-affected soils and use of low-quality irrigation water, continuing need for host-plant resistance to major pests and diseases (especially blast disease), and the need for greater efficiency in use of inputs are just some of the problems for future research. Although some observers are concerned about the amount of water used in rice cultivation, we urge caution in applying the "water saved from reduced rice cultivation" argument: because rice can withstand saline soils and water better than most other crops, the opportunity costs for using lower quality water need to be examined thoroughly before major changes are made. Egyptian rice scientists have achieved much and can be justifiably proud, but much remains to be done. If all goes well in the next few years, Egypt should soon be harvesting its first-ever national average rice crop of eight tons per hectare.

Maize. Maize represents another success story for Egyptian agricultural research. Although breeding and selection in maize began in the 1920s, with some progress being made, Egyptian scientists consider a real breakthrough in genetic improvement came as a result of collaboration with the International Maize and Wheat Improvement Center, begun in 1966, the year CIMMYT was founded. This collaboration provided Egyptian scientists with maize germ plasm from the center of origin of the crop in Mexico and other maize growing countries. Several introduced populations appeared to be resistant to late wilt disease, an important disease in Egypt, have reasonable productivity, and were well adapted to local conditions. These materials were used to develop some high-yielding varieties.

Efforts to develop varieties and composites continued through the 1970s and into the 1980s. EMCIP further stimulated maize research, including provision of support for new research facilities at Giza and four other research centers, including Sakha.

In the early 1980s hybrid development was stepped up, and new hybrids began to be released for cultivation; Giza-202 in 1981 and Giza-204 and Giza 215 in 1984. These high-producing hybrids were widely accepted by farmers. In 1988 the first three-way cross hybrid, Giza-310, was released; a second 3-way cross, Giza-320, was released in 1989, along with three new single-cross hybrids, with good acceptance by farmers. In 1993 eleven new hybrids, seven

single crosses and four three-way crosses, were released. Of these 11 hybrids, 7 are yellow endosperm hybrids, a type desired for poultry feed. The new hybrids are high yielding, earlier maturing, shorter, and with lower ear placement.

Maize yields increased by more than 2 tons per hectare from 1981 (4.09 t/ha) to 1993 (6.33 t/ha). The average annual rate of yield growth from 1980–81 to 1992–93 was 181 kg/ha/yr, a very high rate of growth by any standard. But if we calculate the annual yield gain of the Egyptian maize crop from 1987–93, we find the average annual rate of gain was 262 kg/ha/yr higher than the average gain for the 1980s to 1990s period. The gains recorded since 1987 can only be described as remarkable.

And what of maize production during that period of explosive growth in yield? Production in 1987 was 3.62 million tons, while in 1992 production was 5.07 million tons, 40 percent higher than in 1987.

The research contribution to increased maize yields was new high-yielding varieties and hybrids with resistance to the major disease, late wilt, and with desirable agronomic traits, responsiveness to agronomic management to achieve high yields, and a massive extension campaign to help farmers become aquainted with the new technology.

Sorghum (grain). New sorghum germ plasm is made available by collaboration with the USAID-sponsored (CRSP) Sorghum-Millet Collaborative Research Program (INTSORMIL), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and other countries in the West Asia–North Africa Region. Some new varieties were developed from Egyptian landraces.

Hybrid sorghum development began in 1990 involving collaboration between the ARC, ICRISAT, INTSORMIL, the University of Nebraska, and Texas A&M University. Several new hybrids are being evaluated in field trials.

Sorghum technology is moved to farms through the cooperation of researchers, research station staff, and extension workers in conducting on-farm verification trials and demonstrations.

Sorghum yields have increased significantly since 1982, when yields were 4 t/ha, to 5.78 t/ha in 1992. Total production increased from 0.6 to 0.74 million tons despite a 12 percent decrease in total crop area. This is but one example of land-saving technology from increased yields. The goal of Egyptian scientists is to increase sorghum yields to 7.0 t/ha.

3.3.1.3. Research to reduce the level of pesticide use on cotton

Cooperation between U.S. universities and the ARC has been fruitful in many areas. The concept of sustainable agriculture and cleanliness of the environment are now emphasized in

every plan submitted for future work. An excellent example of the benefits of such cooperation was an effort to reduce the use of pesticides on cotton without seriously affecting yields.

An integrated pest management program was begun in cotton by collaboration between the ARC's Plant Protection Research Institute and American universities. Before integraped pest management was implemented in cotton, the crop consumed 90 percent of all pesticides used in the country. For four successive years, growers have applied integrated pest management practices: the development of cultural methods to control pests, adequate fertilization and plant nutrition, localized spraying, pesticide application based on economic thresholds, maximization of natural enemies of pests by not using pesticides during periods of their activity, use of environmentally friendly pesticides, resistance, management procedures, use of pheromone traps as control agents, weeding, and destroying stalks at the end of the season to prevent bollworms from overwintering.

This comprehensive integrated pest management program led to a significant reduction in pesticide use. Pesticide imports in 1988 amounted to 15.8 thousand tons; this decreased steadily over the next four years and in 1992 totaled 6.08 thousand tons. This is indeed a remarkable decrease. But what of yields and other factors?

Although the Government of Egypt had increased the price ceiling for cotton over the years, cotton plantings declined because the price increase was not enough to afford profitable production. During the 1970s, areas devoted to cotton ranged between 0.462 million to 0.672 million ha, while in the 1980s these areas decreased to a range of 0.504 to 0.378 million ha. In the 1990s cotton plantings further declined; in 1992 the area in cotton was 0.353 million ha.

In 1991 and 1992 the Government of Egypt price ceiling for cotton was increased sufficiently to provide a good profit margin. Consequently, farmers adopted willingly the IPM program, and, although the area planted to cotton in 1992 was the lowest in some two decades, yields significantly increased over the previous few years. Figures for 1992 and 1993 also show a steady increase in cotton yields.

3.3.1.4. Demonstrated research capacity to respond quickly to a serious problem (whitefly on tomatoes)

One of the tasks of our assessment team was to indicate how NARP may have contributed to an enhanced capacity to respond quickly to address serious problems in agriculture. An example of such capability was the manner in which NARP/ARC responded to a serious infestation of whitefly (*Bemisia tabaci*), which was devastating tomato production in the Fayoum and Ismailia Governorates. In fact, this infestation had a serious impact on the nation's total production of tomatoes. Teams of scientists and extension specialists were brought together to analyze the problem and to take appropriate action to address it. A program of integrated pest management was put into place with quick and dramatic results. (A more complete account of the effort is given in Annex §2.6.1.)

3.3.1.5. Other success through research

Many other examples could be given to demonstrate the contribution of research in recent years. We cite only a few:

- Egypt desperately needs to conserve land and water, so it is essential to practice land-saving and water-saving agriculture. For sugar crops, they have done this by introducing sugar beet as a substitute for sugarcane. Sugar beets occupy the land for only 6 or 7 months, compared to 12–18 months for sugarcane, hence saving land, and require only 8 to 9 irrigations per crop compared 30 irrigations or more for sugarcane. Sugar beet acreage is expanding, and over 100 tons of beet roots can be produced with sugar content of eighteen percent, the highest in the world.

- Development of a faba bean variety with resistance to broomrape (*Orobanche*), a devastating parasitic weed. The gene for broomrape resistance was discovered by Egyptian scientists from indigenous faba bean parents and has been made available to farmers as Giza 402.

- Resistance to chocolate spot disease of faba beans has been identified, and resistant materials have been crossed with high-yielding lines. Four new resistant varieties have been released to farmers.

- Agricultural engineers designed and released an all-crop Turkish-type thresher which operates on a dual-mode, making it satisfactory for threshing both wheat and rice. Manufacturers have adapted the design and are making the machine for sale in the Delta. Farmers have enthusiastically adopted the new design, and many are taking their old machines in to manufacturers for conversion.

- Mastitis in dairy cows is a serious problem. Over 40 percent of cows are infected. An interdisciplinary research team surveyed the problem, using the California Mastitis Test, taking cultures from infected animals, and identifying the bacterium involved. Medication was then prescribed, resulting in 2.6 kilos more milk per treated cow daily and higher gross farm income.

3.3.2. NARP collaborative research program

A research program established by NARP was designed to help support collaborative research between Egyptian and U.S. universities and research institutes. During the period 1988–94, 33 research projects were supported, involving 21 Egyptian and 30 U.S. institutions. More than 135 investigators were involved in this effort, which received $20 million in financial support.

3.3.3. NARP research grants program

The NARP research grants program provides grants to deserving scientists in Egyptian

universities and non-ARC research institutes. For the period 1988–93, 202 research projects were funded, involving more than 500 scientists in 24 faculties within 17 institutions. Total funding was U.S. $10 million.

The assessment team was very impressed with the nature and content of both the collaborative research and the research grants programs. Both appeared to be focussed on high-priority needs. We believe that they strongly merit continued support by USAID.

3.3.4. Human resource development

A major training program was carried out under the NARP research component. The program has served not only the Egyptian research effort but has, in fact, been of importance to all the NARP components and agricultural research organizations. Its magnitude and importance could have justified its being a separate, stand-alone component under NARP. It appears that this is the one major program under NARP that will essentially be completed according to schedule, and the program has been very successful in achieving its major objectives.

The director general of NARP considers the training program to be the "crown jewel" of the overall NARP effort. Of course, well trained human resources have been and will continue to be vital to the future of agricultural research and related efforts in Egypt. We commend those involved in the training program, and suggest this is an area that merits continued support in USAID-supported successor projects to NARP.

3.4. Seed technology component

3.4.1. Background

3.4.1.1. Importance of seed technology

Seeds are a primary input for agricultural production. In scientific agriculture the seed represents the mechanism for transferring the benefits of biotechnology and plant breeding to the farmer. An efficient seed multiplication and distribution system is critical to capitalizing on these programs. To achieve the maximum benefit, the seed must faithfully transfer the genetic characteristics of the improved variety or hybrid in a pure form (genetic purity).

A second characteristic of a good seed multiplication system is the ability to provide the farmer with crop seed free of weeds and other contaminants (mechanical purity).

Through the discipline of seed science and technology, systems have been developed for effectively providing and assuring the genetic characteristics of improved varieties along with the necessary mechanical purity.

Effective national seed programs involve the close cooperation of the public and private sectors. The responsibilities of each sector will vary with the crop commodity, the level of

plant breeding activity, and sophistication and capitalization of the private sector. In most conditions, a strong quality control assurance and monitoring system is conducted by government authorities. These responsibilities are conducted by seed testing laboratories, seed certification programs and seed law enforcement officials.

The beginning of the present-day Egyptian seed supply dates to 1922 when a Cotton Seed Production and Distributing Unit was organized in the Ministry of Agriculture. It later took on other crops seed and in 1942 became a separate branch. It was upgraded to a section in 1957, became a directorate in 1960, and in 1980 became the Central Administration for Seed (CAS) in the Ministry of Agriculture and Land Reclamation.[7]

3.4.1.2. Seed production in Egypt

After World War II, the Royal Agricultural Society developed superior varieties. Over the next two decades, Egypt developed a fairly good and successful seed program. This program was nationalized in 1960. Government policy was to distribute sufficient seed for renewal every year of planting seeds for cotton and renewal every three years of planting seeds for other crops.[8]

In the mid-1980s, the Egyptian seed multiplication and distribution system conducted by the Central Administration for Seed was unable to provide enough seed of high quality required by farmers. As the number of new varieties and hybrids released from the research stations increased, a more efficient system was needed to better serve the needs of agriculture.

3.4.1.3. Seed program status-1985

An assessment in 1985[9] indicated that Egypt's seed industry has a history and more substantial structure than the seed programs of most developing countries. The legislative framework was adequate for effective seed control. There were plant breeding programs as a source of improved germ plasm, an organization with facility to process seed and a laboratory for testing. Nevertheless, the seed industry was not functioning effectively. Seed regulatory and quality control activities were ineffective, testing laboratories were poorly managed, equipment was outdated, and operating funds were inadequate. Processing facilities were old and in poor repair. While adequate quantities of seed might be reaching the farmer, quality for the most part was substandard for germination, purity and other quality factors.[9] Few private companies were involved in seed production.

Several public agencies were involved in production and regulation of seed production:[2, p. 63]

- Agricultural Research Center (ARC): breeding and testing of improved varieties and production of breeder and foundation seed.

- Central Administration of Seeds (CAS)/(MALR): responsible for multiplication,

conditioning, and distribution of seed, as well as fulfilling the regulatory functions in regard to seed.

- Egyptian Agricultural Organization (EAO): imports foreign seed, also owns seed cleaning and conditioning facilities, which is made available to the private sector.

- Organization for Improvement of Egyptian Cotton now the Egyptian Cotton Improvement Fund: finances and supervises cotton seed multiplication, roguing and laboratory testing, with the Central Administration for Seed maintaining supervisory functions to ensure varietal purity.

The seed industry was controlled in Ministry of Agriculture by the Central Administration for Seed headed by an undersecretary assisted by technical directors.[9] In this system, the seed multiplication and quality control functions were conducted under the same administrative structure, creating a potential conflict of interest.

Several studies in the mid-1980s identified significant constraints in the Egyptian seed multiplication and distribution system.[9,10] These were some of the findings:

- greater emphasis devoted to quantity than to seed quality;

- due to poor seed quality, farmer seed planting rates were too high resulting in waste of seed and more land devoted to seed production than if quality were improved;

- several CAS seed processing plants were too poorly equipped to produce quality at required output capacity;

- training of professionals and seed processing plant personnel was deficient;

- CAS lacked laboratory and field inspection equipment to fulfill its role as industry regulator of seed quality;

- storage capacity for raw and finished seed was limited;

- additional seed processing and storage facilities were required in certain areas of the country and others required modernization and/or replacement;

- although privatization was desirable, private sector involvement was limited because MALR was perceived as a "competitor" when it acts to assure adequate quantities of seed are available at planting season;

- breeders rights and variety protection provisions in the seed law needed review and modernization.

Under earlier USAID projects (EMCIP and the Rice Research and Training Project) seed conditioning facilities were constructed. A medium-capacity, modern rice seed facility (with

two processing lines) was constructed and equipped at Sakha. Four modern, medium-capacity seed processing plants were developed under EMCIP at Sakha, Gemmeiza, Sids, and Shandaweel to handle, primarily, foundation class cereal seed. Most of this infrastructure was completed by the end of the project.

3.4.2. NARP seed technology program

3.4.2.1. Goals of NARP seed technology component

The specific goals and expectations of the initial NARP seed technology activity addressed the constraints of seed production and technology identified by studies at that time.[9,10] The seed activity was to be supportive of the NARP research and extension activities.

Revision in the seed technology activity (later component) changed significantly over the life of the project. This evolution of expectations and resources committed must be considered in the evaluation of effort and accomplishments. A detailed review of goals and objectives of the seed technology activity/component over the life of NARP is provided by Deloche.[11]

As later revised, the purpose of the NARP Seed Technology Component was, "to provide farmers with high-quality seed which can have a quick and relatively low cost impact on increased productivity."

3.4.2.2. Plan and objectives

Most of the seed legislation and regulations operative in Egypt for many years evolved around measures for cotton. Revision and updating were considered essential to providing an environment favorable to a developing seed industry in other crops. In order to modernize Egyptian public seed sector and foster private sector seed production and marketing, two objectives were established for the NARP Seed Component in 1988.

- Restructure CAS to fulfill its role of supporting seed technology/transfer, quality control regulation and certification, data collection and dissemination, and seed policy.

- Encourage private sector participation in the seed industry and privatize the Government of Egypt seed production.

These were added to the general objective of "supporting the Agriculture Research Center in improving production and processing of breeder and foundation seed."

3.4.3. Activities of NARP seed technology component

A seed industry advisor was posted to the seed technology activity with the Central Administration for Seed July 1, 1987. Under a later agreement, seed technology was

established as one of the major NARP components and Dr. Abdel-Salam Gomaa was appointed director.

Amendment 2 (August 1988) of the project increased total project funding for the seeds component to over $42 million, including LC and Government of Egypt contributions. With addition of these funds, major emphasis was given to development and rationalization of plans for establishing and/or renovating facilities for the Central Administration for Seed, preparation of design layouts and equipment specifications, other activities related to procurement, and development of a training plan. Activities related to improvements in the organization of CAS, quality assurance and control, and support to the emerging private sector received less attention.

Amendment 3 (September 1988) stipulated a study of current laws and regulations governing the seed industry to provide recommendations for modification of the policy environment to strengthen private sector participation in the seed industry.[11]

Long-term technical assistance to NARP STC ended August 15, 1993, with the departure of Dr. Bill Gregg.[12] The project has continued with technical assistance by short-term consultants to complete the workplan.

3.4.4. Results and accomplishments of NARP seed technology component

In general, progress in each task has been slow but steady. Procurement plans for commodities and services needed to improve and/or establish facilities to achieve project objectives were completed and purchase has been made except for vehicles. Comprehensive training is complete except for that related to new equipment and facilities which are in-country but not yet delivered (April 1994). More than 60 reports and studies were published.

3.4.4.1. Restructuring the Central Adminstration for Seed to perform its new roles

The restructuring of the Central Administration for Seed is well under way. Necessary Ministerial decrees have been promulgated. A plan for liberalization of production, distribution, and marketing of cotton planting seeds has been developed.

Priority was given to the reorganization of CAS. When CAS was responsible for both seed production, and quality assurance and control (certification for genetic purity), the agency was responsible for production and processing, then evaluating and approving its own actions. The reorganization plan calls for administrative, budgetary and physical separation of the seed production and quality assurance/control and related functions to avoid a conflict of interest.

Accomplishments

(1) Ministerial Decree No. 1477 was issued October 30, 1993, restructuring the CAS into two separate organizations: (a) Central Administration for Seed Certification (CASC) and (b) General Department for Seed Production (GDSP) (figure A3-1).

Under the new system, the CASC will be responsible for seed certification and seed regulatory activities: seed testing, recommendation and implementation of seed policy, collection processing and management of a data and information base on seeds for use by the Government of Egypt. The database will be used to set policy to, plan ARC breeder and foundation seed production, assist other agencies in planning seed production, and help the private sectors in planning and managing their involvement in the seed industry.

Necessary reassignment of personnel, preparation of unit and position descriptions and physical separation of units at central headquarters through the governorate and district levels will be accomplished by June 1994.

(2) Implementation of the decree for physical separation of the CAS and new GDSP is underway and is expected to be complete by the end of 1994. When complete, the CASC will serve as a public service organization to produce seed needed for Egyptian agriculture not served by the private sector and cooperatives, due to low profit and/or high risk.

(3) A new organizational schedule is being developed for the CAS and GDSP, including structures at the governorate and district levels. Plans for division of personnel, and preparation of job description and assignments.

To be accomplished: The complete implementation of the ministerial decree reorganizing the CAS and legislative action on seed law reform.

3.4.4.2. Quality control

Increase the coverage of the improved seed quality control from 35 percent to 70 percent for all locally produced seed and 100 percent for all seed imported or exported.

Strengthening CAS (including seed research and genetic resources) to accomplish this objective requires laboratories (including buildings), equipment, data/information management systems, training for personnel, and vehicles for transport.

Accomplishments: Equipment and materials have been ordered. Local procurement is complete.

(1) Laboratories (including buildings): Six new seed testing laboratories and a referee lab (which includes seed health testing and training facilities) are ready to receive equipment and materials.

Three existing seed testing laboratories are under renovation to ready them to receive equipment and materials on order.

(2) Equipment: Equipment with value of $2.594 million was ordered and began to arrive in mid-April. Equipment with value of $1.02 million was re-bid. Local procurement of material, supplies and other items is complete.

(3) Data/information management systems: Plans and requirements for the Data Information System (DIS) and Management Information System (MIS) have been determined by a TDY consultant and are being reviewed in preparation for receipt of systems.

Seed databases have been established and used to develop support and monitor implementation of seed policy, privatization and quality assurance/control activities.

(4) Training for personnel (DIS and MIS): Two persons have returned from training at ISPC (one year) and 180 persons have completed short course/workshop training in computer assisted data and information handling.

Records and reports required for seed certification have been identified and described. A contract is being negotiated for a complete system.

Information has been accumulated for initial entries to the seed database. This includes information relating to production, importation, distribution, use of seeds, and other data useful in private sector feasibility studies.

A comprehensive training plan is nearly complete. A large number of personnel are available with in-depth, specialized, apprentice-type, workshop and on-the-job training to make maximum use of the new CAS organization, facilities and equipment.

Technical procedures and guidelines have been or are being developed for the various tasks the CAS will perform. Some were developed in collaboration with GTZ.

(5) Vehicles for transport :Vehicles were ordered (later reduced by 50 percent). The vehicle procurement process will begin in May with expected delivery in 9–11 months.

To be accomplished:

(1) receiving and installation of new equipment

(2) implementation of data information and management system after hardware and software are delivered

(3) receiving vehicles for field activities of certification and seed control officials.

3.4.4.3. Develop human resources

A comprehensive training program to develop human resources was conducted. These programs included formal training courses, study/travel and in-house workshops and training courses. A summary of such training related to the seed component is found in Annex §3.4.2 and 3.4.3.

To be accomplished:

(1) Complete scheduled training on new laboratory an computer equipment after installation.

3.4.4.4. Privatize GOE seed production and supply and modify/improve seed legislation

Within Egypt there appears to be general acceptance of the need to privatize much of the publically owned seed sector. However, discussions with individuals and agencies (including USAID) suggests some differences of opinion on the extent to which privatization can occur. Drawing on the U.S. experience, some segments of the seed sector requires public support (experiment stations) or quasi-public (foundation seed projects) to support production of breeder and foundation seed stocks of some crops. Crops often receiving support through breeding projects maintaining stock seed include self-pollinated crops (cereals), forage crops and specialized varieties (those with limited demand).

Policy implementation has proceeded in due course generally following recommendations of USAID-NARP studies.[15]

- Policies were decreed in 1991 and 1992 opening seed production and marketing (except cotton) to the private and/or cooperative sectors. Prices are progressively being raised for commercial class of seed to encourage private sector investment.[13]

- A draft seed law is now complete along with decrees relating to regulations under the law such as for seed certification, crop variety registration, and seed exportation. Drafts have been circulated for comment. Review by the NSC is pending (April 1994).

- A plan for reform in the seeds sector was reviewed and adopted by decree and legislation (§3.4.4.1).

- Private and cooperative sector participation in the seed industry is encouraged, promoted, and assisted by the public sector. Interest in seed production by the private sector has increased substantially during the past two years.

  (a) Vegetable, hybrid crops, and forage crop seed segments of the seed supply system are almost wholly in the private sector. Ten private sector companies

are now active in seed production and marketing seed (Annex §3.4.4). This represents an increase from three in 1988. Other cooperatives are being assisted to enter into the distribution and marketing of seeds as the Principal Bank for Development Agricultural Credit withdraws from input supply activities.

(b) Private sector involvement in production and supply of seeds of self-pollinated crops is not encouraging as this activity is regarded as unprofitable and risky. Therefore, production of self-pollinated crops (wheat, barley, rice) are largely the responsibility of the CAS and cotton remains wholly the responsibility of the CAS. However, one organization has entered wheat seed production in a small way. The Rice Cooperative is producing rice seed and renting seed processing facilities from the CAS. The Cotton Cooperative negotiated to distribute and market about 70 percent of the cotton seed.[6]

- The National Seed Council (NSC) is organized and meets regularly. CAS serves as the Secretariat for the NSC. Membership includes representatives from research, extension, universities, and the private and cooperative sectors. Although the NSC is a good communication vehicle within the CAS, it lacks significant input from the private/cooperative sector.

- The NSC and CAS are working to formulate a Seed Trade Advisory Committee comprised of private seed firms and seed traders. This Committee is badly needed as a communication link between the CAS and seed trade on policy issues.

- A Register of Crop Varieties is considered an essential step toward establishment of Plant Variety Protection or Breeder's Rights. Lists of crop varieties are being compiled in preparation for establishment of a crop variety register as part of the crop variety registrations provisions of previous and revised seed laws and regulations. The procedure for registration of new varieties in Egypt by the private and public sectors is being simplified.

- Seed import and export has been discouraged by nontariff barriers and public sector competition in most crops. Procedures are being simplified under the revised law to facilitate importation of new varieties. These proposed changes in the seed law now being considered will reduce trade barriers and create a more favorable climate for trade. The developing private sector seed trade will facilitate in-country distribution and marketing of seed import and export.

Foreign investment and joint ventures in the seed trade have not been warranted due to public sector competition in the field crops. The current development of profitable private sector seed companies and a seed marketing system will provide an infrastructure which will be favorable to more investment by international seed companies.

- Economic and cost studies are being made (in collaboration with GTZ) on seed production, processing and marketing, and cost/benifits of using certified seeds.

Results will be used to establish realistic price structures for seeds, to prevent unfair competition of GOE-produced seeds, with those produced by the private and cooperative sectors. This information will also be very useful in extension programs to encourage farmers to use high-quality certified seeds.

3.4.4.5. Supporting the ARC in improving production and processing of breeder and foundation seed

Activities:

- Assisting ARC in production of high-quality breeder and foundation seed by constructing and equipping two research and foundation cotton seed facilities to produce conditioned and treated cotton seed.

(1) Foundation cotton seed facilities were planned for two locations, Sakha (Delta) and Sids (Upper Egypt). Two gins and processing lines were projected for Sakha facility and one gin and one processing line for Sids. The planned capacity for each of the three lines was estimated at 5,000 tons/season input and approximately 3,000 tons output.

(2) It was agreed to put the two facilities under private sector-type management as a preliminary step for privatization. A plan for liberalization and privatization of cotton planting seed production, processing, and supply was to be in place by December 1992, but was cancelled. The conceptual design of the facilities incorporated the possibility of future privatization. Each facility included ginning, delinting, and conditioning capability. The two facilities were regarded as a models for future work by the private sector.

- The Cotton Research Institute (ARC) is the sole cotton breeding agency for the present time and is expected to continue to be the producer of foundation seed and consequently the supplier of much of the seed for the private sector in the future. Cotton breeding and varietal release could follow the successful public breeding/private sector seed production model in maize.

- Cotton was excluded from the reform plans for the seed sector developed in 1992. The plan established the excellent potential for full and responsible involvement of the private sector in cotton seed production and marketing in a free market format. However, realization of this potential requires substantial improvements in the technologies applied to cotton seed, e.g. delinting, conditioning, seed treatment.

Accomplishments: Preparation of a detailed engineering design for a cotton ginning/delinting and conditioning facility with equipment specifications (based on rotary gin stand-type produced only in the United States).

Need: Establishing a "one ginning/seed delinting and conditioning facility" as a model for private sector activities.

3.4.5. General evaluation

The goals and objectives of NARP activities in seeds underwent major changes during the life of the project. As conceived in the original Project Paper, seeds would be a subcomponent of the research component under a broad mandate. The objectives were significantly increased in later amendments, and ultimately major cuts in programs were made. These cuts seriously affected the achievement of long-term goals of the project.

3.4.5.1. NARP role in seed sector reform

NARP activities included policy, restructuring/reorganization of the Central Administration for Seed, and aspects of privatization. Restructuring CAS is well under way. There is a committment to legislative reform, and laws have been drafted. They are expected to be approved by the end of the year. Some advisory committees have been organized and have meet, but they do not yet serve as a good forum for communication with the private sector.

3.4.5.2. Human resource development

Through the NARP training activity, a large number of staff have been trained in all aspects of seed technology. In-service training programs in seed testing and quality control have been prepared and will be scheduled once the new equipment is in place. Training needs have been met. Provisions should be made for continued in-service training programs and travel to appropriate international conferences and short courses.

3.4.5.3. Facilities improvement and modernization

NARP activities included commodities (e.g., identification of needs, justification, development of specifications, and assistance in procurement).

The nature and extent of the facilities improvement section of the seeds component was altered significantly over the life of the project. Initially, NARP was to continue and follow up on improvements in the seeds supply system initiated in predecessor projects—EMCIP and the RRTP. Commodities were to be provided to correct some shortcomings in design of (1) the four foundation seed EMCIP seed processing plants and the Rice Project rice seed processing facility, and (2) improve processing and testing facilities operated by the CAS.

A major committment was made to improve seed cotton ginning and seed conditioning as a model for private sector involvement. The final output of the NARP seed component differs

significantly from that proposed in the original Project Paper, partly by change in philosophy (amendments to the original Project Paper) and other decisions.

The most significant difficulty has been the cancellation of two cotton ginneries and delinting plants after large expenditures for planning. This problem underscores a large weakness in the cotton seed system privatization plan. The dismantling of the Sids ginnery (in preparation for construction of new gin) is a serious loss to the cotton seed planting stock multiplication program. Cotton seed must now be moved from Sids to Sakha for processing and then back to Sids for planting. Even at Sakha, the equipment dates to late-nineteenth-century technology.

Several major NARP objectives were cancelled or reduced:

- The cotton ginneries and delinting plants at Sakha and Sids were cancelled after expending more than $3 million on planning fees.
- The spare parts for the EMCIP plants were cancelled because the plants were purportedly being used to process seed other than those of the foundation classes.
- The procurement of the vehicles was delayed significantly and ultimately reduced by 50 percent.
- Commodities for the improvements in facilities operative in the seeds supply system finally delivered were between 10 and 15 percent of those projected through FY 1993/94.
- Cancellation of the proposed NARP cottonseed facilities postponed the possibility of privatization of this sector of the seed industry.

3.4.6. Linkages with other donors

3.4.6.1. Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ)

The Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) project (in collaboration with the Central Administration for Seed) for the improvement of seed production and supply under the leadership of Dr. Bernhard Homeyer and his assistant, Christopher Wersbecker, was initiated in 1987.

The general project goal is production of quality seed. Project objectives of the first two phases include: introduction and training in the use of processing equipment; developing a seed certification system; staff training; producing seed in an economical way; and consolidating technical capabilities.

The goal of the current phase (1993–95) conducted by GTZ is to study economics of seed production, train staff in economics and management, develop management capabilities, assist organization of CAS, teach concepts of seed sector privatization of self-pollinated crops

(wheat, rice, fava bean), and demonstrating the value of delinting cotton seed. The GTZ plan is to construct only one (demonstration) plant of 5 mt/h input. Any additional plants would need to be developed by the private sector.

GTZ goals and objectives coincide with many of those in NARP. Staff of the projects cooperated in various seed program activities (First Egyptian Seed Conference, and numerous training events).

3.4.6.2. Other

The only other donor active in seed technology Egypt at this time involves France, which offers soft loans for equipment.

3.4.7. Ability to sustain key objectives in seed technology component

NARP programs built effectively on the foundation of activities of earlier projects (e.g. EMCIP, RRPT). Resources for training and new or upgraded equipment has brought these facilities to a much higher level of effectiveness.

It is fair to say, however, that the Central Administration for Seed activities and the private-sector development of the seed industry are now in a critical stage of transition.

The private sector is becoming significant and growing steadily. However, a great deal of additional, concentrated effort is needed to reach a level of sustainability envisioned in the development plan.[15,16] This is supported by the following:

- The restructuring and strengthening of CAS has not been completly institutionalized.
- Companies in the private sector generally lack quality control facilities.
- Private sector companies are hesitant to enter production and marketing of main Egyptian crop seed other than maize hybrids. A major hinderance to economical seed production is lack of quality in seed sold to farmers. Farmers compensate by using very high planting rates. This is especially true in cotton seed. If lower planting rates were used, farmers could pay more for quality seed without increasing the cost per feddan seeded.
- Installation of equipment in seed testing and quality assurance laboratories will be accomplished late in the project. A training program has been planned. It is important that this program be completed.

3.4.8. Post NARP Activities

Future programs are needed to continue the momentum. These activities are grouped as follows:

3.4.8.1. Support for established programs

Infrastructure development.—NARP has added significantly to the resource base by remodeling seed testing laboratories and by providing new equipment in seed production and technology. However, nearly all of the commodity acquisition for the seed testing labs was received late or at the end of the project and thus was not able to contribute fully to some goals (e.g. staff training and institution building) during the life of the project.

Transportation facilities are critical to enabling CAS personnel to perform their duties, especially with regard to field inspection. Procurement of additional vehicles identified for transportation of certification staff should be provided.

Building peer relations.—NARP has developed a core of trained professionals in the Egyptian seed program. In order to grow and mature, they need resources to establish peer relationships with specialists in other countries. Establishment of a collaborative grant system coupled with funds to support short-term visiting scientists or technical visits on specific topics will be needed.

Institutional reforms.—Seed law changes and implementation need to be monitored and technical assistance provided as needed.

In order for the private sector to succeed in seed production, relevant public sector agencies must take on and carry out essential support and service functions that undergird a seed industry. These functions include seed technology R&D, foundation (basic) seed production and supply of public varieties, objective seed cerfitication, seed law enforcement, seed-related training, and applied research.[17] Appropriate changes have been made in the MOA to accommodate these shifts, but future technical support will be needed to reinforce those new responsibilities.

3.4.8.2. Complete identified programs

Several project goals have not been attained:

Cotton seed processing capability.—The most glaring void is failure to develop cotton seed processing capability and a "model" acid delinting plant. There is a difference of opinion on the best type of gin technology to adopt for an Egyptian cotton seed plant. Tests in a model plant may be necessary to establish the appropriate technology for Egyptian conditions and convince farmers of the merits of reduced planting rates using quality seed. An Australian

study comparing rotary and reciprocating knife machines found no difference in lint quality while the rotary knife machines had a lower power requirement.[18]

Applied seed technology research and academic training.—Seed production and supply systems in Egypt have been relatively isolated from modern developments in seed technology until recently. Pending structural changes in the seed industry will bring new participants into the field, many with limited training or experience.

3.4.8.3. New opportunities

Infrastructure and Administration.—Develop institutional qualifications and enabling decrees for Egypt to become a member in the OECD Certification Scheme. This will enable the private sector to immediately enter seed markets in the EEC and other countries now closed to them by inability to provide OECD certification of production.

Seed technology research and training center.—Under NARP a model for close research-university linkage has been established. It would be helpful if this model could be extended to the development of a seed technology research and teaching capability at a university as recommended in the study conducted by Vaughan.[19]

Developing a center of excellence in seed technology will not only serve the needs of Egyptian agricultural technology and private development; it will also function as a teaching resource for the region.

Institutional changes.—Significant opportunities exist for export markets in selected higher value crop seeds, provided additional quality and control standards are in place. Seed moving in international trade normally must have internationally recognized OECD certification. Authority for OECD certification is granted to qualifying governments.

Once the CAS reorganization is in place and seed certification functioning, efforts should be made to qualify for OECD certification. Private sector seed companies should be fully informed of conditions and opportunities so Egypt can take full advantage of comparative advantages in seed production to open markets in the EEC and Middle East. Crops currently grown having such markets include sunflower, berseem clover, pinto bean, soybean, and alfalfa. Market studies should be made to identify other potential commodities.

Enhancement of seed exports.—In the World Bank Strategy for the 1990s,[20] development of export markets was identified as an opportunity in commodities where comparative advantages exist. Egypt's dry climate and available water resources are important for production of many seeds. The developing seed technology and seed production capability in Egypt offer opportunities for expanding the existing seed trade. As private companies gain experience, the capability for seed multiplication for the international market is enhanced. Recent changes in regulatory systems have served to reduce obstacles to trade.

Seed multiplication for international markets involves close business working relationships and perhaps joint ventures with businesses in the consuming countries.

3.4.9. Specific recommendations

The Ministry of Agriculture and Land Reclamation is willing to go ahead with gradual liberalization and privatization of the seed sector on sound basis so as not to interrupt or hinder the remarkable progress achieved (and anticipated for the future) in productivity of the major crops (self-pollinated and cotton). The prerequisites to assure such conditions are:

- Further strengthening (mainly technical) of the new CAS organization so as to be able to perform it's responsibilities (certification and quality control) effectively.

- Strengthening private sector companies to enable them to take over most of the production activities now performed by the CAS. This requires technical assistance support (quality control, laboratories, training) and some sort of financial incentives or support may be needed, especially for production of low profit self-pollinated crops.

- Privatization of cotton planting seed processing and marketing faces a number of technical and infrastructural obstacles. The recognition and acceptance of merits of quality cotton planting seed and reduced planting rates by Egyptian farmers is critical. If accepted, the seed cost per feddan will be reduced enough to justify the higher cost of quality seed.

Once results of current trials on use of quality seed are available, a high-level policy body should be convened to resolve technical issues and develop a plant to establish a "model" cotton ginning/seed delinting and conditioning facility (estimate one-third of the original plan) under private-type management system, using the planning prepared by NARP.

- Egypt should seek membership in the OECD certification scheme to open trade opportunities in planting stock.

- Economic studies of private sector seed production are needed to assist establishment of policy supporting private sector involvement in seed production. This should be coordinated with GTZ program.

- Government pricing policies must be adjusted to reflect the real cost of seed production if the private sector is to take part in production.

- Seed testing laboratories must be continually upgraded through staff training to fully utilize the facilities and equipment now available.

3.5. Policy analysis and statistics

3.5.1. Project purpose and objectives

Agricultural policy analysis was one of five components constituting the NARP, and an important element in the NARP project purpose—to improve Egypt's capability to provide farmers with productivity-increasing technologies *in a supportive policy environment.*

Establishing a supportive policy environment is dependent on accessibility to immediate, accurate information, including analysis of policy alternatives. Thus, *the main objective of the Policy Analysis Component (APAC) was to establish a sound policy environment which would promote growth in Egypt's agricultural sector.*

USAID's budgeted contribution of $21.6 million was designed to strengthen the policy analysis capability of the Ministry of Agriculture and Land Reclamation's Undersecretariat of Agricultural Economics and Statistics (U/AES) and the Agricultural Economic Research Institute (AERI). The combined effort was to be known as the Ministry's Agricultural Statistics and Economics Group (ASEG). The intended result was to be an enhanced Ministerial ability to monitor the agriculture sector and analyze the impact of policy decisions, facilitating more effective policy reform, liberalization of agriculture, and increased productivity.

3.5.2 Level of effort planned

Five long-term technical advisors and 240 person months of short-term assistance were to be provided. Also, funds were budgeted for training, including U.S. long-term training for 16 high-level technicians and managers, U.S. short-term training for 67 other staff, and in-country training for 573 persons. Other funding was budgeted for commodities (e.g. office equipment and vehicles) and support services (such as technical studies and minor renovation of office space).

Technical assistance and training were to be supplied to the ASEG to improve its ability to conduct and manage priority analyses, interpret and utilize results of these analyses, and address economic policy issues. The technical assistance contractor was to assist in improving management practices and research methodologies, developing a quick response capability for urgent research topics, and establishing feedback mechanisms.

The training program was to provide the staff with advanced analytical and subject area expertise. Policy workshops and seminars were to be utilized to strengthen linkages with the public and private sectors, universities and other groups.

The statistical analysis and data processing capability of the ASEG was to be upgraded with emphasis on improving the quality, scope, and accessibility of information. Technical assistance was to be provided to systematize reporting formats and develop a data base information system for policy and statistical analysis. Seventy-six personal computers were to

be provided to the ASEG and its 38 field offices. Internal training programs were to instruct staff in the use of PC and mainframe computers.

An information center was to be established to support the policy analysis operations of the ASEG. Technical assistance was to be provided for planning and developing this center. Long-term U.S. training for three staff and short-term U.S. technical training for six persons were included. Equipment for archive management, printing, microfiche, and office equipment also were to be provided.[22]

3.5.3. Efforts undertaken and demobilization

Two subcomponents were identified within the agricultural policy analysis component—agricultural economics research and data collection and statistics. Technical assistance was contracted for each subcomponent—Chemonics for economic research and the USDA/PASA for data collection and statistics.

The main objective of the economic research program was to improve and upgrade the professional skills of the AERI staff in their fields of work through research activities that deal with real problems existing in the Egyptian economy. Economic research activities included: (1) national agricultural income and product sccounts improvement; (2) situation and outlook reports on agricultural output and input commodities; (3) performance review of university graduate recipients of new lands; and (4) analysis of efficiency of livestock markets; (5) application of quantitative methods to historical review of agricultural policy; (6) economic analysis of the mechanization of Egyptian agriculture; and (7) end uses of wheat and corn.

Situation and outlook reports with U.S. technical assistance were initiated under the APAC. The first report, "Rice Situation and Outlook," was published with the assistance of a USDA advisor in September 1990. Other reports were prepared with contract assistance. This work has been continued by AERI, and some of the other topics for which reports have been published include cotton, dairy, red meat, wheat, oranges, poultry and eggs, chemical fertilizers, and water resources. The reports were distributed to research institutions. It is planned to update the reports annually.

In-country training was divided into three main stages: general interest courses, professional development, and seminars and workshops. General interest courses conducted included topics such as an introduction to microcomputers. Under APAC and the Research Component, some 200 employees, of the 330 total at the AERI, received English language training. Professional development included a variety of computer courses.

There were 12 Ph.D. training opportunities in the United States for the AERI staff, however, AERI was unable to nominate candidates from its staff. It then advertised more widely to obtain candidates but again failed to nominate any candidates. Following termination of the APAC, there was an agreement between USAID and NARP to continue opportunities until March 1993 for 5 candidates. This date was stipulated in order to assure return of the candidates to Egypt before termination of the training element of NARP scheduled in 1997.

The component failed to nominate candidates before the deadline date and the training opportunities were cancelled.[23]

Efforts undertaken within the data collection and statistics subcomponent were designed to provide assistance in sampling frame development, drawing samples, conducting surveys on agricultural commodities, livestock, costs and returns, and objective yield and forecasting programs. According to a USDA/PASA Agreement report, even though "there was a shortfall of the potential and expectations, there were many worthwhile activities and accomplishments."[24]

Several special reports were prepared by APAC, including reports covering equipment needs, training plans, operations and practices, and computer hardware requirements. Renovation of space for the APAC unit was completed and diverted to use for other purposes. Also, several computers were purchased and are in use by other NARP activities.

Chemonics, the primary APAC contractor, was notified on April 23, 1992, that it should develop a plan to terminate the activities of the APAC and the Chemonics contract by June 30, 1992. Chemonics then submitted a "demobilization plan" to the director general of NARP for his review and approval. A copy of the plan was submitted to USAID for review and concurrence.[25]

A fundamental disagreement between USAID and the Ministry of Agriculture and Land Reclamation over management of the APAC component reportedly was the main reason for early termination.

3.5.4. Effects of early termination

Because the project was terminated early (nearly two years before this assessment), the assessment team was requested to "address," rather than "assess," the APAC component. Less time, therefore, was devoted to this aspect of the current NARP assessment than to other components. It should not be concluded, however, that policy analysis is less important than other components in achieving NARP objectives.

Although the NARP came into existence in September 1985, the APAC did not begin operations until three years later—when the project support office began operations in September 1988. During the 1988–89 and 1989–90 time period, a contract was signed with SCI to provide management and short-term technical assistance as needed. Early in 1990 there was a statistical specialist assigned from USDA under the NARP/PASA. By December 1990 the primary contractor had a long-term technical assistance consultant on board.[23]

As reported in "A Special Evaluation of the National Agricultural Research Project in Egypt" by DEVRES, Inc., February 1, 1991, the Chemonics contract had been forwarded to NARP on Sept. 22, 1990, reviewed by USAID on Oct. 3, 1990, and signed Dec. 4, 1990.[25]

The policy environment in which the agriculture sector operates has improved greatly, not so much through the NARP effort but through the response by the Government of Egypt to earlier endeavors sponsored by USAID. However, many policy issues remain to be confronted. The World Bank country study of Egypt describes in some detail key areas of needed policy reform. In-depth economic studies will be necessary not only in addressing those issues but also in formulating ongoing policy changes affecting all commodities.[20]

One of the key areas identified by the World Bank addresses the same area that was to be addressed through the defunct NARP/APAC: "A technical assistance program for strengthening the planning, policy analysis and monitoring capabilities of both Ministry of Agriculture and Land Reclamation and the Ministry of Public Works and Water Resources."

3.5.5. Findings and recommendations

Gathering and analyzing information and data on which to formulate policy changes needs to be conducted in an efficient and coordinated manner. This means the institutions involved need to be streamlined to use the resources available effectively. This was the purpose of the NARP Policy Analysis Component.

If the Government of Egypt is to continue its policy reform efforts to help stimulate economic growth, it must have reliable information on agriculture. Complete and accurate data, along with impact studies of alternative policy changes, are vital to the adoption of market-oriented policies in the agricultural sector.

Findings of the assessment team support the recommendation to strengthen the policy analysis capability of the U/AES and the research capability of the AERI.

It is recognized that at present the two units are coordinating their efforts informally but effectively. This informal arrangement depends to a large extent on personalities of those in charge of the units. As the Director of AERI, ARC, and the Undersecretary for AES, MALR, advance in their careers and are replaced, there is no guarantee this informal coordination will continue. The coordination framework needs to be instituionalized.

The major loss from early termination of APAC is the lost, or least delayed, opportunity to strengthen the institutional mechanism for agricultural policy analysis.

Given the important role which policy reform has played over the past decade and the continuing need for such reform to accomodate changing conditions, the Assessment Team considers it very unfortunate that the Policy Analysis Component was terminated early. The need for such an effort is still apparent; however, future assistance should recognize that there are two separate administrative units involved—each with different objectives. AERI's main responsibility is economic research of a longer term nature, and the primary mandate of U/AES (Now the Economic Affairs Sector) is to provide short-term policy analysis assistance to the Minister.

3.5.6. Setting for policy analysis

There may be no better time in Egypt's history for the implementation of additional market-oriented agricultural policies than now. Much progress has already been made, and the investment environment for private sector agribusiness appears favorable. For example, there are no longer planting area restrictions on any crop, and marketing restrictions for all crops have been removed. Within the past year (1993–94) control over the land planted to cotton and sugar cane, the only remaining crops with planting area restrictions, was eliminated.

Delivery requirements no longer apply to growers of cotton, sugar cane and soybeans; however, indirect controls are placed on all three products because processing capacity and ginning facilities are still publicly held and limited. The farmer has few commercially viable alternative markets to that of the government for any of the three crops. Government efforts are underway, however, to increase private sector marketing opportunities for all crops. All other crops are free of delivery requirements (see Annex §3.5.1).

Section 1.2 of this report cites the excellent summary by Dr. Ahmed Goueli in putting in perspective the country's agricultural policy history and strategies for agricultural development. Many of those strategies have already been implemented and they have made a dramatic change in Egypt's agriculture.

The challenge in the 1990s is to discontinue policies and programs that still retard the agricultural sector and implement new policies and programs that will stimulate its growth. To do this there must be a solid basis of economic information and in-depth analysis to assess the impact of new policies and programs which could then facilitate implementation of adjustments, as required to achieve policy objectives.

As Egypt's agriculture moves further from being government-controlled to being market oriented, there will be new problems to be faced and a need for new policies to solve those problems. Policy problems can be expected to arise frequently as the country's agriculture changes. For example, "farmers outproduce effective demand in market-controlled economies."[26] If a farmer produces more of a product than can be sold in the local market to recover costs of inputs and investments used to produce the product, production has exceeded effective demand.

Overproduction results in depressed prices, unless there are government price and storage support programs. Problems concerning what kinds of support programs need to be in place to manage overproduction, and the consequences to individual farmers, are policy-problem solving areas that should be addressed by a policy-analysis unit in the MALR. Resources available in the universities and other institutions, also should be available to assist in policy analysis.

Developing an institutional framework for problem-solving research on policy problems will become even more critical as Egypt's agricultural production increases with new technology in a market-oriented economy. Dr. Ahmed Goueli pointed out at a conference in 1992 "that agricultural policy must be designed in a way that reflects the dynamic nature of

sustainability, and that administration of such a policy requires strong coordination between institutions. ....The major challenge facing us at present is how to set up an institutional framework compatible with the new philosophy of a market-oriented economy."[21]

3.6. Technology transfer and extension component

At the outset it should be noted that an earlier USAID project, the Small Farmer Production Project which preceeded APCP, was useful to the Technology Transfer Component (TTC). It was started in 1979 and provided farmers with technological packages through a system of supervised loans. Twenty such packages developed through the project were turned over to the TTC in 1991.

The need to strengthen agricultural extension in Egypt was emphasized in three USAID-supported missions in the early 1980s.[2,3,27] For reasons discussed in §2.2.1.2, however, an extension or technology transfer component was not included in NARP when the Project Grant Agreement was signed in 1985. (Material relating to the TT Component is found in Annex §3.6).

3.6.1. Background of the project

Approximately 18 months after the NARP Agreement was implemented, an Agriculture Extension Consultants Work Group was assembled under Ministerial Law No. 5. In the same year, 1987, a U.S. design team working with Egyptian Counterparts reviewed previous findings and recommendations and proposed a framework for the TTC. This effort was followed by a Project Paper Amendment and Technical Paper.[28]

TTC was approved as an integral part of NARP in September 1988. The TTC Implementation and Financial Plan was developed and approved in April 1989. The Life of Project Plan was approved in August 1989. In-country training of extension staff in the technology transfer system was then initiated with the Center for Agricultural Management and Development. Support staff were hired and a contract was approved with the Consortium for International Development (CID) for technical assistance. CID advisors arrived in April and June 1990. Local hire professionals, however, were not hired by CID until April 1992.[25]

This assessment of the TTC, therefore, is based upon approximately four years of contract technical assistance and two years of operational experience with Egyptian professional staff.

3.6.2. Setting for transferring technology

Prior to agricultural reforms of the 1980s, Egypt's extension service provided regulatory functions for the GOE, in addition to carrying out their technology transfer responsibilities. For example, extension workers were responsible for monitoring the GOE's planting area

restrictions, crop rotation plans, delivery of cotton and other crops, and other regulatory activities described in Annex §3.6.1.4.

As a result of agricultural policy changes, which began in 1986, and implementation of the Government of Egypt's comprehensive economic and social reform measures in March 1990, extension workers have been relieved of a significant number of regulatory functions. Relief from regulatory functions for which extension personnel at the district and village levels were traditionally responsible has improved significantly the environment for transferring technology. Farmers now are more open in their discussions with extension workers. They consider the extension worker more as an advisor rather than a government regulator. The release from most monitoring activities also has greatly enhanced the opportunity to improve linkages between research, extension and farmers.

3.6.3. Objectives of the technology transfer component

In the beginning phases of TTC, the LOPP stated four objectives, and a fifth was added with the Second Amendment. The five objectives were consolidated in 1992 into three:

- Develop and improve the structural base of the MALR technology transfer system.
- Improve the technology transfer capability and decentralize the research/extension system.
- Encourage public and private entities to participate and to cooperate in the technology transfer system.

Human resource development is considered an integral element of all three objectives.

3.6.4. Major efforts undertaken

Major efforts undertaken by TTC are grouped in this report according to the major objectives of TTC as stated above. The three sections are further divided into key output areas and the critical activities required for each. Output units, responsible parties and overall targets are also discussed.

3.6.4.1. Improving the structural base

The TTC *Support Office Plan* has emphasized sustaining improvements in the system that will improve management and planning capabilities at the central level.

Procurement of media and office equipment has been carried out with local purchasing by TTC and off-shore procurement through the PSA. Vehicles are being ordered through a direct USAID contract, but will not likely be delivered for some 9-11 months. Receiving,

inventoring and distributing commodities, according to NARP officials, have been carried out in coordination with the NARP-EO and GOE procedures.

TTC has plans to establish and coordinate Management Information Systems (MIS) units at nine sites. Location of the sites are: one each at TTC and AERI; four at the Central Administration for Agricultural Extension, Horticulture Science, Plant Protection, and Animal Production; and three at Regional Research/Extension Stations—El-Kassassin, Sakha, and Sids.

Communication media materials production has continued to be a key function of the Technology Transfer Component Office (TTCO). Agricultural Extension and Rural Development Research Institute (AERDRI) and other institutions conduct evaluations of communication products.

AERDRI, established in 1977, was a continuation of a small unit in Agricultural Economic Research Institute (AERI). It has five research departments: Rural Communities, Extension Programs, Extension Methods, Extension Organization and Training and Women in Development. The research staff of approximately 160 includes 40 with Ph.D.s, 60 with Masters, and 60 with bachelors degrees—working on their Masters. Forty percent of the staff are located at the RRES. Three disciplines are represented in AERDRI, rural sociology, agricultural extension and home economics. A multidisciplinary approach is used on most studies. Cooperative efforts are undertaken with AERI.

Out-of-country training goals are being met according to the latest amended plan for short courses and scientific visits to research and extension centers in the United States..

In-country training activities, essential to the success of decentralized extension programming, being supported by MALR Special Funds. Regular monitoring and evaluation of training is being conducted.

Development of *long-term planning for the structure and role of extension services* is the key to assuring the sustainability of interventions of an improved TT model made by NARP. TTC is placing emphasis and is supporting actions already initiated by the Ministry to study the extension system. TTC is taking a lead role in developing a proposed long-range plan to improve extension.

3.6.4.2. Decentralization

A decentralized extension system has been established in nine governorates and three more will be added. By September 1994 there will be 12 governorates with decentralized extension systems. The key to decentralization, according to TTC personnel, is involvement of the extension staff and farmers at the village level. VEWs and farmers working together through the RRES to solve production restraints, provides the most effective means for problem solving. The remaining governorates will be brought into the decentralization system as resources permit.

Research/Extension Centers (R/E Centers): TTC is continuing efforts to decentralize the MALR-TT systems operating through selected regional centers, governorate offices and district offices within those governorates. Six of the 10 Regional Research Experiment Stations (RRES) have been selected as locations to establish R/E Centers. The Stations targeted are Sakha, Sids, Gemmeiza, Shandaweel, Kassasin and Sabahyia. The plan to renovate and equip 69 district extension sites and renovate five RRES and to equip all six RRES is scheduled to be completed in 1994.[29] Details are contained in Annex §3.2.2.

Regional Research & Extension Councils: Regional Research and Extension Councils are now being established in accordance with Decrees Nos. 1523 (1992) and 148 (1994). The goal for of the Councils is to promote direct and indirect interactions, coordination and cooperation between scientists, researchers, extension personnel, technologists, decision makers and farmers on a regional basis to increase national agricultural productivity.[30] This is also covered in §2.3 of this report.

Four regional meetings were held in late 1993 and early 1994. It is interesting to note that one of the issues reported to be among the highest priority for assistance is marketing and food processing. That is the same issue most mentioned by farmers during the field trips of this assessment team.

TTC is pursuing strong linkages between the RRESs and the four RRECs. Through the established system of needs assessments, program planning and approvals by ARC scientists, as well as effective programs of demonstrations and practicum training of both extension staff and farmers.[31]

Technology Packages: Efforts to improve research-extension-farmer linkages has focused on the decentralized system, but it has also included support materials such as the technology packages. The objective of the packages is to improve productivity and incomes by providing farmers with adapted technical information and recommendations. Technology packages are developed for specific crops and livestock and for specific geographic areas. Development of the packages is linked with 18 programs of the RSP.

Monitoring & Evaluation: Efforts were undertaken, as recorded in the annual reports, to continuously monitor and evaluate the impact of TTC programs.

3.6.4.3. Public and private participation

Central to the operations and programs of TTC has been the collaboration and cooperation with MALR Central Administrations and allied agencies, through which nearly all activities are implemented. These are the Central Administrations for Horticultural Crops, Plant Protection, Animal Production and Agricultural Extension Services. CAAES is the main implementing institution for field crops extension work. TTC has also tried to strengthen coordination with other MALR agencies and GOE institutions, such as the universities, NRC and DRC.

Technology Transfer Grants (TTG)

TT grants have been made available to groups both in the government and in the private sector. The groups are selected by their abilities to provide assistance with new technology to farming communities. Examples include private voluntary organizations, universities, companies and other private enterprises.

The two main objectives of the TTG are to: 1) Encourage individuals/groups in both government and the private sector to contribute to the transfer of technology; and 2) Support activities that will assist receiving organizations to participate in the GOE's extension programs.

Grant proposals are evaluated on the basis of a determination by an interdisciplinary committee that (1) the subjects had been properly tested at the farm level, and (2) that the technology is affordable, easily understood, and available immediately to the farmer.

From 462 grant proposals that were evaluated, 25 were selected—10 from the private sector and 15 from government. In addition to the grant activities, two workshops were conducted—one involving the Principal Bank for Development Agriculture Credit projects and the other involving the Water Resource Center. The total available budget was LE 1,840,000.

3.6.5. Results of actions taken

Following are the major achievements of the TTC as of April 1994 according to the TTC director:[32]

* **Implemented** successfully a decentralized extension system in 9 Governorates. Plans are to decentralize the systems in three more Governorates by the time of termination of the NARP on September 30, 1994.

* **Established** 6 R/E Centers and 4 Regional R/E Councils, and developed a system for planning extension programs through the RRES.

* **Renovated** 28 research and extension sites, including TTC offices, 24 districts and 3 RR/ES. Renovation, now underway at 48 additional sites, will be completed at a cost of $1.8 million.

* **Procured** computer, office and media equipment for extension centers at a cost of $6 million.

* **Produced** media materials, video films, flyers, posters, etc. for the technology packages at a cost of $350,000.

* **Provided** funds for 25 TT grants—10 for the private sector and 15 for non-MALR organizations, at a cost of $560,000.

* **Designed** more than 40 extension programs, and trained staff to meet problems and needs of small farmers.

3.6.6. Findings

Based on a review of NARP publications and unpublished documents, consultant reports, and related materials along with discussions with officials of the MALR, ARC, NARP, RRES, RR/E Centers, governorates, districts and village extension workers, farmers, USAID and NARP consultants, the following points emerged.

3.6.6.1. Interviews

Several people familiar with the TTC of NARP were interviewed by the Assessment Team to determine their views on points affecting the assessment of NARP. A compilation of those views follows:

- **Major Objectives of TTC:** Most of those interviewed gave equal weight to all three objectives of the TTC; however, decentralization of the research and extension system seemed to capture more attention. Some said the priorities were in proper order.

- **Major Constraint:** Delays in the flow of funds resulting from both USAID and GOE bureaucracies seemed to be a major constraint to acheivement of objectives. Also, some people said the administrative lines added confusion and were not well coordinated. (For example, according to Presidential Decree, the CAAES is administratively under ARC. In practice, however, CAAES reports to the First Undersecretary for Extension rather than to the Deputy Director of ARC for Extension.)

- **Major Achievement:** Developing extension programs from the bottom up seemed to a concensus of the major action taken under the TTC. It is, reportedly, "the first time this approach has been undertaken scientifically and properly." Previously, extension programs in Egypt were developed from the top down. No scientific effort had been taken before to determine the farmers' views of their extension needs.

- **Major Activities that Need to be Continued:** Most of those interviewed believed there was a need for outside assistance to continue some activities of the TTC. Training, support of MIS, technology transfer grants, regional councils, and extension programs in marketing and the new lands were mentioned more often. This did not mean that other activities should not be continued, but it was not anticipated that USAID support would be required to continue those TTC activities.

3.6.6.2. Targets and accomplishments

Progress toward meeting Life of Project Plan targets is shown in a TTC Annex §2.6.10. Targets and progress are shown by TTC objective, activity and output. As indicated, procurement of vehicles is far behind the target. Other activities, such as printed publications and audio programs, have exceeded the target set for September 1994. The Outstanding Farmer Recognition activity was terminated earlier than planned; hence, the larger spread between target numbers and accomplishments.

One of the main targets was to improve management/planning at the Central Level. In an effort to improve management, Ministerial Decree 729 was issued in June, 1993 to reorganize and reassign extension activities as follows:

- An extension agent was to be appointed at the village level for each field and horticultural crop, and for animal production, as well as for other agricultural activities, according to the prevailing cropping pattern at the particular village.

- For each village an Agricultural Extension Specialist was to be appointed among extension agents with the duties of: planning extension programs; arranging duties among extension agents for different crops and different activities; and executing a time table for extension seminars, meetings and field/harvest days.

- Providing supervision at different levels as follows: (a) A senior extension agent was to be appointed at the district level for each agricultural activity (crop) to follow up extension activities for that crop; (b) A follow-up committee was to be formed at the district level, consisting of the District Director of Agriculture as the chairman, and the members were to include the district extension director, and representatives of the plant protection and agricultural affairs sections.

- A follow-up committee was to be formed at the governorate level under the supervision and responsibility of the Director General of the Agricultural Directorate, and the directors of agricultural affairs, extension service, plant protection and field crops.

- Ministerial Decree 1518 was issued in November, 1993, to provide for the following: (a) Nominations of extension staff for different agricultural activities; and (b) prevention of assigned duties being changed without the approval of the head of the Central Administration for Agricultural Extension Services.

The Central Administration for Agricultural Extension (CAAES) provides overall technical supervision, while Agricultural Directorates at each Governorate undertakes the administrative supervision.

3.6.7. Conclusions

- Those interviewed were candid and objective in their views of the accomplishments and constraints of TTC. The TTC activities represent the more impressive efforts in extension-type activities in Egypt, according to one member of the team who had made earlier studies of extension in Egypt.

- Efforts should continue to decentralize the extension system. A major step forward would be to disburse funds to the RR/E Centers for their allocation and accountability.

- A previous UDAID supported mission report recommended that personnel considered to be primarily involved with extension (as opposed to regulatory functions) at the governorate, district and village levels be placed administratively and budgetarily under the office of the deputy director of ARC for extension.[2]

As a result of major agricultural policy changes taken in 1986 and since then, as well as major economic and social reforms announced in March 1990, extension workers appear to be released from many regulatory functions that would have significant negative impact on their work.

If there is, indeed, true separation of regulatory functions from extension, there may be no need to bifurcate the system at the governorate level because of regulatory functions; however, this assessment should be reviewed periodically. New policies, to accompany market oriented agriculture, may require monitoring at the local level. If increased monitoring would impede extension efforts, it might be desirable to separate personnel into those concerned with regulatory functions and those for extension.

- Confusion exists concerning the relationship between responsibilities of the Undersecretary for Extension at the CAAES, MALR, and the Deputy Director for Extension at the ARC. The 1984 team of consultants report said that to be most effective, extension should be organized and operated as a single, well-coordinated program. Accordingly, field extension should be linked administratively, programmatically and budgetarily with the national extension office and be made an integrated part of the total national program. This team concurs with that recommendation.[2]

- Efforts should be continued and, to the extent possible, increased to encourage the participation of the private sector in technology transfer and extension programs. One area that will provide increasing opportunities and could contribute to transferring technology, is the USAID supported Farmer-To-Farmer Program. This program works with a core of some 600 Egyptian farmers. U.S. farmers transfer technology to the Egyptian farmers through visits lasting approximately one month. This technology could be, and in many cases is, then transferred to neighboring farms. Working with extension through a formal/informal arrangement could be beneficial to extension efforts.

Another area of cooperation with the private sector that should be explored is that of U.S. commodity groups working with private farmers in Egypt. These cooperative projects usually involve feeding experiments and provide information on results of feeding trials. Technology resulting from these on-farm trials could be transferred to other farmers through the extension service.

- A major national effort should be undertaken by CAAES, utilizing resources of AERI, AERDRI, NARP/TTC, other units of MALR—such as cooperatives and other appropriate administrative units, universities and the private sector to encourage the formation of private sector entities to facilitate marketing of farm products. Commodity groups should be organized to assist the government and universities to resolve research problems and to increase marketing efficiency. Consideration should be given to various means of raising funds to support these activities, such as "check-off" programs.

- Some progress has been made in employment of women in extension; however, based on data available there, currently, are 896 women extensionists. Comparable data available for the period prior to NARP indicate 790 women were employed. These data, however, are not official and may not include all extension employees at the Central, Governorate, District and Village levels. Steps are being taken to verify the numbers of extension employees, and more reliable data should be able in the near future. It can be concluded, however, that CAAES needs to train and employ more women.[33]

- Currently, there are 18,001 employees in Egypt's Extension Service, located at the Central, Governorate, District and Village Levels. The number of employees are: Central Administration, 6459; Horticulture, 2,151, Animal Production, 3,683; Plant Protection, 4,029; and Veterinary Services, 1,679.[33]

- In addition to the 18,001 MALR extension employees, there are 18,456 field extension workers.[33] These are, principally, individuals previously employed on state and cooperative farms but are now employed in the extension service. Field extension workers, although technically extension workers, do not appear to be included in future extension planning. It is anticipated that as the private sector grows, the field extension workers will join the private sector labor force. More detailed data on numbers of extension emplyees by MALR agency and by administrative level are shown in Annex §2.6.11.

- Excluding field extension workers, Egypt's Technology Transfer/Extension resources include 18,001 employees of the MALR, and (by Ministerial Decree) up to 30 percent of the time of the 3,570 technical staff of the ARC. This provides an equivalent total resource of nearly 20,000 technical and professional staff to transfer technology from the researcher to the farmer.

3.7. New initiatives and management

The New Initiatives/Management is one of the four components under NARP, consisting of the New Initiatives Program and the Executive Office.

3.7.1. Objectives and organization

The New Initiatives program (NI) was established and approved by USAID in October 1989 and began activities in January 1990. However, the Mulletfish, one of the NI projects was started in late 1988 under a different program and incorporated later into the NI. A contract with a U.S. contractor to provide technical assistance was to be implemented by September 1990. This contract was delayed one full year by the Gulf War and began in September 1991.

The goal of the component was to stimulate studies and activities relating to new and unique approaches to agricultural development and emergency activities. It was intended to foster collaborative work between Egyptian and American institutions. The research, training and technology transfer activities are conducted by two or more principal investigators representing both the Egyptian and American sides. There are 13 American Universities and institutes involved in the New Initiatives program. On the Egyptian side, there are 7 ARC Institutes, 3 universities and one joint venture company participating in the program.

This program includes 9 projects (as shown in table 3.7.1), two studies (New Lands Development Study and the Commodity Marketing System Study) and one emergency response program (Screwworm Control). A Fisheries Sector Study was planned but not funded.

The NI program in designed to provide quick and flexible resources to address unforseen requirements that may surface and cause a bottleneck to improving agricultural develoment. Its purpose is to support new and unique activities that offer the opportunity of improving Egypt's capability to provide agriculturalists (especially those in the private sector) with profitable alternatives to current technologies. In carrying out its purpose the NIC cooperates with existing institutes and agencies providing support and opportunites that are difficult to access within the present structure. In no case will the NI compete or infringe on the activities or responsibilities of other NARP entities. This effort is expected to result in the formulation of new development activities and studies which could create opportunities to address emerging problems or opportunities, undertake special initiatives and take advantage of time sensitive opportunities not covered elsewhere in this or any other on-going program.

The primary objectives of the NIC activities and brief summary of progress is reported below. Additional details for each program are included in Annex §§3.7.1–3.7.4.

Table 3.7.1. New initiative projects

Project Title:	Institution U.S.A.	Egyptian
1. Agroforestry Techniques to Ameliorate Prevailing Conditions in Arid and Saline Parts of Egypt	Oregon State University	Dept. of Forestry and Wood Technology Alexandria Univ.
2. Introduction of Biotechnological Methodologies for Poultry Improvement	Pennsylvania State University	College of Agric., Cairo University, Animal Production Research Institute
3. Control of Anaplasmosis and Babesiosis in Egypt through Biotechnology	University of Florida	Animal Health Res. Institute & Faculty of Vet. Med., Cairo University
4. Soybean Utilization Cooperative Technical Assistance Program	INSTOY-University of Illinois	Food Technology Research Institute
5. Transfer of Technologies in Molecular Biology to Egypt: Development of Recombinant Vaccines and Rapid Diagnostic Kits for Rinderpest	University of California, Davis	Vet./Serum and Vaccine Research Institute Abbassia, Cairo, Egypt
6. Technology Transfer for Enhancing Agricultural Equipment Testing Capabilities in Egypt	University of Nebraska	Agricultural Engineering Research Institute
7. The Development of Marine Finfish Hatchery Technology in Egypt:	Oceanic Institute, Hawaii	Maryut Fish Farm Company
8. Whitefly Research Initiative	University of Arizona	Agricultural Genetic Engineering Research Institute

Table 3.7.2. New initiative projects-continued

Project Title:	Institution U.S.A.	Egyptian
	9- Agricultural Biotechnology for Sustainable Productivity	
9-1 Development of Maize Resistant to Stem Borers via Genetic Engineering Approaches	Texas A&M and Cornell University	Agricultural Genetic Engineering Research Institute
9-2 Control of Potato Tuber Moth Resistant Germ Plasm via Genetic Engineering	Texas A&M and Cornell University	Agricultural Genetic Engineering Research Institute
9-3 Dev. of Virus Resistant Cucurbit Crops via Conventional and Genetic Engineering Approaches	Michigan State University	Agricultural Genetic Engineering Research Institute
9-4 Development of Transgenic Tomatoes Resistant to Tomato Yellow Leaf Curl Disease	The Scrips Research Institute	Ag. Gen. Eng. Res. Institute

Table 3.7.3. New initiative component projects

Project	Term (Y.M.)\[1]	Training (PM)	Budget (US$) LC	US	Total
ABSP \[2]	1.7	64	2,037,432	1,144,000	3,181,432
Agroforestry	2.8	2	127,212	92,031	219,243
Anaplasmosis	1.9	78	201,307	1,715,921	1,917,228
Machinery	1.9	62	105,455	514,980	620,435
Mulletfish I, II			234,734	586,000	820,734
Mulletfish III	1.5	30	699,735	2,815,256	3,515,000
Poultry	2.8	40	168,787	737,804	906,591
Rinderpest	2.2	75	106,060	1,889,563	1,995,623
Screwworm		0	477,034	477,034	
Soybean	1.9	54	219,697	1,234,700	1,454,397
Whitefly	1.6	9	196,960	339,066	536,026
New Lands Study		0	900,000	900,000	
Market Systems Study		0	420,000	420,000	
Emergency		0	100,291	100,291	
Totals		414	4,097,379	12,966,655	17,064,034

\[1] Y.M. number of years and months
\[2] Agricultural Biotechnology for Sustainable Productivity. Commodities include: maize, potato, cucurbit, and tomato.

3.7.1.1. Provide a mechansim for emergency response to unforseen problems or situation.

This is illustrated by the screwworm monitoring program. Response was made to a threatened screwworm invasion from Libya that could have damaged the livestock industry of Egypt and potentially spread to other areas of Europe, the Middle East and Africa. Twenty-five vehicles equipped with sprayers were purchased and other commodities provided along with short-term technical assistance to establish an effective detection and monitoring system in Egypt while the international donor community through FAO implemented an eradication program to eliminate the screwworm from Libya. These efforts have apparently been successful in removing this threat.

3.7.1.2. Undertaking studies and analysis as the basis for agricultural program development.

These studies and analyses may form the basis for future support for specific GOE/USAID agricultural program development for future USAID financing. Examples include the "New Lands Development Study" and the "Commodities Marketing Systems Study."

A New Land Development Study analyzes the past successes and failures in new land development and identifies primary factors causing success or failure based on collection of primary data. These analyses would be used as guidance in undertaking new investment in this area by the GOE, USAID, and other donors. A Commodity Marketing System Study started mid-January 1994. The findings were recently reported in a workshop.

3.7.1.3. Introduce new biotechnology techniques in crops and animals.

Activities in this category include "Rinderpest Control," "Poultry Biotechnology" and "Anaplasmosis Vaccine Development" in the animal sciences. It also includes the use of biotechnology to improve resistance in major crops to pests, disease and other adverse environmental factors, and Whitefly control.

3.7.1.4. Develop and implement special initiatives to address specific problems with focus on the private sector.

Examples of projects addressing these issues include soybean processing, establishing the aquaculture potential in Egypt with the current effort on developing private sector commercial developing aquaculture potential of finfish. Agricultural equipment testing and agroforestry techniques are examples of projects under this objective.

The initial activity in soybean utilization is in the implementation stage to provide Egypt with new and improved methods of handling, processing and using soybeans to provide a range of products for human and livestock consumption. The establishment of a private sector industry to produce and market a range of these soybean products is a major objective of this project.

Development of the aquaculture potential of Egypt has focused on transfer to Egypt of the finfish hatchery technology developed by the Oceanic Institute in Hawaii. Its purpose is to produce and distribute large number of finfish fingerlings, initially concentrated on mullet and bream. Two development phases of this technology transfer have been completed. The third, now in progress, is to construct a commercial-scale hatchery and bring it into full production as a model for the private sector.

An agroforestry development project for arid and semi-arid regions of Egypt has been launched to introduce and utilize trees and shrubs for producing improved quantity and quality of forest products and livestock forage.

A project on agricultural equipment testing is being implemented by the Agricultural Testing Station at Sabbahya (Agricultural Engineering Research Institute) and the University of Nebraska in the United States to assist in the design, acquisition, fabrication, installation, calibration and operation of testing and research equipment.

Following are four main dimensions of NI activities:

- Provide quick and flexible resources for urgent and unforeseen problems.

- Transfer of vital and modern technologies between Egypt and the United States

- Development and upgrading human resources working in research and technology transfer. About 400 person-months of training in the United States were to be conducted under the NI. Besides, a great number of workshops and training programs are being conducted in Egypt.

- Improving and/or building the research capacity of the Egyptian institutions. This is realized through establishing new labs and other related facilities, including necessary equipment.

The total budget for the NI Projects is US$17,064,034 (US$4,097,379 LC and US$12,966,655 USAID). See Table 3.7.1-B for detail.

3.7.2. Accomplishments of new initiatives projects

This section highlights the NIC accomplishments. Additional details are provided in Annex §§3.7.1-3.7.11.

In NI technology transfer projects, training of Egyptian postdoctoral and graduates and renovation and equipping of facilities have been completed, with a few exceptions. Equipment is yet to be installed in some projects. The facilities visited appear to be used very effectively. All institutions are to be commended for the number of training programs developed and completed in Egypt as part of their activities. This training and the workshops support the transfer of technology and involves the private sector. Some NI projects are midway into their programs; thus, accomplishments cannot be reported at this time. Highlights are listed below.

- **New Areas of Advanced Science — Biotechnology**

The NI genetic engineering projects, with improved facilties and trained staff, offer Egypt a potential for overcoming major constraints to increased agricultural productivity. The facilities and Egyptian cooperating organizations along with linkages with U.S. Institutions are shown in Table 3.7.1.

These NI biotechnology facilities are a model for the region. By virtue of it's facilities, excellent staff, and output, the laboratories and Institutes are becoming recognized centers of excellence through conferences and training events.

- **Emergency activities of time sensitive nature**

The response to the threatened screwworm invasion from Libya is an excellent example of marshaling resources of collaborative institutions to deal with a potentially serious problem (as discussed in Section 3.7.1.1).

- **Support of Private Sector Activities**

Agroforestry test sites are producing high quantities of biomass. The project also evaluates use of trees and shrubs for producing livestock forage. An international conference was hosted in Egypt in 1994. Contacts are being made with wood processing industry to locate profitable uses for wood biomass produced.

The Finfish Hatchery Technology project has demonstrated the effectiveness of the technology under Egyptian conditions with mullet, sea bream, and sea bass. A model prototype scale hatchery is now being constructed. The model hatchery will supply the initial demand to encourage the development of a private sector finfish aquaculture industry. Once profitable development of this industry has occurred, the private sector can expand by building additional hatcheries as demand justifies. As a separate part of this project, a comprehensive market analysis will be conducted to determine the size and other features of the finfish market, and the potential profitability of a finfish aquaculture industry.The associated transfer of technology to the private sector holds great promise.

The Finfish Phase I and II established the base for construction of the model hatchery for mullet in Phase III and established technology to develop hatchery multiplication of additional species. Successful completion of Phase III will provide the basic technology for donor support of a major demonstration program for using the technology for private sector development and replenishing a diminished fish supply.

The Soybean Utilization Cooperative Technical Assistance Program not only supports private sector development of a soybean industry by evaluating pilot plant extrusion/expelling technology, modifying INTSOY soymilk process for Egypt but also promises to improve the Egyptian diet by introducing soy foods through linkages with extension programs.

The development and ultimate release of germ plasm through the ABSP and Whitefly NI projects from AGERI research with resistance to serious pests and diseases by biotechnology will aid private sector business and has potential to reduce impact of pesticides on the environment.

The Agricultural Equipment Testing project is of great interest for the Egyptian agricultural community and private sector equipment industry. It assists in enhancing the technology transfer, modernizing the equipment testing and formating the regulation and policies governing these kinds of activities.

- **Economic impact studies and analyses that identify opportunities for meaningful program development for USAID and other donors.**

The New Lands Study provided primary data on new lands development that will guide public policy. The Commodity Marketing Systems Study identified needs and potential and needed programs for marketing of citrus, grapes, tomatoes, and potatoes.

The New Lands Study had the following objectives:

- Develop an updated cost/benefit analysis of alternative land reclamation approaches applying current policies and price relationships.

- Analyze the impact of policy modifications since 190 and of current economic conditions on small holders, graduates and investors as principal participants in distribution and sale of public lands.

- Assess, and to the extent feasible, quantify the joint, and if possible, individual impacts of the policy, institutional and technical constraints on the viability of small holder, graduate and investor programs.

- Compare the expected socioeconomic viability of investment in reclamation of additional land with expected socioeconomic viability of improving existing reclaimed land.

- Review and assess urban and rural land utilization including the evolution of policies and the economic, technical, political and institutional factors influencing future land use policies and directions.

- As appropriate, based on the above analysis, identify potentially promising investments in either existing or future new lands.

The Commodity Marketing Systems Study had the following objectives:

- Describe the essential economic configuration and significant variables of the subsector.

- Provide diagnostic information about the subsector, identifying the problems of participants, unexploited economic opportunities and barriers to improved performance.

- Project the future economic configuration and significant variables of the subsector based upon existing evidence and predict the consequences of specific modifications of the system.

- Prescribe changes in policies, institutions, practices or behaviors which would lead to improved performance of the subsector.

3.7.3. Future activities

The concept of new initiatives — providing funds to address emergency problems and encourage international collaboration between research workers in specialized fields — should be maintained. We affirm the recommendation that New Initiative-type activities be

continued, emphasizing flexibility for quick response to emergencies, focus on cutting-edge and innovative technologies and a policy of limiting such activities to pilot phases of new efforts, be continued.[25]

Through the New Initiatives component, Egypt has developed significant research capability. Providing resources or matching funds to enable these trained scientists to continue to collaborate with international colleagues will maximize the investment in training and construction of facilities through development projects to achieve their full potential.

The cooperation between universities (both U.S. and Egyptian) and ARC in this component is commendable. Resources and encouragement of this cooperation should be provided in the future.

The encouragement of the private sector to participate is another unique characteristic of the NI. This feature should be retained in future programs.

3.7.4. Executive office

The need for an "Administrating Unit" was identified in the original Project Paper but not formalized until September 1988 in the Project Description of the Third Ammendment.[34] The unit was named the Executive Office with broad administrative responsibilities for all of NARP.

The Executive Office established a management system, trained staff and implemented an inventory system for all NARP units. Improved communication and reports have helped NARP management and apparently improved relationships with USAID/Cairo. Since this office was added, the management of the project has, apparently, greatly improved (Annex §3.7.12).

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4.0. Performance of Egyptian Agriculture

4.1. A country in the midst of agricultural transformation

Egypt is in the midst of a dynamic agricultural transformation, highlighted by unprecedented yield gains in its major crops. This is a tremendous accomplishment for a country that has limited arable lands and water supplies and that already enjoys high crop yields. Dependent almost entirely on irrigation, Egypt is limited by treaty with its southern neighbors to 55 billion cubic meters of water at its point of release at the New High Dam at Aswan. And, with some 3.151 million hectares (7.5 million feddans) of arable land supporting a population of some 58 million, Egypt has only 0.05 ha of arable land per person, probably the lowest in the world for a country with an agricultural economic base. By contrast, India has about 0.13 ha per person of cultivated land, while China has about 0.11. Egypt's situation is critical, since 0.05 ha per person means each Egyptian citizen must be sustained by only some 500 square meters of cultivated land. For Egyptian agriculture, there is little margin for error.

The case for research in Egypt is easy to make because without effective research, all bets for the future are off. Limited land, limited water, rapidly growing population, food needs outstripping production these circumstances require continuing intensification of production on a limited natural resource base. Such intensification requires continuingly higher yields, greater input efficiencies, reduced negative environmental effects, a greater knowledge base, and superior management. But this picture, while daunting, is not all bleak, for the Egyptian farmer is one of the best in the world. Egyptian farmers know much about the land and the soil and water to be managed; they also possess an abundance of knowledge and experience concerning the art and craft of farming. One long-time resident of Egypt says the Egyptian farm resembles gardening in many ways, in that the farmer exercises a care and an intensity of cultivation that often surpasses that seen elsewhere. Cropping intensity on old lands in 1991 was estimated to be 1.82. However some estimate it to be as high 2.0.

While the Egyptian farmer is exceptional in skills and acumen, to continue to succeed, each farmer also needs a continuous flow of new technologies. Packages of practices are less important than an array of technologies from which the farmer may choose appropriate ones. Only a productive, problem-solving research system can fulfill that need. We are convinced that Egypt is building such an effective research system to help solve its agricultural and natural resource management problems and that this research system is essential to Egypt's future. NARP and its predecessor projects have played key roles in the changes and improvements that have taken place, and the work NARP has begun or stimulated will become even more valuable in the future. What is important now is to build on the base that has been established to ensure that Egyptian agricultural science can be vibrant and innovative in solving the great problems the nation faces.

4.2. Productivity gains

The assessment team was asked to consider two major factors in evaluating the contributions of NARP: productivity and capability or capacity. Certainly productivity is an important indicator of the effectiveness of national research systems and will be considered in the following section. The capacity of the research system will be treated under sections 5.4 of this report.

4.2.1. Yield gains

Yield growth in major Egyptian crops can only be described as phenomenal over the past decade. Table 4.1 presents yield gains for 16 crops in which Egypt has achieved exceptionally high rates of yield growth over the period 1979–81 to 1990–92. To give some measure of what has been accomplished, it should be noted that the United Kingdom achieved its currently high wheat yields (nearly 7 mt/ha in 1992) by gaining an average 75 kg/ha/yr of yield annually for most of the years following World War II. Gains in wheat in Egypt are well above that figure, and climbing.

Table 4.1. Annual yield gains in Egyptian crops, 1979–81 to 1990–92

Crop	*Annual yield gain kg/ha/yr*	*Crop*	*Annual yield gain kg/ha/yr*
Wheat	172	Carrots	239
Rice	159	Cucumbers	135
Maize	197	Onions, dry	1335
Sorghum	111	Peas, green	252
Lentils	76	Tomato	980
Artichokes	562	Grapes	264
Beans, gren	155	Sugar beets	1632
Cabbage	351	Sugarcane	1507

Figure 4-1 shows wheat yields in Egypt from 1939 to 1992. Yield gains have been dramatic, especially since 1980. This is impressive indeed, and it is even more impressive when one understands that total production has more than doubled since 1986.

Figure 4-2 depicts the remarkable increases in wheat yields since 1980. By almost any standard of productivity, Egypt's wheat research program can be considered a resounding success. The Principal Bank for Development Agriculture Credit indicates that the area in improved wheat varieties has increased from 32 percent in 1980 to 83 percent in 1991. Obviously, these varieties have contributed significantly to increased output.

Figure 4-1. Wheat yields: five-year averages (1939–92).

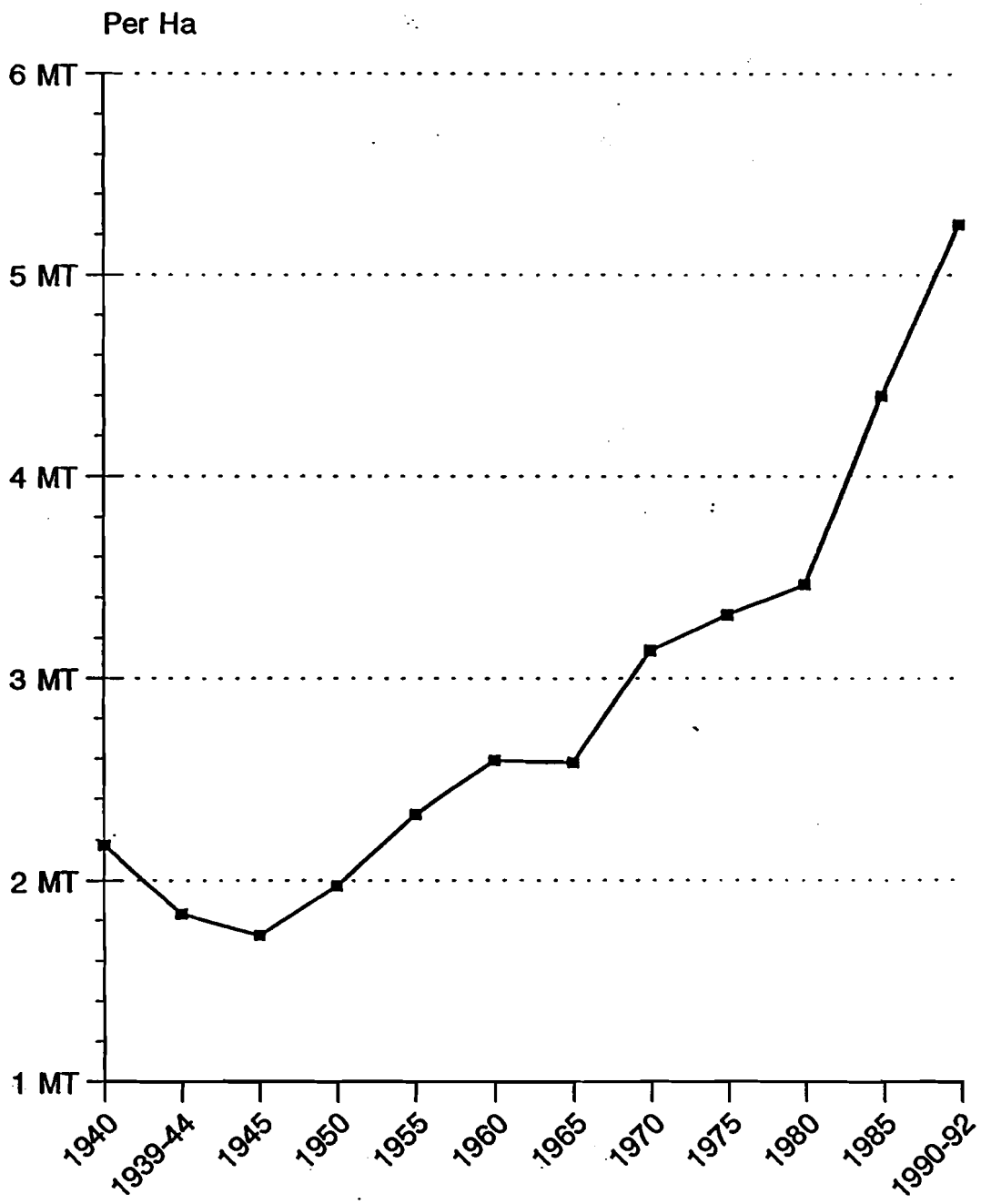
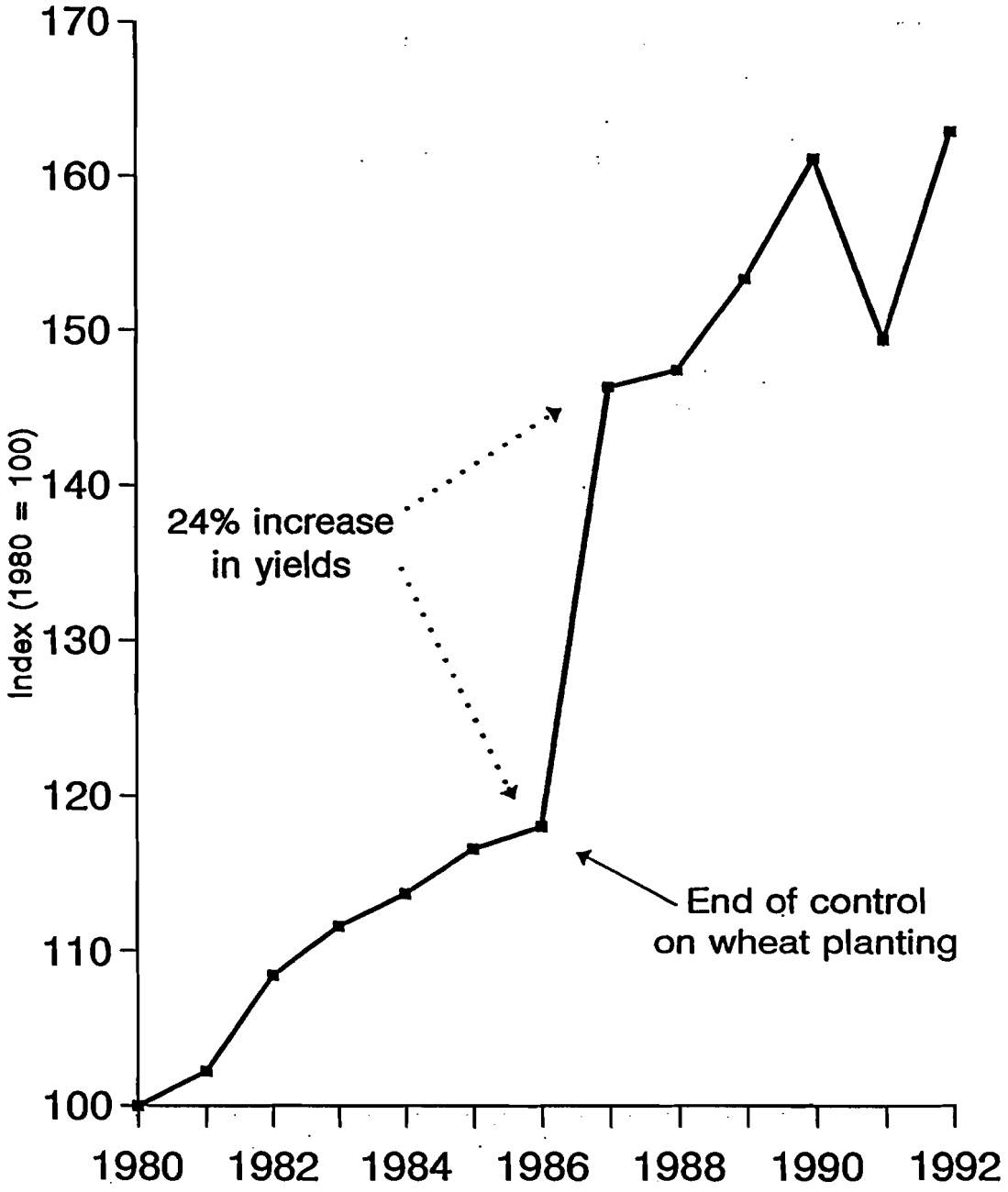


Figure 4-2. Wheat yield index (1980–92).



Source: USAID/AGR/ACE

Figure 4-3 shows rice yields in Egypt from 1939–92. Here again tremendous gains in productivity are shown. Yields leveled off at a point above 5 mt/ha during the period 1955 to about 1980, when they began to rise again, with explosive growth from 1985 to 1992. As in the case of wheat, rice research, too, must be judged a great success.

Figure 4-4 shows maize yields for the period 1939–92. Dramatic gains are noted with maize since about 1985. So maize research, too, must be considered a great success for research.

Figure 4-5 shows tomato yield (index) from 1980 to 1992. Tomato yields increased some 61 percent from 1980 to 1987. A severe infestation of whitefly, the vector for a serious virus disease, resulted in a dramatic drop in production for the next 2 to 3 years. However, steps were taken through research and technology transfer to address the problem and, from that period on, yield increases have continued their strong upward trends.

Figure 4-6 depicts the potential impact of this response to the whitefly problem. The lower dotted line shows what yields could have been if the trend line in tomato yields for the 1970s had continued into the 1980s. The difference in the solid and dotted lines indicates the potential impact of the introduction of the improved technology through the efforts of the University of California–Davis team in the late 1970s and early 1980s working under the USAID-sponsored ADS project. Another contribution to the large improvements in tomato yields was the fact that tomatoes, unlike cereals and many other crops, were not subject to rigid controls.

It has been suggested that essentially all of the tomato varieties grown in Egypt were introduced through USAID projects (including ADS). USAID/Cairo estimates that the level of gross benefits from these introduced varieties has been between $111 and $250 million.

4.2.1.1. Egyptian yields compared with the rest of the world's yields

We have seen how Egyptian yields of wheat, rice, and maize have increased. But what can be said about Egyptian yields in comparison to the rest of the world? Several comparisons can be made.

Annex §4.2 presents yields of 31 crops plus milk production per cow, comparing Egyptian yields and annual yield gains with those of the world, the United States, and Europe, and the highest producer (HP) for 1992 for that crop or commodity. Of the 31 crops, only with carrots does Egypt fall behind the world average for 1990–92, and the figures for Egypt are just barely under world averages. With many crops Egypt is still obtaining high average annual yield gains. In two crops, artichokes and garlic, Egyptian yields were the highest in the world for the years 1990–92. For several other crops Egyptian yields were second or third in the world. Egypt's production of milk per cow, however, is only about one-third the world average.

Figure 4-3. Rice yields: five year averages (1939–92).

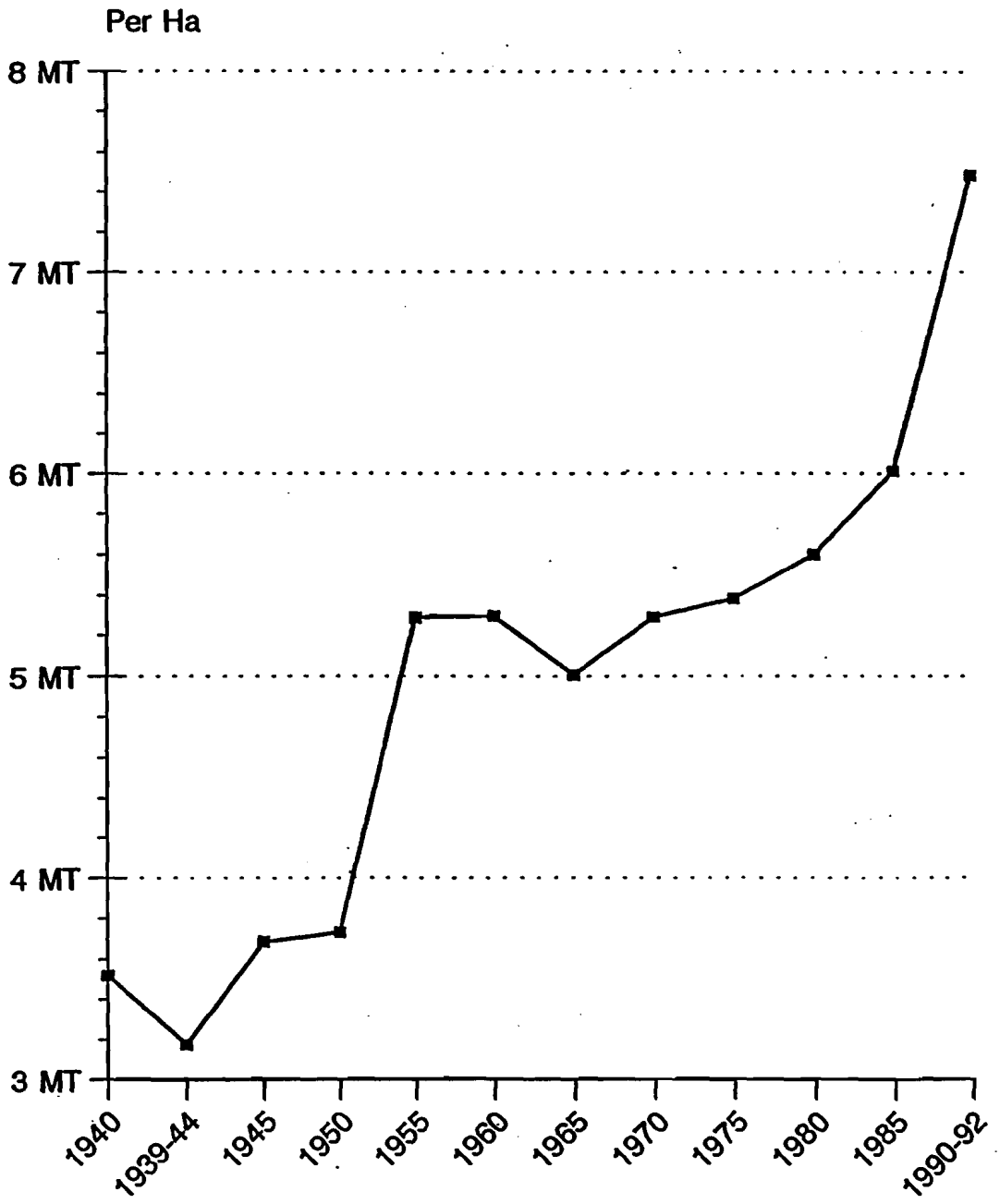


Figure 4-4. Maize yields: five-year averages (1939–92).

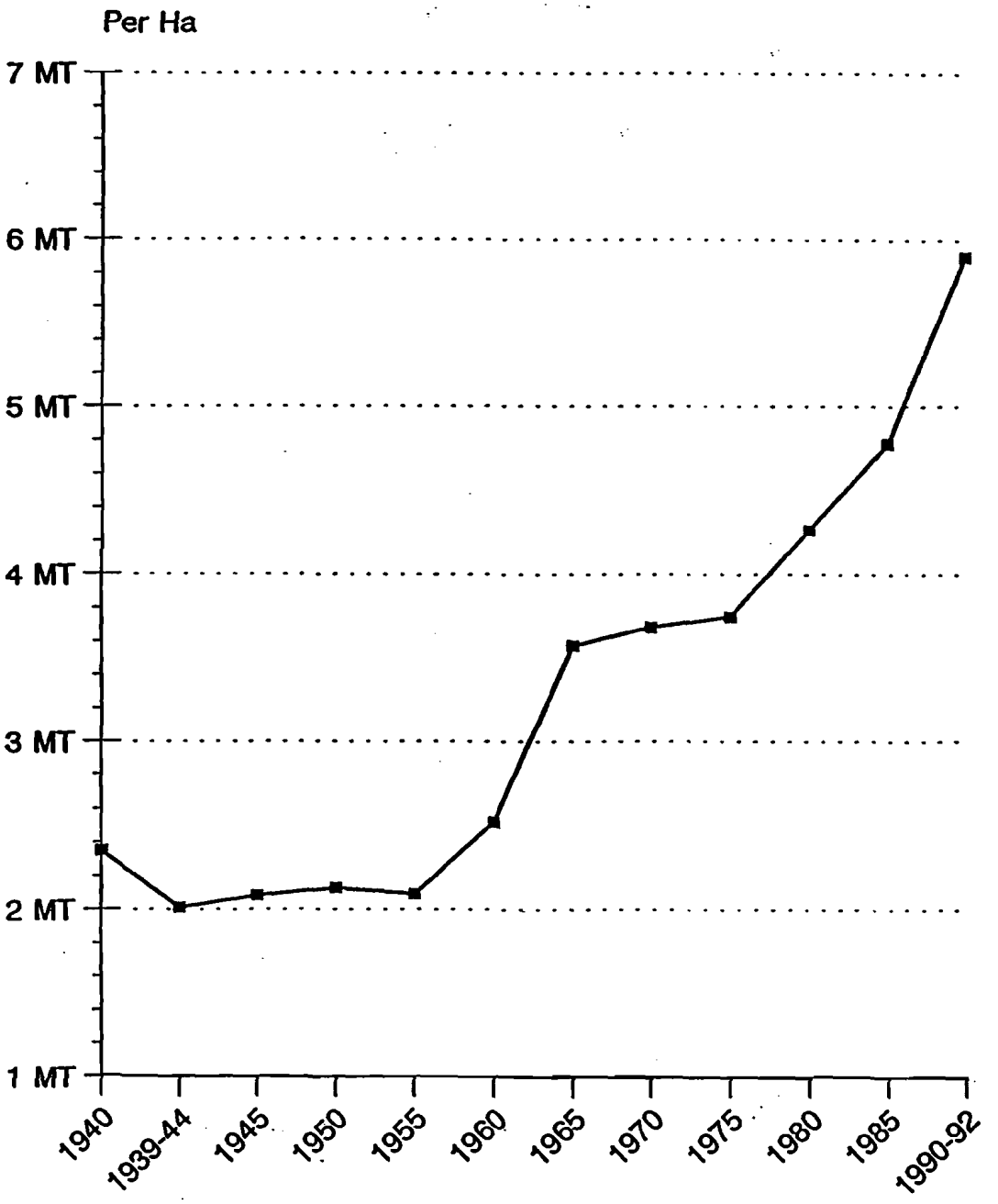
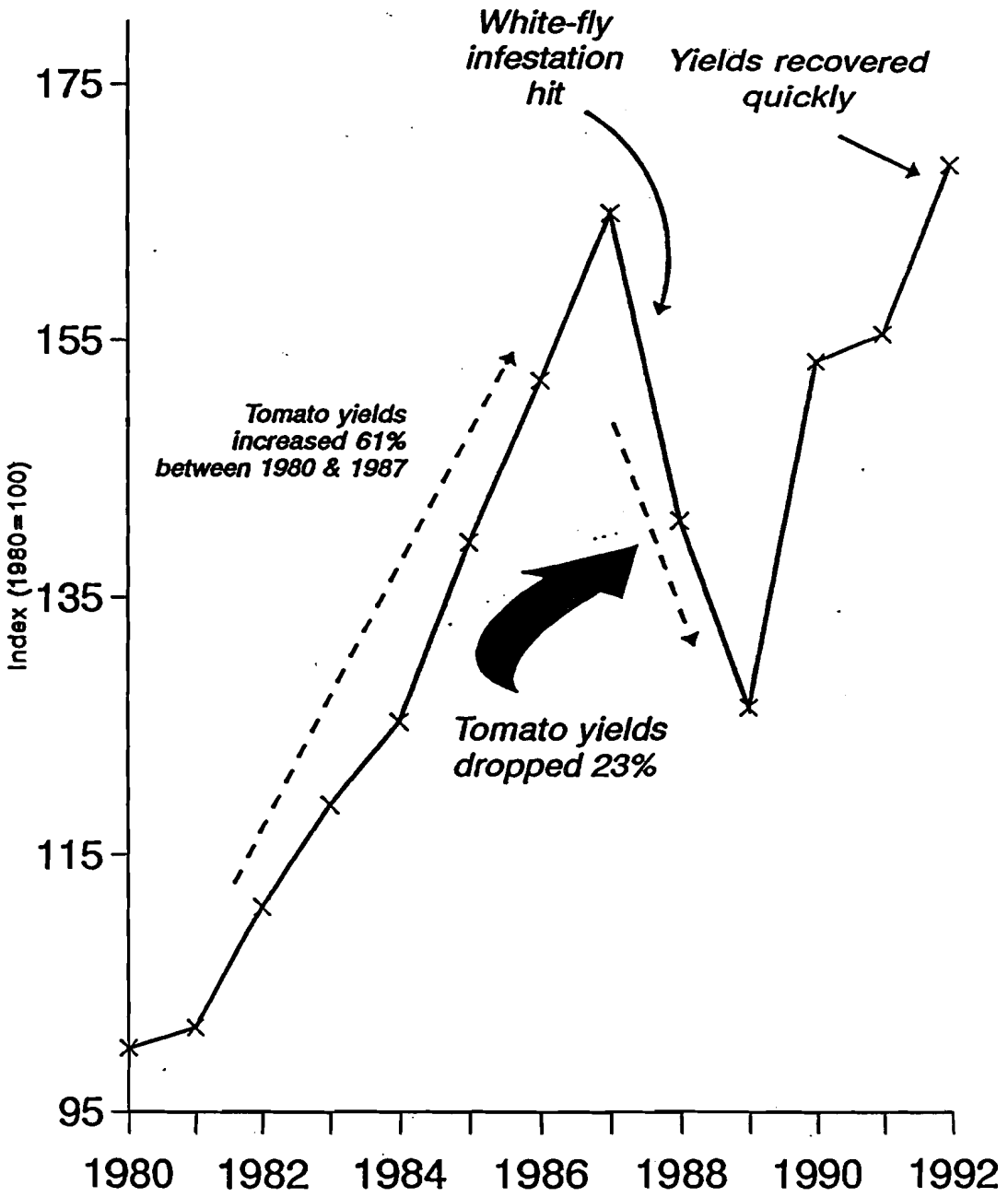
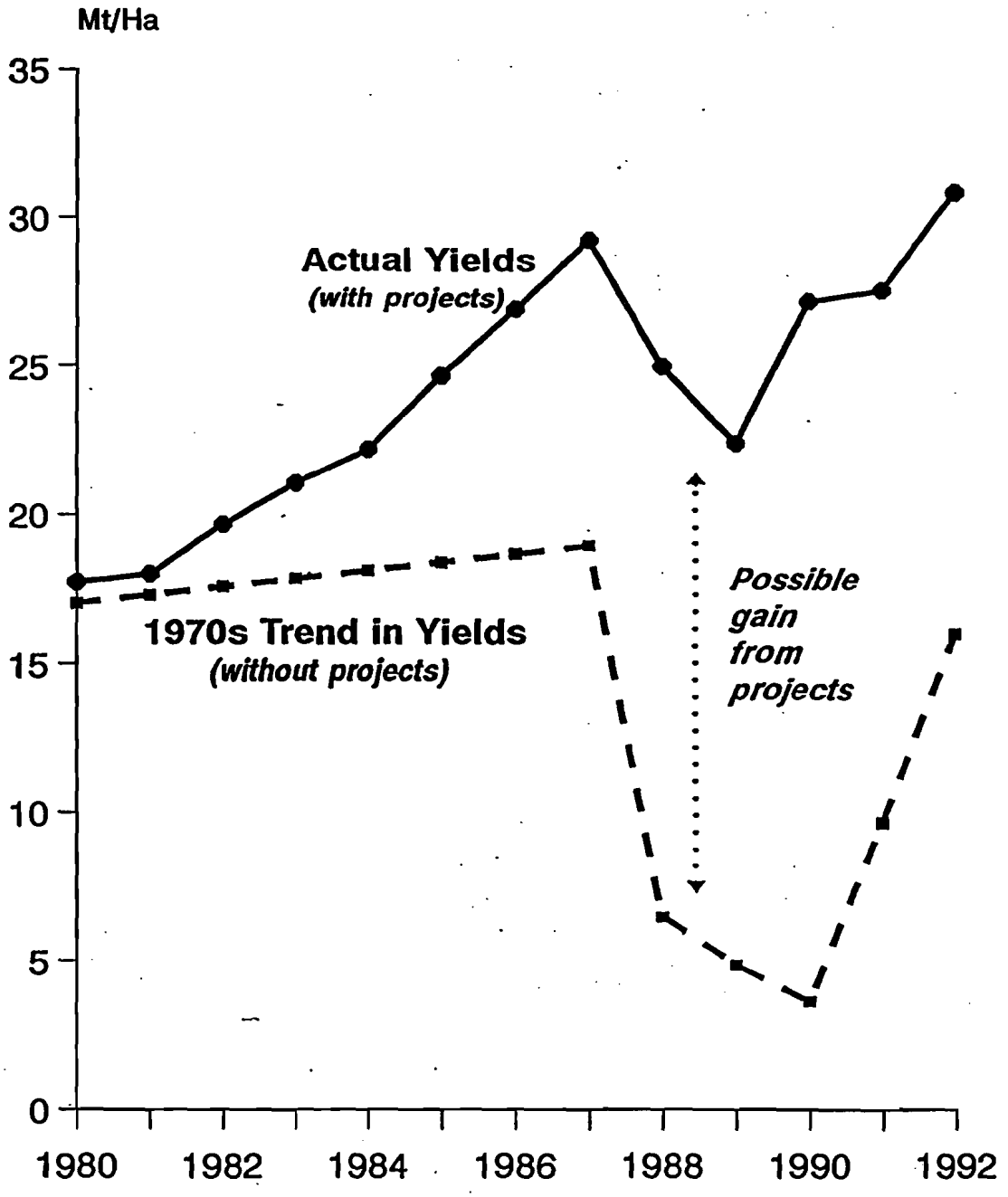


Figure 4-5. Tomato yield index (1980–92).



Source: USAID/AGR/ACE

Figure 4-6. Impact of improved tomato yields (possible gain from USAID projects).



Analysis by USAID/AGR/ACE

Table 4.2 presents agricultural production indices comparing Egyptian performance with that of the rest of the world. In total agricultural production, Egypt was just slightly behind the rest of the world in 1981 and 1985, but by 1990 it had moved well ahead (138 vs. 125), and even farther ahead by 1992. In per capita agricultural production, Egypt was behind the rest of the world in 1981 and 1985, but by 1990 and 1992 had moved slightly ahead. In total food production, Egypt again lagged slightly in 1981, but moved ahead in 1985, and further lengthened its lead in 1990 and 1992. In per capita food production, Egypt began slightly behind the rest of the world in 1981 but gained a slight edge in 1985, then made even further gains by 1990 and again in 1992. These data illustrate the remarkable gains in Egyptian agricultural productivity during the last decade.

Table 4.2. Agricultural production indices comparing Egypt's production with the rest of the world's production

	1981	*1985*	*1990*	*1992*
Total agricultural production				
World	102.69	114.21	125.37	126.92
Egypt	101.36	115.66	138.08	144.11
Agricultural production per capita				
World	100.94	104.66	105.36	103.05
Egypt	98.81	101.66	107.67	107.42
Total food production				
World	102.44	113.90	125.62	127.23
Egypt	101.80	119.89	149.90	156.22
Food production per capita				
World	100.69	104.38	105.56	103.30
Egypt	99.23	105.38	116.89	116.45

In two recent papers, Professor Dr. Adel El-Beltagy, director general of NARP, presents excellent overviews of how Egypt has improved its agricultural research system and how Egyptian agriculture has out performed world and U.S. agriculture since 1980.[2,3]

4.2.1.2. Upper limits of yield

The question must always be asked, how high can yields go? Globally, scientists know there is a biological limit to yield, but those limits have not yet been reached, despite claims from time to time that yield limits or yield plateaus have already been reached for certain crops. Yields still continue to rise in some crops and in some places. Analysis shows that previous theoretical yield estimates made in the Netherlands hold up well when compared with record yields by superior farmers and on research stations. The Netherlands researchers estimated

maximum production in grain equivalents for lands with "extremely high land productivity" at more than 25,000 kg/ha/yr. Much of the Nile Valley and Delta would fall into this category. Today, in some countries where two or three crops are grown under intensive cultivation on the same land, annual production figures are climbing toward a 20,000 to 25,000 kg/ha grain yield equivalent. Egypt itself might be approaching a 20 mt/ha grain equivalent level in lands where double cropping is practiced.

Record yields are assumed to be indicative of the current potential yield of a crop; the ratio of record yields to average yields may indicate the possibility that changes in technology can increase yields. Here a large ratio indicates a higher probability for yield increases, and a small ratio indicates a lower probability for yield increases. Ratios calculated for Egypt in table 4.3 indicate that prospects appear to be relatively high for (in descending order) potato, sorghum, maize, barley, soybean, wheat, and rice. Also, when best farmer yields in Egypt are compared with world record yields, it appears that there still may be considerable scope for increased yields in maize, wheat, soybean, sorghum, barley, potato, sugarcane, and sugar beet.

Table 4.3. Average yields and best farmer (BF) yields in Egypt (1991–92) compared with world record yields

				Ratio of world record yield	
Crop	*Average yield (t/ha)*	*Best farmer yield (t/ha)*	*World record yield (t/ha)*	*to average yield*	*to best farmer yield*
Rice	7.61	13.8	14.4*	1.89	1.04
Maize	6.42	14.1	22.2	3.45	1.57
Wheat	6.21	10.3	14.5	2.33	1.42
Soybean	2.60	3.3	7.4	2.84	2.24
Sorghum	5.26	6.6	21.5	4.08	3.25
Barley	3.99	6.8	11.4	2.85	1.66
Potato	20.56	57.1	95.0	4.62	1.66
Cotton	2.85	5.5	5.5	1.93	1.00
Sugarcane	103.53	164.2	250.0	2.41	1.52
Sugar beet	45.90	95.2	120.0	2.61	1.26

* 28 t/ha/yr in Taiwan, 2 crops.

Maximum yield trials could and should become an essential part of Egyptian agricultural research. Trials should include the best practices and scientific ideas of Egyptian scientists and extension subject matter specialists to achieve sustainable food production. Maximum yield trials tell what is possible using present knowledge and technology. Egyptian scientists should be encouraged to test constantly the limits of available technology and their own ability to put together technology components in a multidisciplinary approach to achieve maximum production. Successful Egyptian farmers test the limits of yield; research should always attempt to test those limits and to learn from such attempts to push yield frontiers even further.

4.3. Performance of animal-based agricultural sector

Very little is said in this report about the performance of the animal-based agricultural sector because of the dearth of reliable information concerning the production, sale and prices of poultry, other animals and their products. We were told that data found on this subject are, at best, no more than intellectual guesses.

In Annex §4.2, data indicates that the milk production per cow in Egypt was only approximately one-third that of world average levels—in sharp contrast to the relative performance of Egyptian crops. While there is no assurance that these precise figures are correct, it is readily apparent that milk production in Egypt is far below world average standards in terms of production per animal.

The NARP Policy Component had a major segment dealing with the development of a good data base for livestock and poultry. However, this work was unfortunately terminated before the work could be done, leaving a significant unmet need for such information.

A recent report by Dr. Moussa Abd El-Azim[1] dealing with an analysis of food balances for various agricultural commodities include some interesting information on the adequacy of animal products. The report indicates the following:

- Published FAO materials on nutrition levels among 21 countries over the period from 1986-88 revealed that Egypt ranked first with respect to per capita of calories from food of plant origin but was ranked 19th of the 21 countries in per capita of calories from animal sources.

- The gap in dairy production increased from 925,000 mt in 1982 to 2641 in 1987, and decreased to 710,000 mt in 1991. Self-sufficiency levels in those three years was 68 percent, 45 percent, and 76 percent respectively.

- Red meat self-sufficiency changed from 78 percent in 1982, 74 percent in 1987 and 79 percent in 1991.

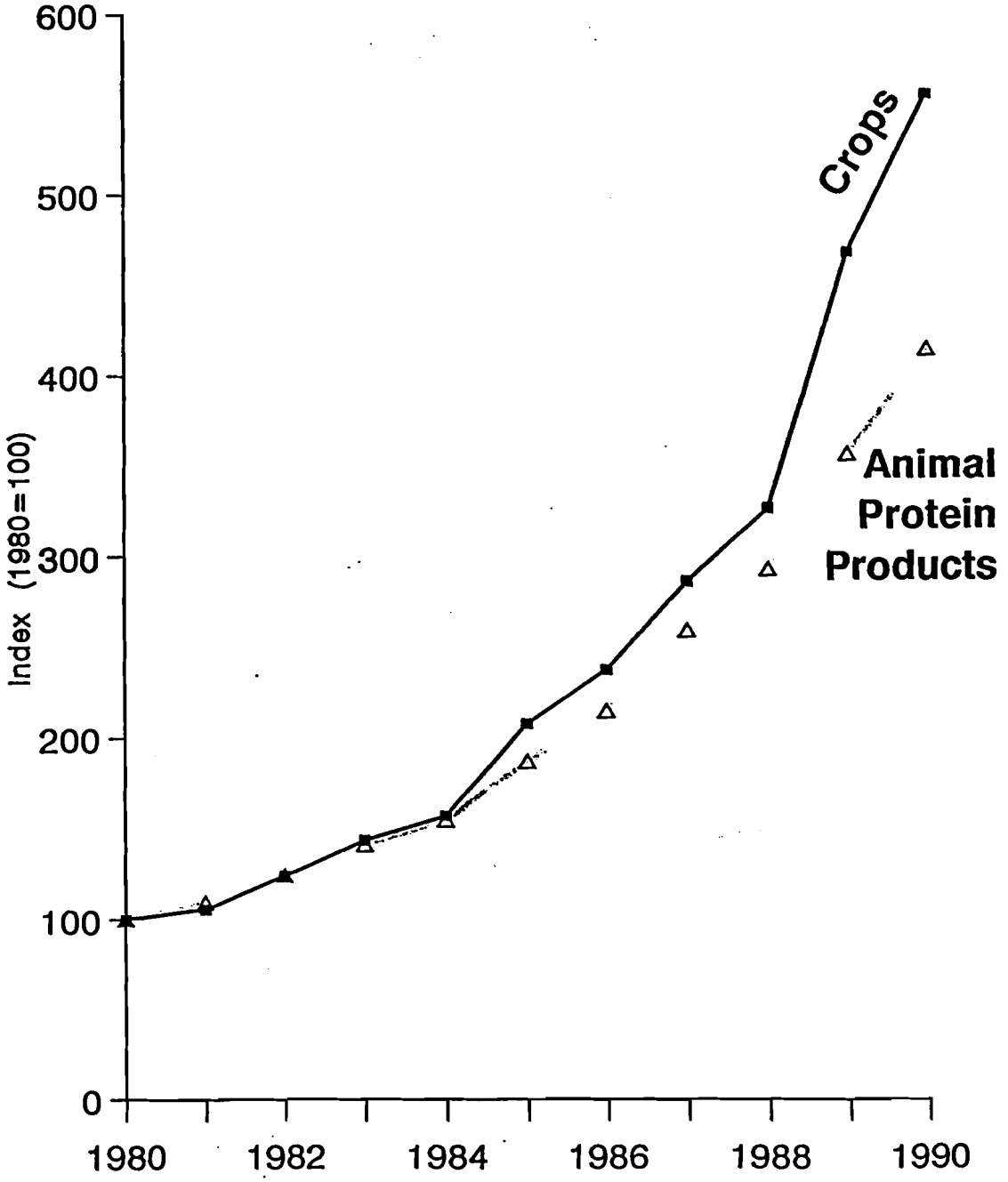
- Poultry self-sufficiency in these three years ranged from 90 percent in 1982 to 88 percent in 1987 and 93 percent in 1991.

This report suggests that "the target of raising the standard of living in Egypt should result in an increase in per capita consumption of animal protein." The report also suggests that "it appears extremely important to find effective solutions to the (animal protein) gap as donors of food aid will cease these grants in six years."

Although the data may be imprecise, there is considerable evidence to suggest that Egypt should expand its output of animal-based products to improve the dietary standards of the Egyptian people—especially those at lower economic levels.

A recently completed study of animal protien production in Egypt conducted by Winrock International with USAID support provides some significant information concerning the food animal sector in Egypt (figure 4-7).

Figure 4-7. Nominal value of crop and animal protein production, 1980–1990, for 21 major crops and all animal products



Source: Crops: USAID/AGR/ACE; Livestock: Winrock Int.

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5.0. General Assessment of NARP Contributions

5.1. Factors responsible for recent advances in Egyptian agriculture

There have been very significant advances made in Egyptian agriculture during the period of NARP's existence since 1985. However, it cannot be said that NARP, by any means, was totally responsible for such improvements. The nature of agricultural research is such that it takes several years from the time research to improve productivity of a crop is conducted until such improvements are reflected in higher production by farmers. Consequently, the most significant impact and benefits of NARP will be felt for the next decade and beyond in terms of an improved Egyptian agriculture.

We believe the significant improvement in Egyptian agriculture since 1985 can be attributed to three major factors (not in any priority order):

1. The major policy reforms which have been implemented during the past 12 years under the dedicated and enlightened leadership of Deputy Prime Minister Youssef Wally. Many of these reforms have removed significant disincentives that were holding back agricultural development, providing a policy atmosphere that is much more supportive of such development.

2. The improvement in agricultural research programs made possible, in part, by the USAID-supported projects in the late 1970s to mid-1980s. These projects helped to provide the technology and demonstrated capacity to significantly increase agricultural output. Moreover, these earlier efforts included policy work which helped to provide the basis for the policy reform discussed above.

3. Contribution by NARP, building on the foundation established by the earlier USAID-supported research projects. NARP has not only built on that foundation but has also supported other areas, not covered by the earlier projects. Results of these efforts will likely be felt primarily in later years.

We would note that the significant improvement in the agricultural sector would likely not have been realized in the absence of either the policy reforms or the improved research programs over the last 15 years. Each was, in some respects, dependent on the other if the full impact was to be realized.

We would also emphasize the fact that while there has been significant policy reform, NARP has contributed little to this since this component was terminated before there was time for it to have a significant influence. We believe, however, that some of the earlier USAID-supported policy work has had a positive impact.

NARP has also supported extension or technology transfer activities which are vital for getting the technologies generated through research applied by the farmer. These programs are

beginning to contribute to more rapid adoption of technology and further strengthening of the agricultural sector.

The improvements in the seed industry in recent years—also a major objective of NARP—are beginning to contribute to the improvement of the agricultural sector.

The New Initiatives Component has provided an excellent vehicle to address emerging problems or opportunities which could not be anticipated when the Project was originally designed. The benefits of most of these efforts will be realized after NARP has been completed.

In light of these observations concerning the factors that the assessment team believes to be primarily responsible for the significant advances in the agricultural sector, especially since 1985, let us examine more specifically the nature of the improvements.

5.2. Increased agricultural output and value of agricultural products

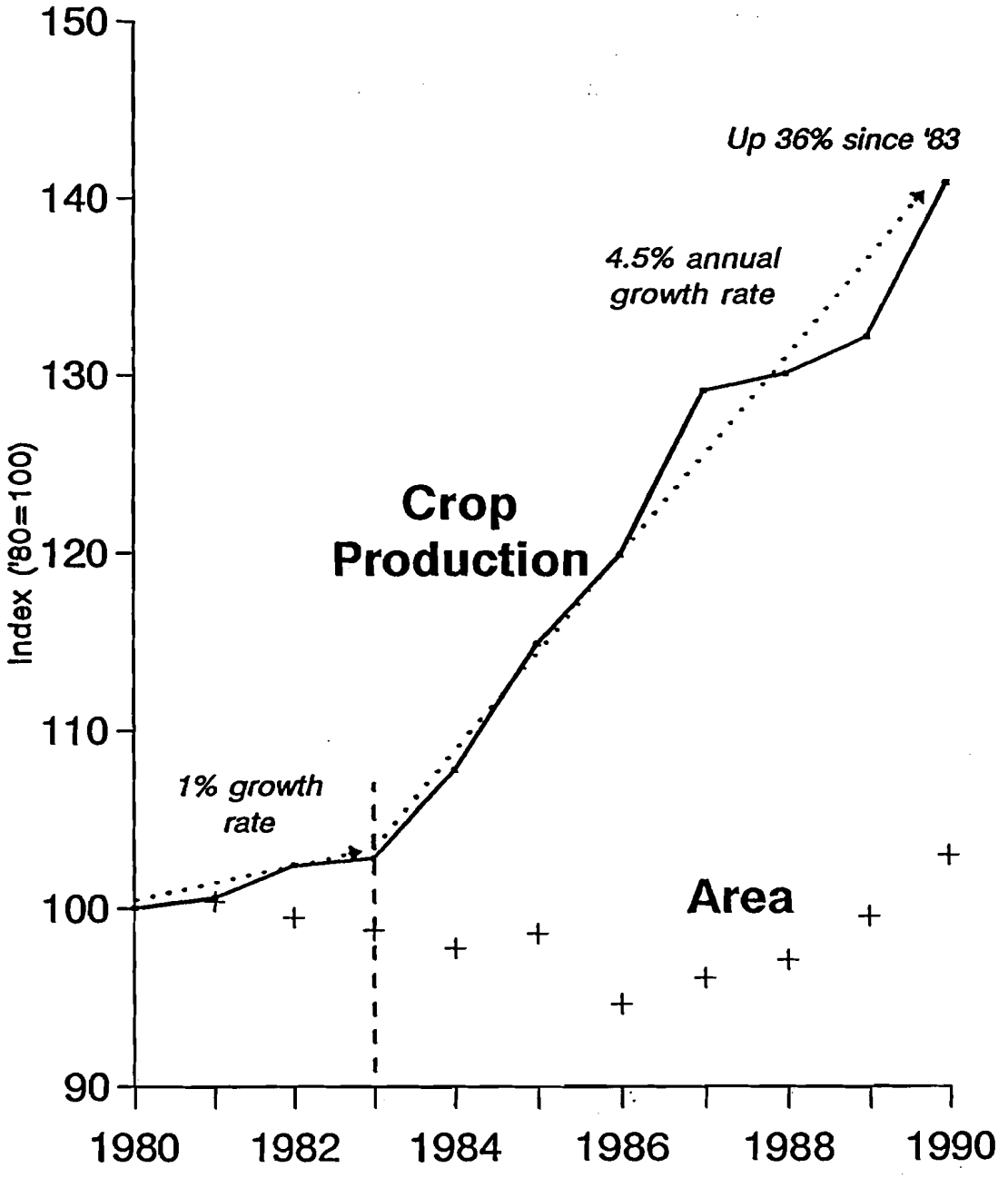
Changes in the production of 21 major crops since 1980 are shown in figure 5-1. These data indicate a very modest increase in the crop production index from 1980–83 of 1 percent annually—but a substantially higher rate from 1983 to 1990. Indeed, this shows an increase in production of the 21 crops of 36 percent during this period, reflecting a 4.5 percent annual growth rate. These data indicate that improvements in crop production have not been limited to cereals only but significant improvement have also been made in a broad spectrum of other crops as well. Such advances with the 21 crops are even more dramatic when changes in the *current* or *nominal value* of these crops during this period are examined. Figure 5-2 indicate growth rate in nominal values of these crops of some 19 percent annually since 1980—with the rate of growth much higher since 1984—and still higher since 1988.

Such improvement in value reflect not only greater production but also significant improvements in prices of the commodities resulting from the major policy changes of the 1980s and early 1990s.

These rapid gains in current value since 1980 (figure 5-2) reflect inflationary price increases. However, figure 5-3 also indicates very significant improvements as well in *real value* of this production. In fact, in the period from 1980 to 1990 the real crop production value increased 89 percent with an annual growth rate of 6.6 percent. Such improvement in the real value of crop productivity should be reflected in significant advances in income to the farmer.

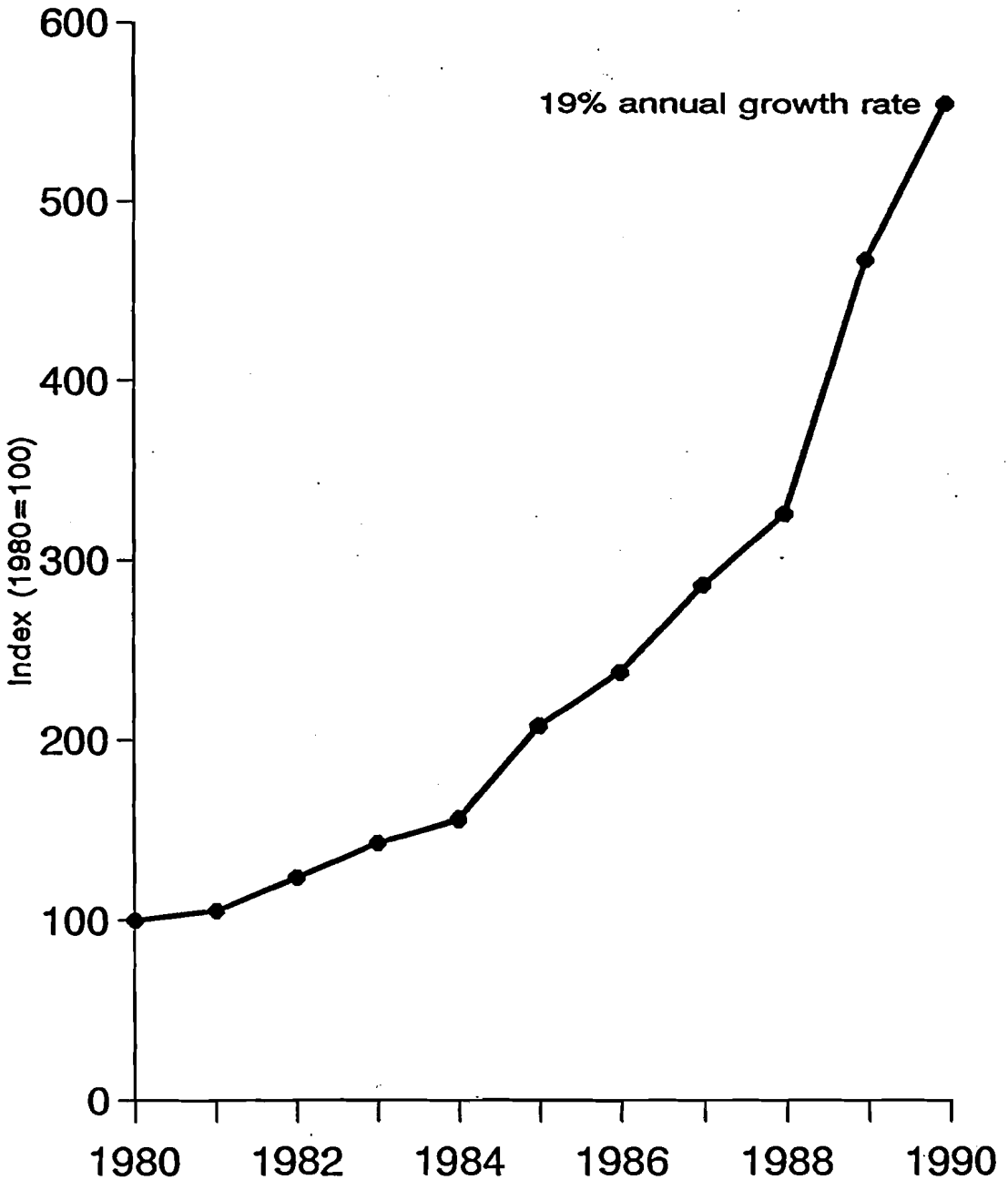
It is of interest to note how the current values of both crops and livestock have changed over a longer time span (1960–90) (figure 5-4). Relatively little change occurred in the decade of the 1960s. A small rate of increase occurred in the 1970s. A much more rapid rate of growth occurred from 1980–85—with significantly faster growth taking place from 1985–90.

Figure 5-1. **Crop production index (metric tons of output from 21 major crops, 1980–90.**



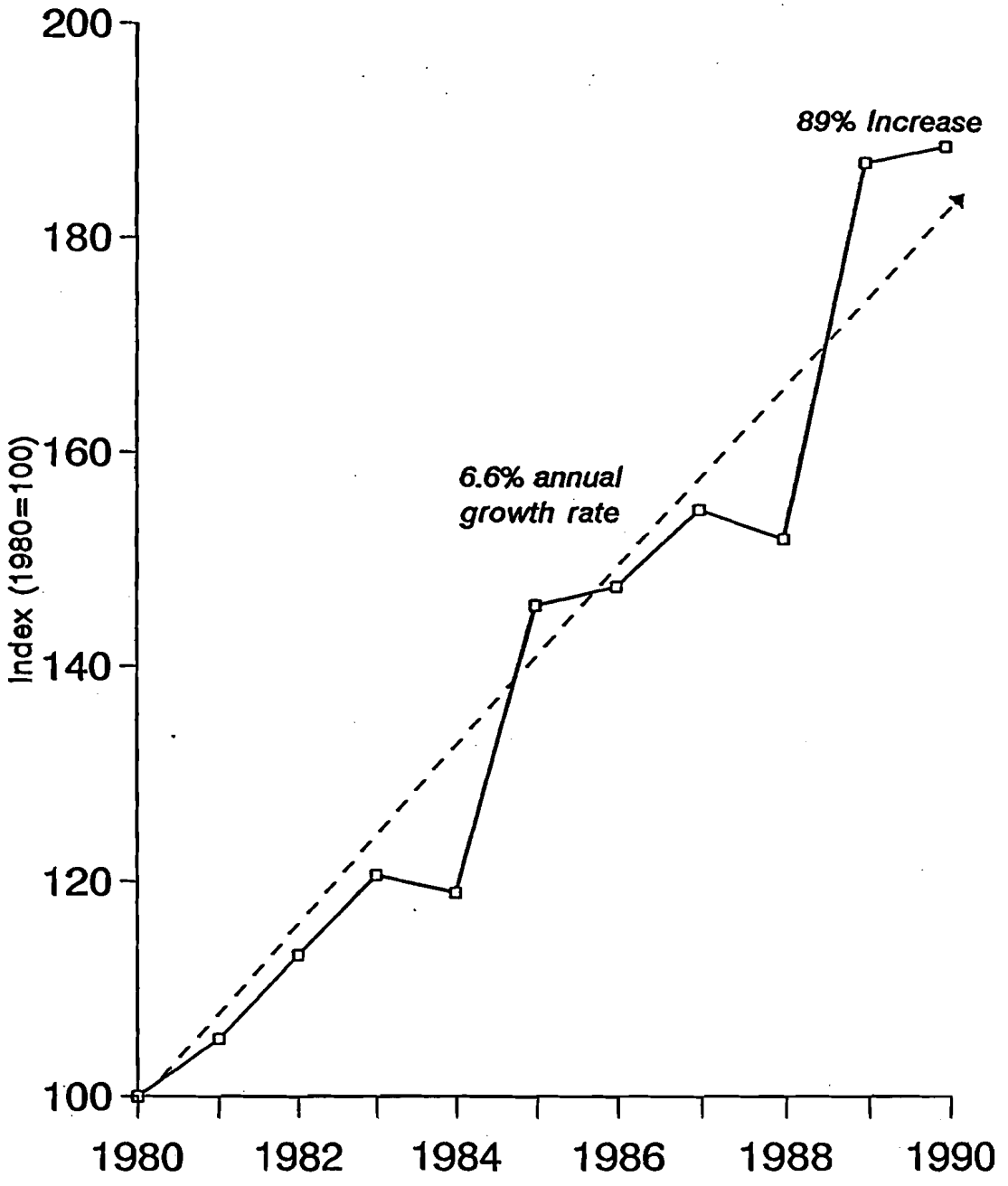
Source: USAID/AGR/ACE

Figure 5-2. Nominal crop production value index for 21 major crops, 1980–90.



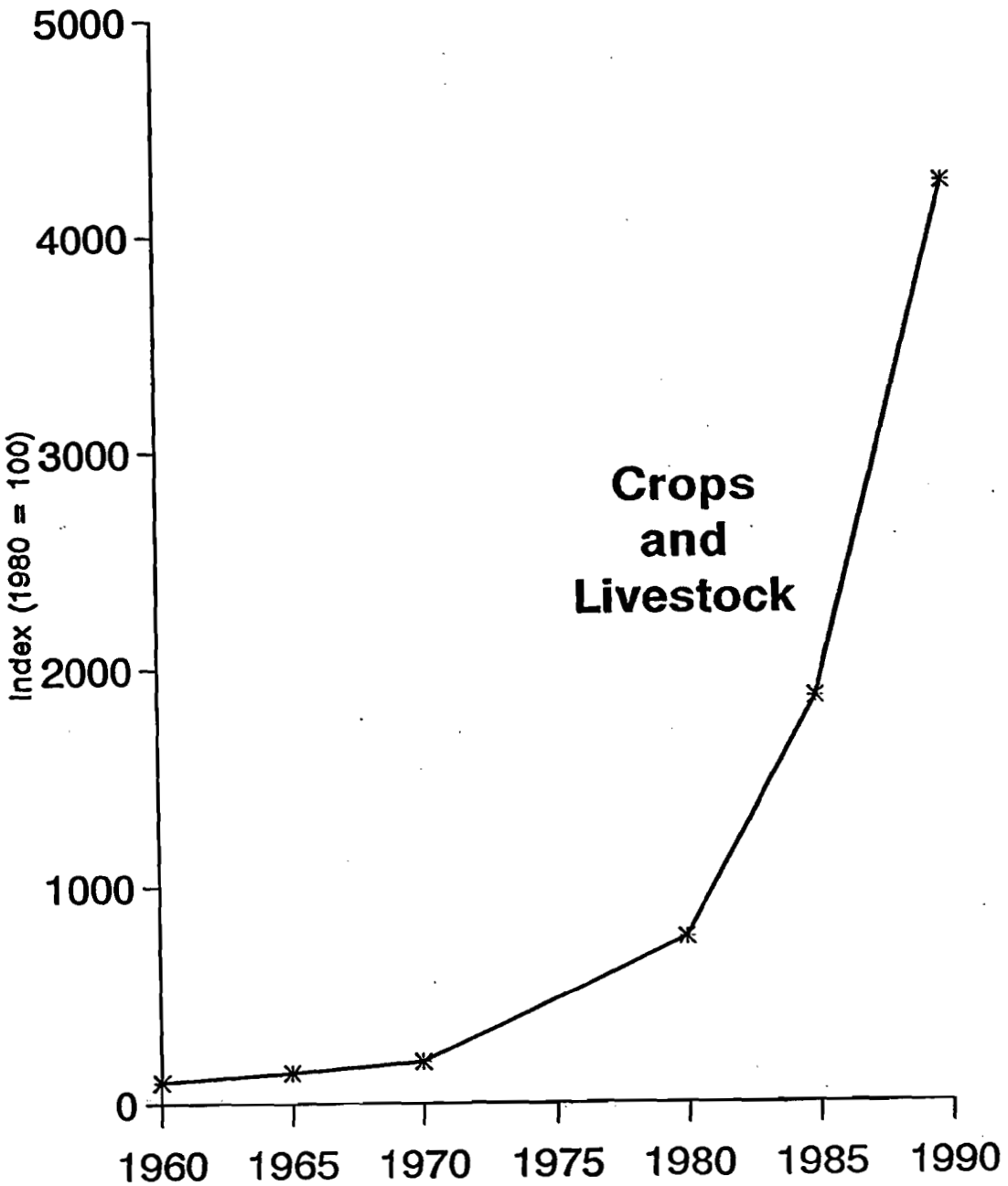
Source: USAID/AGR/ACE

Figure 5-3. **Real crop production value index for 21 major crops deflated by GDP deflator, 1980–90.**



USAID/AGR/ACE

Figure 5-4. **Current value of agricultural production (index of crop and livestock production combined).**



Source: Ministry of Agriculture

There are likely several reasons for this differential rate of growth with crops and livestock. Undoubtedly one circumstance that contributed to this was the fact that with the low government-controlled prices for many crops along with the absence of such controls on livestock, farmers began—even in the 1970s—to give more emphasis to the production of berseem clover and fodder crops for livestock in place of rigidly controlled field crops. Moreover, the Government of Egypt was, at the same time, subsidizing the cost of feed to encourage more animal production. It was also in this period that extensive technology was brought in from the United States, which helped to facilitate a major expansion in the poultry industry. All of this tended to favor more rapid growth in animal-based industries.

The assessment team would again emphasize that these advances cannot be attributed to NARP alone. The fact that NARP has built on and continued some of the earlier USAID-supported efforts, we believe, is a significant factor in maintaining, and even accelerating, the rate of improvement in the agricultural sector which began immediately before NARP was initiated. Moreover, major policy changes in the last decade have made a significant contribution to these improvements. But we should emphasize that USAID has also had a significant role in encouraging such policy change.

But the greatest impact of NARP, we believe, is yet to come. The National Agricultural Library is yet to be equipped and stocked. Much laboratory equipment, vehicles, and other commodities are ordered and are yet to arrive. Buildings and laboratories are still being renovated and improvements continue to be made in upgrading the land and other infrastructure at the research centers.

Important improvements are being made through the technology transfer program in upgrading facilities for extension workers. Management information systems are being installed through the technology transfer component at some nine locations for use by extension.

Four regional research and extension councils have just been formed for the major regions of Egypt. When fully activated they should serve a useful function in helping to coordinate more effectively the total research effort of the country and focus attention on continuing needs for research and extension as new problems emerge.

The extensive training program, which is still continuing, should continue to pay dividends for many years to come. Significant improvements have been made in the seed industry which should contribute to further improvements in the agricultural sector.

5.3. NARP's contribution to improving the capacity of Egypt's agricultural research system

Measuring capability or capacity for effective research is very difficult and, at least, somewhat subjective. However, we have identified several indicators which we suggest are important in assessing the development and effectiveness of a national agricultural research system. We have also presented in the following sections our views of how NARP is contributing to such improved capacity in Egypt.

5.3.1. Ability to deal with change

To the unpracticed eye, Egyptian agriculture may appear traditional, but significant change, including modernization, is going on. New practices, new cropping patterns, especially now that government controls have been lifted; new crops are being adapted and are flowing in, from the private sector, from neighboring countries, from international centers and collaborating institutions. Egypt greatly needs a continuing flow of new ideas, better germ plasm and improved technology along with an exchange of views. We believe NARP has helped Egypt prepare better for continuing change, but vigilance is required to keep sharp the capacity to meet and deal with change.

5.3.2. Ability to introduce new enterprises, new technologies, and to present new opportunities

Here NARP is performing well. Research on new crops such as sugar beet as a replacement for sugar cane is an example. The challenge of productivity on the old lands and improving productivity on the new lands will take ingenuity and close linkages that have developed with the IARCs and other research organizations. Only time will tell whether the momentum built up under EMCIP, the Rice Project, and other USAID efforts along with NARP will last and multiply. We can only hope it can, for Egypt must rely on constant flow of new ideas and technologies. The new initiatives component of NARP has provided an excellent vehicle for exploring new opportunities in the agricultural sector. One indication of the Egyptian agricultural system's capacity is the development of improved germ plasm. Annex §3.3.1 includes an impressive list of improved crop varieties and hybrids by ARC during the period of NARP's existence. But some of the breeding work led to these varieties and hybrids began before NARP.

5.3.3. Ability to deal with emergencies

Here NARP and its collaborators score well, we believe. The New Initiatives effort has allowed Egypt to deal with the screwworm when it reached Libya and to deal with the tomato whitefly problem when it emerged in the Fayoum. We were impressed that technologies worked out for the Fayoum for growing tomato seedlings were being used in Ismailia in new lands we visited near Suez Canal.

5.3.4. Ability to identify important problems and constraints

An old axiom in agricultural research states, "There are many researchable topics in agriculture. Some are important." Problem recognition can be difficult for some scientists, who have been known to become interested in a method or technique or a machine and therefore tend to look for some way to use these. That is usually not an effective way to identify problems. Another axiom states, "In agricultural research, pick the low apples first." This means don't pick the hardest problems first; if there is something going on in which research can make an

early impact, tackle those first. Problems in agriculture may be continuing ones, such as the constant search for host plant resistance to help solve pressing production problems, or they may be just emerging, or they may be management problems related to the production environment for crops or animals. It is the business of agricultural research to identify problems and move on to their solution— sometimes in disciplines, sometimes in multidisciplinary teams. In our brief visit, we have been impressed that the ARC and its units seem to be identifying important problems. Moreover, NARP has significantly contributed to this by supporting new research initiatives.

5.3.5. Ability to solve important problems

Once identified, problems must be addressed. This is the bread and butter of an agricultural research institution. We have been impressed with the array of research and flow of research results from the programs supported by NARP.

5.3.6. Able, motivated, well-educated pool of scientists

Here Egypt doesn't have to take a backseat to anyone. The pool of scientific talent is remarkable in its educational attainment, intellect, and potential. What is not so satisfying is that the pool of talent is not used as well as it could be for the benefit of the country. The reward system is part of this; so is the organization and management of research. NARP knows of this, and has done much through collaborative research grants and research grants to recognize and support scientific talent in the ARC, the universities and other research institutions. Egypt could have the finest agricultural research establishment anywhere if it could use its pool of talent to its full capacity.

5.3.7. An institutional management capability to make the best use of available resources and to provide an environment in which scientists can make best use of their talents.

The assessment team was not able fully to evaluate progress in this area. However, this has been a major objective of NARP—to enhance management capabilities of research administrators or managers. Given the efforts expended in this area through NARP, this is an area which should, in time, show marked improvement. This is an area, however, which greatly needs continued attention. This is an area which, historically, has been weak.

5.3.8. Facilities, equipment and support sufficient that reliable research can be done and problems solved

This is an area that has been significantly improved through NARP and preceding USAID-supported projects. The Genetic Engineering Institute laboratories and facilities, made possible through the New Initiatives Component funding, are world class, with excellent personnel and

apparent high performance. So were the Rice and Major Cereals facilities at the Sakha Rice Research Center. These were in sharp contrast to the conditions of laboratories and equipment ten years ago as reflected in the report of the 1984 USAID-sponsored Mission to study research and extension in Egypt.[1] Many laboratories and other facilities are being renovated and provided with modern instruments and other equipment through NARP. However, many of these improvements are yet to be completed. There still remains many old facilities which are in dire need of improvements similar to those made possible through NARP. However, improvements which have been made should greatly enhance the capacity of ARC to do good work. The ability to maintain this capacity will depend upon the continuing support of the Government of Egypt after the termination of NARP.

5.3.9. An institutional culture that places heavy emphasis on serving the farm and farmer

It is evident that research efforts in Egypt are and have been strongly oriented to serving farmer needs, with emphasis on improving the efficiency and effectiveness of farming operations and the income of farm families. NARP is focusing on ways of further improving this responsiveness to farmer needs by establishing the four regional research and extension councils, with farmer representation, and a mission of enhancing such responsiveness. The technology transfer program of NARP is also focusing on improving an extension program with similar objectives—building programs from "bottom-up" to reflect farmer needs rather than a "top-down" approach, which imposes the objectives and desires of government bureaucrats on farmers and their operations. NARP is contributing to much progress in this area.

5.3.10. A system that gains the confidence of the agricultural community

It is difficult to evaluate in such a limited time whether the agricultural community has confidence in this sytstem. In the past, however, the Ministry of Agriculture and its various components have had a major role in regulating what farmers do—mandating the production of certain crops, setting low prices for the crops they grow, etc. Such a system is not conducive to winning the high confidence of the agricultural community. With major policy reforms, however, this is all changing as farmers gain much freedom to make decisions about their farming operations and receive greater assurance that they will enjoy fair prices for their products. Again NARP and earlier USAID-sponsored efforts have contributed to this. Moreover, the technology transfer program is aimed at supplying the information to farmers that can help them in making decisions concerning their farming operations. During farm visits, farmers were very outspoken in their apparent appreciation for how research and extension programs were helping them.

5.3.11. International recognition and effective collaboration

We believe NARP has been particularly effective in meeting the objectives of international recognition and effective collaboration. A major focus of NARP has been to facilitate and

foster collaboration. This objective has been pursued through active collaboration between the Agriculture Research Center and (1) other Egyptian institutions engaged in agricultural research, (2) international agriculture research centers, and (3) U.S. universities and USDA. This has greatly benefited Egyptian as well as U.S. institutions and international agriculture research centers.

Certainly Egypt is beginning to receive the international recognition it so richly deserves—as one of the most productive agricultural countries in the world and with a research program that has contributed greatly to that productivity. Evidence of that recognition was observed during the assessment team's stay in Egypt when a high-ranking delegation from one of the other African countries visited Cairo and asked the Government of Egypt to assist in their agricultural development efforts. The assessment team believes that Egypt, with its demonstrated capabilities in agricultural research, could render great service to other developing nations through such assistance.

5.4. Summary of Egypt's enhanced capacity in agricultural research

There is strong and unmistakable evidence that NARP is greatly enhancing Egypt's capacity to do excellent agricultural research. All of the capacity-building indicators discussed herein point strongly to such enhancement.

5.5. Some further documentation of NARP's success

Some of the improvements in Egyptian agriculture to which NARP has contributed were documented by the CID/NARP staff in 1990 and are listed here. It should be noted that such a list could be greatly expanded today. Following are some of the successes documented in 1990 (listed by the headings on the written material):

- Increased dairy products resulting from liver fluke control.
- Mastitis control boosts milk production.
- Machinery research and development assists private sector manufacturing.
- Organizational and biological success in tomato production.
- Sugar beets decrease need for (sugar) imports.
- No-till cotton boosts yields and saves time.
- NARP provides 265,000 research training days (many more since).
- Collaborative research targets high-priority goals.

- Interdisciplinary research applied to problems in New Lands.
- Management system ties plans, budgets, and results.
- Public-private sector combine research efforts.
- Technology transfer training connects former to research.
- Women farmers receive new technology in animal production.
- Development support for private sector.
- Certification improves genetic purity of seed.
- Preventing new world screwworm in Egypt.

5.6. Overall evaluation of NARP, its program content and leadership

5.6.1. Criticism of NARP and response thereto

We understand that NARP has received rather severe criticism from some sources, including a critical audit by the USAID Inspector General for Egypt. This audit, resulted in a prominent U.S. senator in 1989 criticizing the project and expressing serious concern about the effort. This episode and perhaps other incidents caused USAID/Washington and USAID Egypt to focus much attention on NARP leading to serious questioning of whether the project should even be continued. In fact there has been a major reduction in USAID funding and a total cancellation of important parts of NARP. About this time, serious questions were raised about the administrative management of NARP, leading to a change in leadership in 1990.

We were told by a senior USAID official that "many USAID and Government of Egypt actions, reaction and responses that hindered the project can be traced back to the early negative history." There were also changes in leadership on both sides of the project (three USAID Mission Directors, for example)—as well as "changes in direction as natural responses to different leadership management styles and visions."

This USAID official pointed to many interrelated issues: "decision-making on both sides, flow of funding, along with ARC politics, and USAID/Cairo—AID/Washington politics— all of which affected NARP management." We were also told that there have been delays in reaching agreements and sticking with them. "Agreements, made at the working level, were often delayed, overruled, or renegotiated later when reviewed at a higher level. This led to a serious loss of valuable implementation time, increased costs, frustration and misunderstanding."

It is believed that USAID also compounded the delays in the period immediately following

the audit problem in 1989. A senior USAID/Cairo official says: "This was a disaster. It forced USAID into issuing and approving of documentation within one of the most inefficient and control-oriented bureaucratic system I have ever seen. ... As a result of the delays growing out of this system, collaborative agreements were not funded on schedule, USAID was put on the defensive, and justification for no-cost extensions of activities were made simply because USAID was slow in processing documentation. ... In summary, USAID shared in delays especially in the processing of documentation, once agreement with the Government of Egypt was reached. Most of these delays can be charged to burdensome systems—the balance can be attributed to the negative name recognition and corresponding lack of support for action associated with NARP."

It is quite evident, however, that from the beginning of the Project there have been major delays in program implementation as indicated by disbursement records. This is reflected in table 5-1, which indicates that less than one-fourth of the obligated funds had been spent by April 1992, after some three-fourths of the projected time for the completion of the project has passed.

Table 5-1. Record of financial disbursements under NARP

Cumulative amount of project funds disbursed

As of ... (date)	Cumulative amounts (in thousands of $US)
10 November 1986	$3
10 September 1990	$35,399
12 July 1991	$50,150
15 April 1992	$70,000 (est.)

Source: USAID/Cairo

At any rate, the assessment team feels that the problems and delays were apparently contributed to by both sides, and the burden of responsibility for these problems and delays does not reside with one party alone—both must share some of this burden. Indeed, one somewhat disinterested party who has had an opportunity to study the program suggests that the responsibility for such delays might well be shared equally.

We should add that the major items serving as the primary basis for the negative Inspector General's report in 1989 have apparently been addressed in a positive fashion. In response to management difficulties that apparently occurred in the early years of the Project, a new leader of NARP was appointed in 1990.

The other principal issue raised by the inspector general—the failure of the Government of Egypt to provide its share of NARP funding—has also apparently been resolved. In fact, on March 17, 1993, the NARP director general reported to USAID that the total length-of-project contribution to NARP would exceed £E 240 million—an amount in excess of what the agreement called for.

We do not wish to dwell on this point because problems of this nature frequently occur with USAID-supported efforts in many developing countries. Given the magnitude of the Project, it would likely have been unusual if there had *not* been administrative difficulties and delays in implementation. Poor management should certainly not be condoned. However, it would appear that when serious questions were raised, the minister of agriculture responded by changing the leadership of the project. The new director general initiated major changes, including the establishment of an executive management program, with an impressive management information systems unit in his office.

Perhaps some of the earlier management difficulties grew out of the fact that the NARP administering unit was not established until some two years after the initiation of the project. The Executive Office, which reports directly to the NARP director general, has established a significant management information system, trained staff, and implemented an inventory system for all NARP units. Improved communication and reports from this system have helped NARP management and apparently improved relationships with USAID.

Since the change in leadership of NARP in 1990 there have apparently been no major management problems. There have continued to be implementation delays and other administrative difficulties that are undoubtedly irritating and frustrating. We believe such minor difficulties should not be the source of undue concern or criticism. Indeed such difficulty *must be weighed against the overall accomplishments of the project.* However, the effect of delays has been that the full implementation of the Project has not been on the schedule originally planned, and many of the improvements have yet to be completed—within a few months of planned termination of the project.

5.6.2. Leadership of NARP

In 1990, Minister Wally appointed one of his top associates, Professor Dr. Adel El-Beltagy, as leader of the project.

While it is not within our specific scope of work to evaluate the administration of NARP, in view of all of the earlier concerns, we take the liberty of making these observations.

We cannot evaluate the severity of any management problems that predate the assumption of the leadership role of NARP by the current director general. However, from all indications, many of the difficulties being experienced at the time were addressed in a timely manner.

Frankly, we have been impressed with Dr. Beltagy's leadership of NARP. He is obviously a good scientist, well versed on current developments in science related to agriculture, very intelligent and perceptive, and strongly committed to trying to accelerate the rate of progress in the area for which he has responsibility. Time limitations have not permitted us to evaluate his management skills. However, the overall achievements of the program along with the apparent absence of major problems, speaks well for his leadership.

Currently, NARP is undergoing an audit by USAID, but at the time of this report, the results had not been made public.

5.6.3. Scope and content of NARP program

We have also been impressed with the scope and content of the NARP program. Its various components, and subcomponents, we believe, were effectively and meaningfully formulated to address some of the major constraints and need of the agricultural research systems in Egypt. In fact, the project addressed many of the recommendations made in earlier USAID-supported missions to Egypt in the early 1980s.[1,2,3]

The progress being made in improving the country's extension effort through the technology transfer component of NARP is especially noteworthy. Although much still needs to be done to develop a truly effective extension program, the technology transfer component reflects, by all odds, a most impressive move toward a more effective extension program for the country.

We are also impressed with the Collaborative Research Program and the Research Grants Program. These efforts are involving some of the best research talent in Egypt outside of the Agriculture Research Center in supporting the national effort as well as developing very meaningful involvement with prominent world-class scientists in the United States and the international agriculture research centers.

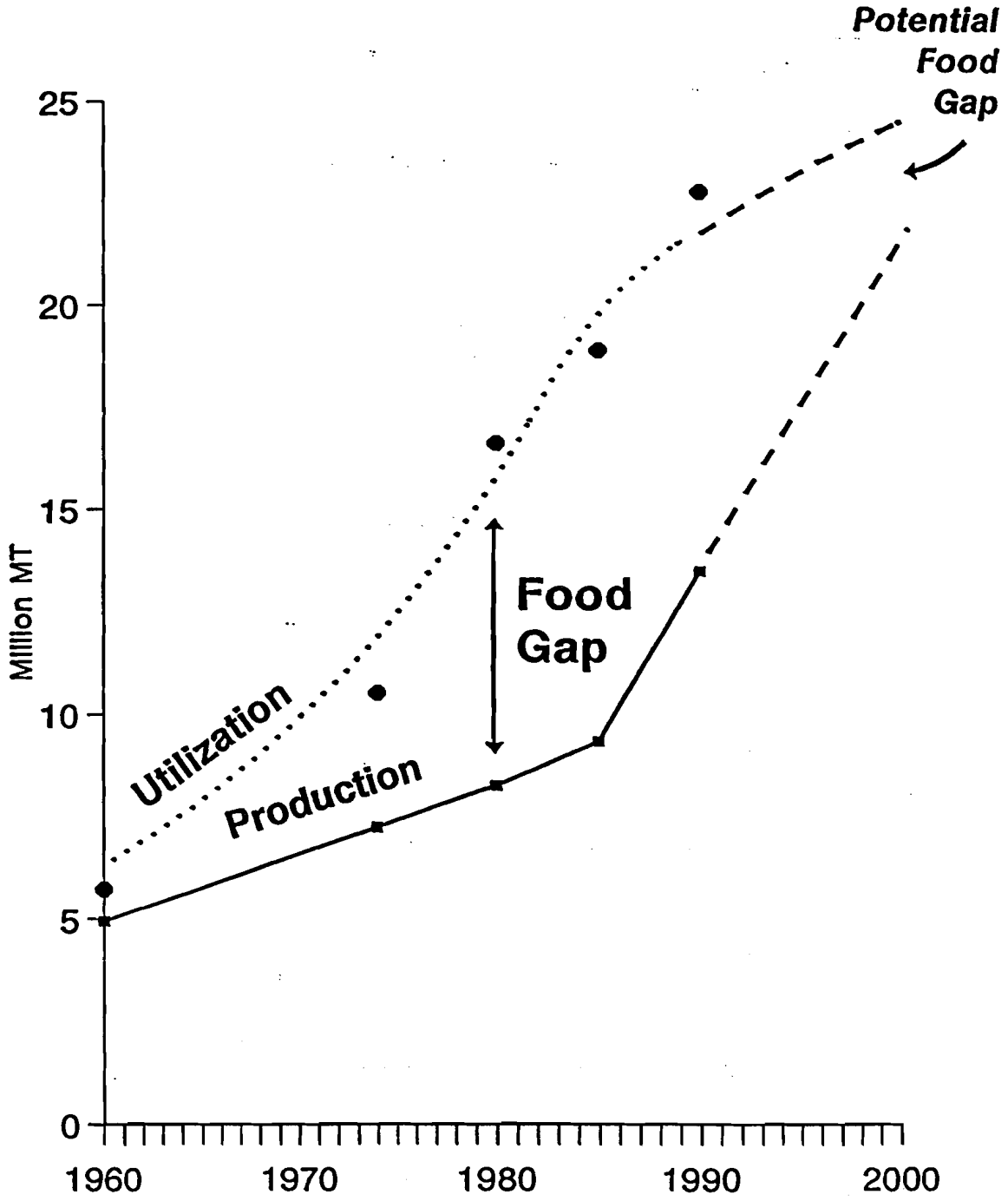
The NARP training program would appear to have been very successful in terms of providing an excellent array of both in-country and out-of-country human resource development effort to some diverse needs in Egyptian agriculture.

5.7. Reducing the "food gap" in Egypt

In the report of the U.S. Presidential Mission on Agricultural Development in 1982,[2] major attention was devoted to the "food gap" in Egypt. The gap had been rapidly increasing since 1960 when Egypt was essentially self sufficient in food (figure 5-5). Food production increased at a steady, but slow, pace from 1960 to 1980. However, utilization of the 10 primary food products wheat (and flour), maize, groundnuts, lentils, sugar, cooking oil, red meat, white meat, dairy products, and fish was increasing at a much faster rate, than production, especially from 1974 to 1980. If nothing were done to modify these two trend lines, by the year 2000 the food gap would have grown from approximately one million tons in 1960, to nine million tons in 1980 and 26 million tons in 2000.

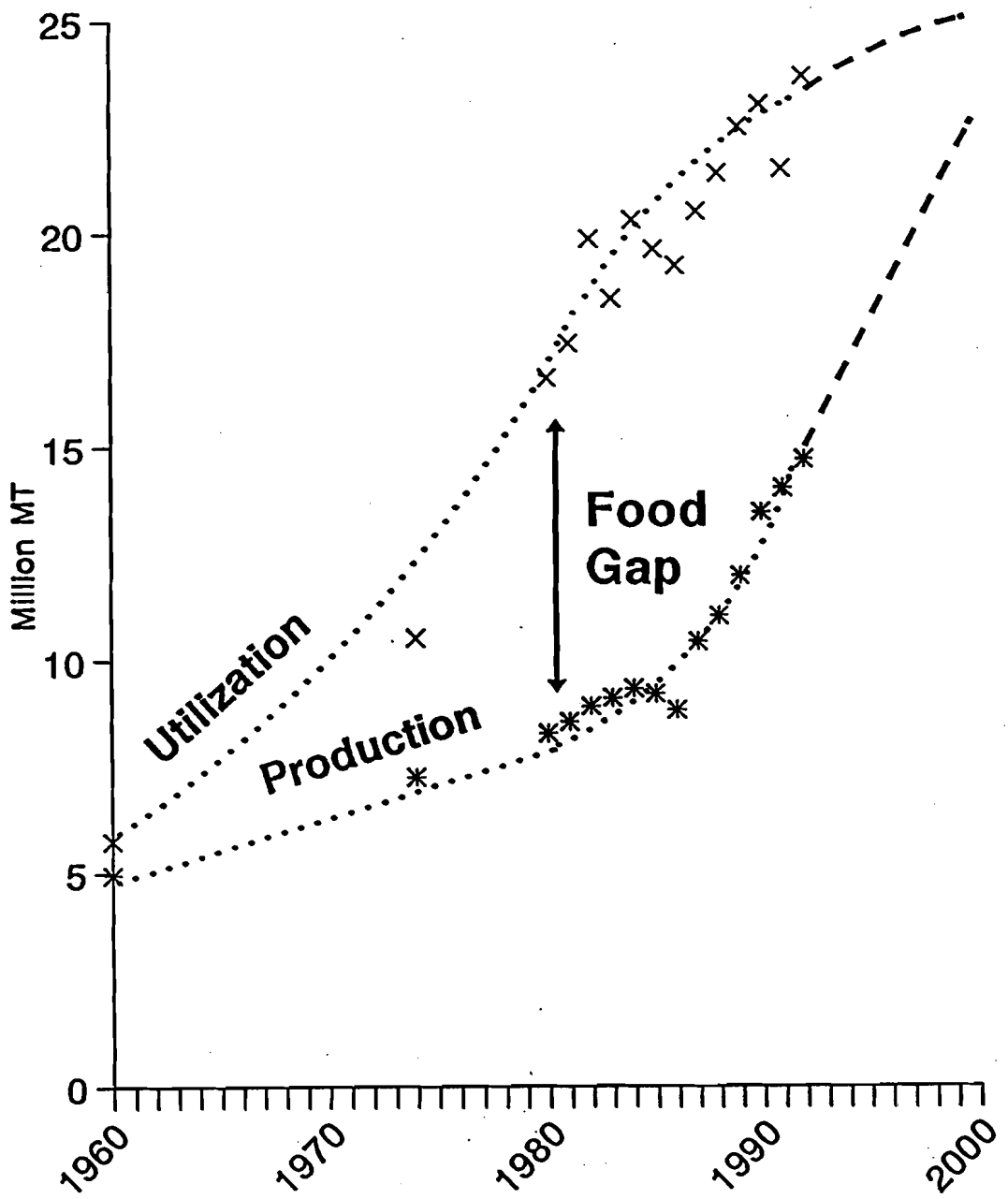
Changes in production and utilization from 1980 to 1992 are reflected in figure 5-6, along with extrapolations of the two lines to the year 2000. These data clearly show a sharp increase in production, primarily since 1985, with a distinct slowing down in the rate of gain in utilization. These two changes in the slopes of the two curves since 1980—when projected to the year 2000—show a food gap in 2000 of about 4.5 million tons. This gap is about 17 percent of the projected gap that would have occurred in 2000, based on the extrapolations of the trends in 1980. This is further illustrated in figure 5-7.

Figure 5-5. **Domestic food production and utilization (1960–90 with extrapolations to 2000).**



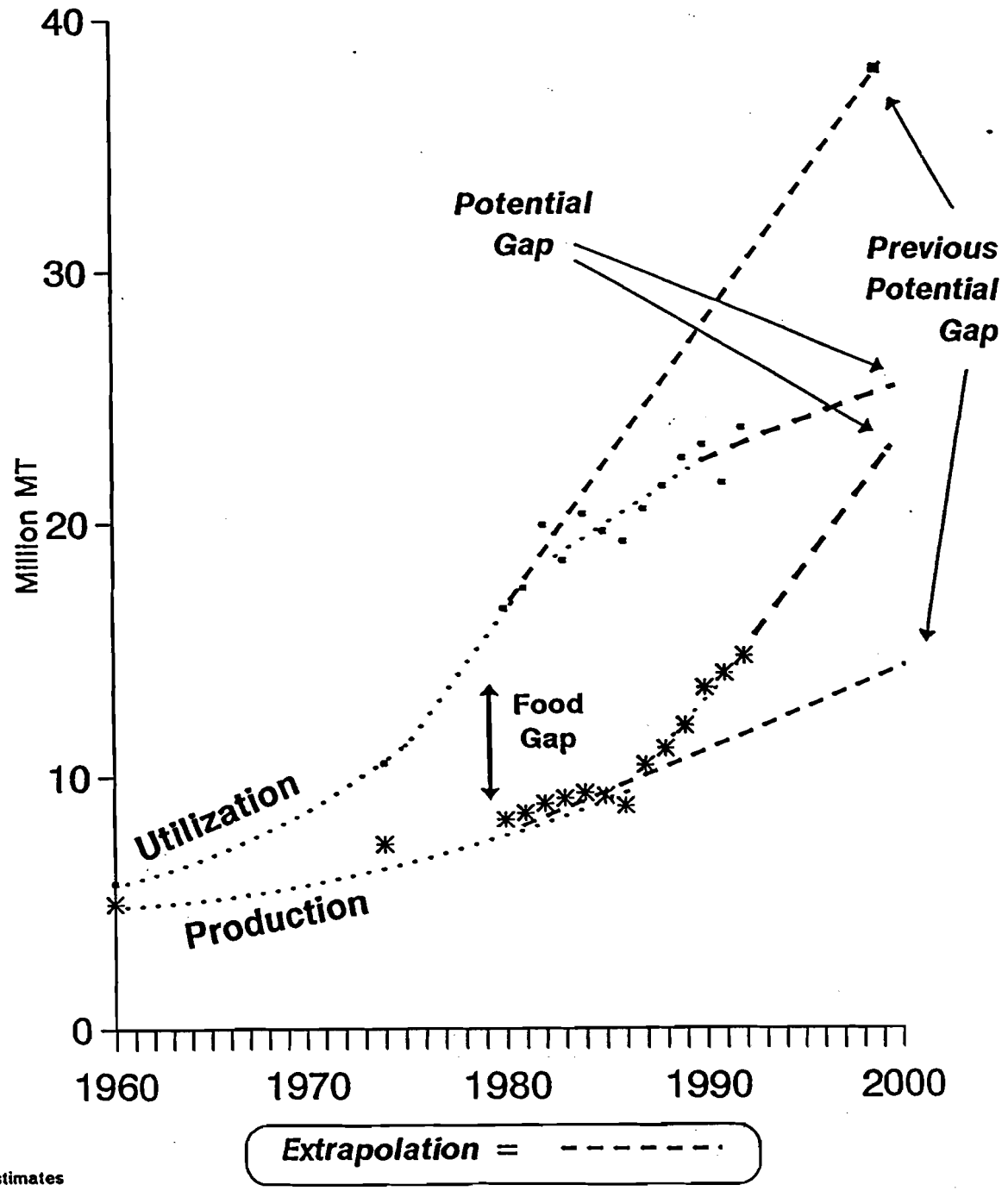
Team Estimates

Figure 5-6. **Domestic food production and utilization (1960–90 with extrapolations to 2000).**



Team Estimates

Figure 5-7. **Domestic food production and utilization (1960–90 with extrapolations to 2000).**



Team Estimates

Most of this narrowing of the gap resulted from the sharp upturn in production since 1985. However, it is obvious that the rate of utilization is beginning to slow down, as well.

Some comment about the rapid rise in utilization is appropriate. This was discussed in detail in the Presidential Mission report.[2] At that time, rapid increasing in wheat utilization were occurring because of heavily subsidized bread prices that were resulting in greater per capita use and much waste as bread was fed to chickens and livestock. More waste occurred as a result of the low, government controlled prices for wheat, which made it more profitable to mix wheat grain with the straw because prices were higher for straw than for grain. Moreover, the government was subsidizing the cost of feed grains to encourage the further development of the poultry and livestock industries. This also stimulated rapid increases in utilization. Furthermore, there is evidence that per capita utilization of products such as sugar also greatly increased during this period to satisfy consumer demands. The slowing down in rate of gain in utilization, shown in figure 5-6, reflects a decline in population growth as well as a slowing down in rates of gain in cereal utilization. The latter has resulted in changes in policies with regard to wheat/bread and a slowing down in rate of growth in the poultry and livestock industries. Moreover, it would appear that per capita demand for some commodities such as sugar may be reaching a saturation point and are, therefore, not continuing to expand.

Further evidence of these changes is found in figure 5-8, indicating self-sufficiency levels in maize and wheat from 1960–92. Wheat self-sufficiency dropped from around 70 percent in 1960 to about 21 percent in 1985 but turned sharply upward to 44 percent by 1992. Maize self-sufficiency dropped from around 94 percent in 1960 to a low point of about 72 percent in 1985 but was up to almost 80 percent in 1992.

These changes were also reflected in wheat imports that reached the maximum level of around 7.4 million tons in 1987 and dropped to around 5.3 million tons by 1993 (figure 5-9). Figure 10 vividly indicates the relationship between higher wheat production and reduced wheat imports in recent years.

It is interesting to note in figure 5-11 that both total and per capita consumption of wheat were continuing to increase until 1990—although the rate of increase for total consumption declined some from 1980 on. We understand that Egypt may have the highest per capita consumption of wheat in the world.

Figure 5-12 shows a somewhat different picture with sugar. The consumption of sugar increased dramatically from 1960 to 1985, especially from 1974 to 1985. However, total and per capita sugar consumption dropped significantly from 1985 to 1990.

These and other data indicate that the rate of gain in overall food consumption has been declining since the mid-eighties. This along with the sharp upturn in the production curve since that time accounts for the significant narrowing of the food gap as shown in figure 5-6.

Data in figure 5-13 indicates that little progress has been made since 1980 in improving the self-sufficiency level of vegetable oil, fish, and red meat. This would suggest that there is significant need to produce more of these products for domestic consumption.

Figure 5-8. Self-sufficiency in wheat and maize (Egypt: 1960–92).

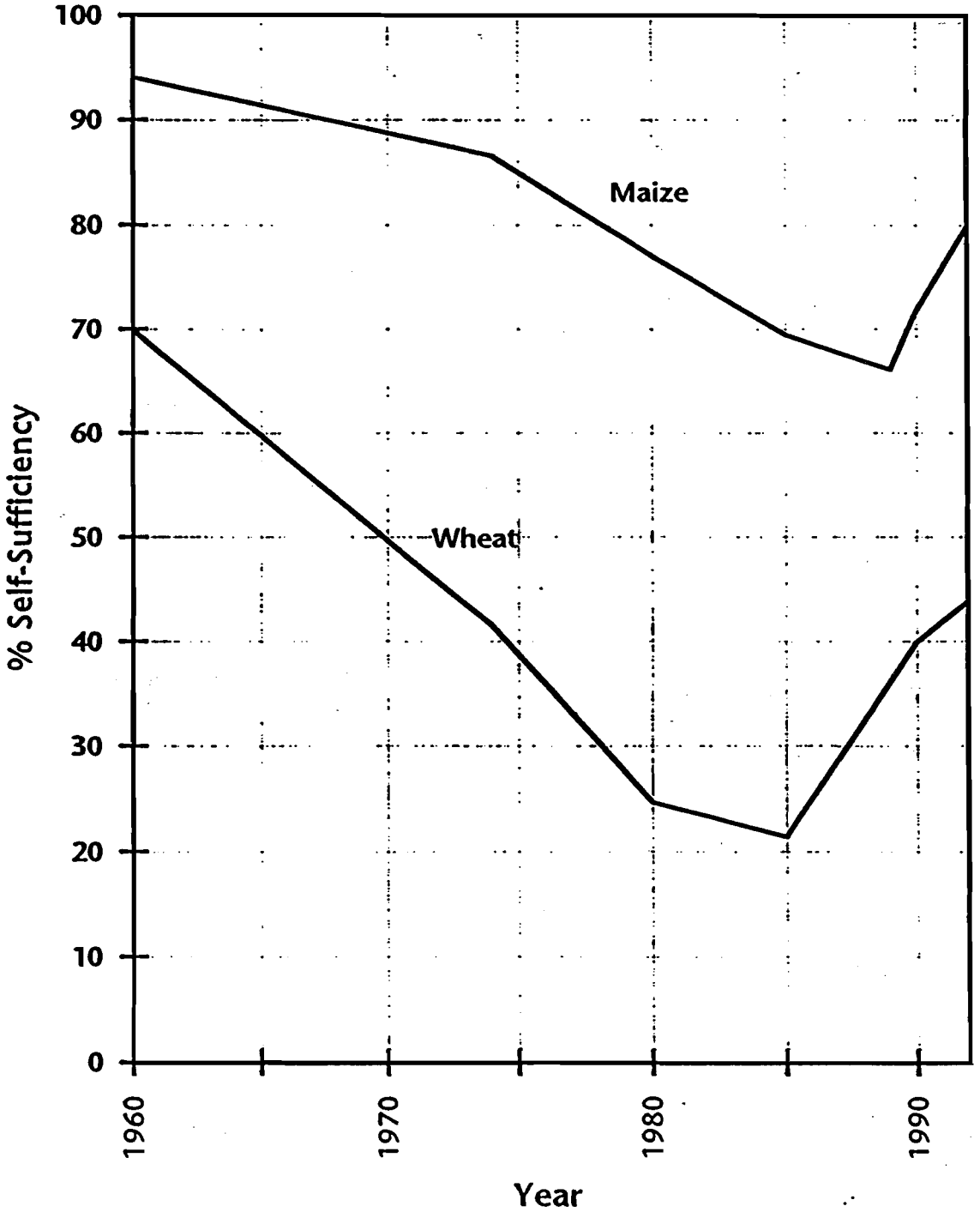


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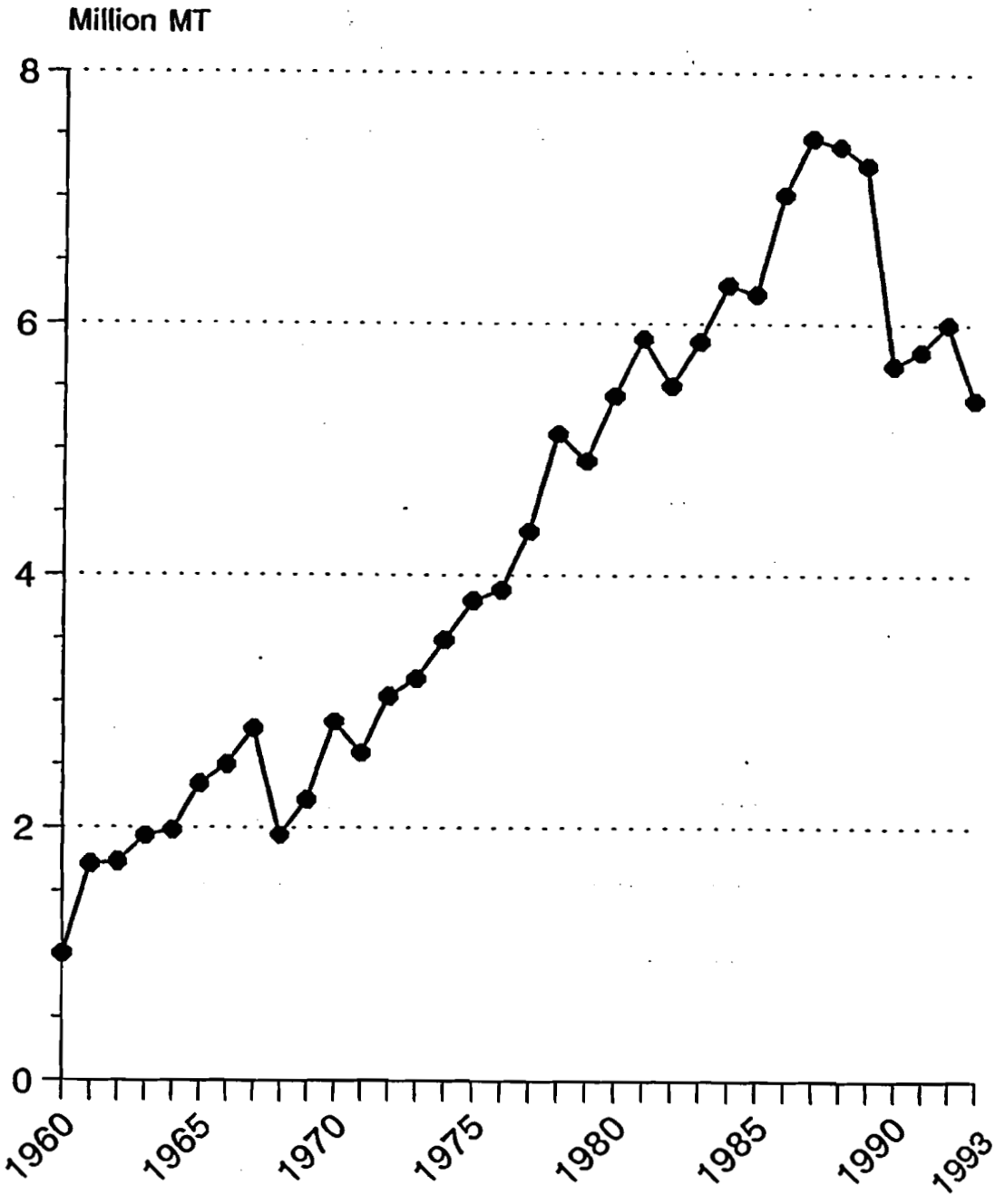
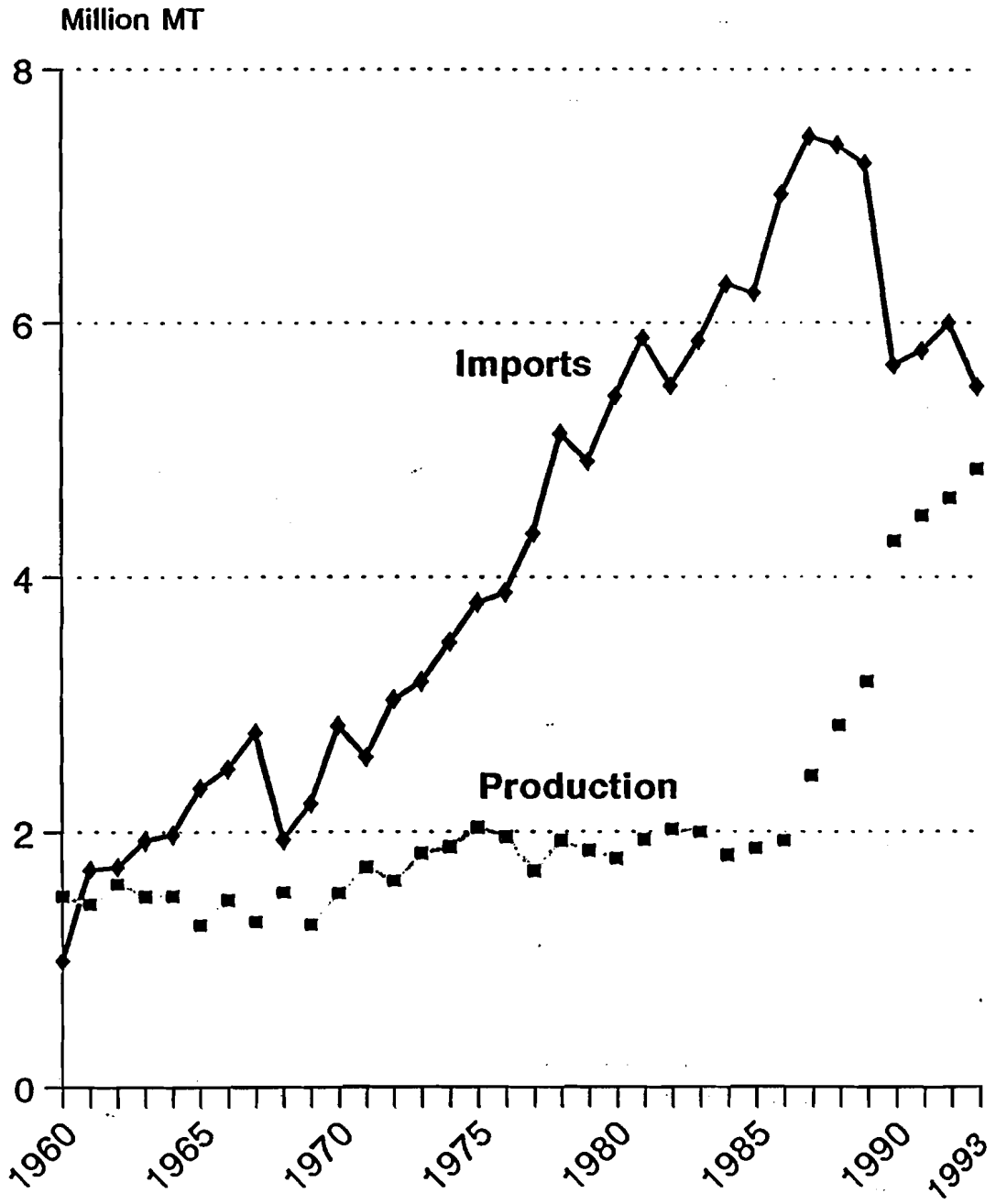
Figure 5-9. Quantity of wheat imports (1960–93).



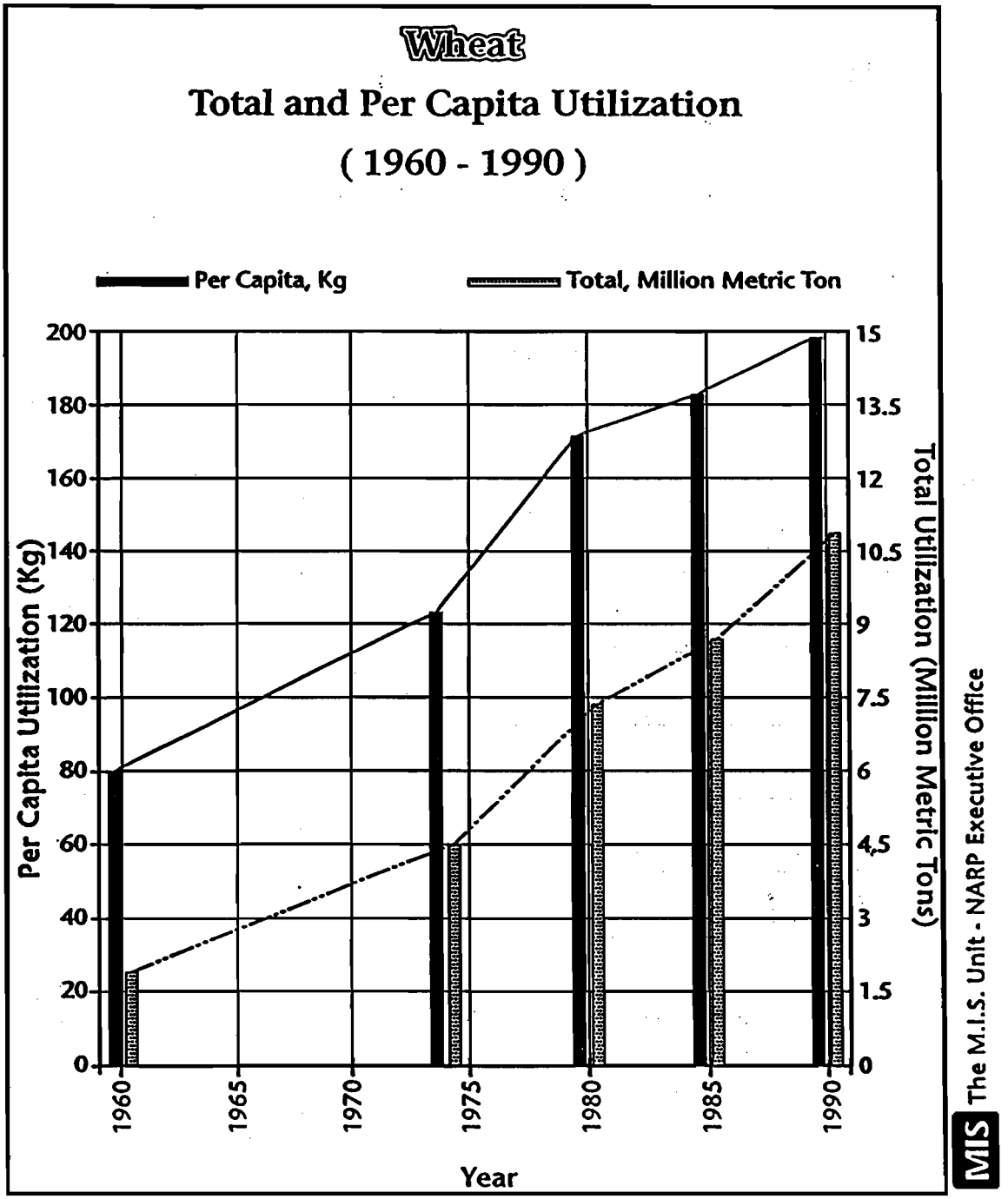
Source: USAID/AGR/ACE

Figure 5-10. Wheat production and imports (1960–93).



Source: USAID/AGR/ACE

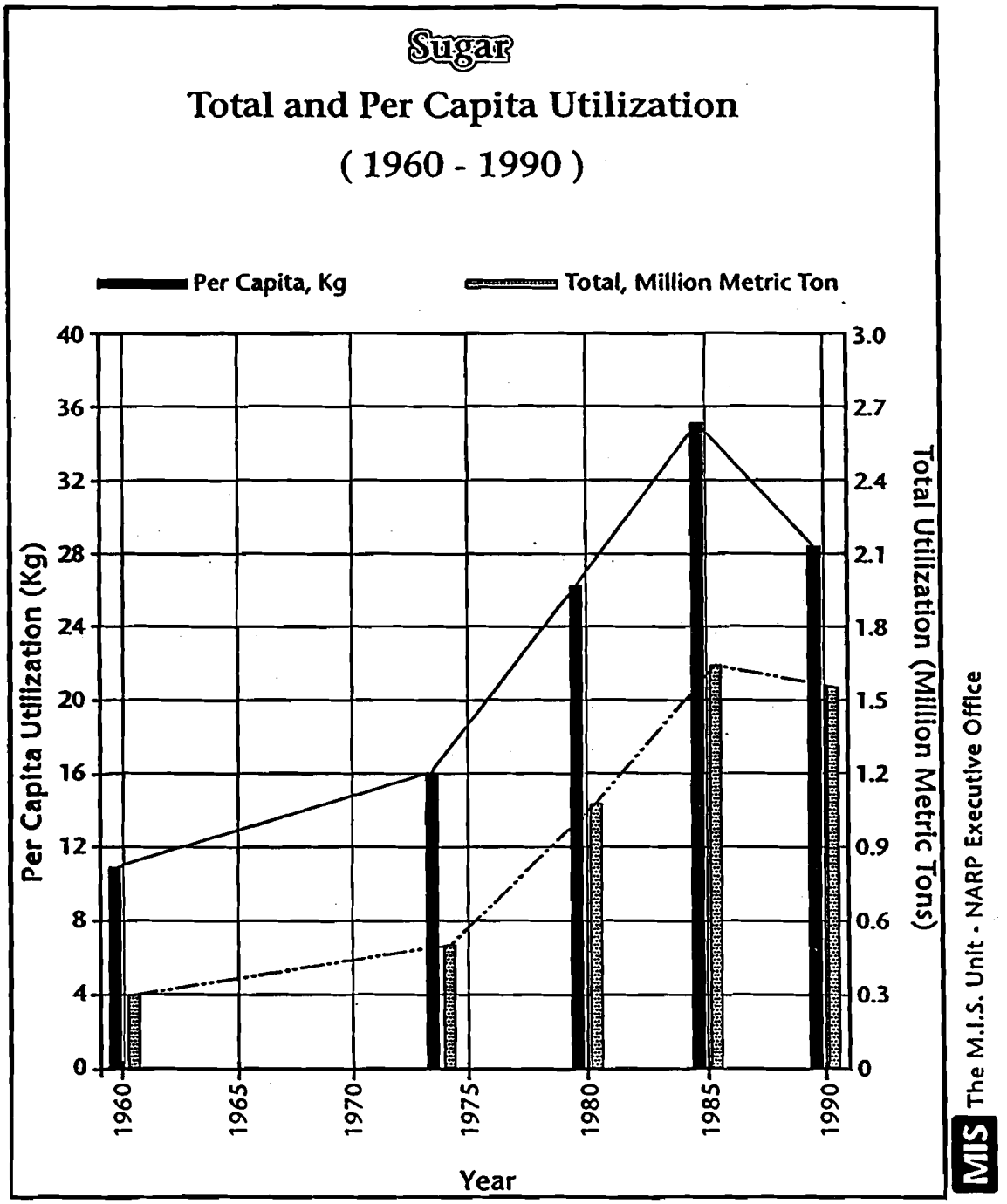
Figure 5-11. Wheat: Total and per capita utilization (1960–90).



Sources:

- *"Strategy for Agricultural Development in the Eighties for the Arab Republic of Egypt", Youssef Wally, et al.*
- *The Central Department for Agricultural Economics and Statistics.*

Figure 5-12. Sugar: Total and per capita utilization (1960–90).



Sources:

- *"Strategy for Agricultural Development in the Eighties for the Arab Republic of Egypt", Youssef Wally, et al.*
- *The Central Department for Agricultural Economics and Statistics.*

Figure 5-13. Self-sufficiency in oil, red meat, poultry, and fish (Egypt: 1981–91).

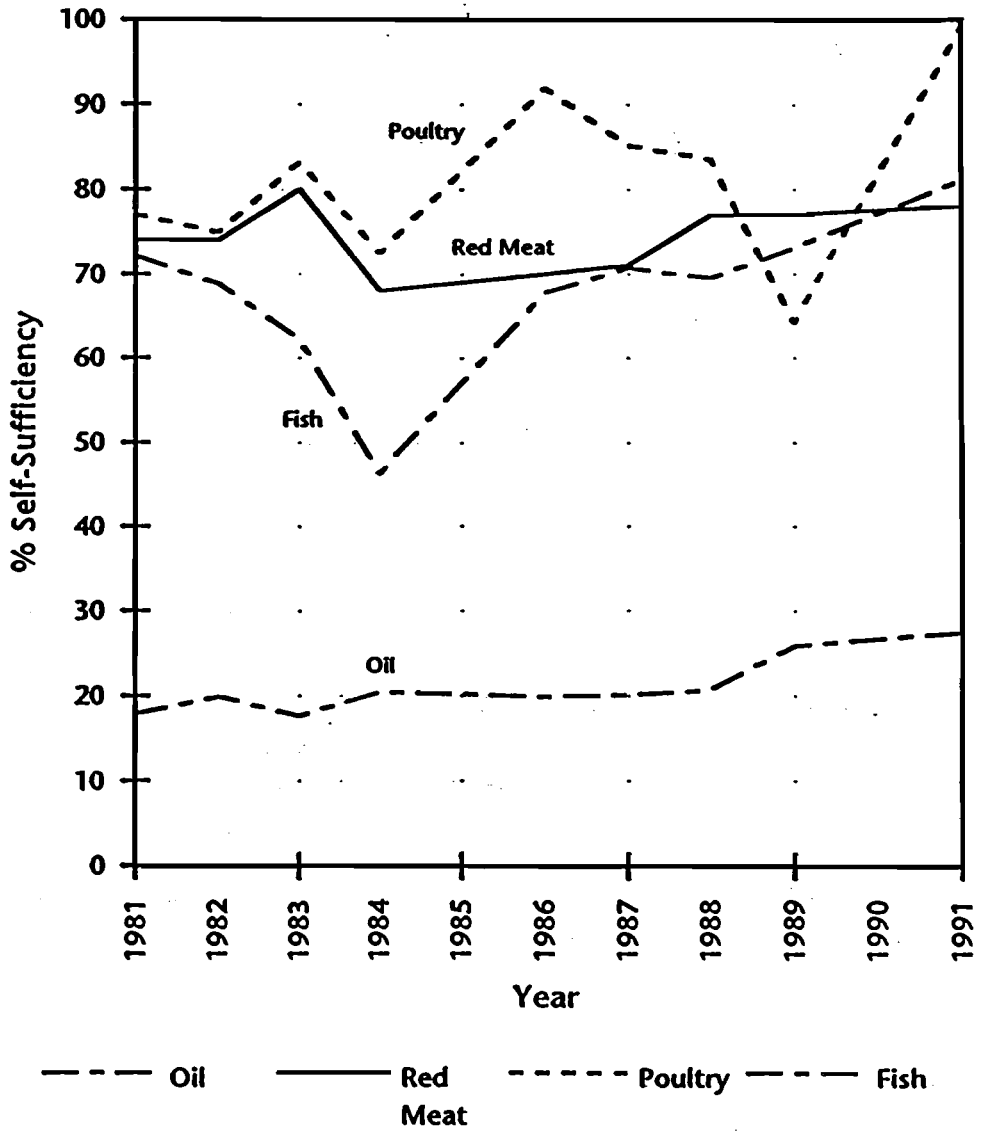


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Figure 5-14 indicates how the importation of vegetable oils has increased from none in the early 1960s to over 700,000 metric tons in the early nineties. This would suggest an obvious opportunity and need to increase domestic production in this area.

5.8. Self-reliant or economically self-sufficient

Perhaps Egypt should never be expected to close the food gap fully—or to become totally self-sufficient. However, it would be desirable for Egypt to become *self-reliant* or *economically self-sufficient* in food production. This would entail exporting sufficient products from agriculture to cover the costs of importing the agricultural commodities that are not produced domestically.

5.9. Opportunities for exporting high-value horticultural crops

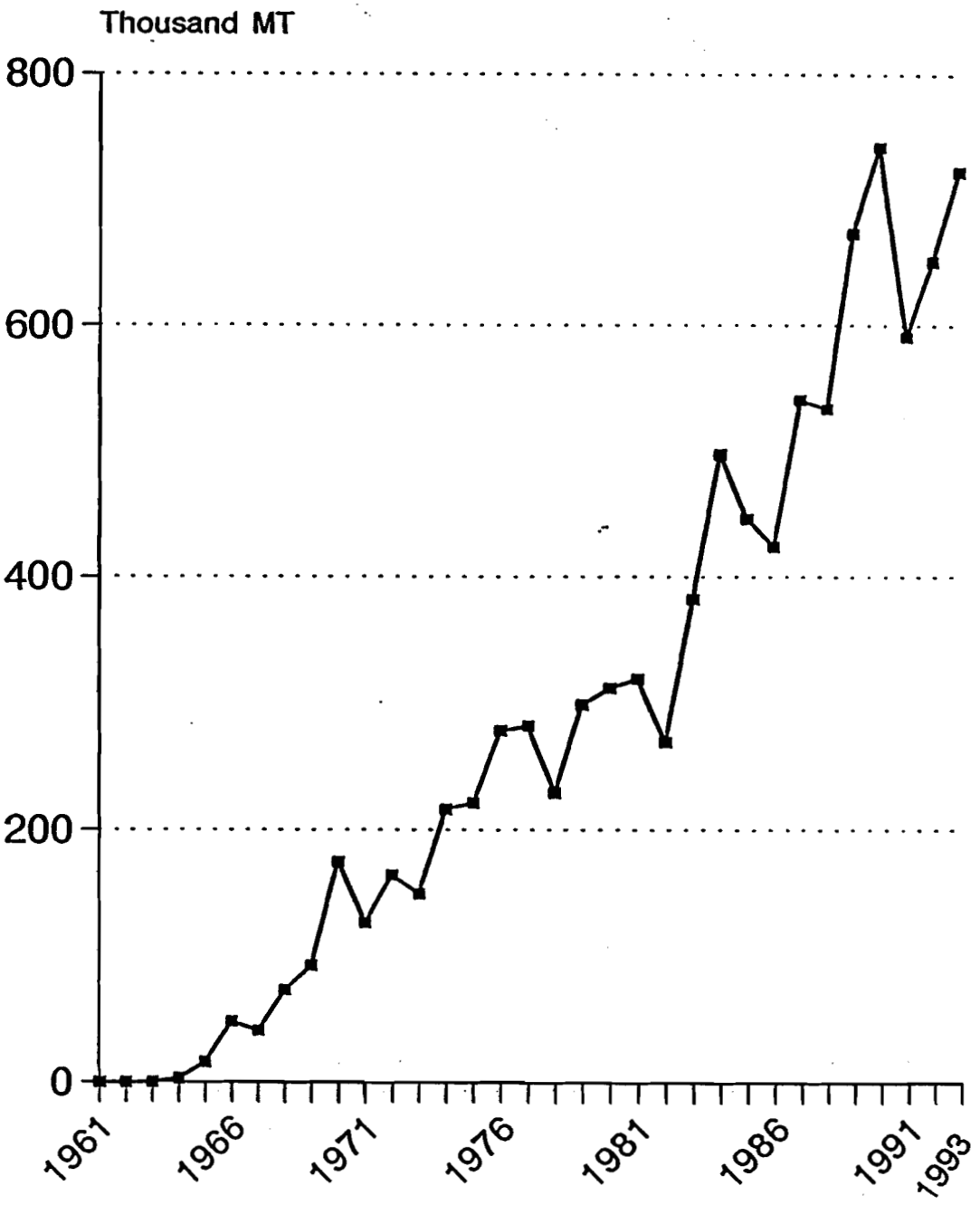
There would appear to be excellent opportunities for such exports—especially of higher valued horticultural products. Several factors make this feasible: the nearness to large markets in Europe and the Gulf States; the ability to supply these markets during winter months when needs in Europe, especially, are greatest; unusually favorable weather conditions including an almost totally frost-free climate; the ability to control water supplies; the absence of major, damaging storms, etc. In fact, Egypt has been likened to a large greenhouse in which environmental conditions can, in large measure, be controlled.

Egypt has, thus far, developed a very modest export market for horticultural crops. However, there is no stability in these markets. Figure 5-15 indicates the level of potato exports since 1961. Figure 5-16 shows the same for dry onions. Both indicate no consistent, stable level of exports from one year to the next. The same "up and down" pattern prevails for all other horticultural crops such as tomatoes, oranges, green beans, etc. If Egyptian farmers are producing enough to supply the high levels of demand in some years, they are undoubtedly producing too much other years when exports are significantly lower. We saw evidence of this in Ismailia in talking with several growers who said they had great difficulty some years in selling their strawberries and other crops.

Figures 5-17 and 5-18 suggest there are large export markets available but that Egypt is not effectively capturing those markets. For example, Turkey's exports of onions and tomatoes have been several times larger than Egypt's in recent years—despite the fact that Egypt should enjoy significant advantages over Turkey in terms of both nearness to large markets and growing conditions.

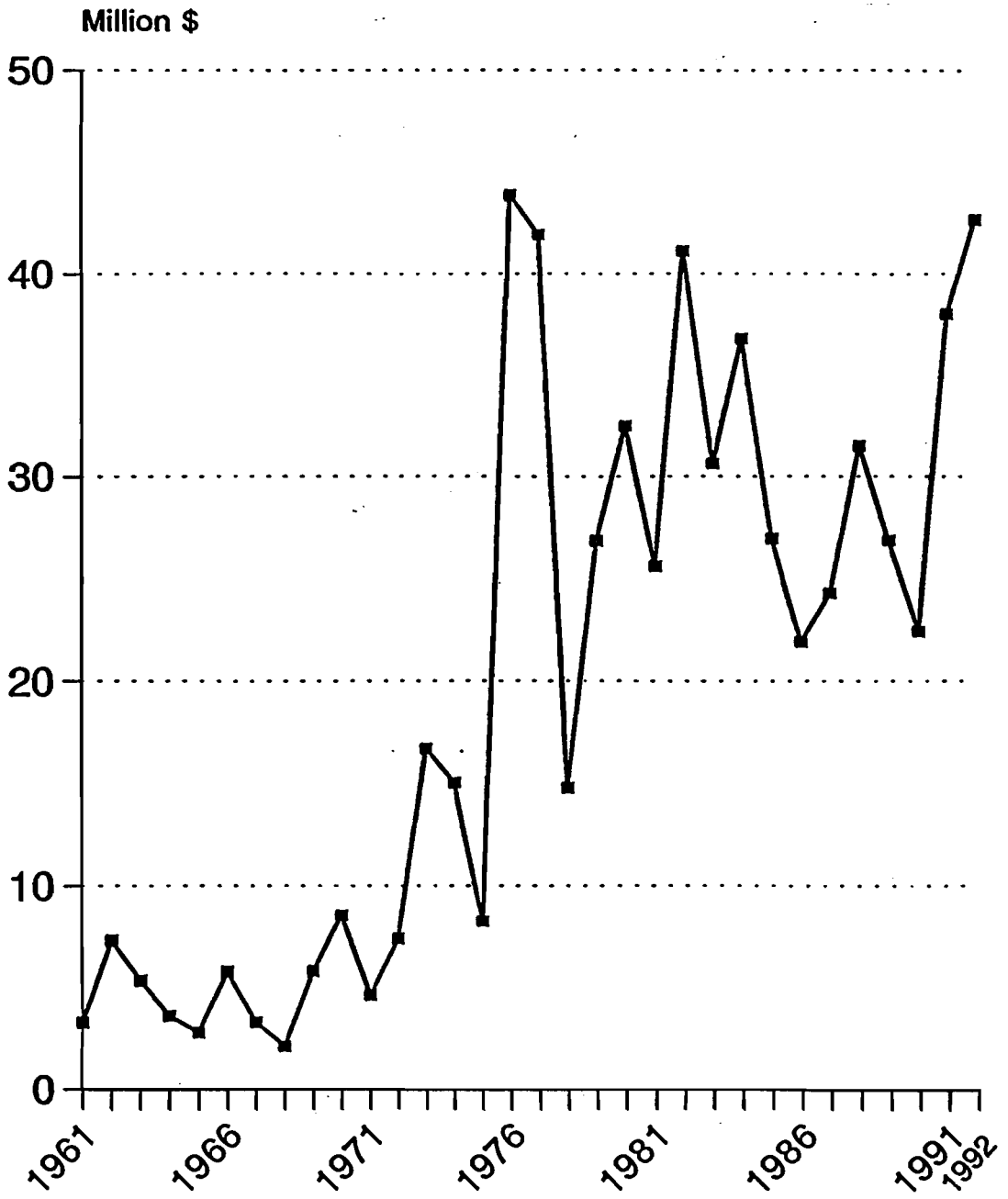
Obviously to be truly competitive in export markets, any country must consistently have available a high-quality product. This requires the development of a system of good grades and standards, handling procedures that do not damage the product needlessly, refrigeration facilities for storage and transportation, etc. To date, Egypt has done little in this area. There is urgent need for this to be done to take advantage of what would appear to be excellent opportunities.

Figure 5-14. Quantity of vegetable oil imports (1961–93).



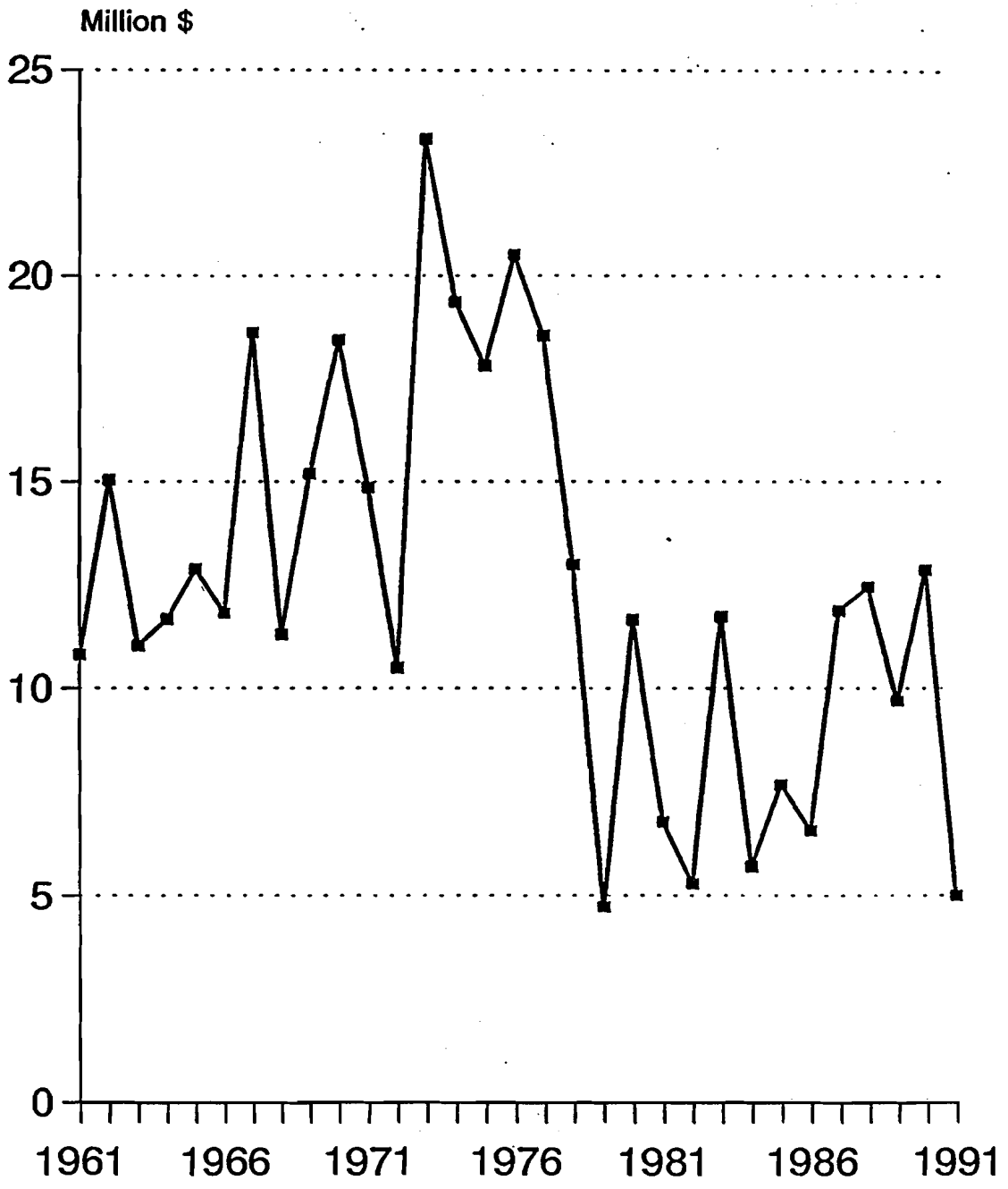
USAID/AGR/ACE

Figure 5-15. Value of potato exports (1961–92).



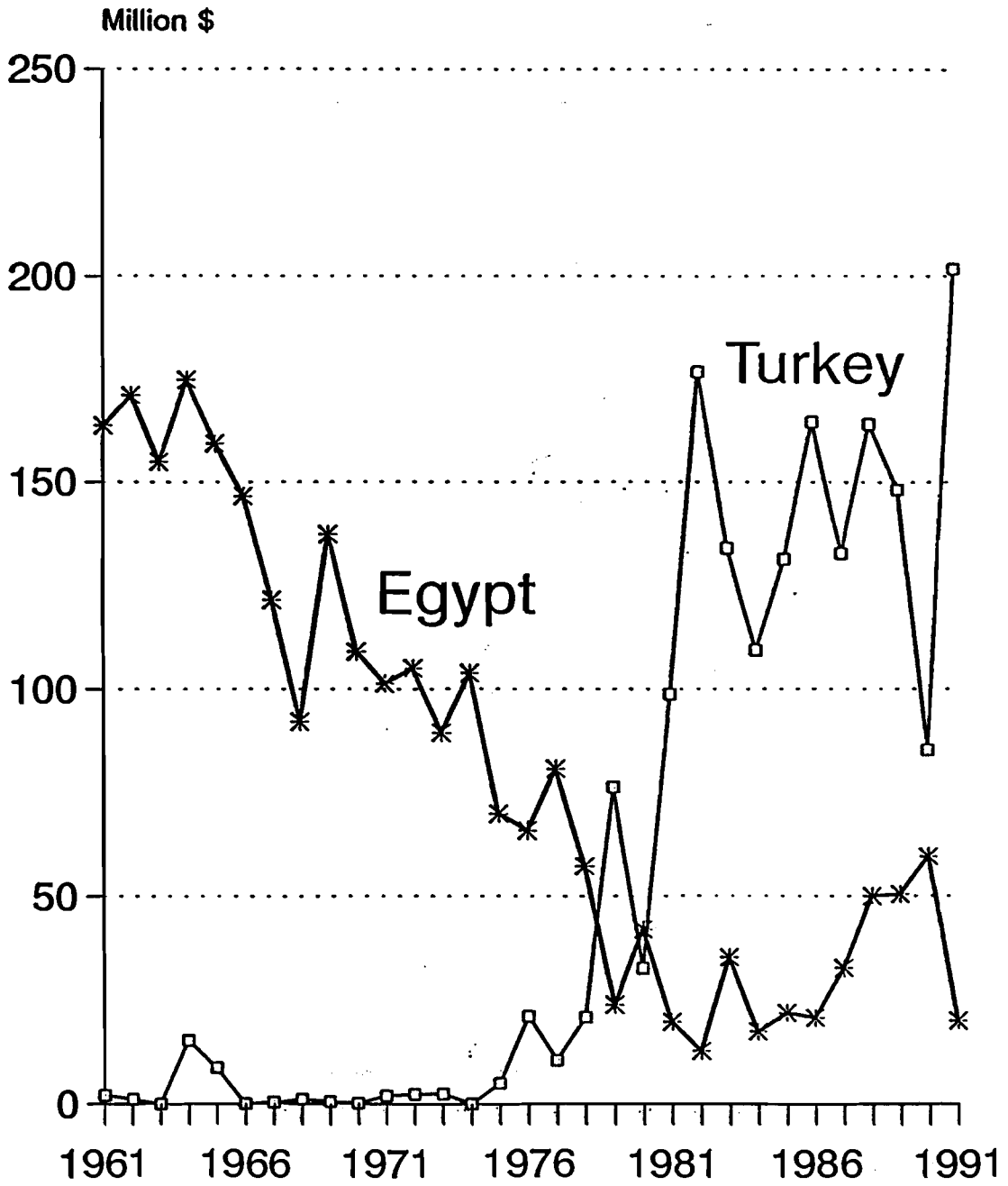
Source: USAID/AGR/ACE

Figure 5-16. Value of dry onion exports (1961–91).



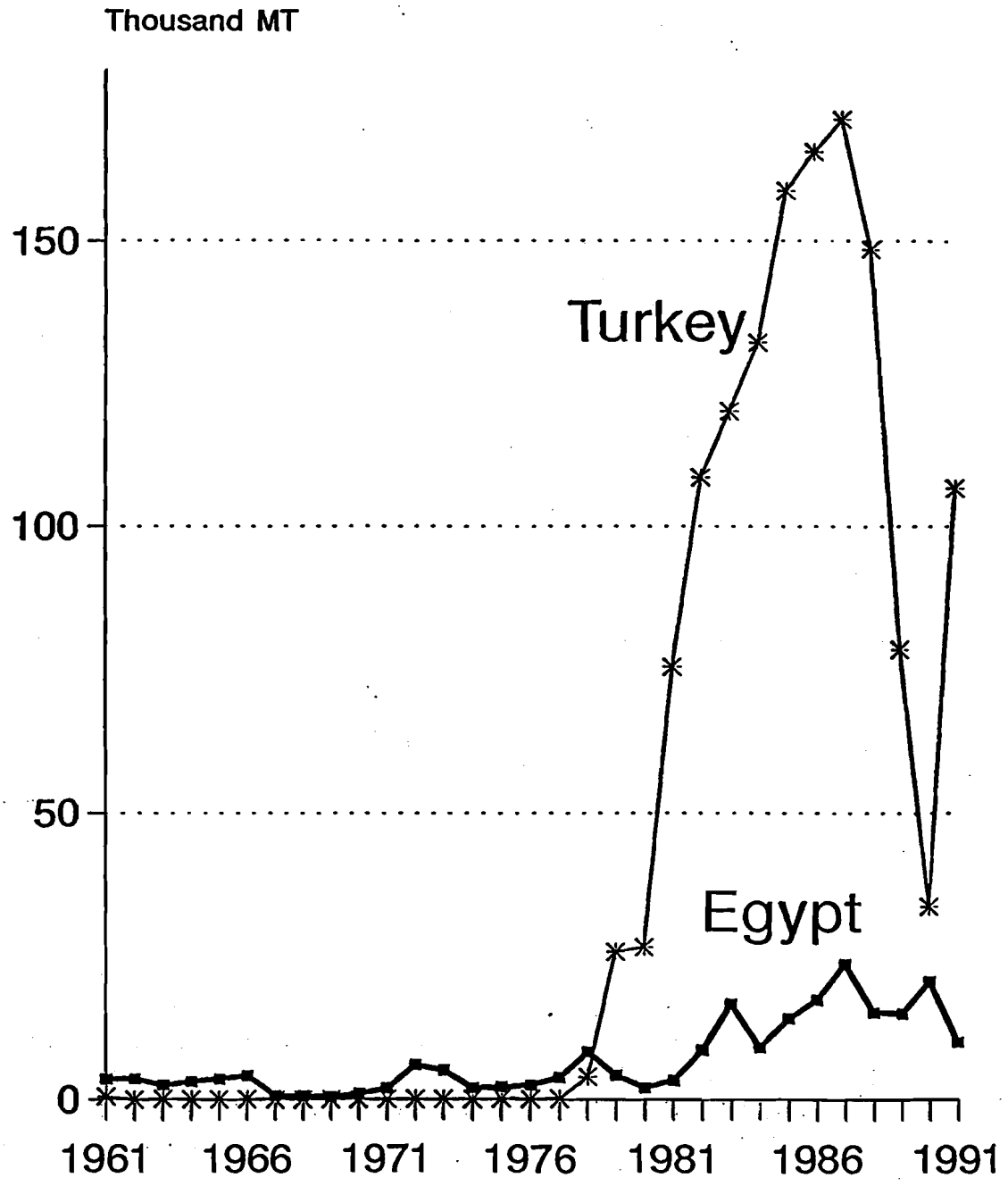
Source: USAID/AGR/ACE

Figure 5-17. Value of dry onion exports from Egypt and Turkey (1961–91).



Source: USAID/AGR/ACE

Figure 5-18. Quantity of tomato exports from Egypt and Turkey (1961–91).



Source: USAID/AGR/ACE

We think it is extremely fortunate that Dr. Kelly Harrison and a USAID-supported team of specialists in various horticultural fields are now exploring the opportunities for export markets with several fruits and vegetables. Their study should provide valuable information to help guide further development efforts in this area.

5.10. The need for better domestic markets for cereals and other commodities

With the move toward privatization of agricultural operations, there is a great need to develop effective storage and marketing procedures for commodities to meet domestic market needs. This is especially needed for cereals. We were told by some of the cereal research leaders that farmers come to them and say—"we use your recommendations and make a big crop, and then we cannot sell it for enough to make a profit." The researchers point out that at harvest time, farmers flood the market with their product because they have no storage facilities and they need income as soon as possible. With farmers all over the country doing this about the same time, prices drop precipitously. However, prices quickly come back up once the glut has been dispersed of.

This is no different than what has occurred in the United States and elsewhere. The problem may be dealt with by either the commodity producers forming commodity organizations or cooperatives, developing adequate storage facilities, and providing loans to the producer, if necessary, until favorable market conditions prevail. Another approach would be for the government to establish a program to store the commodity, lend the producer a part of the potential value of the crop and pay him the balance when the product is sold under more favorable conditions. Given the significant steps to privatize the agricultural sector we believe the first alternative is preferable in Egypt.

We strongly recommend that steps be taken to improve and further develop both domestic and export markets for agricultural commodities to better take advantage of excellent production capacities.

5.11. References

1. York, E.T., et al. "Increasing Agricultural Production in Egypt Through More Effective Use of Technology." USAID/Cairo. 1981.

2. York, E.T., et al. "Strategies for Accelerating Agricultural Development." Report of the Presidential Mission on Agricultural Development in Egypt. USAID/Cairo. July 1982.

3. York, E.T., et al. "Increasing Egyptian Agricultural Production Through Strengthened Research and Extension Programs." USAID/Cairo. 1984

6.0. Recommendations for Future USAID Support for Egyptian Agricultural Research Related Activities

The assessment team generally concurs that much of USAID's future support should be more sharply focused—although the broad-based support through NARP has been appropriate for existing circumstances. Indeed some continued broad-based support may be warranted to complete some aspects of the NARP improvement program.

6.1. Need to support basic Government of Egypt/Ministry of Agriculture goals

We are fully in accord with the current four Government of Egypt/Ministry of Agriculture major strategic goals for the agricultural sector, namely to optimize crop returns per unit of land and water; enhance sustainability of resource patterns and protection of the environment; bridge the food gap and achieve self-reliance in agriculture; and expand foreign exchange earnings from agricultural exports.[1]

To achieve such goals the World Bank Strategies for the 1990s[2] report suggests:

- the need for measures to ensure efficiency and environmental sustainability in management of soil and water;
- the need for emphasis on free market considerations;
- the need to implement an agricultural sector strategy within the context of overall rural development, including better involvement of rural women and diversification of rural activities;
- recognition of social and political issues and need for social safety nets, which may result from implementation of a comprehensive reform program;
- initiating a program of institutional reforms to strengthen the array of institutions serving agriculture and make these more responsive to needs.

Future USAID support in agriculture should be consistent with the four major strategic goals of the Ministry of Agriculture and supportive of the objectives suggested by the World Bank team.

6.2. Specific areas needing continuing USAID support

During the assessment team's visit to Egypt, we were asked a very pertinent question by a USAID staff member: "If Egypt is making all these advances in agricultural production, why is there need to continue support for further research-related activities in agriculture. Isn't this task now done so that we can move on to address other needs?" The simple answer to that question is that research to improve efficiency and productivity in agriculture is never done—at least as long as there are human mouths to feed, there is continuing need for such research.

In fact, a significant amount of such research would be needed merely to accommodate the food needs of a stable level of human population. But, global population is not stable. In fact,

over 90 million additional people are added to the world population annually—and Egypt's rate of population growth is significantly above world average.

International agriculture research centers such as CIMMYT and IRRI estimate that one-half to three-fourths of their budgets for varietal improvements are devoted to "maintenance" research—just to maintain existing levels of production. New strains of diseases and insect pests are constantly evolving, and other problems develop that require continuing research effort, merely to keep yields from falling.

Such constantly growing need, resulting from population growth, demands increasing levels of research—especially in situations like those found in Egypt where yield levels are already high. When a country reaches a very high level on the crop yield curve—as Egypt has—each additional increment of production may become more difficult to achieve.

But Egypt, because of its very limited arable land and water resources, is probably more dependent on research to expand food production than any other country in the world. Moreover, the primary beneficiary of such research is the consumer who is not only served by having not only an adequate supply of food, but also higher quality and less expensive food as well. Therefore, the need for a high quality, productive agricultural research program is *vital* to a sound economy and a stable political future.

Certainly, much has been achieved through past support of agricultural research but much more effort is needed.

6.3. A task half-done

USAID projects have contributed significantly to improving the productivity of Egyptian agriculture for some 15 years through their support of research, policy reform and other programs. NARP, we believe, has been a vital part of that effort for the past 8–9 years. However, because of significant delays in the implementation of the Project, along with major reductions in the amount of USAID financial commitments, there is still much to be done.

Although USAID is considering a successor project to NARP, it is obvious that it would be impossible to have such a successor project in place by the time of the planned termination of NARP. However, if a major part of the Project is terminated September 30, 1994, as now planned, much of the NARP structure could, and possibly will, be dismantled, and key personnel in NARP will move on to other things. We believe it would not be in either Egypt's or USAID's best interest for this to happen. There would be a tremendous loss of time, resources, and effectiveness of future effort if this were to happen.

The assessment team strongly recommends that the NARP project be continued essentially intact until a USAID-successor project has been designated and can be ready for implementation, and that much of the support committed to NARP by USAID in 1988 but decommitted in 1992 now be restored. Some of these resources should, undoubtedly, be used for those purposed for which the funds were originally intended. However, we believe there

should be some flexibility in the use of such funds at this time to address high-priority needs that have developed since these additional funds were originally committed. Frankly our assessment team has had difficulty understanding why USAID's commitments were drastically cut in the first place, given NARP's obvious success.

We also recommend that USAID and the GOE begin, immediately, to plan a successor project to NARP so it can be ready to be implemented as soon as NARP is finished. The task to which NARP was committed in 1985 is by no means over. Indeed it may be no more than half done.

In the following sections, we make a number of observations and recommendations concerning future efforts of NARP (assuming the Project is continued) along with the nature of the efforts to be covered by NARP's successor project.

6.4. Egypt and the global agricultural research system

Ten years ago Professor Vernon Ruttan of the University of Minnesota called attention to the fact that we were moving toward a global agricultural research system. In his opening remarks was the following statement:"...[in the future] expansion of agricultural output will have to be obtained almost entirely from more intensive cultivation in the areas already being used for agricultural production. Increases in food and fiber production will depend in large measure on continuous advances in agricultural technology. It is imperative that over the next several decades we complete the establishment of agricultural research capacity for each commodity of economic importance in each agroclimatic region of the world."[3] Those were true and powerful words then, and they still are today.

Before World War II, there was little cooperation between countries in agricultural research or technology generation; therefore, most countries had to go it alone in developing necessary technologies. That is no longer true. Today, we have in place some major elements of what can be described as a global agricultural research system, within which any country can link its research efforts, to help solve important problems.[4]

The global system is made up of three major players: national agricultural research systems of developing countries like Egypt, international agricultural research centers, and advanced research institutions in more developed countries. These players interact in a variety of ways, including bilateral and multilateral agreements, contracts, and research networks. The system is founded on scientific and research needs. No one has passed legislation calling for its formulation, no one has appropriated funds to ensure its establishment. With its growth and development, it has become the world's largest collaborative scientific enterprise. Almost every country is involved in some way and has invested some of its own resources, mostly at home, to participate. Many developing countries worry that science and technology advances will continue to pass them by. The global agricultural research system provides a means for developing countries to participate in solution of important problems. Egypt, through NARP, is beginning to be a significant participant in this global system.

The global system, being informal, depends largely upon goodwill and the meshing of perceived needs of numerous research organizations. Self interest is a strong motivator, and in the work of the global systems there is something of value for almost any country.

Egypt has had linkages with parts of the global system for some time. These linkages need to be expanded and strengthened in the future, especially through collaborative research.

Past linkages have been with CIMMYT in both maize and wheat improvement, IRRI in rice improvement, ICRISAT and INTSORMIL (the Sorghum-Millet CRSP), ICARDA through the Nile Valley Project in faba bean, and now the Nile Valley Regional Program for wheat, barley, and cool-season food legumes; the International Plant Genetic Resources Institute (formerly IBPGR), and with many American universities and institutions, including USDA. Of course, ICARDA, as the regional research center of the CGIAR in the West Asia and North Africa regions, has long had ties to Egypt and today maintains an office in Cairo near the Agriculture Research Center from which the Nile Valley Regional Program is administered and where staff from IRRI and IPGRI maintain their offices.[5]

Linkages with the international agriculture research centers have allowed Egypt to have ready access to global germ plasm collections of important crops. The benefits to the country are increased productivity and greater stability of production. New ideas, concepts, materials, training, and other benefits accrue from the peer relationships developed between Egypt and its IARC partners.

Linkages with U.S. universities and institutions and with institutions in other countries are effective and are essential. The Central Laboratory for Aquaculture collaborates with the Pond Dynamics/Aquaculture CRSP, and we were told the Bean and Cowpea CRSP also collaborates in research with Egypt.

In the future, Egypt must find ways and means to continue working relationship and linkages with elements of the global agricultural research system. Cut off from the larger scientific community, with little chance to share ideas, problems, or solutions, and lacking opportunities to collaborate in research on major problems, scientists will not be fully effective, nor will they be satisfied. The global system allows any scientist, any institution, any country the chance to participate actively in the search for solutions to common pressing problems and to share the benefits of them.

NARP and its successor project can be very helpful in enabling Egypt to expand linkages with the global agricultural research system.

6.5. Areas of emphasis for future USAID-supported efforts

We recommend that the following areas be emphasized in future USAID-supported efforts. (These are not in any priority order.)

6.5.1. Expand research collaboration both internationally and domestically

The need for international collaboration with IARCs and institutions in the United States should be a major goal of the Egyptian agricultural research community as indicated in 6.4. This has been one of the important features of NARP that should be continued and expanded. Research grants to universities in Egypt through NARP have not only encouraged collaboration, but have also helped these other institutions to focus their effort on major national problems and needs. Such efforts, therefore, have contributed to a much more coordinated approach to addressing important problems of the nation. Such grants need to be continued and, if possible, expanded.

6.5.2. Research on new lands

There is great need for more research on New Lands. The Government of Egypt is spending large sums of money in land reclamation efforts. There is need to make these new lands as productive as possible in order that greater returns might be realized from the large investments made in reclaiming these areas. There is very limited technology available for use in expanding agriculture onto these desert areas. Much of the technology developed for the Valley and Delta is not suitable for the New Lands. The New Lands Study made possible through NARP identifies many research needs for the New Lands (Annex §3.7.1).

6.5.3. Need to focus research activities on maintaining a sustainable agriculture

Essentially all agricultural research should be planned, conducted and evaluated with a *sustainable perspective*, and future USAID support should encourage such an objective.

The Technical Advisory Committee of the CGIAR provides an excellent definition of sustainability as "the successful management of resources for agriculture to satisfy *changing human needs* while maintaining or enhancing the natural resource base and avoiding environmental degradation." To satisfy "changing human needs" for agricultural products means that to be sustainable in Egypt, agriculture must satisfy *expanding* human needs.

In some circles, however, (especially in the United States) some groups attempt to equate sustainable agriculture with "low-input" agriculture, organic farming and other "alternative" forms of agriculture (alternative to "conventional" agriculture), which generally ignore the general need for increasing output. We do not agree with such characterizations.

Sustainability must, of course, be concerned with environmental or natural resource degradation issues. However, sustainability cannot be equated with low inputs. Actually, high inputs may be needed under many circumstances to "meet changing (growing) needs of people" for food and other agricultural products. If inputs are causing damage to the environment, research must help find ways of reducing or eliminating such damage while resolving the problems that such inputs were intended to address.

6.5.4. Breeding to reduce the need for pesticides

In keeping with the goals for sustainability (above), plant breeders should make every effort to breed crops with resistance/tolerance to plant pests. The development of such crops not only reduces the potential damage to human health and the environment from pesticides but can also reduce farmer costs. For the same reasons the development of biological control measures for pests should be encouraged. The further use of integrated pest management approaches should also be fully explored through research.

6.5.5. Development of cultivars more tolerant to environmental stresses

This should include tolerance to high salt content of soils and water, cooler temperatures, inadequate water, etc. Such research will be increasingly important as there is need to use irrigation water mixed with drainage water having higher salt content. There is need to explore ways to conserve water as supplies become more limited. Conceivably, cultivars can be developed that will give desired production with lower water requirements. The development of horticultural plants more tolerant to lower winter temperature in the northern part of the country, would also be useful.

6.5.6. Research aimed at producing more per unit of land and water

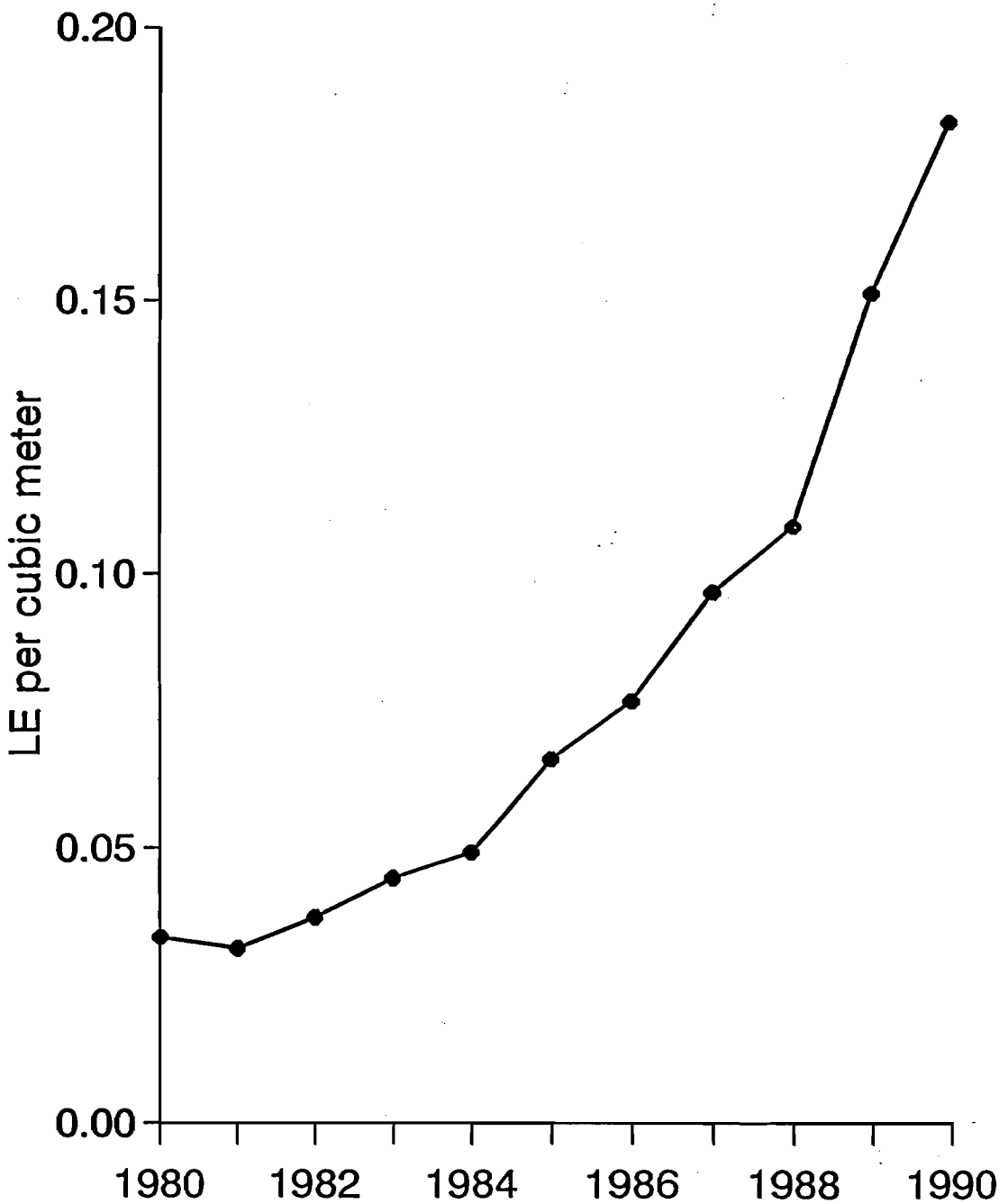
Work toward increasing the productivity of all crops per unit of both land and water will be vital in the future. Much research is already oriented toward producing more products per unit of land. This must be continued and even intensified. Given the likelihood of more limited water supplies in the future, increasing the productivity per unit of water must also be stressed. In a 1993 paper presented to an FAO meeting in Rome, Professor Dr. Adel El-Beltagy, director general of NARP, discussed strategies to use water for agriculture more efficiently and better maintain its quality.[1] The need for such efforts is clearly evident among Government of Egypt leaders.

It should be recognized that research to increase productivity per unit of land will give parallel improvements in productivity per unit of water, as well. Figure 6-1 shows the return from 21 crops per cubic meter of water in the period 1980–90. This curve obviously parallels the yield curves shown in §4.0 of this report. This should not be surprising in view of the fact that it may take little more total water to produce high yields than low yields. Thus, high-producing crops are very efficient users of water.

6.5.7. Public policy and data analysis

Dr. Ahmed Goueli, Governor of Ismailia, has done a superb job in characterizing the periods of change in Egypt's agricultural policies.[1,2] The period Dr. Goueli refers to as Economic Reform (1986–92) has provided a favorable base from which to encourage privatization of agriculture. Policies are being put in place and institutional changes are being made that will

Figure 6-1. **Returns from 21 crops per cubic meter of water (1980–90, water from the Aswan High Dam).**



Source: USAID/AGR/ACE

encourage private ownership of not only the means of production, but also the processing and marketing of intermediate and end products. The agricultural sector appears positioned to significantly increase development of the private sector.

It should be recognized, however, that with the privatization of the agricultural sector will be the need to continue policy work and economic analyses to deal with conditions that will likely result from such privatization. Such policy work is dependent of good statistical information. These two complementary functions, which were to be covered in the policy component of NARP, still need to be significantly strengthened in future USAID-supported work.

6.5.8. Market research and development

Our assessment team believes there is a great need for both research and development effort to improve and expand both domestic and international market capabilities—as discussed in §5.9. While research is needed to plan and carry out such marketing efforts, there is need to go far beyond research to help develop appropriate infrastructure to support such enhanced marketing capabilities. This could include assistance in developing grades and standards related to quality, the development and installation of facilities to handle delicate horticultural crops, the installation of cold storage facilities for storage and shipping for export, the development of storage facilities, especially for cereals, possible formation of commodity associations or cooperatives to help develop and coordinate such activities, etc.

Currently, inadequate marketing systems severely limit the benefits that farmers should be realizing from improved production. The two efforts, production and marketing, should go hand in hand.

6.5.9. Improved infrastructure

The improved infrastructure in the Agriculture Research Center made possible through NARP has had a major positive impact on the effectiveness and future capacity of NARP to carry on effective research related activities. There is much more to be done however. Many vital buildings (research and extension) and laboratories are still in dire need of renovation and modern scientific equipment. There is also need for more improvement in land used for research throughout the Agriculture Research Center system. Significant sums could be allocated to this.

6.5.10. Build on the experience of the technology transfer component and continue the improvement of extension

One member of the assessment team (Dr. York) was involved in several other USAID-sponsored missions the in early 1980s which, in part, led to the creation of NARP. From impressions then and now, he suggests that there has been great progress in improving the agricultural research effort, but considerably less progress with extension. Dr. York suggests that the

most significant improvement in extension since the early 1980s has been through the technology transfer component of NARP. The entire assessment team, most of whom has had extensive experience in extension-not only in the United States but all over the world has been very impressed with what this component has achieved. Such efforts obviously need to be continued and expanded until there is a strong extension program nationwide.

One complicating factor is that there is now a bifurcation of extension within the Ministry of Agriculture—with a deputy director of the Agriculture Research Center for extension plus an undersecretary for extension in the Ministry of Agriculture. There are also extension programs and specialists under the commodity undersecretaries in the Ministry of Agriculture—as well as specialists and programs under the deputy director in the Agriculture Research Center. A legitimate question is "who is administratively in the charge of the national extension program?"

The assessment team suggests there is a need for a brief follow-up to this Mission to have someone from the United States examine the issue of the administrative organization of extension within the Ministry of Agriculture–Agriculture Research Center—indeed on down to the governorate, district, and village levels. Such an examination would also have the objective of developing recommendations concerning how the technology transfer component of NARP could be effectively expanded and incorporated into the total extension effort nationally.

In that regard, one thing is now evident—that there is the need to make the same sort of improvements in extension in both New Land areas and in middle and upper Egypt (from Assiut south) as NARP has made possible in a number of governorates, primarily in the Delta.

As an indication of such need, some 10 percent of the people live in the area south of Assiut, but only 1 percent of the Agriculture Research Center staff and 1 percent of the agricultural faculties and staff live there.

6.5.11. Cotton ginning capabilities for breeding work

Original NARP plans called for new ginning facilities to serve the needs of the cotton breeding programs at the two research centers doing such work. Anticipating such new facilities, the old facilities were torn down at Sids and the other center at Sakha is still attempting to operate with equipment that dates back to the close of the 19th century.

There were apparently a lot of difficulties associated with this effort, including the fact that the estimated costs of the new facilities were greatly expanded. At any rate, USAID eventually canceled the effort. However, the need for such facilities is still readily apparent.

The assessment team, therefore, recommends that the issue be reexamined—looking, especially, at the issue of what the cost of such facilities to serve the needs of the *research program* would be, and determine the feasibility of still constructing these facilities. (Apparently, the original plans called for features that went considerably beyond what was needed to meet research needs.) There is an obvious need here to serve the breeding program. Further

consideration of this need and how it can be met is warranted and recommended.

6.5.12. Need for greater emphasis on research dealing with food animals

Various indicators suggest that progress in improving the production and quality of food animals is not nearly so impressive as with crops. Although time limitation did not allow us to examine specific research in this area, the apparent performance of the animal sector would suggest there is significant potential for improvement through a more concerted research effort. This need should be addressed through future research support.

6.5.13. Need for greater concentration on improvement of vegetable oil production

Egypt should have the ability to make significant progress in the production of vegetable oil. The importation of such oil has been rapidly expanding since the early 1960s (figure 5-14) despite the fact that Egypt should be able to produce such oil crops competitively with other area. We believe that support to strengthen in this area would be highly warranted.

6.5.14. Continued support in genetic engineering and other areas of modern biotechnology research

The assessment team was very impressed with the new Agriculture Genetic Engineering Institute in ARC, which was made possible through New Initiatives funding. We concur with the general orientation of the program, which is not to do basic work in genetic engineering but rather to take advances made elsewhere and apply them to Egyptian problems and needs. The laboratories and the research leaders, including the Institute Director, appear to be "world class." Indeed this program should allow Egypt to be on the cutting edge of research in this area.

Moreover, many of the research grants to universities are directed to supporting the practical application of other modern technologies in biotechnology.

Egypt is in an early stage of building capacity for work in this area. There is need to support such work until greater strength can be developed.

6.5.15. The "expert systems" program to be used by both extension and the private sector in technology transfer

A very impressive and innovative approach to effective transfer of technology is being developed through the "Expert System" program funded under the Research Component through the Collaborative Research Grants Program. This program with computers can be used by nonspecialized extension workers and private sector companies at the local level in helping to diagnose farmer problems and provide appropriate recommendations for dealing with them.

It takes considerable effort to develop one of these programs for each crop and food animal. Thus far only two or three have been developed. Many more are needed. A well developed program in this area could be of great assistance in enhancing the capabilities of extension workers and personnel in the private sector working with farmers.

A continuation and expansion of this effort is recommended. In a new project, this function might, logically, be placed under technology transfer/extension.

6.5.16. Human resource development

The NARP training program appears to have been very successful, and it would appear that support of this represents resources well spent. Having well-trained personnel is vital to further capacity building in the national research system. We believe, therefore, that the task in this area is not complete.

Consideration might be given, however, to the nature of future support for training. For example, Egypt produces large numbers of Ph.D. graduates. Some consideration should be given to the question of whether there might be more effective use of some of the training resources to send three or four Ph.D. degree holders for one year of postdoctoral work rather than one master's-level student for a Ph.D. program.

One area that continues to need attention is management training. Such efforts are vital to the future effectiveness of Egypt's research program. We believe, therefore, that future efforts should continue to emphasize such training.

6.5.17. On-farm water management

The need to improve the efficiency and effectiveness of water for agriculture demands that there be carefully structured and well coordinated program of on-farm water management research. Both the ARC and the Water Research Institute (WRC) in the Ministry of Public Works and Water Resources are currently doing such work. There may well be need for more assistance for such research; however, before that is done, **it would appear highly desirable for the on-farm water management work in the WRC be moved to the ARC to function along with researchers responsible for other phases of on-farm research. Unless there are strong reasons to the contrary, we recommend that this be done.**

6.5.18. Research to address long-term strategic issues

It is not too early for Egypt to begin to address long term strategic issues that are somewhat unique to this country—such as Egypt's limited arable land base and the growing recognition that water could be just as important limiting factor in agricultural production as land.
For example, sugar and rice are extensive water consumers. Should these two crops be replaced with crops less demanding for water? Partial answers are already being provided to

this question. Sugar beets may be able to replace sugar cane. Most of the rice is being grown down stream toward the Sea in areas where the salt content is higher—a condition that rice may be able to tolerate better than many other crops. The need to replace rice, however, is still not clear.

Another issue is a question relating to wheat and maize. Wheat, a winter crop, apparently takes about half as much water as maize, a summer crop yet the two crops produce about the same amount of product. If water became a *major* limiting factor in the future, less emphasis might need to be placed on land intensification, involving high water demanded crops, with more emphasis on crops that could produce more per unit of required water.

These are the types of long-term strategic issues that should begin to be studied now, drawing upon the knowledge and expertise from the U. S. and elsewhere.

6.5.19. Summary of needs for continuing support for research

The foregoing section suggests many areas that need further attention and would merit further financial support from USAID. It is not an all-inclusive list, however. Further study could undoubtedly identify other priority areas for such support.

The assessment team firmly believes that while great progress has been made over the past 15 years or so through USAID assistance, there is continuing need to develop strong and sustainable capacity to provide further support for agricultural research and related efforts. This is especially true until there can be developed means for assuring adequate financial support from local sources—Government of Egypt and otherwise.

6.6. Future funding for research-related activities

Our scope of work did not call for this but we would like to suggest some ideas for an enhanced level funding to support research-related activities.

At some point USAID support will likely be greatly reduced or cease. Hopefully that will not occur until a much strengthened research capacity is developed and until there is better assurance that there is adequate support to maintain the capacity of such enhanced programs.

The national research effort in agriculture will likely be primarily dependent on future Government of Egypt funding. We firmly believe that agricultural research and related efforts should receive higher GOE priority in such funding. However, given past experience, there is little assurance that this will be adequate to maintain a vigorous research program. Therefore, we suggest two possible approaches through which funds could be generated to complement Government of Egypt funding.

6.6.1. Check-off program with agricultural inputs and farm commodities

We recommend that consideration be given to the development of programs to generate research funds through farmer assessments/contributions. For example, a possible approach could be one in which each ton of fertilizer or feed purchased and/or each ton of product a farmer sells is assessed a very small percentage of the value, with the funds so generated being put into a special fund—to be used *only* for supporting *research-related activities*. The amount of the assessment would likely be no greater than one-tenth of one percent (0.1 percent) per ton—although different rates could be established for different items.

This technique has been used extensively in the United States. For example, some 40 years ago in North Carolina, North Carolina State University, the organization primarily responsible for agricultural research in that state, instituted what was called the "Nickels-for-Know How" program in which farmers agreed to be assessed a nickel (five cents) per ton for all feed and fertilizer purchased—with the funds raised going into the University Foundation for agricultural research. There have been similar efforts in many states involving small assessments on farm products sold.

A "Piasters-for-Pounds" program or something similar in Egypt could be effective—with farmers realizing that they are investing very modestly in programs that will pay them great dividends in terms of enhanced incomes, resulting from research.

6.6.2. A possible use of current U.S. funding for future support

In addition to direct funding for current programs, we recommend that while the United States is committing large amounts of money to Egypt, consideration be given to using some of these funds to establish an endowment, the proceeds from which could be used to provide continuing support for research-related activities.

Funds could be either in the form of U.S. dollars from Economic Support funding commitments or from local currency generated through PL480, PL416 or other U.S. programs. Funds from these sources could be put into a "special", nongovernmental foundation annually for several years through which an endowment could build up sufficiently to help assure that the progress made through current U.S. assistance could be sustained. The Foundation into which such funds would be placed could be governed by a joint Egyptian-U.S. board, if desirable.

A somewhat similar approach has been taken place in several other countries, using U.S. generated resources. In Costa Rica, for example, many millions of dollars worth of local currency generated through Economic Support funding, plus some direct dollar funding, was used for two programs: (1) to build Earth University in that country, and (2) to establish an endowment fund to provide a perpetual source of funds for CATIE, a regional institution located in Costa Rica. A member of the evaluation team serves on the board of the foundation, which governs the foundation. We believe a similar approach in Egypt should be feasible and effective.

6.6.3. The use of U.S. funds committed to Egypt

The U.S. government provides at some $815 million annually to GOE in Economic Support funding as the result of a program that grew out of the Camp David Accord in the late 1970s. In fact it was primarily these funds that were used to support the research programs discussed in this report. The continuing question is "how can these funds be used most effectively?"

A very strong case can be developed for putting significant amounts of these funds into the agricultural sector. Agriculture continues to be one of the three most important segments of the economy. Some one-half of the Egyptian people are engaged in farming or agriculturally related business/industry. Moreover, the agricultural sector has already enacted more reforms and has moved further toward privatization than any other sector and is therefore better positioned to use U.S. assistance more productively than any other sector.

We believe that high priority should be given by the United States to supporting the agricultural sector. We further believe that, at this juncture, support for functions and needs we have addressed herein should receive highest priority in terms of future U.S. support.

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2. Agricultural research and extension in Egypt[1]

A significant level of research into food and agricultural production is being conducted throughout the country and financed from many resources. Much of this work appears to be part of a carefully planned and well-coordinated effort reflecting national goals and needs. In order to achieve high production yields from every unit of land and high production returns from every unit of water (m^3), eighteen research programs were executed by the Agricultural Research Center (ARC) in its five-year plan (1993–1997).

Of the 18 programs, 10 are commodity oriented and 8 are discipline oriented. The 18 programs are dedicated to fiber crops (flax, kenaf, and sisal); cereal crops; oil crops; food-bean crops; forage crops; onion; sugar crops; horticultural crops; vegetables (including medicinal plants); ornamental and forest trees; animal production and animal health; soil and water; agricultural mechanization; pest management; food technology; agricultural economics; statistical designs and analysis; extension and rural development; genetic engineering; and aquaculture.

Similarly, a variety of extension efforts are aimed at getting farmers to use improved technology, but many of these efforts appear to be uncoordinated and independent of the formal government extension service. Through the technology transfer of National Agricultural Research Project (NARP), however, the administrative responsibility for extension programs within the governorates has been further strengthened.

Not all agricultural research and extension activities are centered in the Ministry of Agriculture (or bodies relating to the ministry). Although Ministry of Agriculture-related activities constitute a substantial part of the total agricultural research and extension effort, other organizations and institutions, both within and outside the Government of Egypt (GOE) are also involved and are considered a vital part of the national research and extension effort in agriculture.

This collaboration has been brought about through research as well as technology transfer grants. These efforts are still in their infancy, and there is much to be done. For these attempts to be fruitful, consideration of the 18 national research programs of the ARC (five-year plan, 1992–1997), the Regional Research Extension Stations, the Regional Research Extension Centers, and the Regional Research Extension Councils are good steps taken by NARP toward this end. These structures need to be institutionalized and strengthened effectively to extend the linkages between research, extension entities, and farmers.

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[1] Annex material was prepared by members of the Egyptian counterpart team of the NARP expatriate assessment team.

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The recently reorganized Agricultural Research Center, which is under the administrative responsibility of the minister of agriculture, has the primary responsibility for agricultural research, extension, training, animal health, fisheries, and land reclamation within the Government of Egypt. Other ministries, such as the Ministry of Public Works and Water Resources, because of their concerns with agriculture, have important research responsibilities as well.

Furthermore, other Egyptian institutions, such as the National Research Center, the Academy of Scientific Research and Technology, and universities, are also involved in research and, to a certain extent, extension. In addition, organizations such as the international agricultural research centers (CIMMYT, ICARDA, IRRI) are conducting research in the country either independently or in cooperation with government agencies. Following is a description of some of these organizations and activities.

2.1 Agricultural Research Center (ARC)

General organization

The ARC was initially established as a semi-autonomous organization with the minister of agriculture as chairman of the board. Although technically outside the Ministry of Agriculture, the ARC is generally considered to be a part of the Ministry of Agriculture since it was administratively responsible to the minister of agriculture.

The ARC has undergone extensive reorganization resulting directly from Presidential Decree No. 19 (January 19, 1983). This Decree established the ARC as a research and extension institution and gave it broad, general authority for agricultural research and extension activities in the country. An earlier Presidential Decree (Number 483 of 1982) gave the ARC responsibility for the production farms, formerly referred to as "state farms" under the General Authority for Agricultural Production. However, since 1989 the production farms have been under the authority of the Production and Development sector of the Ministry of Agriculture.

The current Board of Directors of ARC consists of the minister of agriculture (chairman), the director of ARC, who is responsible for the day-to-day operations, two deputy directors (for research and extension), the directors of the research institutes, a representative of the Academy of Scientific Research and Technology, a representative of Ministry of Public Works and Water Resources, and five consultants versed in agriculture selected by the minister of agriculture.

At present there are 16 research institutes located in Cairo under a deputy director for research. There are 38 commodity-oriented research stations located throughout Egypt. Sixteen of these stations are designated agricultural research stations, each of which includes staff from one or more sections of the field crops, cotton, sugar crops institutes, and others. There are 10 horticultural and 12 animal research stations. Staff from the discipline-oriented

ARC institutes and from institutes with commodity orientations are located at the research stations.

Academy of Scientific Research and Technology

The Academy of Scientific Research and Technology (ASRT) cites the following activities in its efforts to strengthen programs relating to science and technology throughout the country:

- support research directed toward solving problems of national interest;
- encourage application of modern technology;
- formulate policies that strengthen linkages between science and technology organizations;
- define priorities for research in scientific and technological aspects of major development areas;
- encourage basic research and support research schools;
- participate with universities in manpower development for training of researchers in specific areas;
- organize state awards in branches of science;
- support scientific societies;
- develop international relations in science and technology.

A broad-based, Council gives overall guidance to ASRT activities. The Council is made up of the president of ASRT, university rectors, representatives from 15 ministries, the directors of the three largest research institutes, one representative of the Union of Scientific Societies, two vice presidents of ASRT, and 10 "at large" members selected by the president of ASRT.

There are nine somewhat autonomous research organizations included under the ASRT "umbrella." These are Theodor Bilharz Research Institute, Central Metallurgic Research and Development Institute, Institute of Oceanography and Fisheries, Institute of Astronomy and Geophysics, Egyptian Petroleum Research Institute, Technology Transfer Organization, Ophthalmology Research Institute, Electronics Research Institute, National Institute of Standards, and Remote Sensing Center.

Many of the ASRT's activities and programs are formulated and carried out by 11 specialized councils:

Food and Agriculture	Transport and Communication
Industry	Construction and Housing
Petroleum Energy and Mining Res.	New Settlements
Health and Medicine	Management and Economics
Environment	Social Science and Demography
Basic Sciences	

The Council on Food and Agriculture is a prestigious group including several former ministers of agriculture, the director of the Agricultural Research Center, and others representing a broad range of agricultural activities.

ASRT developed a five-year plan to guide its activities and serve as a basis for securing financial support. Each specialized council, such as the one on food and agriculture, has developed goals and objectives for the five-year plan and is inviting proposals from organizations such as universities, government ministries, and in-house research institutes to address specific areas of research intended to meet these goals.

The Food and Agricultural Council has developed the following statement regarding its proposed activities and priorities for the ASRT Five-Year Plan. *3*

The Research Plan includes programs and studies in these fields:

- Plant Production
- Plant Protection
- Agricultural Natural Resources
- Fish and Animal Production
- Food and Feed Industries
- Agricultural Economics and Society Development

The five-year research plan aims at the following:

- To maximize the use of land and water resources and climatic conditions.
- To increase important field and fruit production.
- Implementing the scientific approach in agricultural production.
- Expanding mechanization.
- Intensifying the vertical increase in production, and expanding the use of hybrid, high-yield, and fast-growing seeds.
- National efforts to concentrate on applying specific results in the domain of producing strategic agricultural products.
- Designing the means to counteract plant diseases, keeping in mind the integration between plant production and plant protection.
- To study water requirements for different crops in the New Valley areas and the other reclaimed areas and to compare different irrigation systems.
- To benefit from results of terminated projects.
- To put more interest in the application of the results at all levels, including those of the farmer.
- To raise the rate of local animal production and to pay more attention to fish farms and nonconventional sources of food (to participate in solving the national food shortage).
- To raise the level of nutrition and to make sure that the produced food (both

local and imported) reaches the consumer in good condition with high nutritive value.

- To improve the rural food industrialization to prevent emigration to cities and to help increase the farmers' income through introduction of some farm industries and environmental industries to the village.
- To improve the quality of Egyptian bread by raising its storage and dietary qualities.
- To check the best period of storage of frozen protein foods imported for human use.
- To integrate rural development.
- Agricultural labor.

The ASRT has supported research and extension aimed at improving the production of rice and maize. In some cases the recommendations are different from those being advanced by the Ministry of Agriculture. The Food and Agriculture Council's five-year plan embraced a very broad scope of work and obviously included areas of work covered by the ARC and the research programs of the Ministry of Public Works and Water Resources. Yet the ASRT officials insist there is no overlapping and duplication because high officials of the other ministries, universities, etc. take an active part in planning ASRT programs and have endorsed whatever the ASRT undertakes to do.

The Council on Food and Agriculture has no "in-house" research capability and must achieve its objectives through financial support provided to other organizations.

2.1.1 Research institutes and central laboratories

Some of the research institutes at Cairo have been in existence for many years. For example, the Cotton Research Institute was created in 1900. As Cairo has grown, increasing amounts of land once available for institute use have been taken, leaving only about 70 feddans for research purposes at Giza. Land available will continue to diminish, making the outlying research stations increasingly important. Even so, the research institutes at Cairo will continue to be important to the research effort because of their extensive facilities, large staffs, and proximity to major universities and other important government agencies.

Agricultural research is represented in the Ministry of Agriculture and Land Reclamation by the Agricultural Research Center (ARC) and the Desert Research Center. In 1971 Presidential Decree No. 2425 was issued to establish the general authority for the ARC. In 1983 Presidential Decree No. 19 was issued, moving the extension functions to ARC from within the Ministry of Agriculture and specifying three major divisions: research, extension, and production farms. ARC has the following research and central laboratories:

1. Soil and Water
2. Cotton
3. Field Crops
4. Horticulture
5. Plant Protection
6. Plant Pathology
7. Animal Production
8. Animal Health
9. Agricultural Economics
10. Agricultural Engineering
11. Sugar Crops
12. Animal Reproduction
13. Veterinary Serum and Vaccine
14. Extension and Rural Development
15. Genetic Engineering
16. Food Technology
17. Central Agricultural Pesticides Laboratory
18. Central Laboratory for Aquaculture
19. Central Laboratory for Statistical Design and Analysis
20. Central Laboratory for Food and Feed
21. Central Laboratory for Expert Systems

Cotton Research Institute (CRI)

The CRI is a large, well-established institute (125 Ph.D., 19 M.S., 15 B.S.). It is housed in buildings with ample space, but they are old and difficult to maintain. The research has been and continues to be heavily oriented to breeding, which has been highly successful. Most cotton varieties grown in Egypt have been developed by the CRI. Some of the breeders are located at Cairo (Giza), but others are located at the research stations; all field testing is done at the latter.

The technology section conducts extensive tests on hybrids and new lines as part of the evaluation program. Tests include such things as fiber color, strength, and elongation, and various yarn characteristics. There is also a building with several small gins, most of which are old.

The equipment for spinning processes and fiber and yarn testing has been partially modernized. These laboratories are nevertheless in need of updating, considering the age of the equipment and the superior equipment available on the market. Two greenhouses, three screen houses, and a limited amount of land are available.

There are also sections dealing with fiber chemical modification and plant physiology. These laboratories are very deficient in equipment and are in need of refurbishing.

The CRI is not supported by any large donor project at present.

Field Crop Research Institute (FCRI)

The FCRI staff (260 Ph.D., 86 M.S., 38 B.S.) conducts research on a wide range of highly important crops. There are eight crops-related sections: maize and sorghum, wheat and barley,

legumes, rice, oil crops, fiber crops, forage crops, and onions. Onions, which are usually considered a horticultural crop, are included in this institute because they are often grown with cotton.

There are also sections of seed technology and plant physiology. Seed technology is involved with milling and testing of the various hybrids, breeding lines, and varieties for their milling and processing characteristics. Research is heavily oriented to breeding, as indicated by the fact that there are 12 maize breeders, in addition to breeders of other field crops. There are, however, other important lines of research.

The FCRI received large amounts of assistance in the development of research facilities through two United States Agency for International Development (USAID)-supported projects. These were the Egyptian Major Cereals Improvement Project (EMCIP) and the Rice Project. The FCRI is embarked on a project funded by EEC called the Nile Valley Project. A preliminary study of the project's feasibility was completed in December 1993. The study covers ways and possibilities for improving wheat, barley, and legumes. It is anticipated that in the near future an agreement will be signed between the Ministry of Agriculture and EEC to initiate the work. It should be emphasized that this project will deal with areas not covered by NARP. There is also collaborative research funded by NARP for wheat and maize in collaborative work with CIMMYT and ICARDA. NARP is supporting a joint project between FCRI and IRRI on rice.

EMCIP has developed excellent facilities at the FCRI at Giza and at research stations at Sakha (North Delta), Gammeza. (Middle Delta), Sids (Middle Egypt), and Shandaweel (Upper Egypt). A complex of buildings was constructed at each location. Only facilities for Giza are discussed here. EMCIP was a multidisciplinary team project with members not only from the FCRI but also from discipline-oriented institutes and universities as well. It also had a strong extension component.

The EMCIP construction included the main building with entomology, pathology, and soils laboratories as well as others for breeding and agronomic work. There are laboratories for chemistry, cytology, physiology, and biochemistry and cell biology. Several laboratories have been refurbished with an excellent array of new instruments. Virtually all instruments for laboratories at all locations have been purchased and installed. The laboratories are furnished with excellent instruments and materials and have all needed utilities, such as cold and hot water, electricity, compressed air, and gas. In addition, there are an auditorium, publication room, darkrooms, conference room, a library, mail room, cafeteria, and library. The library developed by EMCIP for the project purchased back issues of a number of journals for the ARC central library. There are other buildings for field equipment, storage, maintenance, and seed handling.

EMCIP has a number of vehicles and has installed a radio-telephone system to connect Giza and the four research stations at which other EMCIP team members were located.

Egyptian staff members of the team received salary incentives from project funds. The team performed well, and without question, the project developed superb facilities for maize and sorghum, wheat and barley, forage, legumes, and seed technology.

A new administration building was constructed at Giza with GOE funds for the rice section. All research staff are located, however, at the Sakha station where a complex of buildings, laboratories, vehicles, field equipment, and machinery repair facilities comparable to those constructed by EMCIP were developed for the rice section by the RP. All of the staff members in the rice section were members of a multidisciplinary team formed by the RP. This team had a fine extension component housed in the new buildings at Sakha.

Other sections, such as onion, oilseeds, fiber crops, and plant physiology, do not have adequate laboratories, and building space is generally substandard. This is not to say all other facilities in the FCRI are nonfunctional. The existing laboratory for milling and related work is functioning even though equipment and instrumentation are old and outdated.

On the other hand, laboratories for the plant physiology and oil crops sections are very inadequate, making it difficult to conduct meaningful research in them. Those for fiber crops and onion, while better, are still inadequate.

Sugar Research Institute (SRI)

SRI was formed from the sugar section of the FCRI in 1981. About 55 of the professional staff (33 Ph.D., 16 M.S., 7 B.S.) are located at Giza and the remainder on research stations.

Breeding and testing of exotic varieties of sugarcane is the largest part of the research program. The main activities of SRI are to breed and select new varieties of sugarcane, introduce sweet sorghum, expand sugar beet production, develop agronomic practices, and improve technology transfer and extension services. All breeding, with the exception of a small amount being conducted in greenhouses at Giza, is done at the Sabahia (Alexandria) Station, because this is the only location in Egypt where sugarcane flowers naturally. All agronomic work on sugarcane is conducted at stations in Upper Egypt (Kom Ombo and Mataana). There is also interesting work on sugar beets at Nuberia.

The SRI constructed a new four-floor building at Giza on a total area of 2800 m^2. Lab and office areas occupied 1600 and 800 m^2, respectively. The laboratories are now well equipped. A pilot mill for sample processing and an automatically controlled greenhouse (80 m^2) were established. SRI established a sugarcane research station at Shandaweel and introduced sugarcane cultivation and sugar industry to Sohag governorate. SRI has access to four experiment stations representing geographical zones.

Horticultural Research Institute (HRI)

HRI has one of the largest staffs in ARC with over 3,000 people (216 Ph.D., 94 M.S., 38 B.S.). Additionally it has responsibilities for a number of things that are peripheral to research, such as a large seed production unit and the maintenance of botanical gardens at Aswan and Orman.

Most of the staff is located in the institute at Cairo. This is partly because Kanate, one of the largest horticultural research stations, is very near Cairo and is to a large extent a farm for HRI staff at Giza.

The HRI encompasses a large array of crops with widely varying cultural and climatic requirements. Thus there are sections of minor fruits, citrus, grape, pomology, olives, tropical fruits, and data palm; plus work on mineral nutrition, fruit handling, packaging, and storage; the maintenance of botanical garden ornamentals, and forestry.

HRI also includes a wide array of vegetable crop breeding including tomato and other self-pollinated crops, cucurbit and other cross-pollinated crops, potatoes and other vegetatively propagated crops, vegetable handling, vegetable production under controlled conditions, plus medicinal and aromatic crops. There is also a vegetable seed production unit.

The HRI is housed in 10 buildings at Giza and Dokki in Cairo. Most of the buildings at Giza are substandard but usable with refurbishing.

The HRI contains its own maintenance shops; while functional, these are in a state of disrepair. Cold storage rooms have deteriorated to a point where they would need complete rebuilding to function.

The HRI has an auditorium it once used for extension when it had an extension component.

There is a canning plant, but it is used only for production and not research. It is not well maintained. Buildings at Dokki, which house vegetable and medicinal crops research, are newer and in better condition than those at Giza; they are nevertheless in need of renovation. There is a battery of walk-in growth chambers, but they have not functioned for years. The horticulture subproject of the University of California (Davis) Agricultural Development Systems (ADS) project was managed somewhat differently than EMCIP. ADS rented a large building from the University in Cairo that had been constructed by FAO some years ago as a postharvest handling laboratory.

This building, known as the Central Laboratory, was refurbished and laboratories fitted with a wide range of modern scientific equipment. There are well-equipped tissue culture, postharvest handling, biochemical, and analytical laboratories in the Central Laboratory that are available for use by team members. There is also a battery of cold storage units. A

relatively small amount of new instrumentation was added to existing laboratories of the HRI, but emphasis was placed on equipping the Central Laboratory. An excellent library of horticultural publications was developed. Several greenhouses were constructed that were assigned on a need basis rather than to specific groups. A certain amount of farm equipment and a number of vehicles for transport were also purchased.

Like EMCIP, the ADS project developed multidisciplinary teams; however, ADS emphasized smaller teams called "activities." These were composed of U.S. and Egyptian co-leaders and Egyptian team members. There were, as examples, citrus, olive, mango, date, deciduous fruit, tomato, cucurbit, garlic, and medicinal and aromatic crop activities. The U.S. co-leaders visited Egypt only periodically during the year. Egyptian and U.S. counterparts often conducted research jointly and co-authored papers stemming from the results.

The precise future of the multidisciplinary teams is not certain, other than that USAID will continue to fund the project through the Ministry of Agriculture for another year. It is assumed the Central Laboratory and associated facilities will become a part of the HRI.

If so, many of the current laboratories deficiencies would be overcome. However, there is a possibility the Central Laboratory building and instruments will become the property of Cairo University. Moreover, HRI has such a large and varied program that there is still need to refurbish some of the old laboratories and for additional instruments and greenhouses.

Plant Pathology Research Institute (PPaRI)

PPaRI has a large professional staff (164 Ph.D., 69 M.S., 28 B.S.) and a large number of support staff. The institute is divided into two main groups: (1) field crops and (2) horticulture and general research. The former contains five sections that cover the various field crops, cotton, and sugarcane. The latter division contains 12 sections, four of which cover broad groups of horticultural crops. Seven sections are discipline oriented: virus diseases, bacterial diseases and biological control, hematology, postharvest diseases, mycology and disease survey, fungicides, and seed pathology. PPaRI has a modest portion of its staff located at the research stations, but the main thrust of its work is at Giza, because much of the research requires good greenhouse and laboratory facilities rather than extensive areas of land. The staff is scattered through a number of buildings and would profit from being together. Recently, the PPaRI constructed a five-floor building to have rooms for personnel and equipment. Some of the existing laboratories were satisfactorily equipped with modern instruments through major collaborative researches funded by NARP: one for integrated pest management tomato, another for pathogens affecting wheat and barley, and another for pathogens infecting sorghum.

PPaRI has a relatively large number of needed greenhouses. Staff of PPaRI are now conducting basic, discipline-oriented research, while retaining a heavy responsibility for commodity-oriented problems in cooperation with other appropriate institutes and research

stations. PPaRI needs new housing or, at least, considerable refurbishing of existing space and a major increase in funding for scientific instruments and supplies.

Plant Protection Research Institute (PPrRI)

PPrRI has a large staff (265 Ph.D, 135 M.S., 79 B.S.) and a support staff of over 300. The institute is concerned with insect control. It also includes bee culture and a unit north of Cairo for silkworm cultivation.

A great portion of the staff is located at the institute at Cairo just as in the case with PPrRI and for the same reasons. The institute had members on the EMCIP team at Giza and at the research stations. The institute is divided into 20 sections. Some, such as the cotton leaf worm and cotton mites sections, relate to specific problems. Others, such as the field crops and vegetable crops insect research sections, are broader in scope. Still others, exemplified by the biological control and insect physiology research divisions, are discipline oriented. The weed control section that formerly belonged to PPrRI in the 1980s is now a section of the Field Crop Research Institute.

The building of PPrRI is now being renovated out of the governmental budget. The institute has received large collaborative research support from NARP, one grant for integrated pest management in tomato and the other for integrated pest management in cotton. The budgets of the two projects apparently enhanced research activities in pest management and out-of-country training. Equipment and computers to serve modeling integrated pest management programs were purchased.

Soils and Water Research Institute (SWRI)

This institute is large (304 Ph.D., 131 M. S., 61 B.S.) and extremely important because of the major problems related to soil, water, and plant relationships in the country. About 40 percent of staff is located at research stations. Virtually all research stations have a component of the SWRI. The institute has two main divisions: soil research and soil technology. There are a number of sections or problem areas under each division. There are eight sections: soil physics and chemistry, soil survey and classification, agricultural microbiology, soil fertility and plant nutrition, saline and alkaline soils, sandy and calcareous soils, water requirements, and development and conversation of cultivated soils.

Much applied work is done, including nitrogen fixation, establishing optimum fertilizer rates, the impact of pesticides on soils, utilization of agricultural wastes, and land reclamation. The institute also analyzes over 12,000 soil samples per year, both for research and as a service.

The institute's building space is adequate, and the quality of facilities and maintenance is much improved. The laboratories are now equipped with modern instruments that are functioning and used regularly.

SWRI has received NARP assistance in the form of training and collaborative research. The first collaborative research dealt with remote sensing for soil survey with Michigan university as a counterpart. The second tackled the topic of water conservation. The two projects made available to SWRI the modern equipment necessary for adequate soil survey (computers, scanners, etc.) as well as those for water conservation (weather station, weighing lysimeter, infrared, data logger). Researchers were sent to the USA to get training on the above-mentioned topics.

Animal Production Research Institute (APRI)

The professional staff (128 Ph.D., 66 M.S., 13 B.S.) with a large support staff is largely located in Cairo. There are 10 research sections: dairy technology, chemistry, microbiology, animal and poultry nutrition, sheep, cattle, buffalo, rabbits, poultry, and poultry breeding.

Cattle and buffalo programs emphasize improving milk production and dairy technology rather than the production of meat. There are feeding trials, some in cooperation with the forage crop section of the FCRI, trials on the use of ammoniated straw for feed, artificial insemination, embryo transfer, and other related work.

Much of the work of the APRI is related to herd improvement through the use of superior sires and balady cattle, sheep, and goats. Careful records are kept of milk production at Sakha and elsewhere to determine performance of exotic breeds, crosses of balady and exotic breeds, and of buffalo selections. Crosses of balady chickens, such as Fayoum, with exotic breeds are made to furnish small farmers with dual-purpose chickens that produce well under the rigorous condition of the small farm. There are neither animals nor poultry at Cairo so the staff conducts all of this work at research stations.

Building space at Cairo is partially renovated and laboratories have been partially supplied with modern equipment.

A satisfactory amount of donor assistance from USAID/NARP and other countries has played a major role in updating the performance of APRI. In the area of sheep and goats, there is a Finnish project to improve local sheep by means of improving twinning rate and milk production. For smallholders, there is a French project to improve milk goat production. The project is implemented in five governorates.

With regard to cattle and buffalo improvement, a program for genetic improvement was initiated to serve smallholders in three governorates. Milk and meat production improved via artificial insemination with the objective of producing in the villages a three-quarter exotic breed and one-quarter local breed cross. NARP and CEMARP participated in funding.

An international livestock management training center had been established by APRI in Sakha for training in the areas of artificial insemination, embryo transplantation, blood typing, in-

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vitro fertilization, hormonal assay, and recording system. Beside training, the center is also offering frozen semen of buffalo and cattle to the private sector, as well as frozen embryos. Moreover, the center is providing extension services in five governorates.
Researchers were sent to the USA and Canada for training on biotechnology techniques for animal production.

Animal Reproduction Research Institute (ARRI)

ARRI staff (31 Ph.D., 28 M.V.S., 28 B.S. or B.V.S.) are located at what is known as the Pyramid Research for Animal Reproduction at Cairo. This institute has recently been formed from a section in the APRI. All of the staff are located at Cairo, but the ARRI has strong linkages with staff members of the APRI at research stations and utilize animals and other facilities there.

The institute has sections on interfertility field investigations, biology of reproduction, pathology of reproduction, artificial insemination, reproductive diseases, diseases of neonates, and mastitis—and a new section on auxiliary production units that will involve an extension unit.

The institute has received considerable money from the Ministry of Agriculture for building renovation, instrumentation, and transport. The main building has been refurbished.

The laboratories are not fully equipped, but modern instruments are being put in place and additional instruments have been ordered. Even so, additional equipment will be needed. There are several comprehensive plans for developing the institute.

The institute is some distance from Cairo proper and transport is need daily to collect workers for the institute. Current vehicles are adequate; maintenance is a problem, and it is difficult to obtain drivers.

There are well-kept pens for a limited number of cattle, buffalo, sheep, and goats.

ARRI has expanded steadily over 10 years. Currently the institute facility is central at Al-Haram with six departments. Fifteen of the research units are affiliated with the departments. To complete the research facilities, there is a unit for special services, one department for public and veterinary services, a unit for production of liquid nitrogen, three conference halls, a training center, a computer unit, and an up-to date library with scientific publications in the fields of animal reproduction.

Personnel of the institute are actively involved in various aspects of research, individually or in cooperation with national and/or international institutions. Additionally ARRI provides training activities and contributes to the supervision of various aspects of animal reproductivity in Egypt. The institute conducts basic and applied research directed primarily

to the diagnosis, control, and improvement of fertility. The different departments and research units are engaged in research activities including studies in the field of biology of reproduction, reproductive disease, artificial insemination, udder diseases, calf diseases, pathology of reproduction, and field investigations.

Animal Health Research Institute (AHRI)

The AHRI staff (190 Ph.D., 223 M.S., 700 B.S.) are primarily concerned with diagnosis and research with mammals and poultry. Vaccination is particularly important because it is not considered feasible under Egyptian conditions to resort to widespread destruction of animals as a means of controlling diseases. Much off the veterinary staff is located in 20 provincial laboratories where over 200,000 animals are examined annually.

There is a training program at Cairo in which members of the provincial laboratories receive one to two months of training annually. Several hundred university veterinary students also receive short periods of training each year.

The AHRI received from NARP, under the New Initiatives Component, a large project aiming at controlling anaplasmosis and babieosis through biotechnology. The project led to the establishment of a new biotechnology lab and partial renovation of the animal facility. Nine trainees were sent to the USA to get the necessary training. A collaborative NARP project dealing with preparation and characterization of monoclonal antibodies against avian Rio virus was also administered by NARP. The two projects furnished labs with modern equipment and supplies.

As for international cooperation, there is an ongoing trinational animal health research project dealing with neonatal calf death and another for diagnosis and eradication of brucella disease in animals. FAO, EEC, and the International Atomic Energy Agency are funding a project entitled "Pan African Rinder-pest Campaign." The work is done through serosurveillance of immunologic status of cattle plaque in animals after vaccination. Application of ELISA technique in diagnosis of poultry disease is another project supported by International Atomic Energy Agency. Money resources for such projects have increased the value and quality of research.

Veterinary Serum and Vaccine Research Institute (VSVRI)

The professional staff of VSVRI (76 Ph.D., 31 M.S., 9 B.S) are supported by 138 veterinarians and 98 administrative staff. VSVRI plays an important role in animal health by providing breeders and farmers with vaccines against contagious and infectious diseases.

The institute provides vaccines, specific antisera, and diagnostic reagents. Because of the good quality of vaccines produced, the institute has gained international recognition that enabled it to export vaccines to several Arabian, African, and Asian countries.

VSVRI has expanded steadily over the years. Currently it has 14 departments. The institute is actively involved in various aspects of research programs, either individually or in cooperation with national and international institutions and universities.

VSVRI covers all the demands for prophylaxis or mass vaccinations of animals and humans of Egypt.

VSVRI conducts mostly applied research, which serves the process of preparation of endemic and exotic veterinary biological products.

The institute has three reference laboratories, namely, Rinder-Pest Research Lab, Foot and Mouth Disease Lab, and the African Borse Sickness Lab, which was established in 1990 by FAO and is now considered one of the reference laboratories in Africa and the Middle East.

Agricultural Economics Research Institute (AERI)

The AERI staff (90 Ph.D., 47 M.S., 19 B.S.) is located on parts of two floors of the Ministry of Agriculture building in Cairo. The main objective of AERI is to conduct research in the fields of agricultural economics and statistics for the purpose of developing production and income within the framework of national agricultural policy. AERI's research activities cover a variety of domains. These are production economics, marketing, land and water resources economics, rural community development, finance, and economic analysis of commodities.

The institute contains two main research sections, one for agricultural economics and the other for agricultural statistics. Within the two sections there are eleven research divisions. These are located in the head office of the institute. Fifteen additional regional research units are spread all over Egypt, as are some associated supporting departments.

Due to the insufficient number of research staff and limited space, three research divisions and some related units are not functioning. Those are labor economics, regional studies, agricultural policy and project evaluation; public services, agricultural extension, building and maintenance; and planning and project evaluation departments.

The institute has been involved in a number of national and international research projects. Through these projects the institute was able to train its staff, establish a database for research strategy development in the agricultural sector, and provide research divisions with computers and software facilities. AERI cooperates with world organizations for developing the Egyptian agricultural sector through the conduct of research projects. About 79 percent of these projects are funded by USAID.

Research staff have been sent to attend training courses both within and outside Egypt through NARP. Training programs include English, computer, management, and academic courses and observational tours.

Agricultural Engineering Research Institute (AEnRI)

The professional staff of AEnRI consists 8 of Ph.D., 49 M.S., and 25 B.S. This institute was authorized in 1977 but was only activated in 1983. At that time only two or three well-trained professional staff were located in crowded office space in the Foreign Relations Building in Cairo. A prefabricated administration building was erected for the AEnRI in front of the Foreign Relations Building. Other new buildings were also constructed, and more are under construction.

The AEnRI was cooperating in the 1980s with the USAID-supported Agricultural Mechanization Project (AMP) in the areas of land improvement and developing farm machinery for Egyptian conditions.

This project was terminated in 1986. Through NARP projects, the institute was able to develop farm machinery for harvesting and threshing cereal crops, especially wheat and rice. Developments in field testing of available equipment to cut, collect, and process crop residues was also achieved. Research extended further to testing tractors and agricultural implements. This has been accomplished through collaborative research with the University of Nebraska.

Research personnel were sent for academic training in the USA (9 Ph.D., 4 M.S., 2 postdoctoral; technical and hands-on training for engineers and technicians).

Agricultural Extension and Rural Development Research Institute (AERDRI)

The AERDRI occupies a floor in the FAO building at Dokki. All of the scientific staff is located at Cairo (31 Ph.D., 44 M.S., 14 B.S.). The main activity of the institute is to develop extension programs, organize and train specialized extension agents, conduct extension research on activities of rural females, and conduct studies dealing with rural sociological issues and women. NARP shared in financing the five-year plan of the institute and in the procurement of demonstration equipment, which is now being purchased.

The FAO building is hosting the AERDRI staff temporarily. Other facilities are needed.

Food Technology Research Institute (FTRI)

Food Technology Research Institute (FTRI) is a new research institute that was established in 1993. It was formerly known as the Central Laboratory for Food Technology. The FTRI staff (98 Ph.D., 39 M.S, 17 B.S.) are found in eight sections, which conduct research on technologies of bread and dough, fish and meat, field crops, horticulture crops, special food and feeding, oil products from plants, milk, and food engineering and packaging. FTRI constructed two well-equipped central labs, one for the assessment of micronutrients, hormones, and vitamins; the other for bakery use.

Through NARP funding FTRI was able to establish a soybean processing center with the technical assistance of the International Soybean program at the University of Illinois. Moreover, an experimental kitchen as well as four well-equipped labs were installed.

A collaborative research project between FTRI and UCLA School of Public Health helped to establish a data processing unit to study the food consumption pattern in five governorates with a sample size of 7000 families.

Short visits to the USA were made available by the training component under NARP. Research technicians and engineers visited Griffin Georgia, UCLA, USDA, and Illinois to be trained on peanut utilization and sensory lab work, food consumption patterns, food basket composition, and soybean processing equipment. Eight persons from the private sector who were interested in soybean processing were sent to the International Soybean program in Illinois for three weeks.

Agricultural Genetic Engineering Research Institute (AGERI)

The Agricultural Genetic Engineering Research Institute (AGERI) represents a vehicle within the agricultural arena for the transfer and application of this new technology. The original establishment of AGERI in 1989 was the result of a commitment of expertise in agricultural biotechnology. At the time of its genesis, AGERI was named the National Agricultural Genetic Engineering Laboratory (NAGEL). The rapid progress of its activities during the first three years encouraged the Ministry of Agriculture to authorize the foundation of AGERI.

AGERI is located physically within the campus of ARC (EMCIP Building). AGERI has upgraded the existing laboratories of the EMCIP building and has used two floors to house the project, for a total net area of 116 m^2 consisting of 14 modern, well-equipped laboratories, a biocomputing and computer networks unit, a central facility, a preparation/washing facility, and a supplies repository.

The recently completed controlled environment chambers (140 m^2) are used to host the transgenic plant material for acclimatization. A fiberglass greenhouse (307 m^2) has been recently added to AGERI property. A containment greenhouse (412 m^2), complying with biosafety and Environmental Protection Agency regulations is under construction now. In this greenhouse, experiments dealing with the degree of gene expression in transgenic plants will take place.

The Governing Board of AGERI includes a national coordinator (chairman of ARC Board), the institute director, a collective group of full-time scientists, and a Finance and Administrative Affairs Department.

AGERI recruited a group of 17 senior scientists of high scientific accomplishments in the field of genetic engineering. Each is a vital link in the program's goals for crop improvement.

The senior scientists have university affiliations within Egypt as well as their scientific responsibilities within AGERI. They work at AGERI on a joint-appointment basis, which maximizes their interaction between the academic and research domains. Their high level of international training in conjunction with their enthusiasm to invest their talents in AGERI's biotechnology programs is an encouraging addition to Egypt's agricultural technology development.

The functional laboratories of AGERI are these: molecular plant pathology, molecular manipulation and gene transfer, plant molecular biology, molecular genetics and genome mapping, micropropagation technology, plant cellular and molecular genetics, immunology and diagnostics, protein/nucleic acid sequencing and synthesis, gene expression, and the biocomputing and computer networks unit.

The main goals of AGERI is to improve Egyptian agriculture by using available genetic engineering capabilities.

Numerous regional and national training courses organized by AGERI provided an opportunity for research from Africa and the Middle East to gain experience in the use of advanced technologies such as RFLP, PCR, ELISA, virus diagnostics, and molecular biology.

Services provided by the biocomputing and computer networks unit include providing worldwide networking and communication capabilities, maintaining a software library consistent with the diverse needs of AGERI's computing, on-site repair and maintenance of Personal computers and laboratory instruments, and employing CD-ROM technology, which allows storage and fast retrieval of vast amounts of information.

The ongoing projects in AGERI are grouped in the following categories:

1. Developing genetically engineered resistance to potato viruses.
2. Engineering of tomatoes to induce resistance to tomato Gemini-Viruses.
3. Development of virus resistance cucurbit crops via genetic engineering approaches.
4. Identification of whitefly biotypes and assessing their role in virus transmission.
5. Production of transgenic Egyptian cotton plants expressing insecticidal toxin genes.
6. Developments of potato germ plasm resistant to tuber moth and other secondary pests.
7. Tomato regeneration and transformation for disease resistance.
8. Development of maize resistance to stem borers through genetic engineering.
9. Identification, cloning and transfer of stress genes in tomatoes.
10. Genome mapping for development of improved rapeseed varieties using molecular markets.
11. Developing PCR-based markers for improvement of important trait loci in DNA of tomatoes.
12. Improvement of the nutritional quality of faba bean seed protein.
13. Development of transgenic maize expressing resistance to fungal diseases.

Central Agricultural Pesticides Laboratory (CAPL)

CAPL has a relatively large staff (62 Ph.D., 23 M.S., 17 B.S.). Located in a two-floor building in Dokki, CAPL has important responsibilities. It attempts to bring imported and exported pesticides under stringent control. The purpose is to prevent pesticides that do not comply with Egyptian regulations from reaching the end user. A prohibition on distribution of any consignment is imposed until the laboratory has demonstrated it is in compliance with the regulations. The CAPL regulates pesticide trade in Egypt, and through its enforcement system it detects violations and penalizes the sources. The CAPL licenses pesticides for importation and provides a pesticide analysis certificate for release from customs. If imported pesticides are not in accordance with the specifications, they may be seized or returned to the point of origin at the shipper's expense.

After the release of pesticides in the Egyptian environment, the CAPL measures the residues in edible crops, soils, and water. The main purpose is to keep pesticide residues below internationally prescribed levels.

Mammalian toxicology is undertaken before permitting the use of pesticides on a large scale to distinguish between safe and determinal ones.

Extensive use of pesticides often leads to the development of resistance in agricultural pests. Monitoring of pesticides resistance is a major task of the CAPL. The purpose is to establish resistance management programs for the optimization of integrated pest management programs.

In order for the CAPL to assume its responsibilities, advanced research is undertaken in 10 departments. The results generated provide farmers and exporters and importers of agricultural commodities with advice and appropriate services.

The CAPL received from NARP support for two large collaborative research proposals, one for the biochemical toxicology and environmental fate of pesticides (University of Maryland is a counterpart), and a second for the control of pest with natural plants products. The two projects provided CAPL with modern equipment, supplies, and training in the USA as well as several facilities. The old CAPL's building has been totally renovated.

Central Laboratory for Design and Statistical Analysis (CLDSA)

The CLDSA is an independent organization attached to the ARC. It has a small staff (11 Ph.D., 12 B.S.). CLDSA's primary research functions are these: assisting ARC staff in designing experiments; statistical analysis of experimental data generated by ARC staff; determining arithmetic models for statistical analyses; and conducting research in applied statistics to improve the efficiency of agricultural experiments. It also stores research data and is involved in budgetary and fiscal matters.

The staff appears competent, and it has access to computer facilities. It needs added computer capacity and additional staff. This unit is not used nearly as much by ARC staff as it could be; this may change, however, as the value of its services becomes better recognized.

The activity of the staff and the potential for the laboratory are great.

Central Laboratory for Aquaculture (CLAC)

The Central Laboratory for Aquaculture was the result of an agreement that was signed between Egypt and USA in 1978. The purpose was to establish a large project for the development of aquaculture in Egypt. The USAID allocated 23.4 million dollars for the project and Egypt allocated 6.7 million Egyptian pounds. The project was to help the fishery sector by creating a national center for aquaculture systems. The center, which is now known as CLAC, became part of ARC in 1991.

CLAC is a large institute with a modest staff (9 Ph.D., 12 M.S., 43 B.S.). The institute is housed in buildings with ample space. It has nine divisions: breeding and genetics, nutrition, disease, aquaculture systems, fish biology and ecology, limnology, fish processing and quality control, economics and extension, and reproductive physiology.

The main objectives of CLAC are to increase productivity of fish raised in water basins, to decrease production costs, to treat contaminated water, to determine causes of and remedies for fish diseases, and tp [rare feasibility studies of aquaculture systems.

The major obstacle facing CLAC nowadays is how to run economically 170 fish water basins occupying 1000 feddans. The water available for the basin is coming from drainage canals. Underground water of CLAC is saturated with iron, a matter hampering adequate fish propagation.

CLAC is acting as a training center for trainees coming from Africa, Asia and Latin America. As for international cooperation, the Central Lab participated in a study funded by the United Nations Development Programme to investigate ways of water treatment of Manzala Lake. CLAC also represents Egypt in the International Network on Genetics in Aquaculture.

In collaboration with American universities, NARP funded a large project for Pond Dynamics/Aquaculture. Its objectives are data collection, bioconversion, polyculture, and biotechnology. One year after the project's initiation, CLAC was able to produce 1600 Kg fish/feddan during a breeding period of 145 days. Tilapia (Bolty) was the main fish used. Under this large collaborative project, CLAC was able to train six postdoctoral scientists in USA and send six others for short visits.

A water quality control lab was established and was provided with modern equipment and necessary supplies.

Central Laboratory for Agricultural Expert Systems (CLAES)

CLAES was established in 1991. It has a very small staff (2 M.S., 2 B.S.). All are located in adequate computer rooms in one of the Ministry of Agriculture buildings at Dokki. The new lab's purpose is to enable research on application of expert systems in agriculture, developing extension packages and training technical and research cadres on using the packages. CLAES has three departments dealing with development of expert system tools and methodologies, building expert systems, and evaluation and maintenance of expert systems and their impact on production.

Four projects are now being executed by CLAES in cooperation with national and international institutions. These are Expert System for Improved Crop Management; Integrating Second Generation Expert Systems Approaches and CERES Crop Simulation Modeling; Development, Testing and Implementation of Expert Systems in Agriculture (collaborative between Egypt and the United States); Development of Expert System for Citrus Agro Management using CD-ROM.

The results derived from such projects would help optimize land resources for crop production and would improve workers' performance to an expert level. The extension service through expert systems would certainly add to the quality of agricultural production and increase farmers' efficiency and effectiveness.

Central Laboratory for Food and Feed (CLFF)

The Central Laboratory for Food and Feed is located within the ARC campus. It has a small staff (9 Ph.D., 8 M.S., 11 B.S.). CLFF conducts research to improve the quality of food and feed; introduces new methods for food and feed analysis; acts as information center for quality control of imported feedstuffs and their raw materials and as a reference laboratory for food and feed analysis.

CLFF has eight laboratories and one division: Sample Delivery and Preparation Lab; Grain Inspection Lab; Amino Acid Lab; Vitamin Lab; Macro Element Lab; Microbiology Lab; Biology Lab; Toxicology Lab; Microscopy Lab; Hormone Lab; Chemical Analysis Lab; and the Nutrition Division.

In order to control the quality of imported feedstuffs, raw materials, and feed additives adequately, CLFF has updated the quality control system through approved advanced analytical approved. Feedstuffs specifications are continuously updated based on those issued by world organizations.

2.1.2 Research stations

The ARC has an extensive system of research stations located in the principal areas of production. It includes 36 research stations and administrative units for agricultural trials located in 20 governorates for the purpose of implementing trials in farmers' field. The research stations for agricultural trials possess a land area of approximately 3,500 feddans as well as 27,000 feddans for the purpose of producing different types of seed crops and fruit nursery trees. Staff at the stations are members of the various research institutes in Cairo, and Cairo-based staff conduct most of their field research on the stations.

The 36 research station units are primarily commodity oriented and exist in 16 locations. These stations have been grouped into 10 regions, and one station in each is designated as the regional station.

Some of the stations are old, and their physical facilities were developed without a well-defined plan. However, a standard ARC design had been used at most locations during the past three decades. Each station has a two-story laboratory administration building with nine laboratories, offices, and a library. There is a guest house, a recreation building, and equipment storage and repair buildings.

There are either four or six buildings, each containing four apartments, plus one building for unmarried staff. There are hospitals and schools at the same locations.

Research stations are usually associated with a production farm, which provides land for conducting research. There is usually sufficient land, but some of it is inadequately drained or lacks a proper irrigation delivery system. Brief descriptions of the research stations and research capabilities are given below.

Land is adequate, but field machinery is deficient. Tractors, ridgers, disc plows, chisel plows, land-leveling equipment, and sprayers are needed. The layout of buildings is the standard ARC design, but some of the buildings are smaller. Utilities consist of only cold water and electricity. Laboratory benches and storage space are substandard or lacking and laboratory instrumentation is limited—except where laboratories have been renovated through NARP.

Upper Egypt region

Kom Ombo is a station located 30 to 40 km north of Aswan. The staff is small (11 Ph.D., 2 M.S., 4 B.S.).

The station is devoted to sugarcane research, for which it is well located. Other field crops such as sunflowers and legumes are studied from the standpoint of how they can be intercropped and rotated with sugarcane. The major research, however, is testing progeny from the sugarcane breeding program at Sabahia.

In the 1980s there was no sugarcane mill for extracting juice from large samples. Such equipment was located only at the Mataana research station, which is an appreciable distance north of Kom Ombo. The research component under NARP allocated £E300,000 for Kom Ombo renovation (Phase II). The implementation estimate was £E240,000. Among the results achieved was the establishment of a sugarcane extraction mill. Renovation extended to station and store buildings; sewage system; wall gate and guard residence; shed foundation; electricity network for administration building, residential block; and the gate and guard facility. A generator was purchased to provide the station with electricity when needed.

Kom Ombo is more attractive (than Mataana) to research staff because of its proximity to the city of Aswan. Kom Ombo has the potential to be a good research station, but it would need major renovation.

Mataana

Mataana is a small but well established station with a staff of 2 Ph.D., 10 M.S., and 10 B.S. Mataana is located in the heart of the sugarcane region between Kom Ombo and Shandaweel. Qualified staff are difficult to attract because of its isolation.

Its major emphasis is on testing sugarcane selections. Research on field crops, however, is also conducted. It is obvious from the lack of staff that the research program is deficient.

The station was developed according to the standard ARC plan. Buildings have deteriorated because of lack of maintenance. Housing for staff is inadequate.

There is equipment for crushing and extracting sugarcane juice and a few instruments for sugar measurement. Laboratory space is, however, well below standard, and instrumentation is virtually lacking except for a few pieces used in sugarcane analyses. Field equipment is old and badly in need of replacement and additions.

There is sufficient land for crops, and there are interesting plantings of citrus and mango on an adjacent production farm that could be used for research. Thus, Mataana research is well located from an agricultural standpoint but is confronted with a serious staffing problem. Major funding is needed to refurbish buildings and to obtain adequate field and laboratory equipment and vehicles.

Shandaweel

Shandaweel is the designated research center of the Upper Egypt Region. The professional staff (15 Ph.D., 20 M.S., 6 B.S.) are involved in field crops or related disciplines, such as plant protection, plant pathology, and soils and water.

The staffing situation is not as difficult as at Mataana and Kom Ombo, but still serious. About 90 percent of the staff and the Regional Director were born or grew up in the Shandaweel area.

Research is directed entirely toward field crops, soils, and water, plant protection and plant pathology. In fact, there is no research in horticultural crops or animals in the Upper Egypt Region, even though both are important commercially.

Land is adequate but the farm is not. The experiment station has the standard ARC building layout. Maintenance is poor.

An EMCIP unit was constructed at Shandaweel and had the same general design as EMCIP units at Sids, Gammeza, and Sakha. This included a two-story administration-laboratory building. There are about 28 offices, considerable space for support staff, conference rooms, a library, and well-equipped laboratories for both commodity-oriented and discipline-oriented staff.

It also has a machinery storage building, repair and maintenance shops, fertilizer and pesticide storage, a large seed cleaning building, generators, guard rooms, and security gates. EMCIP also refurbished the guest house.

Shandaweel is a logical choice for a regional station and EMCIP's location there was appropriate. There was need to refurbish and equip laboratories in existing buildings and to add to the field equipment and housing even though EMCIP has overcome many deficiencies.

The research component under NARP allocated £E795,000 for the renovation of Shandaweel (Phase II). Implemented work estimate was £E397,000. Shandaweel Regional Station received from Technology Transfer under NARP some commodities with an actual final cost of £E1,500.

Renovation covered the station building, guest house, sewage networks, cultural center, water tank, garage and store, electricity room, and electricity network.

Middle Egypt region

Mallawy is a field crop and cotton station located between Assiut and Sids with a relatively small staff (14 Ph.D., 11 M.S., 10 B.S.). Staffing is a problem, as in Upper Egypt, and most of the staff is from the immediate area. However, it is a much stronger station than Kom Ombo and Mataana. It has very active cotton and field crop research programs.

Mallawy has the standard ARC building layout. Building maintenance laboratory instrumentation and field equipment are poor.

This station needed heavy funding to bring it up to a reasonable functioning level. Throughout the research component under NARP, a sum of £E924,000 was committed for its renovation (Phase II). Implemented work estimate was £E646,800. Renovation covered the administration building and laboratories; guest house; cultural center; garage; stores; sugarcane press; electricity network sewage network; sheep ward; sheep research lab; sheep yard; poultry laboratory and poultry research administration; poultry wards; animal production stores; animal production electricity network.

Sids has been designated the regional center for Middle Egypt. In the 1980s the staff was small, but now the number of staff is reasonable (7 Ph.D., 13 M.S., 5 B.S.).

Sids is the only station with field crops, cotton, fruit, vegetable, and animal units. There is adequate land for farming, citrus orchards, and grape vineyards.

Major efforts are directed at variety improvement through breeding and testing, but there is also excellent agronomic work. Animal and poultry work is heavily oriented to animal improvement, but there are also nutritional studies.

The building layout is standard ARC with slight modifications. The administration laboratory building had three instead of four floors. The third floor was allocated to horticultural crops and the first two to field crops. There were no animal and poultry laboratories of consequence. Laboratories devoted to field and horticultural crops were, like most others, deficient and poorly used.

For example, fertilizer for field experiments was being stored and weighed in a laboratory with scientific instruments. The horticultural laboratories were filled with drying garlic. Such work should be done in rooms without instruments. In general, the laboratories needed refurbishing and appropriate instruments. Some of the farm equipment also needed replacement.

An EMCIP unit was developed similar to the one described in Shandaweel. This unit contributed a substantial improvement in the station's facilities. Even so, existing laboratories had to be upgraded and field equipment added if the station was to become a major regional research center.

The money allocated for Sids renovation in phase II was 1,384,000. The actual implementation work estimate was 1,038,000.

Renovation covered the following areas: sewage network; electricity networks; animal production administration building; poultry administration building; main administration building; animal production dairy laboratory; sheep and cow wards; rest house; store; stores near duck ward; animal feed store; old duck ward; wards for breed and graze; experimental

wards; natural suckling ward; old and new hatchery; atomized milking facility; offices near milking facility; cultural center; rabbit sheds; wheat stock green-house.

Sids also received renovation funds from the Technology Transfer Component under NARP.

North and East Delta region

Bahtim, located less than an hour from the center of Cairo, is designated the regional center. It has a staff of (10 Ph.D., 9 M.S., 27 B.S.).

Bahtim is a famous old station, and the building layout is different from the standard ARC design. Primarily, there is an administration laboratory building. Laboratories and equipment are poor by any standards. The fume hood in the nutrition laboratory is inoperable, as is much of the instrumentation. The farm of 450 feddans includes research on both field crops and vegetables. Some members of the institutes in Cairo contend the Bahtim location should be used only for such purposes as a germ plasm bank for breeders because of encroachment of Cairo and water pollution. Whether water pollution is a threat or not, the development of Bahtim as a regional research center is questionable because most of the staff lives in Cairo, where there are already laboratories and libraries. Bahtim's situation should be given careful study before a decision is made to refurbish and develop the laboratories at considerable expense.

Kanater Station, often called the Barrage, is old and about as close to Cairo proper as Bahtim. It has a professional staff of (19 Ph.D., 9 M.S.).

Kanater is the most important station for citrus research. Citrus is by far the most important fruit crop in Egypt both for local consumption and export. In addition, Kanater is important for dates, mangos, deciduous fruits, vegetables, and medicinal and aromatic crops. A small poultry research unit is located there also.

In the 1980s, a large administration laboratory building for fruits and vegetables was in moderately good condition but virtually devoid of instrumentation. Considerable funding was required to develop the laboratories.

There were reasonably good laboratory facilities and equipment in the building housing medicinal and aromatic plants that was located next to fine collections and plantings of these plants. There were other laboratory facilities close by in Cairo.

The land and trees at Kanater are vital to the horticulture research program. Maintenance and upgrading of the farm and orchards was needed, including the replacement of old trees with new ones.

A sum of £E771,336.50 was allocated by the Research Component under NARP. Implemented work estimate was £E513,919. Renovation covered old and new administration buildings, guest house, stores, electricity network, and tops of laboratory benches.

Ismailia, located near the Suez Canal, is new and consists of both field crops and horticultural units separated by 40 km.

The field crop unit has a small staff (8 Ph.D., 5 M.S., 12 B.S.) to work with onions, forage, and oil crops on the sandy, desert soils of the region. There are also soils and water, plant pathology, and nutrition sections. In the 1980s there was adequate land and a new building, but the laboratory instrumentation was quite inadequate. The library had no books. This station represents an irrigated desert region not served by any other station. Considerable money needed to be expended, however, if it was to function well.

Administration and cultural buildings, rest house, store and garage were renovated under the research component of NARP at a cost of £E515,293.43. The original committed fund was £E405,042.

Ismailia station was further renovated through other foreign aid. It has now a CD-ROM library and well-equipped soil research laboratories.

Middle Delta region

Sers is a new station with a small staff (2 Ph.D., 2 M.S., B.S.). Under present conditions, it is difficult to envision this as a viable research station. There are about 20 feddans of land: 5 in cotton, 6 in maize, 5 in wheat and barley, 5 in clover, and 75 in onions. The buildings are very inadequate. There are no laboratories and little field equipment.

Gammeza is the regional center for Middle Delta Region, an obvious choice because the only other station is Sers. The staff is relatively large (24 Ph.D., 15 M.S., 9 B.S.). Gammeza is well located to serve its purpose, and staffing is far less difficult than in Upper and Middle Egypt.

The station conducts research on cotton, rice, and other field crops. There is also a large animal unit with cattle, buffalo, sheep, goats, rabbits, and poultry. Emphasis is placed on breeding and variety improvement of crops, but with attention also to pest control, agronomic work and soil and water research. Animal work is oriented toward animal improvement. There are limited nutritional studies and there is minor research on cheese production.

In the 1980s the land available was adequate. The building layout was standard ARC. Buildings had suffered from lack of maintenance. Laboratory instrumentation was substandard and instrumentation inadequate even for routine work.

An EMCIP unit was constructed at Gammeza and satisfied many needs. As elsewhere, however, it left other units deficient.

During the 1980s, the cotton section wanted to have more equipment for testing breeding lines and selections for quality. These tests were conducted at the CRI in Cairo. This and other discussions with the staff all suggested the desire for more sophisticated laboratories, which in effect would change the role of the station.

Animal pens and field facilities were adequate for present purposes but needed upgrading. The dairy products unit was in very poor condition and extremely deficient in modern equipment.

The research component under NARP funded the renovation of Gemmeza by £E921,600.49. Implemented work estimate was £E694,802.92. Renovation covered administration buildings and library; dairy laboratory; stores; nursery and breeding buildings; duck farm; fences and walls; two nurseries; sheep breeding ward and suckling building; and calf breeding fields.

New lands region

South Tahrir research station has a small staff (5 Ph.D., 2 B.S.). It is located in the southern part of Nuberia Governorate between the Desert Road and the western edge of the Delta.

The research program is devoted almost entirely to citrus. There is no land assigned to the station. Orchard trees and field equipment belonging to a government company are available for research upon request. A small amount of land was furnished by the company for long-term rootstock research.

The building layout is different from the standard ARC design. There is a relatively new administration laboratory building. Instrumentation is inadequate for even the most routine analyses. Not even cold water is available in the laboratory. The laboratories were almost devoid of glassware or laboratory chemicals.

This station could be made very useful with proper planning of field research, modest refurbishing of laboratory space, and a small amount of laboratory instrumentation. The station is of minor value in its present condition.

Nuberia consists of a field crop unit on the Desert Road at the north end of Nuberia Governorate and a horticultural station about 18km east of there. Nuberia is designated the regional center of the New Lands region, and the regional director is located at the field crops unit. The staff consists of 22 Ph.D., 4 M.S., and 2 B.S. The station is sufficiently close to Alexandria to permit commuting. Some staff do commute 1.5 hours each way.

A wide range of variety testing and agronomic research is conducted on field and forage crops. There is also a limited amount of research on sugar beets and on cattle feeding. There are soil and water, plant nutrition, plant protection,. and plant pathology laboratories. All need upgrading.

Research at the horticulture unit involves citrus, deciduous fruit trees, and grapes. Some of the more meaningful horticulture research is a search for superior selections of citrus that might have arisen in the thousands of acres of citrus in the area. This is part of a national program. There is also citrus rootstock research, testing of exotic varieties of deciduous fruits, and a certain amount of work related to cultural practices.

Laboratories at the horticultural unit area are in poor condition and lack instruments, glassware, and chemicals.

The roles of the field crop and horticulture stations need to be studied and clearly defined to determine the level of support that can be justified. These units, along with the South Tahrir station, serve a unique, reclaimed area with large field crop and citrus plantings. Research is badly needed to solve a number of problems.

The Nuberia station's linkage with the University of Alexandria could be further strengthened.

North Delta region

Sakha is designated the North Delta regional center. It is a large research station (104 Ph.D., 37 M.S., 37 B.S.). Sakha does not have the serious staffing problem of Upper Egypt. The station consists of a number of units that involve animals, field crops, rice, and cotton. There is a wide range of research, but variety and animal improvement is emphasized throughout.

A large rice program is centered at Sakha. The USAID-supported rice project in cooperation with the University of California constructed excellent facilities for rice research. These include an extensive administration laboratory extension building with a wide array of laboratories, a library, conference rooms, auditorium, offices, and support facilities. There are buildings for storage of chemicals and pesticides, seed processing, and machinery repair. The laboratories are now equipped with modern instruments to conduct a wide range of analytical and other analyses. Extensive equipment for routine farming and field research was supplied and a large number of vehicles were purchased.

There is an extension component with 20 regional rice specialists closely linked to the station and a subject-matter specialists housed there. Extension facilities are excellent. Adequate land is assigned directly to the rice project.

Thus the rice section at Sakha is virtually a self-contained experiment station with administrative headquarters located in Cairo.

There is also a former EMCIP unit at Sakha located close to the rice project. The basic components of the EMCIP facilities are described under the Shandaweel station.

Thus facilities there are two exceptionally well-equipped research complexes adjacent to each other with considerable duplication of facilities. For example, each has its own equipment repair and maintenance shops.

During the 1980s the rest of the field crop sections and the cotton section were poorly equipped, even though equipment and instrumentation were better than at most stations. Much of the instrumentation was not functional.

For example an old atomic absorption unit and two pH meters in the soil and water laboratory had not been operable for many months.

The animal research pens and shelters are clean and well-maintained. Animal performance records are well kept. There is an artificial insemination unit that functions well but needs upgrading.

Laboratories for animal research are inadequate and the large program at Sakha justifies a higher level of support. Thus, a portion of the staff will be housed in modern facilities and supported well.

The remainder have an adequate quantity of space in several buildings, but most of the substandard and laboratory instrumentation is inadequate.

Sakha station and the closely situated Mahallet Moussa station received a total sum of £E7,246,938 for renovation. Renovation included open and reinforced sheds for cows; open shed for weaning with reinforced concrete wall; delivery ward; suckling ward; weaning ward; dairy labs; administration building; store and gene facility building; buffalo bath; main gate and walls; high water tank and sanitary network; sewage septic tanks; turkey station; all administration buildings; housing; water feeding network; sewage network; gate; central drain; electricity network; paving network.

Sirw is located in the far northeastern Delta. The station has a small staff (2 Ph.D., 2 M.S., 4 B.S.). The location is of particular significance because of soil salinity problems. Rice breeding lines from Sakha are tested at Sirw for salt tolerance. There is a field crop unit with soils and water, plant protection and plant pathology sections and an animal unit (cattle, buffalo, sheep, and poultry). The research programs are small as compared with Sakha. There appears to be a close working relationship with some members of the Sakha station, which is about a 1.5 hour drive from Sirw, especially in animal and rice research.

There are 40 feddans for land farmed for research but more is available from the production farm. Field equipment is available for the research program. In the 1980s, buildings,

particularly a small one housing animal staff members, were below standard. Animal pens needed upgrading. The small cheese unit had little research value and is in poor condition.

Laboratories for field crop and associated sections were poorly instrumented. The staff is anxious to add considerable equipment so as to do such things as soil and plant tissue analyses. The pathologists and entomologists also would like to be much better equipped.

The station has an important role as a testing location. Sirw station received £E3,815,145 for renovation. Thus, the station was able to renovate administration, employee, and laborer buildings; garage and store; main gate; roads; dairy lab air-conditioning.

Alexandria and North Coast region

Sabahia is designated the regional center. It is a large (56 Ph.D., 45 M.S., 12 B.S.) station with horticulture, sugarcane breeding, plant quarantine, soil salinity, and poultry units.

Horticultural research is conducted on citrus and tropical and deciduous fruit trees, vegetables, medicinal and aromatic crops, and ornamentals. The scope of research is broad, including both productions and postharvest handling studies.

Sugarcane research is located at Sabahia because it is the only region with a climate that results in natural flowering. A small amount of other kinds of research is done with pot-grown cane.

The plant quarantine unit, the only one in Egypt, is devoted to the quarantine and inspection of plant introductions.

Soil salinity research is located there because of salinity problems existing in the region. The station undertakes a wide range of research from basic to very applied. It contains soil chemistry, soil physics, plant nutrition and physiology, irrigation and drainage, and applied research sections.

The Montazah poultry research unit is a completely isolated unit located in the Montazah Palace (Alexandria). It is different from other poultry units in that it is conducting programs on physiology, immune genetics, nutrition, and microbiology, rather than on just applied production practices and bird improvement.

Sabahia is an old station representing a distinct area. The buildings have been developed independently and do not form a planned design. They also vary in quality, but have been better maintained than most. Even so, they are, in general, substandard.

There is no production farm associated with Sabahia. The land available is sufficient in quantity (160 feddans) but so poorly drained that research with fruits is extremely limited, even though this is one of the primary purposes of the station.

Laboratory instrumentation is extremely deficient. Very little assistance in developing physical facilities resulted from the California ADS Horticultural subproject, even though a number of staff members were participants in citrus, deciduous fruits, ornamental crop, medicinal crop, and various vegetable crop activities. It is to the group's credit that they have maintained their laboratories and utilized their limited equipment so well.

Sugarcane research is conducted in large greenhouses that are well constructed and adequate for their limited objectives. The plant quarantine greenhouse is appropriately constructed but far too small. There should be at least 10 such greenhouses to accommodate the large amounts of material being introduced. Associated laboratories are well below standard. This important facility needs a much higher level of support. It is not accomplishing its mission in its current condition. The soil salinity and water research facilities have also been maintained and the instruments are in better condition than in most laboratories on other research stations.

The laboratory also has more and better equipment than most. Even so, the relatively large building in which it is housed needs renovation, and the instruments should be modernized and added to. This laboratory could be extremely important as salt problems increase, which they surely will. Also, it is located in a region of poor drainage and near to sandy calcareous soil regions. Thus, its location has particular relevance.

It is not clear why a poultry unit devoted to such basic research should be located at Sabahia (Montazah), but the instrumentation and support are inadequate for such work.

In general, the Sabahia station is involved in commodity-oriented research for a distance region. It has the largest vegetable program, one of the largest tree fruit programs and virtually the only ornamental research that is conducted on a research station in Egypt. Its plant quarantine and sugar breeding programs are unique and the soil salinity and water programs are particularly relevant. Thus, there is reason to support a program for improving soil drainage, increasing greenhouse space for quarantine work, and for large increase of instrumentation in horticulture, plant quarantine, soil salinity, and poultry laboratories.

It would be highly desirable to strengthen its linkage with the nearby University of Alexandria, one of the best universities in Egypt.

For renovation purposes, Sabahia received £E553,110. Administration building, walls, stores and ground floor were renovated.

National Research Center

The National Research Center (NRC) was organized in 1956 as a GOE program to "conduct basic and applied research in natural sciences" which would "contribute to the national welfare." During the 1980s, NRC functioned as a unit under the umbrella of the Academy of Scientific Research and Technology. In the 1990s, however, the situation has changed, and NRC is now functioning under the supervision of the Minister of Scientific Research and Technology.

Since 1975 research and development activities have been organized under the following five programs: technology transfer (with particular emphasis on the industrial sector), food and agriculture, health and environment, energy, and natural resources. The center is also involved in scientific and technical consultancy and technical advice as well as training and human resource development.

The NRC is under the management of a director with policy guidance provided by a governing board. The basic administrative unit is the laboratory. Currently there are 52 laboratories grouped into 13 divisions, including food industries, agricultural and biological, environmental, and basic science research.

The divisions dealing with food industries, agricultural and biological research, and basic science are involved in an array of research activities relating to food and agriculture. While most of the programs involve research, some are concerned with extension efforts such as work to increase the production of certain crops. We could not determine the extent of cooperation, if any, between the NRC and the ARC in the conduct of these research and extension programs.

NRC employs 4000 people. One fourth of the research staff hold the Ph.D. degree. The Agricultural Research Division is the largest, with some 600 employees, including 384 with Ph.D. degrees.

In agricultural research, NRC develops programs to help improve the output of certain crops. Among these programs is the "More and Better Food" project initiated in 1978 as part of the Applied Science and Technology Program funded by USAID. The main output of this project is the confirmation of the value of transfer of simple technology packages that, when fully developed, can be applied on a broad scale.

The success of that project served as start for some of the campaigns adopted later by NRC in cooperation with the ORDEV, Ministry of Local Government, and the extension staff of the Ministry of Agriculture. For example, a campaign dealing with maize production started in Giza Governorate in 1981 in an area of 1360 feddans. Its success led to an increase in the area of implementation, and in 1983 the campaign it was also extended to 40,600 feddans in

Middle Egypt provinces. This campaign is parallel to a similar one adopted by the Food and Agriculture Council of the ASRT in the Nile Delta.

Another campaign dealt with improving tomato production on 15,000 feddans in Middle Egypt provinces in 1983. This campaign led to an increase of almost 300 percent in production, with an average yield of 25 tons/feddan.

The team was told that in programs such as this, the NRC sometimes develops recommended farmer practices based on its own research. Such recommendations might or might not be consistent with those of ARC and the extension service.

In addition to the research programs supported by the NRC budget, there are some other programs that are supported by a wide range of donor sources including USDA, USAID, and Environmental Protection Agency.

One feature of the NRC that should be of particular interest to all research organizations in Egypt is its service laboratory. This laboratory has an impressive array of instrumentation and trained operators. For modest fees, the laboratory will perform virtually any analysis that might be needed. Services range from nematode identification through mineral analysis of soils and tissues to electron microscope sections and photographs. The ready availability of these services could often make the development of similar functions by other organizations unnecessary. In other cases these services can be used to augment facilities of sister research organization, including those in agriculture.

Another service of the NRC is a training school for instrument repair and maintenance. This is a badly needed service that is infrequently used, if at all, by agricultural research institutions such as the ARC.

NRC had 10 research grants from NARP, a matter that enhanced cooperation between both NRC and ARC.

2.2 Universities

Egypt has an extensive university system. Fifteen of the universities contain faculties of agriculture. These universities are associated with and funded by the Ministry of Education and Scientific Research. Unlike the ARC, they are not organized into a system, yet many decisions concerning them are made by the Supreme Council of Universities, which consists of the minister of education as chairman and the presidents of the universities.

Each university agricultural program is administered by a dean and includes a wide range of commodity-oriented and discipline-oriented departments. Human nutrition and more broadly based home economics programs are included in agricultural facilities of Alexandria, Cairo,

Ain Shams, and Zagazig. Helwan University has a program in home economics offering graduate degrees.

The faculties of agriculture all have both undergraduate and graduate programs. The three largest faculties of agriculture are Alexandria with 2087 undergraduates, Cairo with 1988, and Ain Shams with 1594. Others such as Assiut and Zagazig have enrollments of 951 and 1152, respectively. Some of the new universities, such as Fayoum, Mansoura, and the Suez Canal are much smaller. The Suez Canal University at Ismailia has 466 undergraduates and the new faculty of agriculture at Elareesh has only 155 (table A2-1).

The universities have not had an organized research program; however, they do conduct considerable agricultural and related research through their graduate students, many of whom are staff members of the ARC pursuing advanced degrees and who often use ARC as well as university facilities. There is also general recognition that academic faculties traditionally conduct research, and there is considerable independent research being conducted by the faculty despite meager support from the Ministry of Education and Scientific Research.

The university faculties have some excellent scientists who could contribute greatly to agricultural and related research in addition to the teaching programs in which they are engaged. The universities also have considerable amounts of functional laboratory space for research, through such desirable features as hot water, compressed air, gas and air conditioning are usually lacking.

There are some well-instrumented laboratories, and a considerable amount of excellent equipment is scattered among various departments of agriculture. Moreover, equipment of other faculties of science at both the Suez Canal and Assiut University is available to faculty members in agriculture. Much equipment had been purchased through the USAID-University Linkage Program funds and support from foreign donors.

Table A2–1. Number of Undergraduates in the Faculties of Agriculture during the Years 1988–1992 (§2.2.1)

	Years				
Faculties of Agriculture	1988	1989	1990	1991	1992
Cairo	3359	2940	2627	2239	1988
Fayoum	616	573	518	436	379
Alexandria	3967	3340	2864	2370	2087
Saba Pacha	584	429	312	245	203
Damanhour	—	—	—	268	239
Ain Shams	2990	2653	2114	1760	1594
Assuit	2444	2143	1780	1213	951
Tanta	1849	1507	1320	1015	933
Mansoura	2066	1811	1619	1356	1340
Zagazig	2399	2079	1846	1311	1152
Zagazig-Moshtohor	983	935	834	685	600
Menia	1196	1110	1075	874	689
Monofia	1337	1078	957	790	701
Suez Canal	646	574	530	428	466
Elareesh	—	84	128	156	155

Although the academic staffs of the faculties of agriculture vary in size, they all seem to be adequate. As examples, Cairo University has an agricultural faculty consisting of 161 professors, 101 associate professors, and 121 assistant professors. It also has 80 assistant lecturers and 55 demonstrators. The Suez Canal University, on the other hand, has a total faculty of only 133. Most of the faculty at the professional levels hold Ph.D. degrees. Alexandria University, for example, has over 294 agricultural faculty members with the Ph.D. degree.

Quality of education varies. As might be expected, the three older and larger faculties of agriculture (Alexandria, Ain Shams, and Cairo) are generally considered to be the most prestigious and to have the highest quality faculty, teaching programs, and facilities.

A few other universities, notably Assiut, are becoming recognized as also having programs of high quality. Other universities have certain areas or departments of excellence, but their programs are not considered equal to those of the three oldest and largest institutions.

The new Suez Canal University is impressive in the vigor and enthusiasm of its small faculty and the excellent facilities currently being developed. It received laboratory equipment and training from GTZ, Germany's technical aid program. Fayoum University, on the other hand, appears to be having greater difficulty in securing badly needed support for laboratories and other facilities.

Most, but not all, universities have at least small farm areas for teaching and research. None compare to the large farms of the ARC, but some are 100 to 200 feddans and the Suez Canal University has over 1000 feddans developed into a farm. Al Azhar University, on the other hand, has only a small amount of land for greenhouses, a nursery, and a few plants. Cairo University has a small farm, but it appears to be little used.

University libraries are generally better than the ARC Central Library but still deficient. Libraries at Alexandria, Cairo, and Ain Shams are by far the best.

Massive funding would be required to bring laboratories and land for research at all 11 departments in all faculties of agriculture up to a satisfactory standard. However, there is a base of excellent faculty, laboratory space, and instrumentation that could, with well-directed support, make a substantial contribution to a national agricultural research effort. Such research would enhance the quality of the graduate programs in agriculture, which are a major source of the staff for the ARC.

As shown in table A2-2, the research component under NARP funded a number of projects for the universities. The projects' funds enabled the universities to update laboratory equipment and renovate buildings. This substantially contributed to improvement of research. The research grants further stretched links between universities and ARC. The NARP support has been very effective in getting the universities involved in research related to national needs.

Table A2–2. Number of Projects. Research Grants Phase I and II (§2.2.2)

Institution Name		Phase I	Phase II	Total
Ain Shams University, Agriculture		11	18	29
Private sector (Comibasal)		0	1	1
Menia University		3	2	5
American University–AUC		0	2	2
Mansoura University		4	2	6
American University–DDC		0	1	1
Alexandria, Agriculture		8	10	18
Desert Research Center (DRC)		2	11	13
Cairo University, Agriculture		15	7	22
Cairo University, Fayoum		5	0	5
ADSs	2	0	2	
Assuit University		11	8	19
Zagazig University, Moshtohor		7	8	15
National Research Center		5	5	10
Menofya University		10	4	14
Zagazig University, Zagazig		6	3	9
Production Efficiency Institute (PEI)		0	1	1
Cairo University—Veterinary Medicine	2	4	6	
Nuclear Research Center		0	1	
1				
Suez Canal University, Ismailia		3	2	5
Suez Canal University, El-Arish		0	1	
1				
Ain Shams University–Engineering		0	1	1
Al Azhar University		7	1	7
Alexandria University–Veterinary Medicine	0	1	1	
Tanta University, Kafr El-Shiekh		5	1	6
Private sector (EDFINA)		0	1	1
Total Projects		105	96	201

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2.4 Ministry of Public Works and Water Resources

Research in the Ministry of Public Works and Water Resources was consolidated in the Water Research Center (WRC) by Presidential Decree in 1975. The scientific staff is 60 Ph.D., 93 M.S., and 165 B.S. degree holders. The WRC now consists of 11 research institutes, a project for the Water Master Plan, a Department for Technical Training and a Department for Research Services. Three of the institutes and the Water Master Plan are conducting studies that are closely related to research being done in the Soil and Water Research Institutes and the Agricultural Engineering Research Institutes of the Agricultural Research Center. It is recognized by the directors of WRC and ARC and by the heads of the concerned institutes that cooperation is necessary in studying problems of soil and water management at the basin level, i.e., between the branch canal and the drain. The Water Master Plan project and the activities of the three WRC institutes most directly related to agricultural production are described briefly below.

The Water Master Plan is a United Nations Development Programme-supported project initiated in 1977, Phase I, completed in 1981, established a data base and developed the following planning tools:

- Upper Nile Model for flow routing
- Lake Nasser Model for reservoir operation
- Agro-economic Model for determining the effects of numerous planning policy options on agricultural production
- Groundwater Model of the Nile Valley for investigating the feasibility of vertical drainage and conjunctive re-use with surface water
- Distribution Model for determination of irrigation requirements downstream of Aswan and corresponding operation of the irrigation system
- Equatorial Lakes Model for assessing effects of changes in the Equatorial Lakes basin down to the Lake Albert outlet

Three planning scenarios were developed for new land development. The economic rate of return and the returns to water were used in ranking land development projects.

Since the completion of Phase I in 1981, the project has improved its data and refined and made additional runs of the models. Other development scenarios have been prepared and analyzed. The main report and the technical reports relating thereto constitute a valuable source of information on systemwide water use and management. Participation by the Ministry of Agriculture scientists in providing data and in the use of the agro-economic and the irrigation-use models is essential and should be encouraged and expanded.

The Water Distribution and Irrigation Systems Research Institute (IRI) was established as part of the WRC when the latter was formed in 1975. It has the responsibility to

- conduct, at the national level, studies on water requirements to determine water duties that help to raise agricultural production
- develop irrigation methods and practices
- study and develop irrigation rotations
- study the methods of water delivery and the improvement of farm outlets, and introduce modern systems as well as automatic control of the assigned shares of water
- study water losses by seepage and evaporation and means of reducing them.

Field studies were conducted for many years on a set of 11 water-requirement field stations distributed throughout the Nile Valley and the Delta. These studies are used to establish the water requirements of individual crops and to compute the water needs of various cropping systems. The studies are similar to ones being made by the Soil and Water Research Institute of the ARC, often at nearby field facilities. A careful evaluation should be made of the quality and utility of such studies with a view to redirecting much of the work and upgrading the research methodologies being used.

IRI is currently conducting a very productive multidisciplinary field study of on-farm water management (EWUP). This activity has shown the potential for substantial improvement in water-use efficiency and in crop production through technically and economically feasible improvements of the meskas and field distribution system.

There is an obvious and extensive overlap of competence and responsibility between the IRI of the Ministry of Public Works and Water Resources and the Soil and Water Research Institute and the Agricultural Engineer Research Institute of the Ministry of Agriculture. Close cooperation and joint action in the field by personnel of both ministries is needed to ensure that soil- and water-management problems are analyzed, studied, and resolved in an integrated manner.

The Drainage Research Institute was established as a unit of WRC in 1976. Prior to that time it functioned in the Egyptian Public Authority for Drainage. The Drainage Research Institute is composed of five divisions: drainage technology (covered drains), open drainage, experiments and laboratory analysis, economics and evaluation, and foreign public relations. Among its responsibilities are to

- study and develop the best design and execution methods that are suitable for local physical, hydrologic, and manpower conditions encountered in the field of drainage of agricultural land and to develop technologies for their use;
- set up the standard specifications of drainage;
- study the use of different materials, tools and machinery used in drainage works;
- conduct research on re-use of drainage water, water management, and drainage technology and to conduct evaluation studies of drainage projects;
- give technical backstopping to the Egyptian Public Authority for Drainage and to assist in achieving better control of waterlogging and salinity in cultivated areas.

There are about 237 civil and agricultural engineers on the Drainage Research Institute staff. It is reasonably well equipped with laboratories and other facilities needed for its mission. It monitors the hydraulic performance of various parts of the drainage system and is currently conducting a "crash program" on the effects of recently installed field-drainage systems on crop production. It conducts pilot area studies to test new materials and filters under diverse soil and hydrologic conditions and to measure groundwater behavior and soil salinity in relation to drain depth, spacing, and design. It studies the socioeconomic impact of drainage on farmers and conducts water-management studies. Considerable attention is directed to studies of drainage water quality as it relates to the feasibility of re-use in the irrigation system.

The Drainage Research Institute conducts training programs for the Egyptian Public Authority for Drainage and Drainage Research Institute staff, which include short courses for field supervisors and technicians on system installation, operation, and maintenance.

Studies of groundwater were initiated by the Ministry of Public Works and Water Resources in 1963 and were placed in the Groundwater Research Institute of the newly created WRC in 1975. The institute has a professional staff of about 30 civil and agricultural engineers, geologists, and chemists. Its objectives are to

- study the development and management of groundwater resources
- compile and analyze hydrologic data
- study the feasibility of utilizing groundwater resources in different applications
- protect groundwater reservoirs from potential sources of contamination
- train personnel involved in groundwater research and related fields
- provide information and consultancy services in the field of groundwater hydrology

The main activities of the Groundwater Research Institute include

- monitoring of regional networks of observational wells
- conducting hydrogeological studies of the Nile Valley
- designing groundwater-use project
- studying changes in the groundwater regime due to the construction of Aswan High Dam
- studying the effects of land reclamation in the Kom Ombo plateau on the hydrogeology of the groundwater reservoir in the plateau and adjacent areas
- studying the feasibility of using groundwater in newly reclaimed areas and new cities in the desert fringe east and west of the Nile Delta
- investigating saltwater intrusion in the northern part of the Delta
- studying the seepage from main irrigation canals
- examining the feasibility of vertical drainage in the Nile Valley
- participating with other agencies in the study of the aquifers of the Nubian sandstone in northeastern Africa.

The work of the Groundwater Research Institute relates to that of ARC institutes on problems of conjunctive use of groundwater for irrigation and on questions of production practices on water quality and groundwater behavior.

2.5 Former Ministry of Land Reclamation

The former Ministry of Land Reclamation is now a part of the Ministry of Agriculture. It has little research capability. A few project-related studies have been conducted by the staff of the International Center for Rural Development to guide the management and settlement of some of the new lands. Research on well drilling, groundwater and geological behavior, corrosion, pump performance, soil surveys and land classification have been conducted by the General Company for Research and Ground Water.

The Desert Research Center formerly known as Desert Research Institute was established in 1936 and was inaugurated in 1951. It is now affiliated with the Ministry of Agriculture. Its main objective is to conduct studies useful for the development of the desert. It gives research emphasis to water and soil resources and to plant and animal production. Its research programs are conducted mainly in:

- the Sinai Peninsula, where winter rainfall averages 100 mm and where there is adequate soil and range plant cover;
- the New Valley on clayey soils and lacustrine origin underlain by a major artesian basin in the Nubian sandstone;
- the marginal gravelly plains of the Nile Delta, where there is a major groundwater basin
- the Mediterranean littoral zone, having significant winter rainfall and adequate soil and natural plant cover
- the fringes of Lake Nassar in such valleys as Kurkur, Kalabaha, Tushka, etc.

The staff of the center consists of 161 Ph.D., 73 M.S., and 36 B.S. degree holders. The center library has about 5,000 books and periodicals and publishes "The Desert Institute Bulletin" once every two years. It has a 50-hectare experimental station at Marriut in the Mediterranean littoral zone, where studies on sheep production, range management, horticulture, reclamation of saline soils, irrigation techniques, and use of saline water for crop production have been made. Another field station is under development in Sinai within the arid belt of the Gulf of Suez.

The center has published a study of the natural agricultural resources of the Sinai Peninsula and analyzed its future development to year 2000. The study discusses the geographical, geological, and hydrological features of the area with particular attention to soil types and their distribution, and it explores the possibilities of agricultural and animal use of the resources.

The need for more detailed and sustained research on developing new lands and creating a productive and economically viable agricultural production system on them was pointed out in the SAAD report. It is unlikely that the Desert Research Center can or should be expected to meet this important need. It could, however, participate with appropriate units from ARC and WRC in a well-planned program of research and pilot studies in areas for potential development well in advance of the initiation of the land development work.

3.3.1 Varieties and hybrids recently developed by ARC

The following is a listing of field crop varieties and hybrids developed under NARP.

1. Maize:

   - white hybrids:

     - single crosses: Giza 122, Giza 123
     - 3-way crosses: Giza 320, Giza 321, Giza 322

   - yellow hybrids:

     - single crosses: Giza 151, Giza 152, Giza 153, Giza 154 Giza 155
     - 3-way crosses: Giza 351, Giza 352

Remark: The following hybrids are submitted for registration in 1994.

White single crosses	Yellow single crosses
Giza 124	Giza 156
Giza 125	Giza 157
Giza 126	Giza 158
Giza 127	Giza 159
Giza 128	Giza 160
Giza 129	

2. Wheat:

   - bread wheat: Gammeza 1, Giza 165
   - durum wheat: Beni-sweef 1, Sohag 3

3. Rice:

- Giza 175, Giza 176

4. Legume crops:

(a) faba bean: Giza 461, Giza Blanca, Giza 402, Giza 2 Improved
(b) lentil: Giza 370, Giza 29, Giza 4, Giza 5
(c) chickpea: Giza 129, Giza 531
(d) soybean: (for registration in 1994) Family 21 (tolerant to insects), Family 82 (early maturity), DR 1 (drought tolerant)

5. Forage crops:

(a) millets: 2 varieties for registration in 1994
(b) Egyptian clover: Gemmeiza 1, Serw 1, Helaly
(c) alfalfa: Geiza 91, Ismailia 92, Nubaria Composite

6. Oil crops:

(a) sesame: Giza 32
(b) peanut: Giza 5
(c) sunflower: (introduced hybrids) Hysum 354, G 10, TBH 166, Pioneer 6480, Multibeszt

7. Sorghum:

- Duradoo: short, dual purpose
- Giza 113: long, grain yield

In addition to three new hybrids in final stage of large scale evaluation.

8. Barley:

- 6-row varieties: Giza 125, Giza 126 (both for rainfed areas)
- 2-row varieties: (for malt production) Giza 127, Giza 128, Sakha 1, Sakha 2 (all for irrigated areas)

9. Onion: Three new promising varieties in final stage of large scale evaluation, to be registered during 1994. These are
Behairy (no pink)—for export or local consumption
Elbustan Composite—for export and local consumption
Assuit Early—early maturity, for export

10. Fiber crops:

- flax: Giza 7, Giza 8
- kenaf: Giza 4

3.3.1.1 On-farm research (OF-R).—The major objective of OF-R is to validate agricultural technologies with farmer participation under the agriclimatic as well as socioeconomic conditions. OF-R main goals are (1) priorities of farming systems based on agriclimatic zones, (2) adequate practicum training, and (3) adjusting OF-R with agricultural policy and free markets which support unsubsidized inputs. These activities are implemented in 20 governorates. About 1,000 OF-trials are implemented annually. They mainly cover field and horticultural crops to prove the suitability and profitability of the test factors.

The obligated budget of OF-R is US $1,575,000, which was all expended by December 31, 1992. OF-R has fostered the technology transfer process from the researchers' plots to the farmers' fields and thus supplied a missing link in the technology transfer chain and brought the farmers' socioeconomics and practices under the researchers' attention.

Land improvement

The main target of the land improvement program at the research stations is to (maximize) yield through proper water (irrigation and drainage) and soil (subsoiling, leveling, and gypsum) management. Funding has been made available in the amount of US $1,817,532 for land improvement at 12 research stations and 3 greenhouses.

The expenditures for the land improvement program is estimated to be 57 percent of the total up until April 1994. The program is divided into three subprograms; commodity procurement, system installation, and soil condition improvement. More than 2,000 feddans will be improved through this program, which will improve soil productivity of the research station farms and experimental plots.

Laboratory, office and farm equipment

The goal is to improve and upgrade the research facilities (laboratory, farm, and office equipment) to help produce high-quality research and reliable results. The cost of the first consignment received was US $2,721,000 for farm equipment and US $3,452,000 for lab equipment. Another $22 million contract was signed for the procurement of equipment as follows:

Equipment	Amount (Million US $)
Office	936,883
Laboratory	18,408,211
Farm	378,267
Library	1,868,536
Subtotal	21,591,897
Seed Technology	4,241,615
Technology Transfer	1,362,546
Subtotal	5,584,161
Total	**27,176,058**

These facilities will help maintain ARC laboratories and farm equipment at an up-to-date global standards to meet the research needs of Egypt.

Research Support Program (RSP)

The objective of RSP is to strengthen the research capabilities of ARC. This activity covers nine commodity-oriented programs to replace the previous 23 programs based on institutional and research needs of ARC. This program encourages interdisciplinary work among and across different institutes of ARC. Among these programs are cereals, oil crops, fiber crops, sugar crops, fruit crops, vegetable crops, animal production, etc. Total obligated budgets US $12,132,000; expended as of March 3, 1994, was $11,760,886.

Funding of RSP was projected to be through the special account, since January 1, 1993. As of September 30, 1993, this funding was still not available. Urgent expenditures were made from ARC budget on a limited basis. This has severely affected the performance of the RSP. RSP has a major impact on technology generation by ARC scientists, institutes, research stations, and production farmers, where basic, strategic, applied, and adaptive research are being implemented.

Egyptian National Agricultural Library (ENAL)

The mission of ENAL has been described as "to serve the people of Egypt as a modern state-of-the-art facility" for Knowledge Acquisition and Information System. ENAL under NARP provides facilities and updates information to Egypt's agricultural sector.

It will function as the primary center for the storage, research, and dissemination of agricultural information in Egypt, the Near East, and Africa regions as well as contribute to the improvement, technology transfer, and extension of agriculture and its products.

ENAL helps to fulfill the NARP purpose of providing flow of the most up-to-date appropriate technology by managing the purchase, organization, and production or research publication and popular versions of research results.

Development of farm machinery

The primary goal of the NARP Agricultural Mechanization Program is to upgrade the capabilities of the Agricultural Engineering Research Institute (AERI) in commercial style machinery designs, development, testing, and extension. This program established a Machinery Design and Development Section and assisted in training of engineers in machinery design, development, testing, operation, maintenance, and manufacturing in the USA and other countries. A few critically needed machines were developed including cereal crop thresher and seeder. The program also builds industrial linkages and commercial production with manufacturers to strengthen AERI's role in technology transfer to end users. The program has expended US $4,825,000 as of April 1994. The program has provided hands on training on machinery development, testing, and industrial extension and field application and adoption of new implements under the direct supervision of NARP.

3.3.1.4 Solution to tomato virus in Fayoum and Ismailia governorates.—[2]

Infection of the Tomato Yellow Leaf Curl Virus (TYLCV) transmitted by the whitefly (*Bemisia tabaci*) drastically reduced tomato production on 42,401 feddans in Fayoum Governorate to 4.5 tons per feddan (t/fed) in the 1989 Nili season and on 12,023 feddans in Ismailia Governorate to 9.5 t/fed in the winter season (table A3-1). These are the major tomato seasons in the two governorates. Lack of supply of tomatoes in the market from the Fayoum Nili season forced the price to £E3.00–4.00/kg and quality was very poor. Other crops infected by the whitefly are Chile hot pepper and several grass species. Host plant species—other crops and plants on borders of fields and canals—serve to increase populations of the whitefly on the tomato crop.

As a result of damage to tomato production by the severe infection of the whitefly in the Fayoum and Ismailia governorates, Minister of Agriculture Dr. Youssef Wally formed a committee chaired by Dr. Mohamed El-Beltagy, undersecretary of state for horticulture, to address the problem. The chairman selected well-qualified representatives of the key disciplines related to tomatoes to clearly identify and diagnose the causes for low production. Once this was done, technical committees were formed to develop recommended management practices and steps for their implementation. Management was the key element in quickly defining and resolving the tomato production problem. The technology transfer component of NARP helped to bring together an interdisciplinary team of

[2]Prepared by Dr. Willis McCuistion

Table A3-1. Tomato Production in Fayoum and Ismailia Governorates (§3.6.1)

	Fayoum — Nili Season		*Ismailia — Winter Season*	
Year	*Area (Feddans)*	*Mean (Tons/fed)*	*Area (Feddans)*	*Mean (Tons/fed)*
1989 (before NARP)	42,401	4.5	12,023	9.5
1990 (start of NARP)	26,848	21.8	12,846	15.5
1991	13,255	22.2	13,315	21.6
1992	22,344	17.5	14,347	24.6

scientists (specialists in horticulture, plant nutrition, entomology, pathology) from ARC institutes, NRC staff, universities, governorate directors, extensionists, and growers. The team leader and the assembled team managed this problem well and solved in one year what could have taken several years to accomplish.

Agricultural extensionists were assigned designated areas. A group of 10 extensionists under the supervision of a leader in direct contact with governorate officials worked to obtain a picture of crop status and to monitor implementation of the total recommended package. Training of the extensionists through special courses began in January 1990.

A plan was prepared to solve the viral problem and increase production in the 1990 season. The following steps were included:

(1) Virologists confirmed that serious plant protection and disease control began at the two-leaf stage of plant development, the most critical period affecting economic yield. Infected plants were eliminated up to four weeks after transplanting in the field. Plant protection was continued up to eight weeks after transplanting, and then all treatment for whitefly ceased.

(2) Seed to generate transplants for a given production area was sown in collective nurseries. Protection against whiteflies until time for transplanting was accomplished in three ways: (a) Sowing a border of cucurbit (squash), which is highly preferred by the whitefly. Squash was intelligently selected over cucumber because it must be cooked before eating whereas the cucumber can be eaten fresh in the field. The flowers of squash were picked off to eliminate or greatly reduce fruit set. Chickpea is also preferred by the whitefly, but it is very slow growing compared to squash; (b) Insecticide Temic was applied to the entire nursery to control whiteflies; and (c) nets were used to cover the nursery area, keeping out the whiteflies during development of the transplants. Seedlings were grown in plugs (peat pots) in Ismailia, which promoted vigorous early growth compared to bare-root transplants. Application of the recommended dose of fertilizer at the proper time also stimulated the rapid development of the plant to move beyond the critical stage of infection. A healthy plant at the fruit production stage will not sustain loss from late infection.

(3) The benefits of squash were its preference as a food source and concentration of the whiteflies for effective chemical treatment. Due to this preference, fewer flies visited the tomato nurseries. Use of insecticide on the border of cucurbits would efficiently kill most of the flies and those remaining on the tomatoes were effectively controlled by the insecticide. There is a direct relationship between the number of flies per plant and transmission of the virus; thus the absolute number of flies must be kept at a minimum. As the fly population increased in the tomato field, they were sprayed by surface equipment on small fields and by helicopter on large collective fields. The helicopter was the most effective equipment for application of insecticides to eliminate the fly population over a large area and to restrict movement among fields. The propellers created maximum movement of the chemical to the undersurface of the leaf and uniform coverage of the soil surface.

(4) One of the main factors for the program's success was the efficiency of the trained extensionists: their ability to identify the problems arising before the crop stage and to transfer of knowledge to farmers.

(5) The recommended planting period for Nili season is July–August in Fayoum. The Fayoum governorate was subdivided and different sowing dates were prescribed considering wind direction for control of fly movement from older to younger plantations in the same area. This system permitted control of the fly for 7–8 weeks only in the field. It also facilitated extension of the marketing period. Decrees were issued against summer planting in Fayoum and Nili planting in Ismailia to eliminate transmission of virus from prior seasons to the main crop seasons.

(6) Weeds in and around the nursery and in the field, one of the main contributing factors to increased whitefly population, must be controlled.

(7) Timing, forms and quantities of fertilizer, and irrigation were specified and promoted as part of the management package.

Transfer of the tomato technology package was very successful in the 1990 Fayoum Nili season resulting in total production of 585,286 tons from 26,848 feddans compared to 190,804 tons from 42,401 feddans in the 1989 season. Average yield was 21.8 tons/fed in 1990 vs. 4.5 tons/fed in 1989 (table A3-1). This was nearly a fivefold increase in one crop season. Adoption of improved management practices in Ismailia increased average tomato yields from 9.5 tons/fed in 1989 to 15.5 tons/fed during winter 1990 and 21.6 tons/fed in winter 1991, for total production of 114,218, 199,113, and 287,604 tons, respectively.

As a result of the program involving 50,000 farmers in Fayoum, 440 village extension workers and 50 technology transfer specialists were trained in tomato production and protection. Permanent links were established among farmers, extensionists, subject matter

specialists, and administrators. Other benefits of high tomato production per feddan are savings of land, fertilizer, water, and chemicals for use on other crops.

"This is an excellent example of how researchers and extensionists can formulate a team, collect known technologies into a recommended package and effectively apply it with producers to solve an identified problem," said Prof. Dr. Mohamed El-Beltagy.

3.3.4 Human resource development

The following material prepared by the Egyptian counterpart team.

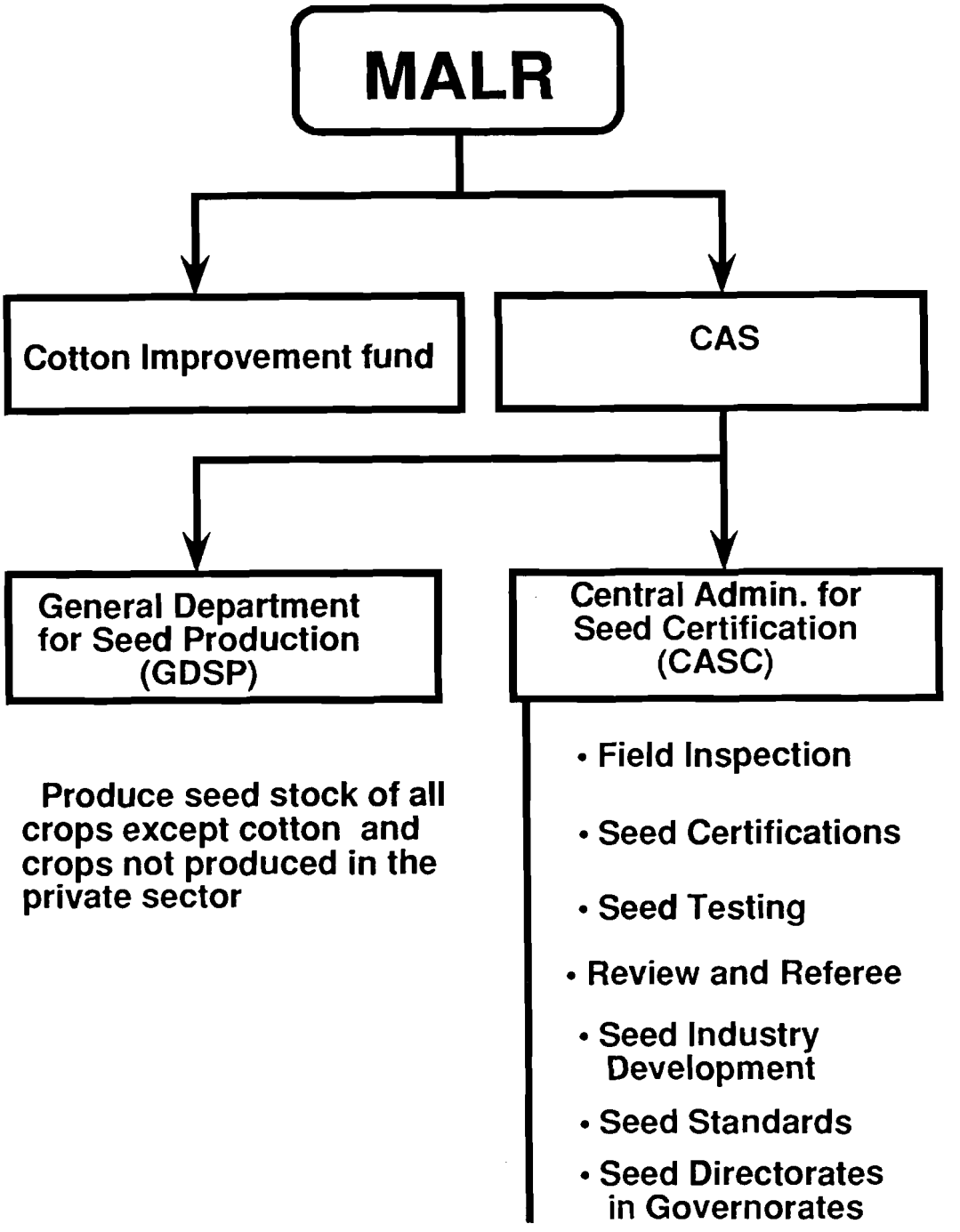
NARP-training programs are designed to improve the capability of Egyptian agricultural human resources to generate and transfer improved agricultural technologies to Egyptian farmers. In- and out-of-country training has a major objective of upgrading knowledge and skills of Egypt's pool of agricultural scientists and extension staff. Out-of-country offers opportunities for degree training (M.S. and Ph.D) and postdoctoral as well as short scientific observational training. More than 1,412 trainees have traveled on that program. In-country training covers management, technical and English language training. More than 25 million person, training days were conducted under NARP in-country training.

Obligated budget for out-of-country training is US $19,499,401 and the expended amount up until March 3, 1994, was US $18,870,012. For the in-country training, these are $10,246,637 and $8,411,848, respectively; with a total US $29,746,038 and $27,281,860, respectively.

These training programs have a major impact on the high-quality research being implemented and the fast flow of information from research to end-users in the past four years. The training programs are supported by media production (about 2 million copies of technical information) and some 47 temporary assignments in different subject areas. The obligated budget for media was US $386,000; expended was US $289,552 up to March 4, 1994.

A science writing unit was established (April 1993) under the direction of the NARP-DG to improve the quality of scientific writing at ARC and to create informational material to publicize the institutions and accomplishments of ARC.

Figure A3-1. **Reorganization of seed component responsibilities in the Ministry of Agriculture and Land Reclamation (§3.4.4.1)**



3.4.2. Seed component training program.

Number of persons	Type of training	Subject
20	Post-graduate training	
30	9-week course	Seed Improvement
24	1-month short term	Various topics
5	2-month course	Seed health testing
5	3-month course	Seed health testing
3	Travel/study	Cotton seed conditioning
2	1-year course	Computerized data & information systems
Several	Conference	Int. Seed Testing Asson.

3.4.3. Seed component training, in-country events.

Number of persons	Subject
25	Seed processing
20	Seed production
50	Field inspection
72	Business and finance
74	Organization & management of seed programs/ operations
180	Computer-assisted data & information handling

Table A3-2. Private sector seed companies, 1994 (§3.4.4).

Company	Maize	Commodity vegetables	Wheat	Other
Egyptian Agric. & Seed Co.	x		x	
National Seed Co.	x	x		
Nile Seed Co.	x	x		
Danton - Misr Seed Co.	x			Potatoes*
Misr Pioneer Seed Co.	x			
Nile Storage & Crop Imp. Co.	x			
Misr Hytech Seed Co.	x			
El-Foaad Seed Co.	x			
Agrarian Reform Organization	x			
Central Cooperative Society	x			

*Tissue culture

3.4.4.2. Renovation of buildings.—The aim is to improve ARC research facilities, e.g. rehabilitation of research stations (renovation of station buildings and extension offices and improvement of experimental farm hands) and upgrading the research facilities (laboratory, farm, and office equipment) in order to increase and maintain the research/extension capabilities of ARC. The obligated budget for station renovation is US $6,982,968 (not to exceed £E20,837,175). The obligation of GOE is £E2,800,000; expended was £E19,674,236 up until March 4, 1994. Major renovations have been made in stations as well as in five research and experimentation centers and 69 extension offices.

3.5 EGYPT: Agricultural policies affecting planted area, product price and delivery requirement, 1994

Name of commodity	*Area restric-tion*	*Price control*	*Delivery requirement*
Cotton	No	Processor	Market limited to GOE ginning[1]
Sugarcane[2]	Yes	Processor	Market limited to GOE processing[1]
Rice	No	Floor[3]	No
Wheat	No	Floor	No
Broadbeans	No	Floor	No
Lentils	No	Floor	No
Sesame	No	Floor	No
Groundnuts	No	Floor	No
Onions	No	Optional contracts[4]	Optional contracts
Maize	No	Floor	No
Garlic	No	Optional contracts	Optional contracts
Soybeans	No	GOE price	No[5]
Potatoes	No	Optional contract	Optional contracts
Fruit & vegetables	No	No	No

1. While the market for farmers in reality is limited to processing and ginning facilities owned by the GOE, each farmer has the freedom to market his product wherever he can find a buyer.
2. A technical area restriction for cotton does exist in that, if a farmer grows cotton, he must grow a specific kind for that area.
3. Floor price is a minimum price the farmer can receive by selling his product to the GOE, usually purchased by the PBDAC.
4. Optional contracts refer to the farmer's option to sell his product on the open market or sell under a contract with a private processing facility.
5. No delivery requirement; however, GOE is the only buyer.

Figure A3-2. The Agricultural Extension Organization in the Arab Republic of Egypt: Central Level (§3.6.2).

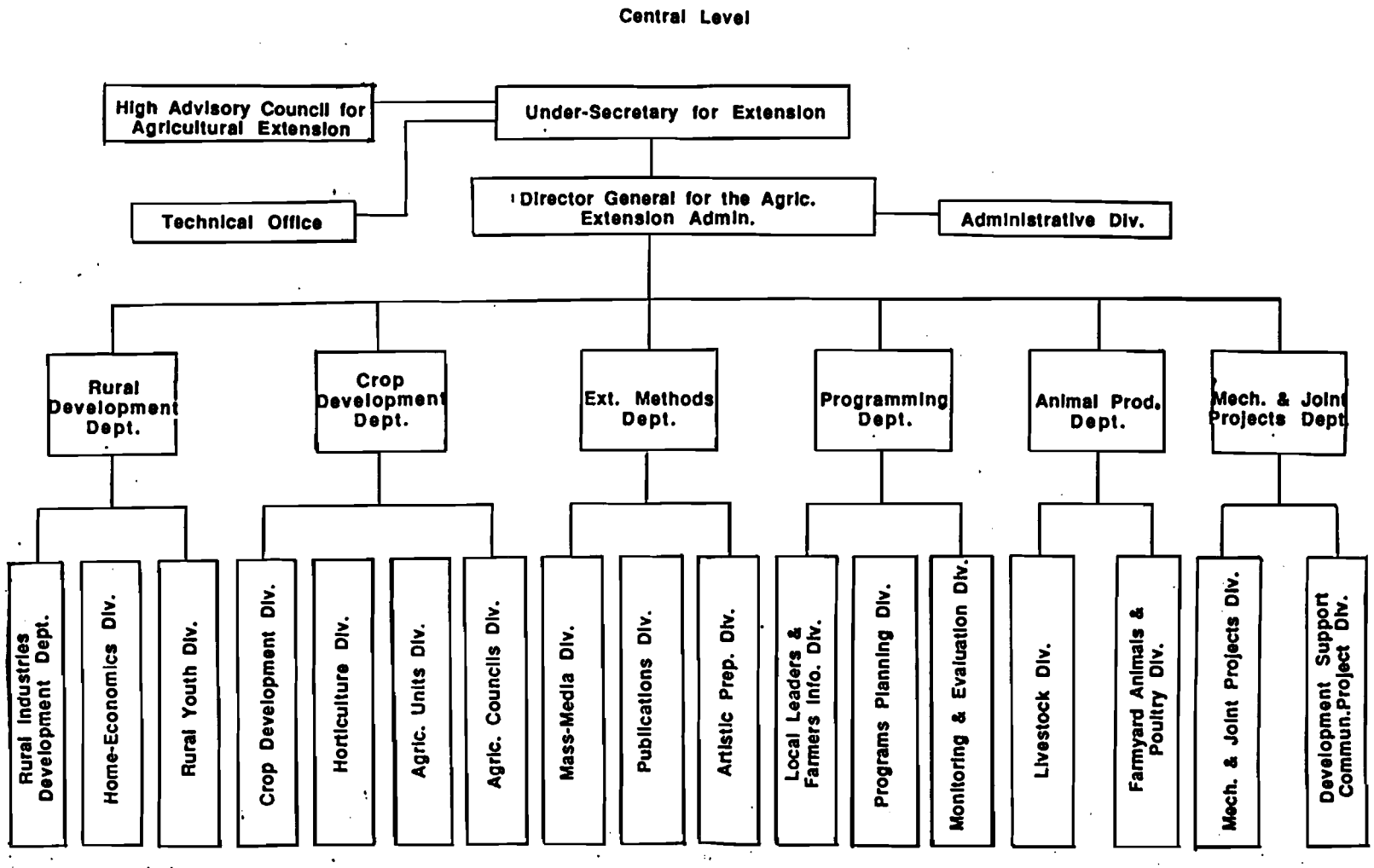


Figure A3-3. Agricultural Organization at Governorate, District, and Village Levels–Arab Republic of Egypt (§3.6.2).

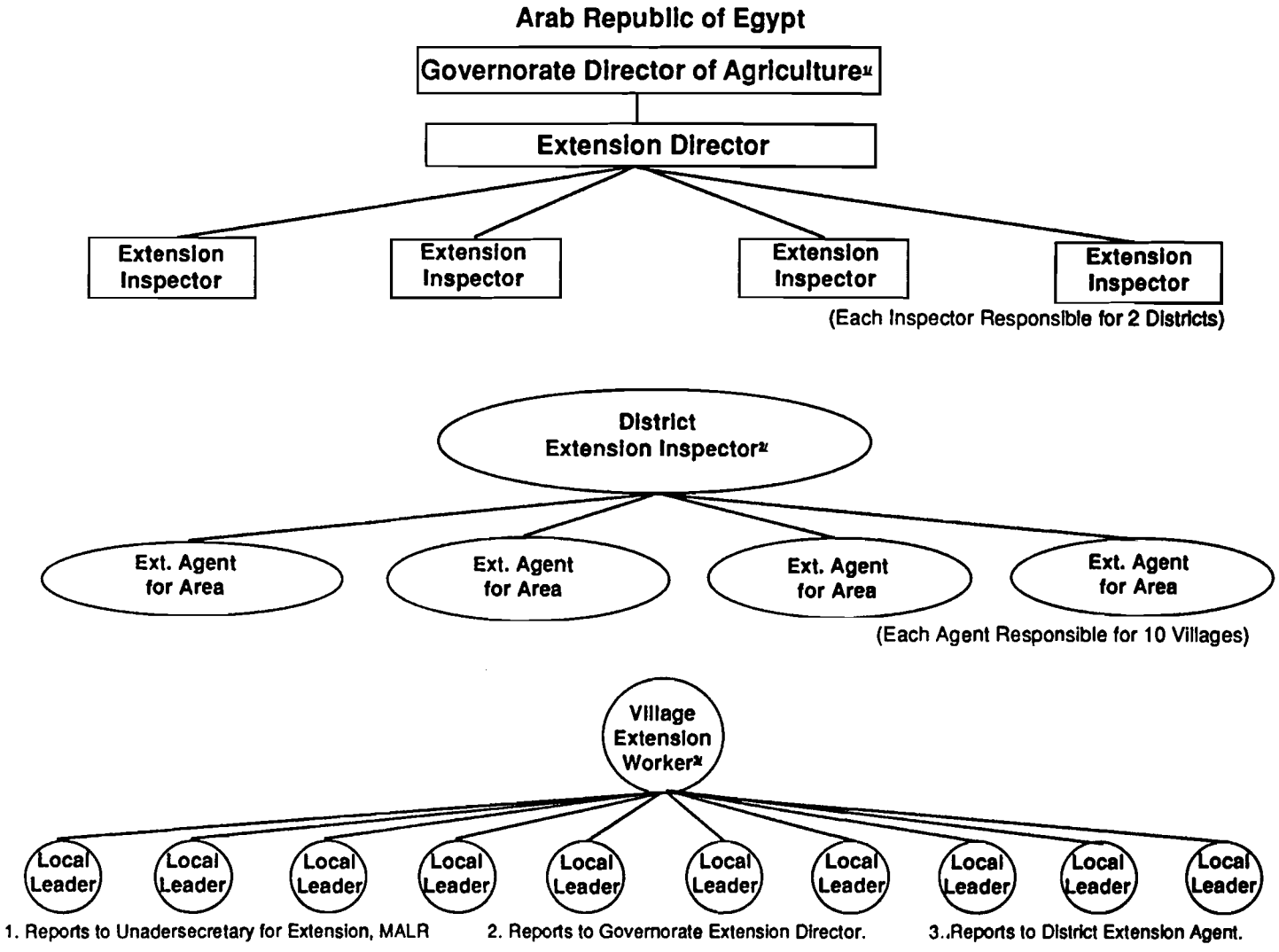


Figure A3-4. Extension-Research Office/Regional Research Extension Station/ Agricultural Research Centers: Officers and Responsibilities (§3.6.2).

ARC

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Regional Agricultural Research Station (RRES)

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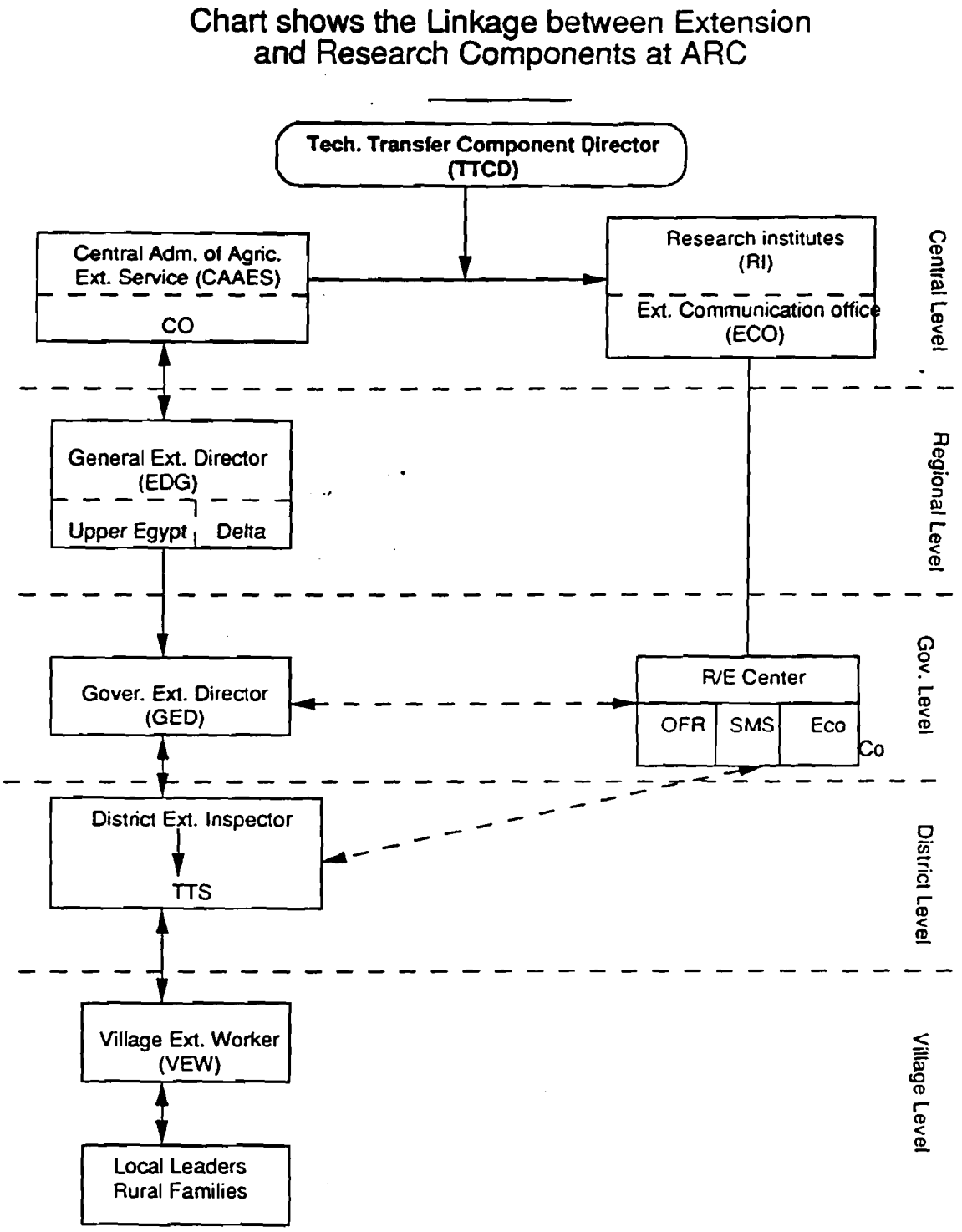
Extension - Research Office

Officers & Responsibilities

Position	Responsibility/Job Description
1- Director	*(Program plan, day -to -day operation and reports)*
2- Governorate extension Liasion officer	*(Linking governorate extension with the extension - research office and share training)*
3- SMS - Audio-Visual Aids	*(Audio-Visual aids, information dissemination, communication and training)*
4- SMS - Program Planning	*(The annual program plan and governorate plans; field days, harvest days, meetings and share training)*
5- MIS Specialist	*(MIS data-base, information system and assist with reports)*
6- (2-3) assistants (MIS)	*(MIS assistant day- to -day operation & data collection, feed & analysis)*
7- Auditor (Finance/Admin.)	*(Finance plan day to day operations and administrative matters)*
8- Secretary	*(Secretarial work, typing, filling ...etc.)*

Figure A3-5. Linkage Between Extension and Research Components at ARC (§3.6.2).



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3.6.6. NARP/TTC horticultural crops development programs[3] (§3.6.2).

The NARP technology transfer component (TTC) sponsors twenty-one horticultural crops programs in 15 governorates throughout Egypt. The goal has been to increase production and quality, to optimize profit, and to transfer new technologies to the end user. The achievement of this goal has been based on the belief that a two-way flow of information and an interdisciplinary approach are essential ingredients for successful agricultural development.

Horticultural development in Egypt.—Prior to the introduction of the NARP/TTC system, there was little coordination of horticultural development by the various research and/or extension organizations in Egypt. Individual activities for different crops were targeted by ARC, the universities, and the Academy of Science, but these programs emphasized either research or extension, while farmers' participation was neglected. Programs provided the farmers with disease-free seedlings, but linkage between research and extension was fragmented, the programs themselves were scattered, and the concept of need assessment as integral to development did not exist. Thus the need for a national horticultural program was clear. The idea is to have interdisciplinary teams and let the farmer participate in nearly all aspects of the system, from planning to the transfer of technology. This is what it's all about—farmer involvement in research/extension.

The NARP/TTC, under the directorship of Dr. Mohamed El Beltagy, was given the assignment of rectifying this situation. Crops were targeted for development programs based on three criteria: the farmers' needs, the presence of acute problems, and the absence of other programs to address those problems. The tomato program was initiated in 1990. In 1991, apricot and olive programs were implemented, with apple, grape, mango, peach, pear, plum, cucurbit, and aromatic and medicinal herb programs added in 1992. As four crops are included under cucurbits, and eight crops under aromatic and medicinal herbs, a total of 21 horticultural crops are now included.

The system and approach.—At the top of the organizational structure is the steering committee, which is responsible for the overall planning and follow-up. Representatives on the committee come from all concerned areas of expertise, including the Agricultural Research Center (ARC), the National Research Center (NRC), the universities, the Central Administration for Horticultural Crops, the Central Administration for Plant Protection, and governorate agricultural undersecretaries. Producers, farmers, and exporters, considered essential for a well-rounded presentation of ideas, are also included.

The technical advisory committee for each program is made up of commodity and disciplinary senior researchers from both ARC and non-ARC research establishments. The

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[3]submitted by A.I. Allam, Research-Extension Coordinator TTC/NARP

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committees' task is to backstop the interdisciplinary team of subject matter specialists as they consider each commodity by both discipline and agrizone.

The system of horticultural programs hinges upon the work of various interdisciplinary teams comprised of subject matter specialists, representing all disciplines, from ARC, NRC, the universities, the regional research stations, and other research organizations. These specialists are the implementers of the system.

The subject matter specialists form a core group responsible for recommending new technologies to the farmers and then overseeing implementation by extension staff at the governorate, district, and village level. The extensionists themselves form a network spreading out across Egypt, providing education, communication, and training to farmers in orchards and fields from the Sinai to Marsa Matrouh, from Sohag to Alexandria. It takes a lot of spadework to uproot deep-seated cultural perceptions and to achieve success, but the farmer must move forward with the technology to increase income and meet food needs.

One of the goals of the horticultural program is to create young, progressive leaders at all levels through this management system. They see how the system works—organizing human resources to get the best people to help, delegating authority to stimulate leadership, and organizing to efficiently manage available resources and technology. There is no discrimination in selecting the committee or team leaders: They may be the subject matter specialists in plant pathology, entomology, or commodity experts. The best people must be chosen to work on the comprehensive problems we face.

Two-way communication.—Published technical recommendations and opportunities for farmer feedback are essential parts of the Horticultural Crops Programs. Biweekly meetings are held for the subject matter specialists to review progress and plan future activities. They make weekly visits to provide on-the-job and on-site training to both farmers and extension staff. Follow-up, monitoring, and evaluation of each program are essential to assure accurate recording of both progress and problems. This enables necessary changes to be made and problems to be addressed swiftly. To aid in the collection of data, special follow-up cards are given to each farmer to record all activities such as agrimanagement practices and visits paid by the subject matter specialists or extension staff.

Extension bulletins, farmer guides, and agricultural calendars are produced by the subject matter specialists under the review of an editorial board chosen from the Steering and Technical Advisory Committees. Specific recommendations for the farmer are also made. The subject matter specialists are in constant contact with the farmers and other end-users via the extension system staff and programs. "Other end users" includes both producers and exporters, whose representatives also sit on the steering committee, thus augmenting the flow of communication. This two-way communication within the research/ extension/farmer continuum ensures that research will be driven by the farmers' and end user's needs.

A sample of achievements.—In the areas covered by the Horticultural Crops Program, there has been more than a twofold yield increase for tomatoes (table A3-3), while cucurbit yield increase has ranged from between 15 and 87 percent for different crops and governorates. Improvement in yield (both quantity and quality) of all fruit crops under the program has been documented. For example, apricot yield has increased from 3.6 in 1991 to 6.9 and 7.5 metric tons per feddan for 1992 and 1993 respectively (table A3-3). Bioproduction of aromatic and medicinal plants has ensured safety for use, and a cleaner environment, a yield increase of 25 percent, and quality improvement. Above all, the farmers have gained confidence in the system, the subject matter specialists, and the extension staff, and have been given a sense of ownership in the program.

Table A3-3. Average yield increase (in tons per feddan) (§3.6.6.1).

Governorate		1989	1990	1991	1992	1993
Tomato						
Fayoum (Nili Season)	4.46*	21.8	20.3	17.5	NA	
Ismailia (Nili Season)	3.5*	9.4	16.7	21.8	NA	
Beni Sueif (summer season)		NA	NA	12.9*	30	NA
Sohag (winter season)	NA	NA	10.4*	20.3	NA	
Apricot						
Fayoum and Qualubia	NA	NA	3.6*	6.9	7.5	

* Before NARP program
Beni Sueif (Summer Season)

Future prospects.—The future of the TTC Horticultural Crops program looks very good. The program's strength is its dynamism, which will allow it to address future problems as they arise. Facing a surplus of production in some crops, agriculture and food industries as well as the exporters can be addressed. In the near future, marketing and other socioeconomic strategies will be considered as a topic for agricultural extension under privatization (agricultural economist teams are already represented among the subject matter specialists).

The TTC Horticultural Crops program also provides a model that is flexible enough to be adapted for other subject areas such as field crops and animal production. The strength of the program is its ability to bring the researcher, university professor, extensionist, and farmer together into a workable communications framework for the benefit of the end user and, ultimately, the national economy.

3.6.7. Role of technology transfer specialist

The NARP Technology Transfer Component sponsored a unique approach to the methodology of communicating technical agricultural information. To facilitate two-way communication within the farmer/researcher/extensionist linkage a position designated Technology Transfer Specialist (TTS) was created. This paper presents the context in which the TTS has been created, the role of the TTS in training programs, and the role of the TTS in the field.

First, within a healthy, properly functioning, community of people who seek to blend the principles of science with agricultural production, no individual and no discipline stands alone. Each makes its contribution to, and receives benefit from, others within the overall organization. The interdependence of the various persons and groups involved must be recognized and accepted by all if the community as a whole is to reap the greatest benefit. Isolation of any person, group, or discipline will interfere with this interdependence and harm all who are involved.

Secondly, communication within the science/agriculture community is, and must be, a two-way system. In a one-way communication system, those who only speak are deprived of the wisdom of those who only listen. Needs soon become a matter of guess work, responses become poorly aimed, and eventually any benefit received is as much accident as it is intent.

The context for the TTS

The reason for existence of an agricultural technology transfer organization is to develop, diffuse, and apply scientifically sound answers to practical problems in the production, processing, and marketing of farm products. Two very important and interrelated goals are served by these efforts:

Production of food and fiber for the population of Egypt and for export.
Production of a reasonable net profit for the farm family.

Remembering the need for two-way communication, it is quickly apparent that this system must be constantly involved in dual activities. One is the sending of information from the developers of new technologies (scientists) to the users of new technologies (farmers). The other activity is the sending of information from the users of technology to the developers. This feedback function of the system is essential to keep the focus of research on problems that are being faced by the farmers.

With a constant two way interchange of information regarding technical information a substantial training effort is extremely important. Information exchange can take place without training programs, but the quantity and quality of information exchanged is likely to be far lower than the levels desired and deserved.

At least four factors of technical information exchange are improved by suitable training programs:

Accuracy. Technical information is often difficult to understand and mistakes are easily made unless the presentation of it is made very carefully. Furthermore, inaccurate information is often worse than no information at all. Therefore, training is essential to assure that correct information is transmitted from one person to the next.

Understanding. Even the most accurately expressed information is of little use if it is not understood by the receiver. Accurate interpretation of scientific information and re-presentation of it in a form that is understood by an audience having little or no scientific background is a critical skill. The importance of this skill is greatly increased when translation from one language to another is involved as is frequently the case. Training is necessary to develop this skill (Training Of Trainers). Once the trainer has been developed as a communicator, it is absolutely essential that there be continued training regarding newly developed technologies. Without continual training, there will soon be a breakdown in the flow of newly developed technologies from the developer to the user.

Application Knowing *how* to do something is as important as knowing *what* should be done. This is the reason for practicum training. Without practicum training there is a strong possibility that knowledge of a new technology will exist without application.

Efficiency Without adequate training technology transfer does sometimes still take place. As has been pointed out above though it suffers from lack of accuracy, understanding, and application. This results in much less actual transfer and much more resources (time and money) are used for the transfer that is accomplished. A proper training effort will provide a great deal of efficiency in achieving high quality, timely transfer of new technologies.

TTS role in training.—When a new technology is developed it is, at first, known only to the person or small group of persons who have due the research. At this point the new technology has much potential value but no actual value is realized by farmers or consumers. It has been developed but not diffused.

The comments above have pointed out that development of a new idea or technology is only a part of the job. Diffusion is the next part and it is an area where training is of great importance.

We must consider how the diffusion is to take place, and who is to be responsible for it.

In the past, subject matter specialists have taken a dual role. They have been heavily involved in the research end of the system and they have also had a very strong role in preparing (i.e., training) the village extension worker to diffuse the information into the farming community.

This has been effective over the years, but is it the most efficient use of the time and educational background of the specialists? Furthermore, are the skills of a scientist entirely adequate to serve the communication needs of an efficient diffusion system? Is there a method that can be substituted for the traditional training approach which will be an improvement?

Creation of the Technology Transfer Specialist suggests that the answers to these questions favor a change in approach.

Research, communication, and agricultural production are three distinctly different skills. Each is highly developed as a discipline, and each is very important to the concept of a blended scientific and agricultural community. In **spite of their** identification as different skills it is difficult to say precisely where research ends and communication begins; where communication ends and production begins.

This overlapping and blending has been present in the traditional system. Typically the approach has been for the scientist to assume the role of trainer (communicator) when approaching the village extension worker and the production community. The degree of success varies, but in all cases the amount of time spent in being a communicator diminishes the amount of time spent in being a researcher. This is a drain on research efficiency.

To increases the effectiveness of technology transfer in Egypt an attempt is being made to have one well trained village extension worker for every 500 feddans of farm land. This requires an increase in personnel and training.

The amount of training could perhaps be raised simply by increasing the number of scientists in the system and directing them to spend an increased percentage of their time in communication. The demands of accuracy, understanding, application and efficiency in training however, suggest that a skilled communicator with a strong understanding of science and production would be a better choice. From this situation arises the need for the Technology Transfer specialist. The TTS should have strong shots in communication, a good general agricultural background and at least one area of some expertise in agriculture (e.g. crops, horticulture and livestock etc).

This approach will offer three areas for improvement.

First, the scientist will to some extent be freed to do more research, There will not be a complete shift away from training as the TTS will still need to be trained in new technologies. Still, by having the TTS as a skilled and well trained intermediary, the village extension worker should get good training and the scientist should have more time available for further research.

Secondly, use of a skilled communicator in the TTS position will benefit the village extension worker and the farmer through employment of techniques for which the researcher had little time and perhaps few skills. This would include such matters as increased training in the use of audio-visual aids and preparation of written and graphic materials that will be quickly and easily understood by village extension workers and farmers. Finally, the amount of practicum training of village extension workers and Key Farmers could be increased. Some scientists are well prepared for this function and others are not well equipped at all. In any event their time would generally be more efficiently spent in research than in further work as a trainer.

TTS role in the field.—There are several ways that the TTS will continue to contribute in the field.

The additional time (relative to the subject matter specialist) that can be spent in the field with the village extension worker will allow improved opportunity for interaction between the village extension worker and those who provide contact with the scientific community.

By working with the village extension worker on communication skills in the field the TTS will, in effect, establish a practicum in communication along with the improved practicum training in newly developed technologies noted earlier.

Time spent in the field with village extension workers on farms will provide the TTS with the opportunity to observe problems at the farm level. When a problem is observed by the TTS or expressed by a farmer or village extension worker, the TTS will be able to communicate this to the specialist. Under these circumstances, the specialist will have feedback is from a point of view somewhat different from that received through an advisory council even though the same problem is being addressed. This additional definition of the problem will be of value to the specialist in determining what sort of intervention should be made. It may also speed up the communication process as there will be frequent contact between the TTS and the specialist.

Finally, there will be occasions where the TTS will observe farmer generated solutions to problems in the field. At these times the TTS will be able to inform all village extension workers in the area of the innovation and thereby speed transfer of farmer generated technology. The TTS will also be in a position to relay such information to the specialist who will often be able to refine the idea to be scientifically sound across a large area and of benefit to many farmers.

Summary.—The TTS position offers great potential value to the overall Technology Transfer effort. In training, positive impact will be received in the areas of accuracy, coherence, application, and efficiency. In the field, the TTS will be able to provide improvements in communication of technologies to the farmer and of feedback from the farmer. The overall benefit of these improvements will be a contribution to the production of food and fiber for people and net profit for farm families.

The ARC/NARP response to the conditions which suggest a need for the TTS position is unique in the world. If successfully implemented, this will place Egypt in a position of world leadership in the area of extension methodology.

The extension workers in the ARC are to be commended for their efforts to make the TTS concept work. They can rest assured that the NARP staff will do all that is possible in support of this effort.

3.6.8. Role of subject matter specialist

1. To maintain contact with research agencies and researchers to know current recommendations, and subjects being researched, and to provide input into research activities by bringing to researchers the insights of the real world situation of the end user.

2. To study status and trends in particular production commodities on the national level and by regions, to determine deficiencies, interpret available information and develop concrete recommendations as to: (a) Needed action by government services and agencies, (b) problems that need further investigation by research institutions, (c) new methods and improvements to be introduced and promoted through the extension service, and (d) proposed objectives for the extension program in his/her field of specialization by regions and for the country as a whole.

3. To participate in planning of the extension program on the national level and assist regional services to set up priorities and objectives for regional and district programs.

4. To develop training plans and other activities that will convey knowledge and the results of research to village extension workers who can transfer it to farmers for the resolution of their problems.

5. To cooperate with agricultural information specialists to prepare bulletins, circulars, newsletters, and appropriate visual aids to be used to convey information to village extension workers.

6. To participate in field activities (as and when possible), working directly with researcher, village extension workers and farmers on on-farm trials, extension demonstrations, workshops, and so forth.

7. To participate in evaluation studies and surveys conducted by supervisors, extension specialists in other fields, research workers and others.

3.6.9. Role of village extension worker

1. To develop friendly working relations with farm people and be considered by them as one of their own.

2. To regularly visit farms, demonstration plots, and other installations in the village according to schedule, and develop plans of work based on the needs of the people.

3. To contact and cooperate with farmers, cooperative and commodity leaders, local dealers in farm products, agents of farm equipment and supply firms, leaders of farm organizations and officials of agricultural institutions, services and agencies operating programs in the district.

4. To prepare extension programs and annual plans of work with the help of rural leaders, extension supervisors and subject-matter specialists.

5. To establish committees, councils or other mechanisms to obtain local-level input and feedback into problem identification (program development, execution, and evaluation).

6. To plan and conduct educational activities such as demonstrations, meetings, surveys, field days, study tours, evening classes and workshops for farm youth and adults, and organize agricultural exhibits, campaigns and special projects involving farm people.

7. To provide accurate information to all groups of farmers, based on an authoritative and unbiased source. Local extension workers should make use of one-to-one instruction, face-to-face group discussion, distribution of single concept fact sheets and other publications, as well as to assist as needed in preparing releases for the press, radio, and/or television.

8. To cooperate fully with staff members in the extension organization in planning, conducting, and evaluating extension programs.

9. To bring to the attention of the extension administration problems and situations requiring study and action. Report on extension activities and accomplishments through progress and special reports, personal letters and though contacts with district extension supervisors and subject matter specialists.

Table A3-4. Technology transfer component: lop plan summary, update to March 31, 1994 (§3.6.2)

Objective/Activity/Output	Unit	LOPP Target Thru PACD	Progress 03-94	Cumulative Target 09-94
I. Develop and Improve the Structural Base of the MALR TT System				
A. Improve Management/Planning at Central Level				
1. Support Office Plan	Plan	1	1	1
2. TTC Staffing	Persons	_	18	18
3. Prepare/Approve Procurement Plans	Plans	3	3	3
4. Procure Vehicles	Vehicles	132	0	132
5. Execute PSA Procurement Contract	Contract	1	1	1
6. Establish MIS Installations	Unit	9	0	9
7. Establish TT Task Groups	Groups	6	6	6
8. Printed publications	Public.	_	73	21
9. Photographic Files	File	_	78	129
10. Produce Video Products	Quantity	1	14	17
11. Produce Audio Programs	Programs	_	1081	36
12. Establish Monitoring and Evaluation System	System	1	1	1
B. Draft Sustainable Production-Enhancing TT Model	Report	1	0	1
C. Develop Extension Long-Term Planning	Plan	1	0	1
II. Improve TT Capability and Decentralize the Research/Extension System				
A. Establish RRES	Stations	6	6	6
B. Plan Renovations	Sites	76	76	76
C. Execute Renovations	Sites	76	47	76
D. Needs Assessments/Governorates	Plans	48	72	72
E. Recognize Outstanding Farmers	Farmers	401	14	387
F. Develop Technical Packages	'Paks'	50	52	52
G. Disseminate Technical Packages	'Paks'	50	52	52
H. Semi-Annual Training Evaluations	Reports	5	4	5
I. Equip Governorate Offices	Sites	12	0	0
J. Equip District Offices	Sites	75	45	69

Objective/Activity/Output	Units	LOPP Target Thru PACD	Progress 03-94	Cumulative Target 09-94
III. Encourage Public/Private Extension Entities to Participate in TT				
A. Needs Assessments	Reports	8	4	4
B. Prepare TT Grant Manual	Manual	1	1	1
C. Execute Public TT Grants	Grants	10	15	15
D. Execute Private TT Grants	Grants	10	10	10
E. Establish Grant Evaluation System	Plan	1	1	1
F. Produce/Broadcast T.V. Episodes	Programs	66	17	17
G. NARP/APCP/MIS Workshops	W/S	6	2	4
H. Collaborative Field Exercises	Sites	4	0	2
IV. Other				
A. Execute Technical Training (Training Days)	Millions	3.4	2.6	2.6
B. Initiate M.Sc. Programs	Partic.	5	5	5
C. Initiate Ph.D. Programs	Partic.	4	4	4
D. Execute S-T Training Out-of-Country	Partic.	178	171	178
E. Prepare LOP Plans	Plans	2	2	2
F. Prepare Training Plan (LOP)	Plans	1	2	2
G. Prepare IFPs	Plans	4	5	5
H. Prepare Annual Training Plan	Plans	4	4	5

(Updated to March 31, 1994)

Table A3-5. Numbers of MALR extension employees, July 1993 (§3.6.2)

AGENCY	CENTRAL*	GOVERNORATE	DISTRICT	VILLAGE	TOTAL
CAAES	365	434	1202	4458**	6459
CA HORT	141	52***	1958****	--****	2151
CA AN PROD	51	790	1246	1596	3683
CA PLT PROT	150	135	1202	2542	4029
ORG VET SERV	13	106	360	1200	1679
TOTALS	720	1517	5968	9796	18001

* Includes only technical staff, not administrative

** Does not include 18, 456 field extension workers

*** Agricultural Director plus Horticulture Director

**** The number in the districts include extension staff who have responsibility for specific villages

Table A3-6. No. of extension female engineers, CAAES only, 1994 (§3.6.2)

1.	Cairo Governarate	57
2.	Behira Governarate	8
3.	Dakahlia Governarate	229
4.	Damietta Governarate	3
5.	Sharkia Governarate	60
6.	Monoufia Governarate	69
7.	Qalubia Governarate	32
8.	Beni Suef Govrnarate	25
9.	Menia Governarate	25
10.	Assuit Governarate	8
11.	Sohag Governarate	21
12.	Quena Governarate	1
13.	Aswan Governarate	14
14.	Nile Valley Governarate	16
15.	North Sinai Governarate	5
16.	South Sinai Governarate	6
17.	Matrouh Governarate	16
18.	Kafr El Sheikh Governarate	58
19.	Alexandria Governarate	70
20.	Fayoum Governarate	39
21.	Suez Gverbarate e	5
22.	Ismailia Governarate	42
23.	Giza Governarate	21
24.	Port Said Governarate	—
25.	Red Sea Governarate	—
	TOTAL NO.	896

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Table A3-7. No. of technology transfer specialists by commodity or activity and by governorate, actual 1994 and projected 1995 and 2000 (§3.6.2)

Crop	No. of Gov.	Actual 1994	Projected 1995	Projected 2000
Rice	7	72	100	120
Cotton	14	500	1000	5000
Sugarcane*	4	130	160	160
Suugarbeet*	3	70	100	200
Cereals	12	140	300	1000
Rural Women	7	80	100	200
Fruits & Veget.	15	300	500	1000
Animal Prod.	4	70	100	500
Plant Protect.	14	120	200	500
Total		1,482	2460	8560

* Sugar and factory extension staff + MOA extension staff

Table A3-8. Egypt: Functions of a regulatory nature performed by village, district, and governorate extension personnel, before 1986 and now 1994 (§3.6.2)

Function	Before 1986	1994
Rotation Planning & Implementation: Corn, Wheat & Rice	Monitoring and Reporting to MALR	Technical Advice Only: Farmer Makes Decision
Cropping Patterns per Village, District & Governorates	Same as Above	Technical Advice Only: Farmer Makes Decision
Pest Control: Chemical Applications	Same as Above	Some Monitoring Responsibilities
GOE Quota on Fertilizers	Same as Above	No Longer a Quota on Fertilizers
Required Delivery of Crops to Government	Same as Above	No Delivery Requirement on Any Crop
Cleaning of Canals and Ditches	Monitoring and Reporting	Monitoring and Reporting
Survey of Numbers and Types of Animals Owned by Each Farmer	Monitoring and Reporting 1/	Surveys of Animals No Longer Required
Government Distribution of Animal Feed	Monitoring and Reporting	Government No Longer Regulates Feed to Farmers Thru Quotas
Government Plans for Land Conservation	Same as Above	Monitoring and Reporting
Use of Arable Land for Non-Agricultural Purposes, e.g. Bldg.	Same as Above	Monitoring and Reporting
Aircraft Spraying for Cotton Worm Control	Same as Above	Some Monitoring
Fines and Violations of Required Functions	Notified Superiors and Other Officials of Violations	No Longer Required to Report on Non-Compliance of Recommended Practices Except as Indicated

1/ Data used to determine, e.g., feed quotas, animal health insurance, and vaccine supplies.

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3.7.1 Agroforestry techniques to ameliorate prevailing conditions in arid and saline parts of Egypt

Egypt imports wood products and pulp at a value of £E2,574 million annually. Agroforestry Systems could provide cash income if properly directed to the marginal waste lands. There is a local demand for fiber for manufacture of particle board. Some species are useful for animal forage.

Objectives:

— To screen exotic and native trees and shrubs for drought an salinity tolerance.

— To study the physiology and biochemistry of drought and salt tolerance in trees and shrubs.

— To evaluate the wood quality of promising agroforestry trees and develop appropriate utilization techniques for their woody biomass.

— To develop biotechnologies for producing fuel and alcohol products from wood residues.

— To establish a plan germplasm containing seeds and cuttings of potentially useful drought and salt tolerant plants.

— To distribute trees/shrubs which prove to be drought and/or salt tolerant in provenance trials.

3.7.1. New initiative projects

Introduction of biotechnology methodologies for poultry improvement.—The newly established biotechnology laboratory for poultry improvement has been established at the College of Agriculture, Cairo University. The lab is being used by the Animal Production Institute of the Ministry of Agriculture and others.

Studies are underway to characterize the immune response of some of the imported and native chicken breeds and the effect of heat stress on these breeds.

Numerous workshops for technicians and the private sector have been held and a number of publications have resulted from this work. The laboratory plans to provide a wide range of support services to the Egyptian poultry industry in the future.

Control of anaplasmosis and babesiosis in Egypt through biotechnology.—

The main objective of this project are:

— To train Egyptian scientists in biotechnology and to initiate development of recombinant DNA vaccines that will protect cattle and buffaloes in Egypt against anaplasmosis and babesiosis.

— To train Egyptian scientists in the use of DNA probes and submit serological assays for the diagnosis of anaplasmosis in Egypt.

— To determine the distribution of anaplasmosis in cattle and buffaloes in Egypt using the novel diagnostic methods.

— To train an Egyptian scientist in pheromone and tick biology and to develop a novel low-cost, environmentally safe solution for the control of the tick vectors and anaplasmosis and babesiosis in Egypt.

Progress:

1. This project is an important step toward establishing an infrastructure organization for biotechnology, livestock disease diagnosis, and prevention programs in Egypt. Thus, the training component of Egypt's animal health researchers in this field is the major aim of the project. Trainees seem to have acquired sufficient knowledge to fulfill the aims of the program. The training procedure that was used by the University of Florida scientists and Old Dominion University sufficient knowledge to be independent thinkers. Techniques used in the training could contribute significantly to future research an development of diagnosis and preventive measures of economically diseases.

2. The use of the surface antigens of *A. marginal* (MSPLA, b, MSP2, and MSP4) to protect animals against anaplasmosis is still under evaluation. A pilot vaccine trial in underway in Gainesville, Florida. Results from this trial will contribute significantly to the future faith in this vaccine.

3. Development of a new diagnostic test for babesiosis is being conducted by the University of Florida and Egyptian scientists.

4. Progress on the sex pheromones for tick vector control is the most promising research product for immediate field application.

The development of marine finfish hatchery technology in Egypt. Phase III transfer of technology to the private sector..—The marine Finfish Hatchery Technology Phase I and II established the adaption of hatchery technology for stripped mullet under Egyptian conditions. Phase III provides the next step in technology transfer and private sector adoption of practices.

Objectives:

— To build and operate a commercial prototype marine finfish hatchery in Egypt.

— To conduct and document mullet fry production in Egypt.

— To transfer the technology of the commercial prototype marine finfish hatchery and grow-out operations to the private sector.

— To evaluate applicability of hatchery technology for other marine finfish species in Egypt.

Soybean utilization cooperative technical assistance program.—

Objectives:

— Evaluate extrusion/expelling technology in a pilot plant situation;

— Modify International Soybean program soy milk process for use in Egypt;

— Develop soy foods (flour, ice cream, cheese) for Egypt;

— Establish interaction between the Egyptian food industry and ARC; and

— Promote use of homemade soy foods by Agricultural Extension.

To date, the pilot plant has been modernized and is ready for installation of equipment. The pilot plant will be used to adapt existing technologies and products, develop new processes and products using soybeans, legumes and cereal mixtures. Technicians have been trained to maintain and operate the plant. FTRI scientists and private industrialists have learned the possibilities for industrial development by tours and workshops in the U.S. Several publications have been published are pending. Egyptian food products have been modified by using soy products in common recipes.

Development of recombinant vaccines and rapid diagnostic kits for rinderpest.—The long-term objective of this proposal is the transfer of the technologies for modern molecular biology to Egypt. The immediate objective is to provide Egypt with the capability for developing recombinant vaccines and rapid diagnostic kits, to be used in combating livestock diseases. To date, there has been no actual research activity related to this project in Egypt. Reports indicate that progress is being made by Egyptian trainees at UC Davis in developing a diagnostic assay for the disease. Development of the lab and progress in other program goals is limited at this time.

Technology transfer for enhancing agricultural equipment testing capabilities in Egypt.—

Objectives:

— Assist in the design, acquisition, fabrication, installation, calibration, and operation of testing and research equipment.

— Initiate test projects that will increase knowledge about the suitability and quality of agricultural equipment through utilization of performance standards, testing criteria and testing methods.

— Evaluate existing national and international equipment testing standards to determine usefulness for Egypt.

— Evaluate policies and procedures pertaining to the use of installed testing equipment and formalize methods for collecting, processing, analyzing and evaluating results.

— Assist in transferring information to Egypt's agricultural community and equipment industry.

Whitefly research initiative.—

Objectives:

— To identify and define host-related strains or biotypes of B. tabaci in Egypt and Arizona (Sonoran Desert) relative to biological and genetic differences which are important in developing control strategies. This will entail examination of:
- molecular biology and delineation of DNA-level differences (RAPDs) and cloning of nuclear mitochondria DNA genes within and between population in the two study and sites,
- analysis of biotype specific esters banding patterns, and
- targeting of enzyme systems responsible for pesticide and host plant detoxification and resistance management.

— To evaluate virus-vector relationship regarding the abilities/efficiencies of transmission for old and new world B.tabaci, and geminivirus strains to devise anti-transmission strategies through introduction of pertinent genes in transgenic plants.

Agricultural biotechnology for sustainable productivity.—

(A) Maize: Development of maize resistant to stem borers via genetic engineering approaches

Stem Borers are a major limiting factor to maize production in Egypt. Three species, Sesamia cretica, Chilo sp. and Ostrinia nubilalis attack maize in Egypt. The major objective of the maize research is to develop genetically engineered stem borer resistant maize for Egypt. Collaboration is with Texas A&M and Cornell University.

(B) Potato: Control of potato tuber moth resistant germplasm via genetic engineering

The potato tuber moth *phthorimaea operculella* is a serious pest of field-grown and stored potatoes in Egypt and other parts of the world. Potato tuber moth control is currently achieved with the use of insecticides. Developing insect control through host plant resistance can reduce the need for chemical pesticides and lower the health and environmental risks associated with their use. The potato research plans to use transgenic potato plants expressing the biopesticide *bacillus thuringiensis* (B.t) as parental material in a breeding program to develop new improved populations that are resistant to the potato tuber moth. These populations subsequently will be used for selection of improved advance lines directed toward varietal development. Collaboration is with Texas A&M and Cornell University.

C) Cucurbit: Development of virus resistant cucurbit crops via conventional and genetic engineering approaches

Virus infection is a major problem limiting cucurbit production in Egypt. The goal of the cucurbits team is to introduce virus resistance into cucurbit crops using a combination of molecular and conventional breeding approaches. A research team with expertise in the area of plant virology, molecular biology, tissue culture and plant transformation, and plant breeding will continue breeding efforts with cucumber, squash and melon materials that have been developed at Cornell University. These breeding lines will be evaluated for performance in Egyptian conditions. The zucchini yellow mosaic virus coat protein gene that was cloned and introduced into melon in Dr. Grumet's laboratory at Michigan State University will be tested for effectiveness against Egyptian isolates of zucchini yellow mosaic virus. Collaboration is with Michigan State University.

D) Tomato: Development of transgenic tomatoes resistant to tomatoes yellow leaf curl disease

The tomato research project is a continuation of Egypt's tomato project started in 1991 through collaboration with the Scrips Research Institute in San Diego, California. Two Egyptian isolates of tomato yellow leaf curl virus (TYLCV-E) have been isolated and cloned and one of these has been sequences. PCR protocols have been set-up and can be used for diagnostic and molecular studies. The virus has been purified and a polyclonal antiserum has been initiated and should be available very soon. Another virus, presumably the beet curly top virus has been cloned and will be studied to determine its importance relative to the TYLCV-E. The goal of the tomato team is the development of transgenic tomatoes resistant to the tomato yellow leaf curl disease.

Commodity marketing system studies.—Since the early 1960s the Egyptian food system has been heavily dominated by government intervention in cropping decisions, input supply, import and export controls, price controls and state controlled trading. Under that system, the government issued farm production plans, managed state trading firms, and tightly regulated private trade. Recently adopted policies have removed most state controls. In the new free market environment, there is growing awareness that both government and farmers must give more attention to marketing issues. There is, however, lingering distrust of private food marketing firms and little understanding that government and farmers may find it in their best interest to encourage institutional and operational innovation among the private firms who receive and sell farm products.

Under the NARP new initiatives, studies were made on commodity systems for citrus, grapes, tomatoes, and potatoes.

Objectives of the study:

— Describe essential economic characteristics of 4 commodity systems.

— Identify problems, unexploited economic opportunities, barriers to greater efficiency.

— Project future economic evolution of the system considering technical and institutional modifications.

— Suggest changes in policies, institutions, technology and management that will achieve greater profitability and improve system efficiency.

Briefly, the study found:

1. New Land development policy and economic liberalization stimulated rapid horticultural sector development and produced a market-oriented surge in exports which is only beginning.
2. At this stage of development there is lack of reliable production and market information, as well as a need for profit enhancing technology and management practices with less emphasis on production technology and more on marketing, quality control, postharvest technology and management.

Workshops were held following the study where, for each product there was a team presentation of system problems, constraints, barriers to efficiency and possible solutions. Presentations were followed by small group work sessions to get reactions and suggestions. The report of the work group results and plenary discussion will be included in final commodity reports.

New lands study.—

Principal objectives of the study are:

— Develop an updated cost/benefit analysis of alternative land reclamation approaches applying current policies and price relationships.

— Analyze the impacts of the policy modifications since 1980 and of current economic conditions on small holders, graduates and investors as principal participants in distribution and sale of public lands.

— Assess, and to the extent feasible, quantify the joint, and if possible, individual impacts of the policy, institutional and technical constraints on the viability of small holder, graduate and investor programs.

— Compare the expected socioeconomic viability of investment in reclamation of additional land with expected socioeconomic viability of improving existing reclaimed land.

— Review and assess urban and rural land utilization including the evolution of policies and the economic, technical, political, and institutional factors influencing future land use policies and directions.

— As appropriate based on the above analysis identify potentially promising investments in either existing or future new lands.

This is the first study using primary data that includes all aspects, including management.

3.7.4 The Executive Office

To carry out the mandated functions, the Executive Office is divided into three main divisions: administration and financial, technical, and new initiative.

Beside new-initiative-related activities, the Executive Office is secretariat and reporter for the Science and Technology Board and the NARP Executive Committee; serves as an office of the NARP Director General; and establishes and controls the administrative and financial systems for the entire NARP

In addition, the Executive Office supervises specific activities which were agreed to be implemented centrally. These include:

a. offshore training through contract with San Diego State University Foundation as well as local training,
b. offshore procurement,

c. implementing a unified inventory system,
d. arrangement and control of the renovation of agricultural research stations,
e. establishment of the Egyptian National Agricultural Library, and
f. communication with reviewing offices from USAID and the Egyptian side.

The Executive Office is organized into the following unites to undertake support of all NARP activities: Management Information Systems; Publications Unit; Document Control office; and personnel office.

To carry out the mandated functions, the Executive Office has developed and organized the following resources. An automated financial system (Solomon III program); developed the NARP Manual for Personnel and Accounting Procedures; and established procedures for procurement, inventory control, renovation, implementation, etc.

Other activities and innovations introduced by the Executive Office include:

-Improving communication between NARP and USAID by holding regularly scheduled meetings; staff training in management information systems. The Executive Office has dealt with identified shortcomings to be granted "host country certification" by USAID.

4.2. A comparison of yields in Egypt, and selected countries and regions, including the highest producing country (HP) for each commodity in 1992.

Country/Region	Yields, kg/ha 1979–81	1990–92	Annual Yield Gain 1979/81–1990/92
Cereals			
		Wheat	
Egypt	3192	5088	+172
World	1863	2556	+ 63
USA	2291	2538	+ 22
Europe	3597	4743	+104
(HP)Ireland	5364	8071	+246
		Rice	
Egypt	5707	7460	+159
World	2752	3549	+ 72
USA	5167	6324	+ 32
(HP)Australia	6236	8408	+197

		Maize	
Egypt	3947	5891	+197
World	3341	3841	+ 45
USA	6474	7500	+ 93
Europe	4563	4944	+ 34
(HP)Chile	3789	8340	+413
		Barley	
Egypt	2688	2376	- 28
World	1895	2268	+ 34
USA	2745	3115	+ 34
Europe	3373	3951	+ 52
(HP)Belgium/Luxem bourg	4877	6052	+107
		Sorghum	
Egypt	3739	4963	+111
World	1452	1417	- 3
USA	36618	4061	+ 40
Europe	3719	4235	+ 47
(HP)France	4467	5055	+ 53

Grain Legumes

		Chickpeas	
Egypt	1538	1828	+ 26
World	623	701	+ 7
Europe	614	735	+ 11
(HP)Israel	1302	1981	+ 62
		Lentils	
Egypt	1004	1842	+ 76
World	598	784	+ 17
Europe	733	692	- 4
(HP)Lebanon	870	1864	+ 90

	Peanuts (in shell)		
Egypt	2115	2235	+ 11
World	989	1158	+ 15
USA	2590	2604	+ 1
Europe	2146	1427	- 65
(HP)Israel	4429	6726	+209
	Soybeans		
Egypt	2669	2704	+ 3
World	1703	1974	+ 25
USA	1992	2375	+ 35
Europe	1262	2505	+113
(HP)Italy	2697	3427	+ 66
Oil Crops			
	Sunflower seed		
Egypt	1822	2178	+ 32
World	1168	1306	+ 12
USA	1323	1433	+ 10
Europe	1434	1633	+ 18
(HP)Italy	1986	2496	+ 46
	Sesame seed		
Egypt	996	1246	+ 23
World	306	357	+ 5
Europe	481	742	+ 24
(HP)Egypt	996	1246	+ 23
	Linseed		
Egypt	1207	1598	+ 36
World	456	701	+ 22
USA	794	1111	+ 29
Europe	510	1050	+ 49
(HP)China	722	3134	+219

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Fiber Crops			
	Seed cotton		
Egypt	2646	2223	- 38
World	1243	1322	+ 7
USA	1493	1940	+ 41
Europe	2380	2633	+ 23
(HP)Australia	3132	3733	+ 55
	Jute and Jute-like fibers		
Egypt	2410	2516	+ 10
World	1322	1629	+ 28
(HP)Vietnam	1812	2368	+ 51
vegetables			
	Artichokes		
Egypt	16930	23113	+562
World	9853	11649	+163
USA	12060	13521	+132
Europe	9904	11222	+120
(HP)Egypt	16930	23113	+562
	Beans, green		
Egypt	8693	01401	+155
World	6166	66700	+ 46
USA	5783	5750	- 3
Europe	7023	7552	+ 48
(HP)Austria	14241	17799	+323
	Cabbage		
Egypt	23941	27803	+351
World	21417	22830	+128
USA	20173	20000	- 16
Europe	24518	27505	+271
(HP)Republic of Korea	66613	64466	-195

	Carrots		
Egypt	22617	25242	+ 239
World	20377	25595	+ 474
USA	29860	33482	+ 329
Europe	27921	31073	+ 286
(HP)Israel	49579	67105	+1539
	Chilies and Green Peppers		
Egypt	16404	16608	+ 18
World	7317	8370	+ 96
USA	11151	11818	+ 61
Europe	14567	15329	+ 69
(HP)Japan	36118	36356	+ 22
	Cucumbers and Gherkins		
Egypt	15792	17279	+ 135
World	12979	14933	+ 178
USA	12361	13121	+ 69
Europe	19772	22103	+ 212
(HP)Japan	41828	45824	+ 363
	Eggplant		
Egypt	21161	21509	+ 32
World	12716	14380	+ 142
USA	20942	27584	+ 604
Europe	24391	27683	+ 299
(HP)Israel	36088	38322	+ 203
	Garlic		
Egypt	30409	30588	+ 16
World	5885	6526	+ 58
USA	14384	20083	+ 519
Europe	5146	5417	+ 25
(HP)Egypt	30409	30588	+ 16

	Onions, dry		
Egypt	34698	49379	+1335
World	13261	15071	+ 164
USA	34499	42922	+ 766
Europe	14567	15329	+ 69
(HP)Japan	40099	44057	+ 360
	Peas, green		
Egypt	8456	11229	+ 252
World	5929	7203	+ 116
USA	8632	9750	+ 102
Europe	7182	8349	+ 106
(HP)Belgium-Luxembourg	14595	16425	+ 166
	Pumpkins, Squash, Gourds		
Egypt	18643	16844	- 163
World	10440	11398	+ 98
USA	6839	9141	+ 118
Europe	28054	30885	+ 267
(HP)Israel			
	Tomato		
Egypt	17747	28528	+ 980
World	20964	24465	+ 318
USA	42629	57244	+ 1328
Europe	29808	36930	+ 262
(HP)Netherlands	155,236	412,360	+23,375
Fruits			
	Cantaloupes, other melons		
Egypt	31101	19728	- 125
World	14596	16120	+ 138
USA	16667	17929	+ 114
Europe	12948	15247	+ 209
(HP)China	17120	24330	+ 655

	Grapes		
Egypt	11762	14670	+ 264
World	6997	7222	+ 20
USA	15990	17488	+ 136
Europe	6750	6513	- 22
(HP)USA	15990	17488	+ 136
	Watermelons		
Egypt	23453	21531	- 172
World	13947	15554	+ 146
USA	13785	13415	- 24
Europe	19623	20188	+ 511
(HP)Japan	31148	32737	+ 144
Sugar Crops			
	Sugarbeets		
Egypt	28571	46519	+1632
World	30353	34210	+ 35
USA	46198	45400	- 72
Europe	40319	46013	+ 518
(HP)Netherlands	49252	65187	+1449
	Sugarcane		
Egypt	82996	99572	+1507
World	56685	61249	+ 415
USA	81668	76654	- 456
Europe	57370	81018	+2150
(HP)Peru	110361	112715	+ 214
Milk			
	Milk, per cow per location, kg/yr		
Egypt	674	667	- 0.5
World	1970	2070	+ 9
USA	5377	6796	+129
Europe	3569	4136	+ 52
(HP)Israel	6817	8953	+194

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