

PD-ABC-225
69693

Horticulture Improvement and Training Subproject

Project 279-0052.4

Final Evaluation Report

Contract No. 279-0052-C-00-7012
April 1990

Submitted to

USAID/Sana'a, MAF, Yemen Arab Republic

by

Bruno Quebedeaux, Ph.D., Team Leader/Horticulturist
Calvin Arnold, Ph.D., Horticulturist
Bishay F. Bishay, Ph.D., Water Management Engineer

RII

1010 Wayne Avenue, Suite 300
Silver Spring, Maryland 20910

Phone (301)589-6248
Fax (301) 565-5112

HORTICULTURE IMPROVEMENT AND TRAINING SUBPROJECT

PROJECT NO. 279-0052.4

FINAL EVALUATION REPORT

CONTRACT NO. 279-0052-C-00-7012

MARCH 1990

SUBMITTED TO

USAID/SANA'A, MAF, YEMEN ARAB REPUBLIC

BY

Bruno Quebedeaux, PhD, Team Leader/Horticulturist
Calvin Arnold, PhD, Horticulturist
Bishay G. Bishay, PhD, Water Management Engineer

Ricards International, Inc.
1010 Wayne Avenue, Suite 300
Silver Spring, Maryland 20910

Phone (301) 589-6248
Fax (301) 565-5112

TABLE OF CONTENTS

	<u>Page</u>
Executive Summary	
Basic Project Identification Data	
List of Acronyms	
I. Preface	6
A. Evaluation Methods	6
B. Evaluation Team Composition	7
II. Description of Country Context	8
III. Description of HITS Subproject	11
A. Overview and History	11
B. Goals, Purpose, Outputs and Inputs	11
IV. Major Issues Addressed	14
A. Applied Research	14
1. Findings	14
2. Conclusions	16
3. Recommendations	20
B. Extension	29
1. Findings	29
2. Conclusions	33
3. Recommendations	36
C. Nursery Development	43
1. Findings	43
2. Conclusions	44
3. Recommendations	46
D. Pest Management	49
1. Findings	49
2. Conclusions	50
3. Recommendations	52
E. Institution Building and Sustainability	55
1. Findings	55
2. Conclusions	59
3. Recommendations	59

TABLE OF CONTENTS

	<u>Page</u>
V. Lessons Learned	62
VI. Annexes	
A. HITS Evaluation Team Scope of Work	
B. Logical Framework for HITS	
C. List of Documents Consulted	
D. List of Individuals Consulted and Interviewed by the HITS Evaluation Team	
E. Organizational Chart of the MAF	
F. Itinerary of HITS Evaluation Team	
G. Map of Yemen Arab Republic Showing Agricultural Regions	

ACKNOWLEDGEMENTS

The HITS evaluation team wishes to express its appreciation to all the MAF, HBA and USAID/Yemen staff who contributed time and effort in supporting the evaluation. Their cooperation and support greatly facilitated site visits, field trips, interviews, review of project documents and logistical arrangements.

EXECUTIVE SUMMARY

USAID/Sana'a

**Horticulture Improvement and Training Subproject (HITS)
(279-0052)**

Project Evaluation

March 27, 1990

- I. Purpose of the HITS**
- II. Evaluation and Methodology used**
- III. Findings and Conclusions**
- IV. Recommendations**
- V. Lessons Learned**

EXECUTIVE SUMMARY

The purpose of this final evaluation was to assess the performance and effectiveness of the Horticulture Improvement and Training Subproject (HITS) of the Agricultural Development Support Program (ADSP) in the Yemen Arab Republic. The project was authorized in February 1983 for \$14,385,000 and ended in December 1989. The project was designed and implemented through the Consortium for International Development (CID) with California State Polytechnic University in Pomona (CP/P) as the lead university.

The original objective of HITS was to institutionalize within Yemen's Ministry of Agriculture and Fisheries (MAF) an expanded and improved capacity to support increased fruit production through extension activities, plant protection and delivery of disease-free plant materials for improved fruit varieties to the fruit subsector in Yemen. The HITS project concentrated on five primary areas including:

- (1) the construction and establishment of two fruit horticulture training and demonstration stations, one in the Tihama and the other in the Central Highlands, for varietal improvement testing, development of disease-free budwood and rootstocks, demonstration programs and extension training;
- (2) the training of extension agents, subject-matter fruit specialists, technicians, agricultural inspectors and nurserymen in MAF and the private sector;
- (3) the expansion and improvement of the MAF Horticulture Department to strengthen its capabilities to provide the fruit sector with current information on adapted varieties and improved horticultural practices to expand and meet the fruit production needs of the country;
- (4) the expansion and improvement of MAF's plant protection program; and
- (5) the expansion and upgrade of MAF's horticulture plant protection and extension fruit production information for distribution to farmers, nurserymen and private sector input suppliers.

During the period February 26 to March 28, 1990, the evaluation team evaluated the project's progress in accomplishing the purposes specified in the project design and contract. The evaluation team concentrated on six major areas of the project, i.e. applied research, extension, nursery development, pest management, institution building and sustainability, and lessons learned. The evaluation team reviewed project documents, annual work plans, reports and publications provided by USAID/Sana'a, AID Washington, MAF/YARG, CID, California State Polytechnic University, Pomona (CP/P), and Colorado State University, which is managing the HITS Bridging Activity (HBA). The evaluation team made several one day field trips to demonstration plots and nurseries in the Sana'a, Dhamar and al-Irra areas and a three day field trip to the Coastal Tihama region that included Hodeidah, al-Jarouba, Zabid and Taiz. The evaluation team interacted with and interviewed 90 national and regional MAF/YARG Agricultural Officers, private growers, nurserymen, and other individuals associated with the HITS project.

2

The HITS project suffered many serious management and implementation shortcomings including turnover of team leaders, insufficient recruitment of qualified U.S. technical support staff and changes in project direction from applied research and extension training to mass production at the al-Irra and al-Jarouba stations. Also, CP/P had limited horticultural qualifications and experience in implementing foreign horticultural projects. The project lacked planning, priority setting and internal reviews between U.S. technicians, MAF and USAID early in project implementation. The overall performance of the project is rated as "marginally satisfactory."

Institutionalization roles and responsibilities among HITS team members, USAID and MAF were not clear. Common objectives were not always clearly delineated. During the second half of the project, annual work plans bearing the signature of MAF, HITS, CID and USAID officials helped clarify goals and responsibilities for project implementation.

The HITS participant training program was unsatisfactory in achieving effective institution building and sustainability. MAF's Horticulture Department remains deficient in training and staffing. Several long-term participants trained in the U.S. by the HITS project have returned but did not occupy MAF positions. No job placement plan has been developed for U.S. trained technicians.

The HITS project established two horticulture stations. The stations are used for multiplication of propagative material, evaluation of new fruit varieties, and extension demonstration plots. Several new improved varieties of apple, peach, plum and nectarine have been identified and appear to be suitable for Yemen conditions. Station management is weak and basic station records on varietal evaluations are inadequate. Station personnel are unable to determine simple varietal yield responses because of the lack of plot design and field plot supervision. Without continued USAID support, it is unlikely that either the al-Jarouba or al-Irra station will be effectively sustained.

The limited research reported by the HITS project makes it difficult to identify appropriate agricultural input requirements for the fruit industry in Yemen, i.e. equipment, fertilizers, irrigation requirements and practices, insecticides, miticides, fungicides, and herbicides. MAF research and extension linkages are not clearly defined. HITS did not provide sufficient technical information and recommendations to foster the development of a model system for the fruit industry. Critical gaps remain within MAF which hamper the development of technical fruit production information.

HITS established functional fruit nurseries at al-Irra and al-Jarouba. Management training for MAF personnel involved in nursery operations was inadequate and was not sustained. Unfortunately, HITS was encouraged to give priority to mass production of nursery plants at al-Irra and al-Jarouba. This emphasis on production was not compatible with the Project Paper, and served to be a major distraction from training and research. The evaluation team feels that USAID should not have agreed to this shift in station priorities, but rather worked with MAF to identify other nurseries for mass production. With the current strong commitment to encourage private sector nurseries, the evaluation

3'

team recommends that no USAID funds be spent to upgrade selected MAF nurseries for production purposes.

The HITS project increased awareness and understanding of Integrated Pest Management (IPM) in the General Directorate for Plant Protection (GDPP). The GDPP plant quarantine program has only a minor effect on preventing the importation of pests into Yemen. There are very few qualified plant inspectors in MAF to implement the priority programs of plant quarantine and nursery plant certification. IPM programs will probably be sustained in MAF as established with the assistance of HITS. However, the program will not realize its maximum potential until the recommended inputs are provided and recommended changes are implemented. Strengthening MAF plant quarantine and plant protection programs is one of the most urgent needs for sound development of the Yemen fruit industry.

A general weakness of the HITS project design is that it ignored the need for water resource evaluation. The project was implemented without long-term technical assistance in water management. Given the scarcity of water resources, the development of water technology appropriate for Yemen is very important.

According to fruit assessment surveys, fruit production in Yemen remains highly profitable, and supports a favorable return for research and extension activities as envisaged in the HITS Project Paper. Analysis of the HITS project design indicates that it was economically, technically, socially, environmentally and institutionally sound. However, the design was flawed technically by the absence of a major water component with a long-term technical assistant. It is important that in the HBA and the upcoming Farming Practices for Productivity (FPP) project that USAID learn and build from previous project experiences such as HITS. USAID should proceed quickly to implement the suggestions and recommendations presented in the issues section of this report for the FPP, and attempt to avoid the serious shortcomings experienced in HITS.

BASIC PROJECT IDENTIFICATION DATA

- 1. Country: Yemen Arab Republic
- 2. Project Title: Horticulture Improvement and Training Subproject (HITS) of the Agricultural Development Support Program (ADSP)
- 3. Project Number: 279-0052.4
- 4. Project Dates:
 - a. First project agreement: February, 1983
 - b. Project Assistance Completion Date (PACD): December 31, 1990
- 5. Project Funding:
 - a. AID Bilateral Funding Grant: 14,385,000
 - b. Other Major Donors: None
 - c. Host Country Counterpart Funds: 4,430,000

Total: 18,815,000
- 6. Mode of Implementation: Collaborative Agreement between USAID/Sana'a and the Consortium for International Development (CID). Lead University - California State Polytechnic University, Pomona.
- 7. Project Design: The Ministry of Agriculture and Fisheries of the Yemen Arab Republic Government, USAID/Sana'a, and the Consortium for International Development
- 8. Responsible Mission Officials:
 - a. Mission Director: Kenneth Sherper
 - b. Project Officer: F. Rudolph Vigil
- 9. Previous Evaluations:
 - ADSP January 1984 (Overall)
 - HITS February 1987
- 10. Cost of Present Evaluation:

	Person Days	Dollar Costs
a. Contract	96	\$67,438
		(includes travel, per diem, ODC's, indirect costs and fee).

.5

ACRONYMS

ADO	Agriculture Development Officer
ADSP	Agriculture Development Support Program
AID	Agency for International Development
ARA	Agriculture Research Authority
CID	Consortium for International Development
CORE	Central ADSP Project
CP/P	California State Polytechnic University, Pomona
FY	Fiscal Year
FAO	Food and Agriculture Organization
FPP	Farming Practices for Productivity Project
GDAA	General Directorate for Agricultural Affairs
GDPP	General Directorate for Plant Protection
GTZ	German Technical Cooperation
HITS	Horticulture Improvement and Training Subproject
HBA	Horticulture Bridging Activities
IPM	Integrated Pest Management
MAF	Ministry of Agriculture and Fisheries
ME	Monitoring and Evaluation
NES	National Extension Service
PACD	Project Assistance Completion Date
RE	Research and Extension
RDA	Rural Development Authority
SMS	Subject-Matter Specialist
TDA	Tihama Development Authority
TDY	Temporary Duty
T&V	Training and Visitation
YAR	Yemen Arab Republic
YARG	Yemen Arab Republic Government
YPPC	Yemen Plant Protection Center
USAID	United States Agency for International Development
UNDP	United Nations Development Program

I. Preface

This report evaluates the performance of the Horticulture Improvement and Training Subproject (HITS) of the Agricultural Development Support Program (ADSP). It assesses the strengths and weaknesses, and evaluates project progress towards accomplishing the project purpose specified in the project paper and contract. The project was authorized in February 1983 for \$14,385,000 and ended in December 1989. The project was designed and implemented through the Consortium for International Development (CID) with California State Polytechnic University in Pomona as the lead university.

This report completes the final evaluation Contract No. 279-0052-C-00-0010-00 between Ricards International, Inc. and USAID/Sana'a, Yemen Arab Republic.

A. Evaluation Methods:

This final evaluation of the HITS project is based on reviews of project documents, work plans, reports, and publications provided to the Evaluation Team by USAID/Sana'a, AID Washington, MAF/YARG, CID, California State Polytechnic University, Pomona, and Colorado State University (HBA); site visits and direct observations of project activities and offices; and interviews with MAF/YARG officials, USAID/Sana'a personnel, HITS Bridging Activities team members, CID and Cal Poly project advisors, farmer collaborators, and other individuals related to the project. The evaluation team assessed the progress in accomplishing the project purpose specified in the project design and contract. The evaluation team concentrated on six major areas of the project: applied research; extension; nursery development; pest management; institution building and sustainability; and lessons learned.

The evaluation team made several one day field trips to demonstration plots and nurseries in the Sana'a, Dhamar and Amran areas and a three day field trip to the coastal Tihama region (including Hodeidah, Zabid and al-Jarouba) and the Southern Uplands (Taiz and Ibb). The evaluation team interacted with national and regional MAF/YARG agricultural officers, and private growers and nurserymen who participated in farm demonstration and extension activities with the HITS project. Project data, observations, impressions, tentative conclusions and potential recommendations were discussed among the evaluation team members. Prior to the team's arrival in Yemen, the evaluation team leader contacted by phone CID/University of Arizona, and California State Polytechnic University, Pomona, concerning evaluation activities and met with the USAID/Yemen desk officer and the Chief of the Near East Branch in AID/Washington. Each team member took primary responsibility for drafting certain subject-matter sections of the evaluation report. Each member provided comments on each other's findings and recommendations. Interim oral briefings and final briefings by the evaluation team to the MAF/YARG and USAID/Sana'a were held. The team evaluation activities in Yemen were conducted during February 26-March 27, 1990. A draft report was provided to the USAID/Sana'a Mission prior to the team's departure from Yemen. The final report was edited and the final document prepared in Washington.

B. Evaluation Team Composition:

Bruno Quebedeaux, PhD, Team Leader/Horticulturist
Professor and Chairman, Department of Horticulture
University of Maryland, College Park, Maryland 20742

Calvin Arnold, PhD, Horticulturist
Professor and Center Director, S.W. Florida
Research and Education Center
University of Florida, P.O. Drawer 5127, Immokalee, Florida 33934

Bishay G. Bishay, PhD. Water Management Engineer
Vice President, Vittettoe Bishay & Associates, Inc.
5500 Holmes Run Parkway, No. 609
Alexandria, Virginia 22304

The evaluation team was provided with the following counterparts and advisors from MAF and USAID/Yemen:

MAF

Abdul Hafiz Karhash, Director General, Agri. Affairs
Mohamed al-Ghashm, Director General, Plant Protection
Zaid Abdul Rahman, Director, Horticulture Dept.
Abdul Hafez Ali Ghalib, Dept. of Planning and Statistics

USAID

Nasr al-Ghoorairy, Agricultural Specialist

II. Description of Country Context

Production of fresh fruits is not sufficient to meet increasing demands in the Yemen Arab Republic (YAR). A detailed USAID assessment of the fruit subsector was done by Warren Enger of the Ronco Consulting Corporation in 1986. Results of the study indicated that national production of all fruits in the country was about 250 thousand tons with about 200 thousand tons actually marketed. Fruit production in YAR occupies approximately 5 percent of the total land area under cultivation. In 1983, YAR banned the importation of all fruits and vegetables. Because of this importation ban and the low production levels, fruit prices at the farmgate are very good and far exceed production costs. Local prices of most fruits are 2 to 3 times that of international markets. Fruit production is carried out mostly by small scale subsistence farmers with farm size ranging from 1/2 to 5 hectares.

A wide variation in topography and different climatic zones makes it possible to grow a wide range of tropical and deciduous fruit crops in YAR. The production of individual crops is difficult to estimate due to a lack of adequate data. Sub-sector fruit survey studies indicate that grapes, banana, dates and citrus are presently the predominate fruit crops produced. Recent introduction of apple, peach, pear, plum, guava, mango, avocado and papaya appear promising and production areas are predicted to increase significantly. Because of favorable prices and an increasing population growth, demand projections for fruits remain high.

The Yemen Arab Republic can be divided into the following regions as based on the broadly recognized different agro-climatic conditions:

1. The Southern Upland Region with more or less subtropical climate, has elevations ranging from 200 to 1800 meters and an average annual rainfall ranging from about 600 mm at Taiz to 1200 mm at Ibb. There are about 550,000 ha of cultivable land in this area.
2. The Central Highlands Region has a nearly temperate climate, with elevations ranging from 1800 to 3700 meters and an annual average rainfall ranging from 300 mm at Dhamar to 750 mm at Kitab. There are about 600,000 ha of cultivable land in this area.
3. The Northern Highland Region has a predominant semi-arid climate, with elevations of more than 1500 meters and an average annual rainfall ranging between 300 to 400mm. There are about 130,000 ha of cultivable land in this region.
4. The Coastal lowlands of the Tihama Region facing the Red Sea have a tropical climate with low elevations ranging between 0 to 200 meters and the average annual rainfall ranges between 50 and 200 mm. There are about 235,000 ha of cultivable land, mostly located in five wadis, in this region.
5. The Eastern Region has an arid climate with very little rainfall. Desert shrubs predominate in this area, and there are about 25,000 ha of cultivable land.

These five distinct agro-climate regions dictate the kind of crops grown in Yemen.

Several important production limitations and constraints have been identified by the Ministry of Agriculture and Fisheries (MAF) working with USAID and several other donor organizations. Improving yields and increasing production areas are major goals. Water is a serious constraint. Survey information suggests that underground water may become limited in the future, and several experts believe that the pumping rate far exceeds the rate of recharge of the aquifers. Additional hydrological data and studies are needed. Other constraints include the need for more adapted varieties, poor soil fertility and lack of improved cultural practices such as irrigation, fertilization, pruning, and disease and insect control.

Local farmers need to learn basic horticultural practices to improve fruit yields and quality. A large number of local farmers and nurserymen are unable to identify and control diseases and harmful insects. Some YAR farmers have imported untested varieties which are sometimes unproductive, and are often infected with serious diseases and other pests. The MAF is currently strengthening its plant quarantine laws to control importation and transportation of certain plant materials within the country. The MAF is developing technical information and providing institutional support to clean-up nursery stock, improve fruit varieties and develop a package of improved cultural practices for each major fruit crop. The main goal is to stimulate production, reduce farmer costs and minimize risks. In this context, there are plans to develop pre-feasibility fact sheets for each major crop.

Improvement of roads in recent years has facilitated additional fruit production. Improved roads are allowing the expansion of irrigation, input accessibility and transport of produce to markets. Survey studies indicate that yields for most fruit crops are low and fruit quality is below international standards. Fruit produce sold in the market lacks grading and packaging standards. A general weakness of the marketing system is a lack of handling, storage and processing facilities. Cold storage would help reduce post-harvest losses and extend the market period.

Only a limited amount of research has been conducted to enhance fruit production. The MAF has initiated studies on fertilization rates, irrigation trials and the identification of adapted varieties. Results are limited and inadequately reported; however, several assistance projects have initiated research. The development of research workshops, conferences and several national agricultural journals would enhance the communication of research results between scientists, technicians and extension workers.

The fruit subsector in YAR is changing very rapidly. New private sector orchards and nurseries using advanced production technology are now being developed. Small farmers are very interested in fruit production and are beginning to plant new orchards and to expand existing orchards. The fruit industry, however, lacks technical knowledge and recommendations. If the fruit industry is to continue to expand, research studies on production, marketing and post-harvest

storage will need to be strengthened. The extension service needs to expand its depth in technical knowledge for subject-matter specialists. Subject-matter specialists need to be more involved in training of extension agents for the transfer of knowledge and technology to fruit farmers and nurserymen. Effective plant protection, plant quarantine and inspection programs are essential to strengthen the fruit industry.

III. Description of HITS Subproject

A. Overview and History:

The Horticulture Improvement and Training Subproject (HITS) was a seven-year, \$14,385,000 subproject of the Agricultural Development Support Program (ADSP), a Title XII collaborative assistance program in the Yemen Arab Republic. The California State Polytechnic University at Pomona was the lead university and implemented the project under a contract between USAID and the Consortium for International Development (CID). The HITS project agreement was signed in February 1983 and the contract was completed in December 1989. Pre-project implementation was completed under the CORE subproject. Pre-implementation activities involved initial development of the al-Irra station and plant propagation at al-Jarouba. At al-Irra, a fence surrounding the station was installed and border trees planted. A road to the station and a well was completed. The first HITS Team Leader was in place by March 1982, and was responsible for all pre-project activities. The HITS Team Leader reported to the HITS Project Director located on the Cal Poly, Pomona campus.

The main focus of project activities has been at various locations within the country including the Ministry of Agriculture and Fisheries (Sana'a); research and training stations at al-Irra and al-Jarouba; on farm demonstration plots established throughout the country; in private and public sector nurseries; at plant protection program site areas; and training for the private and public sector on improved horticultural practices in orchards.

On January 1, 1990, the HITS Bridging Activities (HBA) Memorandum of Understanding was signed through CID with Colorado State University to continue several HITS activities until September 30, 1990 or until a contractor could be on board for the \$40,000,000 Farming Practices for Productivity (FPP) project, a major USAID supported activity which commenced in FY 1989 and will be implemented throughout the 1990's.

B. Goals, Purpose, Outputs and Inputs:

The goal of the Agricultural Development Support Program (ADSP) and all its subprojects was to increase income and improve quality of life for the rural inhabitants in Yemen. The goal of the HITS subproject was to increase rural income in Yemen through agricultural development, with a subgoal to increase the quality and diversity of fruits produced in the country. The purpose of HITS was to institutionalize within the MAF an expanded and improved capacity to support increased fruit production through extension, plant protection and delivery of disease-free plant material for improved fruit varieties to the fruit subsector. Justification for the HITS project has been to meet increasing demand for fresh fruits in YAR. The HITS project was to address major constraints within the institution building framework. The project was to focus on several important constraints, including lack of an adequate institutional support base within the MAF, disease and pest-free nursery stock, improved fruit varieties, a national plant protection program and the development of a package of improved horticulture cultural practices for fruit production.

To achieve the proposed goals and purposes, the HITS project was designed to focus on five primary areas:

1. The construction and establishment of two fruit horticulture training and demonstration stations, one in the Tihama and the other in the Central Highlands for varietal improvement testing, development of disease-free budwood and rootstocks, demonstration programs, and extension training.
2. The training of extension agents, subject-matter fruit specialists, technicians, agricultural inspectors and nurserymen in the Ministry of Agriculture and Fisheries and the private sector.
3. Expand and improve the MAF Horticulture Department to strengthen its capabilities to provide the fruit sector with current information on adapted varieties and improved horticultural practices to expand and meet the fruit production needs of the country.
4. Expand and improve the MAF's plant protection program.
5. Expand and upgrade MAF horticulture, plant protection and extension fruit production information for distribution to farmers, nurserymen and private sector input suppliers.

The two HITS stations proposed were to improve fruit varieties suitable to the region represented by the station. The stations would be designed and supported to demonstrate effective and appropriate horticultural techniques of plant propagation, sanitation, planting, fertilization, irrigation, plant protection and orchard management. The stations would also produce and distribute clean budwood, cuttings and plants to existing nurseries and farmers in the region. The two stations would also be used to train extension agents, agricultural technicians, nurserymen, and to a limited extent, farmers in improved fruit production practices.

The HITS project was also designed to develop and adapt a YAR plant protection program. An important aspect of this program strategy was to develop a plan for regulating movement of plant material in-country as well as importation of foreign material. The plant protection program would also provide training of MAF staff to effectively administer this plan. The project was to assist in establishing MAF policy relative to use and labeling of pesticides used on plants and plant products.

The HITS project would assist the MAF in developing appropriate procedures for carrying out plant inspections and quarantine. This function would include in-country nursery inspections, movement of plant materials and chemicals, and port-of-entry inspection of plant material, fruits and pesticides. The HITS project would also follow-up on previous plant pest surveys and test procedures for diagnosis, eradication and control of plant diseases, insects and mites.

An important program strategy of HITS was to provide both formal and informal training in improved fruit production practices in order

to institutionalize an effective horticulture improvement program in the MAF. The formal training program would provide MAF with a staff of highly-skilled agricultural inspectors, horticulturists, and plant protection professionals while the informal training would provide basic skills to YAR extension agents, horticulture specialists and nurserymen. Demonstration workshops and organized meetings would provide farmers with practical hands-on exposure to improved cultural practices.

Also, through HITS, the Extension Service would expand its outputs and distribution of extension materials and information to the fruit subsector. This service involves use of an extensive media outreach program including radio, television, newspaper articles, and leaflets or pamphlets with simple illustrations based on applied findings from varietal testing and other research work conducted at the HITS stations.

The principal USAID HITS project inputs included 5.771 million for technical assistance, 0.630 million for participant training, 3.657 million for commodities and 4.327 million for building construction and other costs for a total contribution of \$14.385 million. The MAF/YARG provided counterparts, participants, and land for project sites and road construction estimated to be 4.430 million dollars. Total project funding amounted to \$18.815 million.

IV. Major Issues Addressed

A. Applied Research:

1. Findings

Agricultural research started in the Yemen Arab Republic in 1970 in collaboration with the FAO/UNDP. In 1973, a research station was established to serve Taiz and Ibb provinces. In 1983, the YARG established the Agricultural Research Authority (ARA) which was charged with planning, coordinating and implementing adaptive research, generating a cadre of researchers, and developing and strengthening links with institutions engaged in education and extension. At present, ARA operates three regional stations located in (1) Tihama, (2) Southern Uplands and (3) Central Highlands besides a Central Research Station at the headquarters which consists of the main central laboratories of soil and water, plant protection, seed testing and germination, and feed/nutrition and analysis.

The ARA has a research coordination committee charged with the responsibility of making major decisions and overseeing the implementation of programs. To coordinate research by commodities, six commodity research coordinators and four for supporting disciplines were named Research Program Coordinators as follows: cereals; food legumes; vegetables; fruits; industrial crops; livestock and forage crops; soil and water; plant protection; agricultural economics and statistics; and agricultural mechanization. The professional staff consists of:

Qualifications	Present	Expected to return between 1990-1993	Total
Ph.D.	13	8	21
M.Sc.	21	17	38
B.Sc.	<u>30</u>	<u>-</u>	<u>30</u>
TOTAL	64	25	89

The HITS project had access to U.S. research institutions and was expected to participate in defining the direction and content of the ARA research programs for the period 1987-1991. However, HITS had no input in this area and ARA with FAO assumed the responsibility for defining that task.

Although a young institution with limited facilities, ARA was able to conduct research to evaluate varieties of some horticultural crops and their cultural practices. The treatments were randomized and replicated, and data on crop yields were obtained. Results of these works were presented in the 1988 annual ARA report published in 1989.

Regarding the HITS activities, after the project was finally authorized in 1983, work continued toward the completion of the al-Jarouba station that had been founded earlier as a tropical/subtropical station. In early 1984, MAF assigned a yearly production goal of 100,000 budded citrus trees to the al-Jarouba station that was agreed to by USAID/Yemen. Bacterial canker was discovered at al-Jarouba in 1985 and MAF agreed to destroy all citrus in the location in March 1986. After the removal of all citrus, the fields were leveled, an irrigation system was installed, and mango, guava and avocado varieties were planted in 1986. The following year, other tropical fruit varieties were

introduced. Although station buildings have been constructed, as of 1990, the farm machinery and irrigation system were in need of repair. The Horticulture Bridging Activities are expected to rehabilitate the irrigation system, power station and machinery.

In addition to the al-Jarouba station, HITS developed in 1983 a new deciduous fruit station located at al-Irra. In the same year, trees arriving from the USA for varietal testing infected the plantings at the station with crown gall disease. Additional disease-free land was added to the station. The trees planted at al-Irra include: cherry, pomegranate, fig, persimmon, mulberry, apple, pear, peach, apricot, nectarine, plum, prune and almond. Five irrigation systems have been introduced including surface irrigation, sprinkler, micro-jet, micro-sprinkler and bubbler.

Both stations have suffered from ineffective management. Trees have not been planted in randomized and replicated plots. Record-keeping is inadequate and maintenance has been lacking. The stations are used primarily for training and introducing new varieties rather than research.

The HITS interim evaluation team suggested in 1987 that MAF and ARA share responsibility for managing the two stations. However, ARA refused the proposal of multiple management, and the al-Jarouba station has since been given to the TDA. On the other hand, the al-Irra station is still managed by MAF and the Horticulture Bridging Activities team in collaboration with MAF.

2. Conclusions

Part of the difficulty in evaluating research lies in the definitions. It is not always clear what constitutes "applied", "trial", "verification", "demonstration", and "on-farm" research. Although these terms may appear to be only a matter of semantics,

they were the source of much confusion in the HITS project. In this evaluation, research operations are divided into basic, applied, and adaptive (including on-farm) research. Basic agricultural research is viewed as the process of generating new knowledge. It attempts to explain why certain observed phenomena happen. Examples include research on insect physiology and ecology, to further understanding of the life cycle of insects. Applied agricultural research is viewed as the process of finding practical use for existing knowledge. It attempts to identify ways to take advantage of known scientific facts. Examples include breeding plants for obtaining higher yields or for developing resistance to certain diseases. Adaptive agricultural research is viewed as the process of tailoring the broadly based relevant findings from applied research to the requirements of specific locations and it can be performed both at research stations and on selected farms. On-farm adaptive research should not be confused with on-farm trials and on-farm demonstrations, which aim at testing technology and showing potential users the merits or weaknesses of different practices. On-farm adaptive research and trials do have a demonstration effect; however, this is a by-product of testing a technology in different locations.

Based on the aforementioned definitions, it can be concluded that what has been described in the HITS reports as applied research, and what was observed at the al-Jarouba and al-Irra stations in 1990, cannot be considered research. No experimental statistical design such as planting in randomized and replicated plots was followed. No research methodologies have been tried on cultural practices, and no data on crop yields or plant characteristics have been recorded. It is rather an activity

related to the introduction of new varieties and the production of seedlings, not research.

HITS imported a large number of deciduous fruits and tropical fruits. The HITS team reported that the following deciduous fruit varieties were promising for the YAR.

<u>Peach</u>	<u>Nectarine</u>
1. Flordaking	1. Sunred
2. Flordagold	2. Sunripe
3. Flordaprince	<u>Plum</u>
4. Flordabeauty	1. Gulfruby
5. Flordabelle	2. Gulfgold
6. Flordasun	<u>Apple</u>
7. Flordared	1. Anna
8. Desert Gold	2. Dorsett Golden
9. Early Grande	3. Ein Shemer
10. Four Star Daily News	

These represent valuable introductions; nevertheless, it is unfortunate that after seven years HITS did not establish these promising varieties in randomized and replicated trials in several sites in the country to obtain reliable data needed to make definite varietal recommendations for extension under the FPP. Even more unfortunate is that after almost a decade of activity (Tropical and Sub-Tropical Fruit Project plus HITS), there is still not a list of recommended, research verified, tropical fruit varieties for Yemen. Poor recordkeeping has contributed to this serious weakness.

Regarding research on irrigation, the different irrigation systems introduced to the stations for the purpose of testing have only been used to provide water to plants. Prior to testing any irrigation method, certain soil-water-plant-climatic relationships have to be known. No estimation of crop evapo-transpiration or irrigation requirements have been made. No soil moisture characteristic curves have been developed, and no water balance or

irrigation scheduling have been determined. No adequate design has been followed, and no cost/benefit analysis has been prepared to help determine the feasibility of a system. The most important point that has to be emphasized here is that research on farm water management has to be carried out on farmer's fields and not on isolated stations. The farmer's field is an experimental station free-of-charge enabling direct transfer of irrigation technology without the need for a go-between.

Internal linkages and the transfer of research results are very weak in Yemen, and the development of Research and Extension (R&E) has been dictated by the historical factors mentioned earlier in this chapter. Responsibility for the two functions has generally been carried out by several donor countries, international institutions and government agencies. Responsibility for the two functions tends to be fragmented and uncoordinated. As a result, administrative changes have taken place separately and on a piecemeal basis. As a result, the evolution of institutions responsible for complementary functions along side R&E institutions has not been possible. Moreover, the capability to plan and monitor the use of foreign development assistance is limited.

Weaknesses in communicating research results stem in part from inadequate communication between ARA and the extension services. Many institutions involved in research and extension services in YAR are transmitting technical information independently and separately to farmers. Examples of duplication, and even of conflicting recommendations, were found by the evaluation team.

The importance of communications as an essential element in solving linkage problems within governmental services was not well

recognized by the HITS project. This lack of recognition was evident from the failure of the research, extension, and training components of the HITS project to offer advanced U.S. of R&E approaches aimed at horticultural development in Yemen.

3. Recommendations

a) Development of Research Resources.

ARA appears to have reasonably adequate resources to make an impact, if the FPP focuses on development of these resources. ARA resources are allocated by crop, leaving key agricultural problems without studies. The FPP needs to improve on this situation.

The regional emphasis in research tended to favor advantaged regions with high agricultural potential and with irrigation. Resource allocation patterns in the FPP should extend to the frontiers of cultivation of new and less favorable areas with limited water resources and high population migration.

YAR's interest in intensifying horticultural production via the FPP project should be translated into sufficient scientific manpower necessary to help achieve this goal. Therefore, the FPP should focus on close collaboration with the scientific cadre of the ARA, the RDAs and MAF. The FPP should enforce the creation of an effective coordinating mechanism that ensures sound linkages among national policy-makers, research planners, and clients. It is important that this coordination function not be confused with top-down central control. The latter may be as ineffective as fragmentation. Under the FPP, ARA should be interested in becoming the umbrella management organization

for research in YAR. From a planning and management point of view, if most research institutions are coordinated by one agency such as ARA, it would be easier to make adjustments among staff or to shift resources among the institutions than if they were independently coordinated by individual projects such as FPP working in isolation.

The evaluation team understands that a MAF management reorganization is going to take place in the near future as a result of the anticipated reunification between North and South Yemen. Integration of research and extension services under MAF is being considered as part of this reorganization. Therefore, it is recommended that the administration and operation of the existing stations be under the anticipated integrated R&E institution. These stations are located in the regions that fall under the jurisdiction of the RDAs. Also, it is recommended that all future activities be strongly coordinated with concerned RDAs that have R&E resources.

As part of this consolidation, the irrigation system at the al-Jarouba station should be rehabilitated, and new-farm machinery, suitable power generators, and electric wiring provided. The infrastructure of both al-Irra and al-Jarouba stations should be modified in order to suit the purposes of varietal testing, research, training and demonstration that will follow during the FPP Project.

b) An Approach to Formulate a Priority Research Plan.
Research Program on Irrigation:

As a first step in the proper design of an irrigation scheme, it is necessary to know crop water requirements.

Estimates of the rate of evapo-transpiration for each crop can be made by processing the already available meteorological data collected from each one of the project areas by using the Penman formula developed by Frere and Papov (1979). The second step is estimation of the effective water balance by using data on rainfall distribution and the reference crop evapo-transpiration. This study has to be made on each project site in order to determine the optimum water scheduling for each crop. The third step is determining irrigation water requirements for each crop grown at each project site after considering the variable irrigation efficiencies of each irrigation system.

Studies on developing water saving methods are recommended. Plant factors such as the introduction of short season vegetable crops, elimination of weeds, and testing of useful fruit crops or succulent plants such as pineapples that can close their stomata during the day, should be considered. Moreover, the development of drought resistant varieties through the tissue culture program proposed later in this chapter are recommended. Equally important are night irrigation and mulching either by plant materials or by plastic covers.

Studies on the Development of Water Resources:

There are presently Dutch and UNDP water resource projects in Yemen. FPP needs to coordinate closely with these activities in a number of areas. The proposed studies are:

Hydrological Studies on Ground-Water Resources:

A detailed study of aquifers in Yemen; thickness, permeability, transmissivity, leakage from overlying and underlying formations, piezometric levels, storage and recharge characteristics, pumping records and knowledge of water quality for irrigation are urgently needed. Obtaining such information can be a cost effective process if based on the performance of existing wells.

Studies on Management of Aquifers:

When crop water requirements are known, a working data base has to be established in order to quantify the capacity of the aquifer and to determine safe pump operation procedures. The study recommended should determine the water balance and the maximum amount of available water for pumping from wells. The following step is to divide each of the Project locations into two simple areas: (a) an area with relatively adequate water supplies and (b) a water constrained area. The third step is to design a priority research program for each of these areas.

In an area with relatively adequate water supply, research on suitable high yielding varieties of horticultural crops grown under supplementary unlimited irrigation should be given a first priority. The aim of the research program under this condition should be to maximize production per unit area under an optimum irrigation schedule.

On the other hand, a water constrained area has a limited aquifer that can easily be mined if overpumped. Therefore, the research program should be oriented toward improving the production of existing traditional

horticultural varieties, such as palm dates, which are often drought resistant. Under conditions of limited water supply, a comparative research program on limiting irrigation to only the critical crop growth stages versus reducing the irrigated area so that full crop water requirements can be met on the planted area, should be given a first priority. The goal of this research program should be to maximize production per unit volume of water.

Research on Water Harvesting Techniques:

The over exploitation of groundwater resources in Yemen has serious consequences for long-term sustainability of agriculture. Therefore, developing water harvesting techniques must be seriously investigated. Historically, Yemen has been well-known for its water harvesting techniques. Ancient water harvesting systems and terraced areas can be found in Yemen, and these must give rise to intensive agro-hydrological and agronomic studies on mainly micro-catchments and their optimization. The studies should focus on:

- Analysis of rainfall data and prediction of surface runoff;
- Soil surface characteristics in relation to runoff production;
- Optimization of catchment to cultivated area ratio;
- Water harvesting from short and long slopes;
- Floodwater harvesting within the stream bed;
- Storage of collected rainfall in the soil profile;
- Erosion control;
- Costs and benefits of water harvesting; and
- Sociological aspects of water harvesting including participation, payment, incentives and maintenance issues.

Priority Research Program on Fruit Crops

a) Establishment of a tissue culture facility for fruit crops:

Tissue culture technologies are needed for micropropagation and production of disease-free nursery stocks for several fruits crops. In the past, several fruit crops have suffered severe set-backs because new varieties brought into Yemen were infected with pathogens. The establishment of a tissue culture facility could also serve a vital training function, and also minimize the risk of importing plant materials carrying diseases and other pests. Finally, it will allow rapid multiplication by the private sector of plants under a controlled atmosphere that reduces plant loss due to adverse climatic conditions.

b) Post Harvesting, handling, grading, storing and packing of fruit crops:

If the fruit industry is to expand, research technologies are needed to ensure marketability and reduce risks of spoilage before marketing. Technical packages of information are needed for all fruit types.

c) Fruit variety evaluation:

Variety evaluation experiments for both scions and rootstocks including both deciduous fruits and tropical fruits and nuts are needed. Variety testing should include local as well as imported varieties to expand the harvesting season.

d) Improved cultural practices:

Fertilization trials with manures and composts to substitute for the unavailable expensive imported chemical fertilizers are needed to improve soil structure and soil water-holding capacity. Chemical fertilization experiments should be

conducted to determine optimum rates, fertilizer types, application schedules and application techniques. These experiments have to be interacted with experiments on irrigation requirements (economic irrigation requirements) for the different types of soils in each of the fruit agro-climatological zones of YAR. In addition, research works are needed on plant spacing, fruit thinning, growth regulators, pruning methodologies, insects and diseases, pesticides and biological control, IPM, and intercropping, cultivation, and weed control.

e) Nursery propagation technology.

Research is needed on grafting, budding, air layering, stool beds, seed germination, dormancy, chilling and stratification.

f) Alternative fruit crops.

The potential of new tropical and deciduous fruit and nut crops with low water requirements, such as pineapples, needs to be evaluated.

The above experiments must be randomized and replicated at each of several recommended agro-climatic sites in YAR. It is critically important that yield and fruit quality data be collected consistently and statistically analyzed. The resulting significant responses are essential for formulating production technology and extending them to current and prospective private sector producers under the FPP.

g) Optimum Linkages for the Transfer of Research Results.

External Linkages:

The FPP research activities should be implemented in full collaboration with ARA, the technical departments of MAF and

the RDAs. The FPP should collaborate with ARA in defining the direction and content of the fourth national research plan that will commence in 1991/1992. The research component of the FPP should be included as part of the plan and the research topics proposed earlier in this chapter should be treated as first priority. Strong linkage between ARA and U.S. research institutions can be established with substantial saving of ARA resources. Moreover, attempts at establishing operational links between ARA and U.S. scientists need to be encouraged by the FPP project with training used to enhance needed cooperation. All these measures would help to strengthen ARA. Strong national systems are better able to take advantage of such linkages, at least at the working level, than weak ones.

Internal Linkages:

ARA should more aggressively assume its role as a coordinator of all research activities carried out by agricultural development projects in Yemen. MAF should specifically recognize that communication between R&E is vital to the success of research. ARA should attempt to train its staff and establish units skilled in the reception and transmission of information.

h) Monitoring Research.

The research function does not end once research activities are undertaken. Two other major responsibilities remain: the monitoring of research activities and the evaluation of their results, including acquisition of feedback from clients. Accordingly, the FPP project needs to encourage ARA to introduce monitoring and evaluation in its organization.

The parameters of monitoring and evaluation should change over time. The initial emphasis would be on the development of infrastructure, institutional changes, and so forth. By the end of the second or third year, however, new monitoring parameters would be added including improved planning and research, better candidate selection for training, and closer integration of the research strategy with Yemen's overall development requirements as stated in its Five Year Development Plan. These factors can make or break a research system.

B. Extension:

Technology transfer is usually divided into three main components: (i) agricultural extension or "knowledge transfer" (ii) supply of inputs such as planting materials, fertilizers, pesticides, farm equipment; and (iii) agricultural services, including credit and marketing. These functions are used as the basis for evaluating the extension and training aspects of the HITS Project.

1. Findings

Extension responsibility in YAR is widely diffused within MAF. There are two separate entities that deal with extension, namely the National Extension Service and the Rural Women Development Department. In addition, the General Directorate of Agricultural Affairs (GDAA) conducts extension activities. NES recruits male agents, most of whom are out of the academic mainstream. NES agents with a primary school education receive an 11-month training course, of which horticulture comprises a minor part. RWD female agents have a secondary school education or below (they are not allowed to join the agricultural secondary schools in YAR). Since 1988, HITS provided 7-day and 10-day training programs to 9 and 12 female agents, respectively. There has been some turnover in some recruited female agents, mainly attributed to long distance commuting and reluctance of parents/husbands to allow daughters/wives to work away from home. There are indications that this attitude is slowly changing.

Other extension activities are undertaken separately from MAF by various regional development projects (RDAs) funded by the World Bank, U.K., the Netherlands and FAO. The RDAs train their own extension personnel and employ a variety of extension methods, including the Training and Visit System (T&V) and demonstration

plots. Moreover, the Ibb Secondary Agricultural Institute provides some extension service that has a considerable influence in the Ibb area.

Apart from the distribution of fruit trees, the only field extension activity provided by HITS to farmers was to establish some demonstration plots in selected farmer fields. The six demonstration plots visited by the evaluation team were small varietal plots of different fruit species and for the most part did not appear to be suitable for demonstration. The CP/P End-of-Contract Report (1989) indicated that 36 field plots have been established through YAR, and have been visited by hundreds of farmers. The same report also indicated that practical demonstrations including varietal differences, pest management techniques, tree propagation, planting, pruning, fruit thinning and harvesting were used by HITS.

The evaluation team observed that certain farm practices such as on-farm water management are not done properly. Also, some owners of the demonstration plots are experiencing shortages of certain agricultural inputs such as fertilizers, pesticides, and spare parts for machinery. The private demonstration plots visited by the evaluation team appear to have only a very limited influence on adjacent fields, perhaps partly due to their relatively recent development. It is clear that no sound extension methodology was adopted to transfer the technology to farmers, to obtain feedback from farmers to researchers, or to monitor the extension results.

The CP/P End-of-Contract Report indicated different types of training activities implemented since 1983 including the following:

1. Degree Training. Five MAF staff members have been sent to the U.S. for attending post-graduate educational programs on Horticultural Science. Two completed their studies in 1989 (one holds a PhD degree and the other a MS degree) and joined full-time management positions with the USAID HITS Project. The other three are expected to complete their MS programs in 1991.
2. Overseas Short-Term Training. HITS sponsored more than 15 MAF employees in short course training in the U.S. and in other countries.
3. Training of Nursery Technicians. The HITS report stated that an unidentified number of laborers working at the al-Irra and al-Jarouba stations have been trained on nursery operations including plant propagation, budding, grafting and techniques of stooling bed management for clonal propagation of superior rootstocks. These laborers were used to teach budding and grafting to an unidentified number of other laborers.
4. In-Country Training Programs. The CP/P report stated that 700 people received formal training in thirty-two sessions conducted at HITS stations, with training programs generally lasting between three to five weeks having fifteen to twenty-five participants. After reviewing these training sessions, it was found that twelve sessions lasted one to seven days; five sessions lasted seven to fourteen days; three sessions lasted fourteen to twenty-one days; one session lasted twenty-five days; two sessions lasted between twenty eight to thirty five days; nine sessions lasted for unidentified periods between March 1987 to November 1989, and

an internship for four students that lasted for seven months. These sessions can also be classified according to their topics: ten sessions on cultural practices and plant protection; four sessions on nursery management; five sessions on nursery practices; plus one session each on tropical and sub-tropical fruits, tree distribution, canker eradication, orchard planning, pistachio budding, crown gall, mango grafting, cultural operations, citrus propagation, mango propagation, plant protection and orchard management. Lectures dominated the practical part of these programs. Curricula, text-books and the qualifications of enrolled participants could not be located, in project documentation. Extension agents who attended often appeared to lack the technical background needed.

Regarding practical training, one session on the pruning of deciduous trees and plant protection was held at the demonstration plots of the al-Irra station in December 1989 as well as four field days given for training on cultural practices and operations during 1986. The total period spent on the HITS in-country training held between 1983-1989 amounted to approximately 8,800 man days. About 100 of these were spent in visits to demonstration plots, made by 320 individuals whose qualifications are unidentified. Moreover, the report stated that hundreds of farmers made visits that totalled four field days to Sa'adah, Rehim-Sana'a, Bani Behbal and al-Irra stations.

The HITS Project utilized mass communication by emphasizing a variety of media, including printed materials, displays and radio programs. The CP/P End-of-Contract Report

provided a list of 57 articles: 49 in English plus 8 in Arabic. Only three of these 57 articles have appeared in technical journals. Another three were published in the flight magazine YEMENIA, and the remaining 51 consist of memos and extension notes that were submitted by the project to an unidentified entity in 1987 and 1988. About six of the articles written in English dealt with variety trials, chill units, and nursery surveys. Most of the remaining dealt with entomology and plant protection. The materials in Arabic were on tree planting, propagation and suitability. In view of Yemen's low literacy rates (27 percent for men and 3 percent for women), the usefulness of printed materials provided to farmers is doubtful.

2. Conclusions:

Agricultural extension has generally been viewed as a function of low status performed by poorly qualified and poorly equipped persons at field-level who deal with poor and usually, illiterate farmers in remote rural areas. This perception is supported by facts: low salaries, unclear job descriptions, poor supervision of performance, and poor quality of work by extension personnel. There is no provision for improving salaries across the board or on the basis of merit.

A common feature within the existing extension systems studied has been the involvement of field level extension personnel in the non-educational aspect of the transfer of technology on related horticultural production activities. In addition, village extension workers have multipurpose assignments within the regional development projects,

spending part of their time on public health programs and other time on matters not related to horticultural production. Administrative responsibilities dilute their extension role.

Poor supervision is another problem directly related to multipurpose job assignments. Where it is difficult to define assignments, it is equally difficult to establish criteria to evaluate performance.

While classrooms have been built for HITS training programs at the al-Irra and al-Jarouba stations, curriculum, teaching aids, instructors, instructional materials and practical training have been severely neglected. Even though some resources were provided for these items, a lack of supervision and attention to training needs has been felt.

The allocation of available resources among various elements of the technology transfer system within the HITS project has been affected by two major factors. First, the extension function depends on the availability of knowledge worth transferring. The development of such knowledge in Yemen is still very recent. Second, the transfer of technology from more advanced countries creates needs for the supply and distribution of marketed inputs and for accompanying services at a time when the physical and institutional means available in Yemen are not sufficient.

Extension agents in the projects visited expressed concern about the inadequacy of resources such as transport and supplies for demonstration.

Although extension resources in HITS, particularly human resources may have been suitable for the communication of simple technology such as the spreading of new planting materials, they

have remained inconsistent with the requirements of a knowledge transfer function. The quality aspect was supposed to be addressed through in-service training. However, because extension agents enrolled in such programs have had little or no agricultural education, it appears legitimate to question whether such in-service training was adequate to improve the skills of those responsible for the knowledge transfer function, which requires as broad a set of skills as those needed to develop, modify, or adapt the technology itself.

At one end of the spectrum, agricultural extension is a communications task: transferring information about new farm practices from research to potential users and getting feedback from users to researchers. At the other end of the spectrum, agricultural extension can be seen as an education task consisting of both the communications task and the added task of helping farmers adapt their production process to take full advantage of the technological practice suggested. By reviewing the HITS activities, it can be concluded that the main extension task consisted in transmitting a technical message (mainly introducing planting materials) to farmers by poorly educated extension agents and by arranging some farmer visits to demonstration fields. By that means, the extension agent may become more of a person-to-person communicator than extension agent.

Moreover, HITS supported communication by emphasizing a variety of media, the most suitable one for Yemen farmers being the displays shown in the weekly TV program "Agriculture and the Farmer". However, mass communication methods have to be regarded as a primary tool of extension that can be used only at the "awareness" and "interest" stages of the dissemination process and

are suitable for the diffusion of simple technological practices. For implementing the education task, which is the substance of extension at the "evaluation" and "trial" stages of dissemination, emphasis should be on the regularity of visits to contact farmers by field extension workers and on the regularity of on-the-job training during which extension workers receive a specific message related to the seasonal practice needed to be transferred to farmers. This regularity itself, when implemented, will lead to a major achievement by increasing the awareness of the extension function, and by introducing improved work habits and procedures.

3. Recommendations:

Extension Methodology.

A method based on the Training and Visit (T&V) system of agricultural extension is recommended for the irrigated areas of the FPP project. The system has already been widely adopted in the RDA's supported by the World Bank. Variations on the system are recommended in order to fit local conditions, reflect particular agro-ecological conditions, socio-economic environments and administrative structures. Certain features of the system, however, cannot be changed significantly without adversely affecting its operation. These features include professionalism, a single line of command, concentration of effort, time-bound work, field and farmer orientation, regular and continuous training, monitoring and evaluation, and close linkage with research.

Upgrading the Professional Skills of Extension Personnel.

No special financial incentives to extension personnel in the FPP project should be allowed. While these allowances may improve the staff's morale and make field-level extension work more

attractive during the life of a project such as the FPP, their long-term effectiveness may be doubtful for financial reasons (budgetary constraints) and institutional ones (discriminatory practices among civil servants). Therefore, it is advisable to attempt to improve the working conditions of extension personnel through supporting improved housing for field-level agents, loans for acquiring transportation, allowances for transport, and the acquisition of extension equipment and materials.

Extension personnel need to work full-time on the knowledge transfer component of technology transfer, and a separation of extension from other activities has to be strongly supported. To ensure that extension agents will not drift back to old patterns of work behavior, their extension duties must be structured by a series of regular visits to contact farmers. These visits should involve communicating and demonstrating specific technical practices to farmers. The visits, plus bi-weekly training sessions, must be well structured so that extension workers cannot easily divert to non-extension tasks.

The FPP project should promote monitoring and evaluation (M&E) as a means of ensuring the effectiveness of extension. The M&E units should concentrate on gathering data on the frequency of agent-farmer contacts, on the rate of adoption of recommended practices, and on yields.

It is essential that the extension staff be fully equipped to disseminate improved technology to farmers effectively. Short term in-service training programs conducted by subject matter specialists (SMS) should be provided to extension agents. Extension agents must be trained regularly for one day bi-weekly on typical subjects related to the following month's programs by

the SMS, and have to give the message to be disseminated during the following two-week period. In addition, relatively longer-term pre-service and in-service (few weeks) training has to be established for the extension agents.

The concept of this training appears to be a useful short-term strategy for improving the skills of extension agents while they are on the job. However, this training approach is no solution to the long-term task of upgrading the skills of extension agents. In the long run, Yemen will need to progressively raise the educational level of its field-level extension staff to help its farmers adopt new technology more rapidly. An extension agent without a secondary agricultural school education will not have the foundation necessary to understand farmers' problems and to teach them about increasingly complex forms of agricultural technology.

Training and educating subject-matter specialists (SMS) is very important, especially in Yemen where the proportion of SMS (bachelor degree and above) in relation to the other extension staff is low. Their training programs should have both quantitative and qualitative dimensions. SMS and extension supervisors should learn on the job by working with research workers, by attending seasonal refresher courses of short duration (2 to 3 days workshops) focusing on the latest technology that is being recommended to farmers, and by participating in medium-term training programs to be conducted by the FPP expatriates on specialized matters such as developing water resources for irrigation specialists, horticultural related matters to agriculturalists, etc.

There is a need for post-graduate training for selected individuals to provide the professional expertise required to lead the MAF programs enhanced by the FPP. Priority should be given to counterparts assigned to the FPP team. It is recommended that the dissertation research for the Ph.D candidates be conducted in Yemen under the direction of a major professor from an appropriate U.S. university to insure relevancy to Yemen needs and conditions. The following post-graduate training is recommended:

<u>M.Sc.</u>	<u>Number</u>
Horticulture (1-fruits, 1-vegetables)	2
Nursery Management	2
Post-harvest physiology	1
Tissue culture/biotechnology	1
Hydrology	1
Ag. Engineering (irrigation)	1
Plant Pathology	1
Entomology	1
<u>Ph.D.</u>	<u>Number</u>
Fruit horticulture	1
Pest management	1

Development of Resources. In extension, the central element in resource allocation is manpower resources. The setting of the ideal ratio of extension agents to farmers as a target should be avoided; otherwise it will result in the misallocation of manpower and in the mismanagement of other resources within extension services in YAR. An extension agent to farmer ratio could have meaning only in relation to the following five parameters: (i) Yemen's overall demand for skilled manpower and its training capacity; (ii) its budgetary means and its capacity to generate funds to support extension on a sustained basis, (iii) differences in the level of development of farming among various groups of

farmers; (iv) the potential trade-offs between the use of manpower and media communication for extension; and (v) the potential for trade-off between the use of a few highly qualified and mobile agents and the use of large numbers of poorly trained and less mobile agents.

Linkages. As part of the technology development and transfer system, the FPP project should promote an extension service that is (i) knowledgeable of and responsive to, the needs of its clients; (ii) has access to a source of knowledge for answering client's questions; and (iii) establishes channels to supply inputs and services that complement extension. The recommended linkages between extension and these three elements are described as follows:

i) Extension - Research Linkage. The present institutional separation of extension from research in Yemen has already hindered the creation of operational links between the two functions. Attempts have to be made at improving this situation. The remedy could take a variety of forms including sharing of the physical facilities, sharing of responsibilities for specified tasks, dual appointment of staff, and integration of R&E services that may result from the expected re-unification of Yemen. Moreover, the job description of an SMS could include both extension and research responsibilities in the same way the U.S. university professor has teaching and research functions.

ii) Extension - Client Linkages. FPP should have a concern over linkages between extension and clients that stems from the need for feedback to determine the usefulness of technologies being extended to clients so that extension

approaches can be adapted to the specific needs of various groups of farmers. Attempts should be made to encourage the establishment of internal feedback channels within the extension services through regular contacts between extension workers and farmers. The farmer groups at the village level, such as the local Councils for Cooperative Development, must be taught to look after their own interests in the development and transfer of technology and formal structures through which farmers could participate.

The FPP project needs to provide channels through which less privileged groups (small farmers in general and women in particular) can express their point of views. A significant part of the FPP project should be directed to areas where marginal and small farmers are predominate.

Concerning women, there is an increasing role of women in all aspects of agriculture in Yemen where it is culturally difficult for male extension agents to work with female farmers. Therefore, if women are not fully involved in extension, they are unlikely to be consulted on their production problems and on their priorities. Therefore, the FPP project should promote the recruitment and training of female extension agents at the field level and women should be represented at all professional levels of the extension system. The FPP project should address the issue of female extension agents, taking into consideration that induction of women into rural development has to be gradual, sensitive to the local culture, and supplemented with properly planned training. This should be done on a pilot basis appropriate

to the availability and acceptability of female extensionists to undertake such work.

If, over time, the cultural context is changed and male extension agents can contact women farmers, male and female agents can work in common units to serve all farmers. The extension effort for women should be organized as an independent entity with a structure similar to the extension effort for men. The female agent would be regularly supervised by female supervisors and would receive regular technical support from SMS that can be drawn from a male service. Activities of the male and female agricultural extension services would be properly coordinated so as to ensure that technical packages disseminated by the two groups are consistent.

iii) Linkages between Input Supply and Extension. The effective use of improved agricultural technology by farmers depends on the availability of essential inputs and agricultural services. Ensuring that services and imported inputs are provided where needed, presents considerable administrative and logistical problems in Yemen. Therefore, the FPP project through private sector involvement is recommended to encourage the promotion of a coordinated extension-credit-input-marketing approach, particularly for small farmers.

C. Nursery Development:

1. Findings

Stations at al-Irra and al-Jarouba now have a fairly good germplasm repository of improved deciduous fruits and tropical fruits, some of which appear to be well adapted to the YAR. Based primarily on observations with very little data, HITS reported that 10 peach varieties, 2 nectarine varieties, 3 apple varieties, and 2 plum varieties are promising. Due to managerial problems, poor data collection, and lack of experimental designs, the most promising tropical fruit varieties are yet to be determined. Identification of best adapted varieties (scions and rootstocks) is essential for "mother trees" as a source of nursery propagative material.

Limited studies have been initiated to identify superior local varieties, "baladi" types, necessary for nursery production.

The best applied research with deciduous fruit trees in the orchard and nursery was observed at the British project in Rasabah and at ARA.

MAF increased the price of trees from their nurseries, which has encouraged private sector investments. According to the CP/P end-of-contract report, HITS provided a number of training courses on propagation techniques and other nursery practices as IPM, water management, fertilization, weed control and transplanting for subject-matter specialists, extension agents, agriculture students, and farmers. They also utilized interns in nursery operations.

Nursery management training was provided by HITS for key personnel and included women extension agents in a couple of courses.

MAF counterparts supported by technical assistance from HITS conducted an extensive survey of MAF nurseries in the YAR and recommended selected nurseries for up-grading and phasing-out of the others.

HITS input on nursery improvements and expansion was largely directed toward MAF nurseries instead of the private sector. Some private sector nurseries have been established during the period of HITS, both large scale and small scale. The MAF's Horticulture Department did provide valuable assistance to some private sector nurseries.

Private sector nursery operations and owners are anxious to receive production technology packages. Unfortunately, only a limited amount of technology has been evaluated via good, statistically sound research in Yemen.

MAF is already developing a program for certification of nursery trees.

2. Conclusions

HITS can be credited with the introduction of a number of productive fruit varieties which show promise in Yemen. These trees are essential to the expansion of private sector nurseries advocated in the FPP. However, with a duration of 7 years, HITS should have advanced beyond the introduction stage to the establishment of randomized and replicated plots of the most promising varieties (applied research). The British project at Rasabah was more productive in terms of applied research than HITS, especially when the station budgets are compared. Both stations have had qualified technical assistants, but a major difference was the fact that the British technical assistance resided at the station and spoke some Arabic.

HITS did establish functional fruit nurseries at al-Irra and al-Jarouba.

Management training for MAF personnel involved in nursery operations was inadequate and not sustained. Women have proven to be well adapted to some nursery operations such as budding and grafting in many parts of the world.

The HITS staff made a significant contribution by performing detailed surveys of MAF nurseries, including pest incidence.

The stations at al-Irra and al-Jarouba should be the main source of germplasm (plant material) for the private sector nurseries.

HITS primarily was concerned with meeting YARG quotas for the number of nursery plants produced both at al-Irra, al-Jarouba and other MAF nurseries. This new emphasis on mass production of plants was not compatible with the HITS Project Paper and became a major distraction from the real nursery objectives of the project, principally training and research. In our view, USAID should not have agreed to this shift in project priorities, but rather worked with MAF in selecting several other nurseries in the country to give priority to mass production, not al-Irra and al-Jarouba which were targeted for research and training.

MAF is to be commended for their foresight in being willing to scale down the number of MAF nurseries and to work diligently to promote the development of private sector nurseries.

Most of the technology extended to private sector nurseries must be selected and adapted from other countries by qualified scientists and extension specialists. However, as research in Yemen produces reliable results, they should be quickly incorporated into the appropriate technology packages.

The developing program for nursery plant certification is commendable, and must be closely coordinated between the Horticulture Department and the General Directorate for Plant Protection. HITS should have given leadership with MAF counterparts to the development of a nursery certification program several years ago.

3. Recommendations

The FPP project should support the further introduction of improved varieties of both deciduous fruits and tropical fruits, and place emphasis on propagation of only the most promising varieties in the private sector nurseries. The best means of assuring that the new Yemen fruit industry is based on the best adapted varieties is to only propagate these superior varieties in the nurseries.

The FPP should give priority to evaluation of local varieties for nursery propagation. These evaluations will take time since good applied research of this type was unfortunately slow in starting under the HITS.

Nursery operations at al-Irra and al-Jarouba should be down-sized yet strengthened to serve as model nurseries for training and research purposes, not mass production of plants. Emphasis should be placed on quality not quantity in order for them to truly become "model" nurseries. They should be of higher quality than those in the private sector.

The FPP project should provide a training package for several supervisory personnel from al-Irra and al-Jarouba including technical and managerial skills. The package should include both in country and out-of-country training.

We recommend that women be considered to receive specialized training for certain skilled nursery operations such as propagation.

With the new strong commitment to encourage private sector nurseries, we recommend no USAID funds (PL-480 or otherwise) be spent to upgrade the five selected MAF nurseries. Their principal purpose should not be the mass production of nursery trees for sale due to direct competition with private sector nurseries. It may require 2 to 3 years for MAF to implement the reduction in mass production of plants.

We recommend that appropriate technology, including all cultural practices, (i.e. seed germination, propagation, weed control, fertilization, water management and transplanting, plus selection of adapted varieties) be packaged and extended to current and prospective private sector nursery operators as soon as feasible under the FPP as an incentive to medium and small scale nursery owners and operators.

Only the most skilled and technically trained farmers should be encouraged to enter the nursery business since it is a more intense operation than orchard production. MAF should not encourage too many farmers to become nursery producers within a local area. The market for trees can quickly become saturated.

Formation of a good nursery plant certification program is highly desirable and must be directly supported by FPP resources in regard to technical assistance, plus managerial and inspector training. An inexpensive permanent label should be used to identify YARG inspected and certified plants as an incentive for private sector nurseries to receive a good price for their product, in contrast to plants smuggled into Yemen. An effective

extension effort must be conducted to increase public awareness of the certification program. Only healthy plants of the MAF recommended varieties should be certified, thus certification is a method of encouraging the propagation of adapted varieties and reducing the spread of pests while affording a price incentive.

D. Pest Management

1. Findings

The awareness and understanding of Integrated Pest Management (IPM) significantly increased in the General Directorate for Plant Protection (GDPP) during the period of HITS.

GDPP is effectively utilizing the computer furnished by HITS and Core for word processing to produce pest management schedules, pest control recommendations, etc.

The FPP must provide assistance to strengthen YARG regulations to govern the sale, purchase and use of pesticides.

Citrus in Yemen is infected with three of the most serious and persistent citrus disease problems in the world, namely (1) bacterial canker, (2) greenings disease and (3) a virulent strain of tristeza virus. Citrus red scale and mites on many fruits continue to be major problems which impede profitable nursery and orchard production.

There is a critical shortage of well trained pest management specialists in YAR needed to implement the IPM programs strongly endorsed in HITS and FPP.

The GDPP plant quarantine program has only a minor effect on preventing the importation of pests into the YAR. There are very few qualified plant inspectors in MAF to implement the priority programs of plant quarantine and nursery plant certification.

HITS produced a number of pamphlets and other publications related to pest management, and provided useful training on IPM and safe use of pesticides including production of videos. HITS also conducted preliminary nursery surveys to identify the major plant pests and to determine their geographic distribution.

HITS provided equipment and technical assistance to establish a disease diagnostic lab at the Yemen Plant Protection Center (YPPC) in cooperation with the German Project implemented by GTZ. This lab is critical to back-stop MAF quarantine, certification and research programs.

Only a limited amount of actual research was conducted by HITS to support IPM programs.

2. Conclusions

HITS made a contribution to MAF by training GDPP personnel in the principles of IPM, and effectively used TDY's to deal with major pests of citrus and deciduous fruits. The IPM principles learned in relation to fruits can be modified and applied to other crops.

Computers provided to MAF must be more actively utilized to enhance productivity.

HITS provided training on safe use of pesticides, but HITS and CORE should have provided more leadership to encourage development of pesticide regulations as specified in the HITS PP.

GDPP is to be commended for efforts in formalizing a law concerning movement of plants and fruits within YAR. The FPP should provide assistance with this high priority program.

It will be very difficult for YAR to significantly increase production of quality citrus fruit unless canker, greenings and tristeza are controlled. MAF has changed their citrus rootstock recommendations to suppress the incidence of tristeza. HITS provided good TDY advice concerning canker control. Only limited progress has been made toward implementation; however, GDPP appears to have put forth considerable effort with inadequate resources.

HITS recognized the importance of citrus red scale and mites, and initiated efforts to assist GDPP with control techniques. However, only limited reductions in pest populations have been produced at this stage. This assistance is continuing under Horticulture Bridging Activities.

HITS should have trained several more counterparts in pest management to the BS and MS degree levels plus one at the PhD level.

HITS provided inspector training for several counterparts but unfortunately some have left the plant quarantine section for other positions. Essential facilities are lacking at the various ports of entry. Often infected and infested samples intercepted are transported into Sana'a rather than being destroyed at the port of interception. The head of plant quarantine lacks needed cooperation from other enforcement agencies as customs and police. Unfortunately the credibility of HITS was damaged when crown gall was introduced on peaches at the al-Irra station by the project.

Additional research is needed in relation to entomology and plant pathology to more fully understand the life cycles and biology of the major pests including predator and parasite activity. Also, application of control and eradication techniques from other countries is always risky until evaluated by research locally.

IPM programs will probably be sustained in MAF as established with the assistance of HITS. However, the programs will never realize their maximum potential until the recommended inputs are provided and recommended changes are implemented.

3. Recommendations

Prompt hiring of a long-term IPM specialist under the FPP is needed to ensure that pest management is a major component in the technology packaging for private sector farmers under the FPP. This technical assistant should be housed with appropriate counterparts.

It is recommended that additional computers and accessories plus support for training of operators be provided to MAF, ARA and RDA's to improve research and extension pest management productivity needed for a successful FPP. GDPP could be used as a "role model" in relation to computer usage.

FPP technical assistants must give priority to assisting the GDPP develop pesticide regulations to protect users and the environment. The FPP must emphasize biological control techniques to reduce the dependence on chemicals, protect the environment from pesticide contamination, and reduce expenditures for imports. A national plan must be promptly developed to control canker, greenings and tristeza diseases of citrus. No additional shipments of citrus plants within Yemen should be permitted until this plan is implemented. Priority should be given to keeping the northern and eastern regions free of canker.

The new FPP pest management specialist should give priority to assisting GDPP counterparts achieve successful control of citrus red scale and mites on many fruits.

GDPP should give country-wide leadership to an IPM program to control citrus red scale and fruit mites. This leadership will include research and extension coordination with ARA, GTZ, NES and the RDAs. Under the FPP, support should be readily available to

assist GDPP in dealing quickly with major pest outbreaks necessary to protect private sector and YARG nurseries and orchards.

Support must be provided to GDPP as soon as possible to construct an insectary needed to rear predaceous insects and mites essential for IPM programs.

A minimum of two counterparts in GDPP should be trained to the BS level, one to the MS level and one to the PhD level by FPP.

USAID should work with GDPP to develop a reliable plan to hire and retain at least six more plant inspectors to ensure that private sector nursery and orchard production develops in a sound and sustainable fashion. Facilities must be constructed at the port of entry as storage rooms to isolate suspect samples until positive identification can be made, plus incineraries are needed for plant destruction. Plant quarantine regulations must be widely publicized by travel agencies, airlines, and extension personnel, including the use of mass-media. Coordination and education of enforcement agencies about the importance of the plant quarantine program must be implemented at the highest level in YARG, with encouragement and advice from the FPP team. Donor agencies must be fully versed on YARG quarantine regulations and must set a good example by strictly adhering to them, even though inconvenient at times. MAF should not permit the importation of large quantities of plants of new fruit types into YAR until a small number are evaluated by MAF in advance.

Additional financial support and technical assistance should be given to GDPP to prepare and print publications about pest management, plant certification, plant quarantine, pesticide safety and environmental protection. A major effort should be

launched to significantly increase public awareness about these important programs of national interest.

It is recommended that support be given to ARA under the FPP to design and implement an effective entomology and plant pathology research program to provide data necessary to strengthen the IPM programs in GDPP, and provide the necessary technology for FPP packaging.

E. Institution Building and Sustainability:

The HITS project was designed to strengthen the institutional structure supporting the horticulture subsector of the YAR's Agricultural sector. A major project focus is institutional development and training of human resources. The USAID/Yemen strategy was to address a variety of fruit production constraints for the purpose of improving MAF's capacity to implement a national fruit development program. Through the HITS training program, MAF's Departments of Horticulture and Plant Protection were improved and strengthened. However, several critical gaps still exist within the institution.

1. Findings

MAF's efforts to expand the fruit industry during the 1983-1989 period in Yemen is limited by resource availability, lack of research results and a shortage of trained technicians and agricultural personnel. According to the HITS project documents, the MAF/YARG provided over \$4 million of the total \$18 million cost project over a seven year period. In the newly proposed USAID/FPP project, MAF officials plan to increase its support to \$14 million over an eight year period. MAF officials in the Horticulture Department working through the HITS project assisted in the establishment and operation of four private sector nurseries. Nursery production was increased several fold and the industry probably can be sustained. Yemen has gone from a country producing 12,000 budded fruit trees per year to one producing over 80,000 budded trees per year. By next year Yemen will produce all its own seedlings. Imports will be limited to certain plant types needed for research or budwood for propagation.

The HITS project established two Horticulture Stations, one at al-Irra in the temperate Central highlands and the other at al-Jarouba in the Tihama tropical zone near Hodeidah. The stations are used for multiplication of budwood, evaluation of new fruit varieties and extension demonstration plots for extension training. On a regular basis the al-Irra station has provided clean budwood and cuttings of deciduous fruit varieties to the government nurseries in Yemen where they are propagated and sold to farmers. The station has been established as a demonstration farm which serves as a model deciduous fruit nursery. It provides training to YARG personnel and local farmers in fruit production, nursery development and plant protection. It has identified 3 apple, 10 peach, 3 plum and 3 nectarine improved varieties that are suitable for Yemen conditions and will play a major sustainable role for the fruit industry in Yemen.

At the al-Irra station, the HITS project established adequate field facilities for deciduous fruit tree propagation and variety testing. Station facilities include a shadehouse, a greenhouse, cold storage container, irrigation equipment with a well, training lecture rooms, farm equipment, staff housing and office space for MAF personnel. According to project records, over 65 different varieties of deciduous fruit trees were planted for evaluation at al-Irra. The HITS project activities at al-Irra also included the monitoring of major fruit insect and disease pests. Laboratory facilities for applied research were not adequately developed at the stations.

The second station at al-Jarouba was upgraded by the HITS project starting in 1983. The al-Jarouba station was designed to meet tropical fruit needs for Yemen. It has suffered serious

set-backs in meeting its goals and objectives set forth in the project paper. In spite of the heavy allocation of MAF and USAID resources and U.S. technical assistance (estimated at over \$5 million by MAF officials), the general physical condition of the station is poor. The fruit variety blocks of mango, avocado and papaya are poorly irrigated, and the shadehouse and nursery irrigation systems are in poor condition. The mechanical shop and housing facilities for the manager and technicians need remodeling. It is doubtful if the station can be sustained by MAF, although MAF has recently transferred the station over to the TDA in Hodeidah. Important fruit germplasm has been planted and needs to be evaluated for Yemen conditions. The outbreak of citrus canker, a bacterial disease, in the al-Jarouba nursery caused serious project set-backs. All citrus seedling and budwood production was stopped in 1986 midway through the project. Station development priorities were shifted to mango, papaya, guava and avocado. Progress has been slow. The station management is weak and basic station records on different rootstocks, varietal performance, and orchard management are inadequate. The station is unable to determine simple varietal yield responses because of the lack of plot design and field plot supervision. Without continued USAID support, it is unlikely that either the al-Jarouba and al-Irra stations will be effectively sustained.

The MAF's Horticulture Department remains deficient in training and staffing. Several long term participants trained in the US by the HITS project have returned but did not occupy a MAF position and have been assigned to other donor programs. This has reduced MAF ability to develop and implement a sustained MAF

horticulture program. No job placement plans have been developed for US trained technicians and it is not clear whether they will find suitable MAF positions or will be retained. MAF now recognizes that participant training is one of the most essential inputs for achieving institution-building objectives.

The limited research conducted by the HITS project makes it difficult to identify appropriate agricultural input requirements for the fruit industry under Yemen conditions. For example, fertilizer markets in Yemen are relatively underdeveloped. The HITS project provided little infrastructural development and technical information to support the use of fertilizers, insecticides, herbicides, fungicides and other pesticides.

MAF research and extension linkages are not clearly defined. HITS did not provide sufficient technical information and research results to foster the development of a model system for the fruit industry. Critical gaps remain within the MAF to develop technical fruit production information.

Current market conditions favor private sector involvement for nursery production. MAF policies toward government-owned nurseries are changing to allow a healthy transition from MAF production to the private sector.

The economics of fruit growing remains highly profitable. However, redirection of the HITS project toward tree production rather than research and training during its early stages, reduced project effectiveness and sustainability opportunities for the fruit sector. Profitability will depend on prices and costs. However, a fruit assessment survey supports a favorable return for research and extension activities as envisaged in the HITS Project Paper.

2. Conclusions

The HITS project is credited with the construction and establishment of two fruit stations at al-Jarouba and al-Irra although these facilities continued to be marked by management problems. Without continued USAID and increased MAF support it is unlikely that these stations will be effectively sustained.

The HITS project enhanced and strengthened MAF's Plant Protection and Horticulture Departments to encourage the production, importation and distribution of insect and disease-free fruit trees to farmers in Yemen.

Strengthening of the MAF Plant Quarantine and Plant Protection Department is one of the most urgent needs for sound development of the Yemen fruit industry.

Sustainability of the IPM program on California red scale of citrus and mites on deciduous fruit trees is high. Private sector nurseries have excellent opportunities provided that MAF continues to shift emphasis and policy from public to the private sector in the propagation of fruit trees to meet Yemen's tree demands.

Analysis of the HITS project indicates that the project was economically, technically, socially, environmentally and institutionally sound. According to surveys and project files, the economic rate of return is estimated to be 15 percent which was above 11.9 percent estimated in the project paper.

Improved fruit varieties imported and tested by the HITS project encouraged the initiation and expansion of private sector orchards.

3. Recommendations:

A technical advisory committee consisting of selected technical representatives from MAF, USAID, the contractor and

other appropriate entities, should be formed to coordinate and provide advice concerning FPP technical activities.

Continued limited USAID, MAF and TDA scheduled phase down support of al-Jarouba and al-Irra stations under the new FPP Project is needed to ensure sustainability. Strong applied research programs with direct linkage under MAF's Agricultural Research Authority need to develop in an effort to maximize sustainability. Variety test plots need to be maintained along with continued evaluation of promising varieties and the development of packages of technical information on improved cultural practices.

MAF demands on the two stations for tree production should be reduced and nursery propagation of seedlings transferred to the private sector. Importation of nursery trees should be limited only to research and propagation of certified budwood.

YARG should concentrate on development of a sound fruit industry based on fresh fruit for domestic consumption. After better varieties have been introduced and are producing in Yemen orchards, fruit grades and standards should be developed in preparation for an export market.

Information and recommendations on post-harvest handling, packaging and storing will require further strengthening and development. More stringent cultural practices such as fruit thinning will have to be followed in order to produce the high quality fruit necessary to compete on the export market. Due to the large capital outlay required, emphasis should not be placed on developing a fruit processing industry until the local demand for fresh fruit is met.

The FPP should include a component to improve Yemen technology concerning fruit handling and storage in anticipation of the larger production which will result as the hectarage is expanded and improved varieties start producing.

The FPP should support the development of several tissue culture laboratories at the stations for micropropagation and the development of technologies to enable the production of disease-free plants. Yemen currently has no facilities for tissue culture research. The development of new tissue culture technologies will increase program sustainability and provide needed MAF institution building capabilities for the Horticulture and the Plant Protection Departments.

In 1986, USAID/Sana'a completed a fruit horticultural sub-sector assessment for the YAR to determine fruit production, demand, and technology levels. In 1989, a U.S. Pricing and Incentive Study was completed which included a focus on horticultural products. It is recommended that the horticulture subsector assessment be updated in 1990 to include new fruit development as well as progress in the vegetable and private sector nursery areas. The assessment would help determine what role USAID could play to help develop and sustain the horticulture subsector in Yemen and provide an analysis to determine what position and role horticulture would occupy in the next Five Year Agricultural Development Plan.

V. Lessons Learned

The HITS project suffered many serious project management and implementation shortcomings, including turnover of team leaders, insufficient recruitment of qualified US technical support staff, changes in project direction from applied research and extension training to a production emphasis, limited horticultural research qualifications, lack of contract experience in implementing foreign projects, and lack of project planning, priority setting and internal reviews between US technicians, the MAF and USAID early in project implementation. These shortcomings must be minimized and corrected in the FPP.

It is essential that sound experimental plots which are randomized and replicated be established and successfully concluded under the FPP.

It is recommended that USAID provide a pre-orientation workshop for all selected project team members prior to project implementation to review USAID regulations, policies and program management concepts. The Support Module - Yemen (SMY) set-up by CID to provide financial and administrative support services for the HITS and other CID managed ADSP subprojects was ineffective for the HITS project and created serious conflicts over lines of authority and administration between CID, USAID and the lead University, California State Polytechnic University (Pomona). The SMY approach could be more effective in a Title XII collaborative assistance mode if its primary and sole function was to serve as a support group only and allowed leadership for project implementation to be administered by the team leader from the lead University in collaboration with USAID, CID and MAF.

Project implementation must provide training for managerial skills in addition to technical training.

Institutionalization roles and responsibilities among HITS team members, USAID and MAF were not always clear and common objectives were not always clearly delineated. During the second half of the project, annual work plans bearing the signature of MAF, HITS, CID and USAID officials helped clarify goals and responsibilities for project implementation. In the upcoming FPP it is essential that goals, roles and responsibilities be clearly stated, defined and reinforced by periodic meetings and work plans that allow for structural flexibility.

USAID/Yemen had only two Agricultural Development Officers in place during most of the HITS implementation period and relied too heavily on CID for monitoring and internal evaluations of HITS. The FPP is an extremely important project and it is imperative that USAID ensure active ADO involvement and support throughout implementation.

The major loss of citrus trees due to canker at al-Jarouba would not have occurred if the original intent of the station to conduct applied research and extension activities had been implemented. USAID should not agree to a major revision in the project without a revision or amendment of the Project Paper. Future expansion of citrus must be curtailed until the three major disease problems of canker, greenings and tristeza are controlled.

HITS was preceded by a basically weak and unproductive Yemen/USAID/Tuskegee activity, the Tropical and Subtropical Fruit Improvement Project. It is important for the FPP to learn and build from previous project experience. Projects with difficulties should be monitored and followed more carefully by USAID.

The FPP contractor team must work closely with their YARG counterparts on a day-to-day basis to solve the real problems facing the Yemen horticultural industry.

A general weakness of the HITS project design is that it ignored the need for water resource evaluation and the HITS project was implemented without long-term technical assistance in water management. The FPP should concentrate on areas where the water resources are known. The horticultural crops selected should be based on climatic and soil conditions as well as the availability of irrigation water. Given the scarcity of water resources the FPP should promote the development of surface and groundwater resources as well as the use of cost effective automatic irrigation systems that do not require frequent maintenance.

The HITS long term participant training program was unsatisfactory in providing institution building and sustainability. Lack of sufficient English training was a major constraint. The FPP should provide additional participant training especially at the MS level.

HITS involvement in the training of women was limited. Women have responded well to training and proved capable of accomplishing significant horticultural tasks when given opportunity. A stronger effort should be made in the FPP to expand the training of women, especially in the areas of home economics and horticultural home gardening. Enhancing the role of women in horticultural development requires an understanding of social and cultural issues and improvement measures need to be carefully implemented.

The HITS project expanded its establishment of 36 horticultural demonstration plots with private farmer cooperators throughout Yemen and was unable to follow-up and promote the adoption of improved horticulture practices by private farmers at all selected sites. It is recommended that the FPP authorize a reduced number of approximately 10-12 plots located throughout the country to demonstrate improved

cultural practices, accommodate off-station research and extension training.

The HITS project provided good logistical and material support to the Directorate of Plant Protection in Integrated Pest Management (IPM) and plant quarantine programs. A strengthened MAF quarantine department is one of the most urgent needs for the sound development of a Yemen fruit industry. Additional facilities must be provided at the points of entry so that diseased plant material can be returned or destroyed and not transported to other Yemen locations. Under FPP, the MAF Horticulture Department and the plant protection and quarantine programs should be given sustainable support to minimize the dangerous misuse in handling and application of pesticides and support for quarantine regulations.

The HITS project provided stipends to a selected number of MAF officials working as HITS counterparts or collaborators. This procedure has created an unfair and unacceptable atmosphere and is counter-productive to institution building and project sustainability. US funded projects should not be directly involved in payment of incentives for MAF personnel involved in project implementation. Per diem, overtime payments, and operating costs should be paid by MAF. Some effort should be made by USAID in collaboration with MAF and other donors to standardize a procedure to address this issue.

The MAF Horticulture Department organized a successful first National Horticultural Symposium, with emphasis on fruit production, which was held May 21-25, 1989 in Sana'a, Yemen. Over 50 registrants participated in 7 seminar sessions on fruit development in Yemen. The symposium attracted 11 researchers from 5 countries including South Yemen, Egypt, Iraq, the U.S., U.K. and France. Several HITS team members presented invitational papers. The proceedings of the

symposium were published and made available to participants and MAF Agricultural Officials in Yemen. It is suggested that a second National Horticultural Symposium be organized in 1991 or 1992 with active USAID participation from the FPP project. Also, the FPP should encourage and assist with additional National Symposia on Pest Management and Plant Protection. Information and recommendations from the Symposia based on good research should be seriously considered for implementation in Yemen when appropriate. It is very important that MAF subject-matter specialists present scientific papers and actively participate in these Symposia.

**FINAL EVALUATION
SCOPE OF WORK (SOW)**

I. Activity to be Evaluated

USAID/Yemen requests an evaluation of the Horticulture Improvement and Training (HITS) subproject of the Agricultural Development Support Project (ADSP).

II. Purpose of the Evaluation

The purpose of the evaluation is to assess strengths and weaknesses of the recently completed HITS subproject, with a view towards drawing up recommendations and "lessons learned" based on the HITS experience which will assist in implementation of the new \$40 million Farming Practices for Productivity (FPP) project.

III. Background

The \$14 million HITS activity is one of five components of the \$135 million ADSP project, the "centerpiece" of USAID/Yemen support for agricultural development in Yemen during the 1980s. Other subprojects within ADSP support poultry production, improvements in the Ministry of Agriculture and Fisheries (MAF), and the strengthening of agricultural education at both the secondary and university levels.

The HITS activity, which began in 1983, runs through December 1989 ("bridging" activities related to HITS will continue until a contractor is on board for the follow-on FPP project, on or about September 1990). The main objective of HITS from the beginning has been to institutionalize within the MAF an expanded and improved capacity to support increased fruit production through extension, plant protection and the distribution of disease-free plant stock.

Implementation is through the Consortium in International Development (CID), with California State Polytechnic University in Pomona playing the lead role. The main focus of activity has been at MAF research stations at al Irra and al Jarouba; on farmer demonstration plots located throughout the country; on assisting in the private and public sector development of nurseries; on plant protection; and on training for private and public sector individuals.

A mid-term evaluation conducted in February 1987 noted that the project had "provided useful technical assistance in the areas of plant production, extension, and short-term training." At the same time, it indicated that "little progress has been made in developing a capacity within MAF to manage adequately the HITS stations after project completion." Early setbacks included

the destruction of 180,000 citrus trees at al-Jarouba due to citrus canker and the discovery of crown gall disease at al Irra.

The mid-term evaluation went on to describe progress to date as "unsatisfactory." It also suggested that "it is doubtful that the HITS stations will be sustained." Among other recommendations, the evaluation called for greater support for data collection, applied research, policy dialogue and extension throughout the remainder of the project.

Many of the recommendations included in the evaluation report were subsequently included in annual HITS workplans. Although management difficulties have continued to cause concern, HITS-supported research resulted in the introduction of several new fruit varieties to Yemen and the identification of apple, peach and plum varieties suitable to Yemeni conditions. The project also assessed rootstock and continues to evaluate rootstock and plant materials. Five different irrigation systems were tested at the al-Irra station and 26 demonstration plots established on farmers' fields throughout Yemen. Training programs have also been developed, including two aimed specifically at female extension specialists. The al-Jarouba Horticulture Field Station is scheduled to be formally taken over by the government (Tihama Development Authority) at the end of 1989, when it will take on technical as well as financial responsibilities. Limited USAID support for al-Jarouba is anticipated beyond 1989, mainly for training and the introduction of plant material.

A series of other studies and reports have also emphasized the importance of fruit and vegetables for Yemen's agricultural future. As a result, USAID in coordination with the MAF developed a \$40 million Farming Practices for Productivity (FPP) project aimed at promoting production and productivity increases in fruits and vegetables. This particular evaluation is being conducted with specific reference to FPP--the main intent is to derive concrete, specific "lessons learned" from HITS that can directly assist in the early and effective implementation of FPP.

IV. Scope of Work

The main body of the evaluation report shall be divided into the main sections shown below. The report itself should provide empirical findings to answer the questions indicated below; conclusions (interpretations and judgments) based on the findings; and recommendations based on assessment of the results of the evaluation exercise:

A. **Applied Research**: Assess the effectiveness of the research programs supported at Al Irra and Al Jarouba between 1983 and 1989. What new varieties have been introduced? Who undertook this work and what is the likelihood of its being continued in coming years? What were the strengths and weaknesses of the applied research undertaken under HITS,

including work done in irrigation? To what extent was the program responsive to the needs of the YARG and local farmers? What impact has the program had on farmers? What should be emphasized on the research agenda for the 1990s?

B. Extension: Assess the effectiveness of the extension activities supported under the project. To what extent have new varieties developed under HITS been adopted by private farmers in Yemen? How many farmers benefitted and in what areas? How effective have the training courses for extension personnel been in terms of impact, numbers trained and quality of information provided? To what extent has the extension effort involved women, both as farmers and as extension agents? Which extension activities were most effective in disseminating new practices and products? Which were least effective? What factors hinder or promote the adoption of new practices? In view of the HITS experience, which approaches to extension offer the most promise for the 1990s? What mistakes can be avoided?

C. Nursery Development: Assess the extent to which the project has been effective in meeting Yemen's goal of being self sufficient in the production of suitable disease-free trees in the private as well as the public sector. What can be done under FPP to increase the private sector role in the production of these trees?

D. Pest Management: Assess the effectiveness of the integrated pest management element of the project. What impact has this component had on the ability of the Directorate of Plant Protection within MAF to develop and implement its pest management programs? To what extent are these efforts sustainable? To what extent can they be expanded to cover other crops?

E. Institution Building and Sustainability: Assess the extent to which institution building efforts under HITS during the 1983-1989 period within MAF and at the research institutes at Al Irra and Al Jarouba have been effective in meeting their objectives. To what extent have YARG and USAID objectives coincided during the implementation of HITS? Has the ability of MAF to promote private sector fruit production been increased? What are the strengths and weaknesses of the approaches employed thus far? To what extent have the staffing and recurring costs of the research stations envisaged under HITS been met? To what extent have the training targets been met? What critical gaps remain in institutions involved in promoting horticulture expansion in Yemen and what might be done under FPP to close these gaps? To what extent are the activities begun under HITS likely to be sustained? If not, why? Briefly discuss the costing and economic implications of each of the major activities supported under HITS and assess to what extent they represent a cost efficient approach to horticulture development in Yemen.

E. Lessons Learned: Based on the findings described above, provide a consolidated list of lessons learned through the HITS experience. What were the strengths and weaknesses of project management and implementation under HITS and to what extent were project aims advanced by use of a Title XII collaborative assistance mode? What were the strengths and weaknesses of each of the major activities funded under HITS? How can these lessons learned be applied to the execution of FPP? A list of specific recommendations relating directly to FPP and based on the implementation of HITS shall also be provided.

V. Methods and Procedures

The final report shall be based on a review of the existing literature (Project Paper, previous evaluation, contractor reports, government documents, project files, etc.) and interviews with relevant individuals concerned, including government officials, USAID staff, contractors, private farmers and businessmen, and other donors. Field trips shall include visits to both research stations and a representative selection of nurseries and demonstration plots developed under the project. Prior to departure from the United States, the evaluation team leader shall consult by phone with the USAID Mission in Yemen and then by phone with individuals previously connected with HITS in Yemen and now at California Polytechnic in Pomona and the CID offices in Tucson, Arizona.

The five-week evaluation exercise shall incorporate the following illustrative schedule:

A. Week One: Orientation and team planning meeting (TPM) in Sana'a; review of project documentation; initial meetings with individuals familiar with the project.

B. Week Two and Three: Collection of data; field trips to research stations, demonstration plots, nurseries, and farmers fields. When possible, team members shall split up to expand coverage.

C. Week Four: Report writing in Sanaa.

D. Week Five: Finalization of report and departure.

Team members shall coordinate arrival and departure times to ensure that the team remains intact through the course of the evaluation. Formal meetings shall include at a minimum an initial orientation and team planning meeting (TPM) meeting in Sana'a; a status report to Mission staff halfway through the time in Yemen; and a final close-out presentation no fewer than two days before departure from Yemen. Additional meetings with USAID staff, government officials, or other individuals may be called as appropriate.

The evaluation team shall leave with the Mission a near-final draft of the report. Any additional Mission comments shall be telexed or faxed to the contractor within two weeks after the team departs posts. An entire package of not less than twenty copies of the final evaluation report shall be pouched to the Mission by the Contractor not more than five weeks after departure from post.

VI. Team Composition

The HITS evaluation team shall consist of an agricultural management specialist, a horticulture research specialist with expertise in fruit production, and a horticulture extension and training specialist, none of whom shall previously have worked directly with California State Polytechnic or CID. The contractor shall designate a team leader with full responsibility for completing the evaluation and presenting it in Yemen. All three team members shall have at least a Master's degree in their respective disciplines. In addition, each team members shall have the following qualifications:

A. At least five years of project management experience in areas related to those supported under HITS, with overseas experience in the developing world highly desirable.

B. Prior experience in conducting evaluations in areas related to those supported under HITS.

C. Prior work experience that goes beyond the narrow areas of technical specialization, in particular covering areas of broader management and policy concerns as they relate to agricultural development in the developing world.

D. Demonstrated writing skills.

VII. Reporting Requirements

The final report shall include the following sections:

A. Executive Summary of not more than five pages summarizing the main findings, conclusions, and recommendations. The Executive Summary shall also state the development objectives of the project, purpose of evaluation, and methods and procedures used.

B. Completed A.I.D. Project Evaluation Summary form, based on a sample provided by the Mission.

C. Table of Contents.

D. Main Body of Report, not to exceed sixty double-spaced pages of text. This main section of the report shall be organized by issues/questions provided in the SOW, each section concluding with a list of major findings, conclusions, and

recommendations. The main body of the report shall also provide a brief discussion of the economic, political and social context in which the project takes place; team composition and study methods; and specific lessons learned from the HITS experience that will aid in the early and effective implementation of FPP.

E. Annexes, to include at a minimum a complete copy of the evaluation SOW and a list of documents and individuals consulted, along with institutional affiliations. Additional annexes that report and amplify on the evaluation findings may also be provided as appropriate.

VIII. Other Provisions

A. Duty post in Yemen is Sana'a, with planned field trips to other parts of Yemen. Access to classified information will not be required. USAID's Office of Agriculture will provide basic logistic support, including hotel reservations and transportation within Sana'a. The indirect cost budget provided by the contractor should include provisions for car hire for field trips outside Sana'a (approximately six working days), secretarial support (consultants are advised to bring their own computers) in Yemen, and per diem for counterparts on any trips outside Sana'a (approximately six working days at \$75 a day for two individuals).

B. The period of performance is for the five week period beginning on or about February 17, 1990.

C. This contract is predicated on the contractor's nominees Quebedeaux (Horticultural Research Specialist); Bishay (Extension and Training Specialist), and Arnold (Agricultural Management specialist)

LOGICAL FRAMEWORK
Agricultural Development Support Program (279-0052)
Horticulture Improvement and Training Subproject (HITS)

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
<p>GOAL: To increase rural incomes in the YAR through agriculture development.</p> <p>SUBGOAL: To increase the quantity, quality and diversity of fruits produced in the YAR.</p>	<p>SUBGOAL:</p> <ol style="list-style-type: none"> Increase in number the new fruit growers and expansion of production by existing growers. Increase in tree survival rates. Improved vigor and yield of trees. Increased demand for stock by nurseries. 	<ol style="list-style-type: none"> Evaluation of sample of fruit growers over the life of the project. Review of nursery records. Review of fruit import/export data. 	<ol style="list-style-type: none"> YARG maintains appropriate fruit pricing policy. Fruit production remains important economic activity in the YAR. Farmers willing to allocate more land to fruit production and have access to requisite capital and other inputs. Marketing channels will expand to handle increased population.
<p>PROJECT PURPOSE: To institutionalize within the MAF an expanded capacity to support increased fruit production through extension, plant protection, and the delivery of disease-free stock of improved fruit varieties to the fruit subsector.</p>	<p>PURPOSE (End of Project Status):</p> <ol style="list-style-type: none"> Operational horticulture improvement stations providing 50,000 buds to nurseries annually and developing improved varieties. Functional MAF plant protection program monitoring nurseries to ensure production and sales of insect/disease-free trees to farmers. Functional extension program servicing farmers for expanding fruit production. Increased sales of nursery stock to farmers. 	<p>PURPOSE:</p> <ol style="list-style-type: none"> Review of records at horticulture improvement stations and nurseries. Evaluation of PPD. Evaluation of sample of fruit growers. Review of records extension agents. Evaluation of extension information produced; review of records re: distribution of information. 	<p>PURPOSE:</p> <ol style="list-style-type: none"> YARG remains committed to increasing fruit production. Trained persons remain employed in respective positions. YARG remains committed to enforcing plant protection laws. Farmers willing to adopt improved farm practices and fruit varieties.
<p>OUTPUTS:</p> <ol style="list-style-type: none"> Establishment of horticulture training and improvement station. Expanded plant protection department trained in plant protection methods. Trained extension agents, horticulture specialists, horticulture technicians, agricultural inspectors, nurserymen. Expanded horticulture information production and distribution program for farmers, nurserymen and private horticulture input suppliers. Developed improved fruit varieties in insect/disease-free condition. Farmer demonstration program and workshops. 	<p>MAGNITUDE OF OUTPUTS:</p> <ol style="list-style-type: none"> Two-stations One department 250 extension agents 200 specialists 10 technicians 5 inspectors 10 nurserymen Three programs Not limited Minimum of ten 	<p>OUTPUTS:</p> <ol style="list-style-type: none"> Review of MAF records. Physical inspection. Evaluation of station records. Project Records 	<p>OUTPUTS:</p> <ol style="list-style-type: none"> Appropriate persons will be available for training and in timely manner. Improved varieties can be adaptable in the YAR. Timely provision of construction/engineering services. Farmers willing to participate in demonstration programs.
<p>INPUTS:</p> <p>USAID:</p> <ol style="list-style-type: none"> Technical Assistance Participant Training Commodities Construction Building Other Costs <p>YARG:</p> <ol style="list-style-type: none"> Counterparts Participants Land for project sites Construction (road) Local labor 	<p>MAGNITUDE OF INPUTS:</p> <p>USAID:</p> <ol style="list-style-type: none"> \$) \$) \$) \$14 Million \$) (See Annex G for details) <p>YARG:</p> <ol style="list-style-type: none"> \$) \$) \$) \$ 4 Million \$) (See Annex G for details. <p>Also see Section IV.D)</p>	<p>INPUTS:</p> <ol style="list-style-type: none"> USAID/YARG records Drawdown on CID work plan budgets 	<p>INPUTS:</p> <ol style="list-style-type: none"> YARG identifies counterparts. Timely availability of funds/TDY support.

LIST OF DOCUMENTS CONSULTED

- Agricultural Research Authority. 1989. Directory of National Agricultural Research Projects (1978-1991). Taiz, Yemen Arab Republic.
- Agricultural Research Authority. 1989. The 1988 Annual Report Horticultural Research. Internal Report. Dhamar, Yemen Arab Republic.
- Agricultural Research Authority. 1989. Agricultural Research in the YAR. Vol 1, Taiz, Yemen Arab Republic.
- Agricultural Research Authority. 1989. Agricultural Research in the YAR. Vol. 2, Yemen Arab Republic.
- Agricultural Research Authority. 1989. Agricultural Research in the Yemen Arab Republic. Vol. I. Ministry of Agriculture and Fisheries and Fisheries, Yemen Arab Republic.
- Al-Koshab, O. 1989. Chilling and Nutritional Requirements of Fruit Trees in Yemen. First National Horticultural Symposium, Vol. II. Yemen Arab Republic.
- Al-Mallakh, R. 1986. The Economic Development of the Yemen Arab Republic. Croom Helm-London, pp 92-120.
- Askari, A. 1989. End of Tour Report. USAID/Yemen, Horticulture Improvement and Training Sub-Project.
- Askari, A. 1984. Citrus Canker Survey Report from Tihama Area including al-Jarouba, HITS Station. USAID/Yemen, Horticulture Improvement and Training Subproject.
- Asmon, J. 1982. YAR Horticultural Production, Extension, and Training Project. RONCO Consulting Corporation for USAID/Yemen. (PDC-1406-I-07-1138-00).
- Ballard, J.C. 1980. Evaluations and Recommendations on Yemen Extension Services and Secondary Agriculture Institute Program. USAID/Yemen.
- Bonine, M.J. 1980. An Evaluation of Social Analyses and CID Projects. Consortium for International Development for USAID/Yemen.
- Burr, T.J. 1986. Report on the Crown Gall Situation on Deciduous Tree Fruits at al-Irra, Yemen Arab Republic. USAID/Yemen, Horticulture Improvement and Training Subproject.

California State Polytechnic University, Pomona. 1989. End of Contract Report for the Horticulture Improvement and Training Subproject (HITS). USAID/Yemen.

California State Polytechnic University, Pomona, 1988. Annual Workplan for the Horticulture Improvement and Training Subproject (Oct. 1988-Sept 1989). Ministry of Agriculture and Fisheries, Yemen Arab Republic and USAID/Yemen.

California State Polytechnic University, Pomona, 1988. Annual Workplan for the Horticulture Improvement and Training Subproject (Oct. 1986-Sept 1987). Ministry of Agriculture and Fisheries, Yemen Arab Republic and USAID/Yemen.

California State Polytechnic University, Pomona, 1987. Al-Irra History (1982-1987). Ministry of Agriculture and Fisheries, Yemen Arab Republic and USAID/Yemen.

California State Polytechnic University, Pomona, 1988. Annual Workplan for the Horticulture Improvement and Training Subproject (Oct. 1987-Sept 1988). Ministry of Agriculture and Fisheries, Yemen Arab Republic and USAID/Yemen.

Carpenter, K. 1989. Bubbler Irrigation in the Yemen Arab Republic, A Guide to Operation and Installation. First National Horticultural Symposium, Vol. II. Yemen Arab Republic.

Carpenter, K and D. Miller, 1988. The Development of Irrigation Technology in the Yemen Arab Republic. Horticulture Improvement and Training Sub-Project. USAID/Yemen.

Castle, W.S. et. al. 1989. Rootstocks for Florida Citrus. University of Florida (IFAS).

Central Highlands Project 1988. Apple Cultivation. Department of Horticulture, Ministry of Agriculture and Fisheries and Fisheries, Yemen Arab Republic.

Central Planning Organization. 1987. The Third Five-Year Plan. Prime Minister's Office. Yemen Arab Republic.

Chapman, M. 1986. End of Tour Report - Plant Pathologist Specialist. USAID/Yemen, Horticulture Improvement and Training Subproject.

Consortium for International Development. 1982. Subproject Paper for the Horticulture Improvement and Training Subproject/Yemen. USAID/Yemen.

Consortium for International Development 1982. Use of Sewage Effluent for Irrigation of Crops, Sana'a System, Stage one Project (No. 052-Yemen). USAID/Yemen.

Consortium for International Development. 1981. Agricultural Sector Analysis, Yemen Arab Republic. USAID/Yemen.

Dimitman, J.E. 1983. Citrus Canker Survey, Citrus and Deciduous Tree Survey For Diseases and Pests, Nursery Survey. USAID/Yemen, Horticulture Improvement and Training Subproject.

Dimitman, J.E. 1985. Survey for Citrus Canker, Other Pests and Diseases, and Evaluation of Possible Destruction/Distribution of Citrus Trees from al-Jarouba Station. USAID/Yemen, Horticulture Improvement and Training Subproject.

Directorate of Rural Extension and Training. 1990. Mangoes. Ministry of Agriculture and Fisheries and Fisheries. Yemen Arab Republic.

Directorate of Rural Extension and Training. 1990. Apples. Ministry of Agriculture and Fisheries and Fisheries, Yemen Arab Republic.

Dwellely, H.L. 1989. Interim Evaluation of the Support Module-Yemen (SMY) Component of the Agricultural Development Support Program (ADSP), Devres, Inc., Bethesda, Maryland for USAID/Yemen.

Enger, W.J. 1986. Fruit Horticulture Sub-Sector Assessment - Yemen Arab Republic. RONCO Consulting Corp. for USAID/Yemen.

Finetto, G.A. 1989. Recommended and Promising Deciduous Fruit Varieties for Yemen Arab Republic. First National Horticultural Symposium, Vol. II. Yemen Arab Republic.

Frere, M. and G.F. Papov. 1979. Agrometeorological Crop Monitoring and Forecasting. FAO Plant Prod. and Prot. Paper Nov. 17, Rome.

German/Yemen Plant Protection Project. 1986. A Concise Guide of Diseases and Disorders of Cucurbits. Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ), Eschborn/W. Germany.

German/Yemen Plant Protection Project. In-Service Training Programs on Plant Protection. Ministry of Agriculture and Fisheries, Yemen Arab Republic.

German/Yemen Plant Protection Project. 1989. In-Service Training Programs on Plant Quarantine Works. Ministry of Agriculture and Fisheries and Fisheries, Yemen Arab Republic.

German/Yemen Plant Protection Project. 1986. A Concise Guide of Pests of Cucurbits. Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ), Eschborn/W. Germany.

German/Yemen Plant Protection Project. 1986. A Concise Guide of Pests of Tomatoes, Potatoes, Pepper and Eggplants. Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ), Eschborn/W. Germany.

German/Yemen Plant Protection Project. 1986. A Concise Guide of Pests and Diseases of Grapes. Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ), Eschborn/W. Germany.

German/Yemen Plant Protection Project. 1986. A Concise Guide of Peach, Apricot and Almond. Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ), Eschborn/W. Germany.

Haidra, M. and D. Jackson. 1989. Irrigation Schedules for Deciduous Fruit Trees in North Yemen. First National Horticultural Symposium, Vol. II. Yemen Arab Republic.

Hermann, C. 1987. Horticulture Improvement and Training Subproject Interim evaluation. Labat-Anderson, Incorporated. for USAID/Yemen.

Horticulture Activities Memorandum of Understanding. 1990. The Yemen Arab Republic, Ministry of Agriculture and Fisheries and Fisheries, and the United States Agency for International Development (Oct. 1989 - Sept. 1990).

Hussein, A.M. 1989. Post Harvest Technology of High Cash Crops (Fruits and Vegetables). First National Horticultural Symposium, Vol. III. Yemen Arab Republic.

Jackson, L.K. et al. 1989. Introduction to the Florida Citrus Industry - Its Production, Harvesting and Marketing Practices. University of Florida (IFAS).

Karpowicz, J. 1984. Final Report on the Dhamar Beekeeping Rehabilitation Program. USAID/Yemen, Horticulture Improvement and Training Subproject.

Knapp, J.L. (Editor). 1989. Florida Citrus Integrated Pest and Crop Management Handbook. University of Florida (IFAS).

Laredo, D. Haratani, J.M. and W.G. McMullan. 1985. Sana'a Basin Water Resources Assessment. WASH Project Activity 165, USAID/Yemen.

Lockard, R.G. and K.H. Morris, 1988. Deciduous Fruit Tree Handbook for the Yemen Arab Republic, Horticulture Improvement and Training Subproject, USAID/Yemen.

Lockard, R.G. et. al. 1988. Investigation of Chill Units at al-Irra Research Stations. USAID/Yemen, Horticulture Improvement and Training Sub-Project.

Lockard, R.G. 1986. First Report on Fruit Variety Trials at al-Irra. HITS Leaflet No. L1. USAID/Yemen.

Lockard, R.G. 1986. Information on Crown Gall. USAID/Yemen, Horticulture Improvement and Training Subproject.

Lockard, R.G. et al. 1988. Fruit Nursery Survey - Final Report. USAID/Yemen Horticulture Improvement and Training Sub-Project.

Lockard, R.G. End of Tour Report. USAID/Yemen, Horticulture Improvement and Training Sub-Project.

Magid, A.H.A. 1989. Fertilizer Recommendations for Deciduous Fruits in the Yemen Arab Republic. First National Horticultural Symposium, Vol. II. Yemen Arab Republic.

Moghni, A.A.A. 1986. Minutes of Meeting on Crown Gall Disease. Plant Protection Department. Ministry of Agriculture and Fisheries and Fisheries, Yemen Arab Republic.

Mutwali, A.M. 1984. Final Report - al-Jarouba Farm (1980-84). USAID/Yemen. USAID/Yemen, Tropical and Sub-Tropical Fruit Improvement Subproject.

Phillips, R.L. 1986. Final Report - Horticultural Advisor. USAID/Yemen, Horticulture Improvement and Training Subproject.

Randhowa, G.S. 1982. Technical Report on Fruit Crops. Agricultural Research Services (Taiz), Ministry of Agriculture and Fisheries and Fisheries. Yemen Arab Republic.

Revri, R. (Editor) 1980. Half Yearly Paper for Farmers and Plant Protection Extensionist. Plant Protection Bulletin, Ministry of Agriculture and Fisheries, Yemen Arab Republic.

Stall, R.E. 1985. Citrus Canker in North Yemen. USAID/Yemen, Horticulture Improvement and Training Sub-Project.

Tweeten, L., Rassas B and T. Earley, 1989. Yemen Arab Republic: Farm Prices and Incentives. Technical Report No. 104. Abt Associates, Inc. for USAID/Yemen.

Twine, J. 1986. Orchard Irrigation Using Bubbler System for Yemen Arab Republic. Overseas Division Report No. 86/18, National Institute of Agricultural Engineering, Wrest Park, U.K.

U.S. Department of the Interior. 1980. Ground-Water Resources Investigation in the Amran Valley, Yemen Arab Republic. Open-file report 80-774, USAID/Yemen.

U.S. Department of the Interior. 1985. Contribution to the Geochemistry, Economic Geology and Geochronology of the Yemen Arab Republic (IR) YE-17, USAID/Yemen.

USAID, 1990. Country Development Strategy Statement (CDSS) (Draft). Yemen Arab Republic.

USAID, 1987. A.I.D. Evaluation Handbook. USAID, A.I.D. Program Design and Evaluation Methodology Report No. 7.

USAID, 1980. Design and Evaluation of AID-Assisted Project. Office of Personnel Management, U.S. Agency for International Development.

USAID/Yemen. 1989. Project Paper - Farming Practices for Productivity Project. U.S. Agency for International Development. Project No. 279-0084.

Varisco, D.M. 1985. Land Tenure and Water Rights in the Central Highlands. The IFP Project, Central Highlands, Yemen.

Verloop, R. 1987. End of Tour Report. USAID/Yemen, Horticulture Improvement and Training Subproject.

Weidemann W.C. et al. 1988. Yemen Arab Republic - Agribusiness Development Problems and Potentials. Robert R. Nathan Associates, Inc. for USAID.

Whiteside, J.O. et al (Editors). 1988. Compendium of Citrus Diseases. APS Press, The American Phytopathological Society.

YOMINCO/TNO-DGV. 1985. Water Resources of the Saadah Area. Report WRAY-3.3. Yemen Oil and Mineral Resources Corporation, Sana'a, Yemen.

INDIVIDUALS INTERVIEWED

Ministry of Agriculture and Fisheries

Abdul Hafiz Karhash	Director General, Agr. Affairs
Zaid Abdul Rahman	Director, Horticultural Dept.
Mohamed al-Ghashm	Director General, Plant Protection Dept.
Mohamed Lutf Obad	Director General, Extension Service
Abdul Hafez Ali Ghalib	Dept. of Planning
Ahmed Saif al-Haq	IPM Program
Abdul Malik Hamim	IPM Program
Abdul Hakeem Bahir	Horticultre Dept.
Nabil Mansour Harroub	Plant Protection
Abdulla M. al-Salawi	Plant Protection
Abdul al-Aleem Saif	Hort. Dept.
Abbas Ali Abdul Ghani	Director, Plant Quarantine Service
Abdul Rahman Sallam	ARA, Director
M. al-Dean al-Ghoury	ARA, Dhamar
Hussein al-Ward	ARA, Dhamar
Abdul Hakeem Farah	Dept. of Irrigation
Mortada Abdul Rab	Dept. of Irrigation
Eskandar Thabit	Dept. of Irrigation
Sadek Noman	Dept. of Irrigation
Hayat al-Gershi	Director, Dept of Rural Women Deve.
Ali al-Thor	ARA, Taiz
Abdul Khatib	ARA, Taiz
Abdul Rahman Abdul Latif	ARA, Taiz
Ali Abdullah	ARA, Taiz
Abdou M. Abdou	ARA, Taiz

Ministry of Education

Mohamed al-Harazi	Director General of Agr. Education
Gamal al-Dean Rassam	Director, Ibb Agr. Secondary School
Abdulla al-Dabii	Hort, Ibb Agr. Secondary School
Kairi Abdou al-Syood	Consultant to the USAID Project

USAID/Yemen

Kenneth Sherper	Director
John Swanson	Chief, Agr. Dev. Officer
Abdel Moustafa	Deputy Chief, Agr. Dev. Officer
Jonathan Addleton	Deputy Program Officer
Ben Hawley	Program Officer
John Schamper	Agr. Dev. Officer
F. Rudolph Vigil	Agr. Dev. Officer
Abdulla T. Ben Yehia	Agr. Specialist
Nasr al-Ghoorairy	Agr. Specialist
Kamal Siddik	Agr. Specialist

AID/Washington, D.C.

Lee Voth	ANE/TR/ARD
Charles Uphaus	Chief, ANE/TR/ARD
Paul Novick	ANE/TR/ARD

Core Evaluation Team

John Rowntree	Consultant
Charles Rogers	Consultant
Ahmad Ahmadi	Consultant

Horticulture Bridging Activity

Abdul Hamid Majeed	Team Leader
Charles Basham	Consultant
Mohamed Sharif ul-din	Specialist
Othman al-Khoshab	Specialist
Mansour al-Dalas	Specialist
William M. Brown	Specialist

Support Module - Yemen

Jeffrey Sole	Team Leader
--------------	-------------

CID and Cal-Poly Office in U.S.A.

Earl Kellogg	CID Executive Director
Larry Boone	CID Dept. Exe. Director
Gary Cretser	Cal-Poly Director
Allen Christensen	Cal-Poly Dean of Agr.

British Rasaba Fruit Extension Project

Abdulla Amer	Co-manager
David Jackson	Advisor
Tony Parlman	Advisor

German Plant Protection

Ali Ali Masoud	Co-manager
Raman Revri	Plant Protection Specialist
Nageeb al-Asbahi	Specialist
Monawar al-Sagheer	Specialist
Hassan Suleiman	Specialist
Abdul Rageed al-Aryani	Specialist
Abdul Majid Saleh	Specialist

Tihama Development Authority

Abdul Momen Hazza	Director General
Jaafar Alawi al-Jeffrey	Deputy Director
Musa Ahmed Allagabo	Hort. Dept.
Ali Ghalib	Agricultural Specialist

Abdullah M. Saif	Director, Southern Region
Sharaf al-Qahlami	Civil Engineer
Saif Abdou Saif	Civil Engineer
Abdul Raquib Ali Mohamed	Veternarian
Hamoud Saif el-Nasr	Irrigation
Mansour Hassan	Irrigation
Gamal Sallam	Director, al-Jarouba Station
Mohamed Sultan	Horticulture
Anisa Mohamed al-Faqih	Extension Agent
Rokaia Mohamed	Extension Agent

Southern Upland Regional Development Authority

Lutf al-Ansi	Director General
Abdul Rahman Abdul Latif	Director, Hort. Dept.
Abdul Wahab Allam	Senior Agr. Advisor
Abdul Hameed Sharshar	Agr. Advisor

Northern Regional Agricultural Development Project

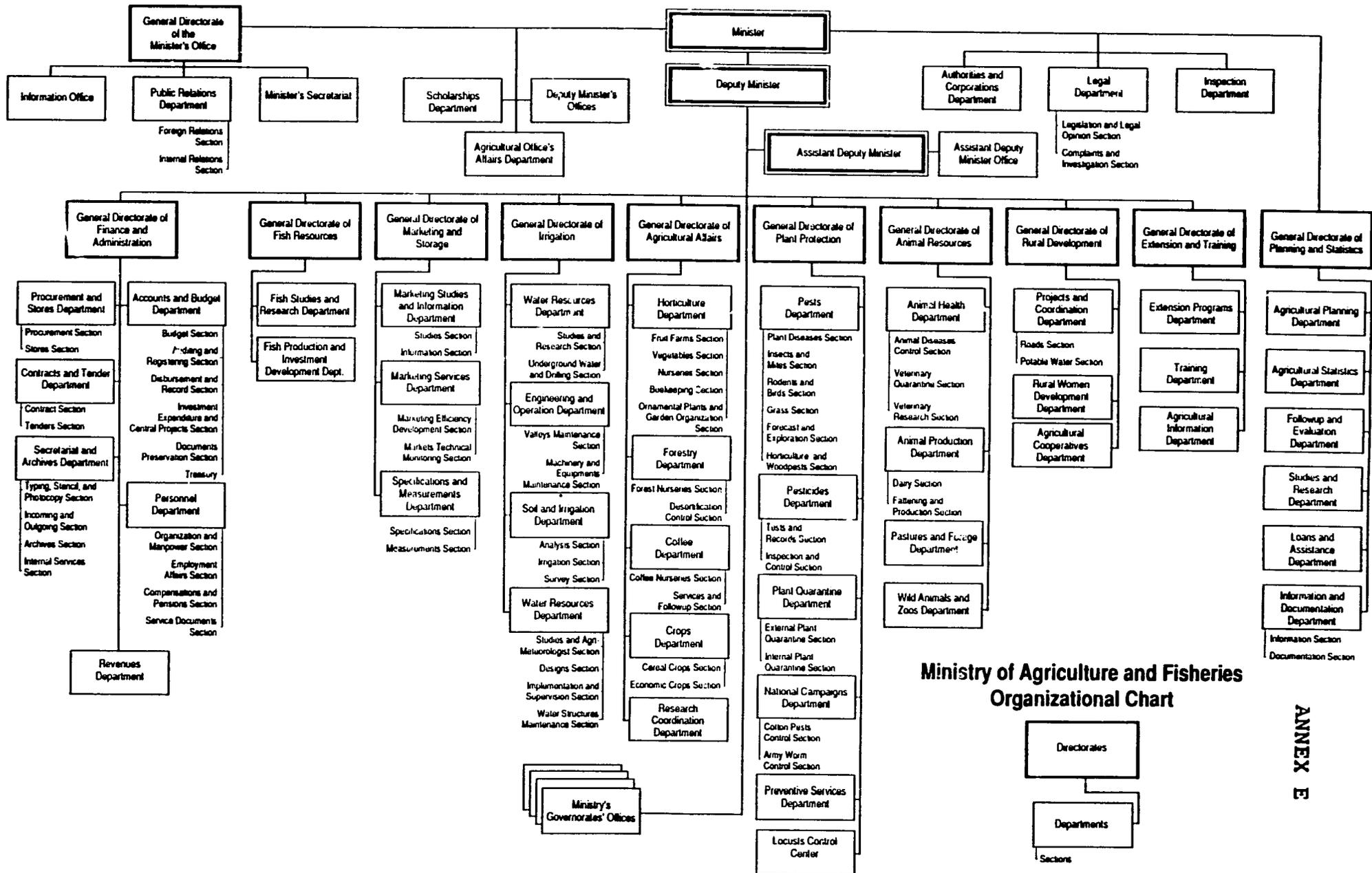
Mazhar F. Abdullah	Senior Agricultural Advisor
--------------------	-----------------------------

Other Persons

Essam Shaltout	Advisor, to the private sector Green Valley Nursery
Shamsan al-Goubi	Farmer at al-Boun Area
Saleh	Farmer at Kaa al-Kaed location
Saad Ali Saad	Farmer at Kaa al-Kaed location
Mahmoud Hashim al-Bargougi	Director Egypt/California Hort. Project

ACRONYMS

ADO	Agriculture Development Officer
ADSP	Agriculture Development Support Program
AID	Agency for International Development
ARA	Agriculture Research Authority
CID	Consortium for International Development
CORE	Central ADSP Project
CP/P	California State Polytechnic University, Pomona
FY	Fiscal Year
FAO	Food and Agriculture Organization
FPP	Farming Practices for Productivity Project
GDAA	General Directorate for Agricultural Affairs
GDPP	General Directorate for Plant Protection
GTZ	German Technical Cooperation
HITS	Horticulture Improvement and Training Subproject
HBA	Horticulture Bridging Activities
IPM	Integrated Pest Management
MAF	Ministry of Agriculture and Fisheries
ME	Monitoring and Evaluation
NES	National Extension Service
PACD	Project Assistance Completion Date
RE	Research and Extension
RDA	Rural Development Authority
SMS	Subject-Matter Specialist
TDA	Tihama Development Authority
TDY	Temporary Duty
T&V	Training and Visitation
YAR	Yemen Arab Republic
YPPC	Yemen Plant Protection Center
USAID	United States Agency for International Development
UNDP	United Nations Development Program



ITINERARY FOR HITS EVALUATION TEAM

Sat, Feb 24

4:00 p.m. Quebedeaux, Arnold, Bishay departed for Airport
7:00 p.m. Quebedeaux, Arnold, Bishay departed US

Sun, Feb 25 Quebedeaux, Arnold, Bishay in transit

Mon, Feb 26

12:35 a.m. Quebedeaux, Arnold, Bishay arrived in Sana'a, Yemen
02:00 a.m. Quebedeaux, Arnold, Bishay arrived Sana'a. Met by John B. Swanson. Checked in Taj Sheba
11:30 a.m. Quebedeaux, Arnold, Bishay visit USAID Office. Met USAID personnel - office tour - Agricultural Office, Program Office, Contract Office, Conference rooms etc. Provided with draft of schedule visit outline, set-up Evaluation Team Office in GSO.
7:30 p.m. Team planning meeting - orientation - Scope of work - discussion. Quebedeaux, Bishay, Arnold

Tues, Feb 27

7:30 a.m. Travel to USAID Office
8:30 a.m. Briefing by Dr. John Swanson - USAID Evaluation Expectations
09:00 a.m. USAID Joint Team Planning Meeting - HITS and Core Evaluations - Chair Jonathan Addleton. Participants: Ken Sherper, Director; Ben Hawley, Jonathan Addleton and Abdul Ali, Program; John B. Swanson, Chief ADO, John Schamper, Abdullah Bin Yahya, Nasr al-Ghoorairy and Kammal Siddik, Agriculture Office; Paul Novick, AID/W; John Rowntree and Charles Rogers, Core Evaluation; Bruno Quebedeaux, Calvin Arnold and Bishay Bishay, HITS Evaluation. Briefed by Ken Sherper, Jonathan Addleton, John Swanson, Abdullah Bin Yahya and AGR Staff, USAID Staff and Evaluation Team shared expectations and concerns.

12:00 p.m. HITS team Planning Meeting - Review of
Scope-of-work. Quebedeaux, Arnold and Bishay
2:00 p.m. HITS Evaluation Team meet with USAID, F. R.
Vigil, Agr, Jonathan Addleton, PRM .
Discussed HITS Team Evaluation schedule and
Scope of Work.
3:30 p.m. Visited USAID Library - Nasr al-Ghoorairy
4:30 p.m. Return to Hotel
5:00-6:00 Visit to Sanaa Market to observe vegetable
and fruit marketing
9:00 p.m. Review HITS Project documents

Wed, Feb 28

7:30 a.m. Quebedeaux, Arnold and Bishay travel to USAID
office
8:00 a.m. Briefing with F. Vigil, USAID, HITS Project
Officer, Dr. Abdul Hamid Majid, HITS Bridging
Team Leader, Colorado State University
9:00 a.m. MAF Introduction, project evaluation
expectations and discussions. Participants:
Eng. Abdul Hafiz Karhash, and Eng. Zaid Abdul
Rahman, (MAF, Agr. Affairs), Dr. Mohamed
al-Ghashm, MAF, Dr. Ibrahim Moharram, USAID
Office in Sana'a (Extension)
10:30 a.m. MAF Meeting with Horticulture Dept, Eng. Zaid
Abdul Rahman, MAF, Mr. Abdul Hafiz Ali
Ghalib, MAF - HITS
1:30 p.m. CID/ADSP - Introduction to Horticulture
Bridging Activities personnel. Participant:
Jeff Sole, SMY Team Leader, Univ. of
Arizona/CID; Dr. Abdul Hamid Majid, HBA Team
Leader, Colorado State University; Charles
Basham, HBA; Mohamed Sharif, HBA; Dr. Othman
al-Koshab, HBA
4:30 p.m. Return to Hotel
6:00 p.m. Review project documents

Thur, Mar 1

6:30 a.m. Field trip, Hammam ali, Visit IPM program
with MAF Plant Protection staff. Quebedeaux,
Arnold and Bishay. Participants: Ken
Sherper, Director; Dr. John Swanson, S/ADO;
Eng. Nasr al-Ghoorairy, ADO, USAID/Yemen; Dr.
Mohamed al-Ghashm, Mr. Ahmed Saif al-Haq, Mr.
Abdul malik Hamin, Mr. Abdul al-Hakeem Bahir,
Mr. Nabil Mansour Harroub, Mr. Abdulla M.
Al-Salawi, MAF.
4:00 p.m. Return to Hotel
6:30 p.m. Review project documents

Fri, Mar 2 Weekend. Review project information

Sat, Mar 3

7:30 a.m. Quebedeaux, Arnold and Bishay travel to USAID office

8:00 a.m. Field trip to al-Irra Station - program review, demonstration plots, nursery and observation plots. Participants: Engineer, Mansour al-Dalas, HBA; Eng. Abdul al-Aleem Saif, MAF; Dr. Abdul Hamid Majid, HBA; - Quebedeaux, Arnold and Bishay.

1:00 p.m. HITS Evaluation Team Visit al-Boun fruit demonstration plot. Farmer: Shamsan al-Goubi, Farmer: Saleh, Dr. Abdul Hamid Majid, HBA

5:00 p.m. Return to Hotel

6:30 p.m. Team Evaluation meeting - planning

Sun, Mar 4

7:30 a.m. Quebedeaux, Arnold and Bishay travel to USAID office

8:30 a.m. Field trip - Plant Quarantine Service, Sana'a. Eng. Abbas Ali Abdul Ghani, MAF; Dr. Abdul Hamid Majid, HBA

10:00 a.m. German Plant Protection Project, Sana'a, Eng. Abbas Ali Abdul Ghani, MAF; Dr. Abdul Hamid Majid, HBA; Eng. Ali Ali Masoud, GPP, Dr. Raman Revri, GPP; Agr. Eng. Nageeb al-Asbahi, GPP; Eng. Monawar al-Saghir, GPP, Agr. Eng. Hassan Suliman, GPP; Eng. Abdul Raqeeb al-Ayani, GPP; Mr. Abdul Majid Saleh, GPP.

11:30 a.m. MAF Horticulture Dept. HITS Program Review, Discussion-Zaid Abdul Rahman. Quebedeaux, Arnold and Bishay

1:00 p.m. Visit of Private Sector Nursery (Green Valley Nursery). Dr. Aasem Shaltout, Dr. Abd. al-Hamid Majid, HBA; Eng. Zaid Abdul Rahman, MAF; HITS Evaluation Team

4:30 p.m. Return to Hotel

Mon, Mar 5

7:30 a.m. Quebedeaux, Arnold, Bishay, travel to USAID Office

8:00 a.m. Field trip to Dhamar, HITS Evaluation Team Fruit tree demonstration plots (Kaa locations, al-Kaed and al-Nakheel Yesleh, Mohamed Alu Saad, Farmer Saah Ali Saad)

British Rasaba Fruit extension project (Eng. Abdulla Amer, BRFEP, Mr. David Jackson, BRFEP, Mr. Tony Portman, BRFEP, Dr. Abdul Hamid Majid, HBA; Mr. Abdul Hafiz Ali Ghalib, MAF

1:00 p.m. Dhamar, Agricultural Research Authority (ARA) Mr. Mohie al-Dean Ghoury, technical Director, Dr. Hussein al-Ward, Head of Plant Research Division; Dr. Abdul Hamid Majid, HBA, Mr. Abdul Hafez Ali Ghalib, MAF.

4:00 Return to Hotel

7:30 Meet with Dr. Hussein al-Ward (ARA) Head Plant Research Division. Quebedeaux, Bishay and Arnold

11:15 Return to Hotel

Tues, Mar 6

7:30 a.m. Quebedeaux, Arnold, Bishay - Travel to USAID

8:00 a.m. Reading of files and documents

12:30 Bishay, MAF - Water Resource Dept and Irrigation, Eng. Hussein el-Faqeh, Director General, MAF; Eng. Abdul Hakeem M. Farra, MAF; Eng. Mortada A. Abdul Rab, MAF, Agr. Eng. Eskandar Thabet, MAF, Eng. Sadek Noman, MAF; Eng. Nasr al-Ghoorairy, USAID.

2:00 p.m. Quebedeaux and Arnold meet with Dr. Abdul Majid-TDY reports.

2:30 p.m. Quebedeaux, Arnold, and Bishay prepared and discussion an outline of HITS evaluation report.

4:00 p.m. Return to Hotel

Wed, Mar 7

7:30 a.m. Quebedeaux, Arnold and Bishay - Travel to USAID Office

8:00 a.m. Reading of HITS files and documents

4:00 p.m. Return to Hotel

7:00 p.m. HITS team planning meeting - priorities for field trip.

Thur, Mar 8

8:00 a.m. Quebedeaux, Arnold and Bishay - Travel to USAID Office

10:00 a.m. MAF/Dept. of Rural Women Development, Mrs. Hayat al-Gershi.

12:00 noon Meeting with Minister of MAF - postponed.

1:00 Reading of HITS files and documents

4:00 p.m. Return to Hotel
6:30 p.m. Reception at Residence of Dr. John Swanson -
informal discussion with MAF and USAID
personnel

Fri, Mar 9 Weekend, Review project documents

Sat, Mar 10

6:45 a.m. Quebedeaux, Arnold and Bishay. Depart Hotel
for 3 day field trip to Hodeidah, Tihama,
Development Authority, al-Jarouba Station,
Demonstration plots, project nurseries and
Southern Upland Rural Development Authority
and the ARA station in Taiz. Travel with MAF
staff, Zaid Abdul Rahman, Abdul Hafiz, Ali
Ghalib and USAID Staff - Jonathan Addleton,
Nasr al-Ghoorairy
9:00 a.m. Visit fruit demonstration plot near Sana'a.
Quebedeaux, Arnold, Bishay visiting
al-Shaabi Demonstration field with Abdul
Hafiz, Ali Ghalib, Mohamed Sharaf el-Din,
Jonathan Addleton and Nasr al-Ghoorairy.
3:30 p.m. Arrive Hodeidah - Office visit to Director
General, TDA; Abdul Mommen Hazza, TDA.
4:30 p.m. Hotel - Hodeidah
6:00 p.m. Visit fruit and vegetable markets - Hodeidah.

Sun, Mar 11

6:00a.m. HITS Evaluation Team depart Hotel - Travel to
TDA, (Zabid) and al-Jarouba Station.
8:00 a.m. Quebedeaux, Arnold, Bishay, Zaid Rahman, M.
Sharaf al-Din, Abdul Hafiz, Ali Ghaleb,
Jonathan Addleton, Nasr al-Ghoorairy, Abdul
Mohamed Seif, Abdul Baki al Haddah, Nadia
Abbas Helmi, Nashtan Ahmed, Saif Abdou Saif,
Sharaf al-Qahlami, Abdul Raquib Ali Mohamed,
Mansour Hassan, Abdou Hassan, Hamoud Saif
Nasr, Gamal Sallam, Mohamed Sultan, Anisa
Mohamed al-Faqih, Rokaia Mohamed.
11:30 a.m. Quebedeaux, Addleton and al-Ghoorairy visit
with TDA headquarter staff - Hodeidah - Abdul
Momen Hazza, Director General, TDA, Jaafar
Alawi al-Jeffrey, Deputy Director of
Agriculture and Musa Ahmed allagabo - Hort.
Specialist.
2:30 p.m. Bishay follow-up meeting with TDA (Zabid)
3:00 p.m. Evaluation Team travel to Taiz
7:00 p.m. Arrive Taiz Hotel

Mon, Mar 12

7:00 a.m. Evaluation Team Depart Hotel
9:00 a.m. Visit to Southern Upland Regional Development Authority (SURDA) and the station of the Agricultural Research Authority (ARA) in Taiz. Quebedeaux, Arnold, Bishay, Zaid A. Rahman, Abdul Hafiz, Ali Ghalib, Jonathan Addleton, Nasr. al-Ghoorairy, M. Sharaf al-Din, SURDA staff namely: Lutf al-Ansi, Abdul Wahab Allam,

Abdul Hamed Sharshar, Abdul Rahman Abdul Latif and ARA staff namely: Ali al-Thor, Abdou al-Khatib, Abdul Rahman Abdul Latif, Ali Abdullah and Abdou M. Abdou
12:30 p.m. Taiz, Visit Ibb School and the Bubbler Irrigation Plots. Quebedeaux, Arnold, Bishay, Zaid A. Rahman, Abdul Hafiz Ali Ghalib, Jonathan Addleton, Nasr al-Ghoorairy, M. Shaif al-Din, Gamal al-Din Rassam, Abdullah al-Dabii.
6:30 p.m. Return to Sana'a, Hotel

Tues, Mar 13

7:30 a.m. Quebedeaux, Arnold and Bishay - Travel to USAID Office.
9:30 p.m. Evaluation Team - Visit to MAF in Sana'a - Interim Oral Briefing to MAF. Agricultural Affairs and Horticulture Dept. Abdul Hafiz Karhash, (Director General), Zaid Abdul Rahman, Head of Horticulture Dept., Abdul Hafiz ali Ghalib, MAF Counterpart.
12:30 p.m. HITS Evaluation Oral Briefing to MAF - Plant Protection, Director, Mohamed al-Ghashm.
1:30p.m. Return to USAID Office - review of HITS project documents.
4:00 p.m. Return to Hotel
7:00 p.m. HITS Evaluation team - meeting Quebedeaux, Bishay, Arnold.

Wed, Mar 14

7:30 a.m. Travel to USAID Office
8:00 a.m. Review of project documents, reports
2:30 p.m. HITS evaluation team meet with USAID: John Swanson and Nasr al-Ghoorairy for Interim Oral Briefing
4:00 p.m. Return to Hotel

Thur, Mar 15

8:00 Quebedeaux - travel to USAID office. Arnold and Bishay - Hotel - further review of project documents - Research and extension
4:00 p.m. Return to Hotel.

Fri, Mar 16 Weekend. Review project documents

Sat, Mar 17

7:30 a.m. Quebedeaux travel to USAID - review documents and drafting report.
Arnold and Bishay - Hotel - review documents and drafting report.
4:00 p.m. Return to Hotel

Sun, Mar 18 Quebedeaux, Arnold and Bishay Hotel - Team discussions and drafting report. Meet with Nasr al-Ghoorairy regarding schedule.

Mon, Mar 19

7:30 a.m. Quebedeaux travel to USAID review document and drafting report Arnold - Hotel - Review documents and drafting report. Bishay - field trip to ARA and meeting with Mr. A. Sallam and Mr. al-Ghori
4:00 p.m. Return to Hotel
6:00 p.m. Quebedeaux, Arnold and Bishay meeting with Dr. al-Bargougi the Director of a California/Egypt Horticulture Project.

Tues, Mar 20

7:30 a.m. Quebedeaux, Arnold and Bishay travel to USAID. Drafting report.
11:00 a.m. HITS Evaluation team meet with USAID for oral briefing report with John Swanson, Nasr al-Ghoorairy, Jonathan Addleton, Abdel Moustafa
4:00p.m. Return to Hotel

Wed, Mar 21

Qubedeaux, Arnold and Bishay - hotel - evaluation team discussions and drafting report.

Thur, Mar 22

8:20 a.m. Quebedeaux, Arnold and Bishay travel to USAID office - informal discussions with USAID - John Swanson and Abdel Moustafa. Evaluation team discussions and drafting report.

8:00 p.m. Presented the Draft Report to USAID staff. Return to Hotel.

Fri, Mar 23

Team discussions and preparation for the production of the Final Report.

Sat, Mar 24

7:30 a.m. Quebedeaux, Arnold and Bishay received comments from the USAID staff and discussions were held with Swanson, Addleton and Moustafa.

11:00 a.m. Bishay delivered three draft copies to MAF officials.

11:30 a.m. Quebedeaux, Arnold and Bishay incorporate the USAID comments in the Draft Report.

7:00 p.m. Return to Hotel

Sun, Mar 25

7:30 a.m. Quebedeaux, Arnold and Bishay continue incorporating the USAID comments in the Draft Report.

Mon, Mar 26

9:00 a.m. Quebedeaux, Arnold and Bishay meeting with
until MAF staff: Abdul Hafiz Karhash, Zeid, El-
12:30 p.m. Ghashm, Nabil A. El-Amsi, Gameal M. Ahmed. Also, J. Swanson, A. Mustafa and N. El-Ghouriri from the USAID Yemen attended the meeting that was arranged to discuss the MAF comments on the draft report.

2:00 p.m. Quebedeaux, Arnold and Bishay meeting with
until the USAID staff: K. Sherber, J. Swanson, J.
4:00 p.m. Addelton, A. Mustafa, K. Siddik, N. Al-Ghouriri, and Abullah Ben Yehia. Discussions on the AID comments were held.

Tues, Mar 27

8:00 a.m. Quebedeaux, Arnold and Bishay working on
until incorporating the comments received and
4:00 p.m. preparing the matrix needed.

Wed, Mar 28

4:00 a.m. Quebedeaux, Arnold and Bishay leaving Yemen
to USA.

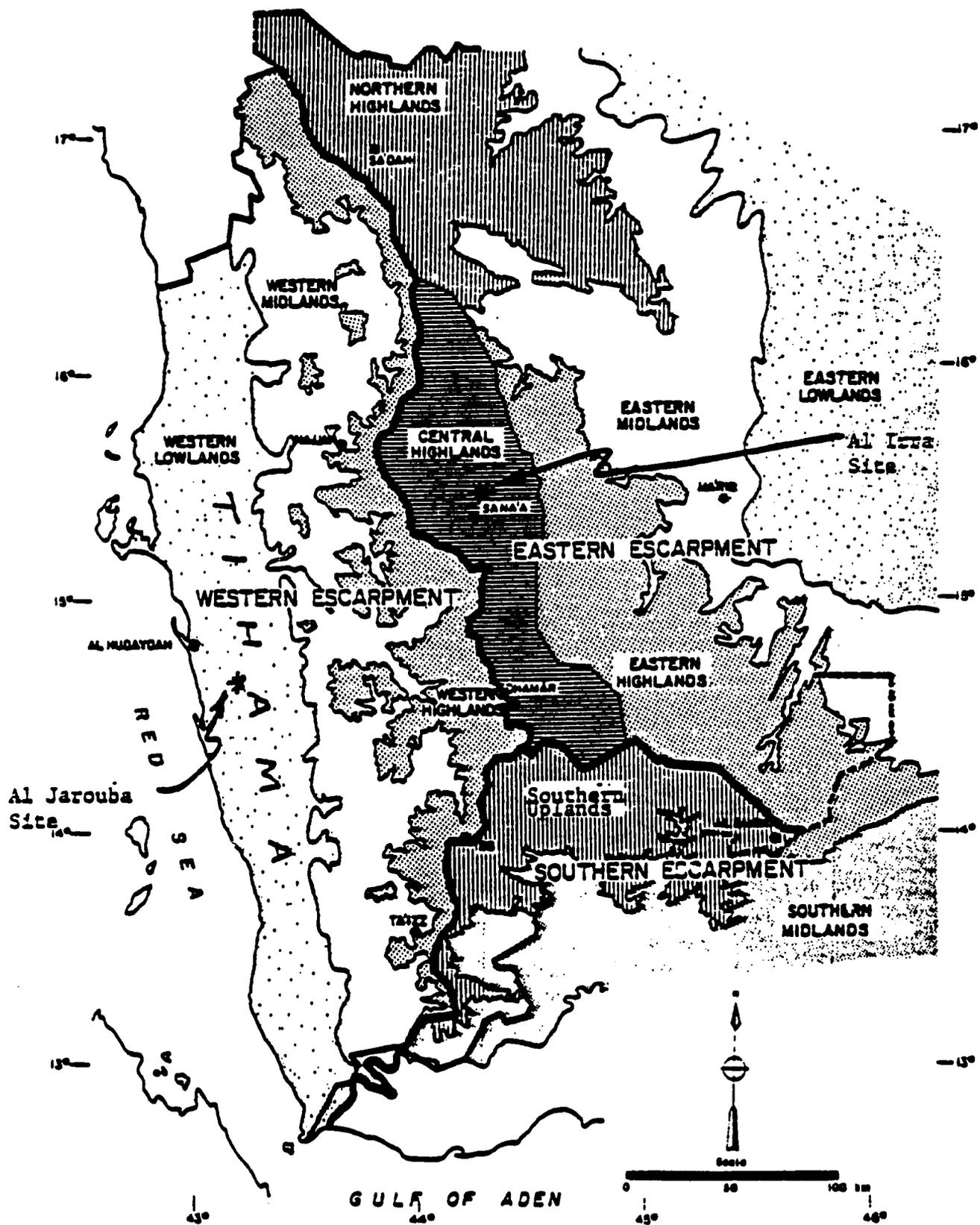
7:15 p.m. Sanna'a - Paris - New York - Washington, D.C.
Arive Washington

8:30 p.m. Arrive home

ANNEX H
MATRIX OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

FINDINGS	CONCLUSIONS	RECOMMENDATIONS	
RESEARCH	<p>The HITS Project established the Al-Irra Station and rehabilitated the Al-Jarouba Station. The stations imported plant materials and propagated seedlings. The fruit trees were not planted in randomized replicated plots. The Al-Irra Station is still in good shape, while Al-Jarouba Station has been dramatically deteriorating.</p>	<p>The HITS Project did not emphasize research and did not establish a strong research linkage with the Agricultural Research Authority. The ARA has a reasonable number of research scientists with Ph.D., M.Sc., and B.Sc. degrees and have produced research results with suitable experimental design.</p>	<p>A plan for developing research resources was prepared. The formulation of a priority research plan for the FPP is recommended. The plan includes research programs on irrigation, development of surface water and groundwater resources, establishment of a tissue culture facility, post-harvest, handling, grading, storing, packing, fruit variety evaluation, improved cultural practices, nursery propagation technology, plant protection and alternative fruit crops. Optimum external and internal linkages for the transfer of research results were suggested. Research monitoring is recommended.</p>
EXTENSION	<p>Extension services are very disbursed in YAR. The HITS extension activities included the establishment of 36 Demonstration Plots, distribution of fruit plant materials, 32 in-country training programs, the training of five MAF staff in the USA to obtain Ph.D. and M.Sc. degrees in Horticulture science, and the production of printing materials and displays. The MAF extension services lacks a suitable extension methodology.</p>	<p>The field agents of the MAF extension services (including those working in the HITS Project) are poorly qualified, functioning without clear job descriptions, and lack transport facilities as well as supplies for demonstration. The low literacy rate among Yemen's farmers is creating some doubt of the usefulness of printed material provided. The availability of TV sets for farmers is making the displays very effective.</p>	<p>The Training & Visit System for Rural Extension has been recommended for the FPP Project. A plan to upgrade the professional skills of extension workers through improved work conditions, provision of appropriate training and the promotion of a monitoring and evaluation system was recommended. Suggested allocations of extension resources were indicated. The FPP Project should establish linkages between extension, research, extension clients, and extension input suppliers.</p>
NURSERY DEVELOPMENT	<p>Al-Irra and Al-Jarouba stations have a good germplasm repository. Ten varieties of peaches, 2 of nectarines, 3 of apples and 2 of plums appear promising. The most promising tropical fruit varieties are yet to be determined. Limited studies were initiated to identify superior local varieties. MAF increased the price of trees which encouraged private sector investments. The HITS project extensively surveyed YAR nurseries. Most HITS inputs on nursery improvement were directed toward MAF nurseries instead of the private sector. The MAF still needs sound production technology packages. MAF is developing a plant certification program for nurseries.</p>	<p>The HITS is credited with the introduction of a number of productive fruit varieties. However, with a duration of 7 years, HITS should have established randomized and replicated plots of these varieties.</p> <p>Management training for MAF personnel involved in nursery operations was inadequate. The HITS made a significant contribution on detailed surveys of MAF nurseries.</p> <p>HITS concern to meet YAR quotas for nursery plant production was not compatible with the HITS project paper. USAID should not have agreed to this shift in project emphasis.</p>	<p>The stations at Al-Irra and Al-Jarouba should be the main sources of new germplasm for the private sector. Technical packages extended to private nurseries should be initially adapted from other countries and when reliable research results become available, they can be incorporated into the technical packages.</p> <p>The development of a nursery plant certification program by HITS is commendable. It must be coordinated between the plant protection and the horticulture departments of MAF. FPP should support the nursery plant certification programs.</p> <p>Nursery operations at Al-Irra and Al-Jarouba stations should be strengthened as a model for T&E purposes. The FPP should provide in-country and out-of-country training. Women should receive specialized training on certain horticultural operations such as propagation.</p> <p>No additional USAID funds should be spent to upgrade MAF production</p>

MAP OF YEMEN



Yemen Arab Republic Showing Agricultural Regions

MATRIX OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

	FINDINGS	CONCLUSIONS	RECOMMENDATIONS
RESEARCH	The HITS Project established the Al-Irra Station and rehabilitated the Al-Jarouba Station. The stations imported plant materials and propagated seedlings. The fruit trees were not planted in randomized replicated plots. The Al-Irra Station is still in good shape, while Al-Jarouba Station has been dramatically deteriorating.	The HITS Project did not emphasize research and did not establish a strong research linkage with the Agricultural Research Authority. The ARA has a reasonable number of research scientists with Ph.D., M.Sc., and B.Sc. degrees and have produced research results with suitable experimental design.	A plan for developing research resources was prepared. The formulation of a priority research plan for the FPP is recommended. The plan includes research programs on irrigation, development of surface water and groundwater resources, establishment of a tissue culture facility, post-harvest, handling, grading, sorting, packing, fruit variety evaluation, improved cultural practices, nursery propagation technology, plant protection and alternative fruit crops. Optimum external and internal linkages for the transfer of research results were suggested. Research monitoring is recommended.
EXTENSION	Extension services are very disbursed in YAR. The HITS extension activities included the establishment of 36 Demonstration Plots, distribution of fruit plant materials, 32 in-country training programs, the training of five MAF staff in the USA to obtain Ph.D. and M.Sc. degrees in Horticulture science, and the production of printing materials and displays. The MAF extension services lacks a suitable extension methodology.	The field agents of the MAF extension services (including those working in the HITS Project) are poorly qualified, functioning without clear job descriptions, and lack transport facilities as well as supplies for demonstration. The low literacy rate among Yemen's farmers is creating some doubt of the usefulness of printed material provided. The availability of TV sets for farmers is making the displays very effective.	The Training & Visit System for Rural Extension has been recommended for the FPP Project. A plan to upgrade the professional skills of extension workers through improved work conditions, provision of appropriate training and the promotion of a monitoring and evaluation system was recommended. Suggested allocations of extension resources were indicated. The FPP Project should establish linkages between extension, research, extension clients, and extension input suppliers.
NURSERY DEVELOPMENT	Al-Irra and Al-Jarouba stations have a good germplasm repository. Ten varieties of peaches, 2 of nectarines, 3 of apples and 2 of plums appear promising. The most promising tropical fruit varieties are yet to be determined. Limited studies were initiated to identify superior local varieties. MAF increased the price of trees which encouraged private sector investments. The HITS project extensively surveyed YAR nurseries. Most HITS inputs on nursery improvement were directed toward MAF nurseries instead of the private sector. The MAF still needs sound production technology packages. MAF is developing a plant certification program for nurseries.	The HITS is credited with the introduction of a number of productive fruit varieties. However, with a duration of 7 years, HITS should have established randomized and replicated plots of these varieties. Management training for MAF personnel involved in nursery operations was inadequate. The HITS made a significant contribution on detailed surveys of MAF nurseries. HITS concern to meet YAR quotas for nursery plant production was not compatible with the HITS project paper. USAID should not have agreed to this shift in project emphasis.	The stations at Al-Irra and Al-Jarouba should be the main sources of new germplasm for the private sector. Technical packages extended to private nurseries should be initially adapted from other countries and when reliable research results become available, they can be incorporated into the technical packages. The development of a nursery plant certification program by HITS is commendable. It must be coordinated between the plant protection and the horticulture departments of MAF. FPP should support the nursery plant certification programs. Nursery operations at Al-Irra and Al-Jarouba stations should be strengthened as a model for T&E purposes. The FPP should provide in-country and out-of-country training. Women should receive specialized training on certain horticultural operations such as propagation. No additional USAID funds should be spent to upgrade MAF production

SCOPE	FINDINGS	CONCLUSIONS	RECOMMENDATIONS
<p>PEST MANAGEMENT</p>	<p>The HITS project increased awareness and understanding of Integrated Pest Management (IPM) in the General Directorate for Plant Protection (GDPP).</p> <p>The GDPP plant quarantine program had a minor effect on pest problems in YAR. There are few qualified plant inspectors in MAF. GDPP is effectively utilizing the computer furnished by HITS and CORE for word processing to produce pest management schedules, pest control recommendations, etc.</p> <p>Citrus in Yemen is seriously infected with bacterial canker, greenings disease, a virulent strain of tristeza, red scale and mites.</p> <p>There is a critical shortage of trained pest management specialists needed to implement the IPM programs.</p> <p>HITS conducted useful surveys to identify the major plant pests in YAR regions and it provided equipment and technical assistance to establish a disease diagnostic lab in collaboration with GTZ.</p> <p>Essential inspection facilities are lacking at the various ports-of-entry and infected and infested samples intercepted are transported to Sanaa rather than being destroyed at ports-of-entry.</p>	<p>The IPM principles learned in relation to fruits can be modified and applied to other crops. IPM programs can be sustained if the recommended inputs are provided and the required changes implemented.</p> <p>GDPP is to be commended for efforts in formalizing a law concerning movements of plants and fruits within YAR.</p> <p>It will be very difficult for YAR to significantly increase production of quality citrus unless canker, greenings, and tristeza are controlled. HITS produced good TDY advice on the control of canker, red scale and mites, but little progress was made toward implementation. Several counterparts who received inspector training through HITS, have left the project. Plant quarantine regulations are lacking cooperation from customs and police.</p> <p>The credibility of HITS was damaged when crown gall was introduced on peaches at the Al-Ira station.</p>	<p>Strengthening MAF plant quarantine and plant protection programs is one of the most urgent needs for sound development of the YAR fruit industry.</p> <p>An IPM specialist under the FPP is needed.</p> <p>Additional computers and accessories plus training of operators should be provided to GDPP.</p> <p>YAR regulations which hamper the importation of selected safe pesticides should be changed. FPP must assist the GDPP to develop biological control techniques. A national plan must be developed to control canker, greenings, and tristeza diseases of citrus. Priority should be given to keep the northern and eastern regions free from canker.</p> <p>The new FPP pest management program should give priority to the control of citrus red scale and mites. Support must be provided to GDPP to construct an insectary. USAID should encourage GDPP to hire six more plant inspectors. Facilities at the ports-of-entry such as storage rooms and incineraries must be constructed and plant quarantine regulations should be widely publicized through mass-media.</p>
<p>INSTITUTIONAL BUILDING AND SUSTAINABILITY</p>	<p>The MAF Department of Horticulture helped establish four private sector nurseries. Nursery production in YAR increased during the HITS period from 12,000 to 80,000 budded trees and by the end of 1991 YAR will produce all its own fruit seedlings.</p> <p>The MAF Horticulture Department remains deficient in training and staffing. Several of its staff trained for long term in the U.S. through HITS, have been assigned upon their return to donor programs rather than MAF.</p> <p>The limited research conducted by the HITS project, makes it difficult to identify appropriate technological packages for horticulture crops in YAR.</p> <p>Current market conditions favor private sector involvement and the MAF is adopting a healthy transition from public to private sector. Redirection of the HITS project from research toward tree production reduced project effectiveness and sustainability.</p>	<p>The HITS project is credited with the establishment of Al-Ira and Al-Jarouba fruit stations although these facilities are marked by serious management problems. The HITS project encouraged the production, importation and distribution of insect and disease-free fruit trees.</p> <p>MAF sustainability of the IPM program on California red scale of citrus and mites on deciduous fruit trees is high. The private sector has an excellent opportunity in the propagation of fruit trees. Improved fruit varieties imported and tested by the HITS project encouraged the initiation and expansion of private orchards in YAR.</p>	<p>Continued USAID, MAF and TDA schedule phase-down support of Al-Ira and Al-Jarouba stations under the FPP is needed to ensure sustainability. Strong applied research programs with direct linkage with ARA need to be developed. Variety test plots need to be maintained along with continued evaluation of promising varieties and development of technical packages of information. Tree seedlings production from the two stations should be reduced and transferred to the private sectors. YAR should concentrate on the development of a sound fruit industry based on fresh fruit for domestic consumption. After better varieties are produced, fruit grades and standards should be developed. Information and recommendations on post-harvest handling, packing and storing require strengthening. More stringent cultural practices are needed. The FPP should support the development of several tissue culture laboratories at the stations in order to increase program effectiveness and sustainability.</p> <p>The horticulture subsector assessment needs to be updated in 1990.</p>