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PROJECT EVALUATION SUMMARY (PES) — PART I

Report Symbol U-447

1. PROJECT TITLE	2. PROJECT NUMBER	3. MISSION/AID/W OFFICE
279-0024 Tropical and Subtropical Fruit Improvement	279-0024	Sanaa, YAR

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) 82-2

☐ REGULAR EVALUATION ☒ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES	6. ESTIMATED PROJECT FUNDING	7. PERIOD COVERED BY EVALUATION
A. First PRO-AG or Equivalent FY 76 B. Final Obligation Expected FY 81 C. Final Input Delivery FY 81	A. Total. $ ____ B. U.S. $ 1,904	From (month/yr.) July 1977 To (month/yr.) July 1981 Date of Evaluation Review August 1981

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
Project 279-0024 will officially terminate 12/31/81. The Mission concurs with RONCO Consulting Corporation, Evaluation Report Findings in Section VII, "Recommendations", beginning on Page VII.9. The recommendations are being incorporated into final PP design in the Agricultural Development Subproject in Horticulture currently underway. Salvagable and useful activities under the 0024 project have already been subsumed under Project 279-0052 being implemented by the Consortium for International Development (CID).		

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9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

- ☐ Project Paper
- ☐ Financial Plan
- ☐ Logical Framework
- ☐ Project Agreement
- ☐ Implementation Plan e.g., CPI Network
- ☐ PIO/T
- ☐ PIO/C
- ☐ PIO/P
- ☒ Other (Specify) New project ~~under design~~
- ☐ Other (Specify) _____

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

- A. ☐ Continue Project Without Change
- B. ☐ Change Project Design and/or ☐ Change Implementation Plan
- C. ☒ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

Dwane Hammer, Project Officer
Theodor E. Bratrud, Evaluation Officer
Pat Peterson, ADO
Mohammed Sharaf al-Din YARG (MOA)

12. Mission/AID/W Office Director Approval

Signature: Charles D. Ward
Typed Name: Charles D. Ward, Director
Per

EVALUATION
TROPICAL AND SUB-TROPICAL FRUIT IMPROVEMENT PROJECT

YEMEN

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July 1981

EVALUATION

TROPICAL AND SUB-TROPICAL FRUIT IMPROVEMENT PROJECT

YEMEN

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EXECUTIVE SUMMARY

This review of the Tropical and Sub-Tropical Fruit Improvement project in Yemen (No. 279-0024) comes five years after signature of the Project Agreement.

An implementing contract was not concluded until ten months after that (May 1977). Under the contract, services were to end in December 1979. A contract team was not in place, however, until the Fall of 1978, and not functioning normally until early 1979. In April 1979, the contract was extended to September 1981.

The negative effects of delay have been lasting. Principally, the project suffered a loss of "credibility," which accounts in part for the YARG's (Government of the Yemen Arab Republic) reluctance to commit its people to the undertaking. Morale suffered. It became difficult to coordinate project inputs.

Our findings with respect to AID's performance in organizing the project would support the following statements.

- Faced with the dilemma that no bids were received for the implementing contract, AID sought out and accepted a contractor whose qualifications were known to be limited in this field.

- AID funding of the project was adequate in amount; but allotments and authorizations to spend were made in a fashion that inhibited orderly forward planning.

- It is a credit to the AID Mission's sense of responsibility that it accepted the burden of mobilizing and coordinating YARG contributions to the project; but it was not successful, on the whole, in doing so.

- Working in difficult circumstances, the AID Mission was slow and inefficient in completing the physical development of the research stations.

- AID/Washington can be faulted for discontinuity in staffing for project management.

- Until recently, relations between the AID Mission and the Contractor were strained. Small problems were allowed to fester. Lack of operational budgets hindered orderly planning; responsibilities overlapped.

- The AID Mission's management of the project has improved over the last half year, with the resolution of a number of administrative problems. The physical condition of the stations is fair. The Mission and the Contractor have responded effectively to YARG's interest in plant dissemination.

YARG was prompt in allocating land for the research stations, but both sites had serious disadvantages. It did not live up to its commitment to assign project counterparts, to make personnel available for training, and to insure a regular supply of project labor. It also cancelled planned socioeconomic studies designed

to provide a context for future development of horticulture work. The YARG's principal interest in the project was short-term dissemination, rather than long-term testing, of imported tree varieties. This put it at cross-purposes with the original concept of the project as primarily a research activity. The project having responded to this interest, YARG appears more inclined to support it.

Our findings with respect to the Contractor including the following:

- It has performed with dedication within the limits of its own capacities and the constraints of the working environment.

- It contributed to (but was not the sole cause of) delay in the posting of a contract team.

- The Contractor lacked the experience and the on-campus and on-site scientific qualifications to meet its contract responsibilities in full. For example, systematic records of plantings and tests were not kept.

- While having fallen short in research work, the Contractor did make the required reports; did prepare adequately for socioeconomic studies (preparations that can be utilized in the future); and is now caring in a highly improved manner for ongoing work at the research stations.

The purpose of the project was to "create the potential for future institutionalization of horticulture work in Yemen..." through the establishment of research stations, personnel training, testing and dissemination of improved technology, collaboration with other agencies in a research "network," and so forth.

A number of deciduous and tropical varieties are being tested at stations created by the project and at several "outreach" sites (governmental and private). However, research activity as a whole has been limited, including work on improved cultural practices. Other project activities such as training have been neglected. The stations themselves represent the principal achievement in "institutionalization."

The project has had no measurable effect on sector goals concerning crop diversification, farm income, and nutrition.

A number of recommendations are made in connection with redesign and extension of the project. Major themes include:

- Build on project achievements, however limited. An entirely new start would be wasteful.

- Recognize and adapt to the fact that top faculty will seldom accept two-year assignments taking them away from their professional career ladders.

- Raise sights on contract team staffing, in a wider range of functions.

- A balanced research/dissemination program is desirable, with improved research techniques and development of nurseries for propagation.

- Consider ways to move the government toward greater participation in the project.

- Devise ways to transfer project management responsibility to the Contractor.

- Coordinate project research with horticultural research elsewhere.

- A fresh effort should be made to initiate in-country, third country, and U.S. training.

I. INTRODUCTION

ORIENTATION IN TIME

The present evaluation of the Tropical and Subtropical Fruit Improvement project (No. 279-0024) comes five years to the month after signing of the Project Agreement and three months prior to the scheduled end of the project.

It is the first full evaluation to be undertaken. An in-house AID Contractor Performance Evaluation was made in July 1978. Annual Project Appraisal Reports were done in July 1977 and 1978, but not since.

TERMS OF REFERENCE

Ronco's Scope of Work stipulated that we were to:

- review the adequacy of inputs;
- evaluate the performance of AID, the Contractor, and the YARG;
- assess achievements at the objectives (output) level;
- evaluate the extent to which the project had achieved its stated purpose and contributed to the sector goal; and
- make recommendations for the further development of horticulture work in Yemen.

As a standard or baseline for the evaluation, we have used the original Project Paper (PP) prepared in 1976. There was

no other. A PP revision to reflect delay in project implementation and important substantive changes was proposed in 1978, but not carried out.

FORMAT

In presenting the material, we have followed the usual Input/Output/Purpose/Goal sequence. Evaluations of the performance of the three parties are included as subtopics of the input section. The Scope of Work calls for remarks on the realism of project objectives and indicators of achievement set forth in the PP Logical Framework. These are included in a discussion of purpose-level achievement.

The Scope of Work includes a series of specific output questions having to do with the ultimate effect the project might have had on farmer technology, extension work, and YARG horticultural management if it had been implemented on schedule over the full range of planned activities. In view of the project's extremely limited overall achievement and the lack of achievement in areas to which the questions apply, we have, in most cases, treated them not as separate topics but as remarks under other headings. The questions, which are treated briefly in Section V Objectives Level (Outputs), were:

. Extension:

1. project influence on extension work;

2. information available to farmers on caring for fruit trees;

3. Ministry of Agriculture manpower and training; and

4. phyto-sanitary controls.

. Research

1. future utilization of high yielding varieties; and

2. how introduction of new cultural practices has (or has not) influenced farming techniques.

. Distribution

1. improved nursery and orchard management practices.

SPAN OF EVALUATION WORK

The evaluation team made a brief orientation visit to the campus of Tuskegee Institute (the implementing contractor) on June 4-5, 1981. It was in Yemen from June 10-July 2.

An exit conference was held with the USAID Mission Director and Agricultural Officer on June 30.

A partial draft report was left with the Mission. This revised and final report was typed at the Ronco office in Washington, mailed to the Mission, and disseminated to AID/Washington.

II. METHODOLOGY

The evaluation consisted of three distinct stages:

. Planning and Orientation;

. Data Collection; and

. Synthesis and Writeup.

PLANNING AND ORIENTATION

The Ronco evaluation team met in the firm's Washington office to review the scope of work, generate a methodological framework, and develop an evaluation schedule.

The team then visited the Contractor's campus in Tuskegee, Alabama. Orientation meetings, over a period of a day and a half, were held with: the Director of International Programs; his administrative assistant; a faculty horticulturist formerly attached to the Institute's field team in Yemen; and a senior faculty horticulturist who had served as a consultant during the project's planning stage.

In Washington, the team was briefed by AID officials of the Near East Bureau's agricultural office, and by a former director of the AID Mission in Yemen.

In Tuskegee and Washington, the team collected a sizeable number of documents and reports, which it hand carried to Yemen.

Upon arrival at the AID Mission to Sanaa, the team was briefed by the Mission's Agricultural Development Office, the Project Manager, and the Contractor's Chief of Party. In this session, problems and issues of particular interest to the Mission, to which it suggested the team give priority attention, were identified.

DATA COLLECTION

Three methods were used in the collection of data: examination of documents; personal interviews; and direct observation. With all methods, objectivity was carefully adhered to and written and oral information was compared for possible contradictions.

Examination of Documents

Mission offices were closed during the second through the fifth days of the team's presence in Yemen. In this period, the team examined documents supplied in the U.S. Later in the week, reports and file documents supplied by the Mission were studied.

Interviews

Nineteen formal, semi-structured interviews (not including briefings)were held in Sanaa, Hodeidah, Taiz, Jarouba, and elsewhere in the Yemen Arab Republic, in addition to some 20 less formal interviews conducted in the same places. (See Table 1.)

Interviews ranged in duration from 15 minutes to two hours.

When possible, in the formal sessions, individuals were interviewed singly. In order to encourage candor, they were assured that no views or information would be attributed to them personally. Tape recorders were not used.

When appropriate, respondents were asked about their area of work, their connection with the project, and other matters giving perspective to their answers to particular questions.

To minimize subjectivity, quantitative and factual data were sought to cross-check controversial oral statements.

TABLE 1

INTERVIEWS

Date	Name	Title	Place	Interviewers
6/3-5	Luther Foster	President	Tuskegee Inst.	Hodson, Krezdorn, Broadnax
6/3-5	B. D. Mayberry	Dir., Int'l. Pgms.	Tuskegee Inst.	Hodson, Krezdorn, Broadnax
6/3-5	Fouad Basiouny	Faculty	Tuskegee Inst.	Hodson, Krezdorn, Broadnax
6/3-5	Anona Bulls	Admin. Asst., Int'l. Pgms.	Tuskegee Inst.	Hodson, Krezdorn, Broadnax
6/3-5	B. T. Whatley	Faculty	Tuskegee Inst.	Hodson, Krezdorn, Broadnax
6/8	Keith Sherper	Chief, Ag. Div.	AID/NE/TECH, Wash.	Hodson, Krezdorn, Broadnax
6/8	Jeffrey Lee	Agr. Div.	AID/NE/TECH, Wash.	Hodson, Krezdorn, Broadnax
6/8	Marx Sterne	Asst. Desk Off.	AID/NE/NENA	Hodson, Krezdorn, Broadnax
6/8	R. G. Huesmann	BIFAD Program	AID/NE/TECH	Hodson, Krezdorn
6/10	C. D. Ward	Director	USAID/Yemen	Hodson, Krezdorn, Broadnax
6/10	H. P. Peterson**	Chief, Ag. Dev. Off.	USAID/Yemen	Hodson, Krezdorn, Broadnax
6/10	Dwane Hammer**	Ag. Dev. Off.	USAID/Yemen	Hodson, Krezdorn, Broadnax
6/10	Mohd. Abubakar*	Ag. Technician	USAID/Yemen	Hodson, Krezdorn, Broadnax
6/10-14	Bruno Kosheleff	Program Officer	USAID/Yemen	Hodson, Krezdorn, Broadnax
6/10	Christopher Crowley	Desk Off. NE/NENA	USAID/Yemen	Hodson, Krezdorn, Broadnax
6/10	Robert S. Burford	Controller	USAID/Yemen	Hodson, Krezdorn, Broadnax
6/14	Don R. Merkley*/**	Chief of Party Tuskegee contract	Sanaa Gov. Ag. Off.	Hodson, Krezdorn, Broadnax
6/14	Sinedu A. Checole	Secretary - 024	Sanaa Gov. Ag. Off.	Hodson, Krezdorn, Broadnax
6/14	Yahaya Shuga	Dir. General	Sanaa Gov. Ag. Off.	Hodson, Krezdorn, Broadnax
6/15	Ali Noman Abdulla	Dir. Gen., Ag. Serv.	Min. of Ag.	Hodson, Krezdorn, Broadnax
6/15	Jami Issa	Horticulturist-024	Hodeidah, Jarouba	Hodson, Krezdorn, Broadnax
6/16	Ali Zoum	Dir. Gen. for Ag.	Hodeidah Governorate Ag. Office	Hodson, Krezdorn, Broadnax
6/16	Ahmed Mahdi	A/Dir. Gen. Ag.	Hodeidah Gov. Ag. Office	Hodson, Krezdorn, Broadnax
6/16	Abdoul Hakimini	Farm Manager	SURDUD Farm	Hodson, Krezdorn, Broadnax
6/16	Hussein Yassin	Chief. Horticul.	Jaraba Nursery	Hodson, Krezdorn, Broadnax
6/16	H. P. Peterson	Chief ADO, USAID/ Yemen	Hodeidah and Jarouba	Hodson, Krezdorn, Broadnax

*Accompanied Evaluation Team on field trip to Hodeidah, Jarouba, Jaraba, Taix and Ibb.

**Frequent interviews.

Date	Name	Title	Place	Interviewers
6/16	Douglas Newman	Emb. Econ. Officer	Jarouba	Hodson, Krezdorn, Broadnax
6/17	James Lenhart	Hort. Tech./CID	Jarouba	Hodson, Krezdorn, Broadnax
6/17		Sr. Extension Off.	Wadi Zebid	Hodson, Krezdorn, Broadnax
6/17		A/Ext. Off.	Wadi Zebid	Hodson, Krezdorn, Broadnax
6/17		A/Ext. Off.	Wadi Zebid	Hodson, Krezdorn, Broadnax
6/17	Jack King	Soil Scientist Cornell Univ.	Taiz, Yemen	Hodson, Krezdorn, Broadnax
6/18	G. S. Randhawa	Horti. (FOA) TDA	Central Ag. Res. Station/Taiz	Hodson, Krezdorn, Broadnax
6/18	Abdoul D.S. Hakani	Econ.-SURDP	Ibb Nursery	Hodson, Krezdorn, Broadnax
6/18	Abdoul S. Atia	Tech.-SURDP	Ibb Nursery	Hodson, Krezdorn, Broadnax
6/18	Ahmed Saidi	Tech.-AOAD	Ibb Nursery	Hodson, Krezdorn, Broadnax
6/18	Hashim Mohamed	Tech.-AOAD	Ibb Nursery	Hodson, Krezdorn, Broadnax
6/18	Musa Ali Gabo	Principal	Ibb Ag. Secondary Inst.	Hodson, Krezdorn, Broadnax
6/18	Amin Abu Shar	Agronomist	Ibb Ag. Secondary Inst.	Hodson, Krezdorn, Broadnax
6/18	Awadella Y. Hamid	Animal Husbandry	Ibb Ag. Secondary Inst.	Hodson, Krezdorn, Broadnax
6/18	Gasim Y. Hassan	Ag. Eng.	Ibb Ag. Secondary Inst.	Hodson, Krezdorn, Broadnax
6/18	Jim Muckleroy	Voc.Educ. Shop	Ibb Ag. Secondary Inst.	Hodson, Krezdorn, Broadnax
6/18	High Henderson	Chief of Party/CID	Min. of Ag.	Hodson, Krezdorn, Broadnax
6/10	Sunny Langham	Chief of Party/NMSU	USAID/Yemen	Hodson, Krezdorn, Broadnax
6/18	Allen Lee	Educ. Adv./CID	Sheraton Hotel	Hodson, Krezdorn, Broadnax
6/20	Ahmed Abubakr	Per. Officer	USAID/Yemen	Hodson, Krezdorn, Broadnax
6/20	Mohd. Sharif Addin	Horticul. USAID	Min. of Ag.	Hodson, Krezdorn, Broadnax
6/22	Ismail Gewaifel (Egypt)	Soil Expert IBRD, Taiz	Sheraton Hotel	Hodson, Krezdorn, Broadnax
6/22	Ali Kambal (Sudan)	Res. Agronm.-IBRD	USAID/Yemen	Broadnax, Hodson
6/23	Saffaa Al Nogomi	Horti. Adv.	Min. of Ag.	Hodson, Krezdorn, Broadnax
6/23	Ali Baraty	Dir. Hort.	Min. of Ag.	Hodson, Krezdorn, Broadnax
6/23	Kamal Mansour	Ag. Adv.-FAO	Min. of Ag.	Hodson, Krezdorn, Broadnax

Direct Observation

The team made a half day field trip in the Sanaa area, principally to inspect the project's Bir al Shaif Horticulture Research Station.

Later, it made a four-day field trip: (1) in the coastal Tihama region, to Hodeidah, Jaraba, Surdud, Zebid, and the Jarouba Research Station in Wadi Rima; and (2) in the Southern Uplands at Taiz and Ibb. The team visited and inspected government and internationally-sponsored research stations, horticultural production sites, various nurseries, the Ministry of Agriculture's regional office for the Governorate of Hodeidah, and the Ibb Agricultural Secondary Institute.

One member of the team made a third field trip, to the farm of a private grower who had received tree distributions from the project's Jarouba station.

SYNTHESIS AND WRITEUP

Data, impressions, tentative conclusions, and potential recommendations were discussed within the Ronco team to seek a consensus and increase the reliability of the findings.

Appropriate members of the team took primary responsibility for drafting particular sections of the report. Each reviewed and commented on the work of the others.

The team met with the Mission Director, the Agricultural Development Officer, and the Project Manager on June 30 to make an oral presentation of findings and to receive comments for incorporation in the final report.

A partial, draft report was left with the Mission prior to the team's departure from Yemen. This final report was edited and typed in Washington.

III. PROJECT HISTORY AND PLAN

U.S. assistance to Yemen's horticulture subsector was first discussed with the YARG in 1972, during the visit of an AID/ Washington country assistance planning team.

Project development proceeded slowly[1/] over the next four years. Technical background was provided by a 1974 sector study[2/]. Project designs were prepared and revised. A Project Paper was approved in mid-1976, followed by signature of a Project Agreement on June 29 of that year.

While no systematic appraisals had been made, it was assumed that conditions existed in Yemen - in its climate, its land and water resources, and the capability of its farmers - for substantial development of horticultural crops.

Data on demand, production, and imports of horticultural crops had been developed (for the period 1970-1974) which indicated the importance of developing domestic production. These included:

- a sharp upward trend in domestic demand;
- the fact that Yemeni farmers, responding to demand, were spontaneously expanding acreage and production; and, nevertheless,
- the fact that imports of these products were increasing at an even greater rate.

1/ In difficult political and security conditions. (The USAID Mission was closed during 1972-1974.)

2/ Dr. Taye Bezumeh, Prospects for Horticultural Development in the YAR.

Development of horticulture, it was argued, would address at least three national planning goals:

- improvement in the country's balance of payments position. With improved quality and marketing advantages, domestic output could compete with and eventually displace high quality imports;

- increased farm income - horticulture, properly practiced, yielding a high return to land and labor; and

- improved nutrition for the average consumer - when the price effect of increased supply was felt at local markets.

The original purpose of the project was: to create the base for future institutionalization of horticultural work in Yemen by testing and developing appropriate production technology for selected horticultural crops[1/] in two major geographical areas of Yemen.

Thus, the core of the plan was research - the introduction and testing of superior tree varieties and cultural practices.

Two research stations were planned - one for subtropical deciduous trees in the Northern Uplands and one for citrus and tropical fruits in the coastal lowlands of the Tihama.

1/ In final preparation, the scope of the project action was limited to fruit crops. Other donors were engaged in or planning to work with vegetable crops.

When possible, testing would also be done on land of cooperating farmers and government stations. The research stations might serve as demonstration centers; but it was not intended in the PP that the project would include a formal extension program. Nor was it clear the extent to which the project was to engage in distribution of internationally proven varieties.

As is essential to any research activity, complete and careful data were to be maintained, on plant accessions, location of plantings, cultivation practices being tested, and the progress of trees, on and off station.

Under a second project "track," field studies were to be carried out, to guide production technology and the fruit industry's development in general. Comparative studies were to be made of the economics of production of the different crops - conventional and improved - at the farm-unit level; and of the structure and requirements of marketing. Macro studies were to explore linkages between horticulture and the agriculture sector as a whole. Social "role" and "impact" studies were planned.

On a third "track," the project was to provide a limited amount of academic and practical training, under the heading of "institutional development." While YARG counterparts were to be assigned to the project, the direction of project operations was left to the U.S. contingent (the USAID and the implementing Contractor) during the life of the project. Thereafter, it was hoped, the Ministry of Agriculture would assume managerial, if not technical, responsibility.

Since the project was itself limited - geographically and in the varieties to be tested - it was considered important that the project cooperate and communicate systematically with other horticultural programs - those having FAO, World Bank, FRG, and other sponsorship; and those that were part of regional development schemes in the Tihama and the Southern Uplands. The goal, evidently, was to transform isolated research activities into a coordinated national system of horticultural research.

The project had been long in the planning stage. It now encountered problems and delays in arranging for an implementing (university) contractor and in fielding a contractor team. See Section IV.

A contract was signed with Tuskegee Institute, Tuskegee, Alabama, on May 12, 1977, ten months after signature of the Project Agreement.

After a series of nominations for Contractor field positions, and rejections of nominations, and withdrawals of candidates (see Section IV), the first contract team member arrived on December 19, 1977. However, it was not until September 1978 that a full three-man team was in place.[1/] Monotonous as it is to stress the delay factor, it is important to note that the full team's arrival came some 16 months after contract signing.

In early 1977, the YARG designated sites for establishment of the research stations - Bir al Shaif in Sanaa, for the Northern

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1/ The original contract called for one Senior Horticulturist and two Horticulturists. The first full team fielded consisted of two Horticulturists and one Field Technician.

Uplands; Jarouba, in the Tihama. The AID Mission made partial physical preparation at the sites. The first plantings of significance at Bir al Shaif were made in February and March of 1979. Delays in staffing and in completing the pumping and irrigation system delayed the first plantings at Jarouba until early 1980.

The Contractor and the AID Mission had been under pressure from the start of the project to speed up the dissemination of trees and seedlings. Accordingly, an order was placed and delivered in January 1981 for some 3,300 citrus trees. These were distributed to growers, in large part, and to government nurseries.

Thus, the dual character of the project - research (testing) and distribution - was fully established.

IV. PROJECT INPUTS

AID

Funding Inputs

Findings: Anticipated funding under the Project Paper is shown below, along with obligations and disbursements through May 1981, as reported by the Mission Controller Office ($000):

	Project Paper	Oblig. 5/31/81	Disbursement 5/31/81
Contract Services	452	1,029	671
Participants	336	52	2
Commodities	345	304	286
Other Costs	140	518	525
	1,273*	1,903	1,484

In large part, funding has been provided both to the contract and to other budget categories (controlled by the AID Mission) on the basis of developing needs, annually or more often. Revisions of Project Agreements and amendments of the services contract were made at intervals as necessary.

The expected duration of the original contract was two years and eight months (May 1977-December 1979). It was extended in April 1978, the project being far off schedule, to September 1981. Projected contract team man-months in the field were significantly increased by this change, despite the fact that the contract team arrived late. Continuing campus costs, a number of short-term

*Unaccountably, the approved Project Paper "face sheet" was not available. We understand that the actual authorization was less than the total shown.

team visits, and the assignment (in 1981) to the Contractor of costs in logistic support, also contributed to the increase in obligations over the original budget in this category.

Excepting in one case, overseas participant training was not carried out. The bulk of obligations for this purpose, we understand, are being de-obligated.

The increase in Other Costs is accounted for, largely, by two items not budgeted in the Project Paper: Logistic Support of the Contractor and Research Station Labor.

Commentary: AID has provided funds adequate for the requirements of approved activities. (Construction of an access road to the Jarouba research station was never authorized.)

The funding process was sporadic and irregular, however, in a series of Project Agreement revisions and contract amendments. Contractor personnel have complained with good reason that they were uncertain what monies were or would be available at a given time, in or outside the contract. The significance of this is that, in a project already off schedule and out of phase, it made more difficult the planning of even near-term operations.

Administration

Structures: Under the Project Paper concept, the AID Mission and the Agricultural Development Officer (ADO) in particular, had a comprehensive responsibility to organize, supervise, and coordinate the project. The Contractor was to work within the operational framework and guidance provided by the Mission, but with an undefined degree of autonomy within that framework.

Again, in relation to the YARG, the burden of action was on the AID Mission. The Ministry of Agriculture lacked staff; the Horticulture Division was manned, in effect, by a single professional; he had little training in horticulture and none in establishing a research program. Management skills were scarce.

It is important to note also that the project was designed to be a self-sufficient entity, standing apart from the Ministry of Agriculture's regular organization and having branches, in microcosm, of the Ministry's own subdivisions (finance, field station management, plant protection, etc.). Counterparts were not to retain their Ministry functions, but to be seconded full time to the project. The point of day-to-day interaction between Yemeni and expatriate personnel would be <u>within</u> the project, rather than in the relationship between the project and the Ministry.

The Mission's own personnel resources were limited - in numbers and in experience in comparable undertakings. Of the two positions responsible for the project, the ADO and the Project Manager, only the latter was concerned with this project alone.

Nor was the Mission able to maintain continuity in project management. The tours of the two incumbents who had worked on the project from the start ended before it was fully operational (in July 1979).

An interregnum followed, lasting over a year, in which the project was managed by a series of individuals on temporary duty or on loan from other AID divisions. A permanent replacement for the ADO was not posted until September 1980.

Activities: In discharging its responsibilities, the Mission operated in three spheres: with the government; in direct operations; and through the implementing Contractor.

Relations with the Government (YARG)

The principal Ministry of Agriculture (MOA) officials the AID Mission has dealt with, on the horticulture project, are: the Deputy Minister; the Director General of Agricultural Services, who is the government's responsible officer for this project; the Director of the Horticulture branch, a relatively junior official; the head of the Ministry's Foreign (project) Affairs, who has a long-standing interest in the project but many competing interests as well; the head of the MOA's office for the Governorate (region) of Sanaa (which includes the site of the Bir al Shaif research station); and, the latter's counterpart for the Governorate of Hodeidah (which includes the site of the project's tropical research station, Jarouba).

The last two officials monitor developments at the stations in their respective jurisdictions, sometimes interpose their views on issues and Contractor personnel matters, and have occasionally assisted the stations in minor ways. However, they have no administrative responsibility for them and have made negligible inputs to them. The other officials deal with the project only as problems are brought before them by the AID Mission or the Contractor.

There has been turnover in all the positions since the project began. Our impression is that present AID Mission/MOA relation-

ships are cordial, that no major issues divide them, and that, in this relationship, there is potential for productive collaboration in the future.

This was not at all true in the past. The Mission complained over the MOA's failures to act, and the MOA reminded the Mission of delays for which the U.S. side was responsible. By the testimony of both sides, the relationship was distant, if not cold. We infer from other sources that below all this was a kind of vacuum - the MOA unclear as to the nature and purposes of the project; both sides vague on how the activities were to be carried out in practice; undefined roles and responsibilities; jurisdictions tangled and overlapping; lines of communication and channels of authority unestablished, etc.

The YARG holding the (sovereign) authority, the AID Mission having the initiative, it is not surprising that MOA officials would complain, as they did in our interviews, that the Mission failed to consult it on actions pending. However, there is a distinct irony in that charge: the day-to-day relationship that would have existed in a jointly staffed project organization did not, in fact, exist, because the Ministry failed to assign staff to it.

One of the AID Mission's principal tasks as organizer of the project was to try to hold the government to its commitments, or what the AID Mission viewed as YARG commitments, and otherwise encourage government participation in the project. Contributions expected of the government were not massive - principally land,

project counterparts, candidates for training, and station labor.

In May 1977, the government did allocate land for the two sites, and the action was reasonably prompt, following signature of the Project Agreement in June 1976, and the Mission's urgings in January 1977. But both sites had actual or potential disadvantages (urban encroachment in one case, isolation in the other - see discussion in Section IV - YARG below) that waranted their rejection. At that stage, when no significant project investments had been made and when no action had been taken under the just-signed technical services contract with Tuskegee Institute, the AID Mission was still in a position to bargain forcefully for better locations, or, in the case of the isolated site, to insist on construction of an access road, as conditions of continued AID support of the project. The Mission steered away from confrontation.

The Mission has been no more successful in persuading the government to appoint project counterparts (one has served with the project, and he only briefly) and to nominate candidates for training.

It is true that the government's reserves of people qualified for project assignment, or training, were limited. However, this problem did not apply uniquely to the horticulture project, and other projects and other donors competing for government support, have had greater success.

Commentary: What explains the AID Mission's limited influence on the government in a competitive situation?

Leaving aside the period when the MOA is said to have been disillusioned with the project for lack of visible achievements (see YARG Inputs, below), we think there were at least four reasons.

1. The Mission was reluctant to use its leverage. Insistence on a high standard at the outset, in a resolute position on the land issue, might have impressed on the government that a research program of this type has rigorous requirements that must be met at each step of the way.

2. The Project Paper was not an agreement and the Project Agreement was not a plan. There is no evidence that the AID Mission and the MOA ever sat down to develop a thoroughgoing joint plan, with agreement on goals and priorities, and on a format of cooperation. (In the two or three planning sessions the MOA has had with the Mission and the Contractor, the topics were general and the treatment brief.)

3. Our review of the correspondence leads to a similar conclusion, that at the time it was calling on the MOA for collaboration in the project, the AID Mission dealt with the Ministry at arms length. The memoranda are abrupt and formal. Unfamiliar references (to Project Paper concepts, for example) are not explained. Written requests are not followed up with personal visits (and written replies, in translation at least, do

not seem apposite.) Project officials did not work at creating the kind of personal relationships in which they could best explain and argue their case.

4. The Mission was activist (to its credit); but its readiness to act may well have relieved pressure on the YARG to assume its responsibilities - for site development, for example.

AID Mission Direct Operations: Site Development

The principal tasks in developing the research station sites were land levelling, construction of irrigation systems and ancillary structures, and erection of fencing to prevent pilferage and animal incursion.

The Mission advised the government that it would commence this work upon allocation of the sites - an action taken in May 1977 - but it was not in fact ready to proceed for some time. The terms under which the MOA would supply labor were under discussion. Development of an irrigation plan awaited the Contractor's plan for plantings. Uncertainty as to equipment and materials requirements delayed procurement. (Some items were not ordered until well after the work began.)

In November, finally, the Mission notified the MOA that it would begin the work at Bir al Shaif, and, in December, that it was specifically committed to installing an irrigation network there.

The AID Mission's Horticulture Project Manager, an agricultural economist, directed the Bir al Shaif job, and site supervision was

provided by the Contractor's Horticulturist/Field Technician. Both were competent, but not specifically qualified for this work.

There were obstacles at each step. Labor arrangements proved unreliable: work stopped frequently when the MOA diverted its labor force to other projects. Implementation plans broke down. In May 1978, for example, when no bids were received on a contract to construct a pumphouse, the Mission was obliged to undertake the task on its own account. Procurement lagged. A case in point was: in June, lack of key materials prevented installation of the irrigation system, and an improvised system - for a small area planted in local tree varieties - continued in use.

The station was not ready to receive the first significant imported plantings until early in 1979. Even then, 13 months after preparation work began (18 months after allocation of the site), protective fencing was incomplete, no storage facilities existed, and the inventory of tools and equipment was insufficient for the proper care and cultivation of the plantings.

The work at Jarouba, carried out under more difficult conditions, proceeded even more slowly. The first significant plantings there in late 1979 and early 1980 were made prematurely, in the sense that the irrigation system was not completed until the middle of 1980 (three years after allocation of the site). In the interim, a substantial number of trees were lost.

Commentary: While obviously it did not control all the factors, the time taken to complete these operations is reason in

itself to question the Mission's performance. What went wrong? What could have been done differently?

First, in planning, the Mission looked ahead only to the next step. The end product - that is, in detail, what a complete and fully equipped station would consist of - was not envisioned in advance. (The staff was not familiar with research stations and had no experience in building them.) Hence, a complete list of material requirements could not be prepared in advance, and procurement could not be initiated promptly to insure adequate leadtime for deliveries.

(We recommend that experienced consultants be called in for planning possible expansion of the Jarouba station and the possible development of a new site for sub-tropical research at al Irra.)

Second, it was probably too much to ask of an agricultural economist and a horticulturist that they carry out essentially an engineering operation. (The Mission's engineer was occasionally available, but not continuously in charge.)

Third, the Mission need not have continued to depend on MOA labor when it proved unreliable. More recently it has supplemented MOA labor with a work force hired by the project. It should have done so sooner, to expedite this operation.

Fourth, if the management of an activity in disarray must choose some arbitrary point to replan, set new time limits, and concentrate resources on a renewed effort, such a reassessment was not made in this case. (It was perhaps impossible during the period of rapid staff turnover in 1979.)

Relations with the Contractor and Logistic Support

The Mission has had a somewhat different relationship with each successive Contractor team.

From December 1977 to September 1978, the team consisted of one person, junior in rank, and resourceful, adaptable and responsive. The role he filled was more that of a direct-hire assistant to the project manager than that of the representative of a separate (contract) establishment. At the time, the contract had no budget for local operations, and supply and other operational requirements for his work at the Bir al Shaif station were met by the "project" rather than the "contract" (the commonly used terms differentiating funds allotted directly to the Mission from funds passing through the contract). Thus, the relationship was a simple one, and productive.

The second group, a Chief of Party (COP) and a Horticulturist, arrived in September 1978 and left a year later. The Horticulturist was assigned to develop the Jarouba station. The first several months of his tour in Yemen were dominated by controversy over the fact that the Mission failed to provide adequate housing for him there, or in Hodeidah, the nearest city. Preoccupation with the question of whether he could be allowed to live in Sanaa, as he insisted, overshadowed professional problems. The team managed to establish a degree of independence, but at the cost of alienating the Mission and having to do without its wholehearted support. Moreover, the work (at Jarouba) suffered with uncoordinated planning, unclear funding arrangements, logistic breakdowns, and so forth.

The third and present team arrived in the latter half of 1979. By then, Mission management of the project had passed over to a series of temporary project managers, who gave somewhat erratic guidance in substantive as well as management matters. An example of the latter is the curious initiative taken in February 1980 to put resources required for the Jarouba horticulture program (labor, water, equipment) under control of the COP of another nearby project (Sorghum and Millet). This arbitrary arrangement, which had not been cleared with the Campus Coordinator or worked out with the Horticulture COP, introduced resentment to a relationship (with the Mission) that was already tense.

That arrangement was later cancelled. A permanent ADO was posted; and he and the COP enjoy a relationship that is more mature, cooperative, and effective, we think, than any preceding it.

The 1977 Tuskegee/AID contract stipulated that the AID Mission and the YARG would provide the Contractor office facilities, interpreter/secretarial services, transportation (vehicles), and housing. The Contractor was also granted full mail pouch facilities and other benefits.

In three of these categories, the Contractor has been adequately supported. Office space was provided (initially by the Mission in its compound, later by the MOA at the Sanaa regional office).

An interpreter/secretary was engaged. Until it reorganized the system of logistic support, the Mission also employed station labor, and drivers and guards assigned to the Contractor.

The Mission promptly ordered project vehicles. (Three were made available to the project as contract team members arrived, in 1977 and 1978. The fourth was appropriated by another project and returned a year later without a motor.) The Mission maintained project vehicles in its shops; and it exercised a rigorous and sometimes constricting control over vehicle use - in procedures that applied equally, however, to contract and direct-hire personnel.

Housing in Yemen is scarce and expensive. The Mission was able to provide accomodations to members of the contract team assigned to Sanaa, but it never resolved the problem at Jarouba. The first horticulturist assigned there, in the fall of 1978, rejected, with good reason, quarters proposed for him at the station; he also refused to live in the nearest important city, Hodeidah, not only because the accomodations were substandard, in his view, but also because schooling for his children was not available. The prolonged controversy, and the fact that he eventually attempted to develop and operate the station residing in Sanaa and commuting (occasionally) the six hours roundtrip to the station, was damaging at the time, if not due primarily to the Mission's logistic support failure. The more important problem now is that accomodations at Jarouba, a house trailer, are not adequate for the present team and will be altogether insufficient for the enlarged resident staff that will be needed for development of the station in the future.

In 1980, the Mission adopted a policy to discontinue logistic support to contractors, and, instead, to supply them funds to make

the arrangements themselves. Tuskegee demurred on the grounds that the contract term was more than half over and that its team was too small to spare anyone to take care of the new problems. Again, prolonged discussions, arrangements proposed and dropped created, on the Contractor's part, an upsetting sense of insecurity. In practical terms, however, the changeover has had little effect on transportation and housing, but it has given the Contractor an administrative burden. The COP maintains that he spends at least half his time on the required records, reports, and procedures associated with the administration of project labor. (We agree that the requirements, as set out in a contract amendment, are elaborate.)

In the long run, a more important question is the manner in which the Mission directed and monitored the Contractor's work. We call it arbitrary, for reasons that will be explained.

The contract established no modus operandi for the operational relationship between the Contractor and the Mission. Questions were left in the air, such as how supply requirements would be developed, how spending would be planned and controlled, what fund source would be charged, what action required the Mission's approval, which did not. By arbitrary, we do not mean necessarily wrong, but rather, unpredictable, changing, and unregulated. In some periods, the AID project manager reserved virtually all decisions to himself; in others, the Contractor went unmonitored for weeks on end. There have been a number of "incidents:" a horticulturist was ordered from Jarouba to Sanaa without notification to the COP; a Contractor driver was fired, again without consulta-

tion with the COP. Equipment was charged to this project and delivered to another; at Jarouba, the horticulture project was subordinated to another project, as noted above, and so forth.

These problems may have reflected a management style. However, they were aggravated by the structural fact that the "project" and the "contract" had parallel and overlapping resources (or general budget categories) and overlapping responsibilities. In that circumstance (and especially during the early years), there was an imperative need of activity budgets and activity plans. By this we mean jointly agreed objectives, for a given period, for which funding was known to be available. Only in a framework of this sort could the Contractor set about his work in an independent and responsible way. To our knowledge, no such budgets were prepared.

One of our principal criticisms of the Contractor is that he failed to keep the systematic record on which research depended. The Mission must share the blame for this, failing in its own responsibility to monitor the Contractor's work. In other more abstruse technical matters, such as research plans, the Mission cannot reasonably have been expected to oversee the Contractor's work because of its own lack of specialized knowledge.

Evaluation of AID's Performance

1. The Mission's funding of the project can be rated as adequate.

2. AID's performance in staffing the management of the project was generally satisfactory, excepting for

multiple, temporary assignments to project responsibility during an interim period amounting to nearly a third of the project's life.

3. The Project Agreement failed adequately to define activities and responsibilities of the two parties.

4. The Mission failed at the outset to create, with the government, a common understanding and common purpose in the project undertaking. (We do not underrate the difficulty of doing so.) Much has been done since to bridge that gap. Also, the Mission has been able to transform a relationship with the government that was distant and distrusting into one that holds promise for future success of the project.

5. With the benefit of hindsight, we think the Mission should have been firmer in demanding adequate sites for the research stations; and that it could have been more inventive and persistent in searching for a solution to the problem of the Jarouba access road.

6. Commendably, the Mission took responsibility for developing the sites. However, its plans for the stations were incomplete; and it executed the work inefficiently. (We have noted elsewhere the difficulties it faced in this work.)

7. The Mission adopted a managerial, rather than a monitoring role vis a vis the Contractor, exercising authority over day-to-day matters, when greater delegation of responsibility would have been desirable - although not desirable during periods when the contract team was weak and disorganized. Its monitoring of the team was deficient in certain technical matters.

8. The Mission's logistic support of the Contractor was fair to adequate.

9. The Mission was prompt in proposing contract amendments when changes were required.

10. The Mission has wisely adapted the project in response to YARG interests, that is, by intensifying the work of propagation and dissemination.

11. The Mission was burdened by the shortcomings of its partners (YARG and the Contractor); it accepted by default responsibilities it did not anticipate; and it was faced with Yemen's difficult working conditions. Giving due weight to these factors, we do not think the Mission provided the steadying influence, the clarity of purpose, the coordinating leadership, and the efficiency, that was required of it. We would rate its overall past performance as fair.

We think the Mission has a firm grasp of the issues that will be involved in working out the next phase of the project.

INPUTS OF THE YEMEN ARAB REPUBLIC (YARG)

Funding

In the original and revised Project Agreement, the YARG undertook a first "tranche" commitment to the project totaling YR725,000 (approximately $160,000) for purposes summarized in the following table.

TABLE 2

YARG FUNDING, PROJECT AGREEMENT OBLIGATIONS

Purpose	Amount ($000)
Technical services	24
Customs, demurrage, etc.	1
Land, wells*, buildings*	125
Labor, materials - unfunded	-
	160

*Apparently unfunded, as land was valued at full amount shown.

The Ministry of Agriculture does not maintain accounts on an activity basis, differentiating expenditures per project, and it was, therefore, impossible for us to determine the amounts actually spent under these headings. We note, however, that other than the brief assignment of a project co-manager, "technical services" have not been provided. On the other hand, something approximating the amount shown for that purpose, according to our own rough calculations, has probably been paid out for MOA labor assigned to the Sanaa research station; and some services and funding have

been provided for customs clearance and demurrage. In addition, the MOA has occasionally provided miscellaneous supplies, such as shading material. Most of the land allocated to the project (at two sites) was government owned. We do not question the government's estimate of its value.

Thus, in total value, the YARG's contributions to the project, largely in land, probably equal its initial commitment to the undertaking. However, it has not made new funding agreements, nor has it budgeted or programmed internally for continuing project support.

Note, however, that a third project site, unofficially valued by the MOA at $280,000, may be put at the project's disposal. (If this is done, YARG contributions would total approximately $450,000, or almost one-fourth of U.S. obligations to date, $1.9 million.)

Note also that, according to one MOA official, there is now a possibility that the MOA will budget for construction of an access road serving the Jarouba research station. If so, it is not likely to happen prior to the termination date of the present project.

Note finally that during this last year of the project, the MOA is providing office space to the Contractor's Sanaa staff in the Sanaa Governorate's office.

Provision of Land; Site Development

In May 1977, the YARG made two sites available to the Ministry of Agriculture for the establishment of horticulture research

stations: (1) an eight hectare tract, Bir al Shaif, in the Northern Uplands city of Sanaa, for subtropical research; and (2) twelve hectares of a 25-hectare government-owned property at Jarouba, in Wadi Rima of the coastal Tihama region, for citrus and tropical fruit research. The balance of this property is available, we were told, for expansion of the Jarouba station.

This action, taken ten months after signature of the Project Agreement, can be considered a reasonably prompt one; and it did discharge a basic obligation.

But the sites, each for different reasons, were of dubious value for long-term research. Bir al Shaif, not far from the center of the city, was threatened from the start by urbanization, and the project's tenure there was not guaranteed. Jarouba is in a remote and rigorous enviroment that would make it extremely difficult to develop and operate the station, limit its usefulness as a demonstration center, and isolate it from research activity in other parts of the country. It is separated from the nearest road by eight to ten kilometers of undeveloped track that can only be negotiated by four-wheel drive vehicles; and construction of an access road was, and remains, a vital requirement.

The Project Agreement is silent on the matter of responsibility for site development - land preparation, construction of buildings, irrigation systems, etc. It fails, even, to identify the work as a discrete activity, a significant undertaking in itself. In addition, in the absence of plan or agreement, the government left all initiative for development work to the AID Mission. The MOA

did provide some labor (at Bir al Shaif only), but no supervision, no logistic support, and negligible quantities of supplies and materials.

The AID Mission, therefore, organized and supplied the work. Assisted by Contractor personnel, it completed most of the planned improvements at Bir al Shaif in early 1979 and, at Jarouba, (with the exception of the access road) in 1980.

A limited number of local tree varieties were planted at Bir al Shaif in 1978. The principal, imported varieties (numbering 67) were planted in 1979. Thus, in 1980, the station was at the peak of its operations.

What happened then (in July 1980) was both damaging and demoralizing. With the agreement of the Central Planning Office, the Municipality of Sanaa constructed a road through the center of the Bir al Shaif station, destroying an estimated 233 trees and reducing the planted area by two full hectares. Some of the trees might have been saved had there been time to transplant them. However, the action was taken without warning; and if the MOA had advance word of it, it did not advise the AID Mission.

Both the AID Mission and the MOA have recognized the need for an alternative site for subtropical research. An eight hectare property at al Irra, near Sanaa, has been identified; but agreement on development of a station there has not been reached, and the work at Bir al Shaif will continue, if not indefinitely, at least for a long transition period.

Personnel

Counterparts: The Project Paper planned that MOA would assign a complete staff to the project organization, including five professionals and five subprofessionals, in the first year. Yemeni (MOA) personnel attached to the project, according to the PP, would free the Ministry itself, and its "administrative systems," of daily responsibility for project management. The professionals were to operate in these functional areas: project direction, station management, plant protection, and tropical and subtropical research. Returning trainees were to replace incumbents who, in turn, would receive training.

The Project Agreement was not specific as to the numbers or the functions of counterparts, but the fact that funding was set aside for "personnel assigned to the project" indicates that the MOA had some intention of appointing them.

In fact, only one MOA official was transferred to the project, as co-manager of the Bir al Shaif station. However, that individual served the project only briefly before leaving for training abroad, and again, briefly, upon his return. He then left the project (for the reported but unrevealing reason of "personality conflict" with the Contractor's Horticulturist) to become coordinator of all foreign agricultural assistance under MOA auspices. (At present, he is an agriculturalist with the Confederation of Yemeni Development Associations.)

A second MOA official was offered a project appointment, but he too left the country for training (in the U.K.). Others were

considered and potentially available for project appointment, but that was prior to the arrival of the Contractor's staff, and thus, the appointments were not made.

No other counterparts having been nominated, the project continues to be staffed exclusively by expatriate and foreign resident personnel.

Training: The Project Paper's training plans were even more ambitious than those for counterpart participation in the project organization. (They included 120 person months of academic work and 144 months in short-term programs.) However, the results were equally meager.

In 1978, the AID Mission project manager invited the nomination of three candidates for long-term (academic) training and ten for short-term tours in the U.S. and third countries.

Up to the time the program was temporarily abandoned, in 1980, only three candidates had been nominated. Two of them failed English-language proficiency tests. One was accepted (see above) and spent nine weeks in the U.S. at various universities.

A training program was written into the revised Contractor work plan of a December 1980 contract amendment. Nothing whatever came of it.

Labor: At present, six MOA-paid laborers are working at the Bir al Shaif station. None is, or has ever been, assigned to the Jarouba station, where labor is therefore paid by the AID Mission. There was a recurring problem of labor shortage during the critical

period of site development and initial plantings at Bir al Shaif, because the MOA frequently transferred its contingent to other projects.

Evaluation of the YARG's Performance

We first measure the YARG's performance quantitatively, against the only quantitative standards available, that is, the Project Paper and the Project Agreement.

Budget Support: (excluding land)

PP	$213,000
ProAg	$ 25,000 - first year (at that rate, $100,000 for four years)
YARG	$ 25,000 - first year; no subsequent obligations

Staffing:

PP	Ten full-time counterparts
ProAg	Required; numbers unspecified
YARG	One counterpart, temporary

Training:

PP	264 person months
ProAg	Unspecified numbers
YARG	Three nominations. One traineee, two person months

Land:

PP and ProAg	Two sites suitable for their respective purposes
YARG	Two sites provided. One later partially destroyed after having been developed, with substantial loss of investment; future in doubt; alternate site may be provided. The other, suitable only if access improved, for which YARG took no responsibility.

Site Development:

PP	Not provided for
ProAg	Unspecified, but with implied YARG responsibility to share in both costs and the work operations.
YARG	Provided approximately one-third of the labor requirement.

Illustratively, if not rigorously, we would rate this performance at two (on a scale of zero to ten) against the PP expectations; and four, against ProAg expectations.

However, the relevance of these standards must be questioned in any more general evaluation of the government's performance.

The Project Paper was, after all, an idealized concept of how the project would function in best-case circumstances, all parties subscribing to the concept and performing on schedule.

The YARG played no real part in the PP design: it was produced unilaterally. The plan was reflected only vaguely in the Project Agreement itself (see above), and it was not subsequently updated in the light of contemporary circumstances. It takes little account of government intentions, or what the government could or could not do, nor of how its decisions would be affected by the performance of other parties.

In the following, we try to adjust for realities of this kind.

With respect to personnel, the MOA could not have supplied ten counterparts in the specialities suggested by the PP without de-staffing the corresponding units in the Ministry itself. Moreover, that number (ten) would have been uselessly disproportionate to planned Contractor staff on the project, a maximum of five.

On the other hand, we think, and Ministry officials agree that, at least two, possibly three, competent people could have been found; they need not have been specialists, since, attached to the project, they would automatically have been candidates for specialized training.

With respect to training, the project was deficient in not providing for language training. The government was delinquent in not seizing upon opportunities for short-term training in Arab-speaking countries.

The MOA's attitude to the project was affected by delay in getting it started. The first Contractor staff arrived 18 months after signature of the Project Agreement; physical achievements (substantial plantings) were not visible for another year. Uninspired, the government was reluctant to contribute to a project that scarcely seemed to exist. On the other hand, the government became a party to delays by its own failure to contribute to site development.

The government did not understand, nor was it consulted on, nor did it subscribe to, the project's original stress on research as opposed to propagation, and it felt, with some reason, that it was not getting from the project what it had asked for. (We, ourselves, favor the more balanced approach that has been adopted over the past year.)

Whatever allowance is made for the various constraints and attitudes that influenced the government, its passive performance

was inadequate, in our view, and rates no more than five (on a scale of zero to ten).

There is strong precedent, of course, for autonomous, donor-operated ("turnkey") projects in Yemen, but the YARG's notion that this could have been one of them - that it could stand aside awaiting a final product - was unrealistic. The product, in this case, was "institutionalization," and that could have been achieved only by full and responsible Yemeni participation.

In our interviews, MOA officials seemed to appreciate this point as they discussed future plans. Their respect for the project has increased. They report prospects for more budget support (funding for the Jarouba access road, for example); and they think the Ministry extension activities can do more to take advantage of the knowledge and experience the project has gained. We take nothing for granted, but we think these are promising signs.

CONTRACTOR INPUTS

Recruitment

Findings: The original contract, signed in May 1977, provided for a long-term team of three to be resident in Yemen on two-year tours:

- one Senior Horticulturist/Chief of Party (COP); and
- two Horticulturists, one for each of two planned research stations, in Sanaa and Jarouba.

Contract Amendment No. 4 of January 1979 reduced the long-term team of three Horticulturists to two.

The initial nominations for the three positions were all unsuccessful, over the period of June-September 1977:

- Senior Horticulturist/Team Leader was nominated on July 8 and cleared by the Mission and YARG. On September 19, the candidate withdrew. Reportedly, his salary requirement, which was supported by the Contractor, was disapproved by AID.
- Horticulturists were nominated on June 9 and July 8, and were approved by the Mission on June 15 and July 14. On September 3, both were turned down by YARG, reportedly for the reason that they were too old (approximately 60). One candidate's qualifications for the job were dubious. The other's file is incomplete, but his qualifications appear to have been

better. No correspondence files were available to indicate whether the age of the candidates was a pretext or the true reason for YARG's turndown. In any case, shortly thereafter, YARG stipulated the following qualifications for project personnel: (1) age in the range of 30-40; (2) ten years' experience in fruit crops, with a B.S. or higher; and (3) competence in Arabic.

Over the period of September 1977 to March 1978, the Contractor nominated three individuals who ultimately took up positions in Yemen, with varying periods of delay, and three others who did not.

- A Horticulturist was nominated in September 30 and arrived on December 19, 1977. His field experience was limited; however, he was the Contractor's only permanent field representative for some eight months thereafter. Filling one of the two Horticulturist positions, he was in fact a "Field Technician," a position established later (see below).

- A Senior Horticulturist was nominated on October 28, 1977, and visited Yemen on a short-term assignment with the Campus Coordinator in December. He was not approved by YARG until January 1978. Housing was not available for his ETA of July 1. The duration of his assignment was an issue as late as

August 1978, with AID pressing for a two-year contract, and the nominee finally accepting only one year. Housing and other problems of settling in were preoccupying for several months following his arrival on July 15, 1978.

- A Horticulturist was nominated in October 1977 but withdrew in March 1978 on the grounds that he could not obtain a leave of absence from his employer, the Florida Department of Citrus. This individual was qualified in the matter of age and language ability, and had a Ph.D. degree.

- Two Field Technician positions, to assist the Horticulturists, had been added informally to the contract complement. The positions were formally authorized by Contract Amendment No. 4 of January 1979. The first Field Technician was nominated on March 22, 1978, and was disapproved by the Mission on March 31. The second Field Technician's nomination of March 31, 1978, was withdrawn on May 10 for reasons of health.

- A second Horticulturist was nominated in March 1978, and was approved by YARG some four months later. He arrived in September, but encountered problems that were preoccupying for the rest of the year. Housing acceptable to him was not available in

Hodeidah nor at the station in Jarouba. He insisted on remaining in Sanaa, a position viewed by the Mission as a breach of contract. His request in November for consultation in Tuskegee to resolve his personal problems was the subject of intra-AID communication for another five weeks. The consultation was ultimately approved, and combined with his mission to purchase plant materials in the U.S. It is fair to say that as a result of these and other problems, and of this individual's reaction to them, the usefulness of his ten-month tour was limited to its latter half. He departed in August 1978.

. A third Horticulturist was subsequently recruited and assigned to Jarouba, as well as a second COP/Horticulturist. Their arrival proceeded more smoothly and promptly. The third Horticulturist's arrival in July 1979 slightly overlapped that of his predecessor. The COP/Horticulturist, who arrived the last part of October 1979, did not overlap the tenure of the previous COP, who left in August 1979; however, he did have the opportunity of being oriented by the Field Technician, who was the first Contractor-appointed staff member and who had a thorough knowledge of the planting, of events that had transpired since his arrival in December 1977, and of MOA staff members.

. Two Field Technicians, an Egyptian expatriate and a Jordanian expatriate, were hired to assist the newly arrived Horticulturist and Chief of Party. Both of these Field Technicians had previously worked for the MOA and were well qualified.

Commentary: In effect, it was not until early 1979, some 20 months after the date of the contract, that a coordinated two-man team was settled and operating normally in Yemen.

A successor team replaced the initial group later in the year. Recruitment proceeded more smoothly. The Horticulturist arrived in July; the COP/Senior Horticulturist arrived in October. Both will serve until the end of the contract in September 1981. (Note that the requirement for a three-man team of horticulturists had been reduced in January 1979 to two.)

The record of fact, allegation, and merit in the various controversies surrounding recruitment, logistic support, and working conditions, is scanty and often contradictory. There is sufficient evidence, however, to support the following observations:

. The YARG was slow to approve or disapprove nominations, and thus contributed to delay in fielding a team. YARG was also arbitrary (if not unreasonable) in setting maximum age and language proficiency requirements as late as it did; and it was also inconsistent in applying these rules in other agricultural projects, and subsequently in this one.

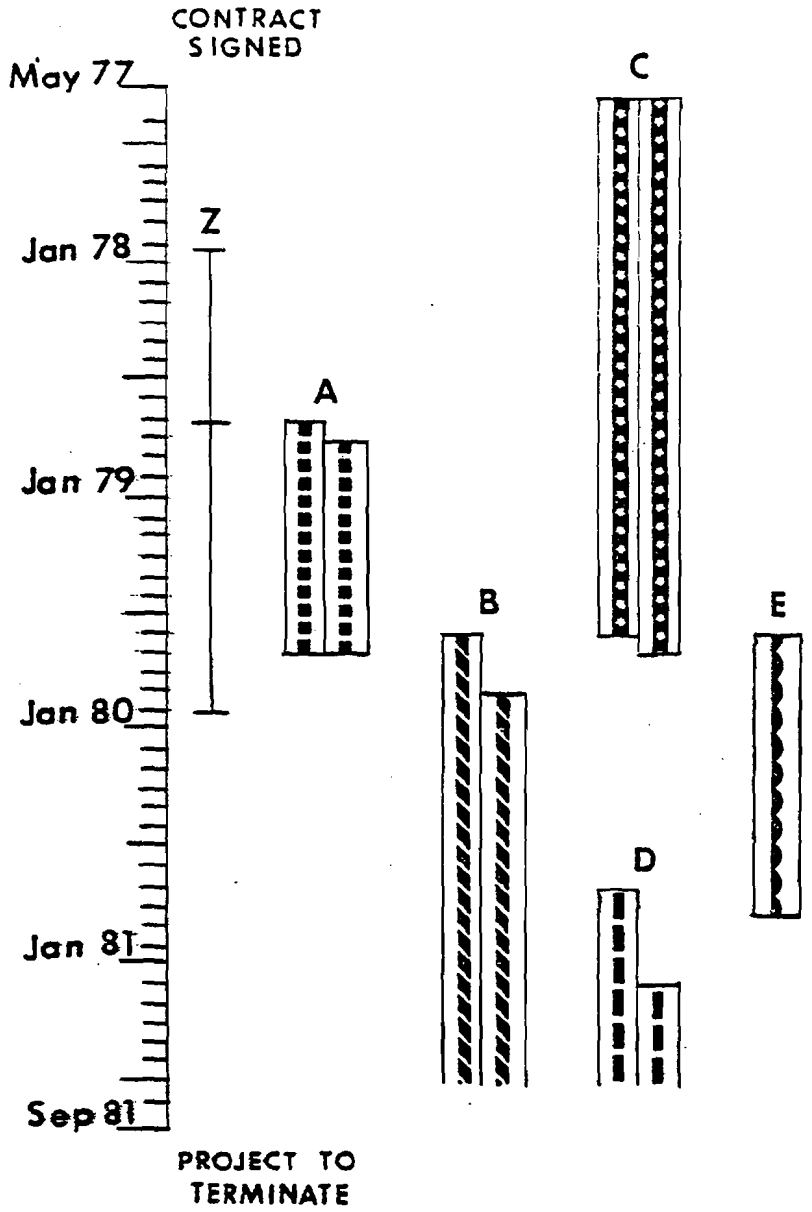
- The Contractor was deficient in a number of instances. Nominations were made of candidates lacking experience and specific qualifications. Premature nominations were made - when the Contractor misread or failed to reach an understanding as to the candidate's probable availability, minimum salary conditions, commitment to serve a full tour, etc. The long intervals between nominations indicate that the Contractor was able to draw on only a limited network of professionals in the field having both an interest in difficult foreign assignments and adequate qualifications.

- The protracted controversy surrounding the second Horticulturist's case was a function in part of his attitude. However, the Mission did little at first to make the team's work operationally viable and personally acceptable. (Moreover, it has failed in its initially accepted responsibility to see that the Jarouba access road was built - lack of which contributed to other problems.)

Whatever its causes, the fact that a full three-man team was never fielded, and that a two-man team was not fielded until August 1978, as the midpoint of the project approached, damaged the project both by delaying its development and, as a consequence, by dampening the MOA's enthusiasm for it. The effects of the original delay in recruitment of the first team are still felt.

FIGURE 1

CONTRACTOR AND USAID PERSONNEL ASSIGNED TO PROJECT



LEGEND

A: CONTRACTOR FIRST TEAM
B: CONTRACTOR SECOND TEAM
C: USAID MANAGEMENT FIRST TEAM
D: USAID MANAGEMENT SECOND TEAM
E: VARIOUS USAID TDY
Z: US-RECRUITED FIELD TECHNICIAN ACTED AS CONTRACTOR REPRESENTATIVE FROM DEC. 77-AUG. 78

Note: See Figure 1 for graphic presentation of the presence of various team members in Yemen.

Development of Work Plans

Findings: A review team from Tuskegee Institute consisting of a faculty Horticulturist and the Director of International Programs visited the YAR on June 1-6, 1977. Its purpose was,

> "... to better acquaint both short-term and long-term (prospective) project personnel with the situation in Yemen and to more effectively and efficiently prepare for it."

In addition, the team's report had something of the character of a technical planning document, (the Contractor's first) including as it did such details as scion varieties and rootstocks to be tested, planting distances, propagation procedures, and cultural practices to be introduced. The report states, "... it is our hope that this document will be accepted as the initial handbook for program implementation in the Yemen," and adds, however, that the plan would have to be changed according to need.

This document has strengths, but also some serious weaknesses.

- The geographical, climatic, and social situations are described well, along with many details on travel and living conditions.

- The objectives of the project were clearly outlined.

- The document did not, however, recognize the problems involved in developing an experiment

station at a site as harsh and isolated as Jarouba, a site that had no facilities and no pre-existing research program.

- The document did not recognize the time requirements and difficulties of staffing and of developing different types of plantings and research activities.

- The plan reveals a lack of in-depth knowledge of citrus and tropical fruit technology. For example, it proposes to introduce three lime varieties (Key, West Indian, and Mexican) which are actually one and the same variety - different names being used in different countries. Also it suggested that sour orange be avoided because it is susceptible to the tristeza virus, disregarding the facts that no tristeza has been found in the YAR; that it is the standard stock and performs well there; and that sour orange continues to be an important rootstock in regions without tristeza or with only mild forms of it. (Admittedly, a program of evaluating tristeza-resistant rootstocks, and gradually shifting at least in part to them, is necessary. However, it would be unwise to cease using sour orange, at least in the near future.) In addition, some of the suggested planting distances were far too close.

- The plan's suggestion to use mulch on citrus in the Tihama is not viable for several reasons. The flood system, the kind of irrigation used there, would wash most of it down the row. There is little mulching material available and it is in great demand for cattle feed. Mulch will decompose with great rapidity in the YAR because of high temperatures and the frequent application of irrigation water, etc.

- Work plans developed on site by the Contractor's Horticulturists lack continuity and consistency with one another; and in some instances, they exhibit poor technical judgment. Moreover, the planning process as a whole was disrupted periodically by external factors - actions or failures to act by YARG and USAID, etc.

The end result of the above is that current plans for research are in a state of confusion, and there is a disproportionate emphasis on tree propagation and distribution as opposed to research, extension, and institutional development.

Commentary: The Contractor's work plans should have taken account of the time needed to develop adequate facilities at Bir al Shaif and, particularly, at Jarouba. No attempt should have been made to plant Jarouba until the access road was built, the land was prepared, and an irrigation system and other facilities

and equipment were in place. It is understandable that the MOA did not understand this, but the AID Mission should have; and it should have prevented premature plantings.

A similar lack of foresight resulted in ordering plants for Jarouba on too short notice. (Citrus nurserymen do not keep large stocks of trees on hand, and they contract for large orders well in advance.) Receiving late orders, suppliers made substitutions at random, with the result that the plantings do not serve original research plans. The Bir al Shaif plantings also reveal a lack of careful long-range planning.

Opportunities to seek advice on plantings were missed. Records should have been kept of the planting materials desired, and of the reason for including each item. Research or extension workers in universities with large ongoing programs could then have been asked to comment on them. We found no evidence that this was done.

Reports

Findings: The principal reports made by the Contractor are listed in Table 3. With the exceptions noted, they were timely and substantive.

The first of the semi-annual status reports required by the contract was omitted, presumably because the first Chief of Party had not yet arrived. Moreover, that COP made only one report during his 12-month tour. Thereafter, these reports were made as required, although they are not of a uniformly high quality (see below).

TABLE 3

CONTRACTOR REPORTS*

Submitted	Subject and Period Covered
	Review Team
6/20/77	Advance Review (June 1-16, 1977)
10/19/77	Second Review (October 1-16, 1977)
	Consulting
11/15/77	Economist (October 1-16, 1977)
5/78	Horticulturist (December 14-30, 1977)
2/14/78	Horticulturist (December 17, 1977-January 4, 1978)
6/20/79	Economist (May 21-27, 1979)
	Tuskegee Trip Reports
6/15/80	Trip (May 5-15, 1980)
12/80	Trip (December 4-12, 1980)
	COP Project Status
1/15/78	Period Ending December 1977
Undated	Period, November 1977-March 31, 1980
Undated	Period, April 1, 1980-October 31, 1980
Undated	Period, November 1, 1980-April 30, 1981
	Miscellaneous
2/1/80	Time Phase and Activities
2/17/80	Time Phase and Activities

*Reports in memoranda form are not included.

Generally, trip and other reports from Tuskegee's Campus staff were promptly submitted, substantive, clearly written, and detailed (excessively so in some cases).

The Contractor's consultants' reports, with one exception (a social analysis), were submitted soon after each visit to the YAR. By and large, the suggestions made in these reports were appropriate and, we think, useful to the Mission.

Commentary: In general, the Contractor performed well in meeting reporting schedules, identifying problems requiring action, and setting forth future plans.

On the other hand, the field status reports do not provide sequential information on technical topics. Thus, for example, seed is reported planted by one report, but the next reports fail to say what happened to them. This deficiency is particularly troublesome in that research records were not kept in standard scientific fashion (in bound record books, etc.), and the status reports are the only records available.

Campus Support

Findings: Campus support was excellent from the standpoint of logistics. The Tuskegee Institute's Office of International Programs is well administered. Its files are well kept, and documents sought are quickly located.

The correspondence files in AID Sanaa indicate that the Campus responded promptly to field requests, and tried promptly to solve logistical and personnel problems of the Contractor's staff.

Technical and scientific support is another matter. There is no suggestion in the correspondence files that the contents of field status reports were monitored by the horticultural faculty at Tuskegee or that the field staff asked for such help. There is no evidence, for example, that Tuskegee monitored research record keeping, or that it systematically reviewed the quality of the field team's performance. If it did, it kept no record of it.

Commentary: The prompt and thorough response of Tuskegee to requests from the staff in Yemen and records of actions taken indicate that the Contractor was deeply interested in the project and considered it important.

The above was primarily the work of the Office of International Programs. Lack of significant input by the horticultural faculty is consistent with the fact that it is small and lacks experience in citrus and subtropical fruits programs. This does not reflect on the quality of individual faculty members. The faculty Horticulturist who went to Yemen with the Contractor's first review team is nationally recognized. Horticulture is a broad topic, however, and his expertise is in certain vegetable crops and temperate zone fruits, rather than citrus and subtropical fruits.

In view of the above, it would have been wise for Tuskegee to develop arrangements supplementing its Campus resources and supporting its Sanaa and Jarouba staff with a variety of outside consultants. (With one exception, all the horticultural consultants brought to Yemen were those being considered for long-term positions on the project.)

It would have been well, for example, to have arranged with someone on the faculty of an institution such as the University of California at Riverside or the University of Florida for periodic advice and assistance relative to citrus and subtropical fruits, and/or temperate zone fruits grown in subtropical climates. This person could have drawn not only on his or her personal expertise but on that of his colleagues. (See Recommendations.)

Evaluation of Contractor's Performance

The completeness and orderliness of the Contractor's files, the timeliness and substantive nature of its reports, and the volume and detail of project correspondence leave no doubt as to the Institute's sincerity and diligence on Campus and in the field. Logistical support was good.

On the other hand, the Contractor's recruiting performance must be rated as poor, even if factors beyond its control, such as time limits and changes in the qualifications required by YARG, are taken into account.

The Contractor's work schedules and research plans too often failed to take into account on-site conditions; and they were too often technically defective. The principal causes of these deficiencies were: the Contractor's lack of experience in developing outlying isolated agricultural experiment stations; a lack of depth in its horticultural faculty; and its lack of experience in citrus and tropical fruits technology.

V. OBJECTIVE LEVEL (OUTPUTS)

FIELD (SOCIOECONOMIC) STUDIES

Findings

The Contractor obtained the services of Dr. C. D. Covey, Professor of Agricultural Economics, University of Florida, and Dr. L. Jones, Professor of Rural Sociology, Tuskegee Institute to review conditions in the YAR and develop plans for the socio-economic studies portion of the project.

This was done during and following one short-term visit to the YAR (October 1-16, 1977) by C. D. Covey and L. Jones and a second visit by C.D. Covey (May 21-27, 1979).

Action by the Contractor was prompt as evidenced by the early date of the first visit of this team (three months after the contract was signed), the rapid development of a substantive report, within one month, and a second visit (May 21-27, 1979), with a follow-up report one month later.

However, the studies themselves were cancelled by the Ministry of Agriculture. Citing the slow development of the project's research and propagation work, its memorandum of May 16, 1979, said that the studies would be premature.

Commentary

The contractor performed well in the preparatory reports, utilizing a Tuskegee faculty member in Rural Sociology, an area in which this institution has considerable expertise; and retaining a well-recognized Agricultural Economist with a wealth

of experience in such work from another university.

Even though it was agreed to eliminate these studies in the current project, they are important for the future and should be implemented if the project is extended or redesigned.

INSTITUTIONAL DEVELOPMENT

There can be no disguising the project's failure - relative if not total - to institutionalize horticultural development work, if by institution we understand a combined "set" of competent people, recognized procedures, a lasting organization, and connections with related institutions.

Two of the planned inputs to the set - training and the integration into the project of permanent MOA officials - did not materialize. Some of the "inner" procedures in research were defective, discontinuous, or simply expedient, and should not be perpetuated. The "outer" procedures of administration, supply, finance, etc., which were created ad hoc for the project entity, will not outlive it. The project's external connections - with growers and with concurrent research elsewhere - are still weak.

Thus, the project as an institution is rudimentary and isolated.

RESEARCH, EXTENSION, DISTRIBUTION

Research

The original research objectives were to improve production of fruit crops through the establishment and evaluation of a collection of imported high-yielding varieties and improvement of cultural practices.

Analysis of Findings

Sanaa, with an elevation of approximately 7,300 feet (2,225 meters), was selected to represent the cool, low rainfall, highland tropics. Such areas have potential for the production of termperate and subtropical varieties of tree fruits and grapes. Excellent grapes are grown in such regions in the YAR, but tree fruits are limited to interior seedlings.

The first Field Technician posted to Sanaa arrived in December 1977, and the first Chief of Party/Horticulturist arrived in July 1978, seven and fourteen months, respectively, after the contract was signed in May 1977. Initial efforts included preparing the site at Bir al Shaif in the city of Sanaa for planting, developing a functional irrigation system, and planning. Visits were made to production sites near Sanaa and to other areas to evaluate existing plantings and to obtain a small amount of adapted material.

The Contractor's research plan called for varieties requiring 200-400 chilling hours. Accordingly, a large collection of these varieties of several species was imported from the United States primarily, and established at Bir al Shaif in January 1979 (Table 4). Thus, the first test planting of any consequence was made 20

TABLE 4

NUMBERS OF VARIETIES OF FRUIT SPECIES PLANTED AT BIR AL SHAIF

Species	No. Varieties Planted 1979	No. Varieties Planted 1980	No. Trees Lost to Road Construction 1980
Almond	5	2	44
Apricot	2	1	22
Apple	2		
Fig	5	1	36
Grape	18		
Guava	1		24
Nectarine	3		
Olive	6	1	53
Peach	9		
Pear	3		
Pecan	4		3
Pistachio	2	1	7
Plum	4	1	17
Pomegranate	3	–	27
Totals	67	7	233 (trees)

months after the contract was signed and 13 months after posting the first Contract Field Technician to Sanaa.

By way of background, many species of deciduous fruit trees, those that lose their leaves during the winter period, require a specific number of hours of chilling during their dormant period (when the leaves are off). Chilling hours are calculated as the number of hours at 45°F (7.2°C) or below to which the trees are subjected. This is not a precise rating because temperatures up to 60°F (15.5°C) or slightly higher are also effective, although less so. (Temperatures of 70°F (21.1°C) or higher may reduce the effectiveness of previously accrued chilling hours. Trees in areas with much cloudy or foggy weather will react differently from those with clear skies.) Thus, while the rating is a good measure or base from which to start, trees must be tested in a given environment to determine their adaptability to the dormant season chilling conditions. There are, of course, other factors affecting adaptability but the chilling hour requirement is so limiting it must be considered paramount.

The first Chief of Party terminated a 12-month tour in August 1979, and the first Contract Field Technician completed a two-year tour in November 1979. A second Horticulturist and COP arrived in October 1979, and a resident Field Technician was hired soon thereafter. They made replacements of trees[1/] lost at Bir al Shaif, added a modest amount of new material and established varietal test plots at outlying field locations (Table 5),

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1/ Inadequately cared for local varieties planted in 1978.

TABLE 5

OUTLYING VARIETY TEST AND DEMONSTRATION PLANTINGS OF TEMPERATE ZONE FRUIT TREES

Location	Number of Trees			
	Apple	Appricot	Peach	Total
Wadi Dhar	64	59	78	201
Marib Road	30	34	36	100
Jihanna	20	20	12	52
Ibb School	4	4	4	12

Then in July 1980, a not insignificant part of the main experimental plantings at Bir al Shaif was lost when a broad, paved roadway was constructed through the center of the station (Table 4).

As of the date of this report, the oldest trees at Bir al Shaif have been subjected to the environment of two winter dormant seasons and the youngest to one season. This is insufficient to thoroughly test trees, but the severe delayed foliation, a specific indicator of inadequate chilling, is so pronounced for a number of varieties that they can be eliminated from the research program. On the other hand, a few have performed so well it is unlikely they would suffer appreciably even in somewhat warmer winters. None of the material is sufficiently old to evaluate for yield, fruit size, and fruit quality.

No research was conducted on cultural practices, such as fertilization, pruning, irrigation and weed control.

Jarouba, with an elevation of approximately 750 feet (229 meters) represents a low-rainfall, hot tropical region. Winds there are occasionally severe.

The area is isolated and several kilometers from a road, making it necessary to travel over rough terrain to get there. Accomodations are spartan at best.

At worst, during the tenure of the first Horticulturist, September 1978-August 1979, there were none. Living in Sanaa, he only occasionally made the six-hour round trip. Since the delivery of a house trailer in 1980, the present Field Technician

spends two or three nights on site; but, the second (and current) Horticulturist, who arrived in July 1979, is forced to live in Hodeidah, commuting four hours daily.

For lack of access, lack of continuous supervision, and lack of the necessary equipment, the physical development of the station was slow. The irrigation system was inadequate for any substantial planting program until construction of a second well in 1980. An excellent shade house was constructed, but only recently.

In addition to the physical problems, the project was hurt by a USAID/Sanaa management decision, i.e.., to place all equipment and labor and the irrigation facilities at Jarouba under the control of another contractor in the area. The horticulture project, receiving residual resources, suffered accordingly.

During the tenure of the first Horticulturist, when the physical situation was at its worst, a shipment of citrus and tropical fruit trees was obtained from the United States, planted in plastic bags, and placed in a shade house that had been constructed during this period. Considerable citrus seed was also obtained, as well as seed of papaya.

However, due to lack of attention and sufficient irrigation, much of this material died. The remainder was gradually planted in the field as facilities improved. Despite the loss of all of the avocados, nearly all of the guavas, and much of the citrus, this importation has residual value in the existing experimental planting. The bananas particularly have grown well and are fruiting, despite damage from severe winds. A complete evaluation

has not been made, but Dwarf Cavendish appears considerably more resistant to wind than other varieties, just as has been found in certain other parts of the world where it is an important commercial variety.

The mangos suffered considerably, but a sufficient number of them survived to make a trial planting. It will be three or more years before meaningful evaluations of these varieties can be made. The papaya collection is fruiting, but there are insect problems and some sun burn. A planting of sweet sop has been established, but is not old enough for evaluation.

Additional citrus trees were imported from the U.S., and trees were produced at the site by budding on seedlings. At the time of this report, a collection of important varieties on several rootstocks has been established at Jarouba (Table 6). This collection is in excellent condition as a result of the care and attention given it by the current Horticulturist and Field Technician, but trees are spaced too close. The trees are not yet of fruiting age, but soon will be. They will serve not only for evaluation of their yield, fruit quality, and general adaptability, but as a source of buds for Ministry of Agriculture nurseries that sell trees to growers. As a precautionary measure, none of the citrus trees should be used for buds to be placed on rootstocks susceptible to exocortis (see Annex F) until it is determined with certainty they are free of exocortis. None of the citrus trees from Florida should be used for bud sources until it is determined whether they are also free of tristeza.

TABLE 6

SCION VARIETY/ROOTSTOCK COLLECTION
JAROUBA, JUNE 1981*

	Rootstock Budded Onto					
Scion Variety	Sour Orange	Rough Lemon	Volkamer Lemon	Carrizo Citrange	Troyer Citrange	Cleopatra Mandarin
Sweet Orange						
Valencia (41)	X	X	X	X		
Pinapple (14)	X					
Hamlin (22)	X	X	X			X
Washington Navel (21)	X	X	X			X
Parson Brown (1)						X
Mandarins						
Ponkan (27)	X	X		X		X
Kinnow (14)	X					
Fremont (33)	X	X	X	X		X
Fairchild (43)	X	X	X	X	X	X
Algerind (14)						X
Satsuma (2)						X
Minneola (12)					X	
Grapefruit						
Redblush (18)					X	
March (16)	X	X	X	X		
Shambar (16)	X	X	X			
Thompson (3)	X					
Ruby (22)	X	X	X			
White (18)	X					
Lemon						
Lisbon (18)						
Meyer (2)	X					
Lime						
Bearss (24)	X	X	X	X		X
Mexican (27)	Seedlings (own roots)					
Pummolo						
Chandler (18)					X	

*Numbers in brackets indicate total number of trees of the scion variety.

Test trees were also established at several locations and given to other governmental agencies (Table 5).

Commentary

Criticism of the project's research procedures, accomplishments and failures must take into account the constraints under which the research effort was made. They include recruitment problems, lack of appropriate climatic data, lack of established physical facilities, isolation of the Jarouba Station, loss of plants through pilferage, destruction of part of the Bir al Shaif plantings, and housing problems. Lack of continuity of staffs of AID/Sanaa, YARG, and the Contractor all hampered the research program - which, despite all, did establish collections of potentially superior varieties and develop some of the physical facilities needed.

Having said this, we go on to list procedures, which, in our opinion, lacked a sound technical basis or showed questionable judgment.

1. No effort was made to establish simple temperature instrumentation for obtaining data from which chilling hours could have been calculated.

Spring-powered thermographs (approximately 5 X 10 X 8 inches) that require only a weekly winding and changing of charts are available from a number of U.S. companies for less than $500 each. These should have been placed immediately at Bir al Shaif and selected sites, such as Taiz and Ibb, where governmental research or extension staff could have cooperated in changing and filing the charts. As it stands, there are no such data four years after signing the contract.

Continuous temperature data are not as necessary for Jarouba. The heat units are important, however. They are calculated from mean-maximum temperatures that can be obtained from a mercury thermometer, as is done at Jarouba. However, since thermometers require daily readings, a thermograph located there would have had more utility.

2. The locations of the various test sites were not properly categorized according to correct elevation and type of surrounding land. The structure of the wadis is such that a given planting site may be at an appreciably different elevation than the general elevation of the region or a nearby town.

Elevation is a factor determining temperature, which in turn, affects the performance of various citrus varieties.

3. No phenological data, such as time of bloom and fruit development, were obtained from existing varieties. These data are extremely useful in varietal testing programs and in research on cultural practices.

4. The lack of plant accession records and the maintenance of records of any kind in standard, bound, record books, is perhaps the program's severest procedural deficiency.

Such recording systems were not kept despite the fact that a Consulting Horticulturist pointed out their vital importance, in writing, early in the life of the project (February 4, 1978). A detailed description of such a system was included in a memorandum attached to the report. Moreover, record books were obtained, but the only record entered was that of the Consultant who made the entry with the then present Field Technican.

Such records are not only of great value to the researcher who makes them, but to those who succeed him or her. It was obvious from discussion with the current contract staff that they were deficient in knowledge of what had been done by their predecessors.

5. Plant material was to be selected on the basis of 200-400 hours range of chilling. This was a sound decision because the range includes the lowest chilling-hour group of peaches for which there are several varieties of good quality. All of the peaches thus rated appear to have adapted as far as the chilling hour requirement is concerned. A few peach varieties with excessively high chilling requirements (outside the range - J. H. Hale and Elberta are examples) were introduced and were lost.

Selection of apple varieties was incorrect. Only one of those selected (Anna) appears to have adapted at Bir al Shaif. This is the most important variety for U.S. regions requiring 400 hours of chilling.

Winter Banana, an apple variety grown successfully in tropical highlands of the American tropica (Mexico to Peru) was not introduced. There are sizeable commercial plantings of Winter Banana in Guatemala at 7,000 feet (2,134 meters). Neither was the Golden Dorset, which is similar to Anna in its chilling-hour requirement, introduced. Failure to introduce Winter Banana and Golden Dorset was a mistake. Moreover, most of the apples introduced have chilling requirements that are obviously too high for Sanaa, and are known to be so.

Several of the low-chilling hybrid pears were not introduced and should have been. None of the so-called soft pears, such as Bartlett, which were introduced, is likely to be adapted.

Apricots are a special problem because they are not grown commercially in 200-400 chilling-hour regions of the U.S. Getting adapted material from the U.S. will be more of a problem, because the chilling requirements of apricots are less well defined.

Most of the plum varieties introduced require slightly more than 400 chilling hours, which the test plantings revealed. They may produce well even so; but others, such as Bruce and Exelsior, should certainly be introduced inthe future, and Gold will probably also do well. Bruce requires cross-pollination and Methley, which was introduced, should be a good pollenizer for Bruce, if it proves well adapted. If not, the extremely low chilling native plum (Prunus angustifolio) can be introduced from Texas as seed. It is an excellent pollenizer, but its fruits are almost valueless.

6. Two sub-tropical fruits which should produce well in the cool areas of the YAR (from Taiz to Sanaa) are the Mexican X Guatemala race hybrids of avocados, such as Fuerte, Hass, and Bacon (California varieties), and both the astringent and non-astringent varieties of Japanese persimmons. The avocado particularly is a serious omission. Testing, of course, is required.

7. The Jarouba citrus collection of scion varieties and root-stocks, developed under extremely difficult conditions, looks very good, and contains some excellent material. However, several important mistakes were made.

- The trees were planted too closely.

- Some of the trees were introduced from a Florida nursery. Florida nurseries cannot guarantee that their trees are free of the tristeza virus, a serious insect-transmitted disease which is not known to exist presently in the YAR. It is particularly damaging to trees on sour orange rootstock, the most common rootstock in the YAR (see discussion on viruses in Annex F).

  Trees introduced from the Willits and Newcomb, Inc. nursery are from an area kept tristeza free by continuous monitoring and action by a governmental agency, with grower cooperation. These are the trees in the collection that should be used as budwood sources, not those from Florida.

- The collection was not made or planted in the most systematic manner. Plants were obtained from commercial nurseries from both Florida and California nurseries on short notice. Substitutes were made at times. Given sufficient notice, the Willits and Newcomb nursery could have produced a variety collection of exactly the selections desired and on a single rootstock. This would have made a much more uniform and valuable collection. If this had been

done at the outset, the trees could have been ready by the winter of 1979-80. This would not have precluded planting out a few other trees for more rapid testing. As it developed, false starts before the land and facilities were ready resulted in much plant loss and some inferior material.

Material such as Pineapple and Parson Brown oranges, which are inferior fresh fruit varieties, used primarily to extend the processed fruit season, were introduced. On the other hand, the various selections of navel oranges and Valencia were not. Rhode Red Valencia, for example, colors better in hot climates than others. There are selections of navels that ripen at different seasons and vary in other respects that should have been introduced.

The rootstock collection for seed does not contain Troyer Citrange, Swingle Citrumelo, Citrus Macrophylla, or Rangpur lime. Rangpur lime, for example, is used almost entirely in Brazil because of its resistance to tristeza, high yields, and tolerance of drought.

The rootstock/scion trial consisted of various numbers of scion varieties on various kinds and numbers of rootstocks. It cannot be used for anything but gross observations. A rootstock trial of a design commonly

used so that statistical analyses are possible would be much superior even if statistical analyses were never made.

The tropical fruit introductions were greatly reduced due to lack of care and inadequate facilities in the early stages of the project. Losses were not replaced. They should be.

8. The failure to develop research on cultural practices is understandable. Uniform plantings that can be subjected to differential treatments must be available. No such plantings were made.

It is possible, however, to evaluate existing grower plantings on the basis of their appearance, fruit yields and quality, and then to suggest changes in cultural practices on the basis of research conducted elsewhere (on-the-site research is not always needed). This approach constitutes extension, not research, but research staff are good sources of information and are often best equipped to do this work.

Extension

Project horticulturists have given advice on cultural practices to over half of the 26 growers and government stations that have received materials propagated by the project or materials (citrus trees) purchased by the project and distributed directly.

The first such distributions were made less than a year ago. Making contact early, the horticulturists have been able, in

many cases, to reach recipients in time to offer advice on procedures in the initial plantings.

There has been no systematic schedule of follow-up visits, except in the case of the eight farms designated as test and demonstration centers, where visits have been made as often as once a month.

Table 7, following, lists eight locations of plantings of temperate zone crops, in the Sanaa Governorate, that have been reached at least once by contract personnel of the Bir al Shaif station. Three of these farms (at Jihanna, in Wadi Dahr, and at Mareb Road) are test/demonstration centers. (Table 5, above, lists the number and species of tree involved in adaptive tests.) Table 8 below, lists four farms designated as test/demonstration centers for budded citrus, in the Tihama. These farms have been visited by the horticulturist stationed at Jarouba. He has also visited, at least once, some of the locations at which citrus trees procured for direct distribution are planted - at six government nurseries, the Ibb Agricultural Secondary Institute, at an Army camp, and at five private farms.

Commentary

In the Project Paper concept, the function of extension is to disseminate information on cultural practices developed and tested at the project's research stations or otherwise proven to be effective in specific Yemeni conditions. Since no research on cultural practices has been conducted by the project, the horticulturists advise on the basis of information they may have of

TABLE 7

TECHNOLOGY PROVIDED FARMER BY PLACE AND KIND

No.	Place	Type of Tree on Which Advice was Given*
1.	Bany Hoshesh	Grapes, Pomegranates
2.	Johanna/Khawlan	Apples, Apricots, Peaches
3.	Al-Mawza A/Wadi Ghail	Citrus, Grapes, Apricots, Peaches, Apples
4.	Wadi Dhahr	Citrus, Apricots, Apples, Grapes, Peaches
5.	Rada	Grapes, Figs
6.	Sadah	Cuttings
7.	Mareb Road	Peaches, Apples, Aprixots
8.	Ahmman Ali	Citrus

*Source: Contractor Report

TABLE 8

BUDDED CITRUS PLANTED IN
GROWERS ORCHARDS AS DEMONSTRATIONS*

Grower	Location	Type of Varieties				Number of Trees
		Grapes	Orange	Mandarin	Lime	
M. Sunehi	Darban	6	6	9	3	24
Z. Gassim	Huseyniah	2	4	12	3	21
A. Chussir	Makayrif	4	6	6	2	18
H. Chussir	Makayrif	-	6	12	3	21
		12	22	39	11	84

*Source: Jarouba Station - Wadi Rema

comparable practices and conditions elsewhere. (In the case of local varieties, this imformation may not be superior to information the growers already have and employ.)

It is unfortunate that no connections at all have been established between the project's extension work and the MOA's Extension Service. (MOA agents might have, for example - but have not - accompanied the horticulturists on their visits, as a training exercise.) Nevertheless, the MOA has been vigorous in encouraging the project to intensify its extension activity; and we think this interest should be turned to urging the Extension Service to involve itself in what is not only an excellent training opportunity but, in a larger sense, a means of advancing the project's "institutionalization" purpose as well.

It is for lack of government collaboration that no organized use has been made of the test/demonstration centers to disseminate information to farmers other than the owner himself. Individual farmers have occasionally visited the farms, but no instruction has been programmed for them and group visits have not been set up.

According to a December 1980 amendment of the Tuskegee contract, senior contract horticulturists are expected to devote two days a week to extension. We question whether it would be wise for them to spend this much time away from their other duties, and in fact, they have not. Full-time staff on this work may well be needed in the future.

Distribution

Findings: A nursery consisting of grape, pomegranate, fig, and olives, was produced from cuttings, and almonds and English walnuts from seed, was established in the winter of 1978-1979 at Bir al Shaif. Approximately 15,000 plants were thereby made available for sale by the winter of 1980-1981.

A second nursery planting of fig, grape, mulberry, quince and pomegranate cuttings, and seeds of almond, apricot, peach, and walnut was made in the winter of 197~~0~~9-1980. Approximately 35,000 of the above plants will be available for sale in the winter of 1981-1982 (Table 9).

The majority of the above plants are grape and pomegranate made from cuttings of local selections that yield well and are of good to excellent quality.

A tentative decision has been made to move the nursery to a new site close to the city of Sanaa, but the current site is to remain in use until the new one is ready.

Establishment of a counterpart nursery for citrus at Jarouba has been slow in getting established. A large amount of citrus seed of a number of varieties was planted on several dates, extending from the winter of 1979-1980 through August 1980 at Bir al Shaif. Unfavorable temperatures resulted in low seedling production but approximately 5,000 seedlings were transferred to Jarouba for planting in the nursery. Some 2,000 to 2,500 have survived and are ready for budding and later for sale and distribution by the MOA.

TABLE 9

FRUIT PLANTS BEING PROPAGATED FOR SALE AT BAR AL SHARIF, APRIL 1981*

Species	Propagation Method	Number (approx.)
Fig	Cutting	5,000
Grape	Cutting	15,000
Mulberry	Cutting	1,100
Pomegranite	Cutting	12,000
Quince	Cutting	
Almond	Seed	1,500
Apricot	Seed	2,000
Peach	Seed	200
Walnut	Seed	3,000

*Plants will be ready for sale in winter of 1981-1982.

An unspecified number of lime seedlings, also grown at Bir al Shaif during 1980, were transferred to the MOA for sale and distribution.

Because of the demand of citrus growers for trees and the lack of a producing nursery[1/] at Jarouba, agreement was reached by YARG, the AID Mission, and the Contractor for the purchase of trees in the U.S. for distribution in the YAR. Accordingly, 3,300 trees were purchased from the Willits and Newcomb, Inc. nursery in California and shipped to the YAR in January 1981 at a cost of $38,552.97 or $11.68 per tree. The following varieties were obtained and distributed to growers and government agencies: 2,438 Parent Washington Navel orange, 107 Ruby grapefruit, 108 white grapefruit (probably March White), 265 Dancy mandarin, 200 Fairchild mandarin, 107 Lisbon lemon (Limoneira 8 selection), and 75 Bearss lime (a Persian or Tahiti lime selection). Table 10 gives the locations to which the trees were distributed. Some were sent to MOA nurseries, such as at Ibb and Taiz, where they will serve as parent budwood sources for thepropagation of citrus trees.

In March-April 1981, a sizeable citrus nursery was started at Jarouba with the planting of an estimated 58,560 sour orange and 31,200 rough lemon seed in the shade house. An estimated 46,138 sour orange and 29,120 rough lemon seedlings were produced. It is probably safe to estimate that approximately 70,000 seedlings will be available for budding.

1/ A nursery producing budded trees ready for distribution.

TABLE 10

DISTRIBUTION OF CITRUS TREES
IMPORTED FROM U.S., JANUARY 1981

Grower Cooperator	Location	Number of Trees
Ahmad Wahas	Artel, Sanaa	100
Muhammed Al-Jurafe	Hammam Ali, Thamar	200
Muhammed Al-Jube	Amran, Saadah	14
Muhammed Al-Jabre	Hammam Ali, Thamar	1,800
Abdullah Al-Ademi	Al Mawzaa, Taiz	70
Minister of Agriculture	Sanaa, Sanaa	189
MOA Research Center	Taiz, Taiz	140
MOA Nursery	Taiz, Taiz	192
MOA Nursery	Ibb,Ibb	110
MOA Nursery	Jahana, Sanaa	100
MOA Nursery	Al-Baida, Al-Baida	65
MOA Nursery	Jaraba, Hodeidah	135
MOA Nursery	Al-Haimah, Sanaa	135
Sanaa Military	Sanaa, Sanaa	50

The above seedlings will be lined out (transplanted in rows in the field) in September 1981, budded in January-February 1982, and sold and distributed by the MOA in January-August 1982.

Arrangements have been made to purchase "certified" budwood. The varieties and the number of buds of each to be purchased are listed in Table 11.

Comments: In the Program Description of the Tuskegee contract, it is stated the Contractor will "Assist in dissemination of proven high producing varieties and cultural practices identified in the project." As explained in the section on research (Section V), no high producing varieties have been identified at either Bir al Shaif or Jarouba because none of them, with the exception of bananas and papayas (just now producing their first crop) have begun to fruit. Thus, taken literally, there would be nothing to disseminate.

Taking a broader and more realistic view, however, there are local selections of pomegranate and grape that had been identified already as producing yields and fruit quality that would be good to excellent by world standards. These selections are propagated vegetatively (stem cuttings) and, therefore, will produce the same yield and quality as the ones from which they were taken.

Propagating the other temperate zone plants from cuttings at Bir al Shaif is at best a questionable practice, since no varieties of good to excellent quality of these species have been found in the YAR, and little known of the performance of those introduced.

TABLE 11

CITRUS TREES BEING PROPAGATED FOR SALE AND DISTRIBUTION AT JAROUBA, 1981*

Rootstocks

Species	Seed Planted	Seedlings
Sour Orange	58,650	46,138
Rough Lemon	31,200	39,120

Budwood

Species	Scion Variety	Number Buds
Grapefruit	Marsh White	5,000
Lemon	Frost Eureka	3,000
	Frost Lemon	3,000
Mandarin	Clementine	15,000
	Kara	10,000
Sweet Orange	Navelina	7,000
	Salustiana	7,000
	Valencia	30,000
	Washington Navel	20,000

*For sale in 1982. Numbers are estimated; about 70,000 trees will be produced.

The planting of seeds of the local material is poor practice. All reports of local seedling material is that it produces small fruit of inferior quality. The MOA requested this material be propagated because of demand and because nothing better was available. This is a reasonable request, but it does nothing to improve the yields or quality of fruit produced.

The dissemination of citrus varieties is quite another thing. There are already commercial plantings of both Washington Navel and Valencia sweet oranges in the country which yield very well and produce good quality fruit. These are recognized as the two best fresh fruit varieties of sweet oranges in the world, and the climates in which they attain their best quality are well known.

The introduction of Valencia and Washington Navel trees free of virus and from known high yielding selections will not necessarily increase yields over those already being obtained in existing plantings, but it will add to the total area planted to citrus, and thereby, the total productive capacity of the country.

Existing plantings of grapefruit, mandarins and limes are less common, but there is little, if any, question of the adaptability if planted in the proper areas in the YAR. Their dissemination will also add to the variety of citrus available and Yemen's total productive capacity.

The adaptability of lemons is less certain. It is likely that lemons will grow too vigorously in the hot Tihama region to attain maximum productivity per unit of land, but they might do well on appropriate sites in higher and cooler regions.

The cost of purchasing citrus trees from the U.S. is too great to warrant continuing the practice. Thus, the establishment of the nursery at Jarouba is a major achievement. Its slow development was due to no fault of the Contractor's Horticulturists involved. A producing nursery could not be developed until an adequate irrigation system and protection from animals became available. This and the development of other facilities only occurred recently. Even now the isolation of Jarouba and the lack of an adequate road to the site impose serious constraints on maintaining a nursery there.

The selection of the rootstock varieties used in the nursery is open to some question. Most of the rootstock material is sour orange, which is good. It is the standard rootstock in the YAR and performs well. The smaller quality of rough lemon seeds is the questionable point. It results in higher production of the scion variety but reduces quality. Its primary use has been in Florida, but it is rarely used in new plantings because of its susceptibility to a serious malady called blight. If a rootstock other than sour orange is desired, Carrigo and Troyer citranges should be tried.

The budwood to be brought from Spain (Table 11) includes mostly Valencia and Navel oranges which are grown in the YAR and perform well on appropriate sites. This decision is sound. Untested selections are also being brought in for budding and distribution. It would be appropriate to bring them in for testing but not for distribution without testing unless there is a clear

understanding with the growers of the risk involved.

Spain's budwood certification or registration program is good, but it has not been in operation as long as California's. California's program is tried and tested and of well established quality. The Willits and Newcomb, Inc. nursery has been shipping budwood, seed, and trees to all parts of the world for many years. On the basis of experience, it would be the best source.

No provisions have been made for storing budwood (refrigeration) or getting period shipments. Refrigeration should be available at the site, or the material must be kept under refrigeration and brought periodically to the site in a cooler. Budwood cannot be stored for long periods without deteriorating. It should be handled as rapidly and carefully as possible.

An increase in the production of citrus and other fruits in the YAR has the potential for making fruit more readily available to the general populace, and thereby, improving human nutrition. It also has the potential for reducing the dependence of the YAR on imports of the fruits involved. At this point, it is not possible to qualify either potential. At best, it is only a beginning which can be expanded in the ensuing years; however, it is an important start.

VI. PROJECT ACHIEVEMENT AND CONCLUSIONS

As objectively verifiable indicators of purpose achievement, the Project Paper lists:

1. Varieties identified for the major crops with yield potentials for 25 percent more than the commonly cultivated varieties.

   This was not accomplished. No introduced varieties have fruited. No yield data have been obtained from local varieties being produced in grower orchards or vineyards.

   It was unrealistic, in any case, to expect such quantifiable yield differences. Some of the project's adaptation work had purposes other than increasing yield. For example, the YAR already had the two best sweet orange varieties in the world, and their yield cannot be substantially increased. However, the introduction of virus-free budwood and new rootstocks for these varieties will guard against potential tree loss from virus diseases.

   Other varieties introduced may extend the season without changing yield. It is an advantage to the consumer to have fruits available over a longer period.

2. Cultural practices proven out which produce 20 percent more than conventional practices.

   Since no research was initiated on cultural practices, no improved practices were identified.

3. Baseline and projection analyses of the potential of selected horticultural crops were a function of the socioeconomic field studies that were postponed indefinitely.

4. Manpower trained and facilities established for use as adaptive research sites.

   Manpower was not trained. The research sites were established, along with cooperating grower sites; and MOA nurseries were assisted by furnishing them improved plant material for budwood sources.

   One research site (Bir al Shaif) is likely to be abandoned, however, and relocated. The Jarouba site still suffers from inadequate physical development; and it cannot serve as a model for the development of other stations.

We summarize here reasons the project fell short of its objectives.

Until recently, the Mission and the Government pursued different aims in the project - research and propagation, respectively.

The government supported the project only passively.

For its part, the Mission misunderstood the proper role of research in the Yemen situation, creating a dilemma. Without horticultural expertise, it believed that, in general, introduced varieties had to be tested and adapted before release to growers. However, it was not able to create facilities for research at this level, nor did it seek out advice as to varieties proven reliable elsewhere that almost surely would be adaptable to the various conditions in Yemen. The result was: professionally inadequate testing of varieties, many of which did not require testing; a reluctance to engage in a vigorous, straightforward propagation/distribution program; and failure to set up facilities for a higher level of research which, over a longer period, could contribute to new knowledge.

Agreements between the Mission and the YARG failed to assign responsibility to one or the other party for the essential tasks, notably the preparation of research station sites.

Resources were not concentrated to construct the stations on schedule; and the Mission, which took the responsibility, did not have the administrative and logistic capacity to do it.

No provision was made for contingencies - in particular, for construction of the Jarouba access road.

Delay in fielding a contract team postponed decisions on the planting program (but, when the team and the planting materials did arrive, the stations were still unready).

A productive relationship between the Contractor and the Mission was not established until recently.

Our view of these problems is that none of them need necessarily recur. Fresh relations with a new contractor will be established. With care, agreements with the government will be unambiguous. Project plans will be defined with a realism fostered by past experience.

Of great importance in speculating on the YARG's probable behavior is the fact that the project has produced some of the "visible results and benefits" which the government hoped for[1/] and which, we agree, have a value in themselves. (Among them: plantings of 20-25 species; nearly 100 varieties; a healthy banana stand; a good collection of mangos and papayas; important varieties of citrus, on several rootstocks; successful propagation of varieties such as apple, apricot, and peach; and distributions of trees to 25 locations.)

The start-up of the distribution program gave the project fresh energy and new contacts, and it strengthened the MOA/Mission relationship. These developments raise the prospect that the MOA may be ready to support and participate in the project. In our view, this is the most important variable in the equation of project success. (We will assume that the new contract team will be technically qualified.)

1/ The consensus of those we interviewed at the MOA is that, in the words of one of them, "the project is past its worst problems."

VII. RECOMMENDATIONS

Note: Our recommendations concerning a next phase of this project assume that a decision has already been made to proceed with further implementation of it.

GENERAL

In our view, the objectives of the project - in research, distribution, and extension - cannot possibly be met at the present level of effort. We recommend expansion of the field staff in differentiated activities (see Project Organization and Staff section below) and the creation of an organized, U.S.-based support group (see section on Staffing and Contract Team).

Whatever its disadvantages in location and environment, we accept that the Jarouba station be retained, provided the Jarouba access road is constructed. A second station is required for citrus research, however. In addition, an alternative to the Bir al Shaif station should be established for sub-tropical research.

While favoring the further development of the research activity, we recommend that the project's work in tree propagation and dissemination be extended - both for its own value to growers and consumers and for its effect on the project's image and on the government's attitude toward it.

Local research is not always needed before a new variety or cultural practice can be adopted. Much technology can be transferred immediately without it. Qualified experts can make judgments regarding cultural practices and variety improvements

on the basis of research elsewhere, and on common sense. The U.S. support group should assist the field staff in making decisions in this area.

We reaffirm the need for government participation in the project. From an administrative, if not a technical standpoint, the purely expatriate operation should not be perpetuated; foreign assistance will not continue indefinitely. Preparations enabling the Ministry of Agriculture to plan, staff, and monitor the activity, which have been postponed for four years, should begin.

1. The Ministry should be invited to participate substantively in the forthcoming work of redesign. The assumption (which has proved sound in Jordan and other Arab countries) is that collaboration in joint planning will foster a proprietary attitude toward the program and that this, in turn, will generate an interest in seeing that it succeeds.

2. In an interim period, before a new contract team arrives, the Ministry should be asked to participate in caretaker functions at Jarouba and Bir al Shaif.

3. At the same time, it should be asked to designate project functions which it is most likely to be able to staff thereafter. It is more important that the Ministry take an initiative than that any particular positions be filled. If it does not, the following counterpart positions should be considered:

. Project Co-Manager;

. Organizer of an Extension Program;

- Assistant in Horticultural Research; (The incumbent should be chosen on the basis of his qualifications for specialized training.)

- Assistant in Nursery Management; (The incumbent would also be a candidate for training.) and

- Administrative Expediter.

The AID Mission should ultimately remove itself from day-to-day operational management of the project. A more fully staffed contract group should be given delegated authority to operate autonomously, within prescribed budgets and work plans.

RESEARCH

Note: The following is by no means a complete research program. It does identify the highest priority issues that can be addressed within existing conditions.

- Research plans should be reviewed by the U.S. support group.

- Systematic recordkeeping methods should be established.

- Establish instrumentation for collecting climatic data at Sanaa, Jarouba, and Ibb. This information is necessary for calculating chilling hours and heat units.

- Revamp all variety plantings at Sanaa and Jarouba.

Sanaa

Reorganize plantings. Maintain only four trees of each test variety. Select material requiring up to 600 hours of chilling rather than the 200-400 chilling-hour limits initially set. This range was suitable for a preliminary program, but unnecessarily restrictive. Performance of peach varieties suggest 600 hours of chilling may be a more realistic figure, and it includes much superior varieties. Remove trees as soon as they prove unadaptive.

Contact those conducting fruit breeding programs at Texas A & M University and the University of Florida for suggested introductions. These two universities have the only meaningful program in the production of temperate zone fruit with low chilling requirements. These include apples, pears, peaches, plums, and apricots. There are, however, no low chilling apricot varieties in the U.S.

Maintain contact with the University of California at Davis relative to grape varieties.

More thoroughly investigate local material and that from Jordan and other mid-Eastern countries with conditions similar to Sanaa's.

Introduce varieties of Japanese persimmon, Mexican and Mexican X Guatemalan race avocados, and jujube.

Do not initiate work on cultural practices unless staff is added and budget increased. Then concentrate on low volume (micro-jet and drip) irrigation. Such practices as fertilization, pruning, and pest control can be transferred without research. They can be refined thereafter.

Jarouba

Reorganize variety planting. Navel oranges will probably prove of too poor quality, but Valencia might be satisfactory. Obtain the various strains of Valencia. Use one rootstock (sour orange) for all sweet orange scion varieties in the test planting.

West Indian (Key, Mexican) and Tahiti (Persian, Bearss) limes should do exceptionally well. Use *Citrus macrophylla* as rootstock.

Grapefruit should do well. Limit varieties to Marsh White, Redblush (Ruby Red), Star Ruby, and Henderson Redblush.

Mandarins are worth a try. Clementine (Algerian), Minneola tangelo, Temple (Royal), and Orlando tangelo have the most potential, but others can be tried also.

Don't waste time with varieties that have nothing to offer in Jarouba's climate.

Initiate rootstock trials for West Indian limes. A rootstock such as Carrizo might reduce tree size, but increase yield per acre. Rangpur might reduce water requirements. Initiate rootstock trials for other varieties as time becomes available.

Do not initiate research on cultural practices other than irrigation and windbreaks. Direct technology transfer is more appropriate. Refinements of this technology or the development of unique problems may require other research later.

Irrigation research should emphasize low volume (microjet, drip) systems, and the regulation of bloom through withholding water to stress the tree, followed by irrigation to cause a strong bloom. This will require additional staff.

Windbreak research should involve establishing the possible need for windbreaks. If needed, test various plants for their effectiveness and competition with the respective crops. Use windbreaks only if absolutely necessary. Windbreaks are effective no more than ten times their height, and maximum effectiveness only five times their height.

The number of tropical fruit species is more restrictive than need be. Additional varieties should be tested. (note: This will need to be considered during the redesign phase.)

Another Location

Citrus holds more potential than any other fruit crop, but Jarouba is too hot for production of best quality sweet oranges and some mandarins. Lemons will also probably do best in a cooler climate. Either establish another station at Ibb or Taiz or closely coordinate work with the experiment center at Taiz.

TREE PROPAGATION AND DISSEMINATION

Sanaa

Establish a better nursery. Loss of cuttings and seedlings is too high. It is not possible to describe in detail how to establish a modern nursery within the confines of this report, but major improvements in physical facilities and techniques are needed. Obtain a short-term consultant to initiate this.

Jarouba

Improve techniques. Seedling losses have been too high, virus contents of bud source trees are not known, and bud source trees

are not properly protected from viral infection. (See Annex 6.)

Use only sour orange rootstock until viral content of bud source trees is known, and don't use trees obtained from Florida as bud source trees. (See Annex 6.)

Don't disseminate sweet orange varieties other than Navel oranges and Valencia on a commercial scale and limit Navels to elevations no lower than 400 or preferably 500 meters. Of course, test plantings can be established at all elevations.

Obtain a short-term consultant to visit the YAR and set up a citrus nursery program.

EXTENSION

Expansion of the project's tree distribution program creates the need for a systematic follow-up extension program. We recommend the following.

- Create an extension unit in the project organization in Sanaa.

- Create a satellite extension farm system. Under this arrangement, successfully tried in East Africa, progressive farmers are selected and trained to work as extension agents in each agricultural region, in return for plantings of improved tree varieties supplied gratis by the project. They develop contacts with other growers in the area, open their farms to inspection, and make advance arrangements for field days.

- Develop extension education at the Ibb Agricultural Secondary Institute.

- Organize a one-week seminar for Extension Service officials and the heads of regional agricultural offices to familiarize them with the aims and methods of the activity.

PROJECT ORGANIZATION AND STAFF

We propose the gradual enlargement of the contract team to staff the following sub-activities, each under the general direction of the contractor's Chief of Party. Ultimately, the organization would be taken over, with modification, by the Ministry's Horticulture Division.

Administration and Operations

The project has operated to date with a single secretary/administrative assistant. The project should be logistically selfsufficient. Administrative support should be provided at each research station. Equipment maintenance and supply procurement capabilities must be established. A direct line of communication between Jarouba and Sanaa, or Jarouba and Hodeidah, is required. Continuing maintenance of research station facilities and irrigation systems must be assured.

These activities require one contract team member and two, perhaps three, local personnel, hired, or, transferred to the project by the Ministry.

Tree Propagation and Distribution

This unit would manage research station nurseries for the propagation of varieties recommended by research and extension staffs. It would establish budwood-source and seed-source trees. It would assist the Ministry of Agriculture in tree dissemination and plantings. It would also establish sanitary and other procedures to be followed in all MOA nurseries. The staff would consist of a horticulturist with experience in nursery practices (he need not have scientific qualifications) and a field technician for each field station.

Research

Depending on the scope of the research program adopted, this activity will require upwards of two horticulturists, two field technicians, and two research assistants. It will maintain close communication with the U.S. support group (see below), so that the horticulturists need not be recognized authorities in their fields.

Extension

One horticulturist with experience in extension work, an MOA counterpart, and at least two qualified extension workers with experience in extension training, are required.

Note: The planning and development of new research station sites will require the temporary services of an individual, perhaps from a U.S. agricultural experiment station, with experience in research station planning, in construction, and in land and

irrigation system development. A provisional committee, of which he would be a member and which would include horticultural research staff, would establish experiment station layouts, building plans, irrigation system plans, equipment and laboratory needs, record files, and recordkeeping systems. (We assume that, as recommended, new research stations will be established, see above, and that research activities at Jarouba will be redesigned.)

STAFFING OF THE CONTRACT TEAM

We think it should be accepted that the contracting university for this project will be unable to recruit its best faculty for two-year assignments in Yemen, and that it will be unable to recruit top staff from other universities. The ranks of such people are thin, even in universities with the largest and most distinguished horticulture departments. The departments are reluctant to release them, and they themselves are unlikely to jeopardize ongoing research and chances of career advancement by long absence from their campus.

Recognizing this, we recommend that young horticulturists with lesser experience and academic achievement, but who see personal advantages in an overseas experience at this stage of their careers, be targeted for the field staff.

It will then be necessary to organize and retain a highly qualified U.S. support group, of which the two or three members agree to maintain continuous contact with the field operation. They should be formally organized, with a subcontract, if necessary.

They would be chaired by a horticulturist from the contractor's campus, and recruited from other universities, or institutes, or the private sector. They would maintain technical correspondence with field horticulturists, and agree to be available for program consulting visits.

TRAINING

Other than the following, we are making no recommendations with respect to training.

Long-term training needs (in general horticulture and its branches) are obvious. The issue is whether and when candidates can be found with educational prerequisites qualifying them for such training.

The answer, we think, is to anticipate. We suggest, for example, that a survey of secondary schools be made to identify promising students who, in a year or two, might fulfill the requirements. Contact with them would be maintained, perhaps employing them at the research stations during school vacations and otherwise cultivating their interest in the profession - always with the prospect of university training abroad for those who qualify.

Programs for in-country training in extension should be developed promptly. The Extension Service is in a position, we understand, to detail employees (agents) to the project for that purpose.

Short-term training for personnel at the field technician level will be useful to circumvent the language problem. Consider Arab countries such as Jordan and Morocco.

OTHER

The originally planned economic baseline studies should be initiated. Their aims were valid. (According to one MOA official, the Ministry is more receptive than in the past to research of this kind.)

Since there is no national organization or system of communication in Yemen that coordinates on-going agricultural research under various government and donor auspices, we recommend that this project take the leadership in creating such coordination for the horticultural sub-sector. It should do this first by setting an example, that is, by itself establishing communications and exchanging materials with other parallel research activities. Second, it should pass on the record of these contacts to the National Agricultural Research Center, in Taiz, with a formal recommendation that this Center carry on and develop this function.

A CAUTION

As we have said repeatedly in this report, one of the more serious errors of the past is that plantings, both of research and propagation materials, have been made without adequate planning and without the prior development of physical facilities. Immediate losses have been considerable, and the long-term value of research work to date has been minimized.

Thorough preparation should be the dominant theme in the next phase. Understandings with the government and the contractor should be as thorough as possible. Commitments should be spelled out for jointly managed activities. Conditions precedent should

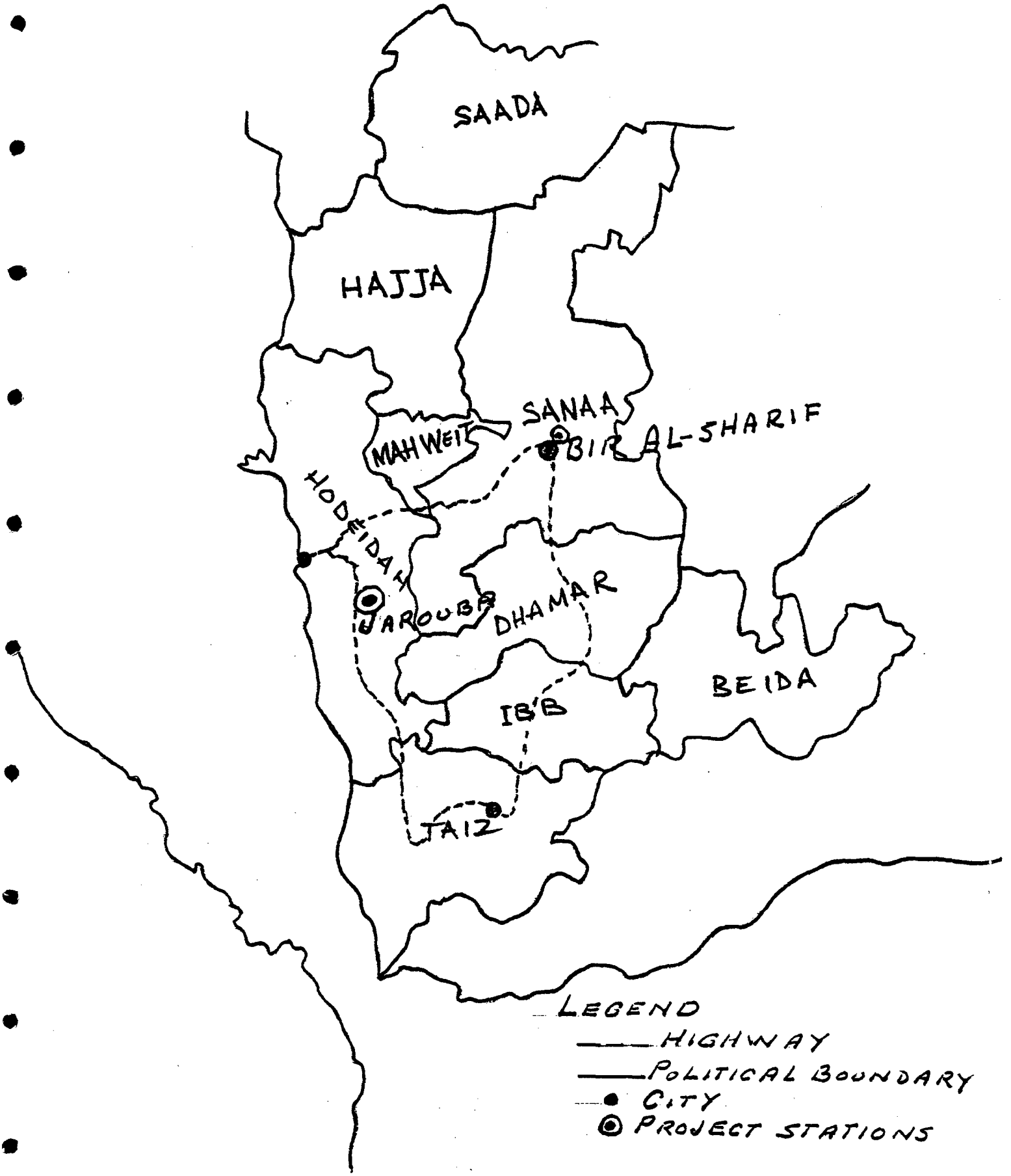
be established for important undertakings such as construction of the Jarouba access road. Finally, the U.S. support group should be mobilized promptly, so that research plans can be settled upon at an early date.

ANNEXES

ANNEX A. GLOSSARY

AID/W	- Agency for International Development/Washington
AOAD	- Arab Organization for Agricultural Development
CARS	- Central Agricultural Research Station
CARTC	- Central Agricultural Training Center
CID	- Consortium for International Development
COP	- Chief of Party
CPO	- Central Planning Organization
CYDA	- Confederation of Yemeni Development Association
FAO	- Food and Agriculture Organization
FRG	- Federal Republic of Germany
IASI	- Ibb Agricultural Secondary Institute
IBRD	- International Bank of Reconstruction - World Bank
LOP	- Life of Project
MOA	- Ministry of Agriculture
MOE	- Ministry of Education
NMSU	- New Mexico State University
PACD	- Project Activity Completion Date
PROAG	- Project Agreement
PIO/C	- Project Implementation Order/Commodities
PIO/P	- Project Implementation Order/Participants
PIO/T	- Project Implementation Order/Technical Service
PP	- Project Paper
RDO	- Rural Development Officer
SOW	- Scope of Work
SURDP	- Southern Uplands Rural Development Project
TDY	- Temporary Duty
TDD	- Terminal Disbursement Date
TDA	- Tihama Development Authority
TI	- Tuskegee Institute
UK	- United Kingdom
UNDP	- United Nations Development Program
USAID/Y	- United States Agency for International Development in Yemen
YARG	- Yemen Arab Republic Government

ANNEX B. YEMEN ARAB REPUBLIC



ANNEX C. REFERENCE MATERIALS

Project Paper - 1976

ProAg 76-7 and amendments

PIO/T's, PIO/C's, PIO/P's

Contract No. AID/NE-C-1358, Tropical and Subtropical Fruit Improvement - Project 279-11-995-024

Contractor - Trip Reports

Contractor - Progress Reports

Chron Files

Country Development Strategy Statement - FY 1982 - Unclassified

Project Files

Demographic Compilations

TDA Extension Plans

CID Baseline Study Report

Area Handbook for the Peripheral States of the Arabian Peninsula

ANNEX D.

SOME STATISTICS ON YAR AGRICULTURE* AND EXTENSION**

Value of Agricultural Imports	1977/78 - YR	1,579,953,000
Value of Agricultural Exports	1977/78 - YR	19,550,000
Cereal Imports	1977/78 - YR	369,209,000
Fruits and Vegetables	1977/78 - YR	1,579,953,000

Tihama Region*

	Hectares
Land Area	1,358,000
Under cultivation	235,000
Irrigated	
Spate	100,000
Rainfed	99,000
Pump well	60,000
Perennially	5,000
Land Use*	**Percentage**
Sorghum and millet	90
Vegetables	5
Industrial crops, dates, bananas	5

AGRICULTURAL EXTENSION SERVICE BY REGION

July 1979**

Region	No. of Centers	No. of Extension Workers
Tihama	20	127
Southern Uplands	55	88
Southern Highlands	6	9
Northern Highlands	-	-
Eastern Slopes	2	6
	83	240

*TDA Extension Reports
**CID Baseline Study

ANNEX E. YAR AGRICULTURAL REGIONS*/ PROVINCES/POPULATIONS**

		Population
1.	Tihama Desert	
	Hodeidah	1,087,500
2.	Southern Upland Slopes	
	Ibb	1,328,600
	Taiz	1,553,700
3.	Southern Highlands	
	Sanaa	1,800,000
	Damar	784,000
	Mahwit	296,000
4.	Northern Highlands	
	Hajjah	900,000
	Sa'adah	337,000
5.	Eastern Slopes	
	Marib	110,000
	Bayda	319,000
	Total	8,525,800

*CID Baseline Study
**Cooperative Preliminary Census

ANNEX F. CITRUS ROOTSTOCK - VIRUS RELATIONS

ROOTSTOCKS

Almost all citrus is budded onto one of several rootstocks for one or more of several reasons:

. To avoid juvenility - Most citrus varieties will produce true to type when grown from seeds because each seed has vegetative (non-sexual) embryos that crowd out most of the sexual ones. Such seedling varieties of sweet oranges and grapefruit take eight to ten years to come into production; however, while trees propagated by budding (with buds taken from non-seedling trees) will fruit within three to four years. Moreover, seedling oranges and grapefruit are extremely thorny and bear erratically for a number of years.

  Mandarins will usually produce fruit within five years from seed and fruit regularly thereafter. Lemons require only two to three years to fruit following planting the seed, but many are from sexual embryos and not true to type. West Indian (Mexican, Key) produce within one to two years from seed and millions of them are propagated from seeds. Even in the case of West Indian limes, however, it is better to use rootstocks.

. For tolerance of salt and/or high pH.

. For resistance to nematodes.

. For resistance to Phytophthora citrophthera and P. parasitica, a disease causing rotting of roots and/or the lower trunk.

. To increase yields, improve fruit size and/or quality.

. For resistance to or tolerance of virus diseases. This is an extremely important problem.

VIRUSES

There are four virus diseases of major importance: (1) psorosis, (2) xyloporosis or cachexia, (3) exocortis, and (4) tristeza.

Psorosis, often called scaly bark, was once a devastating disease in the United States. One cannot defend against it by using resistant rootstocks because it is not rootstock related.

Fortunately, psorosis is only transmitted by propagating with buds taken from infected trees. It has been illegal in the United States for many years to propagate trees with buds taken from psorosis-infected trees. Thus, any Registered or Certified tree purchased in the U.S. will be free of psorosis.

Psorosis does not damage trees until they are 10-15 years old or older. Thus, one cannot determine whether a nursery tree has psorosis by searching for the damaging symptoms.

Xyloporosis, also called cachexia in some countries, is, like psorosis, transmitted only by propagating trees with buds from

infected trees. Unlike psorosis, however, rootstocks vary in their resistance or susceptibility to it.

The effects of xyloporosis are stunting of the tree, often S-shaped trunks, and pitting and gumming beneath the bark of the rootstock.

The disease cannot be identified by merely observing nursery trees, since symptoms do not develop until trees are several years old.

Exocortis, is called a viroid, but for all intents and purposes, it acts like and is treated as a true virus.

Exocortis is transmitted on budding knives and pruning tools as well as by the use of buds from infected trees. This makes it a particularly dangerous virus because a knife or pruning shear used on an infected tree will infect a clean tree by merely cutting or pruning it.

Knives and shears can be sterilized by dipping them in a 50 percent Chlorox-water solution for a few minutes. Be sure to wash tools thoroughly with water after sterilization because the solution will cause the knives and shears to rust.

Rootstocks vary as to their susceptibility and resistance to exocortis and some of the most important tristeza-resistant rootstocks are susceptible to exocortis.

Exocortis causes a scaling of the bark of the rootstock and stunting of the tree.

Tristeza is a dreaded virus desease, because severe strains of this virus have killed millions of trees in some countries.

On the other hand, it has existed for over 40 years in Florida and caused only modest damage. It is not found in many parts of the world, including Texas, Arizona, Mexico, Central America, and the Caribbean Islands. It is severe in parts of California, South America, South Africa, the Far East, and Spain. It has not been reported from the YAR where citrus is grown on the most susceptible rootstock (sour orange).

Tristeza is transmitted by propagating with buds from infected trees, but primarily by aphids. The most dangerous aphid is Toxoptera citricidus, which is not found in Yemen.

There are mild and severe strains of the above viruses. Mild strains of exocortis are at times used to dwarf or control the tree size of Washington navel oranges or on trifoliate orange rootstock in Australia.

Brazil infects many of their trees grown on Rangpur lime (normally considered highly resistant to tristeza) with mild forms of tristeza to immunize or protect them from a strain of tristeza (found only in a part of Brazil) that kills trees regardless of the rootstock.

Certified trees do not necessarily mean the trees are free of all viruses. Florida cannot certify trees free of tristeza, for example, because tristeza-free trees in a nursery could be infected at any time by aphids moving to it from infected trees. A certified tree will have been grown on a nematode-free site, but it could have xyloporosis, exocortis, or tristeza. The nursery is required to indicate which virus(es) are carried by the budwood or trees purchased.

It is possible to get trees certified free of all viruses except tristeza in Florida and of all viruses including tristeza in California. The Florida Budwood Registration Program maintains a few trees of important varieties in a screenhouse which are kept free of all viruses including tristeza. They will ship only a few buds of each variety they have to other countries for cost of cutting and shipping.

Since trees on resistant rootstock may carry a virus without showing symptoms, it is necessary to index them to determine if a tree does or does not have a virus. An index plant is one that is usually so sensitive to the virus that it will show specific symptoms indicatingthe presence of the virus in a relatively short time. The common index plants are:

. psorosis - sweet orange;
. xyloporosis - sweet lime;
. exocortis - a special citron; and
. tristeza - West Indian (Key, Mexican) lime.

It takes a certain expertise and experience to test for these diseases with certainty.

There is a new simpler test for tristeza called the ELIZA test that is based on serology. It is a simple test, but requires proper training to use it. The Key lime test would probably not work at Jarouba, because it is too hot. Tristeza can be killed in a plant by holding it in an extremely hot environment, and symptom expression does not usually occur in Key lime in hot climates.

ROOTSTOCK - VIRUS SUSCEPTIBILITIES

The table below indicates the susceptibility of various rootstocks to the various viruses. Psorosis, as has been mentioned previously, is not affected by rootstock, so it is not included in the table.

SUSCEPTIBILITY OF COMMERCIAL CITRUS ROOTSTOCKS TO VIRUSES*

Rootstock	Virus		
	Exocortis	Xyloporosis	Tristeza
Sour Orange	No	No	Yes
Rough Lemon	No	No	No
Cleopatra Mandarin	No	No	No
Rangpur Lime	Yes	Yes	No
Sweet Lime	Yes	Yes	Yes
Trifoliate Orange	Yes	No	No
Carrizo Citrange	Yes	No	No
Troyer Citrange	Yes	No	No
Citrus Macrophylla	Yes	Yes	Yes
Volkamer Lemon	No	No	No

*Yes, indicated susceptibility; no indicates it is not susceptible to the virus.

Those in the YAR propagating citrus must maintain budwood-source trees free of exocortis virus if certain rootstocks that are tolerant of tristeza but susceptible to exocortis are to be used. These include Carrizo and Troyer citrange, and Rangpur lime (see above table).

The most likely substitute for sour orange will be Carrizo citrange or Troyer citrange.

EFFECTS OF ROOTSTOCKS ON YIELD AND QUALITY

So much attention is given to viruses that yield, fruit quality, and size are often forgotten. Regions like Brazil and Florida produce most of their oranges for processing, in which they blend the juice of various qualities to maintain a standard. They use rootstocks like Rangpur lime (Brazil) and rough lemon (Florida), to get high yields, accepting a lower juice quality. Florida no longer plants on rough lemon, however, because of a malady called Blight which has killed many trees.

Using rough lemon budded to sweet orange as a standard for yield, it can be said that Rangpur lime yields equally as well. Volkamer lemon and Citrus macrophylla induce yields as good or even better than rough lemon. These same rootstocks also induce the largest fruit sizes. Unfortunately, this group produces fruit of eating quality considerably below that of sour orange.

Carrizo and Troyer citranges are very similar in yield and size of fruit induced. Careful research indicates yields of Carrizo are slightly higher than Troyer. Both produce yields higher than sour orange but lower than rough lemon and the others in the lemon-lime group.

Sour orange produces excellent yields on fertile soils, such as are found in the YAR, but not quite as high as those on Carrizo and Troyer. Yields on sour orange are poorer when grown on infertile sand.

The fruit quality for trees grown on Carrizo Troyer and sour orange are about equal and considerably higher than that produced on rough lemon and the other lemon-lime types.

Cleopatra mandarin produces fruit of sour orange quality, but fruit sizes are always smaller than on other commerical rootstocks and, most importantly, yields of trees on Cleopatra are usually quite low for the first 10-15 years, particularly when Valencia and Navel oranges are budded on it.

NOTE: This discussion is not a complete review of rootstocks. The above discussion on quality and yields relates primarily to rootstocks with sweet orange and grapefruit budded onto them. Most of the information holds for the others also, but there are important additional factors to consider when lime and lemon scion varieties are used.

One of the most important things to be aware of is that the best virus-free trees imported into the YAR can become virus infected, particularly with exocortis, if they are not isolated by protecting them with appropriate fences and locks and by proper sterilization and use of knives and pruning shears. This practice is not being followed at either Jarouba or other MOA nurseries. Such rules and precautions should be put into effect immediately!

ANNEX G. THE SCIENTIFIC APPROACH AND RELATED SUGGESTIONS

The success of research depends on use of the scientific approach, a concept accepted by the scientific community, but all to often forgotten. It has been stated several ways, but, in essence, is as follows:

- Delineate the problem. Too often research is started without a full understanding of the problem that exists. The problem should be stated in simple, clear terms and be limited in scope.

- Learn everything that is known about the problem and previous and related research that has been conducted. Review the literature. Talk and correspond with colleagues. Be thorough.

- Develop a plan for solving the problem or discrete parts of the problem. If possible, design so results can be submitted to statistical analyses. This will be of benefit even if statistical analyses are never used, because it makes certain the approach will enable the scientist to apply differential treatments in such a manner that they will not be confounded or confused when the final results are tabulated.

  Keep the plan as simple as possible. Submit the plan to colleagues for criticism and suggestions. Research is time consuming and expensive. Don't waste it on an ill-conceived or poorly planned experiment.

- Conduct the research carefully and meticulously. Take notes and record data systematically in a hard-backed, bound record book. Never use loose paper. Keep dual records if possible. Nothing is as useless or as frustrating as lost data. Keep one notebook in the office and never remove it. The other can be taken to the field.

  Never erase an entry or a note. Strike through the error with one slash line ~~(25)~~ ~~ok~~, and initial it. Date every page and initial notes and data taken. Use ink wherever possible. Typed data obtained from a field notebook can be affixed to a page in the permanent office record book with tape, but be certain to refer to the page in the notebook from which the data were taken. A xerox of field notes is better than typed copies.

- Interpret the data in a logical fashion. Don't use statistics to a fault. Use common sense and judgment as well. If the results suggest the experiment was improperly designed or, if some damage occurred to the experimental plots that render the results invalid or questionable, accept that fact and redesign the work properly.

  Submit your results and interpretations to colleagues for review.

. Finally, write up the research in such a way that the problem, the approach, the results, and the interpretation of the results are clear. Include how the results, as interpreted by the researcher, can be of use to the grower or other researchers. One can speculate to some extent at this point, making certain that it is clear when one is speculating.

. Don't publish data or disseminate it until the work is completed and interpreted. Don't say, "My work is not complete, but it appears as if . . ."

Note: Records are the very foundation of research. Two types of record books should be kept in a field experiment station involved with plant introduction:

. The record book in which data and notes are recorded.

. A Plant Accession Record Book in which each plant introduced into the varietal test block or varietal collection is recorded in chronological order and given a station number. For example, a variety introduced into the Jarouba collection might be listed as JA-1. The date, the source, and any information as to the virus content should be placed alongside the number. If the introduced material is received from stations with identifying numbers, such numbers should be placed in brackets immediately after the

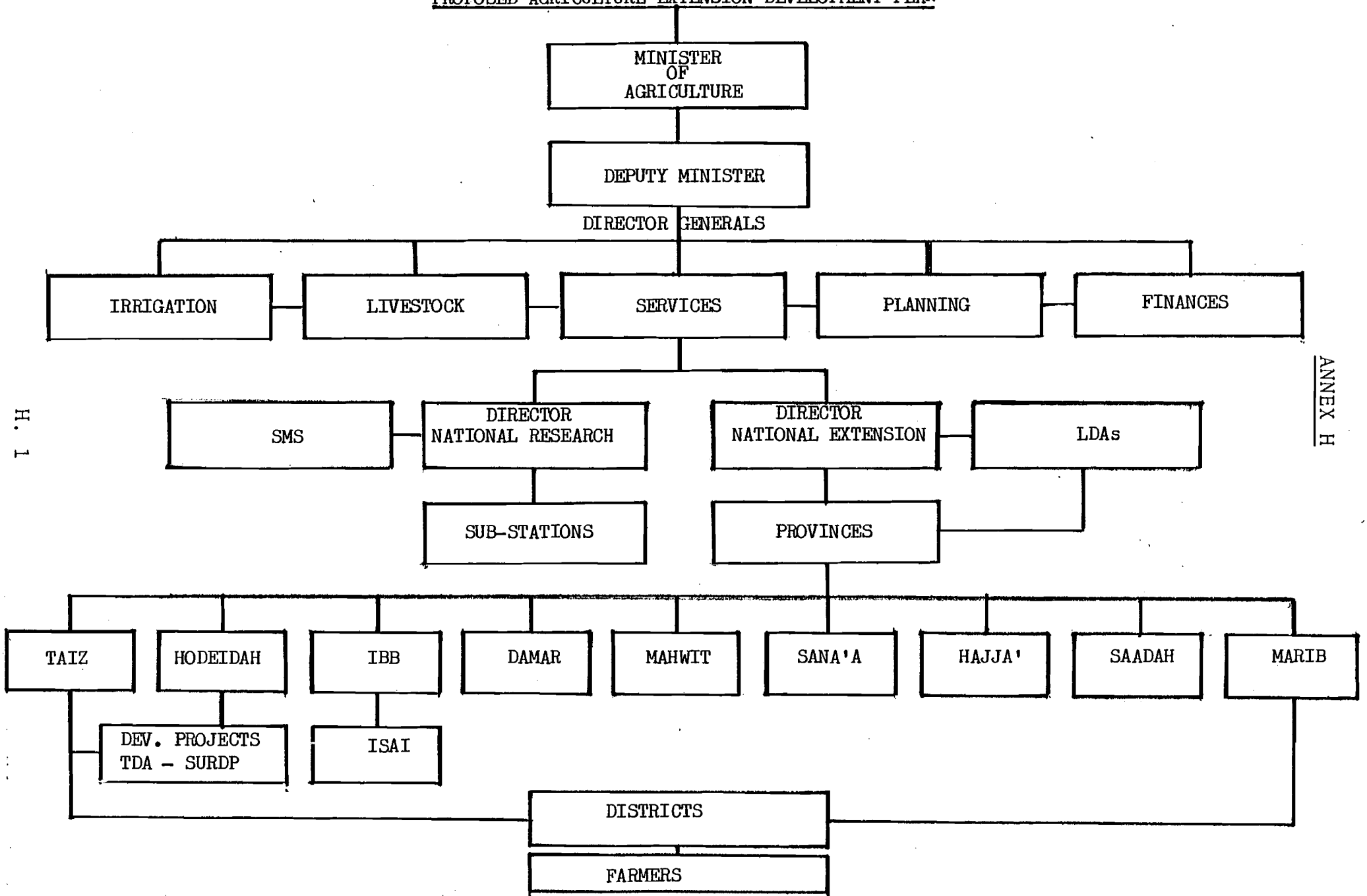
local Plant Accession Number. Citrus budwood or other material will have a budwood registration number or certification number identifying the parent tree front which the budwood was obtained. This should also be included because one can obtain information as to its virus status with this number.

Any material propagated vegetatively from the introduced material should carry only the local experiment station accession number to avoid confusion. Its history can be traced through this number

Note: These suggestions are included because the existing plantings and plans of work do not appear to have taken the above into account.

YEMEN ARAB REPUBLIC

PROPOSED AGRICULTURE EXTENSION DEVELOPMENT PLAN



ANNEX H