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YAR HORTICULTURAL PRODUCTION, EXTENSION AND TRAINING PROJECT

INTERIM REPORT

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EXECUTIVE SUMMARY

1. Fruit production in Yemen is and will continue to be a very profitable enterprise. The present strong demand of the consumers for fresh fruit at high prices and of the farmers for seedlings is likely to accelerate. Preliminary crop budgets for representative tree crops show net revenues of US $15,000-20,000/ha/yr and internal rates of return of 33% to 45%.

2. The project should concentrate on mass production of seedlings from selected high-bearing local trees (in particular mangos, limes, local deciduous fruit), the gradual introduction of low-chilling-requirement deciduous fruit (peaches, apples), and the provision of an effective horticultural extension service. Large-scale introduction of tree crops which have high pest control requirements, such as oranges and apples, should be discouraged. In particular, the production of budded orange trees should be de-emphasized and shifted from the Tihama to the middle altitudes.

3. Project beneficiaries fall into two classes: backyard growers who plant an average of about 10 trees each, and orchard growers who plant an average of about 100 trees each. Backyard growers are both small and large farmers who have access to water. These would benefit from better nutrition and some salable surplus. Orchard growers are typically

middle-income progressive farm owners-operators. Agricultural labor would benefit from higher wages and the rural population from increased availability of fresh local fruit.

4. To assure the effective operation of the project during and especially after the period of USAID support, the seedling production stations must be granted financial autonomy from the Ministry of Agriculture. The Jaruba station should be integrated into the Tihama Development Authority, and the Al-Irra station near San'aa should be constituted as a public service enterprise for seedling production. Both stations should be able within 3 years to cover their operation, maintenance and horticultural extension costs through the sale of seedlings. The Interim Report wholeheartedly endorses the horticultural project if this institutional framework can be provided as a condition precedent for project financing.

5. A short-term Arabic-speaking legal/institutional specialist should be engaged during the PP design period to investigate, in consultation with YARG authorities, the legal ramifications and to recommend the appropriate legal framework for a financially self-supporting organization for seedling production and horticultural extension.

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LIST OF ABBREVIATIONS

MOAF - Ministry of Agriculture and Fisheries

SURDP - Southern Uplands Rural Development Project

TDA - Tihama Development Authority

YARG - Yemen Arab Republic Government

RATE OF EXCHANGE

YR 4.55 = US $1.00

INTRODUCTION

Relative to the apparent potential of the country, fruit production in YAR has been small. Fruit crops (primarily grapes), however, have been successfully produced in Yemen for thousands of years with very limited inputs (little if any fertilization, pruning, or pest control). Present demand for fruit and fruit products (such as juices) is high and rapidly growing, and because returns to growers are quite high, there is evidence of considerable interest by Yemeni farmers to expand fruit production.

USAID has been involved in assisting fruit crop development in YAR since 1977 through the horticultural project managed by the Tuskegee Institute. The main achievements of this project has been the construction of physical facilities at the Jaruba and at the Bir al Shaif horticultural stations. As a first step in designing a follow-on effort of assistance to horticultural development in YAR, the CID (Consortium for International Development) has submitted in early 1982 a PID for a Horticultural Production, Extension and Training project. As several issues, notably the economic feasibility of fruit production in the YAR and the beneficiary analysis, have not been sufficiently addressed by the PID, USAID has requested the present Interim Report to provide additional information on these and other issues, so as to be in a better position for making a decision regarding the continuation of the

PP design effort.

The Interim Report has been prepared by the present Consultant with the active participation of the CID PP design team, in particular Dr. Mervin Klein (Sec. 1 - The Market for Fruit in YAR) and Dr. Thomas Stevenson (Annex A - Preliminary Beneficiary Analysis).

1. THE MARKET FOR FRUIT IN YAR

Fruit Production and Imports

1.1 Figures from 1976/77[1] show that fruit production in the Yemen Arab Republic (YAR) amounted to 25,000 hectares, of which 10,000 hectares were in grapes and 15,000 hectares in other fruits. These other fruits include tropicals such as mango, papaya, banana, and date; subtropicals such as citrus (primarily lime); deciduous temperate-zone crops such as fig, peach, apricot, pomegranate, pear, quince, apple, walnut, and almond. These fruit crops accounted for approximately 2.2% of the total agricultural area in YAR (1,129,900 hectares).[2]

1.2 Grapes are the major domestically-produced fruit crop (55,000 MT in 1979/80, compared with 76,000 MT for all other fruit). Domestic production of grapes has been increasing from 1972/73 to 1980/81 at an average rate of 2600 MT/year and that of other fruit at about 2100 MT/year. Fruit production is concentrated in San'aa Governorate (38% of the total fruit area, mostly in grapes), followed by Hodeida (21%), Ta'iz (17%) and Ibb (11%).

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[1] Final Report of the Swiss Airphoto Interpretation Team, Zurich, April 1978.

[2] Not including qat (*Catha edulis*) which is clearly the most important tree crop and provides farmers with high returns.

1.3 YAR imports of fresh fruit in 1979/80 amounted to about US $100 million. About 72% of fruit imports consisted of apples (US $34 million), bananas (US $23.5 million) and oranges (US $14.5 million). There has been a dramatic increase in fruit imports from 1978/79 to 1979/80: an 81% quantity increase in apples, 36% in bananas and 14% in oranges.

1.4 Total fruit consumption in YAR is roughly 250,000 MT/year. Projecting a population growth of 2% and a GNP growth of 4% annually (which are conservative assumptions), fruit production must increase by 7500 MT annually at once (which is impossible due to the time lag of fruit production), by 8400 MT/year in 1985 and by 9800 MT/year in 1990, just to hold fruit imports at their present levels. The above are preliminary estimates which may be adjusted in the PP, but are felt to be conservative. These figures correspond very roughly (depending upon yield level and crop mix) to about 500 new hectares which must be planted annually to keep fruit imports at their present level.

Market Structure

1.5 There are two distinct markets in fruit products in Yemen: the import market, which is considerably controlled by the government, and the market for domestic products, which operates relatively unfettered by the public sector.

1.6 In the import market, most products are handled by a small number of government-licensed importers who usually sell to numerous wholesalers operating in the urban areas. The wholesalers then sell to the highly competitive retail market which entails retail stores, supermarkets and the small local stands which populate the city streets.

1.7 Because prices and margins are controlled in the import market, there is little price variation throughout the season, although importers and wholesalers appear to have some flexibility in reducing prices moderately in response to market conditions. Retail prices in 1982 for some of the major imported fruits were: apples 7.50 YR/kg, oranges 6.00 YR/kg, and bananas 6.00 YR/kg. Wholesale prices in 1980 were approximately 6.00 YR/kg for apples, 3.20 YR/kg for oranges and 3.80 YR/kg for bananas.

1.8 The market for domestic fruit is less articulated, inasmuch as the produce passes fairly directly from grower to retail. Price comparisons between the import and domestic products are difficult because of the lack of comparable products.

1.9 The differences in prices between cities is also significant in the domestic market, and it presents potential coordination problems in the event that domestic fruit production is expanded. The price range for domestically-grown apricots for five cities in 1980 was from 12.0 YR/kg in Dhamar to 16.1 YR/kg in San'aa.

Razigi grapes varied form 18.3 YR/kg in Dhamar and Ibb to 13 YR/kg in San'aa, and lemons from 14.5 YR/kg in Hodeida to 17.6 YR/kg in Ta'iz.

1.10 In all likelihood, the independent entrepreneurial spirit of the Yemeni private carriers will be equal to the task of handling the fruit transport function for the foreseeable future. Thus a public (government or co-operative) marketing organization for locally-grown fruit does not appear necessary for development of domestic fruit production. The marketing of local fruit may best be assisted by:

a) better market information (e.g. daily radio broadcasts of the prices for various fruit in the different cities);

b) improvement of the access roads to the major fruit-growing areas (e.g. Hamaam Ali);

c) establishment of cold-storage facilities.

2. THE ECONOMICS OF FRUIT PRODUCTION IN YAR

Choice of Fruit Species

2.1 The horticultural project should be designed to draw on the strengths already present in Yemeni agriculture (such as the tradition of fruit growing, the enterprising nature of the Yemeni farmer, and the relatively satisfactory fruit marketing system), while minimizing its exposure to the present weaknesses of Yemeni horticulture (the extreme shortage of trained extension agents and nurserymen, the absence of disease-free nursery stock, and the difficulty of pest control on small, scattered plots). In consequence, the project should concentrate on fruits traditionally grown in Yemen, for which the markets are known, and for which there is a general body of indigenous information on care and maintenance. Furthermore, emphasis should be placed on species which require minimal care aside from watering, and which will grow without heavy, if any, applications of chemical fertilizers and pesticides.

2.2 Based on climatological adaptability, market demand, and the capabilities and limitations of Yemeni fruit growers, the following fruit species should have priority for the horticultural project in each of the climatic zones:

a) The high plateau (e.g. the San'aa region): grapes (production can be considerably increased by simple measures of better crop husbandry); apricots; introduction of low-chilling-requirement peaches and apples; more

propagation of minor species (pomegranates, almonds, pears, quince, etc.) from selected local seeds and cuttings.

b) The middle uplands (e.g. the Ta'iz region): limes, lemons, mandarins; mangos and guavas at lower altitudes.

c) The Tihama lowlands: mangos, limes, bananas, papayas, some guavas and anonas (custard apples).

2.3 Oranges (which have been until recently the main occupation of the USAID-supported Jaruba station) are actually the species which should receive the least priority, for the following reasons:

a) The technology is the most complicated (budding is required, whereas limes can be grown from seeds).

b) Oranges are exposed to a large number of diseases and pests, run the risk of introducing new pests and diseases, and require pest control measures which are at present beyond the capabilities of the Yemeni farmers and extension service.

c) Under the best of conditions, oranges do not give a higher return than other fruit species.

d) Oranges are the tree crop least suited to small farmer production. Whereas a farmer can plant a few lemons or mangos in his back yard or along an irrigation canal, oranges require orchard-type production.

2.4 Because of the above considerations, oranges should receive the lowest priority in the proposed horicultural project. If a limited production of orange budded trees is undertaken, this should be done in the Ta'iz region and not at Jaruba, which is climatologically poor for orange production.

2.5 Similarly, the introduction of low-chilling-requirement apples should proceed cautiously, given the high tree husbandry and pest control requirements of apples, the lack of knowledge of the micro-climatic zones in the highlands which are adequate for apple production, and the lack of familiarity of Yemeni growers with this fruit crop.

Internal Rates of Return

2.6 Exhibits A to G show the crop budgets for representative fruit crops (oranges, limes, mangos, bananas, papayas, guavas and peaches). The main results of these crop budgets are summarized in Table 2.1. It should be emphasized that these crop budgets are preliminary. The results are particularly sensitive to the yields assumed. Yield estimates were based on visual inspection of the trees by horticultural experts and on farmers' responses, but no actual measurement of yields could be undertaken in the time available for the field study. The labor involved in irrigation, cultivation and picking, which constitutes some of the major cost items, must also be regarded as a rough estimate. A study presently being carried out by the SURDP should give more precision regarding the costs and benefits of fruit production.

2.7 The crop budgets include all costs except land rent (since fruit crops are typically grown on the farmer's own property). In particular, all labor costs were included, at the average 1982 cost of agricultural labor (70 YR/day). Since the typical fruit grower uses almost exclusively his own and family labor, his cash revenue would be correspondingly greater than the net revenue indicated by Table 2.1, and quite close to the gross revenue (since the use of purchased inputs is minimal).

2.8 Subject to the above caveats, Table 2.1 permits the following conclusions:

a) The economic results are very good for all of the fruit species examined. For all crops except bananas, the gross revenue lies between YR 60,000 and YR 109,000 per hectare, which is higher than for any other crop except qat.

b) The fruit crop with the highest internal rate of return (IRR) is papayas, since in the tropical climate of the Tihama papayas are practically an annual crop, which gives a fairly high gross revenue (YR 45,000) from the first year of planting, and consequently indicates an IRR exceeding 94%.

c) For the true multi-annual fruit crops (limes, oranges, peaches, mangos and guavas), production starts after 4-5 years and reaches close to its maximum in 8-10 years.

For these species, gross revenue ranges from about YR 90,000 to YR 109,000 per ha, net revenue from YR 71,000 to YR 92,000 per ha, and IRR from 33% (guavas) to 45% (limes). The variation in the above values is well within the accuracy of the assumptions regarding yields and production costs, so that on the basis of these results one cannot conclude that one of the multi-annual fruit crops shows a much better IRR than another. In particular, the economic results of mangos, limes and peaches in their appropriate climatic zones (low, middle and high altitudes respectively) are about equally favorable.

d) The above results obtain for the typical case of ox plowing and hand cultivation. Tractor plowing and cultivation by rototiller, which are rapidly spreading among Yemeni fruit growers, cut production costs and consequently raise the IRR by about 3%.

e) The above results assume well irrigation, which is the typical case. Where a dependable supply of spring or wadi water is available, the expenses of well installation and pumping are avoided, and the IRR is consequently about 16% higher.

f) Bananas show the lowest results among the fruit crops examined, with a gross revenue of about 18,000 YR/ha and an IRR of 23%. These results are inconsistent with the

usually high profitability of bananas in similar conditions, especially considering that Yemen is (so far) free from the most serious banana diseases, and consequently these results might underestimate the profitability of bananas.

g) Considering the high profitability calculated for various tree crops, the large demand for seedlings expressed by Yemeni farmers signifies an entirely rational economic behavior.

2.9 The above results lead to the conclusion that investments in tree crops are very attractive, even at present yields (which can be easily improved), owing to the very high prices for local fruit, which far outweigh Yemeni labor costs. Tree crops are also attractive to the farmer because of the relatively low labor requirements. The prices are expected to stay high for the following reasons:

a) the relatively high prices of imported fruits;

b) the apparent preference of the population for local fruit;

c) the competitiveness of the fresh fruit market, which results in the producers obtaining a much larger share of the final consumer price than is normally the case;

d) the size of the proposed project is far from meeting the expected growth of demand for the foreseeable future.

2.10 Backyard growers (who make very little investments) should have equal or better rates of return, since the added expenses for tree crops intercropped with vegetables during the gestation period are minor.

2.11 A devaluation of the Yemeni rial would increase the prices of imported fruit and correspondingly enhance the profitability of domestic production.

2.12 There is a strong demand for fruit tree seedlings, cuttings and budded trees, with prices as high as US $11 and even US $22 each for imported budded seedling trees. The present effective demand is estimated at about half a million seedlings or more annually.

2.13 Because of the high technological inputs required for apples and oranges, the two main imported species, Yemen is not well adapted at present for efficient production of these crops. Only in bananas can production compete efficiently with imports at the present time. Consequently, the project should focus mainly on increasing production of the species presently grown in Yemen. This should have some import substitution effect, but its main impact will be increasing incomes in the rural areas through production of these high-value crops, and improved rural nutrition through increased availability of local fruit.

3. BENEFICIARY ANALYSIS

Profile of the Fruit Growers

3.1 Table 3.1 records the average number of seedlings purchased by fruit growers at Bir al Shaif (highlands), Ibb (middle uplands) and Jaruba (lowlands). The table indicates that present fruit growers fall into two distinct classes:

a) Backyard growers who plant 1 to 20 trees (average 10 trees) for family consumption: this class accounts for about 1/3 of the seedling purchases in the highlands, 2/3 in the middle uplands and none in the Tihama. Backyard growers may be small farmers as well as larger farmers who want only a few trees for family consumption or who are only starting to experiment with fruit crops.

b) Orchard growers who plant 50 to 150 trees (average 100 trees) for commercial marketing: this class accounts for about 2/3 of the seedling purchases in the highlands, 1/3 in the middle uplands and all in the Tihama. Orchard growers are typically farmers with holdings of 1 to 5 ha in the midlands and highlands, and with 3 to 30 ha in the Tihama lowlands. Table 3.2 indicates that such holdings are possessed by about 28% of the agriculturists, who might thus be described as middle farmers, in contrast to the 63% who are small subsistence farmers. Table 3.3 indicates that the same middle farmers possess about 47% of the farm land. The largest landowners are in general

much less involved in fruit cultivation, as they typically cultivate their lands by sharecroppers while they pursue other occupations.

3.2 However, participation in fruit production is conditioned less by access to land than by access to water, i.e. by availability of surface water or of the capital necessary to construct a well. Access to water is typically as follows:

a) In the Tihama, the typical farmer who enters fruit production is the owner-operator of a grain and vegetable farm with about 10 hectares, irrigated by a hand-dug well about 20 meters deep with a diesel pump set. Investment in such a well amounts to about US $30,000 (in comparison, the ubiquitous Toyota station wagon costs about US $20,000 and a tractor about $25,000). Many thousands of farmers have such funds and are investing in well construction at a rapid rate. There are about 4,000 wells in the Tihama. The groundwater potential in the Tihama has a limit, but through proper water management the area presently irrigated by ground water could be increased. The beneficiaries of fruit production will be a subset of the present and some future well owners. The farmer who enters fruit production plants an average of 100 trees (about 0.3 ha) and may eventually increase his orchard to 1-2 ha. Thus the typical fruit grower is not the poorest of small farmers, nor is he an absentee

landlord, but may be classified as a middle-income farm entrepreneur. A 10-ha well-irrigated grain and vegetable farm gives the owner-operator a net before-tax return of about US $8900 (of which US $6200 may be imputed as a 6% return on the land value of $104,000, and US $2700 as a return on management) (1979 prices). In comparison with the present cost of permanent agricultural labor (YR 1500/month, or US $3960/year), the middle farmer's income does not seem excessive.

b) In the highlands, fruit production is also limited mostly to well-irrigated farms. The cost of a well is normally higher than in the Tihama due to the greater depths required. About 20% of those who plant new trees are orchard farmers with about 110 trees each, and about 80% are backyard growers with an average of 10 trees each.

c) In the middle uplands, fruit planting is undertaken either by well owners similar to the above or by farmers who have access to spring or wadi water. The latter are also privileged in comparison with the average farmer, owing to the availability of water. A few farmers plant market-oriented orchards (averaging 150 trees), but over 95% order an average of 8 trees each.

3.3 Fruit growers usually cultivate their farms, and in particular their fruit parcels, with their family labor and little or no hired help. They have a wider crop mix than subsistence

holders, including in particular more vegetables. They typically intercrop their fruit trees with vegetables. Perhaps surprisingly, none of the 19 fruit growers interviewed has worked abroad or used repatriated funds for on-farm investments.

3.4 In sum, the typical project beneficiary may be classified as a middle-income progressive farm owner-operator. Such people are the real motors of Yemeni agricultural development. The backyard-grower subsector does include, however, a significant percentage of subsistence farmers.

3.5 The truly poorest farmers in Yemen are those in mountainous areas which are unsuitable for qat production, and such farmers have very few agricultural resources which can be developed.

3.6 The characteristics of project beneficiaries are discussed in more detail in Annex A - Preliminary Beneficiary Analysis.

Social Impact of the Project

3.7 The accelerated agricultural development in the Tihama, brought about by the projects of the Tihama Development Authority and by private investments in wells, is pushing the wages of agricultural labor, which have been traditionally only about 60% of the national average, closer to the national average of about US $15 per day. The terms of sharecropping in the Tihama, which have traditionally been 1/4 to the tenant, 1/4

to the landlord and 1/2 to the pump owner, are also moving under the pressure of free market forces to a share of 1/3 to the tenant, 1/6 to the landlord and 1/2 to the waterlord, and the tenant's share may be expected to approach in the future 50%, as is common in the uplands. Agricultural intensification through fruit production would accelerate this process.

3.8 In sum, backyard fruit cultivation would benefit a large number of farmers, small and large, through better family nutrition and some salable surplus. Orchard-type cultivation would undeniably increase income disparities, as well owners would be the first to benefit, but agricultural labor would also benefit in absolute terms through better wages. The rural population would also benefit as a whole from the increased availability of fresh fruit on the local markets.

4. PROJECT DESIGN CONSIDERATIONS

Strategy for USAID Assistance to Horticulture Development in YAR

4.1 As a first priority the project should focus on fruits traditionally grown in Yemen, for which the markets are known and for which there exists indigenous information regarding care and maintenance. Emphasis should be placed on those fruit crops which require minimal care aside from watering and which will grow with little or no chemical fertilizers and pesticides. To realize this objective, project nurseries should initiate mass production of seedlings and cuttings from superior-bearing local trees. For satisfying the requests for seedlings, 100,000 peach and 100,000 apricot seeds could be planted during the winter of 1983 at Al-Irra. 50,000 lime seeds could also be planted, as well as some citrus root stock selections. In addition, some 200,000 lime seeds could be planted at Jaruba along with as many mango and tropical guava seeds as deemed necessary.

4.2 The Al-Irra station should be placed under quarantine, and only seeds and treated cuttings should be propagated for the time being. All seedlings should be sprayed and delivered to the planters free of pests and diseases.

4.3 At the same time, the project should engage horticultural extension agents and train them in basic horticultural skills and elementary pest control practices. These agents should concentrate on extending to the farmers simple technologies which can immediately increase production, such as tree pruning, fertilization and

new irrigation techniques which reduce water losses. Neither the farmers nor the extension service would be ready to introduce effective pest control until a much later stage.

4.4 The project should proceed cautiously with the introduction of foreign tree crops which are unfamiliar to the Yemeni farmer. In particular, the large-scale introduction of trees which have high pest control requirements, such as apples and oranges, should be discouraged; activities in these crops should be limited to the resarch necessary to make possible expanded planting of these crops in the medium term, after the demand for seedlings of more easily cultivated trees has been satisfied and pest control capability developed. Importation of budded trees or scion wood should be undertaken only from locations which are certified to be free of the major pests and diseases. The limited orange cultivation to be undertaken should be shifted from Jaruba to the Ta'iz region and to Al-Irra.

Aspects Relating to Project Design

4.5 Training in Extension Methodology: The project design should include an expert in extension methodology on a part-time basis. His function would be to train the local extension agents in the adequate methodology for reaching efficiently a large number of small farmers, and to create, in collaboration with the horticultural experts, audio-visual materials for the training of farmers and extension agents. The extension expert should probably visit Yemen for 2-3 months before and during

each planting season (January-March). The extension expert should have a thorough experience with extension methodology specifically aimed at reaching large numbers of small illiterate farmers, such as that of the Plan Puebla in Mexico, international tobacco companies, or the French cotton production in West Africa (C.F.D.T.). Experience limited to the U.S. extension service or to extension services abroad which were inspired by the U.S. model (e.g. those of South America) is not considered sufficient for this post.

4.6 The expert would train the local extension agents in methodologies specifically designed for reaching effectively a large number of small farmers, such as demonstration days, demonstration plots on the holdings of participating farmers, organization of farmer groups, etc.

4.7 Specification of Project Targets: Two of the principal project objectives at the output level are (a) the number of seedlings and budded trees distributed, and (b) the number of extension agents trained. Two of the principal project objectives at the purpose level are (a) the number of seedlings distributed and growing in satisfactory condition (which reflects on the quality of the extension service), and (b) the number of extension officers trained and working with the farmers. Annual targets should be specified for these objectives, and the extent of achievement of these targets should be monitored annually.

4.8 Calculation of the National Contribution to the Project: One of the project purposes is to have its fruit trees planted and in good condition at the end of the project. The achievement of this purpose presupposes that the farmers will make the required planting investments and tree maintenance expenses. Therefore, expenses incurred by the farmers during the project period should legitimately be included in the local-cost portion of the project.

Priority with Respect to Other Project Proposals

4.9 The most attractive idea among present proposals for USAID/San'aa agricultural sector projects is technical assistance to the Agricultural Faculty of San'aa University and a University Demonstration Farm. This project has the potential of high visibility in the short term and a high long-range impact in terms of addressing an important need and educating a whole generation of YARG agricultural officials favorable to private enterprise and wary of state controls of agriculture. This project is also the one best suited to CID capabilities. It does not, however, address small farmers in particular.

4.10 The horticultural project and the possible seed multiplication project also share the characteristic of addressing effectively a real need of the respective sub-sectors, but not focusing especially on small farmers.

4.11 Assistance to the Sardud school and to a livestock agents' school also addresses a real need, but its effectiveness is conditioned by the YARG being able to solve the problem of sufficient enrollment.

4.12 The poultry extension project as currently conceived focuses on small farmers, but its impact on the sub-sector is likely to be limited in view of the difficulty of competing with commercial poultry production. Possible projects in dryland agriculture and land conservation, agriculture credit and cooperatives, and vegetable production, also share this characteristic of being better addressed to small farmers but likely to have a limited impact on the respective sub-sector

4.13 Lastly, the preposed Integrated Crops and Water Management Project is likely to have a limited impact on the sub-sector, poor cost effectiveness and replicability, and is not particularly addressed to small farmers.

4.14 In sum, the most attractive idea in the hopper of proposed USAID/San'aa agricultural projects seems to be assistance to the San'aa University Faculty of Agriculture. The proposed horticultural project is one of several projects which merit a second place.

5. THE NECESSARY INSTITUTIONAL FRAMEWORK

Basic Considerations

5.1 The project purpose, as expressed in the PID, is to create within the Ministry of Agriculture the capacity for horticultural research and seedling production, with an efficient extension service to the fruit growers. The writer submits, however, that an efficient extension service belonging to a Ministry of Agriculture is a contradiction in terms. There are very good reasons why an extension service belonging to a Ministry of Agriculture cannot by its very nature be efficient, since such a service does not have its own source of income. The benefits which it creates to the farmers in no way result in revenues to the service. As a result, such a service is totally dependent on Ministry funds, and within the Ministry such a service has always the lowest priority in comparison with, for example, the construction of new and highly visible projects. Thus it never obtains the funds which it needs to function effectively. The result: a weak extension service, understaffed, undertrained, undermotivated, underequipped, overextended, lacking sufficient vehicles, travel expenses and extension materials — a service largely doomed to futility.

5.2 In the writer's experience in thirty-one developing countries, he has never observed a good extension service belonging to a Ministry of Agriculture. Very good extension services do exist, however, in some developing countries. Invariably, these

extension services belong either to an input supply company (distributors of fertilizers or insecticides), to a credit agency (an agricultural development bank), or to a marketing and agro-industrial organization (such as a cotton marketing board or a tobacco and cigarette manufacuring company). The common denominator of these organizations is that they have a direct financial interest in the satisfactory operation of the extension service. For them, a good extension has a measurable impact in increasing input sales, improving loan recuperation, or augmenting the quantity of marketable product. Thus they are financially motivated to provide their extension service with the funds it needs for satisfactory operation.

5.3 None of the above institutional settings seems possible in the context of the Yemen horticultural development. Due to the small size of the orchards considered, the input and the credit requirements are low, while the marketing is done in an individualistic way so that an input, a credit, or a marketing organization would not have a financial incentive to set up an extension service for this type of horticulture.

5.4 An alternative institutional solution must be found to achieve the same objective: create an extension service which will generate the funds necessary for its own continued operation. Fortunately, the proposed nursery and horticultural extension activity can have its own direct source of revenue: the sale of seedlings which it will produce. There is an extremely strong demand for seedlings in Yemen, with prices as high as

YR 50 and sometimes YR 100 offered for imported budded trees, and all indications are that this demand is an accelerating long-term trend. Rough calculations (Annex B) indicate that with the production of 250,000 seedlings annually per station — an objective which the Jaruba and Al Irra stations should be able to reach within three years — a nursery should be able, at the present price of seedlings, to defray its personnel salaries, operating costs, maintenance, horticulture extension activities, and other expenses, including expatriate staff.

5.5 This solution is impossible, however, as long as the seedling production activity is a division of the Ministry of Agriculture, as all Central Government entities are required by law to remit any revenue which they generate to the Treasury. Thus, to allow the seedling production activity to retain its revenues for financing the adequate production of plant material and assuring an efficient horticultural extension service, it must be made financially autonomous of the MOAF. In the institutional context of Yemen, two formulas are proposed for achieving this objective:

a) The Al-Irra station should be made a public-service enterprise for seedling propagation, accountable to the Ministry of Agriculture;

b) The Jaruba station should be integrated within the Tihama Development Authority (TDA).

These two solutions are discussed in the following.

The Yemeni Enterprise for Seedlings (YES)

5.6 To assure the continued existence of an efficient organization for production of plant material and an efficient extension service to fruit growers in the High Plateau region after the end of the project financing period, the YARG would create an entity which may be entitled "The Yemeni Enterprise for Seedlings," or YES. This would be a non-profit corporation whose director would be accountable directly to the Minister of Agriculture. YES would have its own accounting system, separate from that of the Ministry of Agriculture and Fisheries. The proceeds from the sale of plant material will be retained, rather than transferred to the Treasury as is the case at present, and will constitute the revenue of this corporation. From this revenue the corporation would pay its personnel and operating expenses, as well as the maintenance of its facilities, which will be the Al-Irra research and plant production station. The MOAF will set for YES its general policy and objectives, but within these policy guidelines YES will be independent of the Public Service in its day-to-day operations.

5.7 The proposed organizational structure will have the following advantages:

a) YES will obtain the revenue necessary to pay salaries which will attract and hold staff of appropriate quality,

order imported plant materials, pay for the maintenance of its vehicles and other expenses necessary to guarantee the efficient functioning of its research, plant production and extension services.

b) YES will have a direct financial interest in maximizing production and in lowering its unit production costs so as to maximize its total revenue.

c) YES will have a direct financial incentive to keep in the field an efficient, low-cost extension service, because the survival and growth of the seedlings purchased by the farmers will generate future purchases of more seedlings by the same farmers and their neighbors.

d) YES will be sensitive to the market and will produce those species and varieties which are desired by the cultivators. It will also orient its research program to those problems which are of highest priority to Yemen fruit growers.

5.8 The MOAF will maintain quality control of the plant material produced by YES, and every seedling offered for sale will bear a label stating, "Certified by the Ministry of Agriculture.

5.9 The MOAF could second some of its staff to YES as an interim measure. YES would be allowed, however, to hire and fire personnel so as to create its own corps of horticulturists. YES should be free to set its seedling sales cost at a level

which would meet its production expenses. Any surplus would be used to increase its horticultural research and extension activities.

5.10 It is recognized that the creation of a parastatal corporation is not the solution to every organizational problem. Such a corporation would still be open, for example, to a politically-motivated appointment of an inadequate director, overstaffing, or the setting of Ministry policies (e.g. subsidized prices for seedlings) which could destroy its profitability. However, the effect of such decisions will be immediately apparent in the balance sheet of the corporation, rather than tucked away in the budget of the MOAF, and the YARG would be made aware of the price it has to pay for economically inappropriate decisions. This should create an incentive for rational management of the corporation.

5.11 The alternative to the organizational structure outlined above is to leave at the end of the project period the Al-Irra horticultural station with a Yemeni staff which would be better trained and equipped than at present but which would be underpaid, undermotivated, underfinanced and short of means to carry out its mission, as is usually the case with such experiment stations. The writer submits that these prospective results hardly justify the cost to USAID.

5.12 Discussion should be initiated with the MOAF regarding the inception of the Yemeni Enterprise for Seedlings, and MOAF ideas should be integrated into its institutional design,

while guarding the basic principle that YES must be able to retain its income from seedling sales and use it to meet its production and extension costs. A short-term specialist familiar with Arab law and institutional practice (who may be a third country national) should be engaged during the PP design period to investigate, in consultation with YARG authorities, the legal ramifications and recommend the appropriate legal framework for a financially self-supporting nursery/extension organization, as well as the proper role for the MOAF in plant protection activities.

The TDA (Tihama Development Authority)

5.13 The proposed institutional solution for assuring the long-term efficient operation of the Jaruba station is to integrate it within the TDA framework. In order to discuss this solution, a short description of the TDA is in order.

5.14 The Tihama Development Authority was created by the YARG in 1973 as a semi-autonomous body to operate as a development agency for the Tihama region, with all necessary powers for project implementation. Its terms of reference are:

a) To undertake irrigation improvements, infrastructure improvements, and agriculture services.

b) To undertake the necessary studies (water, soil, topography, research, extension, credit and marketing) necessary for the achievement of the foregoing objectives.

The TDA is engaged in the following projects:

5.15 Wadi Zabid, the first TDA project, was completed in 1979. Its objective was to develop agriculture by improving the irrigation and road systems in the area, as well as by providing agricultural services. The project benefits an area of 17,000 hectares. Project cost was about US $39.2 million, financed by IDA, Kuwait Fund and YARG. The project completion report (Ref. 3) states that the project has been very successful from the technical, economic, and social acceptance points of view. Practically all the infrastructure called for by the project design has been completed. The value of agricultural production in the project area has increased from US $22.4 million (in 1980 prices) before the project to US $32.2 million by 1980, and is projected to reach US $52.6 million at full development. The acceptance of the project, judged by the number of farmers who have adopted project recommendations and are achieving results, is very high. Another measure is the result of an opinion survey made in March 1980, in which farmers' replies were generally strongly in favor of the constructed project works, the recommendations of the agricultural extension staff, and the credit services. The above-mentioned report states that the goals of creating institutions for agricultural research, extension, and credit have been well achieved during implementation of the Wadi Zabid Project, and that continuing benefit is being received from these institutions in carrying on the

operations of the Wadi Zabid project, and in undertaking projects now funded in other Tihama wadis.

5.16 The Wadi Rimaa project, now in implementation, will increase the productivity of 24,000 hectares in Wadi Rimaa, which are at present regularly or periodically cultivated. This project will provide technical assistance, facilitate supply of potable water to the inhabitants, and undertake studies of water resources, the tenure relations, rehabilitation of date and banana plantations, marketing, etc. The project will also construct access roads and provide agricultural credit. Of interest to the horticultural project is the fact that the Wadi Rimaa project plans to increase the area of banana plantations from 50 to 300 hectares and that of papayas from 25 to 100 hectares, and to increase production by 2,926 tons of bananas and 2,150 tons of papayas.

5.17 Wadi Mawr, the third TDA project, is at present the subject of feasibility studies and preparations for project implementation (roads, work camps). This project will increase agricultural production and farm income by providing irrigation works and technical assistance and facilitating the supply of farm inputs and marketing. It will also provide feeder roads and potable water, and assist the YARG to develop a regional applied agricultural research station at Sardud, coupled with a crop and seed production farm. This project plans to increase the production of papayas by 2,550 tons and that of bananas by 110 tons.

5.18 For Wadi Sihan, the fourth TDA project, the feasibility study has been completed, and this project has been included in the second five-year plan. For the fifth project, Wadi Rasyan the feasibility studies are in progress.

5.19 These achievements and plans indicate that the TDA is a strong and rapidly progressing organization. The following features of the TDA are of particular significance for the proposed horticultural project:

a) The TDA employs in the Wadi Zabid and Wadi Rimaa areas (which surround the Jaruba research station) an extension force composed of eight extension officers, 40 extension agents and 16 plant protection agents, as well as several research technicians and credit officers. At present the extension agents work exclusively with annual crops.

b) The TDA plans to extend its activities in the near future to the promotion of fruit crops. As noted above, papaya and banana plantations are planned in the Wadi Rimaa and Wadi Mawr projects. The TDA has on its 1,000-hectare farm at Sardud, 32 hectares of existing orchards in good condition, and plans to initiate at Sardud large-scale seedling projection (starting with 10,000 mango seedlings).

c) The TDA possesses research facilities at Zabid and at Sardud (oriented to annual crops).

d) The TDA has, through the long-term involvement of donor agencies, a reasonable assurance of continued financing of its operation and maintenance costs.

5.20 The above review of TDA's achievements, capabilities, and plans argues strongly that, if the proposed horticultural project is to function in the Tihama, its role should not be merely to continue activities at the Jaruba station, but to provide technical expertise and backstopping in fruit crops to the TDA. The TDA should be the vehicle giving the multiplier effect to the inputs provided by the projects. The mode of operation could be as follows:

a) The Jaruba station would be transferred from the MOAF and integrated within the TDA as a seedling production and applied fruit research center. (There exist precedents for such a transfer of projects into the TDA.)

b) Within the TDA, the Jaruba station would have its own accounting system, as is the case at present with the Sardud farm. It would be allowed to retain its earnings from the sale of seedlings, and would be expected to defray its operation and maintenance costs, including the costs of the extensionists specialized in fruit production.

c) The expatriate specialists would backstop the activities in Jaruba, the seedling production at Sardud, and other TDA fruit crop activities.

d) All TDA extension agents would be trained to give the farmers basic advice in tree husbandry (correct planting methods, pruning, etc.) The horticultural subject matter specialists would be called upon for problems requiring greater skill, such as the identification and control of pests.

e) The seedlings would be sold equally to farmers within the TDA area (who would probably be the majority of the beneficiaries) and to those outside it.

5.21 It is believed that this arrangement would give the Jaruba station the necessary long-term institutional backing, an extension arm for reaching the beneficiaries, and a financial incentive to increase seedling production so as to obtain the revenue necessary for its effective functioning.

5.22 The transfer of the Jaruba station to the TDA and the establishment of the Al-Irra station as a corporate entity which would be allowed to retain its earnings from the sale of plant materials for financing its nursery and extension activities, are considered by the Interim Report to constitute a sine qua non condition precedent for USAID involvement in the proposed horticultural project.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Present YAR Fruit Production: Grapes are the major domestically produced fruit crop (55,000 MT in 1979/80, compared with 76,000 MT for all other fruit). Domestic production of grapes has been increasing from 1972/73 to 1980/81 at an average rate of 2600 t/year and that of other fruit at about 2100 t/year. Fruit production is concentrated in San'aa province (38% of the total fruit area, mostly in grapes), followed by Hodeida (21%), Ta'iz (17%) and Ibb (11%).

6.2 Fruit Imports: YAR imports of fresh fruit in 1979/80 amounted to about US $100 million. About 72% of fruit imports consisted of apples (US $34 million), bananas (US $23.5 million) and oranges (US $14.5 million). There has been a dramatic increase in fruit imports from 1978/79 to 1979/80: 81% in apples, 36% in bananas and 14% in oranges.

6.3 Market Projections: Total fruit consumption in YAR is roughly 250,000 MT/year. Projecting a population growth of 2% and a GNP growth of 4% annually (which are conservative assumptions), fruit production must increase by approximately 7500 MT/annually at once (which is impossible due to the time lag of fruit production), by 8400 MT/year in 1985 and by 9800 MT/year in 1990, just to hold fruit imports at their present levels.

6.4 Market Structure: There are two distinct fruit markets: the import market which is significantly government-controlled and the domestic fruit market which is relatively free. Most

imports are performed by a small number of licensed importers. In the local market, most produce is passed fairly directly from producer to retailer. There are indications that Yemenis prefer the local fruit, although there are no strictly comparable imported and local fruit on which price differences may be examined.

6.5 Choice of Fruit Species: The following fruit crops offer the best development potential:

a) The highlands: grapes (improved cultural techniques), apricots, introduction of low-chilling-requirement peach and apple varieties, some almonds, pomegranates, quince and other deciduous fruit.

b) The middle uplands: limes, lemons, mandarins; mangos and guavas at lower altitudes.

c) The Tihama lowlands: mangos, limes, bananas, papayas, some guavas and anonas (custard apples).

d) Oranges should receive the lowest priority owing to the more complicated technology required, pest and disease problems, and unsuitability for small peasant production. Introduction of apples and other non-local fruit crops should proceed cautiously.

6.6 Profitability: The economics of investment in the above species is very attractive, even at present yields (which can

easily be improved), owing to the very high prices for local fruit, which far outweigh Yemeni labor costs. Tree crops are also attractive to the farmer owing to the relatively low labor requirements. Returns on fruit crops in Yemen are higher than for any other crop except qat. Producer prices are expected to stay high owing to:

a) the relatively high prices of imported fruit;

b) the apparent preference of the population for the local fruit;

c) the relatively low marketing margins for local fruit; and

d) demand growth, which is expected to outstrip the projected growth of supply of local fruit.

6.7 Preliminary crop budgets show the net revenue for multi-annual tree crops (e.g. limes, oranges, peaches, mangos and guavas) irrigated from wells to range from YR 71,000 to YR 92,000 per ha annually, and the internal rate of return to be between 33% and 45%. These results indicate that the strong demand for seedlings demonstrated by the farmers is economically rational. A devaluation of the Yemeni rial would correspondingly enhanee the profitability of local fruit production. Backyard growers (who make very little investments) should have equal or better rates of return, since the added expenses for tree crops intercropped with vegetables during the gestation period are minor.

6.8 Beneficiary Profile: Present tree growers fall into two distinct classes:

a) Backyard growers who plant an average of 10 trees each for family consumption: this class accounts for about half the seedling purchases in the uplands, none in the Tihama. Backyard growers may be of small or largers farmers

b) Orchard growers who plant an average of 100 trees each for commercial marketing: this class accounts for about half the seedling purchases in the uplands and all in the Tihama. Orchard growers are farmers with holdings of about 1 to 5 ha in the midlands and highlands, and with 3 to 30 ha in the Tihama lowlands. Such holdings are possessed by about 28% of the agriculturists, who might thus be described as middle farmers, in contrast to the approximately 63% who are small subsistence farmers. The largest landowners are in general much less involved in fruit cultivation since most of their land is cultivated by tenants.

6.9 However, participation in fruit production is conditioned less by access to land than by access to water, i.e. by availability of surface water or of the capital necessary to install a well. Access to water is typically as follows:

a) In the Tihama, the typical farmer who enters fruit production is the owner-operator of a grain and vegetable

farm with about 10 hectares, irrigated by a hand-dug well about 20 meters deep with a diesel pump set. Investment in such a well amounts to about US $30,000. The beneficiaries of fruit production will be a subset of the approximately 4,000 present well owners and some additional ones. Thus the typical fruit grower in the Tihama may be classified as a middle-income farm entrepreneur.

b) In the highlands, fruit production is also limited mostly to well-irrigated farms. About 20% of the planters are orchard farmers with an average of 110 trees each, and about 80% are backyard growers with an average of 10 trees each.

c) In the middle uplands, fruit planting is undertaken either by well owners similar to the above or by farmers who have access to spring or wadi water. A few farmers plant market-oriented orchards (averaging 150 trees), but over 95% order an average of 8 trees each.

6.10 Fruit growers usually cultivate their farms, and in particular their fruit trees, with their family labor and little or no hired help. They have a wider crop mix than subsistence holders, including in particular more vegetables. They typically intercrop their fruit trees with vegetables. Perhaps surprisingly, none of the 19 fruit growers interviewd has worked abroad or used repatriated funds for on-farm investments.

6.11 The typical project beneficiary may thus be classified as a middle-income progressive farm owner-operator. Such people are the real motors of Yemeni agricultural development. The backyard grower subsector does include, however, a significant percentage of subsistence farmers. The truly poorest farmers in Yemen are those in the mountain areas which are unsuitable for qat production, and such farmers have very few agricultural resources which can be developed.

6.12 In sum, backyard fruit cultivation would benefit a large number of farmers, small and large, through better family nutrition and some salable surplus. Orchard-type cultivation would benefit mainly well owners, who are typically middle-income farm owner-operators; however, agricultural labor would also benefit through better wages and the rural population as a whole from the increased availability of local fruit.

6.13 Project Strategy: The proposed strategy for USAID involvement in Yemeni horticulture is as follows:

a) As a first priority the project should focus on fruits traditionally grown in Yemen, for which the markets are known and for which there exists indigenous information on care and maintenance. Emphasis should be placed on fruits which require minimal care aside from watering and which will grow with little or no chemical fertilizers or pesticides. Project nurseries should initiate mass

production of seedlings and cuttings from superior-bearing local trees, and deliver them to the farmers free of pests and diseases. 100,000 peach, 100,000 apricot and 50,000 lime seedlings, as well as some citrus root stock, could be planted during the winter of 1983 at Al-Irra. Some 200,000 lime seedlings could be planted at Jaruba, along with as many mango and guava as deemed necessary.

b) At the same time, the project should engage and train horticultural extension agents. These extension agents should concentrate on simple technologies which can immediately increase production, such as tree pruning, fertilization and introduction of new irrigation techniques to reduce water losses. Neither the farmers nor the extension service would be ready to introduce effective pest control until a much later stage.

c) The project should proceed cautiously with the introduction of foreign tree crops which are unfamiliar to the Yemeni farmer. In particular, the large-scale introduction of trees which have high pest control requirements, such as apples and oranges, should be discouraged. Activities in these crops should be limited in the short term to research. Any orange cultivation should be shifted from Jaruba to the Ta'iz region or to Al-Irra.

6.14 Institutional Framework: Nurseries and extension departments located within Ministries of Agriculture in Third World countries are typically understaffed, underpaid, underequipped and unable to achieve the goals of meeting the demand for seedlings and providing satisfactory extension service to fruit growers, especially after the termination of donor involvement. There is no evidence that Yemen will be an exception to this rule. In the hypothesis that the project sites will be at Al-Irra and Jaruba, the following institutional formulas are proposed for achieving the above-mentioned goals:

a) The Al-Irra station should be constituted as a public service enterprise (the Yemeni Enterprise for Seedlings or YES). "YES" would receive policy guidance from the MOAF but would have its own accounting system and would be expected to meet all of its costs, including the expenses of the horticultural extension service. This could be achieved without increasing present seedling prices after about 3 years of operation, with the sales of about 250,000 seedlings annually. "YES" should be free to set its seedling sales price according to market demand, and to pay salaries which would attract and hold qualified personnel. This should serve as a model for other Yemeni nurseries.

b) The Jaruba station should be integrated into the TDA (Tihama Development Authority). The TDA plans to move energetically into tree crop production, and its project area surrounds the Jaruba station. The objective of the USAID horticultural

project in the Tihama should be enlarged from that of continuing the operations at Jaruba to that of providing integral technical backstopping to the fruit production activities of the TDA. Thus project advisors would supervise seedling production and horticultural extension activities both at Jaruba and at the TDA station at Sardud. Under the TDA umbrella, the Jaruba station would have its own accounting system and would be expected to meet its operation and maintenance costs, including the costs of the extensionists specialized in fruit production. The latter would technically supervise in horticultural matters all of the TDA extension agents (over 60 at present), who would be trained to give the farmers basic advice in fruit production. There exists precedents for such a transfer of projects to the TDA.

6.15 Discussions should be initiated with the MOAF for defining the precise institutional mechanism. The establishment of a legal framework which would assure the financial autonomy of the Al-Irra and Jaruba stations should be a "sine qua non" condition precedent for project financing. A short-term specialist familiar with Arab law and institutional practices (who could be a third country national) should be engaged during the PP design period to investigate in consultation with YARG authorities the legal ramifications and to recommend the appropriate legal framework for a financially self-supporting organization for seedling production and horticultural extension,

as well as the proper role for the MOAF in plant protection activities.

6.16 Priority with Respect to Other Project Proposals: The most attractive present idea among USAID/San'aa agricultural project proposals is technical assistance to the San'aa University faculty of agriculture and demonstration farm. The preparations for this project should be pushed. The Horticultural Project is one of several projects which merit a second priority.

POSTSCRIPT

Another lesson from the history of the YAR Horticultural Project is that the effort involved in PID design should be strengthened. When the PRP was eliminated from the AID design cycle, it has left a certain gap. The PRP was conceived, among other things, precisely to answer such questions as the beneficiary identification and the economic feasibility of the project under various alternatives, before proceeding with the final project design. If AID is to avoid the expenses involved in the design of PP's for projects which are poor from the economic or equity points of view, as well as the momentum which is inevitably generated for the execution of such projects once they are designed, the PID design effort should be strengthened in order to provide at that stage a prima facie case for the economic and social feasibility of the project. The likely alternative would be to return in practice to a three-stage design cycle: a PID, a PP and a revised PP.

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EXHIBIT A: CROP BUDGET - ORANGES (IN YR)

1 ha at 6mx6m (280 trees/ha)

Item / Year:	1	2	3	4	5	6-7	8-20
Ploughing							
(by oxen)[a]	800	800	800	600	400	400	400
(mechanized)	(400)	(400)	(400)	(300)	(200)	(200)	(200)
Levelling							
(by oxen)[a]	200	-	-	-	-	-	-
(mechanized)	(200)	-	-	-	-	-	-
Fertilizer[b]	120	200	400	400	400	400	400
Manure	200	200	200	200	200	200	200
Digging of holes[c]	980	-	-	-	-	-	-
Budded trees	7,000	-	-	-	-	-	-
Planting[c]	980	-	-	-	-	-	-
Replanting[e]	2,240	-	-	-	-	-	-
Irrigation labor[f]	2,800	2,800	2,800	2,800	2,800	2,800	2,800
Pump O&M cost[g]	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Cultivation							
(by hand)[h]	2,350	2,350	2,350	1,180	1,180	1,180	1,180
(mechanized)	(500)	(500)	(500)	(250)	(250)	(250)	(250)
Picking[i]	-	-	-	600	2,550	5,100	7,640
Guard, transport, other expenses	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Total expenses							
(with oxen)	22,670	11,350	11,550	11,020	12,260	14,540	16,820
(mechanized)	(20,420)	(9,100)	(9,300)	(8,770)	(10,010)	(12,290)	(14,570)
Gross revenue[j]	-	-	-	8,400	36,400	72,800	109,200

IRR with oxen, well irrigation[k] = 41.5%
IRR with mechanized cultivation, well irrigation = 44.7%
IRR with oxen, stream irrigation = 56.2%

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[a] At 200 YR/day for ox team

[b] At 80 YR/bag

[c] 20 units per man-day at 70 YR/md

[d] At 25 YR each

[e] 25% of hole digging, trees and planting costs

[f] 20 irrigations per year at 2 md/ha each

[g] 15,000 m^3/ha/yr with a 10 lit/sec pump=417 hr/ha/yr at 7.2 YR/hr (4 lit/hr diesel fuel at 1.5 YR/lit plus 20% lubricants)=3000 YR/ha/yr, plus 500 YR/ha/yr pump reparations.

[h] 6 per year. Years 1-3: 50 trees/md. Later: 100 trees/md.

[i] 1000 fruit/man-day. Year 4: 30 fruit/tree. Year 5: 130 f/t. Year 6-7: 260 f/t. Year 8-20: 390 f/t.

[j] At 1 YR/fruit

[k] For an investment of YR 100,000 (well - 20 year life) and YR 42,000 (pump set - 10 year life) irrigating 15 ha=9500 YR/ha initial investment plus 2800 YR/ha pump replacement at year 11.

EXHIBIT B: CROP BUDGET - LIMES (in YR)

1 ha at 6m x 6m (280 trees/ha)

Item/Year:	1	2	3	4	5	6-7	8-20
Ploughing							
(by oxen)[a]	800	800	800	600	400	400	400
(mechanized)	(400)	(400)	(400)	(300)	(200)	(200)	(200)
Levelling							
(by oxen)[a]	200	-	-	-	-	-	-
(mechanized)	(200)	-	-	-	-	-	-
Fertilizer[a]	120	200	400	400	400	400	400
Manure[a]	200	200	200	200	200	200	200
Digging of holes[a]	980	-	-	-	-	-	-
Seedlings[b]	4,200	-	-	-	-	-	-
Planting[a]	980	-	-	-	-	-	-
Replanting (25%)	1,540	-	-	-	-	-	-
Irrigation labor[a]	2,800	2,800	2,800	2,800	2,800	2,800	2,800
Pump O&M cost[a]	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Cultivation							
(by hand)[a]	2,350	2,350	2,350	1,180	1,180	1,180	1,180
(mechanized)[a]	(500)	(500)	(500)	(250	(250)	(250)	(250)
Picking[c]	-	-	-	2,940	4,900	7,840	9,800
Guard, transport, other expenses	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Total expenses							
(with oxen)	19,170	11,350	11,550	13,120	14,880	17,820	19,780
(mechanized)	(16,920)	(9,100)	(9,300)	(11,890)	(13,750)	(16,690)	(18,650)
Gross revenue[d]	-	-	-	29,400	49,000	78,400	98,000

IRR with oxen, well irrigation = 45.6%
IRR with mechanized cultivation, well irrigation = 49.2%
IRR with oxen, stream irrigation = 65.6%

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[a]As in Exhibit A

[b]At YR 15 each

[c]2000 fruit/md. Year 4: 300 fruit/tree. Year 5: 500 f/t. Year 6-7: 800 f/t. Year 8-20: 1000 f/t.

[d]At 0.35 YR/fruit

EXHIBIT C: CROP BUDGET - MANGOS (IN YR)

1 ha at 10m x 10m (100 trees/ha)

Item / Year:	1	2-4	5	10-40
Ploughing (by oxen)[a]	800	800	800	800
(mechanized)	(400)	(400)	(400)	(400)
Levelling (by oxen)[a]	200	-	-	-
(mechanized)	(200)	-	-	-
Fertilizer[a]	160	160	160	160
Manure	100	100	100	100
Digging of holes[a]	350	-	-	-
Seedlings[a]	2,500	-	-	-
Planting[a]	350	-	-	-
Replanting[a]	800	-	-	-
Irrigation labor[a]	2,800	2,800	2,800	2,800
Pump O&M cost[a]	3,500	3,500	3,500	3,500
Cultivation (by hand)[a]	840	840	420	420
(mechanized)	(500)	(500)	(250)	(250)
Picking[b]	-	-	1,400	7,000
Guard, transport, other expenses	1,500	1,500	1,500	1,500
Total expenses (with oxen)	13,900	9,700	10,680	16,280
Total expenses (mechanized)	(13,160)	(8,960)	(10,110)	(15,710)
Gross revenue[c]	-	-	20,000	100,000

IRR with oxen, well irrigation = 37.1%
IRR with mechanized cultivation, well irrigation = 38.2%
IRR with oxen, stream irrigation = 54.2%

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[a]Same calculation base as in Exhibit A

[b]At 1000 fruit/md. Straight-line increase assumed from year 5 to 10.

[c]At 1 YR/fruit. Straight-line increase assumed from 200 fruit/tree (year 5) to 1000 fruit/tree (year 10).

EXHIBIT D: CROP BUDGET - BANANAS (IN YR)

1 ha at 2.5m x 3.0m (1300 plants/ha)

Item / Year:	1	2 and following
Ploughing/cultivating		
(by oxen)[a]	800	800
(mechanized)	(400)	(400)
Levelling		
(by oxen)	200	-
(mechanized)	(200)	
Fertilizer[b]	400	400
Spreading of fertilizer[c]	280	280
Manure	200	200
Preparation of side shoots[d]	1,820	910
Preparation of holes and planting[d]	1,820	910
Irrigation labor[e]	2,800	2,800
Pump O&M cost[e]	3,500	3,500
Harvesting[f]	-	910
Guard, transport, other expenses	1,500	1,500
Total expenses (with oxen)	13,320	12,210
(mechanized	(12,920)	(11,810)
Gross revenue[g]	-	18,200

IRR with oxen, well irrigation = 23.2%
IRR with mechanized cultivation, well irrigation = 25.8%
IRR with oxen, stream irrigation = 96.6%

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[a]Twice a year, 2 days each at 200 YR/day

[b]5 sacs/ha at 80 YR/sac

[c]4 md/ha at 70 YR/md

[d]50 shoots/day; 50% replaced annually

[e]As in Exhibit A

[f]50 bunches/day; 50% harvested annually

[g]650 bunches/ha/yr, 80 fingers each at 0.35 YR/finger

EXHIBIT E: CROP BUDGET - PAPAYAS (IN YR)

1 ha at 4m x 2.50m, 50% female trees (500 female trees/ha)

Item / Year:	1	2	3
Planting/cultivation (by oxen)[a]	800	800	800
(mechanized)	(400)	(400)	(400)
Levelling (by oxen)[a]	200	-	-
(mechanized)	(200)	-	-
Fertilizer[a]	400	400	400
Spreading of fertilizer[b]	280	280	280
Manure[a]	200	200	200
Seedlings[c]	5,000	-	5,000
Preparation of holes and planting[d]	1,400	-	1,400
Replacement (25%)	1,600	-	1,600
Irrigation labor[a]	2,800	2,800	2,800
Pump O&M cost[a]	3,500	3,500	3,500
Picking[e]	-	2,800	2,800
Guard, transport, other expenses	1,500	1,500	1,500
Total expenses (with oxen)	18,980	12,280	20,480
(mechanized)	(18,580)	(11,880)	(20,080)
Gross revenue[f]	-	45,000	60,000

IRR with oxen, well irrigation = 94.3%
IRR with mechanized cultivation, well irrigation = 96.0%

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[a]As in Exhibit D

[b]4 md/ha at 70 YR/md

[c]YR 5 each (imputation of farmer's own seedling production cost)

[d]50 per man-day

[e]20 times at 2 md/ha each

[f]At YR 3 each. Beginning of year 2: 30 fruit/tree. Beginning of year 3: 40 f/t. (Replaced at year 3.)

EXHIBIT F: CROP BUDGET - GUAVAS (IN YR)

1 ha at 6m x 6m (280 trees/ha)

Item / Year	1	2	3	4	5	6-7	8-20
Total expenses except picking (with oxen)[a]	19,870	11,350	11,550	10,180	9,980	9,980	9,980
(mechanized)[a]	(17,620)	(9,100)	(9,300)	(8,950)	(8,850)	(8,850)	(8,850)
Picking[b]	-	-	-	-	980	3,920	7,840
Total expenses (with oxen)	19,870	11,350	11,550	10,180	10,960	13,900	17,820
(mechanized)	(17,620)	(9,100)	(9,300)	(8,950)	(9,830)	(12,770)	(16,690)
Gross revenue[c]	-	-	-	-	11,200	44,800	89,600

IRR with oxen, well irrigation = 33.0%
IRR with mechanized cultivation, well irrigation = 35.4%
IRR with oxen, stream irrigation = 45.7%

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[a]Production costs assumed equal to those of limes (Exhibit B)

[b]1000 fruit/md. Year 5: 50 fruit/tree. Years 6-7: 200 f/t. Years 8-20: 400 f/t.

[c]At 0.80 YR/fruit

EXHIBIT G: CROP BUDGET - PEACHES (IN YR)

1 ha at 6m x 6m (280 trees/ha)

Item/Year:	1	2	3	4	5	6-9	10-20
Ploughing							
(by oxen)[a]	800	800	800	800	800	800	800
(mechanized)	400	(400)	(400)	(400)	(400)	(400)	(400)
Levelling							
(by oxen)[a]	200	-	-	-	-	-	-
(mechanized)	(200)	-	-	-	-	-	-
Fertilizer[a]	120	200	400	400	400	400	400
Manure[a]	200	200	200	200	200	200	200
Digging of holes[a]	980	-	-	-	-	-	-
Seedlings (YR 15 each)	4,200	-	-	-	-	-	-
Planting[a]	980	-	-	-	-	-	-
Replanting (25%)	1,540	-	-	-	-	-	-
Irrigation labor[b]	1,680	1,680	1,680	1,680	1,680	1,680	1,680
Pump O&M cost[c]	2,300	2,300	2,300	2,300	2,300	2,300	2,300
Cultivation (by hand)	2,350	1,180	1,180	1,180	1,180	1,180	1,180
(mechanized)	500	(250)	(250)	(250)	(250)	(250)	(250)
Picking[d]	-	-	-	980	2,940	6,860	8,820
Guard, transport, other expenses	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Total expenses							
(with oxen)	16,850	7,860	8,060	9,040	11,000	14.920	16,880
(mechanized)	(14,600)	(6,530)	(6,730)	(7,710)	(9,670)	(13,590)	(15,550)
Gross revenue[e]	-	-	-	9,800	29,400	68,600	88,200

IRR with oxen, well irrigation = 41.3%
IRR with mechanized cultivation, well irrigation = 44.1%
IRR with oxen, stream irrigation = 58.0%

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[a] As in Exhibit A

[b] 12 times per year at 2 md/ha x 70 YR/md each

[c] 9000 m^3/year. Same calculation base as in Exhibit A

[d] 1000 fruit/md. Year 4: 50 fruit/tree. Year 5: 150 f/t. Year 6-9: 350 f/t. Year 10-20: 450 f/t.

[e] At 0.7 YR/fruit

TABLE 2.1: ECONOMIC PERFORMANCE OF DIFFERENT TREE CROPS

Species	Years to Initial Fruition	Years to Full Production	Revenue at Full Production, YR/ha		IRR-Oxen, Well Irrig.	IRR-Mechanized, Well Irrig.	IRR-Oxen, Stream Irrig.
			Gross	Net (w/oxen)			
Papayas	1	2	60,000	47,720	94.3%	96.0%	-
Limes	4	8	98,000	78,220	45.6%	49.2%	65.6%
Oranges	4	8	109,200	92,380	41.5%	44.7%	56.2%
Peaches	4	10	88,200	71,320	41.3%	44.1%	58.0%
Mangos	5	10	100,000	83,720	37.1%	38.2%	54.2%
Guavas	5	8	89,600	71,780	33.0%	35.4%	45.7%
Bananas	2	2	18,200	5,990	23.2%	25.8%	96.6%

TABLE 3.i: DISTRIBUTION OF SEEDLINGS BY SIZE OF PURCHASE

Source		Bir al Shaif[a]	Ibb Nursery[a]	Jaruba[b]	MOAF Distribution of Imported Seedlings[c]
Year		1981/82	1980/81 1981/82	1981/82	1981/82
Backyard gardening	Size of sample	33	38	-	-
	No. of trees	330	300	-	-
	Average purchase	10	8	-	-
Orchard Planting	Size of sample	7	1	4	10
	No. of trees	790	150	400	1082
	Average purchase	113	150	100	108
Total	Size of sample	40	39	4	10
	Total no. of trees	1120	450	400	1082
	Average purchase	28	12	100	108

[a]A random sample of all purchases

[b]Total purchases except for one exceptional case (Mawza farm) which purchased 500 seedlings

[c]Total purchases except for 2218 trees sent to the Haman Ali area (distribution not available, but all in orchard planting).

TABLE 3.2: PERCENTAGE DISTRIBUTION OF THE NUMBER OF FARMS IN DIFFERENT SIZE CATEGORIES

Farm Size, ha	San'aa	Ibb	Ta'iz	Mahweet	Hajja	Hodeida	Dhamar	Sa'ada	Beida	Total
Under 0.25	11.9	10.4	40.7	10.7	17.9	5.9	27.6	22.3	5.1	19.5
0.25-0.50	11.0	33.9	19.2	19.7	19.9	2.8	23.0	17.5	10.8	19.0
0.50-0.75	10.5	16.2	7.9	21.2	9.9	1.4	12.9	8.8	14.9	11.0
0.75- 1	7.1	17.1	9.1	13.1	8.1	3.6	9.0	9.7	13.0	10.1
1 - 2	15.6	8.0	10.6	20.4	15.1	17.3	15.6	14.2	26.9	13.8
2 - 3	11.7	7.0	3.6	9.1	6.8	17.3	4.1	7.6	10.0	8.3
3 - 4	8.0	1.1	3.3	3.1	5.8	10.1	2.6	2.9	4.8	4.6
4 - 5	6.1	0.4	0.9	0.1	3.3	10.8	0.8	1.8	4.4	3.2
5 - 10	14.1	0.5	2.1	2.6	7.6	18.5	2.7	8.9	7.8	6.9
10 - 20	3.4	0.4	2.6	-	3.4	8.2	1.4	5.6	1.9	2.8
20 - 50	0.6	-	-	-	2.0	3.4	0.3	0.7	0.2	0.7
50 - 100	-	-	-	-	0.1	0.2	-	-	0.2	0.0
100 - 200	-	-	-	-	0.1	0.5	-	-	-	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No. of farms	11,045	117,787	104,389	21,930	43,812	58,531	56.661	22,231	23,416	559,802

Source: San'aa - Preliminary results of the Agricultural Census.
Other provinces - Final Results of the Agricultural Census, MOAF, June 1981.

TABLE 3.3: PERCENTAGE DISTRIBUTION OF FARM LAND IN FARM SIZE CATEGORIES

Farm Size, ha	San'aa	Ibb	Ta'iz	Mahweet	Hajja	Hodeida	Dhamar	Sa'ada	Beida	Total
Under 0.25	0.6	2.6	4.2	1.5	0.9	0.1	3.2	1.1	0.4	1.2
0.25-0.50	1.3	17.5	5.9	6.3	2.6	0.2	6.5	3.0	1.8	3.5
0.50-0.75	2.4	11.5	4.1	11.6	2.5	0.1	6.3	2.3	4.2	3.2
0.75- 1	2.1	17.8	7.2	10.3	2.5	0.5	6.1	3.5	5.0	4.1
1 - 2	8.2	13.1	13.9	26.6	7.8	4.3	17.5	8.5	17.3	9.4
2 - 3	10.2	20.1	7.3	17.3	6.1	7.4	8.1	7.3	11.0	9.5
3 - 4	10.2	4.4	10.2	9.1	7.0	6.1	7.1	4.4	7.0	7.7
4 - 5	8.7	2.1	3.6	2.1	5.3	8.5	3.0	3.4	8.7	6.6
5 - 10	37.4	4.4	12.8	15.2	18.6	23.3	14.9	25.8	22.7	22.7
10 - 20	15.9	6.5	30.7	-	18.1	18.8	17.3	33.4	10.3	17.9
20 - 50	5.7	-	-	-	22.3	16.4	10.0	7.3	2.6	9.3
50 - 100	-	-	-	-	2.2	2.6	-	-	9.0	1.3
100 - 200	-	-	-	-	4.1	11.7	-	-	-	3.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Farm area, ha	363,301	102,269	122,820	24,594	124,102	333.607	71,181	51,252	52,442	1,218,568

Source: San'aa - Preliminary results of the Agricultural Census.
Other provinces - Final Results of the Agricultural Census, MOAF, June 1981.

ANNEX A: PRELIMINARY BENEFICIARY ANALYSIS

by

Dr. James Stevenson
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Data Collection and Survey Methods

Given the limited time for data collection and analysis, a non-random sample was used. Those included were a segment of the agricultural population cultivating fruit trees. Data were obtained through interviews and observation. To add balance to the data, residents in the vicinity of fruit cultivators were also questioned regarding their interest in horticulture.

The survey lasted 9 days. All of Yemen's three major climatic zones (lowlands, middle uplands, and mountain plateau) were included, allowing for a sampling of tropical, subtropical, and deciduous fruit growers. The least time was spent in the plateau (the deciduous fruit area); the time in the lowlands and middle uplands was about equally divided.

Data Analysis

Data analysis focused on forming a general typology of those involved in some aspect of fruit production (those currently harvesting fruit and those just beginning to cultivate fruit trees). Of particular concern were the social standing, land holding, conditions of fruit production, and access to water resources of these cultivators. This typology could then be

compared to those who were not involved in fruit production and who expressed disinterest in or inability to enter into fruit production.

Cautionary Note

Many of the cultivators interviewed were somewhat suspicious of my aims. There was a general reluctance to discuss market prices for fruit, quantities produced, and to a lesser extent the size of holding. Most of these fears are directly related to matters of taxes. To some degree, which cannot be ascertained, this may render the data inaccurate.

Typology of Current Fruit Cultivators

Although Yemen's climatic zones are varied and offer wide socio-economic variation, a brief survey of budding horticulturalists reveals a number of strikingly similar characteristics. Some of these common features may result because the sample was non-random and small (19 interviews). Briefly stated, fruit producers/cultivators tend to be middle peasants, meaning they are not merely producing for their own subsistence needs but have adequate financial and/or land resources to permit cash cropping. At least a segment of this group has enjoyed enough success to save some venture capital to pursue new agricultural techniques and crops.

Of the similarities among horticulturalists, the following will be discussed: (1) comparatively large land holdings,

(2) access to a permanent water source, (3) labor self-sufficiency, (4) varied crop selection, and (5) no admitted experience in Saudi Arabia.

(1) Among the fruit producers/growers surveyed, land holdings were in the range of 1 to 5 hectares in the midlands and highlands, and from 3 to 30 in the Tihama lowlands (except for one Tihama grower whose holding size could not be obtained). Holdings of this size are possessed by about 28% of the farm owners in their respective ecological zones. More importantly, holdings of this size are larger than those of about 63% of the farm owners, most of whom could be described as subsistence cultivators. Based on land holding alone, fruit growers are at least in the middle strata of the agricultural population.

(2) As each ecological zone is varied, the size of land holding is an inadequate measure. The large land area needed for subsistence probably accounts for larger holdings in the Tihama (as does the lower population density). More significant is the productivity of the parcels in a holding. Productivity is related to the availability of water. Peasants in fruit cultivation have lands adjacent to either wadis or wells, or sometimes both. Thus at least some of their parcels receive adequate watering on a year-round basis and can be assumed to have a higher value than other parcels

in the same general area. By contrast, most other cultivators rely on seasonal rains. In the surveyed areas, well irrigation was the standard irrigation method for about 52% of current fruit growers, wadi runoff was used by 26%, and springs by 21%. In the absence of lands near springs or wadis, wells are the only source of reliable water. Well development costs are not uniform but range from about 1000 YR/meter for machine-drilled wells to 5,000 YR/meter or more for hand-dug wells. Well depth varies from as little as 12 meters to 200 meters. The most common pump set (20 HP) costs YR 42,000.

(3) Peasants in fruit cultivation not only own large holdings but generally work these parcels themselves, drawing additional labor as needed from within their households. Only two of the cultivators surveyed (both with extensive holdings) relied on additional labor, and only one of these on a full-time basis. Further, with one exception, additional labor was not used to maintain trees but for other crops. In fact, labor expenditures for tree maintenance tend to be quite low. This is an important consideration as wage laborers commonly receive 60 YR to 80 YR a day plus food, qat and tobacco.

(4) The crop mix among the middle peasants tends to be more varied than for subsistence cultivators. Many have devoted large portions of their holdings (in well-watered areas) to a variety of cash crops, including a mix of fruits. This is particularly true of the Tihama. While subsistence cultivators rely on cereals (in part because of parcel location), middle peasants also cultivate tomatoes, okra, melons, peppers and potatoes. In several areas new groves were intercropped with cash crops, or fruit trees (notably bananas) were planted on the edges of the fields, thus allowing for maximum land and water use. In other words, these cultivators are in a position to maximize their returns.

(5) None of the horticulturalists interviewed admitted to having used repatriated funds to finance wells, to extend their holdings, or to purchase farm machinery. The question was posed as, "How long were you in Saudi Arabia?" as this was felt to imply that I knew they had been there and they were more likely to respond positively. While this result may appear surprising, most returnees seek investment opportunities which promise a more immediate return, often making some use of the skills acquired in Saudi Arabia. Agriculture does not generally fit into these plans.

Characteristics of the Non-Horticulturalists

Among those interviewed who were not engaged in or considering fruit production, several important points were made. These views represent the "image of limited good," the idea that there is a limit to everything and thus everyone cannot hope to obtain scarce commodities. This is a common form of conservatism found among peasants.

Many viewed the tree growers as wealthy, at least compared to themselves. They did not feel they were in a position to become involved in horticulture, nor that they could do so competitively. Recognizing their own limited assets, they felt they could not take the same sort of risks.

Another important consideration was that horticulture was too technical. This view has several probable causes. First, a number of the trees planted have died. Second, some areas are often visited by foreign "experts," at least giving the impression that without such assistance, trees will not produce. (In one case, even with such outside technical assistance, the trees still died.) Since tree growth and condition was viewed as related to outside assistance, several interviewees stated they were not important enough to merit this type of help. In fact, the fear of high technologic inputs has inhibited some peasants.

Non-horticulturalists, even those who had some of their holding near seasonal or permanent water courses, felt the safest and most economically prudent course was to cultivate cereals

they knew and whose production, if lost to drought or flood, represented only a small setback. In short, they were not willing or able to speculate with their land.

Peasants in areas with some horticultural development were well aware of the lead time involved in fruit cultivation. Many felt they could not wait for a return, particularly as the risk of tree loss seemed to them high. This view was particularly evident in the Mauza area, where 500 trees had recently died.

Peasants in the Mauza area were also concerned over labor costs. It was widely believed that trees required large labor inputs. Although this is not the case, the peasants interviewed expressed concern over prohibitive labor expenditures.

Each of these factors, while correctable through education, extension, and media announcements, currently functions as a brake on interest in fruit production. The lack of a clear understanding can be well described by the often-repeated view of some tree growers and non-growers that farmers cannot obtain trees from government-operated nurseries. It was felt (even by those who had new trees) that only with outside (i.e. foreign or local leader) intervention could trees be obtained, particularly if the number sought was small.

Again from an educational/financial point of view, with the exception of established fruit species (apricots, grapes, figs, bananas, papayas, mangos, dates, limes), small holders were unsure

if they could make money. This attitude was not uncommon among beginning growers. A widely-held view was that imported fruits were of better quality and that returns would be limited.

The most constraining element by far for non-horticulturalists was their limited supply of water. All seemed aware of the need for regular irrigation, but reported they could not afford the costs of well drilling and equipment. However, even if water were available to small holders, the other constraints mentioned above might still limit participation.

Summary

Up to the present, the innovators have been the middle peasants and to a much smaller degree the large landholders. This is neither surprising nor uncorrectable. Small holders, a generally conservative lot, have tended to stay with known commodities. They are not willing to take a gamble. On the other hand, the large landholders usually cultivate most or all of their property by tenants, and are thus less motivated to make improvements in their lands, such as planting fruit trees.

The middle peasants are in a position, from land, water and financial standpoints, to experiment with new crops. No doubt their present positions are related to taking similar chances in the past, and they are willing to devote some segments of their holdings towards improving their position.

Recommendations

In light of the constraints described above, and in order to encourage more widespread participation in a fruit production program, the project should be designed to draw on the strengths already present in Yemeni agriculture. In the absence of trained extension agents (and nurserymen!) and of relatively disease-free nursery stock, the project should focus on fruits traditionally grown in Yemen, for which markets are known, and for which there is a general body of indigenous information on care and maintenance. Furthermore, emphasis should be placed on species which require minimal care, aside from watering, and which will grow without heavy, if any, applications of chemical fertilizers and pesticides.

Through media, LDAs and agricultural cooperatives, the planting of trees (even in ones and twos) should be encouraged. This goal complements the Second Five Year Plan objective of making Yemen green. Small holders, even those without access to enough water for field irrigation, should be encouraged to maintain backyard trees. Aside from a clear esthetic effect, small holders would gain experience in fruit production and may enjoy a small profit from sales, in addition to a dietary supplement.

To dispel many of the misconceptions about fruit production and to overcome the lack of a strong extension service, tree purchasers should receive both a demonstration of tree planting and maintenance at the nursery and a clear, simply written,

well-illustrated text on the care and maintenance of the species bought.

While this approach will benefit the small holder to a limited extent (and it should be noted that little has been accomplished so far by the horticultural project to benefit any particular segment of the agricultural population), there must be further investigation of methods to provide water to small holders. In particular, the Tihama Development Authority and the agricultural cooperatives should be questioned on well drilling programs that benefit the small holders. As it is beyond the scope of this project and the reach of small holders to dig wells, other avenues to increase water availability must be sought, if not through existing institutions then through the Agricultural Credit and Cooperative Bank.

In order to evaluate the success and to identify the problems inherent in horticultural development, the program should establish some target areas to serve as test or pilot areas in which progress can be monitored and the level of participation and status of beneficiaries more fully examined. As a prerequisite to the evaluation process, accurate records of purchasers and their localities must be maintained.

Final Note

Up to the present time, the project has barely gotten its feet wet. While those currently benefitting from fruit production

may not be regarded by USAID as suitable beneficiaries, these fruit producers have not been noticeably helped by the project. Rather, the current "beneficiaries" are those who have taken the initiative themselves. However, until such time as the needed educational, extension, and nursery facilities are in place and trees available in large quantities, this will continue to be the case.

TABLE A.1: TABULATED SUMMARY OF FRUIT GROWERS SURVEYED

	Wadi Sudan (Ta'iz)	Wadi Mauza (Ta'iz)	Wadi Barah (Ta'iz	Zabid (Hodeidah)	Jaruba (Hodeidah)	Hammam Ali (Dhamar)	San'aa (San'aa)	Total
Number interviewed	5	1	4	1	1	4	3	19
Presented land holding figures	5	1	0	1*	1	3	3	14
Method of irrigation:								
Well	5	(?)	0	1	1	0	3	10
Wadi	(5)**	1	(4)	0	0	4	0	5
Spring	0	0	4	0	0	0	0	4

*Admitted to 6 ma'ad, but was reluctant to state actual holding. (1 ma'ad = 0.4096 ha.)

**Figures in parentheses represent alternative water sources, i.e. a well next to a wadi.

ANNEX B: PRELIMINARY NURSERY OPERATING BUDGET

The following cost estimates are based on actual expenses of the Jaruba station in 1982, increased by the estimated cost of an adequate exension service.

Estimated Annual Budget

A. Personnel Salaries

10 laborers x 60 YR/day each x 22 day/month	=	YR	316,800
1 mechanic x 2600 YR/mo	=	YR	31,200
1 secretary x 2000 YR/mo	=	YR	24,000
2 guards x 1300 YR/mo each	=	YR	31,200
1 nursery foreman	=	YR	60,000
2 horticultural extension specialists x 5000 YR/mo each	=	YR	120,000
8 horticultural extension agents x 2500 YR/mo each	=	YR	240,000
1 expatriate director or advisor	=	YR	180,000
Subtotal, personnel salaries	=	YR	1,003,200

B. Operating Expenses

Fuel and lubricants for generator at station	=	YR	60,000
Fuel and lubricants - vehicles and tractor	=	YR	240,000
Purchase of plant materials	=	YR	20,000
Plastic bags, fertilizers, pesticides, etc.	=	YR	60,000
Extension materials	=	YR	20,000
Repairs and miscellaneous expenses	=	YR	180,000
Subtotal, operating expenses	=	YR	580,000

C. Amortization

Lodgings, amortized over 20 years	=	YR	100,000
Station buildings, amortized over 20 years	=	YR	60,000
Vehicles, motorcycles and tractor, amortized over 5 years	=	YR	72,000
Subtotal, amortization	=	YR	232,000
Total, annual expenses	=	YR	1,815,200

D. Revenues

50,000 budded trees x YR 15 each	=	YR	750,000
200,000 seedlings x YR 10 each	=	YR	2,000,000
Total, annual revenues		YR	2,750,000

The above costs are only order-of-magnitude estimates, but they indicate that even at the present low prices of seedlings (YR 10-15 each), sales should cover nursery and extension costs at a production of about 165,000 seedlings annually. At a production of 250,000 seedlings annually, which should be attained after about 3 years of operation, revenues should exceed expenses by a comfortable margin of over 900,000 YR/year. This surplus could be used to finance the horticultural research activities and to further increase the coverage of the extension service.