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EVALUATION OF THE RESEARCH COMPONENTS OF THE AGROFORESTRY OUTREACH PROJECT IN HAITI

(USAID Project No.521-0122)

by

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TABLE OF CONTENTS

216x

A. EXECUTIVE SUMMARY

This evaluation recognizes two major classes of research conducted under the Agroforestry Outreach Project (AOP): operational or applied research; and baseline studies. The quality of both types of research, particularly that executed by the grantees, is of variable quality. Reporting of tasks in reference to overall charge has been behind schedule and poorly done. Setting up an accurate tracking system, especially for ODH, is necessary.

Research such as species trials, survival tallies and case studies have filled a didactic purpose and have imparted some information. Institutionally, it filled the gap for flexible, adaptive problem-solving research. The project knows more or less which species do well and what don't on any given site. Why some trees do well and others die is less known.

Data collection, record-keeping, and to a lesser extent information transfer have been problematic. Instituitional memory is weak and lax; information is not easily transferred to people outside of the project wishing information. The Agroforestry Outreach Newsletter has been a successful, simple means to disseminate information among the four implementing institutions and USAID. Its publication should be resumed. Overextension of staff, lack of training, and extenuating priorities other than research have lessened the quality of research output. Failure to apply uniform scientific protocol to some of the research themes will make replication of field trials and establishment of confidence limits to the data difficult.

Technical constraints which prevent more successful outplanting of trees and soil conservation objectives from being achieved are still poorly known. Perceptions of field staff and recent sociological research conducted under the project auspices by Buffum and King (1985) and Conway and Balzano (1986, in preparation) reinforce the Evaluation Team's observations that growth and survival is as much a people problem as it is a technical one. However, "best available technology" has not been applied either in the research or outreach program. Improved germplasm through use of tropical and subtropical certified seed provenances and inoculation of production nursery seedlings with appropriate bacteria (Rhizobium; Frankia) and fungi (mycorrhizae) are not routinely done, even on research plots. The comparative value of species trials has been lost because of these deficiencies in method. In sum, we know about as much now about why trees die, survive, or exhibit good or poor growth, as we did in 1981. We do know, however, tree species performance on a variety of sites in a qualitative sense and the field foresters have amassed a wealth of information, mostly retained in their heads, about project trees, nursery systems, and ecological processes in their respective regions. A concerted effort must be made to tap this information, before staff departs post. Concisely written species performance reports, modeled after Mark Webb's excellent account in the Agroforestry Outreach Newsletter (Vol. II, No.3) should be required of each forester immediately. Foresters should be relieved of other duties in order to prepare these reports.

Collaboration among the grantees and contractor has been average, mostly a function of real time availability. Organizational

inter-relationships are weakened by the lack of formal mechanisms of cooperation such as a "Memorandum of Understanding". Grant or contract documents add to the problem, sometimes specifying one party's degree of collaboration, but failing to secure another's in the signed documents. USAID should integrate better the collaborative elements required during the next Phase II Extension effort.

ODH has undertaken an ambitious research agenda, which lacks strict application of scientific methods and standards, or if they are present, poorly documented as to their use. Two key activities, tree farm research and production of a local potting medium, appear disappointing in achieving their original purposes. Tree farms have been shown not to be profitable operations under the ODH system of management. The potting medium still is dependent on peat moss, an imported commodity, and may require additional inputs to improve seedling growth when used in small containers. An independent scientific evaluation of this material should be required of ODH by USAID, before taking further action on this matter.

In the application of research and technology through this project, some standards must be established if uniformity of purpose and result is to be facilitated: (1) Inputs such as seed, inoculant and other materials must be available on time and in sufficient quantity; (2) Field staff must be adequately familiar with the technology necessitating an "operations manual" for the project; and (3) there must be adequate supervision at all levels of technology dissemination and research execution.

How to set up a research unit for this project that is adaptive and flexible to overall project needs or to special problems that may arise is difficult, but not impossible. The project has established a nursery production, tree outplanting and rudimentary extension program with additional inputs addressing a pre-defined research agenda executed on contract and within the confines of certain terms of reference. The establishement of this research agenda was not tailored carefully enough to CARE and FADF needs, withe the exception of the local potting medium development and remeasurement of grantee species trials. On the other hand, presently executed research by UMO, and some by ODH, will enable a more targeted Phase II Extension to be designed. In looking to the future, and not dwelling on the mistakes of the past, are we to make significant progress toward achievement of basic project objectives.

The following recommendations are presented for consideration during the redesign of the Extension; they are elaborated in greater detail in the Recommendations section of this report:

1. Continue support for a centrally-organized research unit within the project to conduct operational research and baseline studies.

2. Relieve grantees of their research responsibilities, but redesign the research unit toward more responsive, responsible applied research, conducted in collaboration with PVOs, who should be required to retain a full-time research scientist on their staff to liaise with the central research unit.

3. Develop a more bounded research agenda and determine the most

effective operational mechanism to achieve such in Haiti.

4. USAID should reassess the nature and extent of its committment to tree planting and agroforestry research in Haiti and decide upon realistic goals, their measures of achievement, and appropriate institutions to execute its agroforestry agenda.

5. Discontinue research on large land-holder tree plantations in the Cul-de-Sac Plain as well as on the development of a local potting medium.

6. Discontinue support of research activities under the ODH grant; evaluate ODH nursery and seed production capabilities to service grantees in the proposed extension.

B. CONTEXT OF AOP RESEARCH

Background

The research movement in the AOP began with the idea of cash cropping trees for peasants on private land, a novel, even subversive concept, given the legal implications of cutting a tree on your own land in Haiti. During the project design phase in 1980 it was decided that a strategy of tree planting choices was needed based on land types, objectives of the land, use of fast-growing, coppicing exotics, and a nursery system capable of producing large quantities of easily transportable seedlings. It was admitted that whereas the data base on which to make decisions about which trees to plant on any given plot of land in Haiti was meager, if nonexistent, some intelligent choices were possible, which would stand a measurable degree of success, or could at least be modified if a modest research effort were initiated.

Major responsiblity for research and development of agroforestry technology was given to ODH, and included topics such as nursery practices, species-site studies, seed production and handling, and demonstration tree farms. Complementary research was also to be conducted by CARE and PADF on topics such as nursery practices, state of knowledge of agroforestry systems, appropriate technology and its dissemination, and small farm agroforestry demonstration models. In all these instances, it was assumed that tree planting on private lands would be the major thrust of the project, but that new technologies would be continually tested by ODH, PADF, and CARE, and if promising, eventually incorporated into the project.

The mid-term project evaluation, conducted in late 1983, determined that the original project research mandates were not being adequately carried out by the grantees and suggested that a discrete research component be added. The addition of a Title XII institution, the University Maine at Orono, was accomplished in March 1985 in order to concentrate on applied research, the secondary project goal. ODH would, however, continue with a more targeted research agenda on tree farm

profitability, development of a local potting medium, and seed production, procurement, and storage. some of which would be of a collaborative nature with the University of Maine.

Classification

For purposes of this evaluation, two broad categories of research must be recognized: operational(applied) research and baseline studies(applicable to the situation in question).

Operational Research. This type of research attempts to define the magnitude and limits of a potential project intervention or action by setting up a series of questions to be answered and a methodology to answer them. For example, determination of the number and species of trees to give a farmer is a valid question; farmer preferences and probability of survival and adequate growth increments are part of the solution; manpower requirements to improve growth and survival in terms of extension is another. The types of operational research being conducted by the AOP include: potting medium trials; management and production rates of indigenous versus exotic tree species; leucaena hedgerow trials; cost-benefit analysis; and other topics.

Operational research, as it is conducted on this project, stands a high probability of failure because the ecological constraints to tree planting are not understood or are overestimated. Such research is being supplemented, however, by baseline studies.

Baseline Studies. This type of research analyzes and assesses the present characteristics, status, and processes of an ecosystem such as productivity, nutrient cycling, seasonality of rainfall, temperature, tree flowering and so on. Baseline data creates a monitoring capability whereby adjustments in a project can be made as trends are identified. Data from a monitoring system can be useful in tracking project success and any external influences to which it is subjected. The scale, sampling effort, and relative costs are frequently underestimated. If carried out over a sufficient period of time, baseline studies may enable adjustments to be made in mean values previously acquired in other surveys. Baseline studies being conducted under the AOP include: survival tallies; species trials; case studies; characterization of traditional agroforestry systems; silvicultural relationships; and many others.

Operational research and baseline studies have as their primary collaborative goal movement from extensive to intensive management of resources. The AOP is to be lauded for attempting to accomplish this objective, even if it doesn't know that is what it is doing.

Assumptions

In order to conduct a viable research program which addresses the needs of the project, a number of assumptions were made by various people and institutions which have been perpetuated throughout the LOP.

1. Collaborative Research: Coordination among the grantees and contractors will be necessary in planning, executing, and utilization of findings.

220X

2. Technical Assistance: Technical advice and support services to CARE, ODH, and PADF would be provided by the research unit.

3. Senior Forestry Advisor: A senior-level technician would be available to the grantees and contract research unit to assist in site selection, methods, information procurement and other support matters.

4. Flexible, Responsive Topics: Some of the topics for research must necessarily result from problems in the field, hence would be of a specific, problem-solving nature requiring, perhaps, special methods or resources for their solution. A flexible, adaptive research agenda should address this possibility.

C. ROLE OF THE GRANTEES AND CONTRACTOR IN RESEARCH

A dynamic situation exists in which the grantees and contractor are interested in tree planting and cash cropping as a means of livelihood for rural Haitians. Given the constraints under which they operate, the level of enthusiasm by the implementors of the AOF is surprisingly high. Most project staff understand the value of a research-driven, technical data base and this philosophical concordance facilitates its collection and eventual managment. This section describes the organizational relationships under which research functions and describes the performance and status of grantees and contractor according to research activity, as specified in their terms of reference.

Organizational Relationships

An active network of NGOs conducts research through the AOF. A later section discusses the effectiveness of this framework for intensive research activities (D.2 Special Issues and Problems). Two mechanisms were established to ensure a coordination of efforts towards an improved AOF research program through a formalized system of communication: (1) a series of meetings by research committees; and (2) publication of a "Agroforestry Outreach" newsletter or bulletin. It was also assumed that quarterly reports and workplans would be submitted in a timely manner and circulated to all parties.

Research Sub-Committees. A series of meetings were held from March-May, 1984, to define project research needs. Four sub-committees were established to cover the following topics: nurseries; species trials; case studies; and socioeconomic research. Targets for outputs and schedules were established. Presentation of results were done at a number of technical retreats held in late 1984 and throughout 1985. Once the UMO Team began implementation of their charge in March 1985, the functioning of these committees effectively ceased, despite the fact that three new sub-committees were formed that same month. It was implicitly assumed that UMO would take the lead in synthesizing what had been done and presenting the findings. These sub-committees were not part of anyone's terms of reference, hence participation and implementation of any recommended actions were entirely voluntary.

Agroforestry Outreach Newsletter. Ms. Wendy King, the second AOF Coordinator, initiated the Newsletter with the intention of

disseminating project-related and other useful information on agroforestry to the grantees, contractor, and interested local and international organizations. The Newsletter has published the experiences of several of the grantees field foresters; for example, Mark Webb's excellent account of species performance in the North region of PADF is required reading and should be a standard of reporting for all foresters participating in the project. Unfortunately, only four issues were published; publication is expected to be renewed in 1986.

Aside from these formalized mechanisms of communication among the project staff, no formalized coordination of activities exists. Each grantee's and contractor terms of reference(Grant Agreements; USAID-UMO Contract) make no provision that cooperation from each side to accomplish a particular task will be executed. Operationally, coordination and cooperation in sharing data and information rely on the good faith and time availability of the respective staffs of each organization.

Performance/Status

1. CARE and PADF - Because their research charge encompasses essentially the same topics along similar functional lines, these grantees will be lumped in this section. If one examines their conceptual charge elaborated in the USAID PP, PADF is responsible for collecting and analyzing data on reforestation in rural Haiti and with establishment of demonstration areas; CARE with reporting and monitoring indicators of tree planting, development of replicable agroforestry models including tree growing and appropriate land use practices.

Survival Tallies. The objectives of this research component are to monitor survival over the LOP by taking a 3% random sample of planters each season. There are two planting seasons per year, corresponsding roughly to the availability of rains: May-June; and September-October. Expectations concerning the utility of this information are that by monitoring this indicator of project accomplishment, or failure, adjustments can be made in species mix available for outplanting or training requirement of animators(PADF) and monitors(CARE). The grantees collect and analyze the raw data, providing a reduced data set to UMO for their records.

Case Studies. The grantees through the Project Coordinator's office established a research component referred to as "case studies". These were designed to assist in extension by providing a means of tracking and supervising animators and monitors, and to facilitate research by providing baseline data on project sites and activities. Such case studies represent a 33% random sample of the survival tallies for Spring and Fall 1985 plantings. A questionnaire was designed for execution on each planter's farm. Some aspects of the questionnaire were problematic and only resolved after great debate; for example, soils analyses was viewed by some field foresters as critical to identifying site constraints that may be identified through these case studies, however, it was decided by the sub-committee on Silviculture and Species Trials, set up in April of 1985 that soils analyses were to be eliminated. Only slope, soil depth, and parent material were recorded in the case study. The basic problem with the case studies is that of poor design; for example, it is difficult to determine what many of the questions were

222X

set up to answer. UMO is currently having problems interpreting information recorded on these case study questionnaires with respect to crop calendars and physical site characteristics. If the purpose of such studies was to establish the realtionships between species and local environmental conditions, they may fall short of their mark.

Species Trials. The objectives of this research component were to test indigenous and exotic tree species performance under different site conditions and to establish limits or suitability to a particular zone. Given these objectives, this research has been useful in determining what and what not to use, in many instances. The limitations of the data obtained from these trials, however, must be recognized because uniform seed sources and provenances were not tested, nor were trees inoculated with Rhizobium (leguminous species) or Frankia (especially Casuarina). Comparisons between and among sites are precluded because of the failure to establish these trials according to scientific methods which would enable replicability and confidence limits to be determined. But, as a qualitative source of information of immediate use to field foresters in any particular area, they are viewed as contributive to the progress that has been made so far to match species to a farmer's plot.

2. Operation Double Harvest -

This review focuses less on overall performance and more on the technology and research components of the ODH Grant. The following topics are felt to be pertinent in an assessment of that institution's implementation of the spirit of the AOP:

A. Meeting Specific Grant Objectives:

1) Strengthening the managerial, administrative, technical and financial capability of ODH to carry out its forestry program.

A Forestry Department was established to address the grant objectives, composed of a technical forester (Peter Welle), a nursery manager (Gerald Larson) and a research forester (Joel Timyan), with the necessary support staff and field assistants/day laborers. The research forester has not been full-time since 1984, because he is presently completing the requirements for his doctoral degree at the University of Georgia. He plans to be on staff during the summer of 1986.

The financial monitoring of inputs and outputs has been facilitated by the computerization of the entire operation. Mr. Rick Patten, a computer specialist with experience in setting up financial management programs for other PVOs in Haiti, completed this task during 1985. Mr. Peter Welle verified that the use of this new system has made accountabilty to donors a much easier process than previously.

2) Production of seedlings for outplanting on ODH tree plantations and nearby PADF outreach programs.

Seedlings were produced for the Nadal Plantation (ODH managed); some seedlings for PADF even though PADF has now set up regional nurseries to handle the demand in particular areas; nearly a million seedlings were sold by ODH to the MARNDR for outplanting on selected localities in Haiti.

3) Continuation of the program of seed selection, procurement, production, storage, and distribution.

There is an on-going program to obtain local seed for species such as neem and ODH has a seed orchard for Leucaena. There is some question about the quality of the genetic stock from which any such seed is obtained. The issue is correct variety and provenances suitable for use in Haiti. Also at issue is how the seed is collected that is found in Haiti. The concern is that local Haitians will go out to seed trees under contract, but perhaps select from the wrong king of trees or from the wrong location on an individual tree. According to Peter Welle, a big priority should be to get seed orchards started for a minimum number of species and varieties, which are appropriate for the Haitian environment.

A seed storage facility exists, other than the simple refrigerators present at the Cazeau nursery, at Km 13 near Don Repos. It has been renovated and operational as of February 1986. This facility possesses a unit in which seeds could be stored at the correct temperature and humidity regimes, with the following specifications: a 20' x 40' storeroom, insulated with 2-inch styrofoam aluminum-covered boards, equiped with a Dry-o-matic air dehumidifier/conditioner, seed cleaning sieves, shakers, and dryers; the building is also rodent proof.

A matter of concern by the ODH forester is the absence of a systematic determination of what charactersitics are desired from the local tree stock. The seed collector has some vague guidelines concerning straight boles and the like, but the needs of the farmers for trees that branch or don't branch have not been comprehensively considered. This point was emphasized by Mike Benge during the Evaluation Team meeting with the FADF staff on January 30.

The problem is further aggravated by the haphazard manner in which seeds from international sources are procured, recorded and distributed to the grantees. Many of the field foresters have little knowledge of exact provenances, even for Leucaena, of which ODH claims to have better knowledge.

4) Continuation of the monitoring and management of established demonstration tree farms in the Cul-de-Sac; and collection and analysis of data on the economic feasibility of tree plantations.

The 10 established tree plantations are being managed and monitored by the technical forester. The goal of this management is to demonstrate economic feasibility in the context of Haiti by keeping inputs low, i.e., no fertilization, some weeding and pruning, use of spot enrichment plantings to fill gaps in canopy caused by harvesting or death of trees, and use of direct seedling over containerized nursery-produced seedlings. Another emphasis in this "low-cost" approach is determination of management techniques that increase profit, such as pollarding of species to encourage better polewood growth, coppice managment and other techniques.

The purpose for having these tree farms is viewed as a demonstration effect for farmers interested in wood production. In order to achieve this demonstration effect, ODH believes that a number of uses must be demonstrated for the trees planted on these sites, given the need to have high survival. At present, ODH knows what its costs of establishment are, but doesn't yet know the economic feasibility of the entire tree farm operation, even though its Oct-Dec Quarterly Report(1985) states that charcoal, firewood and poles could not by themselves sustain a viable ongoing forestry venture. It hopes to have this analysis completed by the summer of 1986. Also, market conditions appear to disfavor the selling of wood products, that is, prices are low for polewood and charcoal. Long-term committments from Cul-de-Sac landowners to put trees on their land have not been given. I recommend that no more plantations be started, but that ODH use what it has, regardless of the fact that it has established these plantations in only two distinct life zones: subtropical dry and moist forest. The development of additional secondary products from these tree farms, such as tool handles or furniture, would serve as further incentives to landowners and have a dramatic demonstration effect.

3) Implementation of research by a qualified forester to compare management and production of indigenous versus exotic species.

The technical and research foresters are jointly working on this task. The nature of this research includes the following:

- Species trials on marginal lands, which are construed to be dry sites (less than 1000 mm average annual rainfall) with mineral soils (having low organic matter per unit volume of soil).

- Use of species on these marginal sites which have a reasonable chance of success, including Pithecellobium dulce and species of Acacia other than A. farnesiana and A. tortuosa, as well as comparing their performances against Leucaena, a tree which has had good survival on many different sites throughout Haiti.

- Experiments with "alley cropping" to study forage and organic matter production on farm sites.

- Use of Prosopis juliflora, particularly to determine how much browsing by animals it can withstand and what additional management inputs such as weeding and watering are required for good growth.

- Continuation of the use of Rhizobium inoculants on Nitrogen-fixing tree species in all these research outplantings.

- Development of applied plantation management schemes with low inputs such as direct seeding as a means of plantation establishment, no fencing, use of thorny species which can handle more browsing, ways to use bare root planting for species such as 'neem'; and the monitoring of tree species performance on these sites including survival and growth rates.

Some of the research findings indicate that higher survival can be achieved with a combined nursery and outplanting strategy, depending on the species, that includes:

- Nursery: a more expensive seedling ($0.10); more hardening off.

- Outplanting: use of pioneer species that can be direct seeded such as Acacia, Prosopis, and Pithecellobium; and simple construction of water catchement basins around individual trees on sloping lands; use of a subsoil ripper on flatlands to adequately prepare soil for seedlings or direct seeding.

6) Collaboration of ODH with University of Maine Research Team:

Although the charge of ODH and UMO are different, some areas of collaboration can be noted. Charcoal made by ODH was tested by the UMO Team with reagard to consumer preferences; economic data on tree plantations was analyzed by Gerold Grosenick; Species trials and potting mix comparisons were conducted by UMO on ODH sites, for example, on the Nadal Farm.

No work was done with UMO on soil mix; it apparently was not in UMO's SOW.

7) Establishment of additional tree plantations in different ecological zones.

No attempt has been made by ODH to establish tree farms on ecological life zones other than subtropical dry(e.g. Nadal) and moist(e.g.,Madsen). All of these plantations are on flatlands or on gently sloping terrain, not on steep slopes in the mountains, nor on wet sites, that is, receiving more than 1500 mm of rainfall.

The Nadal Farm was scheduled for 65 ha, but 76 ha were planted.

8) Development of a local nursery potting/soil mix.

Much work has been done on the development of a local potting mix, referred to as Haitian mix by ODH. Its present composition is: 70% composted bagasse; 15% soil; and 15% rice hulls. Other grantees have complained about consistency of quality of this mix, especially since additional peat moss (at least 20%) must be used to improve seedling growth in this medium. ODH would like to mechanize the production of Haiti mix in order to produce a consistently good quality potting mix. Prices are now competitive with "Peat Mix"(TM), brought in by PADF under a tax free franchise. Prices on the open market in Haiti are nearly double for this same Peat Mix.

3. Summary of ODH Forestry Department Research, 1984-1986:

The following listing indicates the nature of the research being conducted by ODH in concise format. For purposes of this evaluation, the details have been deleted.

1. Cazeau container tree nursery

a) Input/output analysis of a million tree container nursery
- labor inputs

- supplies such as electricity, water, fertilizer, pesticides potting medium (Haiti mix only)
- equipment such as "winstrips", bay structure, watering and fertilizer equipment, pumps

b) Input/output analysis of Haiti Mix

2. Plantation establishment

a) Effects of site preparation techniques on germination and initial establishment of Leucaena var. K-28

b) Energy equivalents of tractor, labor, fencing and other establishment costs.

3. Plantation production

a) Maintenance, including labor inputs of water catchments, strip and ring weeding, pruning and pollarding, fence maintenance and grass gathering.

b) Harvesting, including labor inputs of felling, bucking, hauling fuelwood and polewood, sorting and charcoal manufacturing; as well as yield and productivity analyses.

4. Silvicultural trials

a) Clearcut pruned (one sprout; coppice versus clearcut pruned (multiple sprout); coppice versus shaded, pruned (one stem); coppice under stand thinned for lumber production versus control (original 1981 stocking density).

b) Clearcut, pruned (multiple sprout) coppice versus unpruned coppice.

c) Leucaena var. K-28 seedlings and Prosopis coppice versus pure Leucaena seedlings versus pure Prosopis coppice versus Leucaena and Prosopis coppice on a salty-soil site.

5. Species trials

a) Cazeau trials #4 and #5

b) Nadal Plantation: Overseas Forestry Institute(OFI), U.K./ODH semi-arid land

6. Growth studies of 1981-1986 period for Leucaena, Prosopis, and neem in the Cul-de-Sac.

7. Physical wood parameters of exotic and indigenous hardwoods, selected for fuelwood production.

8. Testing of soil samples taken from tree plantations in the Sul-de-Sac.

9. Collection of rainfall data at nine (9) sites in the Cul-de-Sac,

continuously since 1984.

10. Preparation of biomass tables for Leucaena, neem, Casuarina, Prosopis, and Acacia tortuosa.

The major problem I have with this research is in the reporting of tasks accomplished or progress toward completion of these tasks. There has been little systematic effort to inform AID or the grantees about where ODH is with respect to this research, other than when the research forester has completed a particular task and has submitted a report. Using this outline, it is recommended that ODH implement a more comprehensive statement on the status of these efforts, beginning with next Quarterly report.

C. Special Applied Research Topics:

ODH has been involved and will continue to be involved with a number of unique research topics which potentially could improve agroforestry and forestry systems in Haiti. In some cases this research is of a less than scientific nature, whereas in others controlled experimentation is conducted with a mind toward replicability. The following topics are pertinent to this discussion:

1. Research to enhance survival, decrease costs, and increase production.

- Propagation Techniques: Direct seeding technology merits further research for early successional or pioneer species, adapted to areas with high diurnal (24-hour) fluctuations in surface soil temperatures and moisture, light intensities, and seed predators. Silvicultural methods appropriate to establishment of direct-seeded trees should be developed that are "user intelligent" (= Haitian farmer). Longer nursery rotations of containerized seedlings is an important technique to harden off seedlings and increase their capacity to adapt and survive the shock of transplanting on harsh sites. The issue of techology without a cultural feasibility assessment is pertinent to this research because new forestry systems being presently proposed by expatriates should be developed in response to local environmental and cultural constraints. Maybe we need to llok hard at containerized seedlings for dry sites with a mind to shifting or experimenting with direct seeding of more arid zone species.

- Rain Catchments: The scarification and alteration of microsites to enhance rainwater infiltration on sloping sites merits some attention. Although viewed as appropriate for direct seeding and seedling outplants, different land treatments may be required. ODH work with the mechanical rippers on flatlands may not be appropriate for sloping sites, where soil erosion could be aggravated. Construction of small basin catchments for individual trees may be too time consuming given the payback expected by the farmers. Again, we should consider cultural feasibility along with the technology. ODH doesn't appear to be as concerned about cultural aspects. I may be wrong.

- Species Selection: Exotic, thorny species should be compared with native species such as Acacia farnesiana and naturalized species such as

Prosopis juliflora. Improvements of a genetic nature or selection of tropical provenances more suitable for sites in question, especially for self-sustaining fuelwood production on marginal lands merits some attention. These species are time-tested associates of grazing lands and some of the few possibilities for low-input forestry on semi-arid sites in Haiti. One exotic that has performed well in trials for ODH is Pitnecellobium dulce.

2. Genetic Selection:

ODH can make a significant contribution to agroforestry practices in Haiti in the selection of new genotypes that improve productivity on marginal lands or difficult sites. In the Evaluation Team's interview of Art VanWingerten, this belief was reinforced.

For the Cul-de-Sac region, silvicultural techniques already exist and appear to be implemented based on the farmer's socio-economic status. Such techniques focus on spacing naturally regenerated trees for shading large ruminants, locally called "parc". The increase in tree growth rates is related to the organization of the microsite of the lakou for animal shelter. Selection of coppice for polewood is made as shoots develop into the required diameter classes, known to foresters as "highgrading" of sorts. Having existing tree management practices greatly facilitates the integration of new, improved germplasm into the Haitian context, especially if it a species already known, but with improved characteristics.

Regarding tree improvements for species such as Prosopis, selection of phenotypes should focus on: less thorniness; greater pod production; straighter form; physical (e.g., stoney and clayey) and chemical (e.g., high salts, high pH) soil tolerances. Trees would be vegetatively propagated to ensure genetic quality.

The central question of quality of genetic selection can be resolved by firm committments from ODH to upgrade their facilities and/or USAID to support in the medium term, an expert in germplasm banks and tree genetic improvement.

D. Tree Farms: Technology and Profitability

Are tree farms profitable? This issue was posed as a question to several ODH staff and the unanimous reponse was: let's wait and see for another year or so. Why? The question of profitability and sustainability depends on the time interval which is a function of input costs and site productivity, and the art of determining "benefits". A tree farm is immediately profitable to the local community, whose job it is to implement a project from nursery to retailing of the products. Whether or not it eventually becomes profitable to the formal landowner and investor will depend on site productivities, which are presently low (e.g., about 4 tonnes dry weight/ha/yr), input costs which are moderately high (e.g., about $400 - 500 /ha for a six year rotation) and on the degree of expatriate management. Covert practices of grazing and periodic harvests are short return benefits enjoyed by the local communities, whereas the ecological and long-term benefits may include improved wildlife habitat, soil amelioration, soil protection from

erosion, and increased landscape diversity.

UMO recently completed its preliminary analysis of tree farm profitability using Cost/Benefit Analysis. Their conclusions are: few data were systematically collected and reported; what it has tried to do is not working on some sites because site evaluations were not conducted to identify ecological constraints and to locate farms in an array of ecological zones, i.e:, there was little or no site prospection; tree farms are not profitable, but with modification to reduce land preparation costs, might be.

Most of ODH's tree farms are located on semi-arid sites, with exception of the Madsen Farm, which is located in the subtropical moist forest life zone. The species most appropriate to semi-arid sites have small coriaceous leaves, ground-level perennating tissue, multi-stem habit or form, a taproot and thorns. These are all adaptations to the critical hydrologic balance of these sites. Most of the species are from the Leguminoseae family and form symbioses with Rhizobium bacteria for nitrogen fixation and mycorrhizal fungi for enhanced mineral uptake. The most important genus of trees for this life zone is Acacia, but the most important species may be Prosopis juliflora due to its higher salt tolerance and more erect life form.

According to Joel Timyan, it is unlikely that most of these marginal sites will ever produce high value lumber due to the poor form of these thorny species, to the physiognomic response of any tree to sites with shallow soils, high salt content and low organic matter, and to the pressures of periodic grazing and browsing by livestock. In areas of higher rainfall and altitude, the more valuable trees known in Haiti, such as chene, kapab, kajou and pich pin, are appropriate. Most of these species will be located at the garden boundaries, and serve as seed sources for fallow land not intensively grazed.

3. University of Maine at Orono -

The purpose of this section of the overall ADP evaluation is to review the nature and progress to date of research conducted by the University of Maine at Orono (UMO). Linkages between this research, or elements thereof, and the future extension of the ADP will be provided.

A. Status of Major Contract Components

A bar graph of percentage of subcomponent completion is presented in Figure 1. Please make reference to this figure in conjunciton with text descriptions. The following legend should be keyed to Figure 1: TS=Traditional Agroforestry Systems; SYL=Silviculture; NRS=Nursery, Outplanting and Species Trials; CP=Consumer Preference; C/BA= Cost/Benefit Analysis Agroforestry Project; C/BT=Cost/Benefit Analysis Traditional; MKT=Marketing Studies; PD= Planting Decision Studies; SEP=Socioeconomic and Ecological Profile.

The contract starting reference point is March 1, 1985. All progress will be measured from that date, with liberal interpretation for time required to staff up for pertinent activities, commodities procurement and the like.

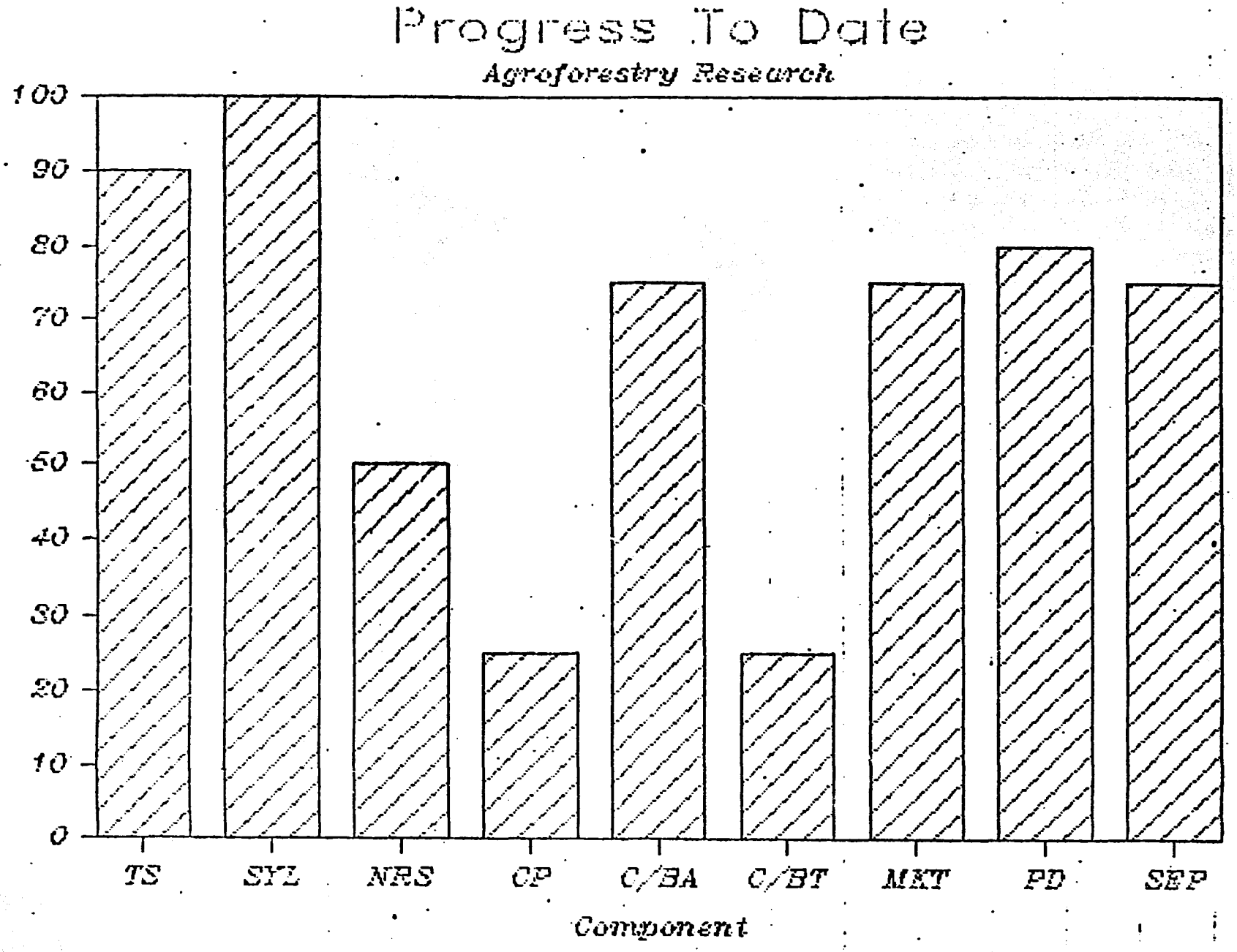

FIGURE 1. University of Maine Performance Through March 1986

1) Traditional Haitian Agroforestry Systems:

Objective: To identify and describe major agroforestry systems practised by farmers throughout Haiti, exclusive of any AOP-related techniques or systems introduced during the LOP.

About 10 months was allocated for this task; a little over 10 months was taken to execute it. The final draft report is being typed and will be submitted to USAID in early March. A student at FAMV, Damien, was used for two months to assist in data collection.

Tree measurements were not done in this subcomponent, but were relegated to the Silviculture subcomponent. These data would have served to generate the following: local volume tables; total volume tables; fruit yields.

2) Silvicultural Relationships:

Objective: Evaluate the effect of silvicultural treatments within different cropping systems on which AOP plantings were made.

About five months were allocated to completion of this subcomponent; about six months was taken to complete it. A final report was submitted to USAID in late 1985.

The exact locations of the sampling sites are listed in the report prepared by Marko Ehrlich. Growth and yield was determined under existing spacing and thinning arrangements on private lands, planted by farmers with AOP trees. Sites were selected based on tree species availability and are not representative of a wide range of sites and ecological zones. Measurements were made on existing plots without any special treatments by the UMO team. Pruning and spacing studies were not done as indicated in the work plan. A coppicing trial was set up in addition to the growth and yield measurements in Cap Haitien area. This resulted in expenditure of an additional month, over that amount of time which was anticipated to complete this subcomponent.

3) Nursery Management:

Objective: To identify container type, potting mix and nursery cultural regimes, which would enhance survival and growth for commonly planted AOP trees.

This subcomponent was subdivided into two parts: a container/potting experiment; and a cultural regimes series of experiments. With regard to the container/potting mix experiment, all trees(neem, leucaena, and eucalyptus) were grown out in the nursery and outplanted in October on the Nadal Farm of ODH. A draft report was prepared by Roland Dupuis comparing survival in the nursery for these species in different types of containers. The measurement of the outplantings is on-going and is being done by a forestry technician every month. It is anticipated that a report will be prepared comparing survival and growth after six months. With regard to the cultural regimes experiments, commonly planted species were compared under the following regimes in randomized block design:

- Direct seeding: comparisons for a dry (Duvalierville - 800-900 mm of annual rainfall) and a wet (Saut d'Eau - greater than 1500 mm) site; this element is on schedule.

- Growth schedule: comparing species which were 'hardened off' in the nursery before outplanting on Nadal Farm.

- Pruning trials: comparing survival and growth of species using top pruning.

It is anticipated that a final report will be prepared after all data is collected after the second rainy season after outplanting and analyzed, that is by summer 1986.

4) Planting Tools:

Objective: To evaluate the effect of different types of planting tools on root form and tree growth.

It was decided by UMO not to conduct this subcomponent because few tools are used by peasant farmers in tree management, other than the machete. Use of a more diversified array of tools makes sense to a farmer on the flatlands, but appear unrealistic for those on hillsides.

5) Species Trials:

Objective: To evaluate the performance by ecological zones of species in trials planted in Haiti.

In order to set the record straight about species trials, the following points are pertinent to this discussion: (1) ODH, PADF, and CARE asked UMO in March-April, 1985, to take over the remeasurement of their species trials, which numbered about 38; (2) UMO never proposed to set up new species trials anywhere in Haiti; (3) existing trials, which were measured by UMO during this last year include those of CARE, ODH and four trials set up by UMO under a previous project entitled "Haiti Reforestation Project", sponsored by the United Methodist Committee on Relief. These latter trials were set up in Gaunthier(three trials) and Duvalierville (one trial). PADF trials have not been measured by UMO, nor will they be.

Whereas four months was programmed to complete this task, roughly 70% of the work remains to be completed, including remeasurements and final report preparation. The following issues have affected the completion of this task:

(a) UMO has many more trials to remeasure than originally programmed; UMO's original estimate was that of the 23 proposed trials, only 16 had any value in remeasuring; it now commonly cited that there are 38 species trials for which UMO is responsible.

(b) UMO had not scheduled taking as many measurements as were required by the "standardized procedures" recommended by CATIE during the summer of 1985, which include: stump diameter; dBH; top diameter; number of stems per tree for multistem trees; and total height. These standard measurements were adopted after UMO had its work plan submitted

and approved by USAID.

(c) Analysis was done on 15 trials, but the computer technician, Doug Gill, ran into problems with the trials, for example, survival by species was kept separate for each replicate, whereas in others it was lumped, making it impossible to establish confidence limits for the data. UMO has settled for "average survival", with a qualitative set of confidence limits calculated from the more reliable data.

6) Consumer Preference Subcomponent of Socioeconomic Analysis:

Objective: To determine consumer preference for different species of wood planted in the AOP with respect to use as fuel and as construction material.

This is the least completed research subcomponent. Preparation and pretesting of the survey questionnaire, selection of consumers, preparation of charcoal, fuelwood and lumber, and execution of one preference test have been completed. Another preference test will be done, followed by data analysis and report preparation. Four months was allocated for this task, but completion of the AOP-wide cost/benefit analysis for the evaluation has disrupted the work schedule of this sobcomponent. USAID can expect a report from UMO in late spring, 1986.

7) AOP-wide Cost/Benefit Analysis:

UMO was asked to prepare a project-wide C/B Analysis for the evaluation in order to plan for the extension of the AOP. The UMO analyst will be listing costs and benefits without limits on the type received/expended, that is, in a cumulative sense. Benefit components include: farmer net benefit; total benefits to individuals; other benefits not accrued to individual planters such as benefits to neighbors not planting trees, environmental benefits of soil conservation, employment generation, etc. Costs of USAID funding will be balanced against these benefits to determine if Agroforestry is providing some net return on AID's investment for Haiti.

This analysis should be completed during March 1986.

8) Traditional(Farm-Gate) Cost/Benefit Analysis:

Objective: To determine the economic benefits of the project to small farmers and the rate of return needed for these farmers to be able to purchase more of less subsidized seedlings.

Six man-months of effort was planned for this activity, which is 25% complete. Recommendations anticipated from this analysis will focus on how a farmer should or does manage trees for profitability, and if we should encourage other farmers to plant trees for profit.

9) Wood Marketing:

Objective: To demonstrate the profitability of growing wood in an agroforestry context.

About 11 months were programmed for completion of this

subcomponent, which is 75% complete. Ms. Lisa McGowan is charged with completion of this activity.

The rationale for this subcomponent was to obtain more information about prices farmers receive for harvested wood by tree species for the categories charcoal, poles, lumber. For Port-au-Prince, two surveys have been conducted at all roadheads into town and port unloading areas to get some idea of products entering the marketplace and the regional and seasonal delivery patterns. One remaining such survey will be completed shortly.

Additional sites were selected in the provinces which reflect a transition from rural to urban settings, one such locality being Thiotte, and any measurable changes in use of charcoal, polewood and lumber.

10) Planting Decisions:

Objective: To determine rationale for small farmer decisions about why to plant project trees and under what spatial arrangement on their farm plots.

Although 11 months were originally programmed for completion of this subcomponent, Dr. Fred Conway was given a six month contract to complete the task. His final draft report is expected by April 15, 1986. Some information from Mr. Anthony Balzano's socioeconomic and ecological profile will be used in the final analysis of this task.

11) Socioeconomic Profile:

Objective: To describe the social, economic and ecological reasons why particular farmers are selected to participate in the AOP as tree planters.

About 11 months were allocated for completion of this task. Two study sites were chosen: Fond-des-Blancs; and Beaumont. The anthropologist will attempt to identify and integrate environmental constraints into decisions farmers make on their land with respect to tree planting.

A draft report on Fond-des-Blancs was completed in January, 1986. The report on Beaumont can be expected by May 1986.

C. ANALYSIS OF RESEARCH COMPONENTS

1. Technology Development, Information, Utilization

Innovative Technology

CARE Staff foresters identified the following as examples of innovative technology developed or disseminated through their project; an (*) asterisk indicates CARE's modification of an existing technology

by adaptive, on-site research:

- *Leucaena hedgerows planted on the contour to control soil erosion.
- *Brushwood checkdams using live stakes to promote soil conservation.
- Vegetative and rock mulching to reduce moisture and soil loss.
- Fruit tree grafting at regional nurseries.
- *Composting
- Use of micro-catchments (water conservation) to enhance tree survival during dry periods.
- *Scarification of seeds using hot water to promote germination.
- Use of wood ash as a source of potassium for plant growth.
- CARE-model container nursery, using local materials.

PADF. Staff foresters identified the following as examples:

- Small container technology, both "ROOTRAINER" (TM) and the PADF nursery system. which is adapted to the establishment of rural nurseries by developing wood and wire frame (rack) supports for the containers; and in the case of Ralph Mathieu's region, more locally-perceived repairable nurseries (e.g., use of materials familiar to local inhabitants).
- Compact and efficient delivery and transport systems, e.g., 30,000 seedlings in one pick-up truck load, and modified cardboard box distribution, using locally-made bamboo baskets instead of imported cardboard boxes.
- Tree planting techniques to enhance survival by use of mini-catchments and mulching of seedlings.
- Use of living hedgerows planted on the contour with a simple A-frame level.

ODH. The following developments have taken place during the last few years. which can be considered as innovative technology and a direct result of operational research of a highly applied nature:

1. Winstrip technology - A containerized system for horticultural and forestry purposes designed to compact nursery operations, improve seedling root development, and decrease costs of artificial regeneration systems. Many believe that the Winstrip has the most potential for revolutionizing the vegetable production industry in developing countries.

2. Haiti Mix - A potting medium derived from local materials, with the exception of fertilizers. Problems of consistent quality are still apparent, but use of a mechanized production system will improve quality and enable ODH to produce significant quantities of this medium for Haiti.

3. Modified Mark V Pit Kiln - A pit kiln modeled after the Mark V Charcoal Kiln, requiring less imported materials, primarily less steel, and greater local labor inputs, decreasing costs, according to ODH, by a factor of 10.

4. Fiberglass Electric Fencing - A lightweight 4-strand barbwire fence utilizing 0.5 inch fiberglass poles and a solar-powered pulsar.

5. Barrel Drip Irrigation System - A micro-drip irrigation system designed for small, intensive gardening operations, using technology appropriate for the local context.

6. Open-Air Horticultural Nursery - A system to raise horticultural crops requiring long nursery time under the canopy shade of Leucaena and Prosopis stands.

Much of the information and technology transfer of these innovations have been done by word of mouth. Access to ODH's Cazeau farm is easily had by local Haitians and occurs frequently. According to ODH sources, observation and implementation of the Cazeau farm's agricultural practices are perhaps wider than realized or measured.

Formal advertisement of some of this technology has appeared in international agricultural journals, as well as in USAID reports. The research involving nursery and charcoal production using Winstrips and the modified Mark V Pit Kiln will appear in academic publications during the ensuing years.

Information Exchange, Dissemination, and Networking

Whereas the project has been struggling with this concern since its inception, a number of positive accomplishments can be identified.

a) Rural training has been imparted with concise technical information, multiple media repetitions, and reinforcement with use of flipcharts, videos, manuals, lectures, siet demonstrations, and role-playing theatrical skits;

b) Resource dissemination in the form of nursery materials, local and imported seed, media materials, and fruit trees;

c) Networking with the GOH, national and international organizations (PVOs, bilaterial donors such as Helvetas, World Bank, FAO, etc) by sponsoring (1) a special study by Warren Cohen (1984) on resource degradation trends in Haiti using aerial photointerpretation. (2) regional meeting of PVOs (August 1985) to discuss reforestation and tree planting in rural communities, and (3) by participation of project staff in international conferences and symposia where project activities and research has been reported;

d) Production of a first-class video on the project (1985), which is available in English, French, Spanish, and Creole, and which has been shown all over the world, including a special viewing for the European donor community during World Environment Week in Washington, D.C., on June 1, 1985.

Utility and Effective Utilization of Research Results

a) General Linkages.

The ability of any organization to absorb and utilize new findings stemming from project-derived research is a function of the following, among many, factors:

- Staff availability to review and test findings for their sites;
- Timing of research with respect to other duties and responsibilities, such as nursery production and outplanting schedules;
- Perceived needs for any particular community or site;
- Concurrence and congruence with established program of nursery production and extension outreach;
- Personal relationships and linkages among the different grantees

The ad hoc, adaptive research conducted by the grantees has been able to be absorbed within each respective organization more thoroughly than from one grantee to another. Inter-grantee transfers have been problematic for the above reasons, but have been improved upon with widespread publication and dissemination of quanrterly reports, special research reports of ODH and UMO, and the Agroforestry Outreach Newsletters. Also, the efforts of the present and past(two) project coordinators have facilitated any transfers by the insistence on the meeting of the research sub-committees in 1984-1985 and by the convening of technical retreats.

More extension-oriented technology transfer must be done, however, with the results of research done on living hedgerows and soil conservation land treatments. In effect, as the project evolves, the staff must be continually aware of the need to inform others of important technical innovations being tried at particular sites.

b) Linkages among UMO Research and AOP Grantees

Organizational

There has been collaboration among UMO and the other grantees with respect to sharing of data and information. Some of these linkages were established by the terms of reference set out in the UMO contract and by less formal mechanisms when UMO was brought into the project last year. Other linkages were voluntary and much a function of individuals interested in what was happening with the project.

Thematic

One of the burning issues of the AOP has been how to set a research arm of the project that is adaptive and responsive to overall project needs, be they gaps-in-knowledge or operational weaknesses in existing production and outplanting systems of the grantees. Resolution of this issue has been difficult. Why? The AOP has established an extensive nursery production, tree outplanting and rudimentary extension/outreach system throughout Haiti, with additional components addressing a pre-defined research agenda, executed on contract or though a grant arrangement and within the confines of a Statement of Work. The establishment of this research agenda was not tailored carefully enough to CARE and PADF project needs, with the exception of the ODH Haiti Mix work on a suitable and cheap potting medium and the UMO remeasurement of the CARE's species trials.

On the other hand, the research presently executed by UMO and, to a lesser extent ODH, will enable a more targeted PHASE II Extension to be designed, by refining our knowledge about the best species to plant on a given site as well as the better nursery techniques to enhance survival within the current cost tructure of the project. Some of the aspects of this research pertinent to future project extension activities include the following:

(1) Consumer Preferences:

The major objective of surveying the existing market for products such as lumber, charcoal, polewood, and firewood in different parts of the country has a number of advantages, including:

- Identification of wood products and the abundance of substitutes
- Determination of how different species come into use through time, and to what people may turn if the supply changes
- Approximation of where exotics fit into traditional systems of wood production and harvesting, so that any attempts to introduce new species into a particular local milieu can be based more on market information.

Consumer knowledge about species produced through the project appears to be limited indicating that future extension work should focus on education as to end uses and limitations. For example, Leucaena has been used to serve as structural supports for peasant housing and for fenceposts, when all technical knowldge indicates that the wood is useful for these purposes only if treated. It may be possible to eliminate those species from the planter tree package if uses are not suited to the anticipated use, or adapt secondary industries around improvement of the end products so that the anticipated use is met.

Harvesting studies will indicate how farmers used exotic species and what they thought of them, compared to native woods.

(2) Cost/Benefit Analysis:

Preliminary indications are that no one tree species is "the" solution to a small farmers shortage of wood products because of the many microenvironments under which project trees must survive and grow. The project assumption that cash-cropping of trees is good demands further scrutiny until we can answer Yes or No. A more mature manner of looking at this same issue is: what type of farmer, in which region, and under which set of ecological conditions should receive Leucaena versus neem.

The determination of factors that add income to peasant farmers could include trees distributed through the project, if income is what the farmer wants. If it is an insect-resistant fencepost, maybe he should not be receiving Leucaena. The project should move towards giving the animators knowledge to screen farmers as tree planters with a mind toward monetary and non-monetary benefits. The C/B research may generate "rules of thumb" for animators to encourage planters to go one way or another, to plant one species over another, based on economic screens.

(3) Silvicultural Research:

Knowledge of biomass production through the use of volume tables and information from the coppicing trials will enable the forestry technicians through the animators to tel farmers what to expect out a particular species when it reaches a certain size. Species currently being planted for their ability to coppice several times should be recognized, and this knowledge passed on to farmers, as not being "perpetual" in the sense that productivity will decrease with each coppice harvest, with some exceptions such as Prosopis.

(4) Nursery Outplanting and Species Trials:

Results of experiments conducted under this research component indicate that on stressful sites (e.g., droughty), the containers currently being used by the majority of nurseries throughout Haiti, namely the "Root-trainer 5's", are problematic for survival. An economic analysis, however, may indicate that going for a more expensive seedling, which means more hardening off in the nursery and perhaps changing the type and size of container, may not increase survival any appreciable amount.

2. Special Issues and Problems

This section poses a series of questions about the nature and process of research conducted under the AOP in an effort to pinpoint serious deficiencies, which can then be reviewed under a follow-on exercise to this evaluation resulting in a redesign of a Phase II Extension. Those topics presented are not exhaustive of all the issues and problems faced by the AOP, but were selected because of their special significance to research.

. Research Planning

What is the research set up to answer? As originally conceived, project-derived research was to be problem-solving in nature, that is, able to identify problems in the nursery production and outreach activities which would preclude effective achievement of project goals. The targets, however, of the project addressed number of trees outplanted, despite the fact that foresters and others were concerned about survival and growth. The technical evaluation and financial audit conducted in 1983 both flagged survival as critical to meeting project goals of 4 million trees by the end of project. If 50% survival was the norm, then 8 million trees would be needed to meet the goal of 4 million trees on farmers' fields by the end of 1985. Research conducted from the inception of the project did, in fact, address growth and survival because species trials and survival tallies were being made, albeit in a less than scientific fashion.

The issue of planning for research, however, was not adequately addressed until 1984, in response to the evaluation and audit reports, when the Project Coordinator convened a series of sub-committees and meetings to prepare a research agenda. This agenda was collaborative in nature and met with the approval of all the grantees, despite cautionary responses from individuals about overextension of staff and the

240x

"day-to-day chores of the project."

Is the research adaptive, flexible, responsive? Once planning was perceived as critical to solution of many of the projects technical problems of low survival and poor growth of trees, implementation of the research agenda designated by the various subcommittees began. Some assistance was provided by the Coordination Unit (Project Coordinator and Senior Forestry Advisor) in refining methods, but execution was the responsibility of the grantees. At this point, the grantees believed that their research agenda was pertinent to their needs. With the addition of the UMO Team in March 1985, the problem of fitting an officially-designated research unit into an existing research network required resolution. Through the efforts of the Project Coordinator, duties and responsibilities of the grantees were rearranged; some were responsible for data collection, but not analysis, others for collaborative analysis with UMO, and so on. UMO took on new research topics, as agreed upon in their contract and work plan, in order to lay the technical basis for a future, perhaps redirected, project effort and to satisfy USAID's desire for more systematic information on forestry in Haiti. At this time, one began hearing complaints about the research not now being flexible and responsive to grantees' perceived needs. The heart of the matter was that new topics were added to a pre-existing research agenda under the assumption that this new research was to be autonomous of the grantees and that if UMO did take over any prior elements of the grantees' research charge that collaboration would be required. No "Memoranda of Understanding" were required to solidify these assumptions or set forth a protocol of operation, leaving the door open for misinterpretation, mistrust, and resentment among all parties.

Execution of Research

Is the NGO model an effective framework for research? In reviewing the adaptive, flexible research model espoused by the grantees, it would appear to satisfy staff needs for data and information for planning of project production and outreach activities. A major flaw in the model lies in the manner in which the means to answer a particular question is determined. Individual foresters are given liberal latitude to determine methods and resources to be applied, without much peer review. Although work plans are required of staff, realistic time constraints to conduct satisfactory research are seldom recognized, and almost impossible to plan, given the "normal" job requirements of the field foresters. The assumption is that research is an "extraordinary" task to be accomplished when and where possible. Why? Basically, the grantees have real agendas other than research; they have real problems other than tree growth and survival with which to deal in the course of their job. Thus, the framework for research would appear less than conducive to answering the questions satisfactory.

Did the growth of project outreach (i.e., extension and trees outplanted) resulted in overextension of staff? Unequivocally yes! All foresters interviewed relegated research to the lowest priority in relation to their normal activities. The increase in seedling demand has driven the project to new heights of activity, increasing the work load for each planting season, without any real increase in staff or staff time to conduct research, which may have even increased given the

emphasis on soil conservation research by the grantees. The feeling that "the hurrier I get, the behinder I feel" prevails with respect to research tasks, particularly for PADF and CARE staff.

ODH staff, on the other hand, has attempted to grow in accordance with the new research mandates of the last Project Amendment, but staff appears to be assigned to other responsibilities at ODH, other than working on the AOP. And, the Research Forester, only works part time because of requirements to complete a doctoral dissertation at the University of Georgia.

Reporting

Are methods and results of research available and easily readable, as well as reproducible, if testing is required on sites other than where the original research was conducted? Reporting of findings appear to follow no standards or format, as they would if reported to a scientific journal. Granted that much of the grantee research is not intended for publication in such journals, there appears to be little concern for making the reports readable and understandable. UMO has initiated the publication of its findings in a "Working Paper Series," which has improved the delivery of research to the grantees and other interested people. One of the biggest problems in interpreting the research effort of this project has been the lack of any centralized data and information repository for all of the research conducted to present. The typical retort to "what did you set out to do; what did you accomplish; and where is it" is: read the quarterly reports. This simply is not true. In few instances are results presented in the context under which they were planned, executed, and analyzed under the existing arrangements of reporting required for this project. The issue of reproducibility is then called into question because of this inattention to details, the very basis of the scientific methods and reporting.

Utilization of Data and Information

Does coordination exist between research and outreach elements of the project so that significant findings can be effectively utilized? The existence of coordination impies that someone is coordinating or that organizations have been mandated to do such. The Project Coordinator function has been construed to be a catch-all position, which can justifiably address this problem. At the grantee level, great strides have been made to integrate research findings into production and outreach activities. Convening of technical retreats, initiated at the insistence of the former Senior Forestry Advisor, has done a great deal to address this question. In the future, some interpretation of research findings of the UMO Team will be required in order to establish a context for the incorporation of that research into existing and planned activities.

Quality versus Quantity

How are standards of quality and their control exercised? There is no peer review process exercised at any level of this project with respect to research. It is anticipated that UMO and some findings at ODH will be submitted to scientific journals for publication, at which time a

peer review will occur. The recruitment of staff would appear to address this question, in part, because people with appropriate academic backgrounds, work experience, language capabilities, and the like, have been sought in many, but not all cases. In the case of use of best available technology, there is no pressure applied by any central authority to adopt a new technology, over another. For example, PADF and CARE use "ROOTRAINERS", when ODH insists its "Winstrips" are state of the art. UMO has researched this issue and has demonstrated that neither are the best to enhance growth and survival once outplanted. Resolution of this issue is important for meeting project target goals of living trees on farm plots at the end of this project, but one not being addressed by USAID or the grantees and contractor.

Are the best possible resources being applied to the outreach activities in order to meet project goals? Forestry research has demonstrated that improved germplasm and inoculation with Rhizobium and mycorrhizae can enhance growth and survival of trees on marginal sites; that use of larger containers in the nursery enhances survival on semi-arid sites; that direct seeding and vegetative propagation are viable alternatives to nurseries in establishing trees and in achieving good growth and survival on marginal sites. Yet, the project has not been applying this technology on any more than a pilot basis on a few sites, if at all. With respect to species trials (at least 37 all over Haiti) set up by project staff, seed provenances are frequently not known, inoculation is not done, and replicable scientific methods have not been practiced, precluding investigators from making comparative judgements about species performance over a wide range of ecological conditions.

Weak Sociological Data Base

Does planter behavior affect tree growth and survival in Haiti? Recent research conducted by Buffum and King (1985), Conway and Balzano (1986, in preparation) implicate planter behavior as critical to establishment, growth, and eventual use of project-promoted trees in many localities around rural Haiti. This research, however, has only started to understand complex questions such as: Why farmers don't plant project trees? Why farmers plant trees the wrong way? Why farmers won't manage project trees? And many others. It has also indicated that some of the project's assumptions about a tree's performance on a farmer's plot were incorrectly assigned to the physical constraints of the site, rather than strategies of the planter for his land.

Although this question appears to have an obvious answer, namely yes, of course planters affect trees, it is the nature of systematic sociological research to provide the details so that the project can better orient its extension activities to achieve higher survival and better growth. Justification of research effort should become a more visible element of the AOP so that better appreciation of applicability can be promoted.

V. Future Research Needs

Suggestions are made herein for pursuit of special topics of research and a method of execution of the same which would support project field needs, especially knowledge to enhance growth and survival and to motivate farmers to plant trees for profit and to manage them.

once in place.

Topics

a) Operational Research to Improve Outplanting

Objectives: Develop appropriate technology to plant trees on any site in Haiti and achieve at least 50% survival or better.

- Techniques for increasing soil moisture retention around each seedling; e.g. comparative effectiveness of mulches and starch graft polymers such as "Terrasorb".
- Species trials to determine the best adapted provenances (selected from tropical and subtropical sites) of keystone tree species under test conditions such as no management, some management, and the like.
- Comparative tests of locally-derived fertilizers, composts and green manures for application on keystone species.
- Inoculation trials using bacteria and fungi inoculants critical for tree growth on marginal sites.
- Sociological research to determine what technical and motivational levels can be expected from farmers given existing incentives under the project.

b) Development of a Local Potting Medium

Objectives: Produce quantities of a sterile potting medium at the regional level to satisfy demands for two planting seasons.

Small quantities of a locally-produced mix are possible with bagasse by carefully controlling the composting process, as has been demonstrated by MCC Deschapelles at their nursery. Some PVOs in PADF SW Region cut the commercial mix with soil, sand and local compost; the quality of this bastard medium is not known. CARE Region II produces small quantities of potting medium in a decentralized nursery by careful preparation of compost and its subsequent mixing with local topsoil and aeration material such as sand. A major constraint is some regions would be availability of organic material in sufficient quantity to satisfy the demands of one or several nurseries. The grantees had hoped that DDH would produce their mix in large enough quantities, but the difficulties in producing a uniformly quality mix has demonstrated that it takes time, supervision, and knowledge of performance of locally-derived materials, especially organic matter and the composting process.

c) Seed Selection and Tree Germplasm Improvement

Objectives: Provide the best possible genetic material for use in project outplanting programs under the AOP; develop a uniform code of standards for seed sources, superior tree form, and progeny testing in Haiti.

The topic of genetic improvement is covered in a separate report by Michael Benge; herein are several recommendations for research to enhance outplanting on marginal sites in Haiti.

Improvement in Local Stocks. Establishment of criteria for superior trees, by species, will enable seed collectors in the field to identify specimens that will subsequently improve the genetic stock of plant resources in the country. Seed produced locally and collected locally avoids the cost and logistical difficulty associated with importing seed. Local seed is fresh and often with high viability. Internal transport and storage problems are reduced by using locally-harvested seed. Seed harvested and later used within a geographical or altitudinal region has an inherent adaptability associated with it. Other vegetatively-propagated resources such as grafts, cuttings are relatively simpler to manipulate, handle, and transport locally.

Uniform Research Methodology. Several factors are pertinent. A design methodology is required whereby adequate seed is collected from superior trees of preferred species. The project grantees can determine these tree species preferences. Criteria for identifying superior trees and methods to monitor performance of superior versus average trees are required. Uniform provenance seed orchards are a necessity. Progeny testing must be done to evaluate species and varieties; some correlation of progeny performance over Buffum-Campbell zones could be used to test the accuracy of this proposed ecological classification of Haiti. Thorough and neat record-keeping is required for all steps in this process. Field foresters claim that it is possible to find genetically superior tree material in some regions; field checks by a competent tree geneticist would be mandatory.

Locally-preferred Species Requiring Improvement. Based on this evaluation survey, the field foresters identified several species in high demand by farmer/planters but with problems of form, growth or adaptation to site conditions at some localities.

- Chene (Catalpa longissima): poor form due to triplet branching
- Acajou venezuela (Swietenia macrophylla): problems in the nursery because it does not develop a fibrous root system, its survival at outplanting is poor
- Teak (Tectona grandis): germination techniques; bare rooting possibilities
- Leucaena (L. leucocephala): problems with defoliation by leafhoppers.

d) Baseline Studies

Soil Testing and Mapping. Very little is known about the soils of Haiti with marginal value for agriculture, which are used more for tree planting. Stratification of project zones would begin using the Buffum-Campbell system. A sampling protocol would give priority to sites with species trials, seed orchards, demonstration plots; soil sampling techniques would be standardized. Testing would be done by a technically-capable unit, but portable equipment would become part of the grantees field equipment in order to do gross checks on farm plots. Maps of key project sites would be made with respect to soil classification and nutrient status.

Rhizobial and mycorrhizae survey for fruit trees and hardwoods. Leguminous tree species form symbiotic relationships in root systems with species of the bacteria Rhizobium. These nodules are usually

visible macroscopically on younger roots. Many hardwood trees which are also valuable in AOP objectives are endomycorrhizal and roots must be collected, sectioned, stained and viewed microscopically. Spores of endomycorrhizal (VA) fungi are also present in soil surrounding root systems, especially the rhizosphere. Soil samples may be collected, wet-sieved, decanted and VA spores present may be concentrated. Taxonomic keys are available to identify certain VA fungi, but many may be new to science. Simple surveys should be done in the field or in nurseries by examining young roots for small, roughly circular Rhizobium-induced nodules (leguminous species). Root nodules should be collected, stored on ice or in a cool place, and verified for presence of Rhizobium. Roots of non-leguminous species, which are VA, must be investigated microscopically. Research should be oriented towards (1) collecting and testing local sources of Rhizobium from established trees as well as obtaining and testing exotic sources commercially available; and (2) collecting, identifying and testing local and exotic cultures of VA fungi which are known or suspected to be beneficial for certain tree species preferred by the AOP. Extensive research should be conducted on tree-symbiont combinations using various seed source lots within a tree species in combination with various isolates of each symbiont tested. Research is needed to develop nursery inoculation procedures for maximum infection-efficiency for the best tree-symbiont combinations. Field-oriented silvicultural trials are necessary to substantiate tree-symbiont combinations and plots replicated over many localities. Additional inputs on recent advances in rhizobial and VA fungi research applicable to Haiti should be sought from U.S. instutitions conducting research, in order to maximize nursery culture as well as survival and growth after planting.

E. LESSONS LEARNED

There is need to examine what has been learned from the research effort of the past four years, as much in a technical sense as in a programmatic sense. The following points are pertinent to this presentation.

1. Applied research conducted by CARE and PADF has been useful for improvement of their program in nursery production and extension. Questionnaires on site conditions and planter behavior, survival tallies, and species trials have filled a didactic purpose and have imparted some information. Data and record-keeping have been problematic and not easily transferred to outsiders. Time constraints on when research could be conducted in realtion to seasonal nursery, training and extension duties have precluded adequate attention to standards of scientific method, appropriate field techniques, record-keeping, and data collection, reduction, analysis, and presentation.

2. A number of technical and human constraints have prevented more successful outplanting of trees, if growth and survival are major indicators of project success, beyond simple number of trees outplanted. Our knowledge of agroforestry associations, weed and vegetative cover

management, efficacy of soil conservation techniques, and farmer motivation in tree planting and maintenance is rudimentary. More targeted research is required for a better understanding of these phenomena.

3. The AOP is complex because of the four institutions implementing scores of activities all over the country; research represents less than 5% of major grantee functions. Keeping track of "who's on first, second, and third" is problematic at the level of detail required for decision-making. Grantees and the contractor rarely explain research in a context that depicts concisely:

- What they set out to do and why.
- How they will achieve individual objective and purpose.
- What they accomplish in a defined period of time.
- Where there are problems or constraints.
- What remains to be accomplished by task and time allocation.

In sum, research planning and execution are weak and there is no standardized reporting system that is useful to evaluate performance.

4. Having the presence of an academic institution implementing reseach on agroforestry in Haiti is healthy and potentially useful to the long-term reforestation objectives of USAID. The context and purpose of this research appears vague, however, and new project extension directions should seek to explain better their role, goals, and objectives, as well as to facilitate interactions with the more hands-on concerned PVOs interested in agroforestry. USAID's role in facilitating the transition and placement of this institution must be increased by better dialogue with the GOH and PVOs. It would appear that USAID would prefer to put the project on automatic pilot and let the research proceed. For a country without a strong history of research execution, this would be a mistake.

5. The ability of the project to address environmental concerns of protecting soil resources appears better served by working with CARE and PADF in outplanting trees on private, small-holdings, than by attempting to develop tree farms for large land owners. Small holders supply most of the charcoal marketed in Haiti. Their extensive exploitation of forested lands could be reduced, if viably economic tree production can be demonstrated on their own land. CARE has already achieved this demonstration effect in Desforge, in the Northwest, an area with less than 1000 mm of annual rainfall. The argument for promoting large landholder tree farms has been that by establishing tree plantations to service the urban market, pressure on extensive forest lands would be deflected. In a sense, large holder tree farms would put the small guy out of business. ODH research has provided no evidence that this alternative scenario would or could unfold. The UMO Cost/Benefit Analysis has shown, quite the opposite, that plantations under current systems of establishment and management are not profitable, because land preparation costs are too high and long-term (great than 8 years) lumber products offer the highest rate of return. If USAID has wanted to put the small land-holder out of the charcoal business by establishing profitable tree farms, why are they also encouraging PADF and CARE to motivate farmers to plant trees on their land, if not to stimulate the profit motive for charcoal and other wood products from these same small

parcels of land.

F. RECOMMENDATIONS

These recomendations regarding research are framed with a mind toward extension of the project into a Phase II redirected effort. They should be reviewed and executed as a package, rather than each on their own individual merit.

Recommendation 1: Continue support for a centrally-organized research unit within the project to conduct operational research and baseline studies.

Rationale. The presence of an academically-oriented research institution in Haiti is needed to address the vast data and information gaps concerning the field of agroforestry. Standards of quality and its control can be better maintained by peer review pressures, by mobilization of wider ranges of talent, and by contractual arrangement under a university organizational structure, than with PVOs.

Recommendation 2: Relieve grantees of their research responsibilities, but redesign the research unit toward more responsive, responsible applied research, conducted in collaboration with PVOs, who should be required to retain a full-time research scientist on their staff to liaise with the central research unit.

Rationale. The model of the PVO as a research institution conducting problem-solving research is flawed. Technical constraints for the project at this moment deal with our lack of knowledge about how trees fit into farmer tree-crop associations and their subsequent interactions; performance of living barriers and soil conservation treatments; vegetative conver management; tree planting/harvesting/coppicing cycles of a long-term nature. Failure to apply existing "best available technology" such as improved germplasm and inoculants has also affected grantee performance in an indirect sense, indicating a breakdown of quality control in those respective institutions. The ability of the grantees to address these constraints thorugh an applied research program, when coupled with an overly ambitious, demand-driven nursery production and extension outreach to farmers, has set counterforces in motion, resulting in overextension of staff, poor quality research, and ultimate failure to answer even the basic questions posed at the inception of the project research program. A number of other factors should be noted at this time:

- Systematic collection and reporting of research data and information is poorly developed four years into the project.

- Experimental approaches are weak, precluding replication and establishment of confidence limits for the data.

- Overextension of staff aggravates problems of application of rigorous standards and controls to research method; routine duties and responsibilities of seasonal nursery production, extension and training take precedent, and should, over research.

- Ad hoc approaches, although valuable in defining some problems and in seeking their solution, lack clear purpose in addressing the major project concerns of low tree survival and poor growth; field staff tend to get distracted by peripheral problems which can occupy more time than reasonably available.

Recommendation 3: Develop a more "bounded" research agenda and determine the most effective operational mechanism to achieve such in Haiti.

Rationale. New directions will evolve in this project regardless of what requirements are elaborated in this evaluation and agreed upon in any subsequent grant agreements and contracts. Witness the shift toward fruit trees, greater diversity of species outplanted, in-house research on composting, soil conservation, and potting media. However, limits to growth should be placed on the executors of this project. USAID can simply not support all research on agroforestry, or whatever topic a researcher happens to think is important. How the research will be executed also demands consideration. Research agendas should be developed in conjunction with staff of the central research unit and grantee staff, thereby addressing the grantee complaint of need for responsive, responsible research activities. Oversight by an academic institution will lend credibility and enforce quality standards of scientific methodology, collection and reporting of data and information, and will facilitate the transfer of information into the worldwide agroforestry network, where further channels of peer review would become available.

Recommendation 4: USAID should reassess the nature and extent of its committment to tree planting and agroforestry research in Haiti and decide upon realistic goals, measures of achievement of such goals, and appropriate institutions to execute its agroforestry agenda.

Rationale. Expediency appears to have been a major element in selection of ODH as an implementer of research in Haiti. Assessment of PVO capabilities to conduct research was not considered, nor was their model of research design and execution evaluated. The manner in which USAID has structured research appears haphazard, if the basic questions are posed: What species do we plant on any given site to achieve at least 50% survival or better; How do we motivate farmers to plant trees and then to care for them once the "blanc" forester goes away? USAID has relegated the search for answers to amateur institutions; not to say that individuals within those institutions were not highly motivated or qualified to conduct research. The context in which they were placed was anything other than conducive to the production of quality research. Selection of a Title XII university as quality control agent of research is to be applauded, but inter-institutional linkages were never formally established, nor insisted upon by USAID. Applied research in support of field activities and baseline studies of agroforestry systems and ecological processes are linked only by some pre-arranged context. Each can stand alone, be executed, and contribute much to the knowledge base on which to build future practical programs of agroforestry in Haiti. Much additional work remains to be done, given the extent of environmental problems and rural poverty in Haiti.

Recommendation 5: Discontinue research on large land-holder tree plantations in the Cul-de-Sac Plain as well as on the development of a

local potting medium.

Rationale. The most recent ODH Quarterly Report (Oct-Dec, 1985) states that charcoal, firewood, and poles would not by themselves sustain a viable ongoing forestry venture on the tree farms established by ODH; alternative cash income could be generated by production of lumber and tool handles. The UMO Cost/Benef t Analysis has shown that plantations under current managmement ar establishment are not profitable; that land establishment costs ar prohibitively high. The following actions are appropriate: establish no new tree farms; consolidate what is known about existing farms and select from these 10 the more promising sites for management; upgrade record-keeping on these select sites and summarize ecologic and economic data; present this data to the private sector for consideration of adoption of the technology, with recommendations for ways to cut land preparation costs.

Development of a local potting medium has been given high priority by the grantees. USAID responded by providing support to ODH to develop such a medium, entirely from locally-available materials. According to ODH, "Haiti Mix" is nearly ready for commercial production. But. ODH reports and information provided by PADF indicate that there are problems with the "Haiti Mix" requiring additional research to eliminate dependence on use of peat moss (at least 20%) to promote seedling growth and vigor in the Winstrip container. ODH hopes to grow consistently high quality seedlings using only 100% local incredients by the Fall 1986 planting season. ODH should provide USAID with an independently prepared, scientific evaluation and analysis comparing "Haiti Mix" with commercially-proven brands such as "Peat Mix" and "Pro-Mix".

The private sector has opportunities to continue with wood production from plantations and with commercial-scale "Haiti Mix" production, if it so desires, based on the information available from ODH. The continued support by USAID of these research subcomponents appears no longer warranted.

Recommendation 6: Discontinue funding research activities under the ODH grant; evaluate ODH nursery and seed production capabilities to service grantees in the proposed extension.

Rationale. ODH is primarily a nursery facility with commercial interests in farming and ornamental plant production. The organization's committment to forestry in Haiti appears firm, but its role in reforestation appears best served as a producer of seedlings or seed for outplanting, rather than as a research unit. The problems with the conduct of ODH research have been elaborated elsewhere, but support this recommendation.

D. REFERENCES

1. Documents Reviewed: All grantee and contractor files were available for perusal, including Quarterly and Special Reports, UMO Working Paper Series reports, and many others. Special useful documents included:

Buffum, W., and W. King. 1985. Small Farmer Decision Making and Tree Planting: Agroforestry Extension Recommendations. Prepared

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on contract for the Haiti Agroforestry Outreach Project, PADF, Port-au-Prince, Haiti.

Greathouse, T. 1985. Final Report - Senior Forestry Advisor. AOP -USAID file report.

Miller, R., and M. Ehrlich. 1983. Mid-Term Evaluation for the Agroforestry Outreach Project (521-0122). Prepared on contract with USAID; AOP file report.

2. One questionnaire (attached) was administered to most of the expatriate grantee forestry staff of ODH, PADF, and CARE. The design purpose of this questionnaire was to focus on past accomplishments, present issues, and future needs with respect to applied research and technology. Information from these questionnaires was used in preparation of this report. Support from the grantees for such information is appreciated.

3. Persons Interviewed or Contacted:

ODH: Peter Welle, Joel Timyan, Gerald Larsen, and Aart VanWingerten.

PADF: Glenn Smucker, Mike Bannister, Gaspard Brice, Stuart North, and Ralph Mathieu.

CARE: Rick Scott, Marsha McKenna, and Gregor Wolf.

UMO: Marshall Ashley, Gerold Grosenick, Fred Conway, Tony Balzano, and Roland Dupuis.

4. Many of the thoughts and conclusions reached in this evaluation of research were enhanced by discussions with the Evaluation Team: Ira Lowenthal, John Palmer, Michael Benge, Richard Fellek, Roger Webb and Bob Wilson. Richard Fellek and Roger Webb contributed original material for inclusion in the future research needs section and as such are gratefully acknowledged.

QUESTIONS FOR AGROFORESTRY OUTREACH EVALUATION:

Please answer the following questions to the best of your abilit briefest manner possible. If an explanation is necessary in ord elaborate a particular point, please be concise!

1. What innovative technology has been developed or disseminated this project? Has your organization modified any existing techn suite your particular needs or sites?

2. What additional applied research is necessary to have all the requisite technology to plant trees on any site in your region t at least 50% survival? 95% Survival?

3. If there are any species native or introduced that require ad research to improve their nursery adaptation to containerized se system, their survival at outplanting, or their use and manageme Haitians, what would they be and why?

4. Please provide an overview of your research, including object accomplishments, expectations, and future needs.

5. If you were outplanting in your region to achieve maximum survivability with the existing technological package what would plant, where would you plant it and why?

6. What ad hoc applied research conducted by you or anyone else project (CARE, PADF, ODH) has been helpful in your outplanting ar extension program?

7. Is your research, or anyone else's at the moment, flexible enc respond to your needs in the field? If yes, what is the nature research? If no, why not?

8. If you were to devise a system of outplanting that is more res to local environmental conditions, what adaptive research would necessary to develop such a system? Who should conduct it?

9. Is there a need to develop a local potting mix? Why? How cou be done in the context of your other duties? If not possible thr your organization, who could be expected to perform this researc how long would it take in your region?

10. Is it possible to find genetically superior tree material in region? What species? Where?

PLEASE PREPARE A RESPONSE IN WRITING AND FORWARD TO JIM TALBOT AT USAID BY

THANKS,

Talbot