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National Program for Agroforestry in Haiti

Volume Two:

- *Social Soundness Analysis*
- *Agroforestry Component*
- *Environmental Assessment*
- *Economic and Financial Analysis*

DESFIL

Development Strategies for Fragile Lands
7250 Woodmont Avenue, Suite 200, Bethesda, Maryland 20814

Development Alternatives, Inc. • Tropical Research and Development, Inc.
In association with: Earth Satellite Corporation • Social Consultants international

National Program for Agroforestry in Haiti

Volume Two

Social Soundness Analysis

Agroforestry Component

Environmental Assessment

Economic and Financial Analysis

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FOREWORD

Development Strategies for Fragile Lands (DESFIL) is a centrally funded project of the Bureaus for Science and Technology and Latin America and the Caribbean, United States Agency for International Development. DESFIL assists those Bureaus in their regional programs to arrest the degradation of natural resources while encouraging the increased production of food and fuel for income generation. Strategic environmental and natural resource planning, including project design, is perhaps the most fundamental purpose of the DESFIL project.

Volume One of this report comprises edited versions of the draft Project Identification Document (PID) and the Project Paper (PP), both prepared by DESFIL at the request of USAID/Haiti. David Gow was Team Leader for both studies. The Project Paper synthesizes the contributions of the whole design team: Laura Bergner, Editor, Development Alternatives, Inc. (DAI); LeRoy Duvall, Agroforester, USDA Forest Service/USAID Forestry Support Program; Frans Van Eysinga, Economist, DAI; Raul Hinojosa, Forage/Livestock, Bureau for Latin America and the Caribbean, A.I.D.; Kenneth Koehn, Institutions, DAI; Ira Lowenthal, Anthropologist, DAI; Jack de Mooy, Agronomist, DAI; June Magnaldi, Training, Social Consultants International; Richard Pellek, Forester, USAID/Haiti; Richard Scott, Extension, Social Consultants International; and James Talbot, Environment, ERM, Inc.

The PID and PP trace the development of the USAID/Haiti National Program for Agroforestry, an uninterrupted follow-on to the highly successful Agroforestry Outreach Project, which was authorized in September 1981 and ended in December 1989. In and of themselves, these documents are of primary interest to project design specialists and managers because of the way in which the social sciences are integrated with agriculture and forestry, to arrive at a clear understanding of the role of trees in the local economy.

As part of the PP design process, several supporting technical documents were prepared. Four of these have been selected and edited for inclusion in Volume Two. The documents in both volumes were written in 1988/89.

Volume Two contains technical reports on four key topics: social soundness, Ira Lowenthal; agroforestry, LeRoy Duvall; environmental assessment, James Talbot; and economic and financial analyses, Frans Van Eysinga. Each report examines the project from a different viewpoint, integrating the approaches used and lessons learned from the preceding eight years and refining the main components to build upon the previous achievements, which benefited 200,000 peasant farmers.

The Social Soundness Analysis is a masterfully written model of its genre, clearly pinpointing the constraints (for example, capital investment and nurseries) and opportunities (such as land ownership and fuelwood markets) for agroforestry interventions. It is hard to imagine any project failing for technical reasons after receiving such a penetrating analysis.

In addition to delving into the technical details of tree nurseries and on-farm tree growing, the Agroforestry Component report makes the strong recommendation to retain flexibility — which was so important in the first phase — in the activities and direction of grantee programs and to continue the production of seedlings for distribution to farmers.

The primary concern of the Environmental Assessment is pesticide use, beginning with nursery operations and extending to the management of trees on the farm. Positive environmental effects of tree planting are noted, including reduction in soil erosion, cutting of wild trees, and grazing pressure.

Project costs and benefits are addressed in the Economic and Financial Analyses. Calculations make clear that producing trees is an attractive enterprise for farmers. The report concludes that from an economic point of view the project is fully justified.

All too often, technical reports such as these are difficult to locate or, if located, to access, thereby hindering technicians, development specialists, and academicians attempting to understand the detailed planning underlying a project. This opportunity to provide full documentation is not to be missed. When the history of 20th-century agroforestry is written, the Agroforestry Outreach Project by itself will unquestionably rank as one of the most important achievements; its accomplishments and the lessons learned significantly enhance the chances of success for the follow-on National Program for Agroforestry.

DESFIL wishes to acknowledge the guidance, assistance, and encouragement of USAID/Haiti personnel in the design of the National Program for Agroforestry in Haiti.

Dennis Johnson
DESFIL Program Coordinator

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ACTEC	Belgian Association for Cultural, Educational, and Technical Cooperation
ADO	Agriculture Development Office
A.I.D.	U.S. Agency for International Development
AOP	Agroforestry Outreach Project
ARD	Associates in Rural Development
CA	Cooperative Agreement
CAFTCEN	CARE Agroforestry Training Center
CATIE	Tropical Agriculture Research and Training Center (Costa Rica)
CDSS	Country Development Strategy Statement
CICP	Consortium for International Crop Protection
CIDA	Canadian International Development Association
CRWC	Christian Reformed World Council
DAI	Development Alternatives, Inc.
DESFIL	Development Strategies for Fragile Lands
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
FA	Farm Agent
FAC	Fonde d'Aide et de Cooperation (France)
FAO	Food and Agriculture Organization of the United Nations
FRLC	Federal Letter of Credit
FSN	Foreign Service National
FY	Fiscal Year
GOH	Government of Haiti
IPM	Integrated Pest Management
IRD	Institute for Rural Development
IRG	International Resources Group, Ltd.
IRR	Internal Rate of Return
LAC	Latin America and the Caribbean
LD50	Lethal dose of a pesticide required to kill 50 percent of test organisms
LOP	Life-of-Project
LRD	Local Resources Development
NGO	Nongovernmental Organization
NPA	National Program for Agroforestry
ODH	Operation Double Harvest
PADF	Pan American Development Foundation
PID	Project Identification Document
PP	Project Paper
PSC	Personal Service Contract
PVO	Private Voluntary Organization
RFP	Request for Proposals
RSC	Research Steering Committee
SECID	Southeast Consortium for International Development
STAB	Technical Secretariat for Watershed Management (French acronym)
TCU	Technical Coordinating Unit
TDY	Temporary Duty
TWMP	Targeted Watershed Management Project

UNICORS	Union of South Region Cooperatives
WHO	World Health Organization

National Program for Agroforestry in Haiti:

Social Soundness Analysis

by

Ira Lowenthal
Development Alternatives, Inc.

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SECTION ONE

A MODERN PEASANTRY IN CRISIS: THE CASE FOR SOCIAL DESIRABILITY

Haiti is the New World's most thoroughly agrarian society. Three quarters of the population are rural, freeholding peasants, deriving the majority of their productive income directly from agriculture and, indirectly, from complementary activities closely linked to the agricultural sector. Haiti's contemporary agrarian economy is a recent historical development, in both relative and absolute terms, having evolved in the immediate aftermath of the western hemisphere's only successful slave revolution, which ended in 1804.

When the revolution began in 1791, the slave population was 500,000 strong, divided into two distinct social categories of equal size — creole slaves, born to their condition of bondage in the New World, and *nèg bosal* ("salt-water negroes"), born and socialized in Africa as free men and women prior to enslavement. Postrevolutionary peasant society and culture, then, had its roots firmly planted in a preslave past. It had been unwittingly nourished through the 18th century by a coercive system of subsistence production in which slaves were forced to work in their off time to defray the costs of their own upkeep. Driven by the indefatigable will of the former slaves to consolidate their hard-won victory by quite literally "grounding" their personal freedom in land ownership and productive autonomy, the peasant way of life flourished in the relatively favorable postrevolutionary climate.

By the mid-19th century, with the death of the last members of the generation that had accomplished and nurtured the arduous and historically unique transition from slavery to freedom, by the work of their own hands, the peasant way of life had spread to virtually every corner of the national territory, and was in a period of growth and efflorescence. The elaborate and systematic adaptations of the nascent peasantry to the vast productive potential of Haiti's then-rich and varied natural resource base set the stage for almost a full century of relative abundance and well-being, during which the majority of the country's inhabitants lived in circumstances that surely compared favorably — materially, as well as spiritually — to those of most of their Afro-American contemporaries throughout the rest of the hemisphere.

Since the second quarter of the 20th century, however, the Haitian peasantry has faced serious challenges — challenges that today threaten the continued viability of what is still essentially an emergent, postcolonial society and culture. Although the productivity of peasant agriculture has, from the very beginning, underwritten the national economy, no corresponding reinvestment of resources, either public or private, has been made in the rural sector. Under such circumstances, a decline in peasant productivity was inevitable. The pressures of population growth, erosion, shrinking farm size, and soil exhaustion have trapped the peasantry in a vicious cycle of ever-diminishing returns to land and labor resources.

It is of paramount importance to approach any developmental analysis in the Haitian context with a clear and realistic grasp of this often-misunderstood historical chronology, and its implications for our understanding of today's peasantry and its predicament. It is all too easy and, in some circles, all too common to allow the contemporary crisis in the peasant sector to obscure the fundamental character of the rural Haitians as successful and highly innovative agriculturalists. Nonetheless, this was an accurate description until a profound and sudden change took place — a change that, in terms of its social and cultural impact, occurred very recently.

In concrete, human terms, today's mature peasant is but six or seven generations removed from slavery, and fewer still from the birth of a fully elaborated peasant way of life. He/she represents the first generation of this young society to confront a precipitous collapse of the productive agricultural resource base, and of the farming systems so recently elaborated to exploit it efficiently and sustainably. At the time of his/her birth, a mere 40 years ago, more than half of the total land area of the country was under forest cover; today, less than 2 percent remains so. Not surprisingly, today's parental generation can recall in detail their own parents' very different farm enterprises, in which, for example, abundant yields of sweet potatoes, manioc, and other root crops and tubers were produced exclusively for use as fodder for the swine herd that in turn provided regular supplies of animal protein for home consumption.

In systemic terms, the potential for crisis in the agricultural sector built up gradually, as the result of increased population, accompanied by attendant decreases in the length of fallow cycles and soil fertility. This process spanned many decades. The current state of real crisis of peasant agriculture, however, came on relatively suddenly, as the result of a qualitative change, triggered by the most recently completed round of intergenerational fragmentation of landholdings, through the workings of the prevailing system of bilateral, partible inheritance. It was at that point that the systems in place crossed the threshold to an absolutely insufficient scale of operations. On the other side of that threshold, the infelicitous convergence of uninterrupted productive pressure on the land, unchecked fertility declines, and the consequent expansion of cultivation up the slopes of every hillside, unleashed the potential that had been building for generations in a chain reaction that quickly consumed what was once Haitian agriculture.

Thus, the peasant way of life passed directly from emergence to emergency, with precious little time either to mature or to crystallize into what anyone could reasonably call a traditional pattern. On the contrary, today's peasantry is still reeling from a blow that knocked the wind out of what were once proven and appropriate local technologies and management strategies. What had been learned in childhood and adolescence no longer applied. At the same time, the available resources — organic, economic, and technological — were woefully inadequate to the task of radical adaptation that the new situation demanded, to maintain a minimally acceptable standard of living. The rules of the game had changed drastically, but there was no new rule book that spelled them out. From then onward, of course, the peasant has still had to climb into the ring each season, but with nothing but the suddenly anachronistic protective equipment, skills, and footwork that had been perfected by his/her forbears for a very different kind of bout. Naturally, the contender consistently takes a beating.

To the extent that he/she remains committed to farming as a way of life, and this varies considerably among individuals at this point, today's peasant is groping constantly for solutions to this fundamental bio-technical lag. Within the material and informational constraints that suddenly became so critical, this generation's struggle to adapt has been both assiduous and inventive. Ironically, many of the short-term strategies initially adopted for coping with the collapse of the production system, such as the clearing and intensive cultivation of what are known to be fragile lands, and the nonsustainable mining of natural stands of hardwoods for charcoal production, have themselves contributed significantly

to accelerating the rate and severity of subsequent decline. Rational, and necessary, decisions do not always lead toward solutions.

Today, both the country's natural resource base and the peasantry's increasingly circumscribed internal capacity to respond to an ever-worsening crisis of productivity are virtually exhausted. The vagaries of climate, the toll of persistent and unavoidable natural disasters, the extractive depredations of the 30-year reign of the Duvaliers, and the serial plagues of African swine fever and coffee rust have rendered the future even more precarious. The peasants were the first — not the last, as some would have it — to recognize their predicament and its dynamic. By and large, their priority investment strategies increasingly focus on emigration for the current generation and nonagricultural, formal education for the next, who, in their turn, will divide among themselves a landed legacy in considerably worse condition than when it devolved upon their parents.

This notwithstanding, the majority of those now making a living on the land will likely be doing so for decades to come. The absorptive capacity of the urban sector and the tolerance of the international community for massive out-migration have, after all, their limits.

The National Program for Agroforestry (NPA), like the Agroforestry Outreach Project (AOP) before it, proposes to transfer a limited set of specific resources — biological, material, and informational — to a significant portion of Haiti's rural farm families. The basic elements comprising this set of resources are as follows:

- Multipurpose tree seedlings and selected forages, along with all of their natural progeny from seed, shoots, and cuttings;
- In-kind and cash income, over an estimated 20-year period, from the wood and other products of outplanted materials;
- Basic concepts of soil and water management, appropriate to current and local circumstances, particularly for fragile lands;
- Practical training in the use of A-frames for determining contour lines on sloping land, and in the installation of living, physical barriers along these contours, using a diversity of plant materials;
- Practical training in other techniques of low-cost, on-farm erosion control, fertility enhancement, and water management;
- Practical training in the on-farm propagation of multipurpose tree species from locally available biological materials, both indigenous and introduced by the projects;
- Practical training in the management of multipurpose tree species and woodlots for optimal performance, in accordance with on-farm production and use objectives; and
- Additional information, as it becomes available, on sustainable farm management techniques using low-cost, locally available, biological materials.

This resource transfer does considerably more than provide a small subsidy, in the form of future in-kind and cash returns, to the participant farmers. Rather, as a package, it significantly expands the

production and management options of the hard-pressed farmer, grappling with the recalcitrant land and struggling to master new and calamitous circumstances of which he/she is more victim than author.

Moreover, the NPA has chosen its resource package carefully. The biological materials to be produced and distributed from project nurseries and other propagation sites have already given strong indications of their potential power as a tool for enhancing productivity and improving on-farm conditions. In the hands of the peasant, this tool may even leverage certain fundamental, if unforeseen, transformations in whole production systems. Unlike many other programs targeting such a transformation, the NPA neither imposes formulaic solutions nor creates true dependency, either on the project itself or on the vagaries of external, national, or international markets.

It is also worth noting that New World creole cultures, such as that of Haiti, are distinguished precisely by their demonstrably creative and appropriative character, in all spheres. The Haitians were born into circumstances that demanded, shaped, and rewarded such tendencies. To take to themselves, and to make their own, diverse elements of essentially alien origins is their birthright, and remains the hallmark of these remarkable, "fresh" cultures even today, as they are prematurely threatened with reabsorption by the mainstream. Their deeply ingrained predisposition to the novel, the interesting, and the useful abets the nondirective transfer of new resources to them, and encourages their maintenance of innovation in the absence of continuous external support.

The NPA quite wisely, if not knowingly, takes full advantage of this distinctive feature of creole culture, as will be seen. While decidedly not the answer to the current crisis in Haiti's agrarian sector, many of whose most fundamental problems have their source of origin far from the barren hillsides, the NPA promises to stimulate and to aid the peasantry in its quest for a future on the land.

SECTION TWO

SOCIOCULTURAL FEASIBILITY

Within the context of a social soundness analysis, the NPA is best understood and analyzed as a follow-on project to the AOP, due to finish at the end of 1989. The NPA is explicitly intended to refine and build upon the successful outreach methodologies and farm-level interventions developed under the AOP. The new project represents an evolution, rather than a simple extension, of current activities, for it is grounded in the recognition that the time has come to capitalize on the AOP's successes by expanding the range and improving the quality of services provided to farmers through the existing outreach network.

It follows that the sociocultural feasibility of the NPA can most clearly be assessed in light of the sociological assumptions and insights that underwrote the AOP's design, and by what has been learned over the past eight years of project implementation and evolution. This approach makes explicit the irrefutable but sometimes overlooked fact that a project of the AOP's scope and duration itself becomes a relevant variable in subsequent analyses of the Haitian scene — a complex social actor and influence on both the local and national stage.

WHAT WE KNEW THEN ABOUT PEASANTS

In 1981, the AOP design was closely guided by some key insights concerning the Haitian peasantry and the rural socio-developmental context. Many of these were made explicit in the original social soundness analysis (Murray, 1981), while others are implicit in the overall design. These "first principles," which provided a kind of sociological charter for the AOP, and have guided NPA design as well, are reviewed here.

Point 1: Haitian peasants are the managers of complex farm enterprises.

Far from conforming to the stereotype of the traditional farmer, repeating the same simple cultivation routines on the same plot of ground year in and year out, the Haitian peasant farmer is a proactive farm manager. He/she consciously and conscientiously manipulates a complex portfolio of productive resources and strategies, comprising a diversity of individual elements and a dizzying array of options concerning their possible combination.

The typical peasant controls a number of separate plots of land, under a multiplicity of freehold tenure categories. These different plots are commonly located in distinct ecological zones and exhibit varied edaphic and microclimatic characteristics. At any given time, any given plot may or may not be under cultivation. The plot may be "owned" by the owner-operator, or by another cultivator who has been accorded temporary usufruct privileges over the land, under a variety of possible arrangements. At the same time, our original owner-operator may well seek similar use-rights over one or more plots controlled by yet a third party. Thus, in any given agricultural season or longer-term cycle, a particular peasant may simultaneously:

- Work land he/she controls;
- Work land controlled by others;
- Offer land to another to work; and
- Devote land to other, nonproductive uses or fallow.

Superimposed on this mosaic of land resources, of course, is an even more complex array of cropping patterns. Multiple cropping, intercropping, panseasonal multicrop rotations, and the combination of perennials and annuals in multistory gardens impart a spatial and temporal dimension to single plot and overall farm management decision making that has yet to be fully deciphered by anyone but the peasant.

An important additional element in most local farming systems, of course, is animal husbandry. Again, an array of livestock is husbanded by many peasants, with a variety of production goals, under equally complex subsystems of management and ownership. Husbandry activities are in turn integrated, at an even higher level of on-farm management decision making, with other productive, commercial, and financial strategies.

Finally, the typical farmer operates these complex and interrelated systems with resource allocation decisions that necessarily take into account a number of different forms of available labor, including own, family, exchange, and for-hire; the seasonality of labor availability; the opportunity costs to household labor; and a variety of labor-saving and labor-capturing stratagems revolving around the disposition of controlled land to children, siblings, other relatives, or neighbors.

Little wonder, then, that no two peasant farming enterprises are identical, even within specific ecological regions; or that no single farm enterprise is ever in stasis, caught in a timeless round of seasonal repetition. Rather, traditional Haitian farm management strategies are dynamic, innovative, and demanding. They both encourage and reward, within severe resource constraints, the skilled and inventive farmers who are their authors.

Point 2: The unit of production and consumption is the peasant household.

For most intents and purposes, including agricultural decision making, the highest order, functional social grouping throughout the countryside is the individual household. This household typically has at its core a conjugal pair and some or all of their immature, common offspring. More often than not, the conjugal pair is joined in a monogamous, relatively long-term, common-law, socially recognized union. They are bound by a culturally explicit contractual relationship, which, at base, involves the exchange of female sexual services for male agricultural labor, but also involves female domestic labor and male economic obligations, more broadly construed, in a mutually satisfactory, collaborative unit of production and reproduction. Nominal household headship (*mèt lakou* in Haitian creole) does not automatically devolve upon the male member of this pair; rather, it is a function of ownership rights over the homesite (*lakou*) and the home itself. Women heads of conjugal households, then, while not the norm, are neither socially nor culturally unusual in the countryside. In practice, household decision making in most spheres is done jointly by both spouses; the most significant exception being commercial decisions relating to the national internal market system, which are by and large the exclusive domain of women.

Around the nuclear core of the conjugal household, it is not uncommon to find one or more additional residents, either adults or children, who have been recruited or have attached themselves to the domestic unit, in accordance with any one of a number of social principles governing potential membership rights and responsibilities. Such auxiliary members of the household rarely, if ever, include a second conjugal pair of any generation. The principle of socioeconomic autonomy for each such pair is jealously guarded, and expressed in residence patterns.

This typical pattern notwithstanding, a good deal of variation occurs. The bulk of this variation is generated by culturally appropriate patterns of serial monogamy for women and polygyny for men, and is expressed in the existence, at any given time, of a substantial minority of female-headed households with no co-resident spouse. Truly spouseless women, without even an extraresidential mate, in turn comprise an important portion of this group of female household heads.

For good historical reasons, Haitian rural society has always been highly individualized. While event-specific cooperation of many kinds occurs in both secular and religious contexts, no enduring, corporate groups, managing a common economic resource over time, have emerged as part of indigenous peasant social organization. Indeed, only one quasi-corporate group, based on ambilineal descent, functions far above the level of the household. Known as the *eritaj*, this group unites all living and dead descendants of an apical ancestor for theological and ritual purposes and managing a common spiritual legacy. Ironically, even these vast and overlapping groups may be interpreted, in their cultural functioning, as elaborate symbolic mechanisms for asserting the identity, distinctiveness, and primacy of each individual member of society.

Where extrahousehold groups do occur in contemporary rural Haiti, they are invariably the result of more or less successful, salutary interventions by exogenous institutions, such as local churches, missions, state representatives, and development agencies. Some well-known examples are *groupements*, cooperatives, community councils, and sectarian congregations. Such organizational efforts are fraught with difficulties, even where they ultimately succeed, for they essentially run counter to prevailing cultural dispositions towards individual and household autonomy. Quite correctly, then, the AOP and the NPA have explicitly identified individual farmers and their independent household economies as the appropriate targets and beneficiaries of project extension efforts.

Point 3: The overwhelming majority of peasant households have secure access to one or more homesite and/or garden plots.

As described earlier, Haiti is a society of freeholding peasants, and has been since the early postrevolutionary period. By the mid-nineteenth century, after several decades of struggle for access to land, the nascent peasantry became deeded proprietors of a substantial portion of the country's agricultural and other rural lands. Although this process of land acquisition and redistribution has fallen short of breaking up all the plantation estates, particularly those occupying the most fertile and well-watered flatlands, Haitian peasants are, by and large, landed proprietors, either through inheritance or purchase. As Murray points out in the original social soundness analysis for the AOP, the fact of widespread deedlessness for individual plots today, as a result of successive generations of informal, unsurveyed divisions of land in a system of bilateral, partible inheritance, does not gainsay this generalization. Deedlessness does not necessarily imply insecurity of tenure. While purchased land may be somewhat more securely held than inherited land, on the basis of whatever documentation was generated by the sale — often simply a notarized record of the transaction, the majority of such transactions transfer ownership over unsurveyed, undeeded parcels. Again, following Murray, what more

eloquent testimony to the basic security of tenure, at least within the informal tenure system internal to the peasant class, than the fact that buyers are willing to lay out hard cash for such parcels?

Point 4: Peasants are not subsistence farmers, but are market-oriented producers.

While there is a mix of monetary and nonmonetary features in the peasant economy, Haitian peasant adaptation evolved in a modern, postcolonial setting and has always been firmly embedded in an international market/cash nexus. Today's peasant is neither a classic subsistence producer nor the marketer of a true surplus. Rather, he/she is a deficit producer and a marketer for subsistence (consumption) goals. That is, the average peasant produces less than the minimum necessary to support a household; he/she operates at a loss, and likely loses ground in one way or another with every passing year.

Yet the woman of the household goes to market at least once a week, and must often make small cash purchases with even greater frequency, to secure basic necessities for daily consumption. Such essential items include cooking oil, salt, matches, laundry soap, cooking vessels, cloth, and a host of other manufactured, processed, or non-locally-produced goods. These necessities are available exclusively through purchase, and some portion of perennially scarce on-farm produce is commonly sold to generate the needed cash.

Paradoxically, the poorer the peasant, the higher the proportion of his on-farm produce sold at market. This inverse relationship holds at least within the lower and middle strata of the peasantry, until the true surplus producer emerges in the upper reaches of rural society. The terms of exchange, needless to say, are controlled from without, and are weighted against the small local producer (Lowenthal and Smucker, 1985).

Understandably, then, the peasant makes production decisions with a good deal of sensitivity to standards and fluctuations of market value for particular commodities. Even if not all on-farm produce is destined for sale — and portions of virtually all types of such produce are retained, when possible, for home consumption — the projected market value for all products at the time of harvest greatly influences production and management strategies. The countervailing influence, of course, is the peasant's reticence to move entirely out of staple food production and commit to nonconsumable cash crops, just in case market prices suddenly drop precipitously for reasons beyond his/her control. Obviously, high-priced peasant consumables that can be produced on-farm are ideal production options. These can be sold outright to generate cash for consumption purposes, or consumed domestically in lieu of significant cash outlays.

Point 5: Peasant lands are underutilized in certain respects, particularly in terms of their potential for the cultivation of hardy, deep-rooted, perennial species.

Ironically, the land-poor peasantry is unable to make the maximum productive use of available land because of the limiting factors of labor — at times of peak seasonal demand, and of poor performance of traditional crops under increasingly harsh conditions. Much land is permanently abandoned, having reached an uneconomical level of productivity under annual food crops. Fallow cycles, where they continue, do not take full advantage of highly productive, improved fallow rotation crops, such as grasses, leguminous forages, and fast-growing hardwoods, because these biological resources are not widely available. Finally, multistory field architecture techniques of intensive mixed

cropping, while deployed within the peasants' own farming systems in the context of extremely complex *lakou* gardens and coffee plantations, are underexploited in annual food crop production plots. Again, this appears to be due to the unavailability, within the indigenous crop mix, of appropriate species to take advantage of deeper soil strata and higher position above the field without shading out shallow-rooted, lower-growing annual staples.

Point 6: Peasants are risk averse, but seek to spread risk through the diversification of the farm enterprise.

This obvious corollary to Point 1, above, is often misunderstood. With a large percentage of small farmers living on the very margin of survival, and the majority just managing to make ends meet from year to year, peasant farming is more strongly oriented to minimizing risk than to maximizing production. The most common strategy for risk minimization, however, is to spread risk, through diversification, within a single peasant farm unit. Different plots, located in different microclimatic zones, are managed in diverse ways, as we have seen. It is precisely this diversification, however, that has left the peasant farmer advantageously positioned to tinker with his/her production strategies on a seasonal, annual, and long-term basis.

Regularly manipulating literally dozens of crops and a mixed livestock herd on a multiplicity of sites, in an effort to minimize risk, the peasant is relatively free, paradoxically, to try new techniques and to incorporate new elements into the overall farm enterprise. This is true, especially for innovations that require relatively low investment of land, labor, and capital, and are not overly competitive with other production goals. From this perspective, the peasants' low-risk agriculture is not the obverse of an incorrectly imputed resistance to change. Rather, the diversification that it has engendered is a necessary and favorable precondition for the cautious exploration of new, alternative production strategies.

Point 7: For most peasants, labor is the least scarce factor of production.

Capital is by far the scarcest of the peasant household's production factors. Capital shortages are a significant constraint to peasant production and tend, today, to foster destructive land use practices. Labor is generally the least scarce factor of production, while land is the pivotal factor. Land serves as the powerful fulcrum for gaining access to both labor and capital resources. Peasant farmers have relatively more control over land and labor than over capital (Lowenthal and Smucker, 1985).

Of course, labor availability can limit the scope of the household production effort, even where land is relatively abundant. On the other hand, the opportunity cost to labor, except during limited periods of peak demand during field preparation prior to the onset of seasonal rains, would appear to be quite low. Introduced technologies and crops, then, must never be demanding in terms of capital investments. Those requiring significant land resources, but low labor inputs, would primarily interest owner-operators unable to marshal sufficient labor to valorize their current holdings. Finally, those requiring only labor inputs, particularly if some or all of that input is not necessarily coincident with peak demand periods, will have the broadest possible appeal.

Point 8: Peasants are staunchly self-interested, and will work to improve their own lot.

The basic idea here is straightforward, and universal. Haitian peasants are willing to work for themselves, but not so willing to work in what they perceive, either rightly or wrongly, to be the interests of others. Like most people, they are not committed altruists. This stance applies broadly to all extrahousehold, extrafamilial relationships, but is particularly strong vis-a-vis nonpeasant outsiders. In general, an historically justified suspicion of all outsiders, particularly those with some measure of perceived power, is also fundamental to the peasant character, and continues to play an important survival function in many contexts.

Additionally, most peasants cannot afford the luxury of such abstractions as "community of interests," "the public good," "the intrinsic value of the natural environment," or other noble, disinterested, and decidedly nonproductive ideals. It is worth noting that a not insignificant number of their countrymen in other, more leisured classes, have also apparently had difficulty in internalizing such orientations. Somewhat paradoxically, this has to do partly with the historically determined individuation of a society that had its cultural genesis under the profoundly disruptive influence of the most vicious slave regimen on record. It also has to do partly with the successful efforts of enslaved men and women to resist the most debilitating aspects of that disruption by assiduously asserting their individuality in myriad ways, in the face of a system that doggedly sought to deny their very humanity. In any case, contemporary circumstance and historical influence here converge to render today's peasant a truly rugged individualist. Whatever the sphere of activity, his/her strongest motivations consistently revolve around personal advancement and familial needs.

Point 9: Trees have always occupied a special place in peasant life and culture.

Given the wholesale destruction of forest cover caused by the forced expansion of peasant agriculture across virtually the entire landscape, and the nonsustainable mining of remaining natural stands for charcoal production by peasants under considerable stress, the impression is sometimes given that peasants do not plant, nor even appreciate, trees. This is emphatically not the case. Peasants have commonly planted fruit trees, although not in large numbers. Trees of many kinds are planted in patterned indigenous agroforestry associations, as evidenced in the botany of the *lakou*, in living fences or boundary markers, and in shade cover for crops such as coffee and cacao. Peasant farmers also have a distinct preference for self-regenerating and self-propagating trees. In arid zones, there is also a traditional practice of managing natural stands of *Prosopis* for sustainable production.

Trees of any kind are of such considerable importance to the peasant that distinct rules of ownership and inheritance apply to them. Patrimonial land may be divided, for example, while trees on the same land, along with their produce, remain a collective resource for generations. Trees may be owned entirely separately from the land upon which they grow, as a result of land transactions that explicitly exclude particular trees standing on the plot. Land may be rented or sharecropped separately from the trees present on the land, which themselves may be rented for one or more seasons.

Much like the land, which, at one time at least, ensured the continued viability of peasants as independent producers and free men, trees too are imbued with more than just material significance. They also play a symbolic role in the spiritual lives of rural Haitians. Many trees on peasant lands, especially those of certain species and most old trees, are considered to be the repositories of spirits. Also, it is customary in many areas to plant a tree over the spot where the afterbirth or umbilicus is buried at childbirth, and to consecrate its future productivity to the newborn. The child is expected to

profit from the tree, and to be anchored both materially and spiritually by it as he or she grows up to face the increasingly stringent demands of making a living on the land (Lowenthal and Smucker, 1985).

WHAT WAS DONE WITH THESE INSIGHTS

First, let us restate these principles in summary form:

- Haitian peasants are the managers of complex farm enterprises;
- The unit of production and consumption is the peasant household;
- The overwhelming majority of peasant households have secure access to one or more homesite or garden plots;
- Peasants are not subsistence farmers, but are fundamentally market-oriented producers;
- Peasant lands are underutilized in certain respects, particularly in terms of their potential for the cultivation of hardy, deep-rooted, perennial species;
- Peasants are risk averse, but seek to spread risk through the diversification of the farm enterprise;
- For most peasants, labor is the least scarce factor of production;
- Peasants are staunchly self-interested, and will work to improve their own lot; and
- Trees have always occupied a special place in peasant life and culture.

It was on the basis of the above assertions concerning peasant life and agriculture that the AOP was designed and implemented. Point 1 suggested that peasants had the management capacity to integrate new elements in their farming systems, on their own, and in ways that might not be apparent a priori to nonpeasant technicians. Point 6 indicated that they might indeed be willing to try one or more such elements, while Points 5 and 7 showed that there was room within their current system to do so without profound disruptions in staple crop production.

Point 8, on the other hand, was cautionary, stressing the importance of promoting peasant perceptions of their "ownership" of the trees, and their consequent freedom to both deploy them and dispose of them as they saw fit. It also cautioned against stressing the idealistic (read: environmental) and long-term benefits of the trees. Point 3 overcame programmatic objections that insecurity of tenure would inhibit peasant investment in relatively long-term land improvement and production strategies, but also provided the rationale for an extension strategy that sought to link the outplanting of project trees on the most securely held land — in other words, purchased or individually deeded inherited plots — to the ownership/suspicion issue.

Point 4, narrowly construed, provided the basic promotional message, or selling point, for the trees — that they could be cultivated as a cash crop, on relatively short rotation, for the managed production of a variety of wood products. As already noted, Point 2 forcefully pointed to an extension

service that gave priority attention to individual farmers, and to the autonomous production units they managed. This is the socially appropriate point of entry into the agricultural system, as opposed to placing primary emphasis on larger social groupings of any kind.

Finally, Point 9 gave planners reason to believe that the large-scale outplanting of substantial numbers of economically useful, multipurpose trees was not only socially feasible, and ecologically desirable, but culturally consistent with preexisting peasant knowledge, attitudes, and practices. This gave rise to a hope that peasant tree-cropping behavior could one day be institutionalized and sustained beyond the life of the project.

SECTION THREE

WHAT PEASANTS HAVE TAUGHT US IN THE CONTEXT OF THE AOP

Under the AOP, 200,000 peasants have planted substantial numbers of hardwood seedlings, and are managing these trees as a crop. For several years, all indications from the field have highlighted a burgeoning enthusiasm for the outplanting of free seedlings distributed by the project. This enthusiasm reached a point some years ago where an estimated 30 percent of registered seasonal participants were repeat planters, having already received at least one prior lot of seedlings from the project.

Additionally, there is clear evidence that, from early on, boxes of seedlings were being broken by officially registered participants, with between 15 and 25 percent of the plants informally redistributed to friends and neighbors interested in trying the new input for themselves. At first, this latter phenomenon was likely related to the fact that seedlings were distributed in minimum lots of 500 per box by PADF, and 250 per box by CARE. Many planters were either not willing to invest the full measure of labor required to plant such large numbers of an unproven performer, or faced real or perceived constraints in terms of land available for outplanting. Some of the seedlings that disappeared — between distribution and the project's first or base count of standing plants at the farmer's designated outplanting site — were likely never planted. Others were probably planted in unmonitored fields controlled by the same participant. Finally, some were surely redistributed and outplanted by other interested parties.

Today, with lot sizes down to between 80 and 150 seedlings a box for PADF and 200 a box for CARE, seedlings are still regularly and everywhere reported stolen from participating farmers' fields in the first few days after outplanting. Anyone familiar with the gravity of predial larceny in rural Haiti — persistent recidivists in some areas may finally be permanently cured of this vice by nocturnal vigilante squads — cannot help but be impressed by such a convincing indicator of project success in promoting and demonstrating the value of trees.

Boxes are still being broken, of course, where social obligations or the bonds of amity demand a sharing of scarce and valued resources. But now that project tree performance has become an accepted fact of rural life in many outreach regions, such generosity is accompanied by no small sense of regret. Even in those areas most intensely saturated with project trees, peasants interviewed in the course of this consultancy are not yet satisfied. "It's now that we need these seedlings," one woman — a repeat planter — averred, "now that we know what they can do for us!" Her sentiments were echoed not only by neighbors in the same area, but by planters across several CARE and PADF regions.

The basic message that satisfied planters — and their larcenous neighbors — are sending is clear, and it resoundingly confirms, at least indirectly, the validity of those first principles discussed above and most of the inferences project planners drew from them. We have learned considerably more from the peasants participating in the AOP, however, than the fact that we knew a few things at the start. Indeed, we have only begun to learn how much they have to teach us.

The AOP design made some additional assumptions about the peasantry that they have had the opportunity to disconfirm in the course of eight years of project implementation. These lessons learned may be summarized as follows:

Lesson 1: Relatively near-term, regular cash returns are not the primary peasant production goal in planting project trees.

Within the framework of the peasants' market responsiveness, as described above, the original idea behind the AOP put considerable emphasis on the short-term rotation possibilities in fast-growing exotic hardwoods such as *Leucaena*. The expectation was that the most effective stimulus for peasant tree planting on a massive scale would be rapid, regular returns from charcoal production, based on a four-year harvest/coppice cycle.

Peasant production goals for project trees are varied, however, not only across a sample of planters, but within a single farm enterprise. Very few planters appear to be growing trees exclusively for charcoal production. Even in parts of the Northwest, a major commercial charcoal production zone in which project trees have been adopted as an improved fallow crop primarily devoted to this end-use, some trees within each plot are being retained and managed for the production of higher-value end products such as poles, posts, and saw timber. Elsewhere, these higher-value end products constitute the primary production objectives for the majority of farmers.

Those not accustomed to producing charcoal commercially, and those able to retain their trees for a longer period before harvest, are opting to do so. Economically, this makes good sense, since the value of larger stock does not simply increase gradually. Rather, there are quantum leaps in value as the tree attains different size thresholds and potential end-product uses shift up the scale towards lumber. Meanwhile, of course, basic tree management techniques such as pruning and thinning — common especially where trees are deployed within garden plots, in order to control shading — are producing small amounts of both firewood and charcoal as interim products.

Peasant interest in longer-term production goals and higher-value end products has been reflected directly in their expressed species preference. In response to peasant demand, the project has shifted the species mix in project nurseries towards slower-growing, higher-value, local lumber species. Today, one such local species, *Catalpa longissima* (*chen* in Haitian credo, or tropical oak), comprises 50 percent of PADF's nursery output.

Peasant economic behavior toward project trees has also been profoundly affected by the national swine eradication program, executed in the early 1980s, as the AOP began. Many planters see trees as a substitute for pigs within their overall domestic economy. That is, project trees are being used as an interest-bearing store-of-value, or savings mechanism, held until such major unforeseen or periodic expenditures as illness or annual school fees and attendant costs make harvest necessary. Although such an approach does not necessarily optimize the economic returns to tree planting — trees may have to be cut just prior to moving from pole to post size, for example, or may not be managed on an optimal rotation schedule over multiple coppice cycles — it serves an essential function for the perennially cash-poor peasant. The combination of higher-value end-product potential and this store-of-value strategy has led what is probably the majority of peasants to develop the idea of holding on to trees for as long as possible before harvest.

Finally, commonly expressed production goals may have nothing at all to do with the commercialization of wood products. Significant numbers of participants are, by their own accounting, planting project trees primarily or exclusively for domestic use. One planter interviewed had already chosen the site on which he planned to build a first home for his now adolescent son. Individual project trees growing on one of his plots had already been designated for specific construction uses within the structure, and were being managed accordingly. On the construction site itself, additional project trees

had been deployed in order to establish the traditional *lakou* garden, around the future home. A single female head-of-household had already begun construction on a new home for her family in her current *lakou*, utilizing project trees not only for construction purposes, but for the burning of limestone to be used in the upcoming masonry work.

Lesson 2: Peasant acceptance and management of some project trees have little to do with wood production objectives.

Conway (1986) conducted in-depth field research on farm-management strategies among a sample of 60 tree planters at seven distinct PADF and CARE subproject sites. His whole-farm, management-decision-making approach to this planter study highlighted several important — and unpredicted — aspects of peasant response to the availability of project trees.

First, soil conditions and their improvement were of major concern to many farmers interviewed. Their primary motivation in planting trees was to improve soil conditions. "Many farmers planted their seedlings with the goal of increasing shade in a garden in order to reduce the rate of [evapotranspiration]" (pp. iii-iv). Others used the trees on specific sites to control spot erosion in ravines. Trees were also deployed as living supports for more complex erosion control structures in gullies and ravines. These farmers had no intention of harvesting their trees for wood product end-uses, although they might likely receive secondary benefits in this regard from pruning and forage production.

Second, while some planters used trees essentially as expected — to complement existing cropping patterns — others were using them as key elements in an effort to transform whole subsystems of on-farm production. At more than one site, for example, planters were deploying project trees to establish or reestablish coffee groves on lands that might otherwise never have been put to, or returned to, this relatively sustainable use. Elsewhere, one informant was successfully moving towards an innovative, complex agro-silvo-pastoral system combining project seedlings with grass for grazing and food crops in different portions of a single field. Both of these land-use conversions were being planned and executed using a step-by-step, multiyear, long-term strategy, with intermediate systems providing interim productivity as the transformation was accomplished. As Conway concluded, peasants are "clearly engaging in new agricultural practices [stimulated] by the introduction of large numbers of nursery-produced seedlings into their farms" (p. 20).

At an even higher level of farm management decision making, planters have begun to deploy project trees in accordance with objectives that relate directly to the planters' current and future access to the two most important factors of production — land and labor. Conway reports some fascinating cases of these sorts of strategies:

- Tenants planted trees on plots leased for several years, to reinforce their "right of first refusal" in the event the land is put up for sale by the owner; or to affect in a way favorable to the tenants the owner's disposition toward long-term renewal of the lease;

- Purchasers of unsurveyed, informally divided, inherited plots removed existing trees and replanted the land to project trees, to reinforce their right to exclude any of the original heirs from the plot; and

- Older children planted intensively on infirm parents' land in what might be interpreted as a stratagem to defray upcoming funerary expenses, thereby avoiding the necessity of selling off some portion of the parental estate to finance costly death rituals, as is commonly the case.

Buffum and King (1985) report at least two cases in one outreach area where planters planted trees on unsurveyed, inherited land they were working, under the terms of a customary informal division with other heirs, to establish a firmer claim for themselves or their heirs. There are even reported cases of sharecroppers planting project trees on plots, with the owner's permission, in an effort either to establish a stronger lien on potential future sharecropping arrangements for the same plot, or to encourage an offer of sale from the current proprietor.

The behavior of the owners of sharecropped plots with respect to tree planting is revealing in terms of the way project trees are being deployed with reference to the differential labor endowments of different categories of farmers. One way of understanding the incidence of what Murray has called "stratum internal" — local peasant to local peasant — sharecropping in rural Haiti is to see it as a strategy of the relatively land-rich, or the absolutely labor-poor, for "capturing" scarce labor, with no required investment or attendant risk on their part. The owner, generally providing nothing but the land itself, is, after all, entitled to a share — usually between a third to one-half — of the harvest, under customary arrangements. Understandably, as well, the plots most commonly "shared out" in this fashion are chosen from among the owner's least productive holdings.

Also, there are strong indications that project trees are being used by some owners as a distinct, alternative strategy for dealing with labor shortages within the production unit (Balzano, 1986). Because trees have low labor requirements and fertility-enhancing, moisture-retention characteristics, they provide a suitable and more productive way of making something off of relatively poor plots, while simultaneously rehabilitating them. This particular utility of project trees — as a labor-saving production alternative — is also regularly exploited by single female heads-of-household who, whether by design or by circumstance, do not have access to male agricultural labor through conjugality.

What the examples in this section demonstrate, from among a limited sample of farmer participants, is perhaps the most important lesson learned in the context of the AOP: "Trees-as-a-crop" is only one of the accomplishments of this remarkable activity, and perhaps one of its most limited.

What we are witnessing here is the appropriation of project trees as a tool by the peasants. As should be evident, their subsequent application of that tool — in its myriad capacities as a biological, social, and symbolic resource — to diverse management tasks and objectives may finally have profound implications for the peasants' ability to survive the current crisis in the agricultural sector. A corollary of this lesson, which we will recall later in the course of this argument and which has guided the design of the NPA, is that neither planner nor technician could ever have foreseen or recommended to farmers the strategies that have evolved in response to this new resource.

Lesson 3: Though trees are certainly a crop, they do not a garden make.

Although considerably less compelling than the previous two points, there is a third, more practical lesson to be learned in the context of the AOP, and one that deserves specific attention in the proposed NPA extension program. In the original social soundness analysis, it was presumed that existing grazing laws, which serve to protect standing crops from animal damage through the application of specific sanctions to the owners of *bèt lage* (loose or released animals), would be applied to project

seedlings automatically, at least insofar as the seedlings were culturally defined as crops in local farming systems. Unfortunately, browsing by free-ranging livestock — particularly goats — remains perhaps the single most important cause of seedling mortality and hedgerow damage within the project. Moreover, even in localities where everyone has planted one or more lots of project seedlings, and has managed them as a crop for several years, this problem remains severe.

The seemingly logical progression from the recognition that trees are a crop to the definition of the land upon which trees or hedgerows stand alone as a garden has simply not occurred. While there may be sound material reasons for this apparent block, in terms of prevailing livestock management systems, there is no prima facie cultural impediment to making this connection. Planters of both seedlings and hedgerows recognize this issue clearly, and some, in different parts of the country, have developed a culturally appropriate way of resolving it. When outplanting trees, or sowing hedgerows, these individuals also broadcast a handful of crop seed — corn, millet and beans have all been reported as used for this purpose. These seeds are not planted in any expectation of harvest, but solely for the purpose of defining the space they share with the seedlings or hedgerows as a garden, to protect the seedlings or hedgerows from free grazing. Repeated over several seasons, at very little expense, this ruse appears to work well, and comes highly recommended from a few truly crafty farmers.

This trick is only one possible way of dealing with the goat-damage problem, but probably one worth talking up as part of the project's overall extension package of tree and hedgerow planting techniques. More broadly, the NPA needs to develop the concept of "plots-where-trees-stand-are-a-garden" explicitly, in the agent-to-farmer extension program, as a key message in the environmental education curriculum, and even in the promotional radio messages now being planned by CARE. This is particularly true because youngsters are given a good deal of responsibility, early on, to graze, tie, and water animals.

Lesson 4: Peasants are interested in a variety of low-input soil conservation/land improvement techniques.

In the first few years of AOP implementation, a wide range of exotic biological material was propagated and distributed to peasants across the countryside in the form of substantial numbers of fast-growing hardwood seedlings. One of the exotic species that would prove to be the most influential from the point of view of project evolution over the subsequent few years was *Leucaena spp*. Peasants did not universally acclaim *Leucaena* initially; it bore a close resemblance to a prolific local weed known as *delin*, which was a persistent problem for cultivators in some areas. Today, many people still remain suspicious of *Leucaena*, and with some justification. It is a prolific seeder and, if left unchecked, a few trees can take over significant areas with volunteer seedlings (read: weeds) quite rapidly. On the other hand, many planters, impressed with its unsurpassed growth performance under the right conditions, continue to request it as part of their species mix.

What is of more interest in the present context is the fact that *Leucaena's* prolific seed production, its hardiness, and its rapid growth make it a good candidate as a hedgerow species. Between 1984 and 1985, with some prodding by USAID, and in response to perceived peasant interest in soil conservation and soil improvement measures that went beyond tree planting, both AOP outreach grantees instituted hedgerow programs on a pilot basis. In PADF's Southwest region, where its hedgerow program began, and throughout the Northwest, farmer response to hedgerows has been extremely positive. Today, with hedgerow programs under way throughout the project area, experimentation with other woody hedgerow species and species mixes has begun.

Positive peasant response to hedgerows is based on a number of factors. First, hedgerows satisfy the basic criteria discussed above for agricultural innovations peasants are likely to try: they are neither land extensive (initially) nor capital intensive. They require only labor and available seed as inputs for installation, although contour lines must be determined using an A-frame level. Also, although ideally planned and installed on an entire subcatchment basis, and installed by the entire group of peasants operating parcels on that topological unit, hedgerows can be sown on a plot-by-plot basis, by individuals, as they were under the AOP.

Furthermore, hedgerows are consistent with the peasants' awareness of and interest in soil conservation, particularly on rapidly eroding hillside plots. Soil retention results are usually visible relatively quickly on such sites, as soil and organic material build up behind each contour row. In this retained soil, peasants are reporting significant yield increases after only a few seasons. Nor do hedgerows take an unacceptable amount of land out of cultivation, particularly when installed at spacing that is significantly wider than that recommended by technicians, although they do require careful management to prevent their going to seed and posing a serious weediness problem.

Finally, unlike mechanical soil erosion control structures, which offer no intrinsic value to the farmer and still require constant maintenance and attention, living barriers like hedgerows generate usable by-products for on-farm use. Hedgerow trimmings provide nitrogen-rich green manure and mulch as a soil amendment, forage, and firewood. Alternately, trimmings, particularly branches, can be stacked up behind each row to reinforce its soil-retention capacity.

In addition, particular stems within the hedge can be allowed to grow to sapling and tree size, at the appropriate spacing, providing larger stock for other end-uses. Peasant attitudes to at least some of these hedgerow by-products are aptly characterized by one man's response to persistent attempts to elicit complaints from him concerning the labor required to cut back the hedges repeatedly before they go to seed. He sanguinely explained that the day's labor expended on that task was more than made up for by the time saved in scavenging far afield for firewood for his wife's kitchen.

Other low-technology erosion control devices that provide rapid and visible results in terms of soil retention are being promoted by CARE in the Northwest. These include both living (productive) and dead barriers of various kinds, particularly for controlling spot erosion in gullies and ravines. Because of the soil buildup behind such structures, and the ability to cultivate even small patches of relatively rich land that was not even there before, peasants are responding favorably to these techniques.

IMPLICATIONS FOR THE NPA

To the extent that proposed NPA extension programs target the same set of beneficiaries — peasant household production units — with the same, basic, nondirective and simple extension strategies and the same basic extension services — subsidized biological and informational resource transfer — as the AOP, there is no reasonable doubt of the program's sociocultural feasibility at the peasant level. The peasantry has, for the past eight years, been voting with its feet on this issue. Significant deviation from these proven programs and approaches, however, must be scrutinized carefully in light of each of the sociocultural insights, principles, and lessons discussed above. See, for example, Annex A — an appraisal of CARE's FARM proposal.

The feasibility of proposed new technical interventions at the farm level, as the NPA expands upon the AOP's hedgerow program to intensify activities in contour soil conservation methodologies and other soil conservation/sustainable agricultural technologies, should also be weighed according to some of the social acceptability criteria discussed above. Three simple rules-of-thumb should be consistently applied:

- Land-extensive, capital-intensive interventions will not likely work, certainly not on a widespread basis. Labor-intensive interventions are possible, if labor demands are not overly stringent during periods of peak demand within the agricultural cycle, and if the labor expended yields visible results or usable by-products within a relatively short period of time;

- Interventions that require coordinated group activity beyond the household are unworkable, except where group organization has been the priority development objective of a local NGO over several years preceding any such interventions, and it has had success;

- Complex interventions, with end results programmed by technicians, are probably overdetermined when one considers the idiosyncratic and microclimatic variations characteristic of peasant farm-management strategies. Put another way, in a truly agrarian society like that of Haiti, in which the changing tenor of one's relationship with a second cousin — who is simultaneously one's co-heir, sharecropper, and exchange-labor partner — may be the prime factor in deciding where and in what configuration one plants trees, programmatic, directive solutions to the peasant's farm-management problems are bound to fail. The creative appropriation of relatively simple interventions and the tailoring of new options to on-farm production objectives are the peasant's job, and he/she has already proved capable of handling them.

Two proposed new technical interventions under the NPA — the on-farm propagation of trees and the introduction of grass and leguminous forage strips into hedgerow systems — may be briefly assessed according to these principles.

The on-farm propagation of trees meets the first two criteria, insofar as particular propagation methods are carefully chosen prior to extension. In keeping with the third principle, the simpler and the more generalizable to various on-farm conditions, the better. Because on-farm propagation is an open-ended activity, with a product that the peasant can then deploy as he/she sees fit, involving techniques appropriable by the farmer, this proposed extension activity is an excellent choice.

The introduction of grass/leguminous forage strips for erosion control meets all three criteria, and the necessary germplasm can be produced and extended within the framework of proven and ongoing outreach systems. Moreover, the by-products of such forage strips may be of considerably greater interest to peasant livestock producers in many parts of the country than even those of *Leucaena* and other woody species.

Political Feasibility: A Cautionary Note

While it is difficult at this point in the evolution of Haitian political culture to predict what the future may hold, it is only realistic to stipulate that the next five years are not likely to be passed serenely. There are basically three different types of potential political constraints to project feasibility:

- General political unrest, most commonly manifest in interference with the national transport system, through the blockage of vehicular traffic on major arteries;

- Aggravated anti-American sentiment, both local and national, by the progressive left and its associated populist organizations; and

- Government interference in the operation of local and international NGOs.

Although unforeseeable eventualities defy advance planning, the project should remain aware of these possibilities in both planning and implementation. The movement of critical personnel and material such as nursery supplies across regional boundaries should be accomplished well in advance of the time when they are required.

At the regional level, every effort must be made to avoid potential misunderstandings or actual conflict with the sometimes confusing array of politicized interest groups and actors on the local scene. Local implementation will depend on maintaining a totally apolitical profile — a difficult task for the single largest USAID-funded rural development activity in the country. As unsavory as it may be to confront, the reality of today's Haiti means that the continuity of project operations is, in many respects, a hostage to a fluid and volatile political situation, both throughout the countryside and at the national level. Ever-stronger feelings and forces are amassed across the gamut of political persuasions, from the staunch and savage Duvalierists to the committed and activist left. In such circumstances, discretion is, indeed, the better part of valor.

Finally, at the national level, USAID and the outreach grantees must remain vigilant against potential Haitian government backlash against the NGO-implemented development portfolio. Leverage in policy dialogue will vary in effectiveness over the next five years. Impression management, based on the prudent maintenance of a low profile for project funding levels and activities, is probably a more significant and important strategy for avoiding negative attention.

The continuity of NPA implementation — along with other similar NGO-based projects — should, of course, be accorded the highest priority by the mission. Thus, in the interest of the peasantry, this low-profile strategy must take precedence over USAID's understandable, but secular, interest in promoting itself and its accomplishments in response to the current mercurial climate of strongly held and loudly voiced public opinions from a variety of perspectives within the political spectrum.

SECTION FOUR

SPREAD EFFECTS AND SUSTAINABILITY

The extended social feasibility study outlined above lays the groundwork for the following discussion of spread effects and sustainability. As background for what follows, the reader should recall these essential points:

- The peasant is aware of his/her problems, and is looking for solutions to them;
- The project does not, and cannot, offer predetermined and prescriptive solutions, but puts carefully chosen, potentially useful resources at the disposal of unprecedented numbers of peasant farmers, in unprecedented quantity;
- Indigenous, preproject technologies include the on-farm propagation of both fruit trees and semiprecious hardwoods; and
- Peasants steal project seedlings from each other, in defiance of extremely strong social sanctions against predial larceny.

SOCIAL SUSTAINABILITY: WHAT DO WE MEAN?

As an admittedly subsidized, resource-transfer activity, the NPA should not itself be assessed in terms of sustainability. Rather, the question at hand is whether the NPA is appropriately designed to stimulate self-sustaining processes within the society at large, which, in turn, will continue following the termination of project assistance. Based on experience under the AOP, and confirmed by fieldwork carried out in connection with the preparation of this social soundness analysis, the answer is an emphatic "yes."

The most exciting and promising social focus for sustainability in this sense is the peasant household production unit. The NPA, building both cumulatively and thematically upon advances made under the AOP, will succeed in setting the stage for the relatively long-term sustainability of both multipurpose tree cropping, and soil and water conservation measures, at the level of the individual farm enterprise.

That stage set includes the following "props" and "prompts":

- A cumulative total of at least 40,000,000 multipurpose trees, their naturally occurring progeny, and their sustained production of fertile seed, shoots, and cuttings;
- A similar biological resource — if in somewhat lesser abundance — of indigenous and exotic grasses and leguminous forage species, and their progeny;

- Validated and demonstrated information on species propagation, performance and management, and on biologically based soil conservation/soil amendment/moisture management technologies; and

- Validated and demonstrated information on the additional, economically useful, by-products of such biologically based conservation measures.

If these biological and informational resources are effective in improving on-farm productivity, they will be appropriated by the peasantry, and sustained at the farm level. Conversely, if they are not useful, or not in keeping with the broader constraints confronting the peasant, they will be abandoned. In this latter circumstance, sustainability is, obviously, mooted.

AOP participants in several different outreach regions are already experimenting with the on-farm propagation of project trees, on their own, with little or no direct stimulus from the project extension program. One informant in the Northwest, a woman, has been broadcast seeding *kapab* (*Colubrina arborescens*) for the past two years, in conjunction with the sowing of her winter bean crop. When the seeds sprout, she consciously selects which seedlings to leave and which to weed out from her field, on the basis of location within the plot. She had planted project-distributed trees in three different seasons since 1982, she explained, but still wanted more trees in her gardens. A second woman had seeded directly both *kapab* and *Leucaena*. Finally, a third informant recounted regular transplanting of volunteer seedlings from project-distributed *Leucaena* to desired locations on several plots. Similar behavior was reported for several planters by Conway, working in other project outreach areas, as early as 1986.

These spontaneous developments — though they are clearly a result of project intervention in the broadest sense of that term — obviously bode well for the long-term sustainability of relatively large-scale agricultural tree planting beyond the life of the project, now that the concepts and experience, together with the biological resources necessary to facilitate such behavior, have begun to accumulate. Again, such behaviors, prominently represented in the qualitative research and anecdotal material available at this time, are even more encouraging when it is recalled that the sample size is so small. Extrapolation from this limited set of data suggests that literally tens of thousands of participants must already have attempted some sort of on-farm propagation, for at least some species of AOP-distributed trees.

At the same time, much more can and will be done under the NPA to stimulate and facilitate on-farm propagation directly. Of paramount importance, of course, is applied research on appropriate techniques of propagation for those many species, both indigenous and exotic, that are more difficult to manipulate than, for example, *Leucaena* and *kapab*. Even the simplest information on the phenology and propagation of some species may be sufficient to spark extensive on-farm response. The woman direct seeding both *kapab* and *Leucaena*, for example, was interviewed in her *lakou*, sitting under a small stand of what were reported to be two- to three-year-old *Casuarina*. When asked if she were planning to try direct-seeding of this exotic, she replied that she would if only she could find the seeds. Ironically, the trees that shaded us were in seed; she had simply failed to recognize the seed cases.

One additional point made by several peasants interviewed is of considerable interest. Having gone ahead on their own to do some limited on-farm propagation, they were asked: Mightn't it be possible to close the local containerized nursery in the near future? Answers were consistent and emphatic: No, not yet, because they were still experimenting with on-farm propagation, and didn't yet know how survival and growth performance might compare with that of nursery-produced stock. The latter, as far as they were concerned, was a proven winner, and only time would tell to what extent and with what results on-farm propagation might reasonably replace nursery production.

With this insight, these innovative peasants made it clear that they may be more realistic, and cautious, in their own expectations and approach to new techniques than even some project planners. This is hardly surprising, once we remind ourselves that they have considerably more at stake than those attempting to assist them.

In closing this section, it should be noted that the biologically based soil conservation programs to be instituted by both grantees under the NPA hold precisely the same prospect of being sustainable in this most important of senses — by introducing concepts, techniques, and living reproductive germplasm whose continued presence, and spread, in peasant-managed farming systems is not dependent upon the continued presence of the project itself. The sustainability of the soil conservation programs depends upon the extent to which they respond effectively and demonstrably to particular, perceived farm management and productivity problems.

THE SUBSIDY OBLIGATION: LIMITING THE SUSTAINABILITY CONCEPT

All this being said, it should be stipulated that, under current circumstances, it is neither necessary nor desirable that on-farm propagation ever fully replace containerized production nurseries. After all, tree planting as such is not the ultimate object here. Project trees, as we have seen, are an important subsidized resource, being produced and distributed in unprecedented, substantial numbers to peasant participants. This resource has had, in the hands of the peasant, a significant multiplier effect, both as a multipurpose productive crop and as a production and management tool.

Not only are containerized nurseries relatively cost-effective, then, but their output is considerably more valuable, directly and indirectly, to peasant participants than any other proven and deliverable production input available at this time. To suggest, as is being done in some quarters today, that this boon be withdrawn prematurely, in anticipation of the prospect that one day, someday, the project must surely end, borders on the irresponsible, particularly when proposed alternative uses for the funds saved are essentially untested and problematic.

For the time being, considerable time, attention, and resources can justifiably be programmed towards developing on-farm propagation as an essential complement to centralized nursery production, and as a hedge against the eventuality that, one day, this project activity will end. This program should only be pursued, however, within the framework of an overall activity structure and resource allocation plan that continues to emphasize and to guarantee that a tangible, concrete resource flow is maintained from the project to the peasant. Regionally dispersed, containerized nurseries are the key technological innovation that allowed for the establishment of this resource flow in the first place, and they must remain at the heart of the NPA to maintain it. Otherwise, the project runs the risk of becoming nothing more than an advice-to-farmers program, with considerably less long-term impact and potential sustainability than is currently the case.

Realistically, there are also many other, higher-order and indirect forms of subsidy to the peasant sector implicit in the project and these, too, must be maintained, for as long as possible, through continued USAID or other donor assistance. The cost and level of such assistance may seem burdensome with respect to overall Mission resources at this moment in time, but the actual amounts are, in fact, minuscule in proportion to the problems being effectively addressed.

This is simply to say that the NPA provides numerous services to promote and facilitate, on a national scale, improved and sustainable agricultural production systems for Haitian peasants. These services include technical assistance, extension services, training, applied research, and quality control.

In most countries, developed or underdeveloped, these are subsidized services to the agricultural sector, funded in whole or in part by public resources. In Haiti, where the public sector cynically relinquished its responsibilities vis-a-vis the peasantry long ago, and appears unwilling or unable to fulfill those responsibilities again, the burden of organizing and financing even a minimal support structure for the agrarian producer falls to the international donor community. This is a sad and sometimes discouraging admission, but it has realism to recommend it. Moreover, the alternatives, and their consequences for Haiti's poor, rural majority, are considerably more depressing.

USER FEES: WILL PEASANTS EVER PURCHASE PROJECT SEEDLINGS?

The answer to this question, which has sometimes mistakenly been put at the center of the sustainability issue, remains a qualified "yes." Some peasants, at some time in the future, will likely be willing to purchase some kinds of tree seedlings at some price. More to the point are the following observations, offered in summary form to put this question to rest.

Equity Concerns

Asking peasants to purchase seedlings, even at a nominal or token price, raises serious equity concerns. The poorest segments of the landed population, now able to benefit significantly from fully subsidized seedling distribution, will effectively be driven out of participation in this aspect of the project. In other words, those who need the trees most will be denied access to them.

Regressive Taxation

Expecting peasants to purchase seedlings, essentially because their own government is unwilling or unable to foot the bill, is another form of what can be called regressive taxation in the Haitian context. The rate of public sector extraction of rural wealth, in the form of direct and indirect taxation of the peasantry, increased significantly at about the same period that agricultural production systems went into serious decline. The rate of public sector investment in the peasant agricultural sector has remained at relatively constant, criminally low levels throughout most of Haiti's postrevolutionary period. The pretense that expecting peasants to purchase seedlings for productive use on their own land is just good sense — a way for the peasantry to assume some of the burden for revitalizing their farming systems and productive natural resource base — ignores these simple facts.

The brunt of the burden for virtually all economic and development activity in this country, throughout most of its history, has been borne stoically by the peasantry. The desired transformation and intensification of peasant farming systems, moving towards greater productivity and long-term sustainability, will be an extremely demanding process in terms of labor and management inputs. It can make no sense to any but the most cynical observers to add even marginally more to that burden now, particularly at this critical point in the potential evolution of agrarian productivity.

Seed for Sale

Once on-farm propagation techniques have been developed to a point where their efficiency and scale of application promise outputs comparable to those of the containerized nurseries, it may be reasonable to try to produce seedlings for sale, at an acceptable profit, within the nurseries. At that point all peasants interested in continued, extensive tree planting will face an acceptable pair of options — either purchase or produce the desired commodity.

SPREAD EFFECTS: AGRICULTURAL TREE PLANTING

The NPA will produce and distribute 50 million hardwood seedlings, over a five-year period, to 400,000 peasant farmers across the nation. The AOP has distributed a roughly equivalent number of seedlings to at least 200,000 individual recipients. With a potential target population of 5 million men, women, and children, distributed in approximately 1 million household production units, these figures suggest that the question of spread effects, at least in connection with tree planting, is moot.

With an estimated long-term survival rate of 40 percent overall, AOP and NPA tree outputs will exceed 40 million and will be equivalent to eight trees/person and 40 trees/household throughout the countryside. Moreover, while the outplanting figures here include an estimated 30 percent constant rate of repeat planters, they simultaneously conceal a comparable percentage of seedlings broken out of project-distributed lots and redistributed to unofficial or unregistered planters. Thus, it is not at all unrealistic to assume that, between them, the two projects, spanning a period of only 13 years, will directly reach upwards of 60 percent of all peasant farm units. As will become immediately apparent, however, it is of some considerable interest precisely how that "60 percent" is distributed over the social landscape.

To the extent that on-farm propagation takes off over the next five years, this direct impact is likely to be consolidated by an important spread effect, in which neighbors begin to share seed, volunteer seedlings, and cuttings among themselves. On the other hand, such fundamentally social processes do require an as yet undetermined critical mass of motivated and satisfied participants, concentrated in relatively circumscribed localities. Put simply, the spread effect for agricultural tree-planting behavior is a localized process, and its strength is most likely inversely proportional to the spread, or dispersion, of direct project beneficiaries across the countryside.

Peasant social life, while linked directly to such far-flung locales as Paris, Cayenne, Chicago, Paramaribo, New York, and Miami is, nonetheless, still based primarily on local, face-to-face interactions among relatively small collections of individuals, all of whom are intimately acquainted with each other's daily activities. Under the AOP, where project tree-planting programs have been highly concentrated within such locales and social circles, as in parts of the Northwest, a critical point of what might be called saturation has been achieved.

Here, peasants ask after each other's trees in the same breath as they ask after each other's health, spouses, children, and general fortunes. It is not unusual to overhear two planters discussing the relative merits of particular species distributed by the project, with respect to moisture regimes, or weediness, for example. And here too, of course, spontaneous on-farm propagation attempts, repeat planters, and the redistribution of both project trees and their progeny are, apparently, most common. The social transformation implicated in the project's original — and quite simplistic message of "trees-as-a-crop"

— is here being translated, or reinterpreted, by peasants themselves, as a complex set of practices, potentialities, and first-hand knowledge that is shared daily by those who know each other well.

The NPA, then, should include a new emphasis in its seedling distribution and extension activities that explicitly identifies and targets particular localities for saturation. In this respect, the PADF outreach system, in particular, will be reexamined. PADF's current shotgun, or extensive, approach to seedling distribution can and should be modified to a limited extent and, where the capacities of particular collaborating NGOs make such a modification possible, should achieve a distinctly higher concentration of project participants in specific locales.

SPREAD EFFECTS: SOIL CONSERVATION

The same social dynamic is at work with respect to hedgerows and related biologically based soil conservation technologies: the more concentrated the direct project beneficiaries, the more effective the social demonstration effect and, consequently, the more rapid the spread of innovation to neighbors, friends, and acquaintances. Innovation must be seeded heavily in a multitude of localities to really take root.

It is particularly important to note, however, that the soil conservation technologies to be promoted by the NPA — like those currently being extended by the AOP — are considerably more complex, particularly in terms of management requirements and site-specific appropriateness, than agricultural tree planting. Thus, the stimulation of a potentially runaway spread effect is not necessarily a desirable project outcome. Hedgerow layout and management routines must be tailored to the specificities of soil type, slope, and climate on any particular plot selected for treatment. There are circumstances where hedgerows are either unnecessary or unsuitable, and entirely different conservation or land-use measures are required.

Yet, because hedgerows generally demonstrate positive effects quickly — much more rapidly than trees — as soil build-up occurs on the up-slope behind the hedge, peasant observers have, in general, been extremely impressed. Of the close to 1,000 kilometers of hedgerows already in place as a result of AOP extension efforts, a significant proportion were established by peasants acting on their own, without the benefit of close supervision and site-specific extension recommendations. Some estimates put that proportion as high as 70 percent in certain areas!

The potential failure of particular hedgerows, inappropriately installed or managed, is only evident in the longer run. After several years, for example, whole rows may collapse under the weight of accumulated soil, particularly if the rows have been set too far apart with respect to the degree of slope. Minor breaches in the rows, left unattended, can become serious point sources for gully erosion over time. Similarly, one or two seasons of lax management can lead to a spread effect of a very different kind, with hedgerow species going to seed and literally taking over entire fields. Such future problems and failures will understandably disappoint many who have already installed hedgerows, and surely will discourage others from taking up the technique even where it might be appropriate and could be properly managed.

Peasants cannot be expected to foresee these potential problems on their own. The technology is, after all, being introduced by the project. In sum, that introduction must be as complete as possible, with the disadvantages and limitations of the proposed new techniques receiving at least as much attention

as their potential benefits. Any other approach is irresponsible. Therefore, project promotional efforts for hedgerows and related soil conservation efforts should be tempered by a strong dose of caution. In this connection, it is highly doubtful whether PADF's current animation system for hedgerows is appropriately designed to achieve such a tempered approach. This system rewards animators in direct proportion to linear meters of hedgerows installed, on what is essentially a task or piece-work basis. It is modeled closely after the PADF seedling delivery/extension task system that has worked so well in promoting and monitoring tree planting. Unfortunately, as we have seen, hedgerow-based soil conservation measures may require a very different kind of extension approach — one that is both more careful and more deliberate than that used to push trees.

Finally, both grantees under the NPA will do well to give priority attention to maintaining and elaborating the project's extension relationships with participants who have already established hedgerows under the AOP. This group of potential clients must be served well, and their initial soil conservation/soil amendment efforts corrected, complemented, and upgraded as needed, if the hedgerow component of the project is ever going to be refined to the point that both technicians/extensionists and peasants have sufficient mastery over the new technology to allow for a measured, rational adoption of appropriate techniques by others. Only under these conditions can the spread effect that is already underway, and which promises to gain considerable momentum under the NPA, be controlled and be guaranteed to have a positive impact beyond the direct interventions of the project.

SECTION FIVE

SOCIAL CONSEQUENCE AND BENEFIT INCIDENCE

WHO IS SERVED?: THE BENEFICIARY PROFILE

With an estimated 400,000 direct beneficiaries under its seedling production and distribution program alone, the NPA will obviously serve an unprecedented proportion of the rural population over the next five years. Still, concerns about the beneficiary profile can and should be raised here.

Data gathered in 1985 under the AOP, based on case studies of a 1 percent sample of officially registered tree planters in two consecutive seasons, suggest that there was some systematic skewing in the beneficiary profile. Registered participants in the 1985 outreach programs were slightly older and disposed of relatively greater land resources than nonparticipants. Also, registered participants were predominantly male. On the other hand, there was no apparent skewing of beneficiaries with respect to religious affiliation, contrary to what might have been expected; many of PADF's NGO collaborators are pastoral and missionary organizations, with explicitly sectarian agendas in other domains.

The age, gender, and resource trends in the AOP planter profile were analyzed in some detail in the brief social soundness analysis prepared by this author in 1986, for use in the second project paper amendment (see USAID 1986: Annex A, pp. 1-3.) Several points made in that analysis should be reiterated here:

- Truly landless members of the target population are unavoidably excluded from direct project benefits, as they must be in the majority of agricultural development initiatives aimed at peasant freeholders;

- Land-poor peasants are understandably less likely to be able or willing to innovate, at least initially, than their relatively better-off neighbors;

- The sheer numbers of seedlings distributed per participant, at the time, required a more than minimal size holding to accommodate outplantings;

- The slight age difference between planters and nonplanters was attributed to convergent factors, including (1) land tenure dynamics — the extent and security of holdings co-vary directly with age; (2) relative labor scarcity — older peasants, having gained control over land, while losing effective access to the labor of adult offspring, use project trees extensively as part of a labor-saving management strategy; and (3) relatively longer time horizons — older people, somewhat paradoxically, having reached a point in their own life-cycles where rapid accumulation and expanding production are less important than the obligation to leave behind a minimally viable, landed legacy for their descendants, are somewhat more apt to be attracted to longer-term strategies and improvements to the land resource base itself;

- The overwhelming preponderance of men among official participants could be explained by the underlying dynamics of women's role within agriculture and peasant society in general; and

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- The skewing of the planter profile might well be more apparent than real, since the outplanting of up to 25 percent of project seedlings by unofficial, nonregistered participants, on the basis of informal redistribution networks, was not accurately reflected in the planter profile. These hidden participants, if included, would likely have softened the impression of skewing within that profile. There were strong indications from a limited number of in-depth studies that the hidden participants were drawn from precisely those groups underrepresented among registered planters — the relatively land-poor, the relatively young, and women.

The AOP extension (1987-1989) mandated two significant changes in the outreach programs. These changes were designed to redress whatever skewing remained in the beneficiary profile after the sociocultural and sampling factors noted above had been taken into account. The purpose of the remedial measures was to lower the minimum number of seedlings made available to registered planters and, second, to increase emphasis on the major component of the outreach program — hedgerow establishment and related soil conservation activities.

With smaller lot sizes, unofficial, land-poor, and younger planters might be brought directly into the project, and benefit fully from the extension education or information-transfer component of the outreach program. Hedgerows and related technologies were of interest in this connection for they promised to enhance staple crop production, provide relatively rapid returns, and could be installed and managed effectively on even the smallest plots. Finally, it was suggested, the sharing of boxes among more than one planter — previously discouraged in the interest of insuring the effective monitoring of seedling performance in the field — should certainly be an option left open to participants.

All current indications from the field affirm the 1986 analysis, and the effectiveness of the recommended adjustments to the outreach program in relieving whatever systematic skewing the planter profile revealed. While statistically reliable data are not available, it appears that over the last few years the AOP has indeed served a somewhat wider, less well-endowed, and younger constituency. There are no plans or program changes under the NPA that threaten to reverse that trend. On the contrary, a continuing reduction in seedling lot sizes — down to between 80 and 125 — is projected for several regions. Moreover, the greatly expanded program emphasis on low-cost, biologically based, soil conservation technologies and sustainable agriculture promises positive impacts for any freeholder, regardless of the extent of his or her land resources.

WOMEN IN DEVELOPMENT: THE HIDDEN BENEFICIARIES

The earlier discussion of the peasant household identified three categories of women, according to residence patterns and conjugal status: women in monogamous, co-residential union; women in polygynous union, without fully co-resident spouses; and women out-of-union, living in nonconjugal households.

Additionally, it was noted that the status of household headship, or final authority over household decision making, cross-cuts these categories, so that women in each might be designated *mèt lakou*. For the purposes of this analysis, however, a much simpler parsing of women's status within the production unit will do. Haitian peasant women either have regular access to male agricultural labor, land, and management skills, through a conjugal relationship, or they do not. That is, women are either in- or out-of-union at any given point in time.

The economic utility of union, from a woman's point of view, is this access it affords to male resources. Furthermore, it is precisely the economic utility of union that is of paramount cultural importance to women. This is the feature of union that is marked or highlighted culturally. Finally, while women are quite capable of living without men entirely — and a not insignificant minority choose to do so — most women prefer to participate in a system of conjugality that explicitly makes them, and their children, the primary economic beneficiaries of male agricultural productivity.

The details of that system need not detain us here. The relevant point is that women in-union are the direct and culturally sanctioned beneficiaries of male productivity in the agricultural sector. Men make gardens — with a good deal of labor input from women and children, it might be added — for a woman. Women, in turn, devote the bulk of the produce of such gardens directly to domestic consumption and, through commercialization, to domestic expenditures. The minor exceptions to this general rule, within agriculture, are occasional gardens expressly set aside by men, in advance, to generate cash income for some personal end. These men's gardens confirm, rather than alter, the basic pattern. That a man must specify such plans well ahead of time, to his wife, stands as eloquent testimony to the strength of the underlying obligation.

Beyond agriculture, on the other hand, men with specialized craft or trade skills (*bós*) are notorious for misdirecting cash proceeds from their profession to nondomestic, personal, and nonproductive pursuits. This also indirectly confirms the relatively simple observation that Haitian men explicitly devote their agricultural production to their spouses and households. Those who do not quickly find themselves in that most difficult and embarrassing of statuses for the peasant man — single.

On the other hand, single women — our second distaff category — commonly find their unmated status neither unbearably egregious nor socially suspect. Though they face significant constraints, particularly in terms of access to labor for the performance of some heavy agricultural tasks, they are competent farm managers and, as commercial marketers, have potential alternatives to agriculture.

Generally, then, Haitian peasant women in both categories are relatively well positioned vis-a-vis agriculture, either as primary beneficiaries of male productivity, or as primary producers in their own right. The first category is by far the most common, but both adult female statuses are represented everywhere in the countryside.

For the NPA, the important question is whether there is something intrinsic to the interventions proposed, or the material resources transferred, that systematically works to exclude women as beneficiaries or participants, or impacts negatively on their status within society. Conway's in-depth field research, and the minimal fieldwork conducted in the course of preparing this analysis, suggest that neither of these reservations is well founded. Women everywhere are benefitting, as active and relatively empowered members of their household production units, from project resources and interventions in the peasant agricultural sector. One of the few things that project trees are not being used for, it seems, is as a tool to leverage greater male control over agricultural production within the context of conjugal households.

This observer went so far as to ask some culturally inappropriate and, therefore, amusing questions to explore this possibility. One female respondent gave some typical answers. First, she laughed heartily at the questioner's attempts to determine whether she or her spouse owned the project seedlings they had recently outplanted. They were on his inherited land, yes. They were planted by us, of course — with him digging the holes, and her planting and covering the root plugs, in imitation of the standard gender-based division of labor in sowing any crop. But whose trees were they, after all — who

did they belong to? "Who cares?" came the still laughing reply, "The good they do will be done for me!"

Finally, there are anecdotal indications that single, agriculturally active women are benefiting disproportionately from new production systems based on the availability of project trees. These systems respond well, as we have seen earlier, to the particular constraints faced by these commonly labor-poor producers.

SOCIAL CONSEQUENCES

Throughout its torturous length, this social soundness analysis has alluded directly to the full range of social benefits the NPA will afford the peasantry. These should not need reiteration here. The careful reader will have already grasped the potential significance of the contribution that this proposed activity promises to those Haitians who have always been both most numerous and most neglected within the national polity.

No significant, unintended, negative social consequences can be discerned.

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ANNEX A

A SOCIOCULTURAL APPRAISAL OF CARE'S FARM PROPOSAL

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ANNEX A

A SOCIOCULTURAL APPRAISAL OF CARE'S FARM PROPOSAL

CARE's FARM proposal represents a fundamental reorientation of the substance and methodology of that organization's current activities in the Northwest, under the USAID-sponsored AOP. The rationale for such a reorientation is based on CARE's concerns that the present project is, first, patently unsustainable in technical, administrative, or financial terms; and, second, fails to address key underlying constraints to increased agricultural productivity and enhanced peasant well-being in the region.

Unfortunately, while these concerns are, to some extent, legitimate, the means proposed by CARE to address them are flawed. These flaws are serious enough so that, if implemented as proposed, the FARM proposal threatens to undo much of what has been accomplished by the AOP in the Northwest and, ultimately, to undermine CARE's advantaged position as the region's leading nonsectarian development institution.

The project, planned within a 10-year frame (1990-1999), will require a minimum of $10 million in USAID funding over its first five years of operation. This represents a significant increase over funding levels under the AOP, and comprises fully one-third of the resources USAID/Haiti has reserved for the five-year NPA.

The project strategy includes six distinct components or activity categories, including: training and extension, community organization, agroforestry, soil conservation, "complementary" agricultural practices, and staff development.

This appraisal addresses each component from a sociocultural feasibility perspective.

TRAINING AND EXTENSION

The entire FARM activity is based on an elaborate training program for cohorts of 125 farm agents (FAs) in four successive 30-month training cycles. The training plan comprises both classroom work and field practica, and includes a number of relatively long-term field exercises in the trainees' home communities, with reflective follow-up and structured self-evaluation preprogrammed.

All other components of the project depend upon techniques and information taught to the select groups of trainees, who in turn are expected to transfer these resources to peasant farmers in their own communities, at a rate of approximately one farm agent per 60 farmer participants.

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The selection process for the trainee cohorts is ill defined, but appears to be based on "the community" nominating "a leader" to benefit from the salaried training position for 30 months. Neither of these extremely problematic concepts — community and leader — are discussed in any detail, much less analysed or critically examined with respect to the specificities of the contemporary Haitian context. Past experience, such as the now defunct community council movement or CARE's own AOP animator/monitor system in the Northwest, suggests that consensual community identification of leaders systematically reflects and reinforces existing rural social hierarchies and local inequities in the distribution of wealth and power.

Specifically, the spontaneously "named," or even "elected," "leaders" are drawn predominantly from among the best-off, most influential individuals in the locality. A culturally sensitive analysis of the characteristics of such leaders consistently demonstrates that their influence is most commonly based not on those qualities of moral suasion, commitment, competence, and respect that are desirable in credible leadership trainees, but on the prerogatives, privilege, and patronage traditionally appropriated by local big shots in the Haitian countryside.

At the end of each proposed training cycle, the 125 graduates will be dropped from the CARE payroll, and expected to return to their personal farm enterprises within their communities of origin. Moreover, the proposal suggests, they will continue to perform extension, community organization, and monitoring functions essential for the continued success and sustainability of the project. This scheme, apparently grounded in an altruistic theory of human nature, would be dismissed as naive in most cultural contexts. In Haiti, where a relatively heightened sense of individualism is the cultural norm, and where material circumstances dictate that all personal effort be directed at maintaining declining levels of household consumption and short-term security, it is totally unrealistic.

COMMUNITY ORGANIZATION

The extension activities of the FAs will be targeted to farmer "groups." These groups are ambiguously defined in the proposal, but are putatively based on agricultural exchange-labor gangs known locally as *konbit*. Where such seasonally active, uni-functional groups exist, they will be identified, selected for participation in the project, and strengthened, for ultimate transformation into enduring, corporate, multifunctional units. Where they do not exist, they will be formed, apparently from scratch, by the FAs — presumably quite early on in their 30-month training cycle. The community organization component of the FARM proposal centers on the formation and strengthening of these farmer groups — four per farm agent; their education and inculcation with more appropriate attitudes towards resource management than those CARE seems to feel are now held by Northwest peasants; and their establishment of group-based local nurseries under the stimulation and oversight of the FA/trainee. One group out of four will establish a local nursery.

Scale, Commitment, and Methodology

Group formation or reinforcement (*structuration des groupes*) has long been known to be an extremely difficult proposition in the Haitian rural context. While a small number of proven methodologies exist for this purpose, they require painstaking and careful application by specially trained — some would say gifted — animators. Even in the most supple hands, the group formation process is extremely fragile because of inauspicious exogenous circumstances and events. Moreover, the quite rare

instances of the successful deployment of such methodologies in Haiti have everywhere been linked to certain identifiable characteristics and capacities of the implementing agency. Chief among these are:

- A relatively small scale of operations;
- An unstinting and absolute prioritization of community organization as the preeminent goal, rather than as an intermediate step, or instrumentality, in the development process; and
- An uncompromising commitment to eschew all manner of material resource-transfer activities for an extended initial period, in the service of group maturation and self-reliance.

Finally, localities in which other institutions concurrently apply development strategies fundamentally inconsistent with the group formation process — and especially where such dependency-producing approaches have been, historically, the norm — have proven particularly inhospitable to even the most effective group-formation methodologies.

In light of each of these lessons learned, both CARE and the Northwest would appear to be ill suited to the basic task that the FARM proposal sets itself in the area of community organization.

Political Constraints

Under the best of circumstances, anywhere in the world, the process of group formation among marginal or disenfranchised people is inherently political, grounded in interlocking notions of cooperation, collective action, constraint analysis, autonomy, and empowerment. Under current circumstances in the Northwest, the merest intimation of group formation objectives is nothing short of incendiary. FARM's implicit suggestion that such a strategy can be pursued apolitically is disingenuous, at best.

As is well known, the Catholic Church, through its development/social action agency, CARITAS, has been closely involved in extensive group formation and peasant organization efforts in the Northwest, both prior to and following the 1986 *dechoukaj* of the Duvalier regime. These activities have been suspended in the Jean Rabel area, in the wake of the massacre of hundreds of members of the Church-sponsored peasant movement by opposing local forces with, presumably, strong vested interests to defend.

Nevertheless, there remains, throughout the region, the very real possibility that the church, already ideologically predisposed to hostility vis-a-vis the CARE activity because of its USAID funding, will view its community organization efforts as a direct and intentional encroachment on its turf. Whatever the truth of such a reaction, clearly very little good can come of a project strategy that cannot help but encourage such a misapprehension.

While working with stable training classes of farmers is an efficient approach — and a logical choice in terms of training methodology — the preceding points suggest that attempting to elevate such classes to the status of permanent, polyvalent action groups is both strategically ill-advised and methodologically unfeasible for CARE in the Northwest.

LOCAL NURSERIES

The concept of local nurseries is only poorly elaborated in the proposal. The term is used to refer to a relatively broad array of decentralized, group-based, and individual tree propagation efforts, employing technologies that are appropriate to — and able to be appropriated by — peasant farmers themselves. The hope is that these propagation technologies, being both less complicated and less capital-intensive, will be more sustainable than those now practiced in the AOP's centralized, containerized nurseries. Indeed, the express intention of the FARM proposal is to replace centralized nursery production with alternative tree propagation systems at the community and on-farm levels.

The proposal sketches a typical, group-based local nursery as follows: 15 peasants, organized in a functional group, cooperate to produce 3,000 seedlings per season in plastic sacks, using locally available materials. The seedlings are divided among group members, in shares of 200 per planter, for outplanting on their farms. No payments are involved. This process, presumably, would be duplicated each successive season and sustainability will be achieved.

While the technological and administrative dependence of the centralized nursery system on external resources is inarguable, the expectation that group-based local nurseries will somehow automatically be more sustainable — simply because of the resolution of these technical and administrative dependency issues — runs afoul of certain unavoidable sociological constraints.

At some point — actually quite quickly — the group members' demand for seedlings will be satisfied. Between two and three seasons' worth of production would likely saturate most participants' land with tree seedlings. Once the absorptive capacity of the group is exhausted, what rationale exists for continued production? It is well known that there is essentially no cash market for hardwood seedlings anywhere within the peasant sector.

With no potential clients, the group can hardly be expected to maintain regular production. Whatever motivation, technical skills, and practices have been mastered in the first few seasons of operation are likely to be shelved as the group-based nursery closes down and, after several seasons of dormancy, can reasonably be expected to be lost entirely. Sustainability of this kind comes at a relatively high price — the rapid disappearance of precisely those activities one originally sought to maintain! Inactivity, of course, is sustainable indefinitely.

Socially, the same local nursery concept faces two insurmountable problems. First, the assumption that peasants are generally able to work cooperatively in groups, on a common activity, and focused on a shared resource, is optimistic in light of the evidence at hand. Second, the strong traditional preference for fruit tree, as opposed to hardwood, seedlings, combined with the marginal but nonetheless extant local market for such seedlings, will immediately bias local nursery production heavily towards such species as coffee, cacao, breadnut, grapefruit, and mango.

While there is nothing wrong with such activities, particularly if they complement project interventions, surely CARE is not serious in its suggestion that they should replace the centralized nursery production of millions of hardwood seedlings. Sustaining traditional farmer practices, which clearly predate the project itself — and accomplishing this feat at the price of the most important and innovative aspects of the project activity as designed — seems to pair an ill-chosen objective with an unacceptable means.

AGROFORESTRY

The FARM strategy plans a significant decline in hardwood seedling production and distribution, while requesting a 33 percent increase in CARE's operational budget in the Northwest. Centralized nurseries are to be phased out — closed down precipitously, but one at a time — over the life of the project and, perhaps more importantly, technologically transformed from containerized systems to massive plastic sack operations in the very first season of FARM operations. Indeed, the latter transformation — again, based on unproven technologies — is already underway under the AOP. This strategy is apparently based on the presumed incompatibility of industrial nursery technologies, and the consequent availability of high-quality seedlings in large numbers for area farmers, with CARE's own vision of "sustainable, peasant-led agroforestry in the Northwest."

CARE would do well, in the first instance, to recall that revealing rallying cry of the enlightened, postindustrial Third World: "Appropriate technology is whatever technology works!" In this, of all countries, in which the traditional culture was literally born from — and miraculously nourished — in the fetid womb of the West's first truly industrialized production system, and in which what came to be known as factories in the field consumed slaves with unprecedented rapacity, using the most advanced technologies available at the time, the plea for "appropriate technology" amounts to a great leap backward at a time when the peasantry can ill-afford such high-minded principles. Undeniably, such a strategy does make sustainability somewhat simpler to achieve. As FARM prematurely closes down what is perhaps the single most important activity under the AOP, and replaces it with untried, decentralized, traditional techniques, grounded in nonexistent local social institutions, there will surely be a lot less to worry about maintaining in the future.

SOIL CONSERVATION

This section of the proposal is lucid. A menu of simple techniques applicable alone or in combination to the varied conditions and manifestations of resource degradation across a complex landscape must be made available to interested farmers throughout the region. As CARE rightly suggests, however, appropriate soil conservation techniques require significant extension, communication, and demonstration efforts. Unfortunately, because the proposal's training and extension component will likely have the net result of destroying CARE's already established, effective, and professional extension system in the Northwest, replacing it with 600 disgruntled former employees, both the farmers' interests and the broader environmental goals of the activity are likely to be ill served by FARM.

COMPLEMENTARY AGRICULTURAL PRACTICES

This component includes several distinct activities:

- Information transfer — the introduction of new techniques;
- Provision of basic agricultural inputs — seed and tools — on a revolving credit basis; and

- "Complementary services," in other words, storage facilities and a marketing assistance and information service.

In brief,

- Information transfer goals will be undermined by the imminent collapse of the extension system;

- The provision of inputs on a revolving credit, in-kind basis — whether linked to nascent, ill-formed groups or to individuals — is a logistical and administrative nightmare, particularly in the vast and remote Northwest on the scale proposed by CARE; and

- The services FARM will offer are either redundant — women in Haiti most certainly do not need CARE's expertise in marketing — or not feasible within the broader set of constraints confronting the Northwest peasant. Simple storage, for example, in the absence of an effective, fully capitalized cooperative system able to purchase produce at harvest, resell at higher post-harvest prices, and provide rebates to participants, is of limited utility to the deficit producers who comprise the majority of the Northwest's peasant population.

STAFF DEVELOPMENT

If nothing else, the FARM proposal demonstrates that CARE's staff development needs should certainly be a priority concern. Ironically, it is precisely those proposing to upgrade the skills of an already demonstrably competent and committed national staff who most patently require some measure of retooling in the areas of communication, interpersonal skills development, development planning, administration, and cross-cultural sensitivity.

CONCLUSION: WHAT IS TO BE DONE?

The principles of sustainability and appropriable technologies, the desire to provide peasants with the biological, material, and informational resources they require to confront and to adapt to the precipitous decline in their on-farm productivity, and the understandable commitment to "do more" than "just" plant trees — all are to be applauded. CARE has, in the past, been an innovative leader in pushing USAID's agroforestry activity past its apparent limits, and breaking new ground in precisely these areas. The FARM proposal, however, needs to be rethought, not simply revised. Because the design team and USAID fully share CARE's expressed "first principles" and long-term objectives, there is a good starting point on common ground, and at least a reasonable chance of success for such an effort.

The design team's recommendations include the following:

- The maintenance of the centralized and containerized nursery system, at least until alternative technologies have been fully explored and proven;

- The elimination of all community organization and group formation efforts, and the virtual abandonment of all group-based or group-dependent approaches;

- The reintegration of training into the overall program, at the service of a rationally structured, professional extension program;

- A significant increase in regional autonomy, under the programmatic direction of the regional team leaders, resulting in programs tailored to the specific needs and capacities of each area of operations;

- A phase-out plan for centralized nurseries on a nursery-by-nursery basis; in other words, decreasing production gradually in each facility, in proportion to the success of other hardwood propagation methods, particularly those practiced on-farm by individual producers and their households, where and when the Regional Manager decides such a phase-out is warranted;

- A priority program area focused on soil conservation and fertility enhancement, moving well beyond hedgerow establishment to intensify the productive benefits of integrating effective conservation measures in farm management decision making;

- A pilot activity in improved feeding techniques for goats, working with farmers who are producing grass and forages between their hedgerows; and

- A modest, complementary agricultural program that is based on new, low-input, locally appropriate techniques, designed primarily to enhance the effectiveness of soil conservation measures, but free to explore other options for improvement in the peasant farming system as well.

National Program for Agroforestry in Haiti:

Agroforestry Component

by

LeRoy Duvall
USDA Forest Service
USAID Forestry Support Program

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SECTION ONE

AGROFORESTRY

DEFINITION

Agroforestry can be defined as the association of trees and agricultural crops, on the same parcel of land, either at the same point in time or sequentially. There are numerous land-management or tree-crop associations possible within the scope of agroforestry. Although agroforestry is considered by many to be a new, modern form of appropriate land use recently introduced into the tropics, it was in existence in peasant agricultural systems long before present-day technicians became aware of it or its potential benefits. Agroforestry is a new term for an ancient, but common, form of land management.

Nair (1980) identifies the biological and socioeconomic premises on which the concepts of agroforestry are based:

> The biological premises include all the advantages of the forests on the soil and the environment, such as closed and efficient nutrient cycle, maintenance of organic matter, prevention of run-off and soil erosion, regulation of micro-climate, and above all the adaptability of trees to soils that are incapable of sustaining annual agricultural crops. The socio-economic factors that substantiate the potential value of agroforestry are that the poor farmers in developing countries, existing in an environment of mounting population pressure and lack of resources, are forced to utilize inherently unproductive areas for food production and practice land-management systems that have disastrous consequences, such as deforestation, desertification, degradation of soils, floods, and droughts.

BENEFITS OF AGROFORESTRY

For the peasant farmer, agroforestry offers several potential benefits in the form of more favorable product mixes and yields, as well as environmental considerations. However, the actual impacts will depend on site-specific conditions and the types of interventions that are undertaken.

Risk Reduction

The Haitian farmer follows a risk-reduction strategy in making land-management and agricultural decisions. Part of this strategy includes the practice of planting several different crops on the same or different pieces of land, so that even if some of the crops fail because of climatic or disease problems, at least one of them will produce some sort of harvest. Multipurpose trees planted on a farmer's land should be considered as just one of the crops he plants in the pursuit of reducing risk and increasing diversification.

Increased Productivity Potential

As a long-term investment, trees offer the advantage of being a low-risk undertaking, once they become established and are large enough to escape damage from grazing, or from agricultural activities such as weeding. Depending on the tree species used, the intermediary benefits derived over time can include fodder production for livestock, fruit production for human consumption, and the continuous production of small amounts of fuelwood from branch pruning. At some point, trees planted for agroforestry purposes can be expected to produce usable wood products in the form of charcoal, fuelwood, or construction wood — either for household use, for sale, or to exchange with others. In the case of fruit or forage trees, they should normally not be harvested for wood production until such time as fruit or forage production has diminished to the point where it is no longer sufficient to warrant keeping the tree.

Reduced Soil Erosion and Environmental Degradation

In addition to the tangible products from agroforestry, there are other less tangible, but nonetheless significant benefits that can accrue. Trees can serve to reduce the degree and rate of wind- and water-induced soil erosion by physically protecting the soil's surface. With certain nitrogen-fixing species, the potential exists to increase soil fertility and productivity. Where appropriate for local conditions, the planting of hedgerows along the contour can significantly reduce soil erosion from surface runoff, and increase soil moisture by impeding overland flow and thereby promoting increased water infiltration. These same hedgerows can be managed for the production of forage or the improvement of soil fertility. However, the benefits from hedgerows can only be maximized when they are properly installed and maintained, and used in conjunction with other agricultural and soil management activities.

AGROFORESTRY UNDER THE AGROFORESTRY OUTREACH PROJECT

The array of agroforestry activities undertaken under the Agroforestry Outreach Project (AOP) varies considerably among the different geographic regions of Haiti, as well as between the grantees and their subregions. Part of this diversity results directly from the variety of climatic and environmental conditions. Part is also due to the differing periods of project activity between regions, as well as the differing cultural and social factors.

One of the most common agroforestry practices is the dispersed planting of trees within a garden or agricultural field. Perimeter plantings, used to delimit fields, are also common. Contour planting of hedgerows in fields, most frequently of *Leucaena spp.*, is widely accepted in several parts of the country and frequently undertaken by farmers without any assistance from AOP technicians. The planting of woodlots and widely spaced rows of trees in fields is less common.

Activities that are either rare, or which occur only locally, include the planting of a mixture of species along the hedgerows; the planting of grass bands for forage production; the planting of trees along the grass strips, at fairly wide spacings for combined forage and wood production; and the planting of adjacent hedgerows of woody species and grasses.

Nonagroforestry soil conservation practices encompass mulching with herbaceous or grass materials; preparing gully plugs, using large stakes from tree species that will sprout and form a living barrier; preparation of rock gully plugs; trash lines in fields; and possibly contour agriculture.

Activity Differences

Given the variety of activities that can be seen on the ground, it is important to remember that not all activities are being practiced everywhere, nor can one usually find individual farmers who are practicing more than a couple of the numerous interventions that are possible. Initially, the major efforts under the AOP consisted of simply disseminating seedlings. It is only recently that hedgerows have been actively promoted. However, it should be acknowledged that both grantees are becoming more and more active in promoting a wider variety of agroforestry and soil conservation interventions. Such efforts should continue to be supported under the National Program for Agroforestry (NPA).

It is possible that a major factor in farmer acceptance of interventions offered under the AOP — and to be proposed under the NPA — may be the prior experience of the individual farmer. There is reason to believe that the array of interventions that will be undertaken, either within a region or by an individual participant, will be influenced by prior exposure to project activities. With experience, it appears that individual farmers become more and more willing to work with project staff, once the initial reticence and suspicion are overcome and once they observe that other farmers are benefiting from the project.

SECTION TWO

EVALUATION OF AOP INTERVENTIONS

HAITIAN AGROFORESTRY SYSTEMS

Ashley (1986) describes six Haitian agroforestry systems according to their geometrical configurations and land use. All six systems have been instituted under the AOP, to varying degrees.

- **Intercropping.** Planting multiple crop species in rows, on a common piece of land, with trees included among the crop species.
- **Alley Cropping.** Planting multiple rows of the same woody species across a garden, with agricultural cropping between the rows.
- **Contour Planting.** Planting woody, herbaceous, or other plant materials on the slope along the contour to reduce or prevent erosion.
- **Border Plantings.** Planting usually single rows of trees to delimit land, either by ownership boundaries or by use; to separate fields; to delimit paths; and the like.
- **Interspersed Plantings.** Planting multiple crop species, including trees, which are planted in the field in a nonsystematic fashion.
- **Tree Plantations.** Planting trees closely together, usually for the production of wood as the primary crop.

NEED FOR CONTINUING MANAGEMENT

All of the agroforestry activities promoted under the AOP require at least some level of continuing management on the part of project participants. For some interventions, the management requirements may be rather limited in terms of duration, frequency, and the required effort, with a certain amount of risk if proper management is not practiced. However, the management and risk factors can be considerable for other interventions and species combinations. It is important that the NPA extension and outreach personnel make a concerted effort to explain this to participants, in suitable detail, for each species and intervention that is being promoted. There is reason to believe that this has not necessarily been the case under the AOP.

One of the more obvious risks is that of species selection. If a species is planted on the wrong site, there is the risk of either slow or poor growth. In the case of extreme site mismatching, very high or complete mortality may occur. Perhaps even more serious is the opposite extreme, which is specific to both neem (*Azadirachta indica*) and *Leucaena spp*. Both species can regenerate profusely from seed and can become invasive weeds, if not properly managed.

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There are scattered sites throughout Haiti where either neem or *Leucaena* has completely taken over parcels of land. In some cases, unmanaged woodlots or agricultural fields adjacent to seed-producing trees have been completely taken over by the profuse regeneration. As a result, many of these lands can no longer be used for agriculture or any other purpose, unless a major effort is first undertaken to remove the regeneration.

SPECIFIC AREAS OF INTERVENTION

Forest Plantations or Woodlots

Development of forest plantations or woodlots has not occurred often under the AOP. A common reason given by farmers for not wanting to plant a woodlot is simply a lack of available land; many farmers are forced to keep all available land under cultivation. Although it is frequently possible to intercrop between the young trees in a plantation for the first few seasons after planting, within a couple of years the crowns will develop to the point where shading will prevent further cultivation.

There are farmers who have planted woodlots as a form of improved fallow. The land is taken out of agricultural production for several years while the trees grow, and then returned to agricultural activity after the trees are harvested. These individuals, however, often do not have the same land constraints common to many rural Haitians.

Interspersed Planting and Intercropping

The random planting of individual trees at fairly wide spacings, interspersed among agricultural crops in gardens, is one of the most common types of planting configuration observed in the AOP regions. The trees, widely spaced within the garden, permit the continued cultivation of agricultural crops underneath. As the trees develop, the branches are pruned to reduce shading, while also providing limited amounts of fuel from the cut branch wood.

The major difference between intercropping and interspersed planting is that the trees and crops are planted in rows for intercropping and more or less randomly in interspersed plantings. An advantage that intercropping may offer is the relatively greater ease in finding and protecting the young trees, which are planted systematically along defined rows. This could greatly simplify the task of protecting small seedlings, especially during periods of agricultural activity, such as clearing or weeding.

Border Plantings

Border plantings are another frequent planting configuration for trees in rural areas. Ashley (1986) indicates that border plantings are a traditional component of the Haitian peasant's land-management system and, as such, have been readily accepted as part of AOP activities. Widely spaced, the trees permit continued cultivation, as in interspersed plantings.

Contour Hedgerows and Alley Cropping

The contour planting of hedgerows has been quite popular under the AOP, and is becoming more so with time. By far the most common technique is to lay out the contour, usually with an A-frame, followed by the direct seeding of *Leucaena spp.* directly in the field. In an effort to diversify the species and reduce the risk of disease or insect problems in the future, investigations have begun in the identification of other species that can be used in place of the *leucaena*. Among the possible alternatives are *Albizia lebbek, Calliandra calothrysus, Moringa oleifera*, and *Sesbania spp.*

The preparation and planting of hedgerows is fairly straightforward. An A-frame is used to determine and mark the contour where the hedgerow is to be put, and then a trench is opened. Seed is usually sown along the berm and allowed to sprout. Portions of the hedgerow that do not sprout, or that are not dense enough, are usually resown.

It is important that the hedgerow be established along the contour. A sloping hedgerow diverts water along the row, which increases along the slope, and eventually breaches the hedgerow at some point. This results in a concentration of the erosion where the hedgerow failed, damaging any hedgerows down slope from the breach. Such breaches must be repaired and resown to maintain hedgerow integrity and avoid increased erosion problems.

One of the major difficulties with the AOP hedgerow program has been the lack of proper spacing between hedgerows on the slopes in farmers' fields. The steeper the slope, the closer the spacing between rows should be. The difficulty lies in convincing farmers to plant the rows closer together as the slope increases. The closest hedgerows are often no closer than five to six meters apart, even on the steepest slopes. Farmers do not want to use closer spacings because of the area that would be taken out of agricultural production. Under the research component of the NPA, a concerted effort should be made to try and determine if the soil erosion and fertility benefits from properly spaced hedgerows would more than offset the opportunity costs of the area lost to agricultural production.

Leucaena hedgerows require more periodic maintenance than most other planting configurations. Once the plants become established, they must be periodically cut back, two or three times per year, to ensure that any shade competition with the adjacent crops will be minimized. Even more important, the plants in the hedgerow should be cut back before they set seed, to avoid problems of natural seeding into the adjacent agricultural areas. *Leucaena spp.* can produce viable seed within the first year.

Alley cropping, the planting of woody species in parallel rows with cropping between rows, and without regard to erosion considerations is best suited to moderately level terrain. According to Ashley (1986) alley cropping has been used rarely in Haiti.

SECTION THREE

PRIORITIES FOR AGROFORESTRY, SOIL CONSERVATION, AND HEDGEROW/TREE MANAGEMENT

THE NEED FOR FLEXIBILITY

A key characteristic of the AOP that should be retained under the NPA is to maintain grantee flexibility in the activities and direction of their programs. The grantees should continue to have the latitude to explore new directions and initiatives, if these new activities are undertaken at reduced levels suitable for new and unproven ideas.

DIRECTIONS FOR FUTURE ACTIVITY

Experience has shown that AOP participants have decided, on their own, what they thought were the most effective options or activities for their individual needs. They have used that as the basis to decide how they would use the trees and what technical assistance they might need. There does not appear to be adequate information available to support an attempt to identify priority interventions that should be disseminated before all others under the NPA.

Agroforestry and Soil Conservation

Efforts should continue in the large-scale dissemination of seedlings. Extension staff should continue to disseminate information on the range of interventions that are already known under the AOP, while actively seeking to incorporate any new information that becomes available concerning refinements of technique, or new knowledge on the relative merits or risks associated with specific activities. The extension programs should continue to provide support for individual technical information needs, as requested by the project participants.

To maximize the effectiveness of agroforestry and soil conservation measures, efforts should be made to avoid placing hedgerows or other high-input activities on extremely poor sites. The effectiveness of such efforts, and the returns that can be expected, are minimal at best, while greater benefits may be obtained by concentrating on the better sites. Whenever possible, the worst sites should be dedicated to sustained tree production or grass cover.

It is important that there be a dialogue between project extension personnel and their clientele. This should include the presentation of complete information packages, detailing the potential hazards and the management requirements, as well as the potential benefits, that apply to proposed activities. Project staff would be doing a great disservice to the farmers if only the positive aspects of proposed interventions are presented, leaving either hard experience or word-of-mouth as the only sources of additional information.

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Hedgerow and Tree Management

Farmers for the most part are managing their hedgerows in a manner that satisfies their individual needs. As long as the grantees continue to advise these planters of the management options that can be undertaken, based up on the end results desired by the planter — soil improvement, erosion control, or fodder production — they will have the means to continue making management decisions in an informed manner.

There is concern on the part of the design team that the laissez-faire dissemination and establishment of hedgerows may be a potential pitfall for the NPA. Farmers are planting hedgerows, at excessively wide spacing, on the steepest sites, where the soils have all but disappeared. There is the possibility that they may become overextended and be unable to successfully manage the hedgerows -- at the risk of having the unmanaged areas seed in otherwise productive sites. The grantees and the research unit of the NPA should attempt to carefully examine and evaluate when and where hedgerows should and should not be promoted, before beginning any major initiatives in hedgerow technology dissemination.

There is no reason to believe that the Haitian peasant needs overly detailed information on the more technical aspects of tree management, such as optimal rotation age or similar information. The farmers will probably continue to manage their holdings as they see fit, and rightly so.

However, given that many former participants will begin harvesting the trees that were planted in the past, it would probably be beneficial to provide farmers with simple information on how to better manage their trees for various purposes, and how to maximize their desired benefit. This could include reminding them of simple coppice management techniques, such as not cutting the stump off too close to the ground, and managing the sprouts to favor the development of only the best one or two sprouts, and removing the rest. Simple pruning techniques should also be disseminated, including information on when to prune and how high to prune individual trees, so as to avoid over-pruning which would reduce tree growth.

Seedling Production Options

Extensive efforts have been made to develop and refine the seedling production capacity of the AOP extension/outreach program. These efforts resulted in the high-tech production system that permits an annual seedling production of between 8 to 10 million seedlings per year. This seedling production should continue as a significant component of the NPA. An estimated 200,000 peasant farmers will have received seedlings from the AOP by the end of 1989.

All indications are that the demand for project seedlings far exceeds the current supply. Discussions with peasant informants have indicated that:

- Most people are pleased with the trees that they have received from the project;
- The seedlings produced in the central nurseries are perceived to be of higher quality and to perform better than any seedlings that farmers would be able to produce themselves, even if they had the necessary skills and materials;

- Seedling demand can be expected to continue at past levels, and will probably even increase for the foreseeable future; and

- The seedlings that have been planted in the past are beginning to furnish usable products that are considered to be both useful and economically beneficial.

Discussions with AOP personnel have indicated that:

- Current seedling production does not meet the present demand for seedlings;

- An estimated 30 percent of the participants are repeat planters; and

- The field staff working under the AOP are fully occupied with their current extension and outreach activities.

Improved Nursery Management

While many of the nongovernmental organizations (NGOs) and other participants wish to increase annual seedling production under the NPA, that may not be the best use of project funds, given the present resource constraints. Rather than attempting to significantly increase centralized nursery production, it should be maintained at present levels. Rather than just "pumping out the germplasm," the time has come to focus on improving extension efforts that may result in greater survival of the seedlings that are being outplanted, and that could result in a greater diversification of existing and proposed activities.

It is preferable, then, to produce seedlings that are of the best possible quality, and put greater efforts into increasing survival, through better control of the tree planting and protection processes.

The NGOs that produce seedlings under the guidance of the Pan-American Development Foundation (PADF) have requested that the seedling payment be increased by one to two cents. This is not an unreasonable request; there has not been any price adjustment since 1986 and the cost of seedling production has risen to a level that equals, or even surpasses, the prices paid by PADF. One option to consider would be to offer a variable price increase, based upon the relative quality of the seedlings produced, the nursery's success at meeting its contracted production targets, and the amount of technical supervision and support required from the regional team leader or other team members.

Efficient nurseries that required minimal supervision from PADF technicians and met the contracted seedling numbers would receive ten cents per tree.

Nonperforming nurseries that required repeated, significant guidance from PADF technicians, and that manifested other performance problems would only receive the current eight cents per tree. Chronically deficient, nonperforming nurseries should be dropped from the PADF nursery production system, if they do not respond to technical recommendations concerning performance.

Setting up such a variable rate system for seedling purchase would be difficult, and might create additional administrative problems for PADF. However, it may be one way to improve or coerce improvement in the NGO nursery activities. If seedling production efficiency were improved, it would be beneficial to both PADF and the NGOs. This would cut down on wasted time and effort in the

nurseries, which in turn would reduce their production costs, while reducing the technical support that PADF must provide to nursery activities.

Alternative Production Options

Based upon the field visits undertaken for the preparation of the project identification document (PID) and the project paper (PP), it would appear that the only proven large-scale seedling production technology available and tested under Haitian conditions is that of the large containerized nurseries funded under the AOP.

The main seedling production should continue to come from the centralized nurseries — for the simple reason that these nurseries function well and are relatively cost-effective, given their levels of production. A sudden attempt to change to other types of nurseries or production technologies would risk seriously disrupting the tree distribution system of the NPA. However, this is not to say that the exploration and development of alternative production techniques and materials should not be investigated, and, if possible, developed to provide an additional source of low-cost nursery production.

Efforts to support the development of local or community-level nurseries, which focus on producing small numbers of trees for local needs, should continue on a small scale. The priority sites for these efforts should be those locations that cannot be serviced through the centralized nursery system. It should be remembered, however, that it takes much more time and effort to train the staff and provide the necessary technical and administrative support to set up and run 15 small nurseries, which produce 10,000 seedlings each, than it does to set up one nursery to produce 150,000 seedlings.

In order to promote self-sustainable nursery production, CARE has proposed the development of local nurseries, which would be locally managed and run. Past efforts at developing small-scale, self-sustaining nurseries have usually been considered failures and have been abandoned.

The biggest barrier is probably the difficulty in identification and training of motivated people who will operate a local nursery without continual outside assistance and support. Several other problems also exist. Small, widely scattered nurseries have much greater training and monitoring requirements relative to their limited production levels, people must be trained for each nursery site. Each nursery must receive periodic inspection and technical assistance visits. Each nursery must have access to a reliable water source, which can prove to be limiting when a large number of nurseries are envisioned. More equipment, such as watering cans and shovels, may also be needed.

Alternative Nursery Technologies

Rootrainers and Winstrips

Three methods are used for propagating seed in the nurseries — Rootrainers, Winstrips, and plastic sacks. Both Rootrainer and Winstrip nurseries have greater water requirements than do plastic sack nurseries. They also require a much greater initial investment for material costs. The Rootrainers generally last only three or four seasons, while the Winstrips reportedly last up to 10 years or longer. The Winstrip was originally developed in Haiti, but both containers are now imported — the Winstrip from Taiwan and Korea, and the Rootrainer from Canada. There are significant costs in buying the

special holding racks needed for the Rootrainers, and in the need for periodic maintenance, occasional repair, or replacement.

Both containers promote good lateral root development and "air pruning" solves the problem of excessively long tap root formation: the roots die back when they grow outside of the rooting medium into the surrounding air. Winstrips can be rapidly filled with soil, but their open bottoms make it difficult to transport the filled blocks, lest the potting mix fall out. There is also a problem with the mix dropping out if the soil mixture is allowed to become too dry between waterings. The "book" design of the Rootrainers permits easy inspection of the seedlings' root systems. Some soil loss through the bottom of the Rootrainer is possible, but this is not the problem that it can be with the Winstrip container.

Plastic Sacks

Plastic sack nurseries are being used successfully throughout the developing world. They offer two distinct advantages in areas with poor soils and erratic or limited rainfall. The reactively large amount of potting soil in the sack frequently has a better nutrient status than the soils into which the seedling will be planted. The large soil volume also provides a moist rooting medium that can often maintain the plant for several days or more, if the rains should fail briefly following outplanting. Another advantage of plastic sacks is that they are relatively low cost.

Plastic sack technology, however, does have several important limitations. First, the seedling and accompanying rooting medium contained in the sack can weigh a significant amount, depending on the size of the bag. The relatively small 300 millimeter plastic sacks being tested by the grantees do offer a significant weight advantage over the larger sacks that are commonly used elsewhere. However, according to informants in Des Forges, an individual can carry only 50 small-sack seedlings at a time, compared to 100 to 150 Winstrip or Rootrainer seedlings. This may be a disincentive for someone who would have to return to the nursery to pick up the remaining seedlings — even if the per-person tree distribution is reduced to between 80 and 125 seedlings per person.

In addition to weighing more, these 300 millimeter plastic sacks take up approximately three times the surface area that a seedling raised in a Rootrainer does. This means that in order to maintain a given level of seedling production, a nursery would need at least three times the surface area, three times the amount of potting mixture, and would require significantly more labor than a similar Rootrainer nursery. Consequently, seedling production using plastic sacks is substantially more expensive than the other techniques.

For some tree species, the root system within the sack can begin to spiral and grow around the inside of the sack. This is deleterious to the future development and survival of such seedlings, as the redirected lateral roots will tend to strangle and weaken the seedling, rather than growing outward and securely anchoring the growing tree. Also, if the plastic sack is not removed before planting, the lateral roots will not develop properly, with slower growth and higher mortality resulting. While plastic pots usually have holes punched in the sides and bottom to promote better drainage, those without such holes risk increased disease and other problems because of inadequate drainage.

For many species, as the seedlings in the nursery become larger, the sacks must be moved periodically to avoid having the seedlings' root systems grow through the sack into the soil beneath. The physical displacement breaks any roots that have entered the soil below. If the root system is allowed to develop in the ground below the sack, a significant portion may develop outside of the sack and will

have to be broken, or cut off, before the seedling can be taken from the nursery for outplanting. Under such circumstances, chances of survival are severely reduced.

"Dry" Nurseries

Trials are underway at several CARE nurseries to develop the techniques needed to produce noncontainerized seedlings in nursery beds that would receive little, if any, watering or other cultural treatments. The idea is to sow the seed during the rainy season, allow the seedlings to develop in the nursery bed, and when they have developed sufficiently, outplant them either as bare-root plants or stumps. Given that these plants would not benefit from the systematic watering and fertilizer applications provided in a centralized nursery, their growth can be expected to be slower. As a result, depending on the species, it may be necessary to hold plants over in the nursery for two or more seasons before they would be large enough to outplant.

If this option can be successfully developed, it would offer significant savings in terms of reduced material inputs and minimal labor costs. The problem is that this technology will have to be tested for numerous species, over several planting seasons, to develop it. Nevertheless, this is an idea well worth pursuing.

Bare-root seedlings. These seedlings are noncontainerized plants that are directly sown and grown in a nursery bed. Once the plants are large enough to be outplanted, they are dug up and transported to the site for planting. The bare-root plants, especially their exposed root systems, ar sensitive to drying injury and must be protected from direct exposure to strong sunlight or drying winds. Bare-root plants need regular rainfall immediately after outplanting in order to have acceptable survival rates. A short break in the rains immediately after planting could be disastrous. Bare-root seedling techniques are, as yet, unproven in Haiti.

Stumps. Stumps are bare-root seedlings that have had their tops and lateral roots cut back or cut off before being outplanted. A severally stumped plant may appear to be a bare stem that consists only of approximately 15 cm of stem and 15 cm of root, with no lateral branches or lateral roots. After outplanting, the root system and top will regenerate naturally. Stumps offer the advantage of being fairly easy to transport, not as susceptible to drying damage as bare-root seedlings, and fairly resistant to short dry periods without rain following outplanting. Major disadvantages are, first, that not all species can be stumped; second, some species require that a large stump be used in order to maximize planting success, which may require up to 10 months or more in the nursery before it is ready; and, third, the stumping of plants is an extra step in the training and production processes for the nursery workers. Stump techniques are untried in Haiti, though CARE is conducting trials.

Direct Seeding

Direct seeding is without a doubt the cheapest method of growing trees for those species that can be directly sown. Direct seeding should only be considered for those species for which seed is readily available, because mortality is usually very high. High-value species and species whose seed is neither plentiful nor readily available should be raised using other techniques.

Cuttings

Not all species can be grown from cuttings. For those that can, however, cuttings — clonal propagation — are one way of producing plants. This is especially desirable if one wants to produce plants of the same genotype, as in tree-improvement activities. Large-scale production of cuttings requires that large quantities of parent plant material are available. Because the parent plant is cut back, and must regrow before cuttings can be taken again, large-scale production is often better undertaken using other techniques. At present, it is doubtful that there are adequate quantities of parent material for many of the species used under the AOP.

The Role of Nursery Research

A study being conducted by the SECID/Auburn research team at the Operation Double Harvest (ODH) nursery will provide an indication of the actual differences in terms of growth between the Rootrainer, Winstrip, and plastic sack containers and the Grow-mix, Haiti-mix, and CARE-mix potting soils. The research component of the NPA should work with the grantee nursery technicians to develop the research designs and protocols needed to begin research programs that would permit testing the potential of bare root, stump, cutting, and direct seeding propagation of the major species grown under the AOP.

Question of Sustainability

One of the major questions in terms of viable long-term nursery production in Haiti is that of sustainability. Are there any nursery options or techniques that can be considered sustainable, and that would continue without ongoing inputs from donors? Probably not.

None of the technicians interviewed felt that any of the current nursery programs would continue if outside funding were to stop. Interestingly enough, several farmer informants claimed that they would begin producing their own seedlings if the nurseries serving their respective regions were to close in the future. Several others indicated that some people in selected regions are already directly sowing seed that they themselves collect: *kapab* (*Colubrina arborescens*) and *Leucaena spp.* are two examples. Other people are transplanting seedlings that they find growing in the wild (wildlings).

This is not to say that tree production has become sustainable under the AOP, or will become so in the near future. These are not large-scale activities, but they are encouraging. Interestingly, one woman who claimed to direct sow *kapab* seed insisted that she also wanted seedling production to continue in the nurseries because a wider variety of species was available from the nurseries and they were considered to be strong seedlings. Other informants felt that the seedlings produced in the central nurseries would be in better condition than the peasant farmers could produce themselves, and nursery-produced seedlings were considered to grow faster than seedlings of the same species when transplanted from the wild.

SECTION FOUR

THE RESEARCH COMPONENT

THE ROLE OF RESEARCH

The research component of the NPA is to provide continued support to the grantees. As such, it should remain focused on project-specific, applied research activities. The research program should continue to be formulated in conjunction with, and as a direct response to, the expressed needs of the grantees. The close, collaborative working relationship that is being developed between the SECID/Auburn team and the grantees under the AOP should continue to serve as an example of the kinds of interaction that should be continued under the NPA.

The possibility exists that the research component of the NPA could become sidetracked or misdirected toward other nonproject activities. To avoid this, the grantees must be closely involved in the conceptualization, development, and formalization of the research program, through the use of formal research protocols that clearly define the responsibilities of all participants, the goals of the research, and the research design.

Every effort should be made to avoid the initiation or duplication of activities that could be developed, are already available, or have already been undertaken by other regional organizations. There are numerous agroforestry handbooks, seminars, and training sessions that are already available through organizations such as the University of Florida at Gainesville, the Tropical Agricultural Research and Training Center (CATIE) in Costa Rica, and other established organizations. There is no reason for similar activities to be developed or funded under the NPA.

The applied research program should be focused on NPA needs. The preparation of reports, papers, or seminars for a wider scientific community should not be considered to be project related nor should such activities be supported with project funds or materials.

THE IMPORTANCE OF COLLABORATION

Research priorities and future directions should be established by the grantees, in collaboration with the research unit. A major responsibility of the research unit will be to assist the grantees in identifying possible topics, as well as to provide the grantees with feedback on the feasibility, cost, time requirements, and potential benefits of research topics and proposals. The research unit staff should bring to the attention of the grantees potential research topics that they feel are potentially of high value to the NPA. It is only through active interaction and dialogue that a dynamic and mutually satisfactory research program will continue to function under the NPA.

Whenever possible, there should be active, on-the-ground collaboration between the research unit personnel and the technicians of the grantee staffs. In addition to collaborating on the establishment of formal field trials and demonstration sites, an effort should be made to include periodic, joint field trips to view other grantee-supported activities first hand, including nursery operations, demonstration sites,

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field trails, and the activities undertaken with participating farmers. Such joint field trips, at least two times per year, would also serve to improve communication between the research unit staff and the technicians in the field. If an effort is not made to foster such in-the-field interaction, the research staff could easily become detached from the project activities in the field.

The research unit should be responsible for the hiring, training, and management of their own field technicians. The grantees should not provide people from their own field staff, nor should they fund people, to perform major activities for the research unit. This should not preclude the research unit from hiring grantee field technicians, who are employed on a part-time basis, on a part-time basis. However, the research unit should not hire away grantee field technicians. The two areas in which the grantees should actively participate in research implementation and monitoring are nursery trials, which will eventually have to be done in the centralized nurseries under field conditions, and demonstration site trials.

FUTURE RESEARCH PRIORITIES

There are three technical areas being investigated under the AOP that will merit increased research efforts under the NPA. These are nursery technology, agroforestry interactions, and soil conservation. Work is under way in the AOP to quantify the relative performance of the three containers in use — Rootrainers, Winstrips, and plastic sacks — and also of the three potting mixes — CARE-mix, Haiti-mix, and Gro-mix. The initial studies at the Operation Double Harvest (ODH) nursery should be followed with similar, comparative studies under the less-controlled conditions found int he centralized nurseries operated by CARE and the NGOs. A study to evaluate field performance following outplanting is being considered, but the protocols have not yet been finalized.

There is limited information available concerning appropriate nursery techniques for containerized production of many indigenous Haitian tree species. There is also a dearth of information on techniques for successfully producing indigenous and exotic species through alternative methods. Of particular interest are direct seeding and stump production techniques for Haitian conditions. Such information is absolutely vital before any major initiatives can begin in the areas of alternative production techniques and on-farm tree production. Protocols for these areas have yet to be developed.

Research on agroforestry and soil conservation interventions and their influence on crop production and soil erosion has begun under the AOP. Studies on these topics should continue under the NPA. Major topics of opportunity and interest exist in the areas of tree/crop and hedgerow/crop interactions, and the influence of hedgerows, green manuring, and other soil conservation and fertility-enhancement measures on crop productivity. Grasses and other forage species should be included under the hedgerow activities. While the productivity of the tree component of the agroforestry system is important, greatest emphasis should be placed, at least initially, on impact on agricultural productivity. Such studies may offer a convenient opportunity to look at different tree, hedgerow, and soil management regimes as well.

RESEARCH UNIT COMPOSITION

Funding constraints dictate that the size of the research unit staff be reduced. Continued research activity in the areas outlined above would require the services of a nursery specialist, an agroforester, and a tropical agronomist, as well as administrative support and up to 10 field research assistants.

Creative funding of research grants to university students may be one way to supplement the research team in a cost-effective manner. Haitian students are required to prepare a thesis as part of their educational program. Funding for students with appropriate technical backgrounds could be a low-cost, but effective, way to undertake numerous practical research topics. It would be preferable to provide such support to Haitian students, whether studying in Haiti or in the United States, to permit them to investigate a topic that would be both beneficial and relevant to Haiti. However, non-Haitian students could also be supported through such a mechanism.

If detailed research designs and protocols for the nursery studies could be developed during the 10 months remaining in the AOP, it might be possible to either eliminate the nursery specialist position completely, or reduce it to an activity that could be completed through regular short-term technical assistance. Once the research design and protocols have been finalized, it may be possible to incorporate many of the nursery studies directly into the existing nursery production program. The agroforestry and agronomist positions should continue to be funded full time.

LINKING RESEARCH TO EXTENSION

A key assumption justifying the continuation of a research component under the NPA is that there will be a linkage with the programs of grantees and their extension activities. Close and frequent interaction, collaboration, and information exchange between the respective technical and administrative personnel will be important for fostering such linkages. The only way that information exchange will come about is if the reports and documentation developed by the research unit are translated into either French or Creole. Failure to do so significantly limits the value of the information produced by the research unit. One way to develop such collaboration is to ensure that the research component continues to focus on applied research topics of interest and potential value to the grantees. The Research Steering Committee that was established under the AOP should continue to function under the NPA and should be used as a sounding board for the identification of research priorities and activities.

The cooperative agreements (CAs) and contracts that will be issued under the NPA should stipulate that there continue to be active participation at the monthly Research Steering Committee meetings by the grantee research and administrative staffs, the research team members, the germplasm improvement staff, and the USAID Project Officer. With the abolishment of the Technical Coordinating Unit (TCU), the Research Steering Committee and monthly AOP Management Committee meetings will serve as important links between the USAID Project Officer and the activities in the field. The position of research committee chair should continue to be a rotating position, as it is under the AOP. In order to facilitate information exchange, every effort should be made to welcome and promote the participation of interested technicians and administrative personnel from other agricultural and agroforestry projects.

The direct involvement of the grantees in the identification, initiation, and development of research priorities and programs should continue under the NPA. Only by providing such direction to

the research team can the grantees ensure that future research continues to be applicable to their program needs. The continued use of formalized research protocols that clearly stipulate the activities to be undertaken, the responsibilities of the grantees and the researchers, and the expected outputs will also facilitate such efforts. No NPA funds should be used for any activities that have not been formalized and agreed to in advance through the preparation of a research protocol.

It is important that the grantees attempt to incorporate new information and technologies into their extension programs, as it becomes available. This can only occur if there is active interaction between the researchers and the grantees, and if there is a strong commitment on the part of the grantees to ensure that program development and in-house training continue to incorporate the findings of the research unit, where appropriate.

SECTION FIVE

POTENTIAL ENVIRONMENTAL IMPACTS

The NPA will actively seek to bring about changes in land use patterns, improve upon traditional agricultural activities and practices, and increase the amount of perennial vegetative cover in the project area. Thus, the NPA is expected to have numerous environmental impacts, both positive and negative. The extent and severity of such impacts will be determined largely by the level of project participation by Haitian farmers, and therefore are neither readily qualifiable nor quantifiable.

The majority of anticipated impacts will have a positive influence on the environment. This is because many project activities will be aimed at changing farmers' access to information and resources, and thereby their land use and land-management practices. It is anticipated that the efforts planned under the NPA to improve upon and intensify the interventions begun under the AOP will result in significant beneficial impacts, especially when compared with the potential environmental impacts if there were no further activities after the AOP.

REDUCED SOIL EROSION

One major anticipated impact under the NPA will be a reduction in soil erosion. This will come about in part because of an increase in the amount of perennial vegetative cover in rural Haiti, resulting from the continued production and distribution of trees, shrubs, and grasses. Erosion will be further reduced as a result of the greater emphasis to be placed on the dissemination of information on improved agricultural and soil conservation practices for peasant landholdings.

The actual impact on soil erosion rates will largely depend on the level of participation by farmers, as well as the planting configurations and types of soil conservation measures that the participants actually accept. The success of these efforts will depend on a highly motivated, well-trained network of field-level extension personnel.

Individual trees planted at wide spacings will offer minimal benefits in terms of reducing soil erosion. Such trees, nonetheless, will have some beneficial, if limited, effects. The greatest erosion reduction benefits, especially on the more marginal sites and steeper slopes, can only be brought about through the establishment of either complete grass cover or tree plantations.

The establishment of hedgerows was a significant component under the AOP, and is expected to continue under the NPA. Properly installed and maintained hedgerows can have significant impacts on erosion reduction. However, if not properly installed or maintained, hedgerows can be expected to have only minimal, short-term influences on erosion reduction.

REDUCED WOOD CUTTING AND GRAZING PRESSURE

The pressure on Haiti's remaining, but rapidly diminishing, natural vegetation resources will be reduced as a result of the NPA activities. The 50 million seedlings and the estimated 1,000 km of hedgerows anticipated under the NPA will provide a readily available, alternative source for many of the materials that would otherwise have to come from the dwindling, natural vegetation that remains in the form of fuel, construction materials, and forage or fodder. The efforts of the extension and conservation education programs will also serve to increase the awareness on the part of the rural population, both children and adults, of the value of this rapidly diminishing resource.

ENHANCED SOIL PRODUCTIVITY

In addition to the benefits of reduced soil erosion, the establishment of trees, shrubs, and other perennial species can increase soil productivity through the recycling of nutrients, fixation of nitrogen, increased absorption of precipitation by the soil, and increase in organic matter. These effects, which are described in detail in most basic agricultural handbooks and manuals, can be greatly influenced by the other soil and water management techniques that are practiced by individual farmers and landowners.

QUALITY OF LIFE

While difficult to quantify, the planting of trees around a home can result in an improvement in the quality of life for the inhabitants. Fruit trees provide nourishment. Most tree species can bring about localized favorable microclimatic changes, in the form of increased shade, cooler temperatures, and other similar, but difficult to quantify, local influences.

PESTICIDES

Potentially the most significant negative impacts could result from the use of pesticides in the nurseries for the control of diseases and pests. Any potential impacts will be minimized by ensuring that, first, only EPA-approved pesticides will be used, and then only if necessary; second, pesticides will only be made available as necessary and in limited quantities; third, any pesticide usage will only be done in an approved manner, while observing proper safety precautions; and, finally, access to pesticides will be restricted to only those project personnel and nursery staff who have received in-depth training in pesticide usage and storage.

SHORT-TERM INCREASES IN EROSION

The planting and maintenance of tree seedlings and shrubs can result in slight, short-term, localized increases in soil erosion. This is because of the necessity to clear existing vegetation from the planting site, dig a hole for the plant, and do periodic subsequent weeding until the plant becomes

established and can successfully compete with the natural vegetational. Because the disturbed area for each tree is very limited, and because most seedlings to be planted under the NPA are expected to be planted on agricultural lands that are already subject to periodic clearing and weeding, any deleterious erosion influences are considered to be insignificant.

CHANGING THE GENE POOL — EXOTIC SPECIES

Under the AOP, over 100 different species of exotic trees have been grown and tested to determine their growth potential under Haitian conditions. It is likely that other new and untried exotic species of trees, shrubs, and grasses will be introduced under the NPA, to be tested for their performance potential.

Whenever exotic species are introduced into a new environment, there is always the risk that they may be better adapted to local conditions than the indigenous species. If there are no local predators or diseases to keep the introduced species in check, there is the possibility that the introduced species may escape and become a noxious, difficult-to-control pest. Both neem (*Azadirachta indica*) and *Leucaena spp.* are examples of tree species which, after being introduced into Haiti, have become localized weed problems in some areas.

Whenever introducing new species, the risk of such problems developing can be reduced by limiting the initial introduction to small number of plants that are grown under controlled conditions. The species and provenance trials undertaken by the seed and germplasm improvement component of the NPA offer the necessary controlled conditions, where the initial performance of new introductions can be observed and assessed, before being distributed to the general population.

CONTINUED EXPLOITATION OF MARGINAL SITES

Many farmers are cultivating submarginal, fragile lands that, under situations of less land pressure, would not be used for agriculture. These marginal sites, mainly areas of shallow, highly erosive soils on steep slopes, are not suitable for sustained agriculture. With the continued cropping of such sites, erosion will continue at a high rate and agricultural productivity will continue to decline. Eventually the land will no longer be able to produce a crop, at which point it is usually abandoned.

It is likely that some farmers will attempt to establish hedgerows or other agroforestry interventions on such unsuitable sites, in the hope of being able to continue to crop between the hedgerows, rather than putting the land into fallow or instituting other more appropriate management strategies. Farmers would be likely to continue cropping the marginal sites, regardless of whether hedgerows were or were not established. Thus, the continuing degradation of such sites can be expected to occur, whether or not agroforestry interventions are tried. Farmers who continue to cultivate these marginal sites will eventually lose these lands as well, but it is hoped that the rate of degradation, while not stopped, may be reduced, thereby giving the farmer more time to develop alternative production strategies.

Ideally, such sites would be taken out of agricultural production and be dedicated to either forestry activities or to grass for managed range and forage purposes — according to modern land-

management tenets. The realities of life for the Haitian farmer, together with the lack of alterative land resources, do not permit such luxuries under prevailing conditions. The best that can be hoped for is to improve the use and management of the better sites, and in that way eventually reduce the pressure on the poorer sites.

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National Program for Agroforestry in Haiti:

Environmental Assessment

by

James Talbot
Environmental Resources Management

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SECTION ONE

SUMMARY AND RECOMMENDATIONS

The U.S. Agency for International Development Mission to Haiti will redesign the Agroforestry Outreach Project (number 521-0122) and refinance it as the National Program for Agroforestry (NPA). Building on the success of the eight-year-old AOP and incorporating new initiatives aimed at soil conservation, environmental education, applied research, and conservation of indigenous tree species of economic value, the NPA will be a five-year, $30-million project affecting 400,000 farmers and 21,000 school-age children.

This environmental assessment (EA) has examined the five key components of the NPA: nursery production, seed and germplasm improvement, applied research and technology generation, extension, and training. Positive environmental benefits will accrue from the technical interventions proposed to improve soil fertility and to reduce soil erosion. Few, if any, negative or adverse effects are predicted.

The role of research will be to focus on farm practices that employ appropriately effective types of vegetative barriers and productive new systems of alley cropping on steep hillsides, which comprise over 70 percent of Haiti's farmlands. A pilot program in environmental education in three rural regions of the country will teach primary school students between the ages of 10 and 18 the value of trees in farming systems, the general ecology of Haiti, and the problems of soil erosion and its causes and cures, as well as practical skills such as fruit tree propagation in school-run nurseries and ways to manage trees on the students' family farms.

The seed and germplasm improvement component will address several basic problems, such as: (1) matching appropriate species/varieties with peculiar ecological site conditions; (2) replenishing the supply of seed for indigenous tree species of potential economic value, many of which have been eliminated from native habitats throughout Haiti because of widespread deforestation; and (3) preserving at least one (and maybe more, if additional species can be identified) species of the economically important and biological endangered species of neotropical oil palm, *Attalea crassispatha.*

Also, a comprehensive analysis of pesticides proposed for use in the centralized, high-volume production, seedling nurseries was prepared in accordance with A.I.D. Regulation 16 and the Agency's *Policy on Pesticide Use.* A number of general use pesticides are recommended for procurement and use under the NPA.

Based on the extensive review of project activities conducted during this EA, the following recommendations are made:

- **Pesticides.** Only pesticides included in the list in Table 1 of the EA will be permitted for use or procurement with project funds. These pesticides are recommended as relatively safe, if used according to label instructions and under proper supervision, and in conjunction with the proposed training and Integrated Pest Management (IPM) practices already begun under the AOP.

- **Applied research.** Applied research on tree species-site relationships and appropriate soil conservation practices will be a critical link toward successful protection of soil resources on

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TABLE 1

TECHNICAL INFORMATION OF PESTICIDES PROPOSED FOR USE ON AGROFORESTRY PROJECT

Common Name	Commercial Name	Chemical Type	Proposed Use	USEPA Registration	Signal Word	Toxicity WHO	Class EPA	Oral	Dermal
Acephate	Orthene	OP	I	G	Caution	II	III	945	2,000
Bacillus Thuringiensus	Dipel	Biological Control	I	G	Caution	--	IV	nil	nil
Benomyl	Benlate	TC	F	G	Caution	III (Tables)	IV	>10,000	>10,000
Captan	--	Dicarboxi-mide	F	G (RPAR)	Caution	III (Tables)	IV	9,000	--
Carbaryl	Sevin	C	I	G	Caution	II	III	500	>2,000
Chlorotha-lonil	Bravo	--	F	G	Warning	III	II	10,000	10,000
Delta-methrin	Decis	Py	I	G	--	III (Tables)	II	128.5 (oily solvent) >5,000 aqueous suspension	>2,000
Diazinon	--	OP	I/M	G	Caution	II	III	300-400	3,600
Malathion	--	OP	I	G	Caution	III	III	1,375	4,100
Mancozeb	Dithane M-45	TC	F	G (RPAR)	Caution	III (Tables)	III	11,200	>15,000
Maneb+	Peltar		F	G	Caution	--		669	>3,100
Metalaxyl	Ridomil		F	G (RPAR)	Warning	III	II	nil	nil
Soaps	Safer's Insecticide Soap	--	I	G	--	--	--	nil	nil
Trichlorfon Methylthiophanate	Dipterex	OP	II	G	Warning	III	II	150-400	>500

F - Fungicide
G - General Use
I - Insecticide
M - Miticide
OP - Organophosphate
Py - Pyrethroid
RPAR - Rebuttable Presumption Against Registration
TC - Thiocarbamate

Trade names are provided for convenience and indicate the name under which the product is available in Haiti; they do not imply an endorsement of a particular commercial product.

steeplands. CARE and Pan-American Development Foundation (PADF) project staff should make every effort possible to develop practical applied research tasks with the research unit of the NPA and quickly translate these results into their extension/outreach programs. Monitoring of the implementation of soil conservation measures on private farmlands should be programmed to determine the effectiveness of extension/outreach based on the results of this research. The mid-project evaluation, planned for the NPA, could further review the effectiveness of these practices;

- **Environmental Education.** This pilot program, discussed in Section Six, should be implemented during years 1, 2, and 3, then evaluated for effectiveness, including content of messages and impact on target groups. Any redesign should be made during year 4 of this program; and

- **Seed and Germplasm.** Elements of a seed and germplasm improvement component will have significant impact on the quality and quantity of germplasm outplanted in the NPA. It is critical to facilitate the continuation of the effort now in progress by the International Resources Group (IRG) under the AOP, without undue interruption. The timing of the nursery production activities planned by CARE and PADF are dependent on the success of the establishment of the seedling seed orchards now underway in five regions, as well as the production of viable seed for known species provenances throughout Haiti. The germplasm component should be fully funded and priority given to rapid procurement to ensure the smooth transition from the AOP to the NPA, without work stoppage.

SECTION TWO

PROJECT DESCRIPTION

PURPOSE, GOALS, EXPECTED ACCOMPLISHMENTS

The goal of the NPA is to maximize the productive potential of Haitian hillside agricultural land and to reduce the ongoing degradation of the country's natural resource base. The purpose is to achieve sustainable increases in on-farm productivity and farmer income by introducing soil-conserving and fertility-enhancing perennial crops and cropping patterns into traditional Haitian peasant farming systems, in a variety of locally appropriate agroforestry systems. The project will build upon the successes of the soon-to-be-completed AOP, project number 521-0122, by continuing to institutionalize farmer interest in the pursuit of appropriate land use practices, plant materials, and extension services begun through the AOP.

The specific objectives include:

- Generation and dissemination of technologies for agroforestry and agro-silvi-pastoral systems;
- Provision of necessary inputs such as improved seed and germplasm;
- Amelioration of soil microenvironments, which are experiencing fertility and erosion problems, through agroforestry practices;
- Production of wood products to meet national demand and household needs;
- Institutional strengthening of local nongovernmental organizations (NGOs) to implement agroforestry outreach activities in their respective geographic areas of influence; and
- Consciousness raising for all Haitian citizens about the deterioration of the rural physical environment through appropriate environmental education programs.

These objectives will be accomplished by the implementation of five key components: nursery production, seed and germplasm improvement, applied research and technology generation, extension, and training. These are described in detail in the project paper (PP).

AFFECTED ENVIRONMENT

An excellent and comprehensive description of Haiti's environment is provided in the *Haiti Country Environmental Profile* (Ehrlich et al. 1987). The material that follows briefly summarizes the affected environment in which project activities will occur. Ecologically, a high degree of environmental deterioration is evident throughout Haiti. Vegetation, soil, and water resources are more degraded now than they were prior to European settlement, and even more so than just one generation ago! Topography, climate, and historical factors, both natural and anthropogenic, have contributed to the

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observed malaise. Increasing population pressures and an absence of institutional and political leadership to address environmental problems have also influenced this situation.

The proposed project will undertake selected interventions to reverse trends in resource degradation on a limited scale by working with individual farmers on their private lands. Thus, the affected environment can best be described as the farm microenvironment and, to a limited extent, small catchment areas, as more and more farmers participate in the agroforestry practices proposed.

Geography, Physiography, and Climate

Haiti is located in the Caribbean on the western third of the island of Hispaniola in the Low Subtropical Region (18-20 degrees north latitude), which is free from frost at low elevations above sea level and in which the temperature range is significantly wider than that in the deep tropics. The highly varied topography, with elevations ranging from sea level to over 2,680 meters, results in a large variability in rainfall and temperatures with a wide range of microclimates. Although most precipitation is brought by the northeast trade winds, site-specific rainfall patterns are influenced by orographic (that is, related to topography) factors. Because most of the rainfall trends from the northeast and because high mountains intercept this precipitation, the highest rainfall areas are in the mountains of the north coast and Southwest peninsula.

Rain shadow effects are evident throughout the country where valuable moisture is intercepted by north-facing slopes, leaving little for slopes facing south. Most of the country, however, receives at least 1,000 millimeters of precipitation annually, and a substantial portion receives at least 1,500 millimeters. Hargreaves and Samani's (1983) manual on rainfed agriculture in Haiti indicates that much of the country has a climate suitable for production of most cash and subsistence crops, given suitable soils and topography, and appropriate farm management practices.

The proposed project will attempt to improve the local soil and microclimatic conditions of certain farmlands by introducing vegetative practices designed to reduce the deleterious effects of wind and erosion on landscapes. Tree planting and hedgerow schemes will form the basis of the interventions aimed at such improvements.

Soils and the Land

About 22,000 square kilometers of Haiti are in steep slopes or highlands. The rest are in slopes of less than 8 percent grade and constitute the major plains of Haiti. Most of the highlands receive adequate rainfall for cropping. With regard to suitability for agriculture, 86 percent of the soils are thin and fragile and the remaining 14 percent are deep. Many of the limestone-derived soils have high natural fertility, as long as they are not mismanaged. About 70 percent of the arable land is on steep slopes. The national average for tropical America is somewhere around 25 percent.

High erosion hazard is common for soils on these steep slopes, although no soil loss data have ever been systematically collected by field measurements in Haiti. Ehrlich et al. (1987) estimated that about 7.4 percent of the country has good lands suitable for crop production with few restrictions, taking into account land/soil class, erosion characteristics, and crop agroecological zones and their suitability for particular kinds of agriculture. Unfortunately, none of these good lands are found in the mountains or on the steep slopes where most of the peasantry is obliged to make a living. The people living in the

Cayes Plain, the Artibonite Valley, the Plain of Leogane, and the Cul-de-Sac are blessed with the highest percentage of good lands. The Northwest of Haiti, where CARE operates, has the lowest percentage of good lands, even without considering the region's highly variable rainfall regime. Even so, mismanagement of soils because of erosion and loss of fertility results in the abandonment of nearly 6,000 hectares of arable land each year.

The proposed agroforestry project will attack the problem of soil degradation on mostly steep-sloped lands in selected regions of the country.

Water

Although Haiti has many rivers, the majority have little or no water during the dry season. Thus, surface water availability is limited on a site-by-site basis. Few storage facilities for water exist, with the exception of special catchment basins erected by enlightened communities or for hydroelectric power, such as the impoundment creating Peligre Lake. All water for irrigation and domestic consumption must be provided by direct diversion of streams or by tapping groundwater at springs. Groundwater occurs in bedrock aquifers in the highlands and mountains and in alluvial sand and gravel aquifers of unconsolidated deposits in the plains. Groundwater is abundant and accessible in the coastal plains, with rates of 10 to 120 liters/second reported. Irrigation potential of the flatter areas is obviously greater than for the steeper slopes, leaving the farmers on hillsides with thin soils and inadequate water reserves.

Improvements are needed in the water retention capacity of the country's major watersheds. The proposed project will undertake more integrated agroforestry approaches that will apply techniques to conserve and retain rainfall that falls on steeplands.

Vegetation

Forest area declined 59 percent between 1956 and 1977, at an annual rate of 7 percent. This was one of the highest rates in the tropical world. According to Pierce (1988), nondegraded dense forest cover constitutes less than 1.5 percent of the land area of Haiti. The demand for cultivable land and fuelwood is at the heart of the problem.

Reforestation efforts at their present level will not provide enough trees to meet fuelwood demand in the near future. Conservative estimates are that for every tree planted or regenerated, three to eight are cut or burned.

But the concern is not only for loss of wood resources. The systematic degradation of forests and landscapes has resulted in the loss of the requisite diversity of genetic resources to allow the landscapes to recover and people to make a living. Tree and shrub species that were prevalent in Haiti only a generation ago have been wiped out in many regions. Tree species such as the caimite (*Chrysophyllum caimito*) and mammey apple (*Mammea americana*) and even Haitian oak (*Catalpa longissima*), which contributed to the productive basis of peasant society, are no longer part of the farmer's repertoire of risk-aversion tactics designed to provide nutrition or a cash crop, when other sources of revenue fail. The loss of germplasm is as real as the loss of soil from the Haitian landscape.

The proposed project will continue to introduce exotic species, such as multipurpose trees and forage species, which have potential for adaptation to the relatively harsh conditions of the NPA

environment. At the same time, the project will undertake the identification and mapping of superior individuals of indigenous species, and the collection and propagation of genetic material through a number of seedling seed orchards scattered around the country.

TARGET BENEFICIARIES

The project beneficiaries are mostly the rural poor who farm the steeplands where agroforestry outreach is practical. The social soundness analysis, which is part of this set of papers on the NPA, amply describes these people. A subset of beneficiaries will be the Haitian NGO staff who learn the techniques of nursery tree production and vegetative propagation, who receive training in agricultural extension, and who apply practices to reduce soil erosion, improve moisture retention and soil fertility, and increase production of animal forage. Many will learn the husbandry value of seed and seedling germplasm and will pass on the knowledge of selection of superior mother trees to their friends, relatives, and neighbors.

The measurement of these benefits is problematic. At the same time, the knowledge that this process of agroforestry outreach has touched, since 1982, 200,000 Haitian farmers and many hundreds of animators, monitors, agronomes,and technicians, some of whom have benefitted by exposure to project technology, is impressive. Under the proposed project, there is no reason to doubt that continued provision of agroforestry resources will directly benefit a broader, more representative cross-section of the rural population than ever before.

RELATIONSHIP OF THE NPA PROJECT TO OTHER ENVIRONMENTAL ACTIVITIES IN HAITI

USAID/Haiti is implementing three other projects in the natural resources sector: Local Resources Development I (LRD I) at Maissade in the Central Plateau region; Local Resources Development II (LRD II) at Leger, near Arachaie; and the Targeted Watershed Management Project (TWMP) in the watersheds in and around Les Cayes.

LRD I is aimed at reducing environmental degradation on hillsides of a local commune. It employs some of the nursery technology learned through the AOP, but focuses on participatory approaches to soil conservation and technology transfer. This project is viewed by many as one of the most successful natural resource projects as a result of, first, its ability to motivate farmers to implement soil conservation and protection based on land capability; and, second, its establishment of a comprehensive demonstration site, illustrating many of the farm practices employed by local farmers. In LRD II, the component dealing with local tree production nurseries has borrowed technology elements from the AOP. The project provides nursery materials, seed and germplasm, and training, but relies on local labor and use of private farmlands to implement soil conservation and tree planting. Unless additional funding is found, both will end during 1989.

TWMP was designed to address the broader issue of watershed management by focusing on several major catchment basins in the Southern peninsula and encompasses a project area of 80,000 hectares. Certain technical interventions aimed at improving soil fertility, reducing soil erosion, and testing new germplasm, such as forage grasses and multipurpose shrubs, have particular relevance to the

proposed agroforestry project. Although TWMP is only one and one-half years into implementation, some of the lessons learned could be of use to the technical staff of the proposed project:

- Alternative cultivation practices such as minimum tillage and contour furrowing;
- Diversified and intensified home gardening; and
- Establishment and management of hedgerows and strip crops on the contour, using trees, grasses and shrubs.

Through PADF, the AOP maintains direct linkages with several of the NGOs involved with TWMP. There is the potential for regular exchange of information via this linkage and by periodic technical seminars that PADF, TWMP, and other NGO personnel attend.

Another major accomplishment of USAID in the sector was the establishment of the Technical Secretariat for Watershed Management (STAB-French acronym) funded with PL 480 monies. Although work only continued through September 1988, STAB was able to establish itself as a workable institution with sufficient support and recognition to function effectively (Pierce 1988). It successfully implemented four activities:

- **Project monitoring.** An inventory of all ongoing watershed projects was completed;
- **Project evaluation.** Several key donor projects were analyzed to determine how to combat the problems of soil erosion more effectively and how to assist in technology transfer beyond the target population;
- **Database development and information exchange.** Results of the project inventory were entered into a computerized database to aid in providing documentation to interested parties; and
- **Conflict resolution and policy development.** Through a Committee of Reflection, established with the participation of private and public sector members, issues such as Food-for-Work and other sensitive policy matters were discussed in an open forum. PADF's director sat on this committee, as did other NGOs involved with the AOP, providing a direct avenue for dialogue with the government on matters of agroforestry.

Although A.I.D. is the major donor in the realm of agroforestry and natural resources, other countries and NGOs are addressing the problems of environmental degradation on a similar, but more limited, basis. France, through its Fonds d'Aide et de Cooperation (FAC), supported two watershed management projects in the area of Jacmel. The Food and Agriculture Organization (FAO) established and maintains an excellent training center for watershed management at Limbé, near Cap Haitien. The proposed NPA will use these facilities to conduct some of its extension agent training. Also, the World Bank, the Inter-American Development Bank, the Canadian International Development Agency, and some European countries are spending more and more resources on natural resource management projects in Haiti.

Perhaps the major AOP contribution to other donors has been their acceptance of the model of a modern tree production nursery and the inculcation of the principle that, to plant trees successful it is necessary to work on private farmlands. USAID has reached 170 NGOs in most regions of the country

with a model concept of agroforestry. Many other donors have embraced elements of the tree production and extension system in their own programs. Information gained from the AOP has been shared in various ways with other donors through the NGO network, resulting in technology transfer and consciousness raising about the benefits of tree planting.

SECTION THREE

SCOPE AND PURPOSE OF THE ENVIRONMENTAL ASSESSMENT

PURPOSE OF THE EA

The purpose of this EA is to provide USAID with a full discussion of the positive and negative impacts of the NPA project activities on the natural and human environment. The EA is prepared in accordance with 22 CFR Part 216, Environmental Procedures, or A.I.D. Regulation 16. Environmental assessment deals with the identification, measurement, interpretation, and communication of impacts. It is conducted to ensure that environmental factors and values are factored into the A.I.D. decision-making process. Due consideration has also been given to A.I.D.'s recent *Policy Paper on Environment and Natural Resources* (April 1988) in the review of the NPA.

Several approaches were taken to arrive at the analysis which follows. A scoping of issues was conducted by review of project documents such as the project identification document or PID (October 1988), by interviewing key staff who are implementing the existing AOP and who are likely to be involved with the proposed project, by discussion with members of the PP Design Team, and by direct observation. The consultant has also drawn on his extensive knowledge of Haiti gained from over four and one-half years of direct field experience, which has included participation on the End-of-Project Evaluation Team for a review of the existing AOP in 1985 and preparation of the *Haiti Country Environmental Profile*. Extensive field visits to AOP project sites were not possible during this 24-day consultancy. A short review of activities scheduled for the seed and germplasm component was undertaken by a one-day field visit with the Chief of Party responsible for these tasks.

SCOPING OF ISSUES

The key issues identified during the scoping exercise include the following:

- Use of pesticides in high-production, containerized seedling nurseries;
- Allocation of agroforestry research inputs so that meaningful, practical results are obtained; and, how to monitor, track, and disseminate useful results throughout the life of project (LOP);
- Appropriate use of positive environmental interventions, such as soil conservation methods, in the farming systems of Haiti;
- Need for and allocation of resources for environmental education in the context of the project; and
- Conservation of biological diversity through the seed and germplasm improvement component.

Pesticide use is a relatively minor component in terms of level of effort and funds allocated, but nevertheless requires a special analysis according to A.I.D. Regulation 16. Section Four is devoted to an analysis of pesticide use and recommends pesticides that are relatively safe to use, following A.I.D. guidelines. Each of the remaining issues will be addressed in the discussion of project alternatives (Section Five) and environmental consequences (Section Six) of the preferred project (Alternative II).

A.I.D. POLICY ON PESTICIDES

Since 1977, a series of stringent policies and procedures have been implemented by A.I.D. to reduce the quantity of pesticides provided through its development assistance funds. The Agency's policies, to its credit, have set a precedent for other bilateral and multilateral donors to develop guidelines on pesticide use in their own programs. In May 1978, A.I.D.'s Bureau for Program and Policy Support issued its *Policy on Pesticide Support*, which is still fully supported by A.I.D. as an effective policy directive on pesticide use.

The policy states that A.I.D. will concentrate its pest management activities on efforts that minimize the use of pesticides, by developing effective integrated pest management (IPM) programs using alternatives to chemical control, such as biological, cultural, and mechanical methods. The policy encourages A.I.D. missions to increase availability of technical assistance to support IPM programs, to improve pesticide safety, and to monitor the effects of pesticide use on human health and the environment.

The present EA includes a detailed analysis of pesticide use because it is felt that the careless use of hazardous and toxic materials by Haitian peasants would introduce unwarranted stress into a natural environment already severely stressed by severe deforestation and land degradation, and a human environment where poverty, disease, and poor nutrition have reduced the average life expectancy to 52 years.

SECTION FOUR

PESTICIDE USE ASSESSMENT

BASIS FOR SELECTION OF REQUESTED PESTICIDES

The guiding principles for selection of pesticides used or procured on A.I.D. projects include, conformity with A.I.D. and host country regulations, effectiveness for demonstrated crop protection needs under prevailing environmental conditions, minimization of threat to human health and the environment, and promotion of IPM approaches.

The selection of pesticides under the proposed agroforestry project is based on effectiveness, relatively low hazard, and availability in Haiti. Table 1 presents the list of pesticides proposed for use under the new project. To understand the evolution of the presently proposed list, it is instructive to review the history of pest management under the AOP.

Under the existing AOP, the use of pesticides has evolved based on a recognition by CARE and PADF that some agrichemicals are necessary to treat certain pest problems in some instances. A decision was made early on by these organizations to limit the use of pesticides to the nursery environment and not to encourage pesticide use by farmers participating in the tree outplanting program. This is a commendable approach that has been fully enforced throughout the AOP.

The AOP started off in 1982 with the full intention that no pesticides would be needed. As pest and disease problems arose in the nurseries, modest use of the following pesticides has been required to avoid substantial losses: benomyl, captan, carbaryl, malathion, mancozeb, maneb+methylthiophanate, and trichlorfon. The focus on appropriate pest management practices was aided significantly by key consultancies arranged at the request of A.I.D.'s Regional Environmental Management Specialist (REMS), resulting in the reports by Michel Cusson (1986) and Guy Tourigny (1987), and the execution of a seminal pesticide safety training course for project personnel by John Hellman, an extension specialist from the Consortium for International Crop Protection (CICP) in November 1986.

In particular, the report by Tourigny helped focus insect pest and disease management on improving conditions in the nursery, increasing awareness of nursery personnel to identification of pests, and using a suite of IPM options that lessened dependency on agrichemicals. The training course increased awareness about the real hazards associated with the use of chemicals in the nursery and led to the development of Creole training materials and a series of training courses on proper use, storage, handling, application, and disposal of pesticides. This training was offered to over 150 project personnel during the period 1987-1989. In sum, one has witnessed the institutionalization of pesticide management into Haiti's major agroforestry project.

Under the new project, which is the subject of this EA, the above-mentioned pesticides, and some additional ones, will be required in the high-production forestry nursery environment. All of the pesticides listed in Table 1 are presently registered for general use in the United States, are locally available for purchase, and are not considered to be too toxic for use on this project. Many of these have been used during the AOP and have been effective for most pest problems in the tree nurseries. In addition, nursery managers are familiar with each product's handling precautions and methods of application. The basis for use of any given pesticide is subject to the following decision framework:

- **Problem identification.** The nursery manager first attempts to identify the insect or disease problem;

- **Examination of present management.** The nursery manager then examines how his nursery practices could have led to the observed problem, resulting in a diagnosis of biotic or abiotic causes of seedling loss or damage. Technical advice is available through PADF's nursery specialist, a position created in 1987 to address technical problems in the nursery, or through CARE's trained agronomists;

- **Assessment of seriousness of the problem.** Depending on the magnitude of the problem, a number of options are available. For example, if a few caterpillars are observed, the nurseryman will instruct his staff to pick them off the leaves. If a large infestation is apparent, he will instruct them to use Dipel; and

- **Pest management.** The first line of defense is prevention through the use of cultural controls. The second line of defense is the use of natural pesticides such as neem-cake and other naturally available pesticides. The final defense, if all the above fail, is use of a chemical pesticide selected from the list in Table 1.

Pesticides will be applied under the proposed project under the strict supervision of trained nursery managers.

The principal pest problems (Tourigny 1987; Webb-Wilson letter 1987) expected to arise in the agroforestry nurseries, and for which chemical control methods may be required, include many of the following (nonexhaustive listing):

Diseases Caused by Fungi:

- Damping off and root rot, observed on *Casuarina equisetifolia, Leucaena leucocephala*, and *Swietenia sp.* and other tree species, caused by *Pythium* and *Phytophtora spp.*, and *Rhizoctonia sp.* Root rot was a particular problem on *Cassia siamea*, the most important species in the current AOP;

- Sooty molds on *Citrus sp.*, which grow on honeydew exudates of sap-sucking insects such as aphids, mealybugs, scales (observed on Citrus sp.), and psyllids (*Heteropsylla cubana* observed on *Leucaena leucocephala*);

- Powdery mildews such as *Oidium sp.*, observed on *Eucalyptus camaldulensis, Cassia siamea, Acacia auriculiformis, Casuarina equisetifolia*, and *Carica papaya*; and

- Leaf spots from *Cercospora sp.*, observed on *Azadirachta indica, Acacia auriculiformis, Cassia siamea*, and some species of *Citrus*.

Plant Stress Caused by Nematodes:

Nematodes are not a serious problem in most nurseries, according to PADF and CARE technicians. According to Tourigny (1987), nematodes may occur in some nurseries where an unsterilized growing medium is used.

Insect Infestations:

- Psyllids, or jumping plant lice, occur where *Leucaena leucocephala* and *Suman samanea* are grown. It should be noted, however, that there have been no major losses in the field to direct- seeded *Leucaena*; and no serious problems in the nurseries with psyllids. Biological control by the ladybird beetle, *Curinus coeruleus*, looks promising. Five predators of psyllids have been identified in the field. Nursery managers have been encouraged to reduce spraying of psyllid infestations to promote population control by the predator beeties;

- Ants are a problem in many nurseries because they carry off newly planted seeds from the rooting containers;

- Crickets are problematic in that they cut off young *Casuarina* seedlings at the base immediately after sprouting; and

- Caterpillars, seed maggots (*Hylemya platura* on *Saman* seedlings), and scale insects are minor problems in some nurseries.

REGISTRATION STATUS OF REQUESTED PESTICIDES

The pesticides listed in Table 1 are available in Haiti and are likely to be used by either CARE or PADF over the course of the project. In accordance with A.I.D. Regulation 16, Table 1 indicates whether each material is registered by the Environmental Protection Agency (EPA) for general use, restricted use by certified applicators, or canceled for uses related to this project. It should be noted, however, that only general-use pesticides will be used on this project. The LD50, EPA, and WHO toxicity classifications are also provided for each product. Because these materials are to be used only on tree species produced in the nursery, either EPA-registered crop uses and tolerance limits for each material, or WHO/FAO recommended maximum residue limits, are pertinent.

Metalaxyl (ridomil) is an effective and widely used product with a relatively low toxicity. However, it should be noted that there have been some problems with the development of resistance to this material. If metalaxyl is to be used extensively, the nursery managers, agronomes, and expatriate technical staff should make use of resistance management tactics and monitor the product's continued effectiveness.

PESTICIDE USE IN THE CONTEXT OF INTEGRATED PEST MANAGEMENT

It is encouraging to note that IPM programs are extensively promoted under the AOP and will play an important role in pest management in the proposed project. The stimulus for use of such practices has come from dedicated technicians at CARE and PADF, based on the technical advice from outside consultants (Cusson 1986, Hellman 1986, and Tourigny 1987) and a general recognition by project staff that simpler pest management strategies must be promoted in Haiti.

The concept of IPM to be espoused under the proposed project is: Use of any suitable techniques and information that reduce pest populations to or maintain them at tolerable levels, while providing protection against hazards to people, livestock, and local soil and water resources in the vicinity of the nursery environment.

The basic elements of IPM, offered to project staff through practical training seminars, include field monitoring and management tactics.

Field Monitoring

Training in identification of insects and diseases likely to occur in the nursery; recognition of insect and disease problems caused or aggravated by environmental factors such as moisture, light, mineral deficiencies, transplanting injury, grafting injury, and fertilization; and sampling to estimate nature and extent of the problem.

Management Tactics

Use of nonchemical and chemical tactics such as cultural practices aimed at preventing problems, natural pesticides of very low human toxicity, and purchased pesticides as a last resort.

The evolution of IPM during the existing AOP will enable the proposed project to:

- Address fungal disease problems by better watering, spacing, and shading of seedlings; for example, by better aeration in the nursery, treatment of certain surface water sources with chlorine before watering, and by use of captan as a seed treatment for only certain tree species, and not uniformly for all species;

- Promote use of locally available natural pesticides such as extract of neem (*Azadirachta indica*) seeds known as azadirachtin in an insect antifeedant, or deterrent to species of phytophagous insects; and extracts of raw tobacco, chile peppers, and seeds from the various species of *Annona* and *Derris indica* (if enough seed can be found locally), which have exhibited insecticidal properties in Haiti and are being tested by CARE and PADF foresters on nursery trees;

- Control use of seed germplasm so that more resistant varieties are outplanted; for example, use of seed from provenances with high and uniform germination rates, and species and varieties of *Leucaena* resistant to psyllid infestations;

- Reduce potential resistance problems by alternating use of benlate and dithane for leaf blight infestations; and

- Apply the triage approach of physical/mechanical, followed by cultural, and, only as a last resort, chemical practices in managing pest problems in the nursery.

The current and proposed IPM training and technical assistance appear to be adequate to address the pest problems of the nursery, given the fact that insect and disease problems have evolved from moderate to serious during the early years of the AOP to low or practically nonexistent, except for *Cercospora* and damping off, in most of the presently operating nurseries of the project. This is not to dismiss the need to monitor pest issues regularly. The appropriate attitudes toward IPM have been promoted and will continue to be promoted by CARE and PADF, so that damages and losses can be minimized in the nursery environment of the proposed project.

PROPOSED METHODS OF APPLICATION; AVAILABILITY AND USE OF PROTECTIVE CLOTHING

If pesticides are used, the project would utilize hydraulic backpack sprayers for liquid formulations, and appropriate shakers for granular and powder formulations. CARE requires each of its nurseries to have this equipment. PADF requires that each NGO-operated nursery purchase this equipment. Protective clothing required by CARE and PADF includes gloves, boots, masks, long-sleeved shirts, long pants, goggles, and hats. CARE buys the equipment and supplies its nurseries with as much as necessary. PADF provides a starter set of equipment for each NGO at no charge initially, but sells replacement equipment to each NGO, as needed. Under PADF components, NGOs are free to purchase this equipment on the open market as well.

ABILITY OF CARE AND PADF TO MONITOR AND REGULATE DISTRIBUTION, USE, STORAGE, AND DISPOSAL OF PESTICIDES

Both CARE and PADF have the responsibility to monitor and to regulate the use of pesticides to ensure that they are handled correctly and safely. Presently, there are no legislated pesticide safety rules and regulations in Haiti, placing the burden of responsibility on the individual and organization utilizing the material. As mentioned earlier, A.I.D. regulations require due diligence on the part of recipients of U.S. development assistance monies. CARE and PADF recognize this responsibility and are prepared to address the concerns regarding monitoring and regulating distribution, use, storage, and disposal of pesticides procured or used on the project.

Pesticides are procured locally in Haiti by CARE and PADF — usually no more than 100 pounds of any one chemical in any given year. CARE regulates the distribution in each of its central nurseries. PADF procures pesticides and sells small quantities as needed to the NGOs contracted to produce trees in their nurseries. Each NGO, however, is free to purchase any material from PADF's recommended — and A.I.D.-approved — list on the open market. No more chemicals than are needed in any one growing season are sold to the NGOs, thus reducing the stock that may carry over from one planting season, or year, to the next.

Random observations by the nursery specialist for PADF and by Dr. Richard Pelleck, Senior Forestry Advisor to the AOP, indicate that both CARE and PADF generally follow the rules about safe use of pesticides.

The key to safe handling, use, storage, and disposal of pesticides in the proposed project is the implementation of a thorough training program for key technical staff and the nursery managers and selected nursery workers. This program was put into effect in 1986 as a requirement for the above staff.

With regard to application, it is the nursery manager's responsibility to select one — maximum two — employee(s) to be responsible for handling, application, and cleanup of pesticides. Both the nursery manager and the handlers go through the pesticide safety training program offered by CARE and PADF. All have copies of the project nursery manual, Chapters 7 and 8. To monitor compliance with use of appropriate application methods and protective clothing, PADF conducts periodic spot checks of pesticide operations at selected NGOs.

Although PADF has no direct power of supervision, each time the PADF nursery specialist visits an NGO nursery, a field sheet — *Fey Vizit Pepinye* — records observations. If negligent practices are observed, the PADF observer can recommend corrective action that in some instances could lead to the dismissal of the responsible party. CARE's nursery managers and applicators are direct CARE employees and are monitored as part of the routine employee performance evaluation.

A locked depot is required at each nursery for storage. Pesticides are stored in their original containers on shelves separating powders from liquids. Access to the chemicals is controlled by the nursery manager, who is the sole handler of the keys. PADF is considering use of a standard locked depot, which would be provided as part of the nursery package to each NGO. This would reduce variability in the means of storage presently found.

For disposal, CARE and PADF take the normal precautions, as indicated in the nursery manual, with slight differences in directives to their respective nursery staffs. For example, CARE uses only five pesticides, all of which come in paper sacks. It recommends that these be burned in the open air. Human population densities are very low in the Northwest, CARE's region, and burning sites are located away from people and buildings. PADF recommends that most pesticides and containers be buried. Their procedure is to dig a deep hole and line it with clay or charcoal; break bottles, puncture containers, and tear bags; and then, dump the materials in the hole and refill. Disposal sites are located away from people, water sources, and, other areas where disturbance might be possible, but always on nursery property.

ACUTE AND LONG-TERM TOXICOLOGICAL HAZARDS

All pesticides are potentially hazardous to people and the environment and should be treated with caution, regardless of their relative toxicity. The potential health hazards depend on the toxicity and the amount swallowed, absorbed, or inhaled. The relative toxicity of a pesticide can be found by examining its LD50 value, which is the amount of the chemical necessary to kill 50 percent of the test animal population, usually laboratory rats. It is expressed in the weight of a pesticide per unit body weight, usually millimeters/kilograms, when swallowed (oral), absorbed through the skin (dermal), or inhaled. The latter value, inhalation toxicity, is expressed in parts per million per unit volume of air. It is only occasionally used in reporting relative toxicity.

Two types of hazard classifications are included in Table 1, the EPA and WHO systems. Any classification distinguishes between the more and the less hazardous forms of each pesticide, based on toxicity of the technical compound and on its formulations. Allowances can be made for the lesser hazards from solids, as compared with liquids. In the general assignment of a particular chemical to a hazard class, acute oral LD50 values are used, except where dermal LD50 values are lower than oral values.

Table 2 summarizes U.S. toxicity categories and precautionary statements by such categories. All pesticide products must carry a warning and precautionary statements concerning the general areas of toxicological hazard to children, environmental hazard, and physical or chemical hazard (40 CFR Ch. 1 of 7-1-86 Edition). There are two groups: those required on the front panel of the labeling, and those that may appear elsewhere. CARE and PADF have taken a firm stand in considering all pesticides as potentially dangerous and have subsequently standardized special labels in Haitian Creole, which are affixed to each of their products.

All of the pesticides recommended for use on this project are registered for general use in the U.S. This means that they are judged not to present an unacceptably high short- or long-term health risk to a user who understands and follows all label instructions, including the required interval before reentry into a treated nursery. No pesticides proposed for use on the project are registered for restricted use. The EPA has issued a special review status for one of the proposed pesticides, captan. This material may pose long-term toxicological hazards from routine exposure over a lifetime at some level. The special review process is a continuing activity and the EPA will not take final action on a pesticide until the process is completed. Ultimately, the only valid source of information concerning legal use of EPA registered pesticides is the pesticide labels. The label should always be followed carefully, as this best assures minimum hazard to users.

The proposed pesticides are generally nonpersistent and, if used according to the label instructions, should present no unusual hazards to the natural environment.

EFFECTIVENESS OF SELECTED PESTICIDES FOR PROPOSED USES

Pesticides selected for use on this project were found in some cases to be effective against identified insect and disease problems (Tourigny 1987). In other cases, they are anticipated to be effective, or have been recommended by pest management experts to be effective, under environmental conditions similar to those in Haiti. The effectiveness of some of the natural pesticides such as neem extract will be tested under the proposed project. It is anticipated that some of these natural products will replace agrichemicals purchased under the project in the long term.

COMPATIBILITY OF PESTICIDES WITH TARGET AND NONTARGET ECOSYSTEMS

Many of the pesticides were selected for use under this project because of their low mammalian toxicity. Some, nevertheless, present significant potential hazard to nontarget organisms. For example, captan and mancozeb are toxic to fish, necessitating special precautions to avoid contamination of surface water supplies. Most suggested insecticides are toxic to some of the natural enemies of nursery pests

TABLE 2

TOXICITY CATEGORIES OF PROPOSED PESTICIDES BY HAZARD INDICATOR

Hazard Indicators	I[a]	II	III	IV
Oral LD_{50}	50 mg/kg or less	50-500 mg/kg	500-5,000 mg/kg	>5,000 mg/kg
Inhalation LD_{50}	.2 mg/liter or less	.2-2 mg/liter	2.0-20 mg/liter	>20 mg/liter
Dermal LD_{50}	200 mg/kg or less	200-2,000	2,000-20,000 mg/kg	<20,000 mg/kg
Eye Effects	Corrosive; corneal opacity not reversible within 7 days	Corneal opacity reversible within 7 days; irritation persisting for 7 days	No corneal opacity; irritation reversible within 7 days	No irritation
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or Slight irritation at 72 hours
EPA Signal Word	"DANGER"	"WARNING"	"CAUTION"	"CAUTION"

[a] The word "POISON" and also a picture of skull and crossbones appear on the labels of EPA registered in Category I.

Source: 40 CFR Ch. 1 (7-1-86 Edition), 162.10 Labeling Requirements.

such as psyllids, or to honey bees. For example, CARE nurseryman have observed that mites become a problem when too much sevin is applied.

Psyllids, a common pest of *Leucaena*, can become problematic if heavy doses of insecticides such as sevin or malathion are applied. It is thought that populations of ladybird beetles, a natural predator of psyllids, are reduced from too much spraying of insecticides in certain nurseries, resulting in increased pest populations. Both CARE and PADF are aware of this problem and have employed IPM strategies to reduce the impact on predator populations in and around nurseries.

Some of these problems are unavoidable when pesticides are used indiscriminately. Minimal adverse effects can be observed when pesticides are used in combination with other control tactics, and when users are educated to the hazards and proper use of the materials. Both CARE and PADF have addressed these concerns through implementation of an IPM program and intensive training of all staff as to the hazards and safe use of pesticides.

CONDITIONS UNDER WHICH PESTICIDES ARE TO BE USED

Under the NPA, pesticides would be used in the nursery environment under the strict supervision of a trained nursery manager. Off-site use of pesticides is not expected. An elaborate set of protocols have been developed to address pesticide safety during mixing, application, clean up, and disposal. Materials, including equipment, are stored in a locked depot where all materials are labeled, kept off the floor, and separated from other chemicals and food.

For those pesticides in Table 1 carrying a **WARNING** label, only the following formulations as indicated by commercial name — this does not imply endorsement of any given product by A.I.D. — will be acceptable for use under this project:

- Chorothalonil: Bravo 500, Bravo 720, Bravo F, Daconil 2787F; and
- Metalaxyl: all formulations, except Apron FL, which carries a DANGER label.

These formulations are considered to be relatively safe for use if all label instructions are followed. Project training courses will review these special label instructions.

AVAILABILITY AND EFFECTIVENESS OF OTHER CONTROL METHODS

A wide variety of pesticides are available on the open market for purchase and use in Haiti. Some of them, such as dieldrin, lannate, and carbofuran, are particularly hazardous. Numerous instances of pesticide poisonings have been reported, especially during the routine training programs run by CARE and PADF on pesticide safety. Use of these more effective, but more toxic, materials will not be permitted on this project.

The project will only use broad spectrum, relatively less toxic, pesticides if the triage approach demands it. Prevention is the method of choice, employing mechanical and cultural practices, followed by use of biological controls such as *Bacillus thuringiensis* and natural pesticides such as extract of neem. Some of the nonchemical methods would include the following:

- Techniques to prevent pest outbreaks, such as avoiding overwatering and standing water; keeping nurseries sanitary by, for example, cutting weeds and cleaning up trash that attracts rats; improving ventilation by putting racks higher; cutting trees and other vegetation around nurseries to increase wind circulation; putting trees in the sun as soon as possible; protecting seedlings from rain and dew; and watching for signs of infections;

- Techniques of a mechanical nature such as trapping rats and mice, picking off insects by hand, and putting grease on poles to block ants; and

- Cultural controls to reduce drought damage, fertilizer burn, over-shading, sun scorch, and over-watering, involving reduced watering, increased sunlight, and reduced time spent in shade to create stronger leaves.

Many of these techniques have been tried through the AOP and were found to be effective. Proven pest control measures will be employed under the proposed project. New techniques to be explored have been mentioned in previous sections.

PROVISIONS FOR TRAINING USERS AND APPLICATORS

A formal training program was developed by CARE and PADF in 1986 to address the concerns expressed by A.I.D. about pesticide safety on the AOP. The CICP offered a seminal training course that stimulated concern for more detailed training materials and methods in Creole to increase awareness of pesticide hazards, particularly in the nurseries.

PADF has trained over 150 people involved in their agroforestry program, including all team leaders, key agronomes, and nurserymen and their assistants — supervisors, managers, and sprayers. Every year a three-day seminar is held for new nurserymen employed by the NGOs participating in the project. Also, a three-day refresher course is offered each year for returning nurserymen. The training materials include the nursery manual, titled *Gid Pepinye* in Creole, prepared by Scott Josiah; and other materials available from several sources, like the CICP *Training Program for Pesticide Applicators*. This training manual was recently translated into Creole for USAID's *Proje Sove Te* (Granovsky et al. 1985). A portion of this training time covers pesticide safety, pest identification, and pest management. The proposed project will continue with this program.

CARE has implemented a somewhat different training program for the AOP, covering more or less the same material. Their approach includes FAO filmstrips, use of PADF's *Gid Pepinye*, some of the material from the *Proje Sove Te* manual, and extensive demonstrations and role playing. For the proposed project, CARE will implement a training-of-trainers program, initially to teach the basic principles of pesticide safety, pest identification, and pest management. CARE plans to conduct pesticide training in the larger context of its FARM project training modules.[1]

Basically, a handful of CARE trainers will teach CARE field agents (FAs), who are the implementers of specific project activities, such as setting up nurseries. These FAs, in turn, will work with farmers on a monthly basis over a period of 30 months. An estimated 10 major training seminars would be held over the LOP. The FAs will be given the pesticide safety course and will then instruct the farmers over the course of their 30-month involvement. Materials will be kept simple and training courses will rely extensively on demonstration and role playing.

[1] This farm project is evaluated in Annex 1 of the social soundness analysis paper.

SECTION FIVE

ALTERNATIVE PROGRAMS

ALTERNATIVE I — MAINTAIN CURRENT AOP LEVELS AND ACTIVITIES

During the development of the PID, it was debated whether to continue with the status quo by funding only AOP's current activities such as tree planting, hedgerow technology, and basic training for farmers in tree planting, maintenance, and harvesting. This is still one viable route for the project to pursue. "If it ain't broke, don't fix it!" is the commonly heard epithet.

Since 1981, through its NGO network, the current AOP has established an extensive production and distribution system for fast-growing native and introduced hardwood species, as well as some fruit tree species. It promotes their outplanting on private farmlands and trains farmers in tree care and maintenance. Since 1985, CARE and PADF have been promoting the establishment of contour hedgerows using primarily *Leucaena leucocephala* for erosion control on steep-sloped lands. The project has also trained hundreds of extension agents in various tree nursery technologies, in safe use of pesticides, and in techniques for improving the survival of trees outplanted on farmers' fields.

Because the project is a success, as attested in the PID and other documents, the temptation is either to continue at present levels or to increase funding to do more of the same, but on a wider geographic basis. Some current project staff even believe that the project would be more successful by focusing any additional resources on one or two key catchment basins in each region of the country. The intensification of similar, proven techniques and training modules can be justified as a viable alternative to the proposed project.

ALTERNATIVE II — EXPANDED APPROACH TO AGROFORESTRY AS ELABORATED IN THE PID/PP

The PID and the PP provide a complete description of this alternative, which is the preferred project option. In a nutshell, this proposal is similar to the current AOP in its fundamental orientation to outplanting multipurpose trees on private farmlands, providing the rural farmer with an economically viable crop. Where the project differs from the current AOP, or Alternative 1, is that it will:

- Continue the seedling production and distribution program in terms of the technology, but will include a broader selection of perennial species of forages, grasses, and non-woody vegetation. This emphasis on vegetation other than trees will necessitate some additions to the nursery production system as it is presently elaborated;

- Introduce a program of on-farm propagation techniques, tree management, and harvest schemes that will serve the needs of the more experienced farmers, who have participated in the AOP and who want to go beyond the present technologies and practices;

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- Diversify interventions beyond simple hedgerow installation and management as a viable method of soil conservation and into development of stable alley cropping systems; improvements in soil fertility by use of green manures, mulch, and livestock forage; and more use of indigenous seed and germplasm; and

- Identify ecologic, topographic, and soil conditions where rehabilitation of the soil, to reverse erosion and increase fertility, is possible by better management on the farm, and, where it is not possible, perhaps opting for more extensive use of forestry on those poorer sites.

ALTERNATIVE III — NO ACTION

The no-action alternative means not funding an agroforestry project in Haiti. This option would test the ability of the current infrastructure, the network of NGOs, and the technology base to continue the tree planting concept in Haiti without USAID's involvement. To continue at present levels of tree planting, the NGOs would have to raise nearly $6 million annually to maintain production and distribution at current levels. Although no alternative means of funding have been identified by the NGOs, it is anticipated that some NGOs would be able to continue with support from other donors. Many would stop production and momentum would be lost in attempting to seek alternatives. At a minimum, several planting seasons could be lost. PADF estimates that loss of tree production would be 80 percent and that one-half of the existing NGOs now funded would not continue at all.

From USAID/Haiti's point of view, the no action alternative is not in the best interests of their program in Haiti, nor in the best interests of the Haitian people, to whom they have a commitment.

SECTION SIX

ENVIRONMENTAL CONSEQUENCES OF PROJECT INTERVENTIONS

Each of the issues mentioned in Section Three, with the exception of pesticide use, is analyzed here with regard to three basic concerns:

- Direct and indirect effects and their significance;
- Unavoidable adverse effects; and
- Relationship between short-term uses and maintenance of long-term productivity of the environment.

The objective is to demonstrate the assets and liabilities of each major issue identified during the scoping exercise for the preferred project option, Alternative II.

For this analysis, direct effects are considered to be primary impacts typically associated with qualifiable or quantifiable results or observations over the short term. Indirect effects are secondary impacts associated with longer-term results or observations, either locally or beyond the project area. One indirect effect of a proposed intervention would be the spread effect of adoption of any given technology beyond the original project area; another would be the subtle changes in microclimatic factors that could occur where dense tree planting is introduced. In many instances, there are little or no distinctions between direct and indirect effects.

THE ROLE OF RESEARCH

Background

The AOP identified the need for research that was adaptive and practical, and implemented two phases through Title XII mechanisms. Phase I, executed by the University of Maine, undertook a characterization of traditional agroforestry systems, silvicultural studies, improvements in nursery techniques, species trials analysis, marketing studies and consumer preference for wood products, cost-benefit analysis of tree planting, and socioeconomic analyses of key farmer decision making for project trees. Phase II, conducted by a team from Auburn University, covered cost-efficient and appropriate systems for the production of vigorous planting stock, establishment and maintenance of trees on small farms, and economic and social aspects of crop and livestock associations with trees. In addition, a seed and germplasm improvement component was designed and funded to address the problem of garbage seed and poor species performance in some areas.

The proposed NPA will refocus the research needs toward applied research that will measure, enhance, and expand on-farm and off-farm impacts of the various technical interventions. New directions will include efforts to:

- Understand hedgerow technology as a viable and practical means of soil conservation on steeplands;
- Characterize appropriate alley cropping systems in terms of crop management practices, spatial distribution, planting density, and other farming practices that will improve soil fertility on steeplands; and
- Develop a range of recommended ecological, topographic, and soil conditions where rehabilitation of farmlands is possible, as well as areas where the investment is best made with only trees.

Additional focus on tree, forage, and shrub species and their relationship to sites will continue as it has in the past, since very little is known about the majority of the 130 tree species outplanted, and even less about the new species and varieties of grasses that could be used on steeplands.

Direct and Indirect Effects

The direct effect of the information gathered under a research program of this nature is to improve our understanding of the ecological and edaphic (soil) conditions under which technical interventions can or cannot succeed in Haiti on a regional basis. Such information will be translated directly into corrective action through the extensive and viable NGO network established by CARE and PADF. Lessons learned during one season can be programmed for the immediate future into training programs and outplanting schemes.

Indirect effects would take place on a farmer's field over the medium term. Soil fertility, and subsequently yields, would be raised by better management using new systems such as green manures, livestock forage, mulch, alley cropping, and sloping terraces with hedgerows.

Unavoidable Adverse Effects

Under present systems of implementation, the hedgerow technology presents certain dangers to the farmer, which are identified in the PP. A well-thought-out, applied research program would reduce the adverse effects of inappropriately applied technology, in many instances.

Relationship Between Short-term Uses and Maintenance of Long-term Productivity of the Environment

The underlying philosophy of an applied research program is to transfer data and information from carefully designed investigations into practical techniques for immediate use in the nursery or on the farm. By definition, it is short term in duration but long term in its usefulness.

The nursery and on-farm research may harm a portion of a farm's microenvironment by setting up demonstration plots that fail the test — for example, by inadequate spacing of hedgerows resulting in breakdown of vegetative barriers during any given storm or adverse weather event. The long-term value of this information, however, will be used to save hundreds of farmers the risk of applying inappropriate technology. In the long term, however, the benefits outweigh the costs of short-term losses for any given plot of land.

SOIL CONSERVATION ENHANCEMENTS

Background

During the AOP, a simple tree outplanting program soon identified the need to initiate soil conservation measures on farmlands of participating peasants. As indicated by Pierce (1988) and others, the history of soil conservation in Haiti is the history of some successes and many failures. Since the 1960s, soil conservation interventions have included raising berms along the contour, constructing rock walls, and digging contour canals to stem erosion on private and public lands. Dry-wall check dams have been constructed in ravines to halt gully erosion as well, usually as larger community participation projects. The AOP and other projects of the 1980s have attempted to promote the idea that land degradation is a function of soil erosion and loss of soil fertility. Project staff implemented the installation of vegetative barriers, usually referred to as hedgerows, but encompassing nearly a dozen very different techniques.

The proposed NPA will focus significant resources on constructing and improving selected soil conservation practices that are economical and implementable on participating farmers' private lands.

Direct and Indirect Effects

When installed along the contour, the direct and indirect benefits of hedgerows have several distinct advantages over crop arrangements under traditional agricultural systems. There are improved water and plant relations, positive environmental effects, and measurable economic benefits. The research component of the project will qualify and quantify many of these over the LOP. In many instances, distinctions between direct and indirect effects are not measurable and may best be interpreted rather as positive benefits.

Direct and indirect effects include the following (from Pelleck 1989):

Water Relations

- Perennial crops with deep root systems increase the depth of penetration of surface water.
- Added depth of penetration of surface water increases storage efficiency in the solum.
- Perennial crops with deep root systems help break up hardpan which may inhibit water movement in the soil profile and into aquifers.

- Root channels of deep-rooted perennial crops improve infiltration rates and downward percolation of rainfall and irrigation water.
- Year-round transpiration of perennials increases the overall humidity in crop canopies.
- High humidity in the canopies of tall perennials increases the water use efficiency in the shorter annual plants.
- Root masses tend to improve the tilth and overall physical structure of the soil fabric.
- Soil fertility is maintained through nutrient cycling and organic matter deposition of perennial crops.
- Mineral cycling efficiency is improved as nutrients in the subsoil are pumped through plant tissues and are returned to the soil surface through the shedding of leaves and other plant parts.
- Litter layers on the surface decrease evaporation in superficial soils. The infiltration of water has been shown to be directly proportional to the thickness of litter layers.
- Thicker litter layers under perennials reduce the soil surface temperatures, improving moisture content.
- Permeable litter layers improve gas exchange by maintaining tilth.

General Environmental Effects

- Contour barriers help to dissipate the force of overland flow of water, lessening the risk of erosion.
- Water that stays on the land longer is more beneficial to crops.
- Living terraces are soil and water conserving and as the slope gradient changes over time, they become more efficient.
- In some cases, vegetative barriers of multipurpose species become more productive with age.
- As hedgerow trees increase in diameter, their stems become thicker and stronger, serving as better traps for soil particles.

Economic Factors

- Hedgerows are quick and easy to install by direct seeding.
- Hedgerows are long lasting and can require little or no maintenance.
- Hedgerows are a source of fodder, green manure, and fuelwood.

- Hedgerows can be planted by a single farmer, using materials that are readily available.
- Income can be derived from hedgerow crops, or indirectly from savings resulting from fertilizer properties of the green manure produced, fodder for animals, and so on.

Unavoidable Adverse Effects

Some of the soil conservation practices are not suitable for steep slopelands. It will be a challenge to determine where vegetative, low-cost, soil conservation techniques work and where they are inappropriate. This is one goal of the applied research component. During the LOP, it is conceivable that some farmers will install hedgerows or alley cropping systems that will fail. The likelihood of widespread failure will be mitigated by the extensive research and field extension efforts of CARE and PADF. Unavoidable adverse effects would be reduced, or nonexistent in most cases.

Relationship Between Short-term Uses and Maintenance of Long-term Productivity of the Environment

The objective of the soil conservation interventions is maintenance of long-term productivity of the steep slopelands of participating farmers. Interventions applied over the short term will have a lasting impact by reducing erosion and increasing soil fertility.

ENVIRONMENTAL EDUCATION

Background

Environmental education has been a basic component of the AOP since its inception. Animators and farmers were inculcated with concepts emphasizing the role of trees in their own economies and in the economy of nature. The positive benefits of planting trees have been described in numerous training courses offered over the LOP. In June 1988, however, PADF undertook a formal pilot program in the Mirebelais area of Region 5. The goal was to establish a program in 10 schools in each of the following areas: Saut d'Eau, Desvarieux, Triano, and Boucan Carré. The initial reaction to the proposal from school directors and teachers was positive. The basic activities of the pilot program were to:

- Introduce basic concepts about the value of trees by use of the booklet *Zanmi m' Pyebwa* (My Friend the Tree);
- Establish plastic sack nurseries producing mango francique and other species;
- Form student clubs, called Friends of the Trees, in each participating school; and
- Conduct training seminars and student workshops on tree production and ecology.

Aside from the booklet, a series of 12 lessons about tree ecology, nursery production, and care and maintenance were developed by a Haitian teacher under contract to PADF to implement the program. The idea for this basic course has been embraced on a wider scale and the demand for a more comprehensive program will be addressed in the NPA.

The basic elements of the program are development and use of a three-year curriculum in environmental concepts, establishment of fruit tree nurseries and demonstration sites for agroforestry species on or adjacent to school property, and site visits and training workshops on selected farm or demonstration sites to visit gardens and to learn basic principles firsthand.

The target audience is primary school children in rural, not urban, schools, between the ages of 10 and 18. There is a wide variance in the ages of primary school children of the same grade in many rural schools. The target number of students to participate in each region over the three-year program is shown in Table 3.

TABLE 3

TARGET NUMBERS FOR ENVIRONMENTAL EDUCATION PROGRAM

	Year 1	Year 2	Year 3	Year 4	Year 5
Course I	1500	1500	1500	1500	1500
Course II		1500	1500		1500
Course III			1500		
Total	1500	3000	4500	1500	3000

PADF Regions 1, 2, and 5 will implement an environmental education program modeled on the above. A training materials specialist, who will be hired by PADF to develop materials for all aspects of the agroforestry project, will dedicate a portion of his/her time to the development of course materials. The budget for the proposed program is presented below. In terms of staff, one full-time training assistant and three part-time monitors will be needed for each participating PADF region. The training assistant will train school teachers in how to convey the course materials; organize seminars and field days for the students; oversee, with the help of monitors, the establishment of nurseries; and work with the training material specialist to refine any course materials developed.

Three types of training materials will be developed: *Zanmi m' Pyebwa*, a short book on the ecological history of Haiti; other materials, such as the *Gid Animate Pyebwa, Liv Plante Pyebwa;* and a booklet on hedgerows. Some funds will be needed to prepare the ecology book, but most of the other materials are completed. An initial search and inquiry to other educational institutions in the region, particularly in Martinique and Saint Lucia, where Creole is spoken, will be made to identify any

TABLE 4

ENVIRONMENTAL EDUCATION PROGRAM
SINGLE REGION: BUDGET ESTIMATES ONE YEAR

Staff	
1 full-time assistant @ $450/month x 12	$ 5400
3 part-time regional monitors @ $50/month x 12	600
Transport	
Motorcycle	2500
Insurance	250
Fuel @ $40/month x 12	480
Training	
60 teachers 2 x 2 day seminars/yr @ $7 each	840
Site visits with selected groups of children from each region; 54 students @ $3 x 5 visits	810
Special training for student club members involved in caring for school nurseries; 22 nurseries x 3 students each x 3.50	230
Nurseries	
22 nurseries x 1000 seedlings x 0.025/sacks	550
Purchase of chadec, citron, mango, corasol seeds	200
Purchase of transport of specific materials, such as Haiti-mix, tools	300
Training Materials	
Preparation of new booklet on the Ecological History of Haiti for school children	5000
Printing of 4500 copies @ $1.50 each	6750
Total	$ 23910

Direct and Indirect Effects

communities within each region, and establishing 22 nurseries within these communities. In addition, 60 teachers will be trained in environmental principles. The basic goals of the education program are to instill in the students the importance of trees and how they fit into their environment; what erosion is and how it can be minimized; and the value of new technologies such as hedgerows, which can increase soil productivity, if appropriately managed.

Indirect effects of the training could have significant positive effects on the way trees are managed on the students' farms. For example, the school nurseries will emphasize how to plant tree seedlings in plastic sacks, thereby transferring a simple technology for potential application on the farm. Also, children take care of animals on many farms, but are careless about where they allow animals under their charge to graze or browse, resulting in trampled or eaten tree seedlings. The education of farm children in proper plant-animal relations and care of trees outplanted under the agroforestry project could enhance survival in some instances. Finally, farming in Haiti follows traditional methods, some of which are good for the land such as crop rotation and some of which have dubious value, such as indiscriminate burning. By helping farm children understand the positive and negative aspects of certain methods, improvements can be made in attitudes and some traditional ways can be modified.

Another indirect and longer-term effect is that a cadre of students will receive training and motivation through the clubs. Some of these students are the teachers of tomorrow. Interest in environmental themes can be instilled at a young age, role models can be identified, and influence on career decisions in favor of the teaching profession could occur.

Unavoidable Adverse Effects

It is hard to imagine adverse impacts from an education program of this scope.

Relationship Between Short-term Uses and Maintenance of Long-term Productivity

The goal of exposing students to a three-year environmental education program is to send a clear message to schools in the region that environmental education is useful and fun. In certain areas, a concentrated message is being sent and children are learning the same lessons their parents are also learning through the extension-outreach elements of the agroforestry project. That message is that there are different farming systems available to them, such as contour systems and hedgerow/tree combinations, that help integrate trees and animals in more productive ways. Those rural children that remain on the land, who do not migrate to Port-au-Prince or abroad, may do a better job of managing the land.

CONSERVATION OF BIOLOGICAL DIVERSITY

Background

Widespread deforestation has resulted in the elimination of many tree species from areas where they were historically abundant and economically important. A needs survey for conservation of tropical forests and biological diversity was prepared by DeGeorges and Ford (1988) for USAID/Haiti. It identified many areas of concern, and discussed the following themes in particular:

- Watersheds and agroforestry; for example, the role of trees in soil conservation and as cash crops such as forage, fruits, medicines, firewood, and building materials;

- Forestry research, particularly species-site relationships, identification of seed sources that produce trees with desirable characteristics, and nursery management techniques that optimize production of seedlings; and

- Conservation of economically important species such as pine, mahogany, cedar, Haitian oak, and frene.

The AOP has undertaken, since 1987, a program to collect the germplasm of targeted, indigenous species, propagate these individuals at a centralized nursery, and establish seed banks of living germplasm in seed orchards for superior phenotypes. Progeny testing is used to select out poor performers for growth and form. In situations where it is felt that there may not be sufficient quality or quantity of superior individuals in Haiti, a concerted collecting effort will be mounted to seek these same species in the Dominican Republic. This will offer a wider genetic base for the seed orchards and offer the possibility of discovering provenances better adapted to the diverse site conditions in Haiti. These efforts are backstopped by technical assistance from the USDA-Forest Service, the Oxford Forestry Institute of the United Kingdom, the Central America and Mexico Coniferous Forest Resources Cooperative (CAMCORE), and numerous academic and botanic institutions in the United States.

The NPA proposes to continue the work begun under the AOP with regard to seed and germplasm collection and its establishment in seedling orchards at particular localities. The goal and objectives of this program mesh nicely with the recommended approaches to biological diversity conservation proposed in State Cable 032584 (USAID 1988b). The NPA will undertake the conservation of economically important species and germplasm, including land races and wild relatives of agriculturally important tree crops, in seed and seedling banks throughout Haiti. One subcomponent, the oil palm, *Attalea crassispatha*, will address the status and protection of an endangered species and its conservation in its wild habitat and in orchards, if suitable propagation techniques can be developed.

Direct and Indirect Effects

Although endangered or threatened species are not ordinarily important in the economic life of a peasant farmer in Haiti, the challenge is how to preserve species that the Haitian peasant might not normally plant. The approach is from the perspective of economic botany — in other words, based on utility, not on conservation themes. One species that has been identified as in need of conservation and which, at the same time, has enormous economic implications for peasant households, is *Attalea crassispatha*, an endangered Haitian palm.

The direct effects of preservation of the existing populations of *Attalea* would be in situ conservation of the remaining individuals — two specimens at Fond des Nègres and 15 at Dumay, both in the Southern peninsula. The consequences are important for the palm because a viable population is the best way of saving its germplasm.

The indirect effects must be borne out over the next few years. Methods of propagation must be identified. The oil-bearing properties and other values, such as for thatch, will be studied. If favorable propagation techniques and economic values can be identified, one objective would be to work this species into the agroforestry outplanting schedule, for example, by year four or five of the NPA.

Relationship Between Short-term Uses and Maintenance of Long-term Productivity

Other species, of less importance biologically than *Attalea*, are nevertheless important vehicles to address the issue of conservation of biodiversity. For most indigenous species in Haiti, little is known about their distribution, methods of propagation, pest and disease resistance properties, or market potential. Each of these species has different end-use potential and different levels of tolerance to the ranges of ecological conditions under which the Haitian farmers live.

In the short term, the NPA will undertake novel approaches to promote long-term productivity of the selected indigenous species of the remaining vegetation. Rather than introduce more exotics, the seed and germplasm component will work on better ways to get indigenous species introduced into tree planting programs. One approach will be to have local peasant groups look out for the naturally regenerating wild seedlings, begin the transplanting process by bare rooting, or by other ways discovered during the course of the propagation trials at the central nurseries.

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National Program for Agroforestry in Haiti:

Economic and Financial Analysis

by

Frans Van Eysinga
Development Alternatives, Inc.

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SECTION ONE

THE CONTEXT

BASIC ECONOMIC DATA

With a total population of over six million, Haiti is the poorest country in the western hemisphere. Per capita gross domestic product (GDP) is $320, while rural per capita GDP is estimated at $125. Rural Haitians are losing ground vis-a-vis urban Haitians, whose incomes have roughly kept pace with inflation. Haiti's currency, the gourde, is overvalued by 25 percent. Its foreign exchange reserves are low. The country is extremely vulnerable to both external and internal shocks. During the past three years, the country has suffered from political turmoil and experienced varying degrees of civil unrest.

Since 1980, Haiti's economy — and the agricultural sector — have declined when expressed in real per capita terms. The services and industrial/commerce sectors are gaining in importance. It is estimated that agriculture's share of GDP in constant 1976 prices has fallen from 41.6 percent in 1976 to 32 percent at present. Agricultural productivity and output have failed to keep pace with domestic demand. Agricultural exports have declined substantially over the last two decades. Haiti is now a net importer of sugar, although it was once a major exporter. Mango has gained in importance as an export crop and is now a major agricultural export commodity.

The agricultural sector is faced with many constraints. Deforestation has taken its toll. Less than 2 percent of the slopes are still covered with forest. As a result of the deforestation, erosion has severely affected agricultural production. The World Bank (1985) estimates that 40 percent of the total hillside area of Haiti has been denuded of soil. It is estimated that 10 to 15 thousand hectares are lost each year due to erosion. The decrease in soil fertility, combined with the increased population pressure, has led to more intense exploitation of the diminishing amount of land available, as well as the exploitation of marginal lands, even further increasing the degradation of this natural resource. The average farm size is declining rapidly. It is estimated that 80 percent of the farms are less than 1.5 hectares in size.

The purchasing power of rural Haitians has declined over the years. The swine eradication program was a severe blow. These animals were the farmers' "bank," and could be turned into cash when needed. There are no financial institutions in the rural areas to provide farmers with an alternative savings possibility. Trees are more and more considered as a way of generating money when required. Trees can be easily turned into charcoal, or sold as poles. Farmers are often forced to sell off most of their crops at harvest time at low prices in order to meet debt repayments and to pay for school fees. Family food has to be purchased in the course of the year at substantially higher prices, increasing the farmers' debt. It is estimated that 50 percent of the rural population suffers from some form of malnutrition.

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PROJECT HISTORY

The Agroforestry Outreach Project (AOP) was authorized in September 1981 and came to an end in December 1989. The project has been extremely successful and has far exceeded initial expectations. The AOP tree planting activities were primarily implemented by CARE and the Pan American Development Foundation (PADF).

During the AOP, substantial amounts of data were, and are still being, collected. To date, no thorough economic analysis of the benefits of the AOP project has been carried out; the economic analysis carried out by the University of Maine research team is the most complete analysis. The same team also provided valuable socioeconomic and marketing data. It is expected that the SECID/Auburn University research team will have completed a detailed economic analysis by the end of 1989. Primary data have been collected by the team's resource economist on a wide range of socioeconomic factors (Street 1989).

Because the AOP is active in many regions in Haiti, each with its own specific climatological conditions, and because many different farming systems are practiced in order to optimize the use of the different types of soil, it will be extremely complicated to properly assess and quantify the economic benefits of the AOP project.

Due to the success of the AOP, the U.S. Agency for International Development (USAID) has made $30 million available for a follow-on project, the National Program for Agroforestry (NPA). The NPA will be designed based on the successes of the AOP, incorporating the lessons learned.

METHODOLOGY

The geographical spread of the AOP activities is such that months of fieldwork would be required to properly assess the economic and financial benefits of the AOP. Over 20 different cropping systems are practiced (Grosenick 1986). Soil conditions vary considerably from farm to farm, and also from region to region. Great variations in rainfall exist between the regions, affecting agricultural production systems.

Because of the complex nature of the proposed project and the time constraints faced, simplified economic and financial analyses will be performed. The economic analysis will take an extremely conservative approach, quantifying only one set of benefits resulting from the project, while the other benefits will not be quantified. All the incurred project costs, including in-country overhead, research, and extension, will be charged against a single benefit, namely the economic value of the trees and products derived from trees produced under the NPA. The calculated economic internal rate of return (IRR) will, therefore, grossly understate the real economic IRR.

The analyses carried out are based on existing AOP data, complemented by data collected during fieldwork and interviews with AOP grantee project staff. Due to national holidays (Carnival) and political turmoil, fieldwork had to be limited to eight days. During these eight days, interviews were conducted with six farmers in three regions, eight nurseries in various regions of the country were visited, nursery managers were interviewed, and meetings were held with CARE and PADF field staff. Fieldwork was equally divided between the CARE and PADF regions. The aim of the fieldwork was to verify existing data, and to collect additional data.

SECTION TWO

FINANCIAL ANALYSIS

This section will briefly analyze the costs incurred under the AOP and the projected NPA costs based on the prepared budget. However, this section will concentrate on the production costs at nursery level, using three different containers under identical conditions, and will compare the cost of producing one seedling in a CARE nursery with the cost of production in a PADF nursery. Also, an attempt will be made to indicate what the potential financial benefits could be to the individual farmer growing trees on his land, using a theoretical approach and calculations based on field observations.

DESCRIPTION OF PROJECT COSTS

PADF

PADF data show that the expenditures from 1981 through 1988 were as follows:

TABLE 5

BREAKDOWN OF PADF EXPENDITURES UNDER THE AOP

	Total Expenditures	Percentages
Personnel (expat. and local)	3,222,309	34.25
Material	1,628,479	17.31
Training/doc.	78,209	0.83
Head office direct cost	139,402	1.48
Overhead	1,402,287	14.90
NGO Subproject (seedl. purch.)	2,938,111*	31.23
Total	9,408,797	100.00

* 75 percent of these costs are for nongovernmental organization (NGO) personnel.

The financial cost per seedling produced under the PADF program from 1982 through 1988 is $0.30. The cost is $0.75 per surviving tree, 40 percent of seedlings produced. That costs are rising is evident: the cost per estimated surviving tree, planted in 1989, is $0.088.

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CARE

The CARE 1988 annual report indicates the following breakdown:

TABLE 6

BREAKDOWN OF CARE'S 1988 EXPENDITURES UNDER THE AOP

	1988 Expenditures	Percentage
Personnel and operations	907,744	65.34
Materials and equipment	323,913	23.32
Training	39,931	2.86
Overhead	117,495	8.46
Total	1,389,083	100.00

The financial cost to produce one seedling was substantially higher in the CARE regions. This amounts to $0.49 per seedling or $1.23 per surviving tree. It must be noted that the CARE area suffered badly from the political turmoil in 1987. The financial cost per CARE seedling produced during 1988 was $0.52.

The above cost per seedling calculations assume that all costs incurred are linked to the production of hardwood seedlings. However, this is not the case. Considerable time and effort are devoted to extension, training, and the planting of hedgerows. Data are insufficiently broken down to get a clear picture of what can be attributed to which activity. The financial analysis section will provide a more detailed picture about the seedling production costs at nursery level.

Another explanation for CARE's higher per seedling cost is the fact that the area in which CARE operates is quite different from the regions in which PADF works. Access to the area is difficult due to the poor infrastructure. CARE handles its own seedling production, while PADF purchases seedlings from local nongovernmental organizations (NGOs). These NGOs carry the risk in case of production failures. PADF's seedling purchases have been approximately three times higher than CARE's output over the same period of time, so economies of scale also play an important role.

Summary

Tables 7-10 in the section dealing with nursery costs show that the nursery gate cost of producing one seedling ranges from $0.05 to $0.08. This price excludes the cost of supervision of senior project staff.

The financial cost of producing approximately 50 million seedlings under the NPA will therefore be around $4 million at 1989 prices. The economic cost will be substantially lower when labor costs are adjusted to their opportunity cost.

The remainder of the planned expenditure of $3.0 million will be used for training, extension work, research, technical assistance, operation and maintenance of grantee vehicles and offices, and grantee head office overheads.

NURSERY PRODUCTION COSTS

During the AOP, a lot of time and energy went into improving decentralized nursery production of seedlings with the aim of achieving the lowest possible production cost for the highest quality. Three types of containers are presently in use: Rootrainers, Winstrips, and plastic sacks. Each of these types has its advantages and disadvantages, discussed in detail in the report on the agroforestry component.

Rootrainers last an average of four production seasons. The present Cost Insurance and Freight (C.I.F.) price of this container is $130 per box of 2,500 cells, or $0.052 per cell. Each cell can produce four seedlings, so the use of this type of container costs $0.013 per produced seedling. Rootrainers need special racks to hold them, which cost approximately $0.002 per seedling produced.

Winstrips can be used for a minimum of 16 production seasons. The cost of this container amounts to $0.005 per seedling produced. Winstrips can be placed on simple tables.

Sacks cost around $7.50 per 1000. They can be used only once, and the cost per seedling is therefore $0.0075. Ideally they are placed on concrete slabs, to prevent the roots from growing into the soil. They require approximately three times as much soil, twice as much labor, and are more expensive to transport from the nursery to the farm, when compared with Rootrainers.

Another important cost is potting soil. Experiments are going on to replace the imported GRO-mix with locally produced soil mixes. These are still mixed with GRO-mix, usually in the ratio of one to one. One bale of 113 liters of GRO-mix costs $19 C.I.F. Port-au-Prince, while a similar quantity of so called CARE-mix costs $5.60 to produce. CARE tests have shown that seedlings produced with the CARE-mix are of satisfactory quality (Van Schaik 1988). The tables below present a comparison between the costs of using plastic sacks, Rootrainers, and Winstrips.

TABLE 7

COST COMPARISON FOR VARIOUS SEEDLING CONTAINERS
AT DOS D'AN NURSERY (CARE)
(Production: 400,000 seedlings per year.
Type of container: Rootrainer, deep 5s)

	Total Cost	Percentage	Per Seedling
Personnel	$ 10,885	47.33	0.0272
Rootrainer (write off: 4 seasons)	5,200	22.61	0.0130
Potting soil (50 - 50 mix)	2,400	10.43	0.0060
Watering costs	2,000	8.70	0.0050
Write off small equipment and racks	1,000	4.35	0.0025
Various costs (shading)	800	3.48	0.0020
Transport costs for inputs (estimate)	715	3.10	0.0018
Supervision CARE personnel	p.m.		
Land	p.m.		
Total	$ 23,000	100.00	0.0575

Source: Calculations based on information obtained during fieldwork

TABLE 8

COST COMPARISON FOR VARIOUS SEEDLING CONTAINERS
AT DOS D'AN NURSERY (CARE)
(Production: 400,000 seedlings per year
Type of container: plastic sacks, 300 ml)

	Total Cost	Percentage	Per Seedling
Personnel	$ 18,510	54.59	0.0463
Plastic bags (300 ml)	3,000	8.85	0.0075
Potting soil (50 - 50 mix)	7,200	21.23	0.0180
Watering costs	500	1.47	0.0013
Write off small equipment	200	0.59	0.0005
Various costs (shading)	2,400	7.08	0.0060
Transport costs for inputs (est.)	2,100	6.19	0.0053
Supervision CARE personnel	p.m.		
Land (3 times surface)	p.m.		
Total	$ 33,910	100.00	0.0848

TABLE 9

COST COMPARISON FOR VARIOUS SEEDLING CONTAINERS
AT DOS D'AN NURSERY (CARE)
(Production: 400,000 seedlings per year
Type of container: Winstrip)

	Total Cost	Percentage	Per Seedling
Personnel	$ 10,885	56.39	0.0272
Winstrips (write off: 16 seasons	2,000	10.36	0.0050
Potting soil (50 - 50 mix)	2,400	12.44	0.0060
Watering costs	2,000	10.36	0.0050
Write off small equipment	500	2.59	0.0013
Various costs (shading)	800	4.15	0.0020
Transport costs for inputs (est.)	715	3.71	0.0018
Supervision CARE personnel	p.m.		
Land (3 times surface)	p.m.		
Total	$ 19,300	100.00	0.0483

The above calculations do not include provisions for risk, nor are interest charges included as a cost.

TABLE 10

BREAKDOWN OF COSTS FOR LIANCOURT NURSERY (PADF)
(Production: 43,000 seedlings per season
Container: Rootrainer deep 5)

Item	Investm. (US $)	Est. Life (seasons)	Cost/ Season (US $)	Percent	Cost Per Seedling
Fixed Costs					
Warehouse	1,000	20	50	1.47	0.0012
Shadehouse	435	12	36.25	1.07	0.0008
Shadecloth	328	6	54.67	1.61	0.0013
Plastic	270	3	90	2.65	0.0021
Rack frames	602	8	75.25	2.21	0.0018
Racks	138	4	34.50	1.01	0.0008
Small equipment	100	4	25	0.74	0.0006
Rootrainers	2,632	4	658	19.35	0.0153
NGO nursery mgmt			1,020	30.00	0.0237
PADF supervision	p.m.		p.m.		
Land	p.m.		p.m.		
Subtotal	5,505		2,043.67	60.10	0.0475
Variable Costs					
Fert./Agro chemicals			40	1.18	0.0009
Potting soil (imported GRO-mix)			480	14.12	0.0112
Seed			20	0.59	0.0005
Part time labor			585	17.21	0.0136
Transportation of inputs (estimate)			200	5.88	0.0047
Various			30	0.88	0.0007
Subtotal			1,355	39.85	0.0315
Grand Total Per Season			3,398.67	100.00	0.0790

In brief, production systems using Winstrips are the cheapest, while sacks are the most expensive. The main reasons that sacks are the most expensive are that the 300 milliliter sack uses three times as much soil and twice as much labor, transportation costs of inputs to the nursery are three times as high, and seedling distribution costs are higher when compared with the Rootrainers. From the above tables, it is also evident that personnel, seedling container, and potting soil count for approximately 80 percent of the cost of production in the case of a production system using Rootrainers.

The CARE nurseries require little in terms of investment, other than the equipment directly used for the production of seedlings. The main difference between the CARE and the PADF nurseries is that PADF nurseries have specially built warehouses and shadehouses, required because of climatological conditions. CARE nurseries use palm leaves for shading and a simple wooden shed as a warehouse.

For a nursery with a production capacity of 43,000 seedlings per season, one shade tunnel of 6 by 13.5 meters is required, costing $1,100. The warehouse would cost $1,000 to build in 1989.

With a production level of 40,000 seedlings, as a result of a lower survival rate, the cost would be $0.083 per seedling in the same nursery.

These per seedling costs are identical to those of the nursery of the Centre Agricole in Quartier Morin, which had an output of 292,000 seedlings during the fall 1988 season.

All the above calculations have assumed that land is available at no cost, and that the only water costs are those of labor needed to water the seedlings. The surface required for a 40,000-seedling-per-season nursery is relatively small, but the land used has to be flat and near a water source. Many PADF nurseries have piped water from deep wells which could add $0.005 to the cost of producing a seedling. This means that the opportunity cost of this land is probably high, since it could be used to produce vegetables or other higher yielding agricultural crops. The same is true for water, particularly in the areas with low rainfall. The price of fencing is not included in the cost calculations.

A comparison of the costs per cost line, when expressed as percentages of total production costs, between the CARE Rootrainer nursery and the PADF Rootrainer nursery shows the following:

TABLE 11

PERCENTAGE COST COMPARISON BETWEEN CARE AND PADF NURSERIES

	CARE Percentage	PADF Percentage
Personnel (incl.water)	56.06	46.21
Rootrainers	22.61	19.35
Potting soil	10.43	14.12
Racks	4.35	3.33
Shading	2.24	6.99
Transportation	3.10	5.88
Various	1.21	4.12

The CARE nursery produces five times more than the PADF nursery and has a much higher level of supervisory staff, one manager with two assistants and two permanent employees. Water haulage costs are high at the CARE nursery. The PADF nursery is still using the 100 percent imported GRO-mix,

while CARE is using a mixture that includes 50 percent GRO-mix and 50 percent CARE-mix. Shading costs are much higher at the PADF nurseries due to the shadehouses. The transportation costs of inputs for the nurseries are the consultant's best estimates.

Production costs vary from nursery to nursery. The majority of the costs are for personnel, Rootrainers, and potting soil — 80 percent in the PADF example, and 88 percent in the CARE example. Economies of scale are thought to play a role, although the nursery of the Centre Agricole at Quartier Morin is not producing at a lower cost than the Liancourt nursery. This can be partly explained by the fact that part of an expatriate's salary — $0.016 per seedling — is included in the cost of the Centre Agricole nursery. Also, investments in watering systems and other infrastructure were substantially higher.

The payment of $0.08 per seedling by PADF to the cooperating NGOs does not cover any risks nor does it sufficiently reimburse management time of senior NGO staff.

The substantially lower production costs of the CARE nursery are probably due to economies of scale, and very low investment costs.

FINANCIAL BENEFITS TO PARTICIPATING FARMERS

Little is known about tree yields in the various regions of the country. The Auburn research team is in the process of collecting these data, and towards the end of 1989 more results should be available.

Data collected during fieldwork, and collected by other researchers (McGowan 1986), indicate that the primary aim of tree-growing farmers is to use these trees for their own use as posts, poles, and boards for the construction of homes for themselves and their children.

Posts that can be used as support structures can be sold at a premium. Five-year-old trees with a Diameter at Breast Height (DBH) of 15 centimeters can fetch $3 each, as opposed to smaller poles, that sell for $1. Pole prices in rural areas tend to be higher than in urban areas. In urban areas people pay $0.60 for a pole with a DBH of 9 to 12 centimeters while the same size pole would fetch $1.10 in rural areas (McGowan 1986). Larger, 10-year-old trees sell at a premium if they can be used to make boards. These trees can fetch up to $8 each.

Due to the fact that few farmers are selling off poles or posts, there are few reliable data about the market value of these products. The price of imported timber is $0.90 per board foot in Port-au-Prince. In the rural areas, locally sawn oak boards can be purchased for $0.60 per board foot — the price quoted in Limbé. A post measuring 300 by 10 by 10 centimeters equals approximately 13 board feet and would therefore have a potential value of $7.80 when expressed in locally produced board foot prices. Other varieties that are more commonly planted, like *Leucaena*, are usually of lesser quality and may fetch lower prices. The price per board foot would be around $0.40 (personal communication, Dr. Street).

Under the AOP, farmers receive 125 tree seedlings each for planting. Assuming that 40 percent of these will grow into mature trees, farmers are left with 50 trees occupying a total of 0.02 hectares.

Data about the age of the trees when cut indicate that farmers have not adopted a standard tree management pattern as far as harvesting is concerned. The value of the tree increases over time, so the farmer is not foregoing income by delaying the harvest of his trees, but merely leaving it in his "bank" where it gains in value.

For the purpose of this study, it is assumed that the farmer will harvest his trees four times over the economic tree life of 20 years. It is also assumed that half of the trees will be used to make charcoal, while the other half will be sold as posts.

Table 12 presents a theoretical model of the value of production a farmer can expect if he plants *Leucaena leucocephala*.

TABLE 12

PRODUCTION DATA FOR *LEUCAENA LEUCOCEPHALA* USING A DERIVATION TABLE

Technical Data

- Trees are planted in dispersed manner
- DBH after 5 years = 15 cm
- Charcoal conversion factor is 20% by weight

Yield Data

- Fuelwood production: 2,420 kg @ 0.2 = 484 kg of charcoal
- Post production: 2,250 kg = 3.214 m^3 (stacked)= 950 brd ft, which would be the equivalent of 50 posts of 400 X 10 X 10

Financial Data

• 484 kg of charcoal = 16 bags of 30 kg @ $ 2.50	=	$ 40.00
• 50 post @ $ 3.00	=	$ 150.00
Remuneration for labor and land (0.02 ha)		$ 190.00

Source: Timyan 1987

The return per hectare every five years would be 50 x $190 = $9,500, or $1,900/ha/yr.

The above approach assumes that trees are planted in a dispersed manner, or relatively few trees per hectare, which is usually the case in Haiti. If the maximum planting configuration of 2,500 trees per hectare would be applied, the estimated yield would be substantially lower and would be approximately $1,000 per hectare.

The above yield data are based on derivation tables prepared using tree yield data from the Madsen tree farm near Port-au-Prince. In the consultant's opinion, based on field observations, these tables should not be applied to trees grown under peasant conditions. Tree management techniques at that level are not yet sufficiently developed, and it is unlikely that 50 marketable posts can be produced under those conditions.

From data collected during fieldwork in Northwest Haiti, the consultant has derived the following calculation: using the same 50 *Leucaena leucocephala* trees, harvested at five year intervals, it is assumed that half the trees will be used to make charcoal, and that the other half will be sold off as posts.

TABLE 13

ESTIMATED PRODUCTION DATA FOR
LEUCAENA LEUCOCEPHALA PLANTED ON-FARM

The value of production per five years would be:	
25 trees and branches and tops of trees sold as posts; yield 5 bags of charcoal @ $ 2.50	$ 12.50
25 trees sold as posts @ $ 3.00	$ 75.00
Total	$ 87.50

When expressed on a per hectare basis, the value of production would be $4,375 over five years, or $875 per year per hectare. The value of production of one hectare of fertile land, growing maize intercropped with beans, would be around $400 (Grosenick 1986). Tree lots are primarily established on marginal lands, where it would not be feasible to cultivate other crops. However, many trees are planted as border plantings or planted in gardens where growth rates may be higher.

From the above calculations, it is clear that producing trees is an attractive enterprise from the farmer's perspective. Labor requirements are minimal, and it can even be argued that time is saved because the farmers can use the wood from pruning for firewood, which otherwise might have to be collected from a much greater distance. Trees allow farmers to make marginal lands productive again.

The success of the AOP confirms this. AOP experience has shown that farmers often become repeat planters.

Observations in the Northwest indicated that on-farm tree propagation is also rapidly expanding, increasing the number of planted trees. This was also communicated by one of the regional managers from the Southwest. This is an indication that farmers have started to think of trees as a crop they can grow themselves and promises a certain level of sustainability of tree planting once the project stops. However Auburn researchers have not found this to be true during their field studies of some 100 farms (personal communication, Dr. Street).

In certain areas of the country, trees are used as firewood to produce limestone. Limestone can fetch attractive prices, and the yield per eight-year-old tree used to transform the rocks into limestone is approximately $10. Costs of labor required to haul the rocks necessary to make the limestone are not accounted for. These trees also have a high opportunity cost as saw timber.

Other studies indicate that under optimum circumstances, tree farming can be a very profitable enterprise indeed, as is borne out in the following table, which is based on data obtained at the ODH Cazeau estate near Port-au-Prince, where charcoal prices are high:

TABLE 14

VALUE OF PRODUCTION FROM AN INDUSTRIAL-TYPE TREE PLANTING

Technical Data	
Species planted: *Casaurina equisetifolia*	
Moderate productive land (good for growing sugar cane)	
Rainfall: minimum of 1100 mm/yr	
Trees planted at 1.7m X 1.7m spacing	
Assuming 10% mortality, this would give 3,114 trees/ha.	
Projected diameter (DBH) growth rate = 3.5 cm/year	
Charcoal conversion factor = 25% by weight	
Volume estimates derived from actual 5-year growth of trees at the ODH Cazeau site, using UMO volume table derivations (1986)	
Financial data	
Pole income	
Thin at 2.5 years. Cut 1,557 trees/ha @ $0.50	$ 778
Labor costs	$ 155
Net income	$ 623
Charcoal income	
Clearcut after 5 years. Final average DBH = 18 cm	
One 18 cm tree = 108 kg X 1,557 = 168,187 kg/ha, which yields 42,047 kg of charcoal or 2,102 bags of 20 kg. 2,102 bags X $4	$ 8,409
Labor	$ 3,784
Net income	$ 4,625
Total income per ha per 5 years or $1,050/ha/year. Cost of labor = $788/year	$ 5,248
Return for labor, cost of capital and land/year	$ 1,838

Source: Josiah 1987

Using the above data, the financial rate of return to the farmer owning this land would be close to 100 percent.

CONCLUSION

The above calculations have clearly demonstrated that management techniques as well as soil and climatological conditions, play an important role in the profitability of tree farming. The species planted is also of crucial importance. However, there is no doubt about the profitability of tree farming. The application of derivation models to calculate tree production figures under peasant conditions seems to overestimate yields substantially. Table 12, using the derivation model, calculates the value of production of trees grown under peasant conditions to be around $1,900/ha/year as remuneration for labor and land, whereas the consultant's calculation estimates this to be around $857/year. Farmers could add to the value of their production by using trees to make limestone, which is only possible in certain areas of the country, or by letting them grow to the stage where they can be used to make boards. From these illustrative calculations, it is also evident that very little is known about production rates, values of production, and the use of trees.

SECTION THREE

ECONOMIC ANALYSIS

Economic analysis compares costs with benefits and determines whether the project has an acceptable return to the nation as a whole. In other words, the nation is treated as an enterprise that has to decide about the best allocation of available funds. The cut-off rate is the rate below which a project is considered unacceptable from an economic viewpoint. The cut-off rate is usually the opportunity cost of capital.

Financial prices are adjusted to reflect their true value to society as a whole in terms of both the inputs and outputs of the project. For example, overvalued currencies are adjusted to reflect their real value, salaries are adjusted to reflect the opportunity cost of labor, and project outputs are expressed in market prices, usually an adjusted C.I.F. value for identical products. Subsidies and taxes are eliminated since these are direct transfer payments. This process is also called shadow pricing.

ASSUMPTIONS AND DEFINITIONS

For the purpose of this analysis, several assumptions had to be made due to the absence of reliable data. These assumptions are set out below, as well as a number of definitions used. Some of these will be discussed on the following pages.

- The cut-off rate — opportunity cost of capital — is set at 12 percent.
- The gourde is estimated to be overvalued by 25 percent.
- The opportunity cost of unskilled labor is estimated at $0.50 per day.
- Fuel — gasoline and diesel — prices have been adjusted to their C.I.F. Port-au-Prince values, eliminating taxes and company profits.
- The value of charcoal is expressed in equivalent C.I.F. gas values.
- Posts are expressed in C.I.F. values for imported logs.
- Under the NPA, 10 million trees annually will be planted.
- All trees planted are coppicing trees.
- 40 percent of the planted seedlings will grow into mature trees.
- Trees will be harvested once every five years. Four harvests will be possible during the tree's economic life of 20 years.

- Half of the total marketable tree biomass will be posts, while the other half will be converted into charcoal.
- Each hectare, planted with 2,000 trees, will yield 8 m^3 of wood per year.
- Only the production of charcoal and posts from project trees will be treated as a project benefit in the economic analysis.
- All the incurred project costs will be offset against the above-described benefits resulting from the project.
- The opportunity cost of land on which trees are planted is zero. Approximately 25 percent of the trees are planted on land that is also used for agricultural production. These trees are usually planted and maintained in such a way that agricultural production can continue and may even benefit from the planted trees.

Estimated Economic Value of Charcoal

One kilogram of charcoal, air dry, yields 24,090 British Thermal Units (BTUs) compared to 91,044 BTUs from one gallon of propane gas. It therefore requires 3.78 kg of charcoal to obtain the same amount of BTUs produced by one gallon of propane gas.

The C.I.F. Port-au-Prince value for propane gas is $0.53/gallon. It is the most widely used alternative source of fuel for cooking, and most likely to replace charcoal in case of a severe charcoal shortage. It can therefore be stated that the economic value, or opportunity cost, for one 30-kilogram bag of charcoal is: (30 kg : 3.78 kg) X $ 0.53 = $4.21. Transportation and handling charges to Port-au-Prince, from the major producing area in Northwest Haiti, amount to $1.20/bag. The economic farmgate value of one bag of charcoal is therefore $3, or $100 per metric ton.

Estimated Economic Value of Logs

Based on a Free On Board (f.o.b.) price of $290/$m^3$ for Merranti logs, the estimated C.I.F. price Port-au-Prince is $340 (World Bank Quarterly Price forecasts, October 1988). Allowing for an average transportation cost from the production areas to Port-au-Prince of $75/$m^3$, the average economic farm gate price would be $265/$m^3$. One m^3 equals 444 board feet. The economic value of one board foot is therefore $0.60, which equals the current market rate for locally produced oak boards.

Economic Value of Gasoline and Diesel

The A.I.D. Petroleum Status Report (Caprio 1989) provides the C.I.F. values for imported petroleum product. These are: gasoline — $0.55, and diesel — $0.54.

PROJECT BENEFITS

Quantifiable Benefits

Over the five-year life of the project (LOP) approximately 50 million trees will be planted, benefiting an estimated 400,000 peasants. It is expected that approximately 40 percent of these trees, or 20 million, will mature into fully grown trees. AOP experience has shown that farmers do not harvest trees when they are large enough to be cut, but prefer to let them grow longer. For the purpose of this study, it is assumed that trees will be cut once every five years. Delaying harvest increases the value of a tree because the tree can be sold and transformed into higher value products, such as boards.

Although growth rates will differ substantially from area to area, it is assumed that, with a planting density of 2,000 trees/ha, that average yields will be 8 m^3/ha/year. The 20 million trees will cover the equivalent of 10,000 ha, once the project activities stop. Half of the tree production will be turned into charcoal, while the other half will be sold or used as posts. Based on this assumption the following values of production, when expressed in economic values, will be obtained:

TABLE 15

ECONOMIC VALUE OF PRODUCTION

Charcoal
Total fuelwood: 4 m^3 × 10,000 ha = 40,000 m^3 × 0.7 = 28,000 t
Total quantity of charcoal: 28,000 t × 20 % = 5,600 t
Total value of charcoal 5,600 t @ $100 = $560,000/year, or $2,800,000 every 5 years.

Logs
Total logs: 4 m^3 × 10,000 ha = 40,000 m^3
Total value of logs: 40,000 m^3 × $265 = $10,600,000/year, or $53,000,000 every 5 years.

Economic value of production
The gross total economic value of production for five years is $55,800,000.
The economic cost of required labor for charcoal making and tree felling is $4,217,000.
The net economic value of production for five years is $55,800,000 - $4,217,000 = $51,583,000.

The total estimated economic value of labor ($0.50/day) is based on the time required to produce charcoal and logs as presented in Table 14.

Non-Quantifiable Benefits

Apart from the trees, the project produces a great many other benefits that are difficult to quantify. These benefits include the following:

- **Increased soil fertility.** As a result of the hedgerows seeded on slopes, erosion will be slowed down. Valuable soil nutrients will not be washed away. Water penetration will improve. Organic material from the hedgerows cuttings will be added to the soil above the hedgerows. Yield increases of over 50 percent are reported on slopes benefiting from hedgerows (Street 1989). Fieldwork showed that substantial yield increases may occur on slopes where the top soil has not yet eroded away. Yield increases only occur directly behind the hedgerows, one to two meters uphill. On a per hectare basis and for the total area covered by the AOP, the yield increases resulting from the hedgerows are thought to be substantially lower than 50 percent. Insufficient data are available to quantify these estimated yield increases. It is expected that, over time, now abandoned agricultural land may be brought back into production as a result of hedgerows and trees;

- **Environmental benefits.** Due to the availability of alternative tree sources in the areas covered by the project, existing natural forest in those areas will suffer less. Because of hedgerows and trees, improved microclimates are created, enhancing soil fertility;

- **On-farm propagation of trees.** Fieldwork showed that many farmers are practicing on-farm tree propagation without any training in this field. They are starting to realize that trees can be treated like any other agricultural crop. A conservative estimate is that on farm propagation will increase the total planted number of trees by 20 percent;

- **Labor savings.** Since farmers have easy access to fuel wood, less time is required for collecting it. This is particularly important during times of peak labor demand;

- **Improvements in the quality of life.** Due to the possibility of turning trees into cash, farmers can pay for schooling of their children that will result in a higher quality work force. The possibility to purchase food to supplement the diet will improve health. Farmers can use the trees to build improved homes for their families. A relatively small number of fruit trees will enhance the diet of the families planting these trees. Also the sale of fruit can be quite profitable. The biointensive gardens will provide vegetables to supplement the family diet. Surplus vegetables can be sold, providing more cash;

- **Increased agricultural production.** The introduction of improved agricultural techniques such as contour planting, mulching, use of manure, and on-farm seed selection and storage will increase agricultural production. Slopes planted with hedgerows will benefit from these techniques; and

- **Income distribution.** Income from trees will help to improve income distribution.

PROJECT COSTS

The total cost of the project will be adjusted to reflect the true cost to society.

Labor

Tables 7-10 show that labor costs for producing one seedling are $0.0322. The labor costs to produce 10 million seedlings per year would therefore be $322,000 in financial terms ($3/laborer/day). Applying the economic cost of labor, this cost would be $53,667. The difference is $268,333.

Assuming that one person can plant 200 seedlings per day, the economic cost of planting 10 million seedlings would be $25,000.

Fuel

Project vehicles and motorcycles are estimated to use $150,000 worth of fuel per year. Half of this is thought to be diesel. The economic value of this fuel, or the C.I.F. value, would be gasoline — $21,154, and diesel — $26,298, for a total of $47,452.

The difference between the financial and economic cost is $102,548 per year.

Adjusted Annual Project Cost

The total estimated annual project expenditure would therefore have to be adjusted as follows:

$ 6,000,000+
$ 268,333-
$ 102,548-
$ 25,000+
$ 5,654,119 = annual economic project cost

THE ECONOMIC INTERNAL RATE OF RETURN

The calculated economic IRR using Lotus 1-2-3 is 33 percent. The sensitivity analysis shows that a 10 percent reduction in project benefits will lower the IRR to 30 percent. An increase in project costs of 10 percent still yields an IRR of 30 percent. The Net Present Value at the cut-off rate of 12 percent is over $44 million. All these calculations are based on the sole benefit of the estimated number of trees produced under the NPA. The real IRR of the proposed project is therefore substantially higher. These calculations are detailed in Table 16.

From an economic viewpoint, the decision to go ahead with this project is fully justified.

TABLE 16

INTERNAL RATE OF RETURN CALCULATIONS
(in $ '000)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
BENEFITS																					
Charcoal	0	0	0	0	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800
Logs	0	0	0	0	10600	10600	10600	10600	10600	10600	10600	10600	10600	10600	10600	10600	10600	10600	10600	10600	10600
Totals	0	0	0	0	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400
COSTS	5654	5654	5654	5654																	
CASH FLOW	-5654	-5654	-5654	-5654	7746	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400	13400

IRR	0.328
NPV, 12%	43227
NPV, 24%	6496

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