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UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
Washington, D.C. 20523

HAITI

PROJECT PAPER

TARGETED WATERSHED MANAGEMENT

AID/LAC/P-347

Project Number:521-0191

UNCLASSIFIED

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Amendment Number

DOCUMENT CODE: 3

2. COUNTRY/ENTITY: HAITI

3. PROJECT NUMBER: 521-0191

4. BUREAU/OFFICE: USAID/HAITI — 5

5. PROJECT TITLE (maximum 30 characters): TARGETED WATERSHED MANAGEMENT

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 09 DD 30 YY 91

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)
A. Initial FY 86 B. Quarter 4 C. Final FY 90

8. COSTS ($000 OR EQUIVALENT $1 =)

A. FUNDING SOURCE	FIRST FY B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total	1,500		1,500			15,000
(Grant)	(1,500)	( )	(1,500)	( )	( )	( )
(Loan)	( )	( )	( )	( )	( )	( )
Other U.S. 1.						
Other U.S. 2.						
Host Country		300	300		1,000	1,000
Other Donor(s)						
TOTALS	1,500	300	1,800			16,000

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
						15,000		15,000	
TOTALS						15,000		15,000	

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 050 | 070 | 020

11. SECONDARY PURPOSE CODE: 213

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)
A. Code: BS | R/AG
B. Amount:

13. PROJECT PURPOSE (maximum 480 characters)

TO EXTEND SOIL-CONSERVING AND FERTILITY-AUGMENTING LAND MANAGEMENT PRACTICES IN THE PIC MACAYA WATERSHEDS AND TO APPLY LESSONS LEARNED FROM THIS FIELD EFFORT TO NATIONAL-LEVEL HILLSIDE MANAGEMENT PLANNING.

14. SCHEDULED EVALUATIONS
Interim MM 10 YY 83 | MM YY | Final MM 10 YY 90

15. SOURCE/ORIGIN OF GOODS AND SERVICES
[X] 000 [ ] 941 [X] Local [ ] Other (Specify)

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ____ page PP Amendment)

I HAVE REVIEWED AND APPROVED THE METHODS OF IMPLEMENTATION AND FINANCING FOR THIS PROJECT PAPER.

CONTROLLER, USAID/HAITI

17. APPROVED BY
Signature: GERALD ZARR
Title: MISSION DIRECTOR
Date Signed: MM 09 DD 03 YY 86

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION
MM DD YY

AID 1330-4 (8-79)

AUTHORIZATION

Country	:	Haiti
Proj ct Name	:	Targetted Watershed Management
Project Number	:	521-0191

1. Pursuant to Section 103 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Targetted Watershed Management project for Haiti, involving planned obligations of not to exceed Fifteen Million United States Dollars (US$15,000,000) in grant funds over a six-year period from the date of authorization, subject to the availability of funds in accordance with the AID OYB and allotment process, to help in financing foreign exchange and local currency costs for the project. The planned life of the project is six years from the dat of obligation.

2. The project consists of assisting the Government of Haiti to strengthen the institutional capability of the MARNDR to plan and implement, on a sustained basis, the ecolocigally sound developmc :t of Haiti's waterhed basins.

3. The Project agreement, which may be negotiated by the person to whom such authority is given, will be subject to the following essential terms and conditions, together with whatever other terms and conditions as may be deemed appropriate:

   A. Conditions Precedent. Prior to any disbursement, or the issuance by AID of any commitment document pursuant to which disbursement will be made, Grantee will, except as AID may otherwise agree in writing, provide to AID, in form and substance satisfactory to AID:

      (a) An opinion of the Minister of Justice of the Republic of Haiti or other counsel acceptable to AID that this Agreement has been duly authorized or ratified by, and executed on behalf of, the Grantee and that it constitutes a valid and legally binding obligation of the Grantee in accordance with all of its terms;

(b) A statement of the name of the person holding or acting in the office of the Grantee specified in Section 8.3 and of any additional representatives, together with a specimen signature of each person specified in such statement; and

(c) Evidence that a full-time project director has been appointed.

B. Covenants

During the life of the project, Grantee will exercise its best efforts to take those legal, regulatory and/or other appropriate steps necessary to:

(1) reinforce laws and customs which protect small farmers;

(2) encourage renters or share-croppers of state lands to undertake soil conservation measures;

(3) eliminate the tax on cutting trees that farmers have planted themselves;

(4) develop laws that will ensure that the person who makes land improvements (including tree plantings and soil conservation measures) is compensated for the increased value due to those improvements;

(5) establish a national policy for all hillside projects concerning the uses of food for work and payments to farmers for work on their own land;

(6) vigorously pursue the suppression of the trade in charcoal and lumber originating from illegal cutting on the Pic Macaya Reserve area;

(7) actively implement the program for the preservation of the flora and fauna of the Pic Macaya Reserve as established;

(8) establish a national park service in the Pic Macaya Park to guard existing resources and regenerate the flora and fauna of the zone;

(9) compensate the legal owners of land within the Pic Macaya Reserve boundaries;

(10) give priority, in hiring forest service agents and reforestation program laborers, to local farmers who live near the Reserve's border; and

(11) complete the marking of the Reserve's boundaries as quickly as possible.

Gerald Zapp
Director
USAID/Haiti

SEP 3 1986
Date

DRE:RGyess:rjLabat:twampact:08/27/86

C/RDO, VCusumano
RDO, JVDLewis
DRE, RGilson
CONT, CBrooks
RLA, TCarter

Targeted Watershed Management I (521-0191)

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ACRONYMS USED IN THE PROJECT PAPER

ADS II : Agriculture Development Support II (521-0092)
AID : Agency for International Development
AOP : Agroforestry Outreach Project (521-0122)

BCA : Bureau de Credit Agricole

CARE : Cooperative for American Relief Everywhere
CCH : (Association des) Cooperatives Cafeieres d'Haiti
CEEH : Conseil des Eglises Evangeliques d'Haiti
CICP : Consortium for International Crop Protection
CIMMYT : Centro Internacional de Mejoramiento de Maiz y Trigo
CN : Congressional Notification
CRIES : Comprehensive Resource Inventory and Evaluation System
CRS : Catholic Relief Services

DAEC : Development Assistance Executive Committee of AID/Washington's LAC Bureau
DCCH : Developpement Communautaire Chretien d'Haiti

EPA : Environmental Protection Agency

FAO : Food and Agriculture Organization (of the United Nations)

GOH : Government of Haiti

HAVA : Haitian Association of Voluntary Agencies

IADP : Integrated Agricultural Development Program (521-0078)
IICA : Interamerican Institute for Cooperation on Agriculture
IRD : Integrated Rural Development (a World Concern-supported project)
ISPAN : Institut de Sauvegarde du Patrimoine Nationale
ISRP : Interim Swine Repopulation Project (521-0170)

LAC : Latin America/Caribbean Bureau of AID/Washington
LORG : Local Organization

MARNDR : Ministere de l'Agriculture, des Ressources Naturelles et du Developpement Rural

ORE : Organization for the Rehabilitation of the Environment
OSU-IPPC: Oregon State University International Plant Protection Center

PID : Project Identification Document
PDAI : Projet de Developpement Agricole Integre (521-0078)
PL 480 : Public Law 480 (Food for Peace)
PP : Project Paper
PPMS : Projet Pic Macaya Sud
PSTO : Proje Sove Te Okay

RFTP : Request for Technical Proposal

S&T/AGR : Bureau for Science and Technology, Office of Agriculture
STAB : Technical Secretariat for Watershed Management (Secretariat Technique

de l'Amenagement des Bassins Versants)

SRCS : Strengthening Rural Credit Services (521 0121)

TWM : Targeted Watershed Management I

UMO : University of Maine at Orono

UNESCO : United Nations Educational and Scientific Organization

UNICORS : Union des Cooperatives du Sud Ouest

WHO : World Health Organization

I. PROJECT RATIONALE AND DESCRIPTION

I.A. RECOMMENDATIONS AND SUMMARY

Recommendations. The Project Committee recommends that the Targeted Watershed Management I (TWM) Project be approved for an LOP funding total of $15,000,000 in ARDN grant funds. The detailed project review has demonstrated that the project is technically, ecologically, economically, socially, financially, administratively, and environmentally sound.

The project will be obligate ' via three different instruments:

(1) in Fiscal Year 1986, $1.5 million will be obligated by means of a bilateral grant agreement with the Government of Haiti for the purpose of reinforcing the Technical Secretariat for Watershed Management (STAB) located within the Ministry of Agriculture, Natural Resources and Rural Development (MARNDR). This agreement will cover the five-year life of the project, and will be supplemented by local-currency funds from the Title III program and other donors, as explained further in the body of this paper. The MARNDR will then work with AID to locate a contractor to assist with the implementation the Pic Macaya forest reserve management component (PPMS).

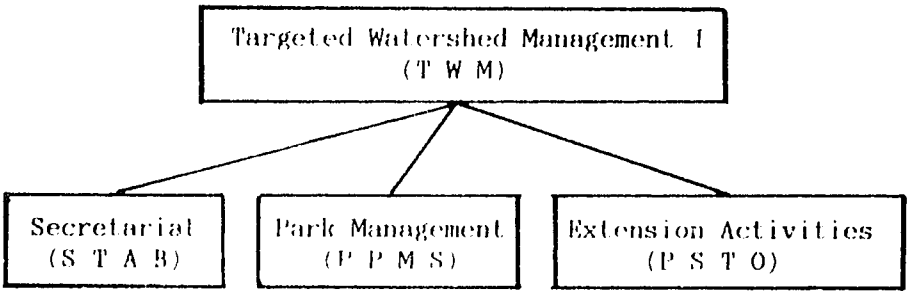
(2) in Fisal Year 1987, the Mission, in consultation with MARNDR, will competitively recruit a US rural development institution (PVO or consulting firm), using an open request for proposals. This RFP will leave the proposing, lead institution the choice of including or not including, other entity, such as a University, as sub-contractor in their bid. The Mission will then sign a $13.0 million contract with this "umbrella organization" to implement the remainder of the project through local PVOs in the target watershed areas. This second contract will provide funding both in support of the umbrella organization's activities and for subgrants to the local organizations. This component of the project will be known as Proje Sove Te Okay (Save the Soil of Cayes), or PSTO.

(3) Also in fiscal year 1987, the mission will recruit a U.S. rural development specialist, through a Personal Services Contract (PSC), as a fulltime project coordinator based within USAID's rural development office (RDO).

Thus, outside of the mission the project (TWM) will have three subcomponents: the Secretariat (STAB), the Pic Macaya park management project (PPMS), and the field activities carried out through NGOs (PSTO), as shown in Figure 1. The first two components will be obligated in Fiscal Year 1986 and the third in FY 1987.

Summary. The Targeted Watershed Management I Project (TWM) will improve agricultural productivity and regenerate soil fertility on the hillsides of the watersheds flowing south from Pic Macaya in the Southern Region of Haiti. This area, which runs from Cavaillon in the east to Les Anglais in the west, encompasses an area of 80,000 hectares and a population of approximately 400,000 people.

Figure 1
PRINCIPAL COMPONENTS



TWM will generate, test and extend a series of integrated technical packages of agricultural and soil conservation measures to 20,000 farm families during its first five years. These packages, adapted to specific agronomic, ecologic and sociological microzones within the targeted area, will include innovative interventions in annual and perennial crop agriculture, including fruit trees, coffee and other export crops, forage crops for an improved animal husbandry, agroforestry, and other income-generating soil conservation measures. Alley cropping between strips of perennial vegetation planted on the contour levels will be an important technical feature of most of these packages.

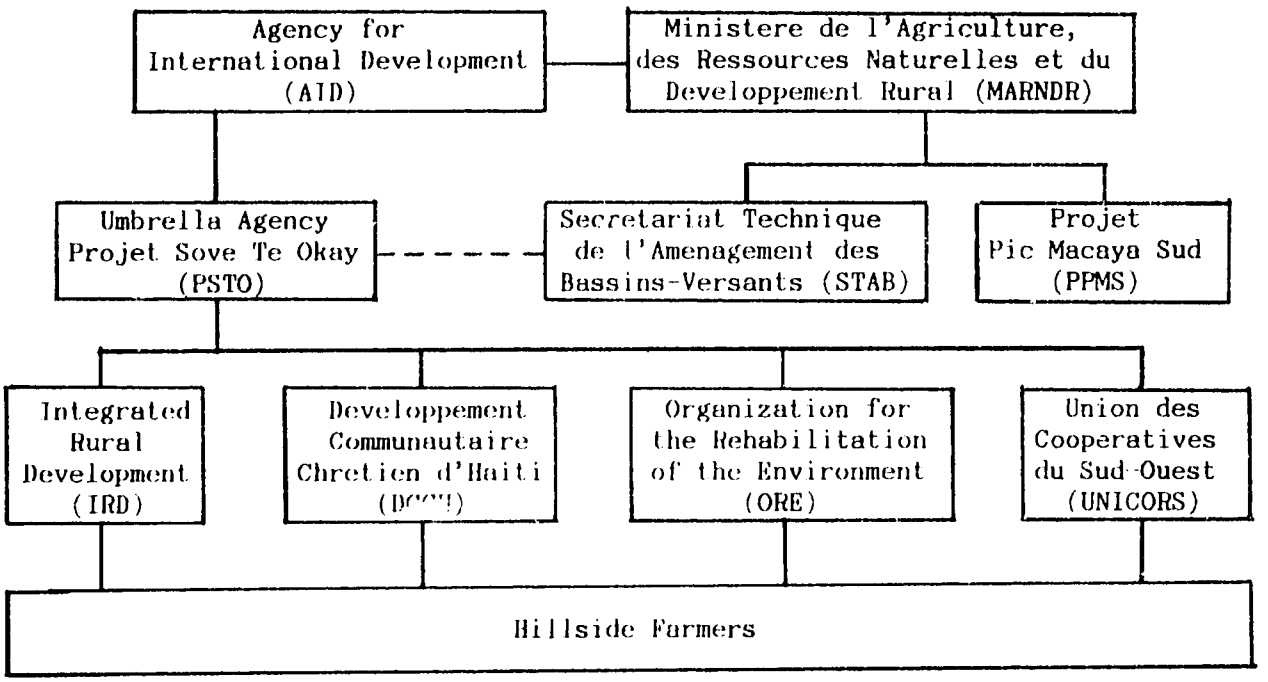
To encourage farmers to adopt the proposed innovations, TWM will establish experimental demonstration sites at 20 locations in the watersheds. These sites will also serve as extension centers. In addition, it will collaborate with local farmers to establish several thousand on-farm adaptive trials. Finally, the project will extend those interventions which are both economically and ecologically sound as widely as possible throughout the watersheds.

AID will sign a contract with an American institution to set up an umbrella agency to implement PSTO. This agency will rent offices in Les Cayes and provide technical assistance and equipment and funds to private organizations in the targetted area. These local organizations will administer the agricultural activities of the project, while the Technical Secretariat for Watershed Management (STAB) their experience to provide information and policy coordination with other entities doing similar work in Haiti. At the same time, STAB/MARNDR links with agricultural research stations around the world will be used to guide the technical content of all of these activities. Finally, another environmentally-oriented PVO will be competitively selected to implement the land management plan for the Pic Macaya Forest Reserve. Figure 2 is an organigram illustrating the administrative arrangement.

The local organizations listed in the organigram have all worked in the rural areas of the Southern Region for a number of years, and represent the best available agencies to execute the TWM program (see Annex J: Administrative Analysis). TWM will encourage the private sector to provide all commercial inputs to the project area, including chemical fertilizers and improved seeds.

Figure 2
ORGANIGRAM

Targeted Watershed Management I



I.B. DAEC REVIEW ISSUES

The DAEC reviewed the PID for this project on February 26, 1986, and gave the Mission authority to approve the Project Paper in the field. The project design as presented in the PID has been modified only slightly in the course of project development. The observant reader will note that the project's goal and purpose have been reversed, in accordance with the Mission's Action Plan goal of arresting the deterioration of the Haitian hillsides.

The AID/W guidance cable (STATE 077946, given as ANNEX A), raised several issues which have been dealt with in this document, as follows:

(1) **Role of the public sector.** The proposed design calls for the involvement of the Ministry of Agriculture in project implementation, although at a scale reduced from that proposed in the PID (which budgeted the public sector component at $2.25 million, whereas the design proposed herein recommends a level of $1.5 million). It was concluded by the Project Committee that the project is not feasible without the direct and continuing involvement of the Ministry in the project. The long-term problems of the Haitian hillsides, which this project is designed to

address, cannot be solved by nongovernmental or voluntary organizations only. The problems of protecting and policing the Pic Macaya park are an example of this principle. The creation of the Watershed Management Secretariat has begun to focus the public sector's attention on the institutional and structural problems of the hillsides, and is an initiative that should be continued and supported. Finally, the inclusion of the Ministry in the project will be viewed as a measure supportive of the new transitional government. The rationale behind the Ministry's inclusion is explained further in the administrative analysis (ANNEX J) and in the detailed project description (Section I.D).

(2) **Watershed management strategy.** The Mission's watershed management strategy is explained at length in the FY 1986-1987 Action Plan. This project represents the flagship in the Mission's new thrust toward a comprehensive attack on the problems of Haiti's hillsides. While the implementation focus of this project will be the private land of the hillside farmer, the MARNDR and STAB will advise the GOH on complementary policies vis-a-vis state lands and coordinate PL 480 Title III interventions going on in the same target watersheds. These parallel PL 480 interventions will include (a) the management of the Pic Macaya Forest Reserve, (b) certain land reclamation public works projects downstream and (c) the rehabilitation of irrigation infrastructure serving over 7,000 hectares in the plains below.

(3) **Local Organizations.** The administrative analysis confirms the presence of viable local organizations (LORGs) in the project zone. Four of the principal LORGs (UNICORS, DCCH, ORE and IRD) are thoroughly analyzed there. Both the project description and the administrative analysis discuss the role of the umbrella organization in project implementation.

(4) **Depth of markets.** The DAEC table asks that the PP "demonstrate how increased crop and livestock production projected under the project will be absorbed by the domestic market without lowering market prices below the production incentive point". This question is discussed in the economic analysis (ANNEX I). Although the project will cause an increased amount of agricultural produce to be presented at local, national and international markets, there is sufficient absorptive capacity in each to sustain this increase. The umbrella implementation team will monitor relevant price trends in these markets throughout the life of the project.

The goods to be produced under the project are all freely traded, and in a free market, the long-term effect will be equilibrium between the cost of production and the price to the consumer. Neither AID nor the GOH advocates price controls on these commodities. Furthermore, it should be recalled that Haiti imports half of its major staple food supply and that per capita production is decreasing.

(5) **Land tenure.** As is shown in the monitoring plan and the Social Soundness Analysis, the question of land tenure is less important than had been originally thought. Nevertheless, a detailed survey will be made in the project area during the early years of implementation. That survey will provide a comprehensive analysis of the nature of land tenure in the project's target zone.

(6) **Procurement.** The Mission proposes that the project be obligated by means

of a contract, as recommended by the DAEC, with a US-based rural development institution with sufficient international experience and techncial competence. The first step will be an openly competitive Request for Proposals in early FY 1987. The best-qualified respondents will be recommended to the mission contracts office by a formal selection committee that will have technically rated each proposal in a formal review process. Full competition will thus be employed in the selection key contractor.

(7) **Pesticides.** When it became clear that pesticides might be employed in the technical package to be recommended by the project, the Mission requested the services of a pesticide expert to perform a risk-benefit analysis. His report (given as Annex K) which has been approved by the Regional Environmental Management Specialist and the Bureau's Environmental Officer sets guidelines for the use of pesticides in the project area. These guidelines will be incorporated into all relevant contracts and grants under the scope of this project and no pesticides will be procured without the prior approval of AID, the implementation of a thorough training program for the subgrantees, and constant monitoring by qualified project personnel. It is expected that pesticides will play a very minor role in the project.

I.D. PROJECT RATIONALE

An Economy and ecology in crisis. The economy of Haiti is, by all measures, in serious danger. Despite recent urbanization and emigration trends, Haiti continues to be the most rural society in the Western Hemisphere, with as many as eight out of ten people living in rural areas and making all, or a substantial part, of their income from activities related to crops and livestock. Further, it is difficult to imagine a more inappropriate or vulnerable physical setting: an island with an unusually high percentage of its land in hills and mountains. Nearly two thirds of Haiti's land is on slopes of over 20 degrees, and more than half of this is on slopes of over 40 degrees.

The demographic sparsity of 50 people per square mile that worried Haiti's earliest post-revolutionary rulers has given way to the opposite fears among contemporary leaders who face a density of some 500 people per square mile. If only one fourth of Haiti's land is truly arable, then there is an effective density of some 2,000 people per cultivable square mile.

Industrial economies are able to support such densities. Unfortunately, the farming systems of the mountain peasants of Haiti lack the capital intensive and soil-protecting techniques from which those economies benefit. The application of an underproductive and destructive technology to a vulnerable topography has produced an island society that is now in serious trouble.

Development Assistance Strategies. Virtually all watersheds in Haiti are inhabited, and will continue to be inhabited, by farming populations. Watershed protection is therefore inseparable from the issue of appropriate hillside farming systems.

One approach is to write off the mountains as hopeless. Some developmental strategists argue for an intensification of lowland irrigated production, and the conversion of the mountain peasantry into wage laborers on lowland plantations. Such a hillside depopulation model is not only improbable but

unnecessary. There is no intrinsic impediment that precludes *a priori* the development of genuinely productive hillside farming linked to environmentally safe watershed protection strategies.

TWM is by no means the first project to deal with the Haitian uplands. For decades both the GOH and numerous bilateral and multilateral donors have been aware of the need to program resources toward the hillsides. As early as the 1940s, a UNESCO project in Marbial addressed the need for reforestation and soil conservation. In the 1950s and 1960s organizations such as Church World Service successfully used relief food to encourage terracing systems in the Kenscoff area. In the decade of the 1970s FAO engaged in reforestation and dry-wall building activities in the hills near Les Cayes. During the same decade, FAO also utilized Swiss funding to launch what was intended to be a model watershed management project in the river basin of Limbe. For the better part of a decade, the Ministry of Agriculture (under PDAI) has also been building bench terraces and ravine check dams in several watersheds.

Despite some scattered successes, the results of these developmental efforts have not been encouraging. The mediocre results of many previous hillside efforts can be attributed to several clearly definable factors:

(1) Mechanical structures of erosion control are generally unattractive to peasants because they take up valuable space on scarce land and bocause they have virtually no intrinsic short-term income-generating potential. Farmers generally build them only under the stimulus of wages or Food for Work. Even then they prefer to build them on State land or on somebody else's land. When forced to build them on their own land, peasants have been known to maneuver to have them built on agriculturally marginal parts of their holdings, to avoid taking up valuable cropping space. With the cessation of wages, the walls are, for the most part, left to crumble.

(2) In the case of tree planting, the ownership and usufruct rights over planted trees have often been left ambiguous. In some instances, after peasants had resisted the notion of planting State trees on their private land, paid work gangs were actually ordered by frustrated project staff to plant trees on private land whether the owners wanted the trees or not.

(3) Most tree planting and wall building efforts were further hampered by being entrusted to public-sector agencies. The institutional weaknesses of public sector agencies under the Duvalier regime ensured that even well conceived projects would be sabotaged by implementation variables.

Profiting from these lessons, the Mission has gradually begun to subscribe to a new project design model which recognizes the micro-economic motives that govern Haitian peasant land use behavior. This has led to a search for techniques compatible with this microeconomic focus. The program implications involve the use of a bipartite non-governmental implementing mode, in which an private umbrella agency receives a large bloc of resources and links up to localized non-governmental entities who actually implement project activities at village level.

Limits of the PVO extension model. This new programming model, however, has been applied effectively only to the mobilization of single commodities such as trees (in Agroforestry Outreach, 521-0122) and pigs (Interim Swine Repopulation, 521-0170). The current challenge, and the logical "next step" in

the evolution of this hitherto successful approach, is to go beyond this focus on the *gratis* distribution of specified items and to move toward a wider-ranging program that more closely engages the farmer. It is true that trees are needed, both by the hillsides and by the cash-needy farmers who work those hills. But the long term viability of life in the mountains of Haiti will be assured only by the transformation of the total hillside farming system.

Any transformed hillside farming system, to be truly viable in the mountains of Haiti, must solve two general types of problems: the problem of protecting and restoring the fertility of the land, and the problem of augmenting the income of the human population living on that land. Some techniques like alley cropping and nitrogen-fixing hedgerows show some promise of addressing these two needs simultaneously. Unlike mechanical structures, they dynamically restore the fertility of the hillsides on which they stand; more importantly, they provide possible direct sources of income to the owners of those hillsides.

The region chosen for this effort is particularly appropriate, the watersheds flowing south from Pic Macaya. From an ecological point of view, the protection of this region is critical to the well being of the Southwest. The land in this region is, furthermore, still productive. Ecological degradation is still only incipient, and investments by programs and by individual farmers stand a chance of yielding returns. Therefore, in the Southwest, this new hedgerow-alley cropping technique can be tested in an ecological setting, leaving a greater margin for error. Once the technology is better understood, it can be extended to other parts of Haiti where the land and its peasants do not have as wide a margin for taking experimental risks. Finally, it is programatically appropriate to begin this undertaking in the region whose implementing PVOs have endowed the Agroforestry and Swine Repopulation Projects with their most rapid rates of acceptance.

The Project participants and beneficiaries will be hillside farming families living in seven watersheds (Cavaillon, l'Islet, Grande Ravine du Sud, Torbeck, l'Acul, Port a Piment, and les Anglais) to the south of Pic Macaya in the Southwest of Haiti.

The key features of the Project design are:

(1) the development of technical packages linking economically more productive and ecologically more protective land use behaviors. These technical packages are based on improved, integrated land use techniques devised for application to six soil types identified in the Project region. They will be tested on project managed demonstration plots, and through on farm trials in which large numbers of local farmers will carry out simple interventions on one of their holdings (see Annexes E and F).

(2) an incentive package emphasizing the gratis provision of land improvement, productivity-enhancing farm inputs and designed to accelerate widespread adoption of at least certain urgently needed vegetative measures of erosion control; and

(3) a two-part institutional delivery system which allocates several research and monitoring functions to a public sector Technical Secretariat for waterhsed management (and the management of public lands to the decentralized authority of the local Agricultural District Office), but

allocates the Project's operational and managerial tasks to locally based non-governmental institutions.

Assumptions. The project's rationale can best be summarized by listing the assumptions which guided project development:

(1) Current land-use practices in the targeted watershed are not only underproductive in terms of generating income, but also destroy the environment. They therefore not only create long-term problems for the lowland population but also undermine the very resource base on which the hillside population itself depends.

(2) There is no short-term hope of displacing the hillside population by any measure short of massive coercion, and that is advocated by no one. Nor is there any short-term likelihood that alternate income sources would be available to them in the lowlands even if they were somehow made to cease cropping the hillside. Development programs must therefore proceed as though the watershed population is there to stay for the foreseeable future.

(3) No technical innovations can bring anything approximating genuine prosperity to the watershed population, nor completely remove ecological dangers attendant on the presence of this population on vulnerable hillsides. Nonetheless, a series of changes in land-use practices would increase small-holder income, lessen the damage being done to the hillsides, and in some cases contribute to the restoration of the fertility of the land.

(4) No fully proven technical packages for hillside farming have been established in Haiti. However, experiences in Haiti and elsewhere point to a series of discrete interventions, each of which may prove useful. But there is as yet no combined package whose economic effectiveness, ecological appropriateness, and feasibility to Haitian peasants has yet been demonstrated. That is, though individual elements can be disseminated, there is as yet no package to demonstrate or extend. The technical interventions recommended herein should be taken as a series of hypotheses to be tested, rather than as a package to be immediately extended and promoted. The testing of these hypotheses, however, should lead to the successful verification and dissemination of some fully extendable hillside farming packages. Specific packages need to be tested on demonstration plots in strategic ecological zones, and the results widely disseminated.

(5) The long-term goal of the Project is a shift from an emphasis on annual crops toward an integrated land use system that skillfully mixes annuals, perennials, nitrogen-fixing hedgerows and forage crops. This goal will be reached only in phases. The short term project strategy will be to promote nitrogen-fixing hedgerows followed by improved varieties of annual crops.

(6) The introduction of improved varieties of annual crops and of fertilizer could lead to an intensification of agricultural activities in the watersheds and to increased deforestation and erosion as a result of this intensified agricultural activity. Therefore, access to these improved inputs will be made contingent on project participants' willingness to take simultaneous measures of erosion control.

(7) Experience in Haiti has shown that Haitian cultivators are more inclined to accept vegetative, rather than structural, measures of erosion control, because of the income generating potential of the vegetative measures. For this same reason, vegetative measures are more likely to be maintained by the hillside farmer. The Project will therefore emphasize vegetative measures.

(8) It is unlikely that any vegetative measure of erosion control, no matter how necessary from an ecological point of view, will be impressive enough in its short-term economic potential to stimulate rapid widespread adoption by watershed cultivators. Dependence on the slow demonstration effect of the long-term benefits of erosion control measures would cripple the ability of this or any other project to trigger rapid changes in land-use behavior. The Project will therefore devise additional incentives, such as the provision of certain farm inputs, to motivate rapid adoption of at least some protective measures.

(9) No productivity-enhancing agricultural measures should or will be introduced until each farmer interested in becoming a Project participant has first implemented preliminary protective measures on the plot or plots to receive intensified inputs. Unless such protective measures are insisted on and verified, Project interventions could end up accelerating, rather than reversing, the degradation of the watersheds.

(10)The project will avoid payments in Food for Work or in cash wages, both of which have proven their inability to generate or sustain long-term changes in land-use behaviors among Haitian peasants. Alternate incentive strategies will be utilized.

(11)Recent project experiences in rural Haiti have documented the operational efficiency of channelling implementation through private-sector institutions. For this reason the project will follow the already tested privatized institutional model by which project funds are entrusted to a single private umbrella agency which in turn links up to hillside farmers through a network of locally functioning non-governmental organizations (NGOs).

(12)The processes herein planned will be accelerated to the degree that the GOH initiates related policy reforms (land tenure, agricultural imports, markets, etc.) facilitating the transformation of hillside agriculture.

(13)Interventions within the Pic Macaya park and other similar reserves are best made not by PVOs but by the government itself. The ecological feasibility of this Project would be undermined unless the GOH, assisted by designated PL 480 Title III funds, does in fact adopt measures to address the protection of the Park. Technical asistance for this effort should be delivered through a separate channel from that being used for delicate extension work with private farmers.

(14)The Haitian farmer has shown openness to agricultural innovation in the past when the innovations are presented in a way that shows that the farmer's interests will be served by these innovations. Thus, there is reason to believe that the farmers will accept the project's technological and managerial packages.

I.E. DETAILED PROJECT DESCRIPTION

Goal. The goal of the project is to arrest the process of environmental degradation in Southwest Haiti.

Purpose. The purpose is to extend soil-conserving and fertility-augmenting land management practices in the Pic Macaya watersheds and to apply lessons learned from this field effort to national-level hillside management planning.

The project will focus on improving the agricultural productivity of and income wrested from a thousand square kilometers of hill and mountainside land in the seven river basins flowing south from Pic Macaya. All agricultural techniques introduced will be evaluated in light of the goal stated above, and not merely in terms of their income generating potential. The project is based upon the supposition that there exist land management packages that can simultaneously protect the watersheds' hillsides from eroding and improve farmer income.

Over the course of project implementation, the Government of Haiti and AID will aim to achieve the following outputs:

(1) to involve technicians and hillside farmers in the discovery, testing, and refinement of hillside farming practices which simultaneously protect the environment and increase both crop yields and income over levels achieved under existing land management practices;

(2) to devise risk-minimization extension strategies, generalizable eventually to other areas of Haiti, which will permit the accelerated involvement of hillside populations in the new technologies during the transitional period before the new technologies have proven their economic worth;

(3) to develop and validate improved land-use strategies for six distinguishable types of land complexes found in the watersheds;

(4) to involve at least 20,000 peasants in trying out ecologically sounder and economically more productive land use behaviors on at least one plot in their holdings;

(5) to involve 20,000 hillside farmers in the small-scale growing of grafted fruit as an income-generating cash-crop supplement;

(6) to mobilize community participation for the construction and maintenance of land reclamation public works designed for the protection of all the land in the watersheds;

(7) to involve local populations in the management and protection of the Forest Reserve at the top of the target watershed.

Project components. The Project implementation strategy will be one which gives simultaneous attention to three sets of design features: adapted technical packages, motivational strategies, and institutional resource-flow channels. The guiding assumption is this Watershed Management Project, to be successful, must give roughly equivalent attention to all three of these

problem clusters. This section deals with the technical and motivational components of the Project. The following section will deal with the implementing institutions.

Technical Packages. The introduction of new land use technologies is at the heart of the goals and objectives being pursued by the Project. The technical objectives of the Project can be divided into three distinct subcategories.

(1) ***Trial-and-Demonstration Plots.*** On the basis of reviews of the relevant literature and visits to the watershed areas, the PP design team has identified six typical land types in the targeted areas. For each of these land types, an improved land-use sequence has been devised. The altered sequences are viewed as tentative and hypothetical, to be subjected to verification on some 20 project-managed plots in the watersheds. Each recommended land use sequence incorporates a combination of productive measures to increase both yields and income, and protective measures to ensure that this intensified production, rather than exacerbating the ecological stress to which the watershed lands are already subject, minimizes that stress.

These land use models will be implemented by Project-supervised technicians on up to twenty model experimentation and demonstration plots, spread out over the project area. These plots will be worked under direct supervision of project staff. The results of these experiments will provide the raw material from which integrated and locally validated packages will be developed for extension to the farming population living in the watersheds.

(2) ***On-farm miniexperiments.*** The results of these experiments, however, will take several years to assess adequately. In the meantime, the project will endeavour to involve thousands of peasant cultivators in much more limited mini-experiments to be carried out on small portions of their own landholdings. The risk-minimizing and motivational measures which will render such collaboration feasible and safe from the small farmer's viewpoint are discussed below.

Participants in the project will be required to designate one of their parcels as their own trial plot and protect that plot with one technically adequate erosion control measure. The technical assistance and inputs to implement this protection would be provided by the project free of charge. The participating farmer would provide labor free of charge. Only after at least one of his plots has been adequately protected to the satisfaction of project technicians will a farmer be declared to be eligible for access to further project inputs.

Having protected one of his plots, the farmer will carry out a mini-experiment on that plot. A menu of possible experiments will be suggested by the project staff, each characterized by a comparison of the yields from a plot worked by the farmer under the traditional system and a plot of equal size worked with improved inputs and management practices. Since these technological packages do not yet exist, or have at least not proven their viability in rural Haiti, the PSTO staff will define the task as that of evolving such packages with the collaboration of the local population.

(3) ***Grafted Fruit Trees.*** The ecologically soundest long-term arrangement might be one in which the hillside population shifts from its current emphasis on

annual grains to an emphasis on perennials. However, such a shift can be neither dictated from above nor instantly programmed from below. Though all persons interviewed--farmers, marketwomen, and NGO personnel--commented favorably on the local fruit market, the commercial planting of perennials is (with the exception of coffee) somewhat alien to the economic habits of the watershed population. Their favored crops are beans and corn.

The LORGs will introduce some 250,000 grafted fruit seedlings into the region, making them available at concessionary prices to farmers who are experimenting with new land use techniques. It is unlikely that many farmers will try hillside plantings of large numbers of seedlings. Most will probably plant about a dozen grafted fruit trees, and these in the grove that surrounds the house. Though some farmers might allocate hillside plots to the growing of larger groves of income-generating fruit, this is unlikely to be widespread.

Implementing institutions. Perhaps the most frequent source of project failure in Haiti is to be found in shortcomings in the institutions to which project implementation has been entrusted. In light of these previous experiences, the project will employ an institutional strategy derived in part from the experiences of the Agroforestry Outreach and Swine Repopulation projects.

The most effective non-governmental implementing mode has been wherein a U.S. PVO signs an agreement with AID, and enters into operational agreements with the local NGOs already operating in the area who serve as the actual implementers of the project. This bipartite non-governmental model has been found to have several advantages.

(1) Under the "umbrella agency" mode, AID personnel administer and supervise only one large grant. The numerous localized sub-grants are administered and supervised by this umbrella entity specifically contracted with this goal in mind.

(2) It frees the local intermediary NGOs, whose staffs may be unfamiliar with AID administrative procedures, from reporting and other requirements they may be unqualified to implement.

(3) It provides the benefits of years of localized knowlege and localized trust which the NGOs have built up in their areas of operation. It also permits the rapid diffusion of techniques through those localized NGOs who have organized their clientele into operationally effective small farmer groups.

(4) It ensures that activities can continue beyond the PACD. If successful, the project will not only have introduced more appropriate hillside cropping strategies at the farm level, but will have upgraded the capacity of local NGOs to oversee these technical activities and to manage a productive extension program. Project activities will be made more permanent by this upgrading of local capacity.

Differences Between Approaches. The approach described above differs in some basic ways from other approaches that have been tried in rural Haiti and opens the way to dynamic program breakthroughs in the domain of appropriate hillside farming. It is useful to specify some advantages and disadvantages of this approach. Among the advantages are the following:

(1) There is no wage labor or food for work. Wage and food for work arrangements have triggered wall building and tree planting in different parts of Haiti. But walls built and trees planted under those arrangements have tended to crumble or die, as the case may be. The payment of people with negotiable specie (cash and food) to work on their own land undermines their perception of their own self-interest in improving that land.

(2) Nevertheless, the necessary land improvements, although they head to long term improvements in productivity, can cause short-term shortfalls in annual crop production. Therefore, some type of short-term incentive is necessary to encourage land-use management changes in the short-term. But this incentive should be substantively linked to the technical content of the land-use improvement itself. Thus, the project will reward the appropriate land use management innovations with the free provision of the required seedling, grass cutting, improved seed variety and technical assistance inputs.

At the same time, there are at least two important problem sets which this extension approach to watershed interventions will not directly address and which, therefore, will have to receive attention form a separate, parallel set of implementing institutions:

(1) The issue of the Pic Macaya National Forest Reserve will not be directly addressed by the field extension organizations. The proposed approach avoids the use of coercion or clubs. It is based on a structure of positive incentives to make it possible for farmers to engage in more appropriate cultivation practices. It is less applicable to situations in which collective national interest demands the complete cessation of all agricultural activities in clearly delimited areas. It would be disastrously counterproductive to attempt to involve the local NGOs in the types of coercive policing activities that are required by national park projects and that presuppose the authority that only a State can wield. By the same token, as the major land management project in this part of the country, AID cannot ignore the forest reserve sitting atop the watershed. Therefore, it will fund a small activity (PPMS) through PL 480 and a US-based conservation organization to manage the park in cooperation with the local district agronomist. At the same time, the Secretariat (STAB) will play an important role in raising national awareness about the project watersheds management linkages between the mountaintop forest reserve and the project's hillside farmers.

(2) The complete protective coverage of the target watershed hillsides will not be achieved. Any given watershed hillside in the Project area is subdivided into numerous plots owned by numerous proprietors. It is unlikely that all the owners on a specific hillside will voluntarily undertake the coordinated erosion control measures that would crosscut their individual plots of ground and that would be necessary for complete coverage of a watershed. The voluntaristic nature of this approach would make such coverage unlikely. Nevertheless, indications are that the appropriateness of the proposed techniques eventually will induce neighboring farmers to imitate each other baring certain (rare) land tenure disincentives. However, certain land formations require community-wide mobilization to address public danger and, therefore, some public works engineering with public sector involvement may be appropriate here as well. The

MARNDR/PPMS team will have counterpart PL480 Title III funds for some such community needs. Finally, PL 480 Title III funds will also be available for the rehabilitation of most of the irrigation systems downstream: an another important pay off of waterhsed management interventions upstream.

This strategy must therefore be seen as a "system priming" model applicable principally at the early phases of watershed management when productive and protective strategies are being developed. When it has been proven beyond doubt that erosion control is indeed compatible with increases in income, then the moment will have arrived for public authorities to begin insisting on coordinated activities, at least on certain strategically important hillsides. But that moment is unlikely to be reached during the life of this project. In the meantime, public sector capabilities to manage the park and begin to coordinate between gaps in watershed land management need to be reinforced.

Role of the Government of Haiti. In line with the non-governmental institutional implementing model developed in recent years by USAID/Haiti, the project activities described above will be implemented by non-governmental agencies. However, TWM will also endeavour to strengthen the capacity of the GOH in the domain of watershed management and hillside farming systems. It will do this principally through strengthening the capacity of the Technical Secretariat for Watershed Management Agriculture (STAB) of MARNDR's Division of Natural Resources. On the basis of conversations with MARNDR personnel, it was agreed that the best interinstitutional formula would be one in which STAB interacted with TWM's umbrella agency, rather than directly with the implementing LORGs, an arrangement that would also be preferred by the LORGs themselves.

The interchange between STAB and PSTO is be one of mutual utility. From its side, STAB will name one of its employees as a permanent interlocutor with PSTO technicians. STAB will keep PSTO informed of national developments in the domain of watershed management and assist PSTO, both in its extension and data gathering activity, to structure its activities in such a way as to make them comparable with analogous activities being implemented by STAB elsewhere in Haiti. STAB would also be invited to provide input into the three evaluations that will be done of PSTO during LOP.

PSTO will keep STAB informed of its own activities, paying particular attention to mid-course corrections made in project activities. The lessons learned by PSTO in its own activities will be made available to STAB. In addition, TWM will provide a series of material inputs to STAB, to upgrade the implementing capacity of this latter. Among these will be funds for technical assistance, training, office equipment and supplies, and travel funds for national hillside conferences. These are discussed in the Implementation Plan below.

Figure 3

Map of Project Area

II. COST ESTIMATE AND FINANCIAL PLAN

The summary financial plan is given below. In subsequent pages, costs are broken out by component, by fiscal year, by Foreign Exchange and Local Currency, and by line item. An analysis of the methods of payment is given immediately following the summary financial plans.

Table 1
Summary Financial Plan by Component
All Years
in US$

(1) Watershed Secretariat (STAB)	$1,000,000
(2) Parks Management (PPMS)	500,000
(3) Hillside Activities (PSTO)	13,000,000
(4) Project Coordinator (USAID)	500,000
TOTAL	$15,000,000

The following table gives the financial components of the Watershed Secretariat. All STAB local costs (which are not listed here) will be funded from Title III and other sources.

Table 2
Watershed Secretariat (STAB)
All Years
in US$

(1) Personnel	$786,000
(2) Equipment	214,000
TOTAL	$1,000,000

Table 3 gives the all-years cost of the Parks management component of the project.

Table 3
Parks Management Component
All Years
in US$

(1) Personnel	$320,000
(2) Equipment	53,000
(3) Training	21,000
(4) Construction	21,000
(5) Operating costs	41,000
(6) Travel	21,000
(7) Contingency	23,000
TOTAL	$500,000

Table 4 gives the costs, for all five project years, of the PSTO component.

Table 4
Hillside Field Activities (PSTO)
Summary Financial Plan
in US$

(1) Technical assistance	4,000,000
(2) TA support	800,000
(3) Site demonstrations	305,000
(4) Fruit tree outreach	1,842,000
(5) Evaluation and monitoring	479,000
(6) Umbrella agency	243,700
(7) Local PVOs	1,400,000
(8) On-farm trials	356,000
(9) Training	783,772
(10)Farm Input Incentives	500,000
Subtotal	10,709,472
Cont. and inflation	2,290,528
TOTAL	$13,000,000

Table 5 gives the LOP costs by the foreign exchange and local currency components. The 5% inflation rate is compounded.

Methods of payment. There is a separate payment mechanism for each component of the project:

(1) ***STAB.*** For the Watershed Management component, which will consist principally of host country personal services contracts, the method of payment will be direct payment to the contractors. For equipment purchased by the Ministry, AID will reimburse upon submission of receipts and an appropriate voucher. The equipment purchased directly by AID will be paid for directly by an AID Purchase Order or Letter of Commitment.

(2) ***PPMS.*** The method of payment for the PPMS will be negotiated with the entity that wins the contract for management of the parks component. As the local currency element of the activity is somewhat larger than the foreign exchange element, it is likely that a periodic advance will be used.

(3) ***PSTO.*** Inasmuch as the PSTO component of the project will be committed through a direct AID contract with a US-based institution, there will be only one payment mechanism governing it: a periodic advance, with review of voucher submissions by the USAID/Haiti Controller's office.

(4) ***Project Coordinator.*** This manager-technician will be paid through the normal vouchering process used with all Personal Services contractors (PSCs).

Table 5
Master Budget

		L/C	F/X	TOTAL
	ALL COMPONENTS	6,255,000	8,245,000	14,500,000
I.	SECRETARIAT	0	1,000,000	1,000,000
	Personnel	0	786,000	786,000
	Equipment	0	214,000	214,000
II.	PARKS MANAGEMENT	255,000	245,000	500,000
	Personnel	90,000	230,000	320,000
	Equipment	47,000	6,000	53,000
	Training	21,000	0	21,000
	Construction	21,000	0	21,000
	Operating costs	41,000	0	41,000
	Travel	21,000	0	21,000
	Subtotal	241,000	236,000	477,000
	Contingency	14,000	9,000	23,000
III.	PSTO	6,000,000	7,000,000	13,000,000
	Technical Assistance	0	4,000,000	4,000,000
	TA Support	300,000	500,000	800,000
	Site Demonstrations	305,000	0	305,000
	Fruit Tree Outreach	1,442,000	400,000	1,842,000
	Evaluation and Monitoring	179,000	300,000	479,000
	Umbrella Agency	243,700	0	243,700
	Local PVOs	1,400,000	0	1,400,000
	On-farm Trials	356,000	0	356,000
	Training	298,058	485,715	783,772
	Farm Input Incentives	400,000	100,000	500,000
	Subtotal	4,923,758	5,785,715	10,709,472
	Contingencies 5%	246,188	289,286	535,474
	Subtotal	5,169,945	6,075,000	11,244,946
	Inflation 5%	830,055	925,000	1,755,054
IV.	PSC	0	500,000	500,000

Table 6
Local Currency Budget

	YEAR I	YEAR II	YEAR III	YEAR IV	YEAR V	ALL YEARS
ALL COMPONENTS	1,227,586	1,117,092	1,295,533	1,356,781	1,258,007	6,255,000
I. SECRETARIAT	0	0	0	0	0	0
Personnel	0	0	0	0	0	0
Equipment	0	0	0	0	0	0
II. PARKS MANAGEMENT	102,000	43,000	36,200	36,400	37,400	255,000
Personnel	18,000	18,000	18,000	18,000	18,000	90,000
Equipment	42,000	2,000	1,000	1,000	1,000	47,000
Training	10,000	5,000	2,000	2,000	2,000	21,000
Construction	16,000	2,000	1,000	1,000	1,000	21,000
Operating costs	8,000	8,000	8,200	8,400	8,400	41,000
Travel	5,000	5,000	3,000	3,000	5,000	21,000
Subtotal	99,000	40,000	33,200	33,400	35,400	241,000
Contingency	3,000	3,000	3,000	3,000	2,000	14,000
III. PSTO	1,125,586	1,074,092	1,259,333	1,320,381	1,220,607	6,000,000
Technical Assistance	0	0	0	0	0	0
TA Support	138,750	35,500	38,750	43,000	44,000	300,000
Site Demonstrations	60,000	60,000	65,000	60,000	60,000	305,000
Fruit Tree Outreach	268,440	268,440	268,440	268,440	368,240	1,442,000
Evaluation and Monitoring	40,000	44,200	31,600	31,600	31,600	179,000
Umbrella Agency	50,750	47,750	48,250	48,200	48,750	243,700
Local PVOs	311,000	225,060	256,740	303,600	303,600	1,400,000
On-farm Trials	60,000	80,000	107,000	109,000	0	356,000
Training	42,000	69,000	68,156	66,902	52,000	298,058
Farm Input Incentives	50,000	100,000	150,000	100,000	0	400,000
Subtotal	1,020,940	929,950	1,033,936	1,030,742	908,190	4,923,758
Contingencies 5%	51,047	46,498	51,697	51,537	45,410	246,188
Subtotal	1,071,987	976,448	1,085,632	1,082,279	953,600	5,169,945
Inflation 5%	53,599	97,645	173,701	238,101	267,008	830,055
V. PSC	0	0	0	0	0	0

Table 7
Foreign Exchange Budget

	YEAR I	YEAR II	YEAR III	YEAR IV	YEAR V	ALL YEARS
ALL COMPONENTS	1,793,154	1,667,953	1,695,241	1,676,181	1,412,472	8,245,000
I. SECRETARIAT	286,200	204,500	155,300	184,500	169,500	1,000,000
Personnel	185,000	185,000	116,000	150,000	150,000	786,000
Equipment	101,200	19,500	39,300	34,500	19,500	214,000
II. PARKS MANAGEMENT	50,000	48,000	48,500	49,000	49,500	245,000
Personnel	45,000	45,500	46,000	46,500	47,000	230,000
Equipment	4,000	500	500	500	500	6,000
Training	0	0	0	0	0	0
Construction	0	0	0	0	0	0
Operating costs	0	0	0	0	0	0
Travel	0	0	0	0	0	0
Subtotal	49,000	46,000	46,500	47,000	47,500	236,000
Contingency	1,000	2,000	2,000	2,000	2,000	9,000
III. PSTO	1,456,954	1,415,453	1,491,441	1,442,681	1,193,472	7,000,000
Technical Assistance	929,500	809,500	809,500	766,500	685,000	4,000,000
TA Support	162,000	100,000	95,000	90,000	53,000	500,000
Site Demonstrations	0	0	0	0	0	0
Fruit Tree Outreach	100,000	100,000	100,000	100,000	0	400,000
Evaluation and Monitoring	50,000	100,000	50,000	50,000	50,000	300,000
Umbrella Agency	0	0	0	0	0	0
Local PVOs	0	0	0	0	0	0
On-farm Trials	0	0	0	0	0	0
Training	55,000	91,000	120,000	119,715	100,000	485,715
Farm Input Incentives	25,000	25,000	50,000	0	0	100,000
Subtotal	1,321,500	1,225,500	1,224,500	1,126,215	888,000	5,785,715
Contingencies 5%	66,075	61,275	61,225	56,311	44,400	289,286
Subtotal	1,387,575	1,286,775	1,285,725	1,182,525	932,400	6,075,000
Inflation 5%	69,379	128,678	205,716	260,156	261,072	925,000
V. PSC	100,000	100,000	100,000	100,000	100,000	500,000

Technical explanatory notes on the preparation of the PSTO budget follow.

(1) ***Long-term Technical Assistance.*** The team of 6 expatriate technicians will remain throughout most of the life of the project. All expatriate experts are budgeted at $140,000/yr. In addition to a Chief of Party (COP), who should have a strong rural development management and analysis background, this team will inlcude the following specializations:
- Agricultural Economics and Economic Anthropology, Farming Systems Research
- Animal Husbandry, Range Forage Ecology, Extension Methodologies
- Tropical Agronomist/Horticulturalist
- Soil Science and Land Reclamation
- Natural Resource Economics (STAB)

(2) ***Short-term Technical Assistance.*** All short-term TA is budgeted at a standard $15,000/month, which covers all costs. For the purpose of the budget, short term TA is tentatively scheduled as follows:

Table 8
Short-term Technical Assistance

YEAR	1	2	3	4	5	T
		FIELD				
TRAINING	3	1	1	1	0	6.0 MONTHS
PESTICIDE MGMT	1	1	1	1	0	8.0 MONTHS
COMPUTER SYSTEMS	2	1	1	1	0	5.0 MONTHS
INST. DEV/MGMT	1	1	1	1	0	4.0 MONTHS
FINANCIAL MGMT	3	1	1	1	0	6.0 MONTHS
HORTICULTURE	2	1	1	1	0	5.0 MONTHS
SOCIAL SCIENCE	1	1	1	1	0	4.0 MONTHS
SOIL SCIENCE	2	1	1	1	0	5.0 MONTHS
SEED PRODUCTION	2	1	1	0.5	0	4.5 MONTHS

TOTAL: 47.5 MONTHS

(3) ***Technical assistance support*** includes two 4-WD pick-up trucks at $15,000 each, two 4WD station wagons at $15,000 each, and one road car at $12,000. Maintenance is figured as follows: year 1 is budget at 10% of purchase price, year 2 at 15%, year 3 at 20%, year 4 at 25%, and year 5 at 25%. POL is figured at 20,000 miles per year per car, 10 miles per gallon. If gasoline costs $2/gallon plus 0.50 for lubricants and miscellaneous other costs, then $5,000/vehicle/yr x 5 vehicles = $25,000/year.

Equipment includes computers, office furniture (desks, chairs, files), fans, conference tables and chairs, typewriters, a generator for house on the South Coast, air conditioners, photocopier, mimeograph machine, and UPS for computers. Office rental is estimated on the basis of current AOP office rental of $500/month in Les Cayes. Supplies includes consumable office goods and computer supplies. Services include computer maintenance and repair, housing renovation on South Coast ($20,000), office renovation in Les Cayes ($5,000), housing renovation in Les Cayes ($25,000 for

screens, paint, water tanks, etc. on 4 houses: $2,500/yr in years 2 & 3 for renovations/repairs and $5,000/yr in years 4 and 5 for renovations/repairs).

In-country per diem is budgeted as follows: 30 days in hotel in Les Cayes after arrival while awaiting housing and 10 days per month in Port au Prince during the duration of the Project.

(4) ***Site demonstrations.*** Costs were budgeted as follows: land, $150/ha/yr; seed/trees, $225/yr; tools, $40/yr, inputs, $150/yr; labor, 1000 man days/yr at $2.50/day. This was estimated over 20 sites, but the estimate may change either way.

(5) ***Fruit tree outreach.*** Most of these figures were supplied by Sean Finnegan's budget, which one should see for details. In the nursery there are 20,000 citrus/yr at $8.50/tree; 5,000 avocado/yr at $8.89/tree; 2,000 mango/yr at $8.95/tree; and 3,000 other/yr at $5.83/tree. On the site there are 20,000 citrus/yr at $6.28/tree. These figures include all extension and training costs.

(6) ***Evaluation and monitoring.*** Baseline surveys - duration 24 months 2 enumerators/watershed = 12 people at $300/mo 2 data processors for 3 months each at $400/mo miscellaneous - $10,000/yr. Monitoring is a permanent function in intermediary PVOs. There is 1 monitor per PVO at $400/mo for 5 yrs. There are 4 motorcycles at $1500 parts and fuel for motorcycles at $600/yr/moto.

There are three evaluations with 4 person teams: economist, agronomist, institutional analyst, anthropologist each evaluation to last one month total cost included in $15,000/expert/month.

(7) ***Umbrella Agency.*** The following personnel are budgeted for:

2 secretaries at $450/mo
3 drivers at $350/mo
1 night watchman at $250/mo
1 office runner at $250/mo
1 accountant at $600/m

All personnel are costed out for 5 years. Benefits and hospitalization are estimated at 25% of salaries.

Equipment includes soil test kits at $200; tissue test kits at $150; audio-visual training materials at $1500; and miscellaneous technical equipment at $2,000 in years 1 and 2, $2,500 for years 3 & 4, and $3,000 for year 5.

(8) ***Intermediary PVOs.*** This includes the following personnel:

4 agronomists at $700/mo
20 site managers/extensionists at $300/mo
12 more extension workers in yr 2 at $200/mo
12 more extension workers in yr 3 at $200/mo
12 more extension workers in yr 4 at $200/mo
4 input managers at $700/mo
4 input supply assistants at $500/m

Their transport costs include 4 4WD pick-ups at $15,000; 8 125cc motorcycles at $1,500; motorcycle maintenance, parts, and fuel, at $600 per year per vehicle. Equipment includes 4 computers (IBM XT type) at $8,000; 12 weather stations, with max/min thermometers, rain gauges, etc. at $250; 5 soil test kits at $200 each; 5 tissue test kits at $150; books and journals, at $500 per PVO per year; AV equipment for meetings, for $1500 per PVO; and miscellaneous equipment, at $2,500 per PVO per year. Supplies (paper, computer supplies, etc. are costed at $2500 per PVO per year. Overhead to PVOs is calculated at 10% of all above expenses in category 8 in the budget.

(9) ***On-farm trials.*** Seed has been costed at $0.50/lb. It is to be supplied free for sites and on-farm trials. The area covered is: year 1 400 ha; year 2 500 ha; year 3 600 ha; year 4 700 ha, and year 5 700 ha. 100 lbs seed/ha equals $50/ha for beans, corn, and sorghum. Imported germ plasm consists of tree seed, grain seed, vegetable, exotic crop seed, and budwood. The cost is $10,000 - yr 1 and 5,000 - yrs 2-5. Fertilizer is supplied for sites and on-farm trials at $70/ha, with the same surface areas as above. Fertilizer subsidies are budgeted at 50% for two years, then 25% for two years, then nothing. Year one: $2,000; year 2: $15,000; year 3: $30,000, and year 4: $20,000.

(10) ***Training.*** Long-term training consists of 8 Master's students at $25,000/yr for 2 years each. Two leave in year 2, two in year 3, and two in year 4. Short-term overseas courses are budgeted at $12.000/trainee for 10-14 week course in the US or a third country, including all costs. Short term overseas departures will include: year 1 - 5 year 2 - 10 year 3 - 10 year 4 - 7 year 5 - 5. This is a total of 37 trainees for 2-3 months each. In-country training is budgeted at 20 trainees/month in 5 days courses at $20/day = $2000/month.

(11) ***Input Incentives*** are budgeted as follows: year 1 - $75,000 among all 4 PVOs; year 2 - $125,000; year 3 - $200,000; year 4 - $1500,000; and year 5 nothing.

III. IMPLEMENTATION PLAN

This implementation plan is divided into four sections, as follows:

A. The roles and responsibilities of the participating organizations, which include AID, the Technical Secretariat for Watershed Management (STAB), the Park Management Organization, the Umbrella Agency, and the Local Organizations (LORGs);

B. The implementation schedule, including specific tasks for each of these organizations; and

C. The training plan.

The monitoring plan and procurement plan are given in separate sections.

III.A. ROLES AND RESPONSIBILITIES

Although there are two obligating instruments (one bilateral and one with a

private organization), there are five major actors in the project: AID, the Technical Secretariat for Watershed Management in the Ministry, the park management entity; the umbrella organization, and the local organizations in the watershed. The role of each of these organizations is discussed in turn.

AID. AID will supervise project implementation through the Agriculture and Rural Development Office (ARDO). The project manager, in consultation with the MARNDR/STAB coordinator, will establish requirements for the implementing agency, draft the RFP, and participate on the bid evaluation committee. When the implementing agency is in place, the project manager will coordinate AID relations with the project, and will maintain regular contact with the umbrella agency. ARDO will coordinate all TWM activities with those of other AID-funded projects, especially ADS II, AOP, ISRP, and CIMMYT. All research results will be shared and data collection and analysis will be coordinated according to a mutually agreed upon plan. The project will include separate funding for a project coordinator who will serve on the project advisory committee and supervise the contacts.

AID will buy in to the S&T/AGR cooperative agreement with the Consortium for International Crop Protection (CICP) and Oregon State University (OSU) International Plant Protection Center for technical assistance to evaluate the safest ad most appropriate pesticides and for taining in pesticide safety and handling.

With regard to monitoring and evaluation, ARDO will be responsible for organization and implementation of all project evaluations, including recruiting and contracting for personnel. AID will fund periodic audits of the umbrella agency, including both financial and performance audits. USAID will not directly audit the participating Haitian intermediary PVOs, though it may request the umbrella agency to carry out such tasks, if appropriate and necessary.

On the national level, AID will vigorously pursue changes in GOH agricultural policies that will enable the project to achieve its goals. This will be accomplished through regular coordination with the Secretariat, as well as through policy measures undertaken in negotiations for future AID assistance. AID will work to strengthen the capacity of the STAB to coordinate, monitor, and evaluate all hillside activities in Haiti, including research, extension and incentive programs.

The Technical Secretariat for Watershed Management (STAB). The STAB will play a national policy, research, coordination, monitoring and evaluation role for all agricultural and conservation activities on Haiti's hillsides. The TWM will provide the STAB with material, technical assistance, training and other personnel support, which are specified elsewhere in the PP (see the Administrative Analysis and the Budget). The project will work closely with the STAB at all times and keep it informed of project activities, problems and accomplishments. The local organizations (LORGs) will deal directly with the umbrella, which will coordinate information received from them and transmit it to the STAB.

Building on the information in the CRIES system, STAB will establish and implement an automated system to inventory the natural resources of Haiti, including data from the TWM area, and will monitor and evaluate the results of agencies working on hillside improvement projects. It will provide data

from the automated system to the project to facilitate the search for solutions to increasing ecologically sound agricultural productivity in the project area.

STAB is designed to coordinate, monitor and evaluate all hillside projects in Haiti, including engineering and reforestation programs. To this end, it will initiate efforts to define a coherent body of policies to encourage watershed develoment in a rational and long-term manner. This will result in a planning mechanism, including medium term (5 year) and long-term (20+ year) goals and objectives to enable Haiti to work coherently toward the development of its hillside areas. STAB will eventually devise a land tenure policy for state lands which will encourage the protection and development of the hillside zones.

STAB will ensure that information gathered about hillside agricultural systems is compatible with the national data collection and analysis system and disseminate that information to all agencies working to improve hillside agriculture through publications, seminars, workshops, and audio-visual techniques. It will encourage the establishment of an effective applied agricultural research capacity in Haiti, building on the farming systems research underway with the ADS II project, which will develop crop varieties and cultivation techniques to permit maximum utilisation of the hillsides while regenerating soil fertility and conserving resources.

This final task will be of overwhelming importance to the TWM, as only a viable agricultural research program can provide hillside projects with the plant materials they need to carry out a programof adaptive and on-farm trials in their zones of intervention. The STAB will work closely with the District Agronomist Offices in Les Cayes and will assign to the Office such monitoring and coordination tasks as it chooses. It will work closely with all the Directorates of the MARNDR to ensure that all the technical resources of the Ministry are put at the disposal of the TWM as needed.

The Park Management Organization. Immediately upon signature of the bilateral grant agreement in 1986, AID will work with STAB (and the organization chosen by the interim government to oversee park management, if such has been chosen by this time) to locate a US-based conservation organization qualified to undertake park management. This organization will work with the STAB and will work with the District Agronomist's office in Les Cayes to implement the park management program (PPMS, or Projet Pic Macaya Sud).

The *raison d'etre* of the park management program is the protection of the vegetative cover on highest point of the watershed. As is mentioned in the stewardship plan, however, there are at least three ancillary benefits from the project's support of this activity: (1) the protection of national ecological conditions and processes; (2) the promotion of the national patrimony; and (3) the development of a recreation and tourism program. The operational goal of protection will be achieved through a well-designed combination of reforestation and strict zoning.

Responsibility for linking the implementation of Pic Macaya park management program to TWM and parallel PL 480 Title III programs will rest with MARNDR's Cayes Agricultural district and its PPMS program. The Ministry of Agriculture will not have the sole or primary responsibility for

implementation of the project, as there are several areas in which the park entity will need to coordinate with other branches of the Government: the Ministry of the Interior, for enforcement actions, and the Ministry of Finance, for taxes and fiscal matters. Prior to the change of government in early 1986, the responsibility for park management resided in the Ministry of the Presidency, in an organization known as INAHCA. Recently, responsibility has been reassigned to the Institute de Sauvegarde du Patrimoine National (ISPAN). However, all TWM and PL 480 resources going into the park management effort, including the park management contract for the U.S. environmental PVO, will be administered by MARNDR's Direction des Ressources Naturelles, which will involve other GOH agencies as necessary. Any link between USAID and these agencies, with regard to the park, will pass through MARNDR.

The Umbrella agency . The umbrella organization will serve as the intermediary between the GOH and all other organizations working with the project, playing the central role in implementation. From its headquarters in Les Cayes, it will work closely with AID, the STAB and the intermediary local organizations (LORGs) to improve agricultural productivity and farmer income in the project area while at the same time regenerating soil fertility and preventing erosion. With its field staff of experienced technicians, including a Chief of Party, a animal husbandry and extension specialist, two agronomists and an agricultural economist, in addition to a natural resource economist on the staff of the STAB in Port au Prince, the umbrella organization will work at a variety of levels.

It will work with the STAB to establish national policies favoring hillside agricultural improvement and soil conservation. It will provide technical assistance to the LORGs to help them carry out the research, extension, and managerial tasks called for by the project, and provide them with funding and materials to carry out those tasks. It will organize, plan, and execute training programs for LORG personnel, peasants and other interested persons, with the aim of ensuring that the LORGs implement the project in a technically and administratively acceptable way. It will help the LORGs establish mechanisms to ensure the sustainability of project efforts after the PACD. For example, it will establish an accounting, inventory control and reporting system that satisfies USAID requirements for disbursement of funds and materials. This will involve helping the LORGs to organize and administer the credit program using TWM funds.

The team will be composed of the specialists below.

(1) a Chief of Party with strong rural development analysis and project implementation experience,living in Les Cayes, attached to and directing the umbrella agency;

(2) an agricultural economist and farming systems research specialist, living in Les Cayes and working for the umbrella agency;

(3) an animal nutritionist or forage specialist with a background in extension or communication methodologies, living in Les Cayes and working for the umbrella agency;

(4) a tropical agronomist or horticulturist, living in Les Cayes and working for the umbrella agency;

(5) a soils agronomist, land reclamation specialist living in Les Cayes or Chardonnieres and working for the umbrella agency; and

(6) a natural resource economist, living in Port Au Prince, working for the umbrella agency and reporting to the Chief of Party, but attached to the STAB and working closely with the Coordinator of the latter agency.

In addition, the project will require a good deal of short-term technical assistance during the first four years of the LOP. The short term assistance program is discussed below in the section on the implementation calendar. The skills brought by the short-term assistants will complement those of the umbrella agency team as well as those of the STAB and the LORGs, but they are not skills for which the project will have a permanent requirement.

Local Organizations (LORGs). Although the LORGs are mentioned last in this section, their role in the project is fundamental. The Haitian PVOs and other organizations in the TWM zone will carry out the work of the project on the hillsides, with the farmers who are the ultimate beneficiaries of the projects resources and ideas. These intermediary organizations will transmit the resources of the umbrella agency and the GOH to the farmers in a way they will be able to accept and absorb.

The LORGs will establish the program and plans for accomplishing the goals of the project. Once implementation is underway, they will administer demonstration sites in the targeted watersheds. They will conduct outreach and extension activities, including on-farm trials, to spread successful innovations from the demonstration to participating farmers, and administer a program of income-generating credit for participating farmers, tied to the execution of soil conservation activities.

It will be the LORGs' responsibility to hire and train the technical and administrative staff to carry out the project. They will participate in meetings and seminars to set policies and plan activities for all the LORGs working with the project.

As the project evolves, the LORGs will send personnel to TWM-sponsored or financed training activities, in Haiti or abroad. As the project advances the role of the LORGs will be refined and developed, as will the roles of the other participants in the project.

III.B. IMPLEMENTATION SCHEDULE

The project will be implemented in two phases. In project year 1 (fiscal year 1986) AID will sign a project agreement with the Ministry of Agriculture to support the Watershed Secretariat (STAB) and the the preservation of the Pic Macaya Forest Reserve (PPMS). The role of the STAB is discussed below. As the CRIES system is phased out of the ADS II project, it will gradually be absorbed by the Secretariat. The CRIES system will then serve as the informational focal point of the Secretariat.

In fiscal year 1987, AID will prepare a Request for Proposals (RFP) with the intention of recruiting a US PVO. An abbreviated project calendar is given below.

Figure 4
PROJECT STARTUP CALENDAR

Milestone	Agent	Date
Project Paper Reviewed	AID	8/86
CN Expires	AID/W	8/86
Grant Agreement signed	AID/MARNDR	8/86
PSTO RFP Prepared	AID	10/86
Park zoning policy issued	STAB	11/86
PSTO RFP Issued	AID/MARNDR	11/86
Training program issued	STAB	11/86
Park Management RFTP issued	AID/ISPAN	12/86
Closing date for submissions	PVOs	1/87
Socioeconomic survey begins	STAB	1/87
Selection of Umbrella org.	AID	1/87
Contract negotiation	AID/MARNDR	2/87
State Lands Policy issued	STAB	3/87
Field team arrives	Umb.	5/87
Demonstration inputs ordered	Umb.	6/87
Demonstration plots laid out	Umb.	8/87
Pesticide buy in negotiated	AID	10/87
Extension outreach planned	Umb/LORGs	11/87
CRIES absorbed into STAB	STAB	1/88
Short-term training begins	Umb/LORGs	3/88
Evaluation	AID/STAB	6/93
PACD		7/94

Several elements of the implementation strategy are not obvious from Figure 4 particularly the way in which the STAB and the PPMS will interact with the PSTO umbrella organization.

STAB. While STAB will concentrate on the watersheds south of Pic Macaya, it will also have national responsibilities in coordinating the review, planning and evaluation of projects funded by other donors and NGOs in other parts of the country.

STAB will establish a classification of Haitian watersheds, including an estimation of their current condition and expected evolution over the next 20

years. It will coordinate or carry out studies of traditional and modified production systems in each type of watershed in Haiti. In the TWM area, these studies will be carried out by the project in a manner to allow data gathered and analyzed to be compared readily with data from other watersheds.

Among the other outputs to be produced over the life of the project are the following:

(1) a description of the current situation, to include an inventory of all past and ongoing watershed projects; a tracking system for all ongoing projects; a description of donor strategies; a roster of all individuals working in watershed management in Haiti; an inventory of all research efforts related to watershed management; and a research monitoring system;

(2) the development of an action plan, with a set of objectives for watershed management in Haiti reflecting a consensus of all those involved; a set of criteria for determining project interventions; a prioritized listing of watersheds for project interventions; clear definitions of national policies on watershed management; a description of the technical approaches tied to environmental characteristics, including conservation measures, pesticide management, farming systems and agroforestry applications; review of and comments on all waterhsed management projects within the Ministry; project evaluations, including recommendations for project impeovement; the enumeration of major determinants of project success or failure; a research agenda, including specific information needs for watershed management; an inventory and assessment of training programs, and a review and commentary of the training curriculum; and

(3) the collection and distribution of published documentation, with a documentation center for studies and reports on watershed management, and a monthly newsletter containing information relevant to watershed management.

STAB will also work actively in the areas of land and tree tenure and state lands policies, with the eventual goal of producing a national level homesteading and cadastral base for equitable land ownership.

The CRIES system and the STAB. The Comprehensive Resource Inventory and Evaluation System (CRIES), which is now a part of the ADS II project, will become a part of the STAB in the second year of project implementation, in order to ensure its permanent usefulness to Haiti. CRIES has already made some important first steps toward establishing itself as a useful tool for determining development policy and planning development projects in the Ministry.

CRIES is, in essence, a system of data collection and storage around which a national level planning and monitoring program can be set up. Nearly any sort of geographically-based quantifiable data can be entered into the system and used to produce digitized maps of a selected area. With the CRIES system in place, the STAB will be able to produce maps based upon geographic, hydrologic, economic, or virtually any other indicators.

Most of the CRIES activity to date in the ADSII project has aimed at setting up

a useful data base for the analysis of factors influencing hillside agriculture on Haiti's fragile watersheds. Once it is located in the STAB, it can profit from the resources of and supply information to the Faculty of Agronomy as well as all the MARNDR directorates and projects. As the STAB will coordinate data gathering and analysis as well as monitoring and evaluation for all hillside activities in Haiti, it could ensure that all hillside projects collect the data the CRIES needs and presents it in a useable form. In return it could make sure that the CRIES system produces the kind of analyses that will be of use to those on the ground implementing those projects.

ADS II already has purchased some equipment for the CRIES system. They have trained and hired six personnel: a chief digitizer and report writer, four keypunchers, and a keypunch supervisor. They also use two DRN technicians. Eventually, they want to have three teams of four digitizers, working four hours at the task each day. This will keep the digitizer busy 12 hours a day. The personnel will do other tasks during the rest of their workdays. Eventually CRIES will have to train a senior Haitian expert to replace the expatriate. This person will be an employee of MARNDR or the FAMV seconded to the CRIES, whose salary will come from GOH budget sources.

PPMS. As arrangements are progressing for the recruitment of the umbrella organization, the parks program will get underway. The first order of business is the selection of a conservation organization to provide technical and managerial assistance to the Park Management Authority and the District agronomist.

The details of the park management plan are spelled out in a report commissioned by AID entitled "Stewardship Plan for the National Parks of Haiti" by Charles A. Woods, and do not need to be described in great detail here. However, a brief description of the park activities as described in the Woods report is useful to an understanding of the project in general. The steps are as follows:

(1) Select a full-time park supervisor and staff;

(2) develop a park headquarters at Bois Pipirite;

(3) complete the ongoing boundary survey;

(4) establish "biological preserve zones" to protect all plants and animals in the zones;

(5) develop the associated historical site at Les Platons in conjunction with ISPAN;

(6) design, manufacture and put in place signs for the park;

(7) resolve issues of conflict between UNICORS and other landowners within the park, if any such owners are to continue to occupy park land; and

(8) improve the public image of the park in the area by clearly demonstrating the advantages of the park via a series of public meetings and workshops with local residents.

(9) complete a series of research projects that will ensure the conservation of

endemic species of plants and animals;

(10) create educational exhibits for the Park Headquarters or the Les Platons area.

(11) initiate the biosphere reserve by developing a buffer zone of 10,000 to 20,000 ha around the park, and work with landholders in this zone to create a mutually satisfactory land use policy within the buffer zone;

(12) complete a recreational development program for the park and buffer zone that encourages visitors to make use of the scenic and aesthetic features of the park;

(13 improve access to the park via Les Platons;

(14) develop a supplemental park headquarters (outpost) and security stations on the north size of the Park and in the Grande Ravine;

(15) design and construct nature trails;

(16) develop an international fundraising program to be associated with the park;

(17) design an informational booklet or brochure on Parc Macaya;

(18) complete a ten-year climate study of the region; and

(19) complete a series of maps of the park and buffer zones.

At the field level, the park headquarters will be located at Bois Pipirite, two kilometers north of Portal Formon. Depots and maintenance facilities will be located near Portal Formon. A road will eventually be constructed to the area, and since the area is flat it is suitable for the construction of a landing strip. An existing house can be rented or purchased.

There will be an employment impact associated with the parks project. Twenty-seven jobs will be generated by the permanent staff of the park. Additional jobs will be available as the headquarters is being constructed and as reforestation gets underway. Others will be created as tourism increases.

Umbrella Organization. The implementation calendar below details the specific activities to be carried out by the umbrella organization. These will be supplemented in the field by various technical assistants as the need arises. Recommended short-term technical assistance includes:

(1) Training specialists: particularly to train trainers, and to organize, execute and prepare materials for the numerous in-country workshops, seminars and courses the project will organize for peasants, LORG, umbrella, and other agency personnel. During the project's first year, they should prepare LORG personnel to assume as much responsibility as possible for these functions;

(2) Pesticide Management: to evaluate the safest and most appropropriate pesticides and to provide training in pesticide safety and handling (funded by a separate arrangement the AID/W cooperative agreement with

CICP;

(3) Computer systems: to devise automated systems to administer, manage, monitor and evaluate project financial procedures, including credit management and inventory control; and to devise and install automated systems for processing data generated by project activities, including base-line surveys and regular monitoring. These experts will train umbrella and LORG personnel to operate these systems. They will also ensure coordination and compatibility between project automation and that of the STAB CRIES system;

(4) Institutional development and management: to help establish procedures for coordination the multiple entities working with the TWM, as well as to develop and install management procedures for efficient implementation, monitoring, and evaluation of TWM activities. They will also evaluate progress toward sustainibility of project activities and suggest participatory strategies to ensure continuation of project benefits to farmers and supporting LORGs after the PACD;

(5) Financial management: to assist the umbrella and the LORGS to set up adequate accounting systems.

(6) Horticulture: to reinforce the TA team's capacity to identify, test, demonstrate and extend new varieties and species of fruits and vegetables in the project area. They should also train LORG and umbrella pesonnel in grafting, and micro bench grafting.

(7) Social science: to assist LORG and umbrella staff to devise and implement monitoring procedures to follow and correct project activities; to help devise baseline survey procedures and instruments; to assist with the land tenure survey; and to contribute expertise on specific Haitian conditions to project planning and programming;

(8) Soil science: to help establish measures for estimating the effect of project interventions on soil loss and soil use in the targeted watersheds; to contribute to planning and programming project interventions to ensure that soil fertility regeneration results from all operations; to help identify which project interventions will work most effectively on which soils, under which conditions in the targeted watersheds; and

(9) Seed production: to devise and implement programs to help train contract farmers, LORGs and private companies to carry out efficient and reliable seed multipication operations in southern Haiti and, to the extent possible, in the targeted watershed zones.

A suggested yearly schedule for the use of the short term technical assistance personnel is below:

YEAR	1	2	3	4	5	TOTAL
			FIELD			
TRAINING/EXTENSION	3	1	1	1	0	6 months
PESTICIDE MGMT.	1	1	1	1	0	8 "
COMPUTER SYSTEMS	2	1	1	1	0	5 "
INST.DEV./MGMT.	1	1	1	1	0	4 "
FINANCIAL MGMT.	3	1	1	1	0	6 "
HORTICULTURE	2	1	1	1	0	5 "
SOCIAL SCIENCE	2	1	1	1	0	5 "
SEED PRODUCTION	2	1	1	0.5	0	4.5 "
SOIL SCIENCE	1	1	1	1	0	4 "
						TOTAL: 47.5 MONTHS

The outreach efforts of TWM's hillside farming extension program (PSTO) will involve two sets of activities. On the one hand will be on-farm research, with demonstration trials and outreach and extension activities. On the other will be the complex of activities involving participatory communication, animation, organizational development, and groupement formation. These can be shown as follows:

	PARTICIPATION	AGRONOMIC CHANGE
ACTIVITY I	Radio Communication	On Farm Research
ACTIVITY II	Animation	Demonstration Trials
ACTIVITY III	Organizational Development	Outreach inputs
ACTIVITY IV	The Incentive Contract	Systematic Extension
ACTIVITY V	Groupement Formation	Market Feedback
ACTIVITY VI	Spontaneous spread effects	

Some of these activities are sequential, while others must begin together. The division of labor with respect to each can be outlined as follows:

Figure 5
PSTO Functional Components

Activity No. (see below for key)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Year 1	UMB	UMB	LORG	UMB	UMB	UMB	UMB			
Year 2	UMB	UMB	LORG	UMB	LORG	UMB	UMB	UMB	UMB	
Year 3	UMB	UMB	LORG	UMB	LORG	UMB	UMB	UMB	LORG	UMB
Year 4	LORG	UMB	LORG	LORG	LORG	LORG	LORG	LORG	LORG	UMB
Year 5	LORG	UMB	LORG	LORG	LORG	LORG	LORG	LORG	LORG	UMB

The key to the chart is as follows:

(1) ***Radio Communication.*** The project will begin with a serious of well-integrated media announcements to (a) present the project rationale; (b) describe the demonstration sites; (c) introduce the participating LORGs, and (d) explain the organizational and agronomic pre-conditions to participation in the credit program.

In year 2, IRD's links to Radio Lumiere, which serves the Southwest, will be tapped to broadcast these and more detailed agronomic recommendations. By Year 3, Radio Lumie e (and perhaps Radio Soleil) will have well developed extension and ural animation modules for broadcasting. These modules will be prepared by the Umbrella Organization. By Year 4, IRD, CARITAS/La Borde (DCCH) and the other LORGS linked to the project should be preparing these extension and animation modules themselves.

(2) ***On Farm Research.*** The Umbrella agronomist will fine tune the findings of CIMMYT and the ADS II project in the target zone, by setting up a minimal number of small farm trials. The results from these experiments will be used to make the demonstration and extension packages more accurate. They will also be feed, through the STAB, back through to ADS II and CIMMYT and other on-farm research programs that are continually revising their experimental protocols.

The Umbrella will maintain this quality-controling research effort throughout the life of the project. It will be a minimal effort, designed primarily to better check on, verify, and retest the chosen demonstration and extension packages.

(3) ***Animation.*** All of the participating LORGs already have ongoing rural animation programs which will be reinforced to aid the farmers (a) to appreciate the results of the demonstration plantings being put in place simultaneously, (b) manage the farming improvement inputs to be furnished from the umbrella organization, and (c) to reach out for the technical packages, which should begin to be available for extension by year two of

the project.

(4) ***Demonstration.*** The Agronomic Analysis (Annex F) spells out the siting and the content of each demonstration planting that will be set up by the umbrella directly in year one of the project. At least twenty new demonstration experiments will be outplanted in each subsequent year of the project. By year four the LORGs should have sufficient technical capacity to begin to design and implement innovative demonstration experiments on their own. Through the umbrella they will receive technical guidance in chosing soil conserving agronomic packages from the STAB. By year four of the project, they should be in a position to acquire all of the necessary inputs for themselves. The umbrella should no longer be required to procure these on behalf of the LORGS.

(5) ***Organizational Development.*** In this domain the umbrella will be expected to put some major methodological innovations, in outreach approach, at the disposition of each participating LORG. The objectives of this organizational development training will be peer pressure for credit repayment, neighborly cooperation in coordinating contour plantings on adjacent fields, and dialogue about the best ways of enhancing farmer participation in determining the content of the project's technical and organizational agenda. By Year 2 the LORGs should have absorbed these innovations and will be able to carry on this organizational development training themselves.

(6) ***Outreach inputs.*** The umbrella is tasked with the organization and management of this complex procurement chain for at least the first three years of this five year project. In this capacity, the umbrella will foster mutually beneficial contacts with private sector suppliers (Comme Il Faut, ASSA, AgriSupply etc.) in the zone the LORG extension operations, and the hillside farmers served by the latter. These direct procurement contacts will intensify as the incentive package, the gratis provision of land management and other agronomic inputs, are gradually phased out under the supervision of the umbrella organization. Beginning in year four, much of this input supply should be able to move directly between the private sector suppliers and the LORGs, if not directly to certain participating farmers themselves. This sequence of responsibility gives the umbrella at least three years to assure that the agronomically appropriate inputs are moving down the project's procurement chain to the target farmer. It also gives the LORG an opportunity to reinforce their seedling nurseries with the correct species of trees and grass cuttings. The supply of the more technically complex grafted fruit trees, will most likely have to remain the speciality of the ORE nursery.

(7) ***The Incentive Contract.*** The keen interest of hillside farmers in adopting a more soil conserving hillside farming technology is undeniable. Nevertheless, as the economic analysis (see Annex I) shows, at some sites the farmer will suffer a slight decline in annual crop production as his land use improvements get established. He will be more enthusiastic about adopting the new technology if he perceives some compensation for this loss. but this compensation should not distract his attention from the technical problem at hand: hillside farm land management. Therefore, the incentive should come in the form of free inputs, phased in and out according to the following formula:

PARTICIPANTS	PERCENT OF INPUT SUBSIDY
Demonstration Sites	100%
On-farm Trials	100%
Year 2 Adopters	100%
Year 3 Adopters	100%
Year 4 Adopters	50%
Year 5 Adopters	50%

In other words, at the point at which the LORGs take over this input supply chain from the umbrella unit, the farmers will begin to share input costs. The LORGs will arrange for any necessary credit support through BCA on their own means.

(8) ***Extension.*** The PSTO extension plan depends not only on the success of the preceding animation and organizational work, but also upon the agronomic, ecological, and economic appropriateness of the techniques and cropping associations being worked into the project's demonstration into sites. Therefore, by year two of the project, because feedback from these preceding activities will still be very preliminary, the extension initiative will remain somewhat experimental. By year three, however, the content as well as the approach to be used should be sufficiently well-known so that, by year four, the LORGs will be able to take over the extension effort in its entirety.

Umbrella and LORG extension personnel will not be burdened with managing the project's credit relationships. However, they will be able to refer participating farmers to the appropriate quarter. They will be carefully trained to engage the participating farmers in extended dialogue concerning the problems and potential of their hillside fields. They will also be well informed about the content and portent of everything going on at the demonstration sites. Furthermore, they will be able to make accurate diagnoses of field site agronomic characteristics such that in consultation with higher-level umbrella technicians, the proper extension recommendation can be made.

(9) ***Groupements.*** As this crucial dialogue is a very labor intensive process, a technique for further diffusing its impact, through carefully organized farmer to farmer contacts, has been developed elsewhere in rural Haiti. This is called the groupement formation process. It has proved, particularly at Gros Morne in the North and at Papaye on the Central Plateau, to be one of the most successfull techniques, for enhancing rural development participation, yet attempted in rural Haiti.

PSTO has not been designed around the application of this groupement approach, even though certain of its participating LORGs (DCCH in particular) are quite committed to it. Nevertheless, as a fallback device for ramifying the impact of this crucial extension dialogue, it will be made available to the umbrella extension planners. As such, based on feed back from certain extension agents, it will be consciously applied in certain situations as appropriate. Both umbrella and LORG extension personnel will be trained in basic groupement formation techniques.

It is expected that farmer groupements will prove most useful as credit

borrowing groups which, working through BCA could organize themselves into the Societés Agricoles de Crédit (SACs). Under BCA's SAC system, co-borrowers pressure individual members to repay their share of the group loan. These groupements could also function and as soil conservation district units. These land based groupements can effectively pressure upstream land managers to change their soil conservation practices so their own land would be better protected.

(10) ***Monitoring of Market Relay and Spread Effects.*** The Umbrella information system whould be set up to monitor the potential and actual market uptake of each commodity that participating farmers are being encouraged to produce. These market surveys will be used to refine the agronomic packages being sent out through the PSTO extension network, and inform the STAB about their market potential elsewhere in the country.

III.C. TRAINING PLAN

The project will ensure its survival beyond the expiration of AID funding through a program of short and long term training of Haitian managers and technicians. This training will include both in-country seminars and workshops and long- and short-term courses in other countries. Haitian personnel from the umbrella agency, the intermediary PVOs, the STAB and other GOH organisms working with the project will participate in this program.

Long-term training. The project will finance the following degree study courses in the United States:

(1) Master's level courses for future STAB personnel in development anthroplogy, agronomy, agroforestry and agricultural economics; and

(2) Master's level courses for umbrella or intermediary PVO personnel, in agronomy, extension, credit and financial management, agricultural economics and development anthropology.

The STAB will identify its own personnel to follow these courses. The umbrella agency will select personnel from its own Haitian ranks or from participating local organizations.

Short-term training. The STAB will identify appropriate institutions in the US and in third countries, which offer short courses in the fields mentioned below. These courses should last from 3 to 12 weeks and address themselves to particular implementation and design issues of the TWM. The PSTO umbrella agency will identify personnel from the intermediary PVOs and the GOH who could profit from these courses and will fund them entirely.

The program will include:

COURSE	NO. OF TRAINEES
seed multiplication	4
farm management	5
project financial management	5
animal husbandry	4
horticulture	4
computer use	5
grain storage	2
agrostology	2
agro-forestry	2
watershed management	2
soil management	2
Total number of trainees:	37

Seminars and workshops in Haiti. The PSTO umbrella agency, in collaboration with the intermediary PVOs, will organize training courses in the Les Cayes area for intermediary PVO personnel. These courses will cover all the aspects of the project which the intermediaries will implement. The umbrella agency will assure coordination of this training and find staff, making best use of collaborating project personnel and GOH resources.

TARGET GROUP	COURSE	STAFF
extension/site staff	site mgmt	TWM. AOP, ADSII
PVO agronomists	site supervision	TWM, AOP, ADSII
contract farmers	seed multipl.	TWM, CIMMYT, CIF, ADS II
extension staff	extension method	TWM, PVOs
extension staff/PVO agronomists	grain storage	TWM
extension/site staff	tree planting & care	AOP, TWM
extension/site staff	fruit tree grafts & care	ORE, TWM
PVO mgmt staff	computer use	TWM, ADS II
socio-economic research personnel	survey design, research methods, data analysis	TWM, ADS II
extension/site staff	animal husbandry (esp. pig feed)	TWM, SRP
extension/site staff	pesticide management	CICP

Each of these sessions will last approximately 3 days. They can be held in the project area, using the facilities of one of the intermediary PVOs. The Project should not construct a training center as adequate facilities of this nature already exist at Siloe, Cite Lumiere, Chardonnieres, and in Les Cayes itself. The umbrella agency can provide office machines, document production, and secretarial help if needed for these training sessions. All courses will be held in Creole.

There should be frequent re-training sessions for each group on each subject covered, at least once every six months. When appropriate, the umbrella agency will call on short-term technical assistance to help with training courses.

IV. MONITORING AND EVALUATION PLAN

The TWM evaluation plan includes three elements: three baseline studies, regular monitoring, and three evaluations of progress toward project objectives. The three baseline studies are discussed first.

Baseline studies. Although a great deal of agricultural and socio-economic research about Haiti exists, relatively little of it deals with the lives and livelihoods of small-holding farmers on the country's hillsides. For this reason, in order to evaluate reliably its impact on the project's target population, TWM will have to carry out three studies during its first year of operation. These studies will serve to establish the project's starting point as it works toward its goals of increasing hillside agricultural production and farmer income, while preserving and regenerating the targetted watersheds. They will also establish a reliable data base for comparisons among the watershed projects carried out in other parts of Haiti, the Caribbean and Latin America. The three studies will cover land tenure, agricultural production and practices and socio-economic indicators.

(1) ***Land tenure.*** Land tenure in Haiti is a complex issue, made more so by a lack of adequate cadastral records. On any given hillside one finds plots of land worked by the owner, share-cropped under one of several possible sets of conditions, shared among relatives in more or less formal circumstances, or rented from local or absentee owners. The situation is further complicated by the scattered nature of the land-holdings under any tenure arrangement for each individual farmer. Farmers work from one to a dozen plots ranging in area from one 'vingt-cinq' (one sixteenth of a *carreau*, where one *carreau* = 1.29 hectares) to (rarely) a *carreau* or more. When interviewed, peasants say that they are willing to carry out permanent soil conservation or agricultural production measures only on land they own. They express reluctance to make improvements on rented or share-cropped land. The likelihood of these measures' being adopted can only be assessed if project personnel have reliable, broad-based information on land tenure in the project zone.

For these reasons, during the first project year, the umbrella agency will determine the nature of land tenure on all plots worked by farmers living within a radius of approximately five kilometers from each demonstration site in the watershed. This will cover an area of around 31 km² around each site, or 600 km² in the project area as a whole. This represents a sample of approximately 2% of the area the project will influence. This limited area should represent the

targetted zone as a whole because the sites cover a representative sample of soil, slope and rainfall conditions in the targetted zone. Further, the sites are administered by the different PVOs acting as intermediaries for the project and thus will cover all of the watersheds. As those who carry out the land tenure survey will work in the areas where the project is located, the surveyors can hope for more effective cooperation with peasant respondents. The local extension and site supervision personnel will also know the local farmers and will be able to assist with gathering data.

The PSTO implementation team will establish the terms of the study in collaboration with the intermediary PVOs. It will include the following as a minimum: size of holding; land tenure status; and cultural systems now in use on the holding. In subsequent evaluations, teams will determine if the land tenure status of the holding has changed and if new agricultural or soil conservation measures have been introduced. If new measures are evident, the team will determine who put them in and under what circumstances.

(2) ***Agricultural production and practices.*** This study, which the PSTO agricultural economist will implement, will determine the nature of traditional systems of agricultural production and soil conservation in the targetted watersheds. It will also attempt to determine total production levels of different crops and their yields. Finally, it will devise a strategy for measuring erosion on treated and untreated fields in theproject area.Project progress to toward its goals will be measured by changes in these figures over the LOP.

While surveys and extended interviewing will be necessary and appropriate to this study, it should include descriptive case studies of individual farmers or holdings. This aspect of the study could be done in conjunction with the land tenure study.

The implementation team will elaborate a procedure to carry out this research. They will determine what to measure and how to measure it, but the research should cover: yields for traditional crops; labor inputs; tools; other inputs; animal husbandry; cropping systems and rotations; cultural practices soil conservation measures, including use of living fences; surface area, number of plots, and distance between them. The content and format of this study should be compatible with those of other similar studies in Haiti. This comparability will be ensured by consultation with the STAB and with USAID.

(3) ***The socio-economic study.*** During the first year of the project, the PSTO agricultural economist will carry out a survey of socioeconomic indicators in the targetted area. This survey will establish key evaluation criteria by which to judge the project's impact on the lives and livelihoods of the population with which it works.

The study will seek to determine the returns to land and labor in the targetted area, as well marketing structures which affect agriculture. It will establish quality of life measures, such as possession of radios or motorcycles and quality of housing, which will indicate the impact of project measures on beneficiary population. The research will attempt to establish approximate measures of farmer income and cost of living. It should also look at uses of traditional credit and patterns of

indebtedness. Finally, it will monitor local and national price surfaces for all of the marketed crop outputs being increased as a result of the project.

The implementation team will elaborate a plan for the execution of this study and a set of evaluation criteria based on its presumed results. Like the agricultural study, this one should be compatible with surveys carried out in other watersheds in Haiti by other hillside agriculture projects. This comparability will be assured by consultation with the STAB and AID.

Pesticide training. Plant quarantine capabilities are crucial for the importation of clean, uncontaminated plant material to avoid introduction of new diseases (e.g. coffee rust), in addition to meeting import restrictions of other countries (e.g. U.S.) in developing nontraditional agricultural commodities for export. Therefore, two of the staff members will receive short-term training at the USDA/APHIS facility in Hyattsville, Maryland.

Regular monitoring. The PSTO field staff will work with the STAB agricultural economist to establish regular monitoring of the project's progress toward its goals. The STAB agricultural economist will work toward establishing a nation-wide system for monitoring and evaluation of all watershed projects. The PSTO team will develop a set of monitoring criteria for the use of the STAB, to include

(1) financial and economic profitability;

(2) spread effects of agricultural and soil conservation packages, including adoption rates by women and different age and income groups, and any difficulties in extending project innovations;

(3) production, income, and quality of life effects;

(4) the supply and use of inputs;

(5) training; and

(6) the management capacity of the intermediary PVOs.

Periodic evaluations. TWM will undergo formal evaluations of its accomplishments and problems three times during the LOP. The PSTO and PPMS implementation teams will propose a set of evaluation criteria to AID and the STAB, which should include the following:

(1) installation and management of experimental demonstration sites;

(2) personnel trained in Haiti and outside;

(3) adoption of project agricultural and soil conservation measures, and subsequent increases in agricultural production;

(4) decreases in soil erosion;

(5) use and management of inputs;

(6) wood and fruit tree plantings; and

(7) adequate and reliable data gathering operations.

Planned evaluations. Three evaluations are planned, for which funds are provided in the project budget. To insure that the evaluations are useful to as many institutions as possible, all project implementing agencies (STAB, the umbrella institution, AID and interested NGOs) will be encouraged to participate. All evaluations will be coordinated by the STAB and AID.

(1) After 24 months of implementation, a major evaluation will take place, focusing on the effectiveness of extension methods and on project administration, especially in the light of the land tenure data that will have been developed. Particular attention will be paid to the extension program.

(2) After 48 months, an evaluation team will assess progress toward project sustainability. This will include judging the technical, managerial and administrative capacities of the intermediary PVOs, the input supply structures, the success of the extension program, and the financial and economic profitability of the introduced techniques.

(3) Finally, an EOP evaluation will assess project accomplishments. This evaluation will provide a set of lessons learned which have implications for the implementation of other hillside projects.

In addition to these evaluations, there are funds set aside for an audit of the project, to occur during the second half of the LOP.

V. SUMMARIES OF ANALYSES

A. SUMMARY OF LAND CAPABILITY ANNEX

The most severe limiting factor for crop production on the hillsides of the targeted watershed is the low nutrient status of the soils. The vegetative conservation and management interventions proposed in the land capability annex will contribute to the releasing of this constraint and, at the same time, conserve the soils of the hillsides. Farmers will be motivated to accept the proposed interventions because of their positive effect on farm income, and soil conservation will be a byproduct of this process. In this manner, farming practices which have resulted in the erosion and degradation of hillside soils will be replaced with farming practices which regenerate and conserve the soils of the hillsides.

The targetted watersheds have severe soil erosion and degradation problems, but, within the context of the Haitian soil erosion problem, they also have significant soil resources remaining and favorable rainfall patterns.

The soils of the targeted watershed can be divided into two broad categories. The first are mollisols or black soils, as they are referred to locally. These are among the best agricultural soils and are found in drier areas on calcareous parent materials in the targeted area. The second category, ultisols/oxisols or red soils as they are referred to locally, are among the least responsive agricultural soils.

Six categories were used to define the capabilities of the soils of the

watershed. The primary distinction separated black from red soils. A second distinction, made on the basis of potential response to management as a function of weathering, was based on potential risk and classified soils on the basis and slope and soil depth. At the extremes, one soil was classified on the basis of altitude because of the unique conditions prevaling in the area of Pic Macaya and one soil was classified as "reclamation" because of severe constraints for any plant growth.

The vegetative conservation and management interventions will be based primarily on the introduction of leguminous trees planted as hedgerows along the contours of the slopes, but would also include forage production, livestock management, improved varieties of responsive annual and perennial crops, and the judicious use of agricultural chemicals.

A map delineating soil and climatic boundaries has been prepared which includes fourteen point descriptions of locations selected for 32 proposed demonstration sites. Finally, requirements for testing and monitoring, especially for downstream benefits, are discussed.

B. SUMMARY OF AGRONOMIC ANALYSIS

The target zone is located in the Southwestern part of Haiti in the region of Les Cayes. It includes six watersheds representing approximately 4.5% of the total land mass of the country. The watersheds include any of the basins located from the foothills (ca. 100m) to the crest of the respective watershed basins.

Accurate precipitation data for the watershed area are lacking. Rainfall occurence exibits a bimodal pattern with the lowest precipitation during the months of October through February, and again in June and July. The pattern is not as pronounced in the summer as in the winter months.

The area is generally looked upon as severely eroded, intensively farmed and overpopulated. Principal crops are divided into three broad categories: grains (maize, sorghum), grain legumes (bean etc.) and tubers (yam, cassava, sweet potato) which are farmed all year around. Livestock are found throughout the area, generally tethered and periodically moved.

The agronomic work plan will focus on introducing erosion control and agronomic techniques that are simple and practical and which will yield results within a reasonably short period of time. The technical package is not meant to be a simple solution to a very complex problem which is further complicated by social and political nuances. It is a series of alternative choices that can be adopted gradually or all at once depending on the confidence and the ability of the farmer and his willingness to take small risks.

The typical peasant farmer often has as many as 4 or 5 *jardins* located on various soils, with different slopes and at varying altitudes. As many as 15 crops are grown in the area in various forms of association. The annex describes six crop rotations, which when taken as a whole represent approximately 90% of all the situations encountered in the diverse watersheds. The six types of rotation are located on the major soil types encountered in the area.

The six crop rotations are located on the following soil types and referred to as: (1) Reclamation sites, (2) high risk red soil sites, (3) high risk black

soil sites, (4) moderate risk black soil sites, (5) moderate risk red soil sites, and (6) perennial crop sites.

The rotations chosen are typical for the present. It was assumed that under present farming conditions, where soil erosion practices are ignored, yields will continue to decline. For the most part maize, bean and sweet potato vine cuttings are planted in the spring followed by sorghum and, in some instances, another crop of beans in June or July. Maize is harvested prior to planting sorghum. Cassava is a long maturing crop and is generally found growing under very poor soil conditions. The livestock sector plays an important role in the traditional farming system and makes a significant contribution to farm income. Its role in the proposed interventions is discussed in the context of alley cropping (see the Animal Husbandry annex).

The interventions that are proposed will take some time and it is inconceivable to expect a quick turn around especially in situations where severe land abuse has been practiced for many years.

The proposed interventions for the sites described are designed specifically to control erosion and at the same time increase soil fertility and net income to the farmer. In arriving at an ideal farming system that exhibits simplicity, effectiveness and ease of implemention, we assumed the peasant farmer is familiar with some of the crops in the system. Foremost in choosing appropriate interventions were the soil characteristics of the example site and its potential response to a given set of interventions.

The criteria in selecting major interventions were based upon the following conditions: (1) farmers must be familiar with most of the varieties used in the rotation; (2) the program must be easy to implement and maintain; (3) quick results are expected; (4) the package must be aimed at increasing soil fertility and retention of available water; it must (5) prevent soil erosion; and must (6) appreciably increase farm income.

The proposed major interventions include: alley cropping, improved food crop varieties, fruit trees, firewood species, forage species, adapted agronomic practices, perennial cropping methods and inorganic fertilizers. A number of interventions are site specific (coffee) while other interventions are adaptable to many sites and soil types (Black bean). The common denominator for all interventions is to increase profitability as a result of practicing sound soil erosion control methods and promoting soil fertility concurrently.

The alley cropping system evolved as a result of seeking alternate methods to the centuries-old custom of shifting cultivation and bush fallow agricultural production. We recommend that leucaena be utilized as the leading candidate for alley cropping until such time as additional information is developed regarding the use of other nitrogen-fixing species.

An important intervention to assure project success and acceptibility by peasants is the introduction of improved crop varieties. AID should immediately take the necessary steps to start a small seed multiplication program with contract farmers.

To implement any of the above major interventions will take time and a change in agronomic practices. The emphasis will be placed on utilizing natural vegetation (crop, forage, tree) as the principal soil erosion control intervention. In selecting a specific vegetation type, first consideration

will be given to plants which have the ability to fix nitrogen and thus reduce the need to rely on the introduction of expensive inorganic fertilizers.

In recommending the above interventions we could not recommend certain varieties, crop rotation, or other untried agronomic practices without first establishing their validity and identifying constaints under the environmental conditions of the project area. We strongly recommend that two special areas representing a broad spectrum of agroclimatic conditions be set aside to test new untried interventions.

C. SUMMARY OF THE ANIMAL HUSBANDRY ANNEX

Grazing land management and soil conservation are complementary activities provided that two effects are avoided. The first is overgrazing. When this occurs, the protective ground cover is removed, the force of rainfall striking bare soil physically dislodges particles, and there are no surface plants or litter, or even residual roots, to prevent the soil from being washed away. Within the targetted watersheds, however, with some exceptions, the combination of sufficient annual precipitation, predominantly perennial herbaceous plants, especially grasses, and low numbers of animals has deterred overgrazing.

The second harmful effect of grazing on soil conservation is the trails caused by free-ranging animals that act to channel surface runoff and promote gully erosion. This can be especially detrimental on steep slopes. Within the targeted watersheds, the low stocking rate and the practice of tethering livestock rather than allowing them to roam freely, has effectively precluded this problem.

The peasant household is the basic livestock production unit. The inventory of animals per household is very small, and, although not every household owns animals, many non-owners are engaged in animal caretaking arrangements. The small farmer livestock holder has developed an intricate system of agriculture which is the best insurance for meeting the food and cash needs of his household. Due to the extremely small amount of land available to the average farmer, there is little margin for error and risk-taking. Production of various crops is the first priority for both land use and labor allocation, and livestock assumes a secondary place.

Most animals are tended individually, and larger herds are rare. Pasture or rangeland relegated solely or primarily to livestock grazing is virtually nonexistent in the watersheds. Instead, there is a complex system for feeding livestock, which involves tethering along paths and other noncultivated areas; cut and carry of native forage plants, and use of crop residues, either by grazing in the field after harvest or by cut and carry. Most areas appearing as pasture or rangeland are fields in between plantings of crops. This short-term fallow is usually a period of only a few months.

It is unrealistic to recommend removing sizable areas of land from crop production to establish grazing areas, even though this might be the best resource use. At the household level, the vast majority of peasants do not have adequate land to allocate solely for grazing. At the community level, the complexity of the land tenure and use system would be a major obstacle to overcome. Even on state lands, a wholesale decree transferring land into grazing areas would deprive peasants of their subsistence base.

Livestock husbandry within the project area is compatible with the goal of the

project, namely to achieve soil and water conservation without reducing the current level of agricultural productivity. Current production can be maintained and even substantially augmented. Increased animal production can be achieved simply by improved nutritional regimes throughout the annual cycle, and by basic animal health practices. Animal nutrition can be improved by better coordinating the use of available wild forage plants and local agricultural residues. As an example, cutting and conserving the wild grass either as hay or silage when it is abundant for later use during the dry seasons would produce a major improvement in animal nutrition.

Simple and inexpensive animal health measures, such as treatments for internal and external parasites, would certainly improve production, without necessarily entailing more animals. An animal that is not undernourished for two months of the year, and that does not have to contend with debilitating diseases, will reach a marketable size faster. With such practices as planting forage crop rows to conserve steep slopes and increase available forage, increased stocking rates are possible.

If it can be demonstrated that some of these marginal lands could produce greater returns to the peasant farmer under livestock production than under subsistence crops, it might be possible to promote a land-use change. However, it would be unreasonable for the peasant to attempt this transition without the assurance that he will not have to absorb the short- or mid-term risks. Nor can he assume the mid-term risks such as disease or falling market prices. Facing such risks, he will undoubtedly elect to continue current practices. There is also great danger that in establishing a land-use change, the small farmer will be forced out by a combination of state decrees and wealthier individuals or groups who can afford to invest in such an operation.

The success of the project will be determined by the true adoption of new techniques at the small farmer level, and not simply by temporary compliance during the life of the project, when additional money and support are available. Practices perceived to be of direct benefit and economically feasible to the individual peasant will probably be adopted. One of the major advantages of working within the Haitian livestock sector is that people want to have animals. The strong preference for animals will be an important focal point for the project.

D. SUMMARY OF SOCIAL SOUNDNESS ANALYSIS

There are several general approaches to watershed issues, and all of them could be argued for. One model is a depopulation strategy, emptying strategic hillsides of all human inhabitants. Another is a permanent public works and quasi-welfare solution in which the hillside population is paid to carry out project determined tasks, forbidden to engage in traditional ground cultivation practices, and subsidized with regular income flows of a welfare type. Both of these models were rejected. The model adopted is based on voluntaristic changes in land use behavior on the part of the hillside population. The matter is formulated in terms of a negotiated settlement between two sets of actors, each with its own agendas:

(1) development institutions with their ecological emphasis on protecting and restoring the environment and their macro-concerns for the general welfare of society as a whole; and

(2) Haitian hillside farmers with their microeconomic focus on maximizing

short-term food and cash flows and their own view of their major dilemma--shortages of productive capital--as the major "blockage" holding them back, even more than land shortage or long-term yield declines linked with overworking the land.

Information is given on the 60,000 families living in the targeted watersheds. They live in small, dispersed hamlets and survive by the raising of crops and livestock on holdings that average out to about 1.5 hectares, spread out into 4 or 5 ecologically distinct plots. Though they consume much of what they produce, they are deeply involved in the cash-cropping of annual grains, black beans being the most lucrative income generating crop in most of the project region.

Localized populations are held together not only by patrilaterally focused kin ties produced by virilocal post-marital residence rules but also by labor exchanges (many of them purchased) between neighbors and by landsharing tenancy arrangements between peasants who have different amounts of land, acquired through both inheritance and through the frequent land transactions that are an integral part of Haitian peasant life. Former patterns of collectivized resource control by patrilaterally extended compounds have yielded to a highly individualized economic orientation in which each household now manages its own production and consumption activities.

The beneficiary population is homogeneous both ethnically and linguistically. Black/mulatto intergroup tensions found at the national level are nonexistent; local differences in skin shades are viewed individually rather than as a marker of group membership. The region is linguistically homogeneous as well. Creole is the first and only language of most of the population.

There are community-internal differences in amounts of land and livestock owned by different families. But the conventional markers of the exisence of closed socioeconomic strata--permanent alienation from land and livestock ownership on the part of individuals and permanent groups of people who sell their labor or pay rent to landowners--lose their meaning in rural Haiti. Most people both inherit and purchase some land, most people are both buyers and sellers of labor, and most people at different stages of their lives are tenants on plots owned by others and landlords who let tenants work on their purchased or inherited land. The project is structured in such a way that access to Project resources is contingent on making vegetative interventions on at least one parcel of worked land. Since most households possess one or more such plots, there are no numerically significant sectors who will not be able to participate in the spread of project benefits.

There are two conjugal modes, *mariaj* (legal marriage) and *plasaj*, a conjugal union that has not been religiously or civilly legitimized but in which both partners are publicly recognized as spouses and viewed as jointly responsible for the economic support of the offspring. Though no statistics are available for the region, probably some six out of ten conjugal unions are of the informal type. The importance of this for the spread effect of the Project is to be found in land tenure. Women in *plasaj* retain ownership of any land which they have inherited or purchased. Care must be taken to ensure that the percentage of Project-benefitted gardens owned by females is representative of their general statistical importance in the landholding regime of the entire community.

Families are organized into nucleated households, the norm being a husband, a

wife, and their offspring. There are however many variations on this theme. Of great importance is the sexual division of labor. Rural Haitian women are not only responsible for child care, cooking, washing, and other domestic tasks. In addition they are the major actors for certain phases of the agricultural cycle, principally planting, weeding, and marketing of the harvest. It could very well be that they, not the males, might be the principal decision makers with respect to placing vegetative interventions of erosion control on hillside plots. Insufficient knowledge exists concerning the specifics of such decion making; what can be said with assurance, however, is that women in Haiti are much more involved in these decisions than their Hispanic counterparts across the border and TWM should not assume a priori that the male *met kay* (household head) is the key actor in these matters.

Recent political changes are briefly discussed in the annex and their possible impact on Project activities. The verdict is basically positive. Not only has the potentially troublesome civilian militia (tonton makout) been disbanded and many of its more notorious leaders *dechouke* ("uprooted", not necessarily entailing loss of life). In addition the visibility and moral credibility of the Catholic Church has been enhanced because of its prominent role in paving the way for the departure of the old regime. At least half of the PVOs with whom the Project plans to collaborate are well organized Catholic groups. That is, at this point in Haitian history, the Project is working precisely with the right groups.

Traditional Haitian farming used to have fallow periods. These have been virtually eliminated because of population pressure. Traditional technology did not have erosion control measures, though some vegetative ramps have recently found their way into local technology. The major traditional erosion control technology is the root crop mound, a countour ridge used for planting of root crops.

Cropping land in Haiti is privately owned by individuals who have either inherited or purchased the plot. The modal holding contains 4 or 5 ecologically distinct plots worked under diverse tenure modes. In addition to inheritance and purchase, there is a great deal of intracommunity land sharing which takes the form of rental and sharecropping.

Most owner-operated plots do not have separate deeds. Deedlessness in the case of inherited or purchased land occurs because individuals avoid formal surveying costs. Despite the lack of a separate deed, however, such plots are felt to be securely held. People will make improvements on them.

The case of sharecropped or rented land is somewhat different Because the tenant's access to such a plot is temporary, he may be reluctant to invest labor in improving such plots. The Project should, in the beginning, not attempt to devise a policy for this matter. Rather it should leave the decision to the individual participants, most of whom will opt to put any vegetative intervention on a plot that they own, rather than on one which they rent or sharecrop.

E. SUMMARY OF THE ECONOMIC ANNEX

The project as currently designed is economically feasible and exhibits high returns both from the point of view of the farmer and of the national economy as a whole. The internal rate of return has been estimated at over 31 per cent, due principally to gains in farmer productivity.

The analysis attempts to summarize the benefits assumed to flow from the project's two major activities at the farm level: the six intervention packages for crop improvement and soil conservation, and the fruit tree development and extension program. It then compares these benefits with the projected private and public costs of implementing the proposed activities.

In the case of the six proposed interventon packages, the analysis finds, subject to the assumptions in the technical annex, that the estimated net present value of benefits from intervention packages adoption is $347.79 when discounted at 50 per cent. The estimated internal rate of return for package adoption is greater than 50 per cent at the farmer level. The projected benefit-cost ratio discounted at 50 per cent is 1.28. These indicators were derived assuming a participating farm family population of 20,000 over the life of the project.

In the case of the fruit tree development and extension program, the estimated net present value of genefits form the program is $232,072 when discounted at 14 per cent. The estimated internal rate of return is 14.2 per cent for the program under the assumptions in the technical analysis. The projected beneficiary population for this program is 25,000 farm families over the life of the project.

It should be recognized in reviewing these results that they are based upon many technical assumptions by the design team technicans and what useful information could be derived from a deficient national database on hillside agriculture. The actual results of project implementation and farmer adoption of the proposed interventions may be very different from those projected in the analysis. The project makes provision for an on-the-ground project monitoring and evaluation unit during the life of the project to collect both reliable baseline information on existing farming systems on the hillsides and comparable information on the value of project interventions as they were developed and extended. Only as this improved information base is developed and analyzed can one have much confidence in the projected benefits and costs of the proposed interventions.

F. SUMMARY OF THE ADMINISTRATIVE ANALYSIS

The administrative analysis of the project presents a picture of the organizations which will implement and support the PSTO project on the ground. The administrative structure of the project was elaborated on the basis of the experiences of recent development efforts in Haiti and of the impressions of the design team as it travelled through the project area. While the structure presented therein may seem formal and fixed, it is not meant to restrict the flexibility of the implementation team who may wish to test other arrangements in the field.

The ultimate project beneficiaries are the farm families who will adopt the technical package made available during the LOP. In view of the integrated nature of the technical package presented by the project to these farmers, the full advantages of which will only be apparent after several years of trial, demonstration and extension work, farmer adoption of integrated packages should increase gradually. But the project expects rapid acceptance of certain innovations by large segments of the population.

The farmers will participate in the project individually or in groups,

depending on local circumstances. They will provide paid labor on demonstration sites; perform on-farm trials under project supervision and with project guarantees in the case of unsuccessful trials; participate as trainers and trainees in seminars and workshops; and, when convinced of its utility and profitability, carry out interventions proposed by the project on their own fields. The project will recruit field staff from their numbers and certain of them will act as contract seed multipliers.

Directly supervising activities that touch the farmers directly will be a group of Haitian PVOs, all of which have worked in the Les Cayes area for many years. These PVOs include both religious and non-sectarian groups actively engaged in development activities in the targeted watersheds. Their projects include agroforestry, swine repopulation, irrigated agriculture, and hillside farming, as well as social organizational and welfare activities.

Four of these PVOs (DRI, DCCH, ORE, and UNICORS) seem sufficiently well organized and have expressed willingness to work with the project. They form the most hopeful basis for implementing it on a sustainable basis. They all intend to work in the zone for the foreseeable future, whether or not the project helps them. There is thus no need to create a new set of institutions to carry out the project.

To reach an acceptable level of technical and administrative competence to carry out constructive agricultural improvement measures, the PVOs will need technical assistance and financial and material support. To ask AID to grant such support to each PVO individually would be administratively prohibitive both to the grantor and the grantees. Thus AID will establish a contract or Cooperative Agreement with an American development entity (PVO, university, private firm, or some combination thereof) to deliver this assistance to the participating PVOs.

This organization will be chosen on the basis of its understanding of the project, the sensitivity of its animation approach, the techncial precision of extension plan, and the quality of the personnel it proposes as an implementation team. It will establish an umbrella agency in Les Cayes. This agency, will be staffed by a Chief of Party; a farming systems agricultural economist, who will run the monitoring and evaluation system; an animal husbandry/forage/extension specialist; and two agronomists, one of whom will be based in Les Cayes and the other on the Southwest Coast. One of these agronomists will have soils expertise, the other will be a tropical horticulturalist. Finally, this contractor will place a French speaking Natural Resource Economist with MARNDR as an advisor to that Ministry's STAB information management and policy analysis unit. This umbrella agency will provide technical assistance to the Haitian PVO's for the following operations:

(1) selection and installation of experimental and demonstration sites in the selected watersheds;

(2) selection and training of personnel for extension, site supervision, credit management, and monitoring and evaluation;

(3) development and extension of the technical package, including installation and supervision of on-farm trials, and training of farmers;

(4) management of the input program and general administration; and

(5) monitoring and evaluation.

In addition, the umbrella agency will select LORG/PVO personnel for short and long-term training in Haiti and overseas and will finance such training, in order to improve their administrative capacity to run the program after the PACD.

The project will also provide financial and material support to the PVOs to help them carry out their tasks and to prepare them to sustain their activities after the PACD. This help will include vehicles, fuel and parts, salaries to engage necessary personnel, consumable supplies, technical equipment, training, and computer packages.

The GOH/MARNDR will take part in project planning and coordination through the STAB in Port au Prince and the District Agronomy Office in Les Cayes. The STAB will coordinate research and extension activities with those of other hillside projects and will ensure a flow of useful information and communication between them. The District Agronomist will act as a counterpart to the umbrella COP and provide advice to the umbrella team as it works with other private and public entities in the Les Cayes region. He will also act as director of the PL 480/Title III PPMS land reclamation, soil conservation outreach program, including its TWM supported Pic Macaya Park Management activity.

The USAID Project Officer in the USAID's Rural Development Office (RDO) will ensure proper administration of the project. He will see to the execution of the projects work plans and the management of its resources. He will be assisted in these management activities by a full-time PSC project coordinator also based in the USAID mission. Both the USAID project officer and the PSC project coordinator will work directly with the umbrella agency's COP and the coordinator of the STAB.

The PSTO will meet certain input-supply goals by working through the private sector. Fertilizer and other chemicals will be purchased through existing marketing organizations, such as those connected to ASSA, the fertilizer mixing plant in Port au Prince. Although there should be no problems in obtaining needed fertilizers, market structures for other chemicals, such as herbicides, pesticides and fungicides are less developed and less reliable. There exists in Haiti no reliable source of high quality seed for any of the crops the project will encourage, except perhaps coffee. For this reason AID will encourage private entities, including agribusinesses, PVO's and individual farmers to undertake supervised seed multiplication as a commercial venture.

The administrative structure proposed for the PSTO thus combines the advantages of a private sector approach with those of national coordination through a governmental implementing agency. The main implementing agencies of the PSTO, the Haitian PVOs, are already administratively sustainible. They have only to be enabled to incorporate PSTO's activities on a permanent basis in their programs. The attractiveness of the TWM integrated agricultural package should prove sufficient to ensure beneficiary sustainibility for the production-increasing, soil-regenerating activities the project will extend to its participants. Finally, income generating activities like seedling production, input supply and seed multiplication should enable the implementing agencies to continue their activities after the departure of the umbrella agency following the PACD.

G. SUMMARY OF THE ENVIRONMENTAL ANALYSIS

To comply with AID's environmental regulations, procurement and/or use of pesticides should be done as part of integrated pest management (IPM) programs and where capabilities are weak, efforts should be made to augment crop protection activities. In order to provide Haiti and particularly the target area with a good base for the elaboration of IPM programs, it is recommended that eight months of short-term technical assistance in the pest management disciplines (entomology, plant pathology, weed and vertebreate pest management) from individuals with extensive experience in the Caribbean, and a good knowledge of tropical crops and their commonly associated pests, be provided during the five years of the project. Consultants should be fluent in French.

A series of short term training courses and technical assistance packages will be developed. Assistance in developing the training and technical assistance programs may be obtained from the Bureau of Science and Technology, Office of Agriculture (S&T/AGR), through their cooperative agreement with the Consortium for International Crop Protection (CICP) and Oregon State University's International Plant Protection Centwr (OSU-IPPC). Over the five years of the program ten 2-4 week visits (twice yearly) will be arranged for technical assistance by plant protection specialists. The length of stay will gradually decline starting at four weeks in the first two years, decreasing to three weeks each in years 3 and 4, and 2 weeks in year 5. These individuals will:

(1) Identify the nature and magnitude of existing pest management problems, which would lead to the development of a Haiti-specific pest catalogue;

(2) Assist in the design and identification of a testing/evaluation program on appropriate pesticide use and efficacy, which will include some system of crop insurance for participating farmers;

(3) Identify appropriate person(s) to monitor and evaluate the field and testing programs; and

(4) Monitor and evaluate the success of the extension programs in pest management from a safety and acceptibility perspective and the ability of the program to sensitize farmers to the important safety and environmental issues.

Little information is available on the specific and most important pest problems and their economic status. The lack of very basic information may account for the more or less haphazard use of pesticides and the absence of alternative control methods. Perhaps the full-time services of a Peace Corps Volunteer could be procured to coordinate with the technical assistance consultant visits as discussed above. Responsibilities of the Peace Corps Volunteer would include:

(1) Gathering information already available on major pests and confirming existing identifications;

(2) Conducting literature searches on existing problems;

(3) Visiting PVOs and farmers to gather first-hand data on commonly

encountered pests and collecting speciments for definitive identifications;

(4) Describing current management practices and assisting in the design of small scale field trials on pesticide efficacy;

(5) Producing a pest catalogue for extension officers and farmers; and

(6) Conducting crop loss assessments of major pests.

The strong emphasis on extension in the project provides a suitable vehicle through which to develop and implement training programs in integrated pest management. Training modules in IPM and safe pesticide use and handling will be developed for extension officers and promotors associated with the LORCs and the STAB. Training activities should commence after major problems are identified and the monitoring and testing/evaluation programs are begun with participating farmers. Sometime in Year 2, a two-week course in integrated pest management will overlap with the technical assistance to take advantage of demonstrations and field trials implemented by the TA consultant. The costs of the TA and training will be born by the TWM and the specific scope of work will be developed cooperatively by the Mission and S&T/AGR to include: the IPM approach, current pesticide use and safety, and demonstrations of pest protection aspects of on-farm storage of agricultural commodities.

In addition, farmers often do not recognize the danger that pesticides may post to health and safety. Thus, prior to providing pesticides, it would be wise to develop and implement basic education programs (through the extension/promoter system) in pesticide safety, handling and the danger improper pesticide use poses to the environment.

Long term training at the masters and doctoral level is provided in the project for personnel from the STAB. It is recommended that the individual receiving doctoral training conduct his/her research in crop protection.

It is not known at present which pesticides will be used on each of the food crops considered for adoption in the project. It is important that the pesticides authorized for the project be applied only on crops which have either an EPA registration or established FAO/WHO residue tolerances, especially in the case of crops which are destined for export. For domestic crops, WHO/FAO residue tolerance levels and/or registration for the same or similar use in selected other countries (e.g. EEC countries) may be considered sufficient. Since technical assistance is provided, specific guidance on appropriate crop/pesticide combinations and assistance in obtaining any needed residue/efficacy data may be obtained from S&T/AGR and its pest management contractor, CICP. Residue data will be collected for use of pesticides on crops for which tolerances have not been established by either EPA or WHO/FAO. Costs of residue analyses have been included in the budget presented below. Additional analyses may be performed by and at the expense of private chemical companies who are providing the pesticides. To the extent possible, analyses funded by the project will be performed in Belizean labs where capabilities exist.

More information is needed on methods of application, availability of safety equipment and protective clothing. Information is lacking on the following issues:

(1) Who will apply pesticides? When, later in the project, farmers may procure and use pesticides funded by the project, necessary training in safe pesticide use and handling will be required.

(2) How will farmers procure pesticides? Who will determine the most appropriate pesticides and who will furnish the equipment?

(3) If pesticides are repackaged, how will labeling procedures be followed? Assistance to the PSTO will be provided by S&T/AGR with regard to minimum acceptable standards for repackaged pesticides.

Recommendations regarding specific pesticides are as follows:

Methomyl (lannate) is a highly toxic insectide and is registered by EPA for restricted use only. It is currently applied on fruit tree seedlings at the ORE nursery for the control of capterpillars, in addition to the use of ***malathion.*** If effective, ***malathion*** should be considered as a satisfactory alternative. Use of ***dipel (bacillus thuringiensis)*** to control lepidoptera larvae on fruit tree seedlings should be explored.

Four of the pesticides which had been considered for use in the project are among those cancelled by EPA, namely ***chlordane, toxaphene, dieldrin*** and ***aldrin.*** None of these will be permitted for use under the project. This includes use for experimental and demonstration purposes. S&T/AGR will assist in identifying alternatives to these.

The very high phytotoxicity of ***picloram*** can lead effectively to soil sterilization. Its use therefore should be avoided. Other safer general use herbicides should prove effective for most nursery week problems. If ***glyphosate*** alone does not give good control, other substitutes may need to be sought. The herbicide of *2,'-D* is a good candidate. However, low volatility esters of *2,4-D* should be used to reduce similar problems with phytotoxicity. The OSU-IPPC may be consulted for advice on suitable alternatives and the specific formulations.

At present, the extract of neem (***azadirachta indica***) seeds, used to control caterpillars, is produced in very low quantities and may only marginally meet nursery needs. If neem trees are grown as part of a reforestation and agroforestry effort, small farmers could gain some economic benefit if the project were to explore and promote:

(1) The use of neem seed extract by farmers to meet their own pest management needs ;

(2) Possible collection and extraction of neem seeds for commercial production of ***azadiractin*** (the active chemical found in neem seeds);

(3) Improved methods of extraction to be used both by small farmers and commercial ventures; and

(4) Testing of the relative efficacy of varying concentrations of ***azadiractin.***

A system for safe storage of pesticides and disposal of pesticide containers or unused pesticides should be established at each participating LORG nursery as described by Parasram et al. (1980).

Consideration should be given to use of resistant plant varieties when considering introduction of new plant cultivars into the project. These varieties could be screened at the LORG nurseries. Examples include Psyllid resistant ***leucaena leucocephala*** and rust resistant ***coffea arabica.***

VI. PROCUREMENT AND CONTRACTING PLAN

The contracting actions under this project are divided into two parts, along the functional lines of public and private sector activities. The first part of this section describes the procedures by which funds will be obligated and committed, and the second section gives illustrative covenants to be included in the bilateral agreement.

(1) In FY 1986, the first project year, the Mission will sign a bilateral agreement with the GOH to obligate $1.5 million for the LOP costs of support to the STAB and the Park Management activities. The Park Management activities will be subobligated in FY 1987 when the park management organization is chosen. As mentioned in the Implementation Plan, the GOH recipient organization has not yet been chosen, although the enabling legislation is in draft. For this reason, the funds will be obligated to the STAB, with a provision in the Grant Agreement that stipulates that when the appropriate organization is chosen, the funds will be obligated to it.

(2) In FY 1987, the Mission will select a US-based PVO with international experience for the purpose of staffing the Umbrella Organization.

Umbrella Organization. The selection of the umbrella organization will be done through the vehicle of a formal Request for Proposals. The request will be sent forth in late CY 1986, and qualified respondents will be encouraged to submit detailed proposals based upon the project outlined in this paper. The final selection will be made by a formal selection committee composed of officers from several different AID offices. This contract will be a direct contract from USAID to the selected organization(s).

Pesticide Management. Technical assistance to evaluate the safest and most appropriate pesticides and for short term training in pesticide safety and handling will be procured through a buy-in to AID's cooperative agreement with COCP and OSU-IPPC. It will be processed late in Year 1 of the project, or when LORGs have been selected.

Park Management Organization. The procedure for selection of the park management organization is similar to that for selecting the umbrella organization. Several qualified organizations will be contacted to ascertain their interest, and three or more will be encouraged to submit proposals for management of the park. The only difference is that tis contract will be a sub-obligation from the MARNDR/DRN grant.

Gray Amendment considerations. No firm or institution has been identified as a preferred prime implementation contractor for the project. Serious effort will be made to follow procurement guidelines established by OSDBU/PRC to implement the Gray Amendment. The Mission will access the

Automated Consultant Registry Information System (ACRIS) of OSDBU/PRC for an update on small businesses and/or small and economically disadvantaged enterprises which have the capability to become the prime contractor in considering responses to the Request for Proposals. The RFP announcement will also encourage competitive bidders to consider including 8(a) firms as subcontractors. Finally, the Mission will access ACRIS for technical assistance on project evaluations.

Covenants and conditions precedent. The only condition precedent to disbursement will be the identification of appropriate GOH counterpart individuals as Project Director and as STAB coordinator. The following covenants will be included in the bilateral agreement. The covenants are divided into topical areas.

(1) Land tenure policies. The GOH will

(a) reinforce laws and customs which protect small-holding farmers from land speculators, and particularly from absentee owners,notably those which guarantee right of first refusalonany land for sale to relatives of the seller and then to renters or share-croppers of that land;

(b) prohibit sub-leasing of state lands by absentee renters. All who rent state lands must farm them;

(c) make new rentals of state lands first to those who undertake to implement soil conservation measures on that land, ensure long-term access to the land to those who carry out such measures, and reduce their rent during the years that these measures are developing toward producing income (e.g. forestry plantations, fruit trees, other perennial crops, hedge-rows, pasture, etc.);

(d) eliminate the tax on cutting for charcoal, lumber or poles trees that farmers have planted themselves;

(e) encourage owners of rented or share-cropped land to encourage renters or share-croppers to undertake, or permit the owners to undertake soil conservation measures on these fields; and

(f) develop laws guaranteeing the ownership of trees to the planter of the tree, even if such trees are planted on state lands.

(2) Agricultural policies. The GOH will

(a) eliminate what remains of the taxes on exports of agricultural products, like coffee and cacao;

(b) eliminate quotas on basic food imports to encourage farmers to grow perennial and export crops on the hillsides and buy much of their food at affordable prices;

(c) establish a national policy for all hillside projects concerning the uses of food-for-work and payments to farmers for work on their

own land; and

(d) establish a national policy linking access to subsidized agricultural inputs on all projects to appropriate soil conservation behaviors.

(3) Pic Macaya. The GOH will

(a) vigorously pursue the suppression of the trade in charcoal and lumber originating from illegal cutting on the Pic Macaya Reserve area;

(b) actively implement the program for the preservation of the flora and fauna of the Pic Macaya Reserve as established by USAID and other donors;

(c) establish a national park service in the Pic Macaya Reserve to guard existing resources and regenerate the flora and fauna of the zone;

(d) compensate the legal owners of land within the Pic Macaya Reserve boundaries by granting them title to state lands elsewhere at a ratio of two hectares of state land for each hectare of Reserve land[1];

(e) give priority, in hiring forest service agents and reforestation program laborers to local farmers who live near the Reserve's borders; and

(f) complete the marking of the Reserve's boundaries as quickly as possible.

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[1] This will be an obligatory program. The current occupants of the state land and other squatters will be allowed to harvest their current crop and will then be asked to leave without compensation. In certain cases they could be allowed to remain on Reserve land if they agree to a zoning ordinance restricting its use to perennial crops such as coffee and cocoa.

ANNEX A PID APPROVAL MESSAGE

UNCLASSIFIED STATE 077946/01

DATE RECEIVED
MAR 14 1986

ACTION AID-3 INFO AMB DCM

VZCZCFU0885
PP RUEHPU
DE RUEHC #7946/01 0721729
ZNR UUUUU ZZH
P 1317287 MAR 86
FM SECSTATE WASHDC
TO AMEMBASSY PORT AU PRINCE PRIORITY 1751 DUPE MCN
BT
UNCLAS SECTION 01 OF 02 STATE 077946

LOC: 04 890
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CN: 00827
CHRG: AID
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ACTION TAKEN
Date:
By:

Rec: 3/18/86

AIDAC

E.O. 12356: N/A
TAGS: N/A
SUBJECT: TARGETED WATERSHED MANAGEMENT PROJECT 521-0191

THE DAEC REVIEWED AND APPROVED THE REFERENCED PID ON FEBRUARY 26.

1. GENERAL: THE DAEC WAS PLEASED WITH WIDE RANGE OF PROJECT DESIGN ISSUES COVERED IN THE PID AND COMPLIMENTS MISSION ON ITS COMMAND OF THE NUMEROUS CONSIDERATIONS THAT WENT INTO THIS DESIGN CONCEPT. USAID IS AUTHORIZED TO REVIEW AND APPROVE THE PROJECT PAPER IN THE FIELD. THE FOLLOWING GUIDANCE IS PROVIDED FOR PP DESIGN AND DEVELOPMENT:

2. PUBLIC SECTOR COMPONENT. CAUTION IS SUGGESTED IN PLACING THE PROPOSED DOLS 2.25 MILLION COMPONENT UNDER THE RESPONSIBILITY OF THE MINISTRY OF AGRICULTURE. MISSION IS ADVISED TO STUDY ALTERNATIVE NON-GOVERNMENT LOCALES FOR A UNIT WHICH COULD EVALUATE AND DISSEMINATE POLICY INFORMATION ON NATURAL RESOURCE DEGRADATION TO INVOLVED AGENCIES. IF IT IS STILL DETERMINED THAT THE MINISTRY WILL BE ABLE TO PERFORM SATISFACTORILY AS HOST FOR THE PROPOSED HILLSIDE SECRETARIAT, THEN JUSTIFICATION AND THE RATIONALE FOR THIS SELECTION

SHOULD BE PRESENTED AS PART OF THE STATEMENT OF THE MOH'S INSTITUTIONAL CAPABILITIES TO CARRY OUT THE ACTIVITY; AND PROJECT SHOULD BE STRUCTURED SO THAT IF THIS COMPONENT FAILS, IT CAN BE TRANSFERRED TO A PRIVATE SECTOR ENTITY.

3. WATERSHED MANAGEMENT STRATEGY. THE PID DESCRIBED PROJECT ACTIVITIES WHICH FOCUS MORE ON FARMING EXTENSION THAN WATERSHED MANAGEMENT. THE PP SHOULD DESCRIBE THE POSITION OR CONTRIBUTION OF THIS PROJECT WITH REGARD TO THE MISSION'S OVERALL WATERSHED MANAGEMENT AND HILLSIDE FARMING STRATEGY FOR HAITI. THIS SHOULD INCLUDE OTHER PROJECT AND USAID ASSISTANCE THAT ARE PART OF THE PROGRAM' THE ROLE OF THE PL 480 TITLE III PROGRAM, BOTH IN TERMS OF LOCAL CURRENCY SUPPORT OF WATERSHED MANAGEMENT RELATED PROJECTS AND AS AN INSTRUMENT FOR POLICY DIALOGUE IN THIS AREA, SHOULD ALSO BE PRESENTED

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THIS DISCUSSION. THIS DESCRIPTION SHOULD SPECIFICALLY ADDRESS THE BROADER WATERSHED MANAGEMENT GOALS AND NEEDS AS OUTLINED IN THE INITIAL ENVIRONMENTAL EXAMINATIONS.

4. ROLE OF THE NGO'S' THE PP SHOULD CONFIRM THE PRESENCE OF NGO'S AND OTHER FARMER ORIENTED ORGANIZATIONS IN THE PROJECT ZONE ADEQUATE IN NUMBER AND CAPABILITY TO PROVIDE THE PROPOSED EXTENSION SERVICES AND MOBILIZE RURAL DEVELOPMENT PARTICIPATION. THE ROLE OF THE UMBRELLA NGO IN RELATION TO THAT OF PARTICIPATING ORGANIZATIONS IN CARRYING OUR PROJECT ACTIVITIES SHOULD BE ELABORATED, AS WELL AS THE SYSTEM OF COORDINATION TO BE ESTABLISHED WITH BOTH THE GOH AND THE PSC PROJECT COORDINATOR. THE PP SHOULD ALSO SHOW HOW NECESSARY ACTIVITIES SUCH AS DISSEMINATION OF TECHNICAL INFORMATION AND OPERATION OF THE CREDIT PROGRAM WILL BE CONTINUED AFTER PROJECT COMPLETION.

5. DEPTH OF MARKETS. THE PP SHOULD DEMONSTRATE HOW INCREASED CROP AND LIVESTOCK PRODUCTION PROJECTED UNDER THE PROJECT WILL BE ABSORBED BY THE DOMESTIC MARKET WITHOUT LOWERING MARKET PRICES BELOW THE PRODUCTION INCENTIVE POINT. LOCAL, NATIONAL AND INTERNATIONAL MARKETS FOR POTENTIAL PRODUCE SHOULD BE ASSESSED.

6. LAND TENURE. THE DAEC RECOGNIZED THE NEED TO DEVELOP MORE INFORMATION ON THE IMPACT OF LAND TENURE STATUS ON LAND IMPROVEMENT BEFORE PURSUING SPECIFIC POLICY REFORMS (EITHER ADMINISTRATIVE OR LEGISLATIVE) IN THIS AREA. HOWEVER, GIVEN THE POTENTIAL IMPORTANCE OF THIS CONSTRAINT, THIS INFORMATION GENERATION FUNCTION

SHOULD NOT BE LEFT ENTIRELY TO THE PROPOSED HILLSIDE SECRETARIAT. A MAJOR SURVEY SHOULD BE PROGRAMMED INTO THE IMPLEMENTATION PLAN OF THE PROJECT ITSELF, ASSURING THAT AN IN-DEPTH ANALYSIS OF THIS CRUCIAL ISSUE IS AVAILABLE AT THE EARLIEST OPPORTUNITY. THE SURVEY SHOULD BEGIN WITH A BASELINE AS SOON AS POSSIBLE AND FOLLOWED UP BY AN EVALUATION OF THE IMPACT OF LAND TENURE ON PROJECT ACTIVITIES IN NO LESS THAN TWO YEARS.

7. PROCUREMENT: THE PID PROPOSES TO IMPLEMENT THE PRIVATE SECTOR COMPONENT OF THE PROJECT VIA A COOPERATIVE AGREEMENT WITH A NON-GOVERNMENTAL ORGANIZATION. A COOPERATIVE AGREEMENT IS AN ASSISTANCE INSTRUMENT WHICH IS APPROPRIATE ONLY WHEN THE OBJECT IS TO SUPPORT OR STIMULATE THE RECIPIENT ORGANIZATION'S OWN PROGRAM OR PROJECT. IF, ON THE OTHER HAND (AS STATED IN HB1B, 12A3) A.I.D. IS ACQUIRING GOODS AND SERVICES FOR AN A.I.D. PROGRAM, A CONTRACT IS USED. THIS MEANS THAT THE APPROPRIATE INSTRUMENT IS A CONTRACT, EVEN IF THE OTHER PARTY IS A PVO, IF THE FUNDS PROVIDED BY A.I.D.

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ARE TO PROCURE SERVICES RATHER THAN TO SUPPORT THE PVO'S OWN PROGRAM. THE MISSION SHOULD EXAMINE EXISTING PVO PROGRAMS IN HAITI, THE SUPPORT OF WHICH WOULD ACHIEVE THE MISSION'S OBJECTIVES, AND JUSTIFY ITS SELECTION OF EITHER A COOPERATIVE AGREEMENT OR CONTRACT PROCUREMENT MODE IN TERMS OF THE ABOVE GUIDELINES. WE SUGGEST CONSULTATION WITH GC/LAC BEFORE A FINAL DECISION IS MADE.

8. PESTICIDES: MISSION IS REMINDED THAT AN ENVIRONMENTAL ASSESSMENT (EA) WILL BE REQUIRED IF PESTICIDES ARE TO BE PROCURED OR USED IN THE PROJECT. THIS EA WOULD FOCUS ON THE PESTICIDES TO BE PROCURED OR USE AND BE DONE CONCURRENTLY WITH THE PP DESIGN TO ENSURE ITS RECOMMENDATIONS ARE INCORPORATED AT THAT TIME. THE EA WOULD NEED TO BE REVIEWED IN AID/W BY THE LAC CHIEF ENVIRONMENTAL OFFICER PRIOR TO APPROVAL.

9. THE INITIAL ENVIRONMENTAL EXAMINATION WAS APPROVED ON FEBRUARY 26, 1985. COPIES HAVE BEEN POUCHED TO THE MISSION. SHULTZ
BT
#7946

NNNN

UNCLAS SECTION 02 OF 02 STATE 077946

ANNEX B

AID 1020-28 (1-72)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY 86 to FY 90
Total U.S. Funding $15 million
Date Prepared: June 18, 1986

Project Title & Number: Targetted Watershed Management (521-0191)

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: To arrest the process of environmental degradation in Haiti's watershed areas.	Measures of Goal Achievement: Improved agricultural land, soil conservation measures installed. Technical packages accepted. Farmers adopt packages. PVO technical & administrative capacity upgraded. Accurate and timely data are gathered and analyzed. Credit program revolving fund working. Land tenure situation changes, and there is a shift from annual to perennial crops.	Project studies; reports from CCH, OPRODEX, and others; aerial photographs; results from Agroforestry Outreach Project and fruit tree projects; other baseline studies and monitoring programs	Assumptions for achieving goal targets: Watersheds are degrading; watersheds are recuperable; increases in production are compatible with soil protection; population will remain on the hillside; increased income from agriculture is possible; GOH commitment to agricultural development; national agricultural policies encourage agriculture.
Project Purpose: To extend soil-conserving and fertility-augmenting land management practices in the target area and to apply lessons learned from this field effort to national-level hillside management planning.	Conditions that will indicate purpose has been achieved: End of project status. Increase food crop production. Increase yields. Increase export crop production. Decrease or reverse erosion rates. Increase vegetative cover on hillsides. Increase livestock holdings per family.	Aerial photographs; baseline studies and monitoring reports; project evaluations and reports; credit reports; credit records; land tenure study.	Assumptions for achieving purpose: Farmers will innovate and invest; is an effective national coordinator; GOH agricultural policies encourage production; national agricultural research capacity develops; national policy encourages perennial crops; no food for work or salaries paid for work done on a farmer's own land.
Outputs: MARNDR Coordinating Secretariat established. Watershed surface area transformed and farmers' productivity and income raised. Erosion rates diminished. Baseline studies completed and kept up to date. Input supply logistics effective. Improved animal health and production and increased pasture available. Staff trained in appropriate institutions in Haiti and overseas. PVO management and technical capacity upgraded.	Magnitude of Outputs: 30,000 hectares improved; 150,000 gardens improved; 20,000 families helped; three baseline studies completed; monitoring effective; seed production system adequate; input supply logistics adequate; 2M linear meters of hedgerows; doubling of food crop production; 50% increase in export crop production; 1,000 Ha of improved pasture; 50 extensionists and site managers trained;	PVO and project reports and evaluations; aerial photographs; baseline studies; reports produced; updated studies; personnel records; evaluations; national agricultural policy statements; project information.	Assumptions for achieving outputs: Local PVO management ability; technical capacity; GOH and PVOs cooperate; GOH land use policy is positive; input program is manageable; there is public support for conservationist agriculture.
Inputs: Previous watershed studies by AID and others. Resources to purchase, transport, store and distribute inputs, including seeds and fertilizer. Training of host country and PVO counterparts. Periodic evaluations, regular monitoring, and long and short term technical assistance. PVO staff, facilities and contacts, and AID policy and management support.	Implementation Target (Type and Quantity) Project implementation plans; project implementation contract (including TA), subgrants with PVOs; project reports; project evaluations	Project and PVO reports; project management records; project evaluations AID records.	Assumptions for providing inputs: Umbrella organization is efficient; TA team is effective; timely short term TA; is effective; AID policy pressure is effective.

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5C(2) PROJECT CHECKLIST

ANNEX C STATUTORY CHECKLIST

Listed below are statutory criteria applicable to projects. This section is divided into two parts. Part A. includes criteria applicable to all projects. Part B. applies to projects funded from specific sources only: B.1. applies to all projects funded with Development Assistance Funds, B.2. applies to projects funded with Development Assistance loans, and B.3. applies to projects funded from ESF.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?

A. GENERAL CRITERIA FOR PROJECT

1. FY 1982 Appropriation Act Sec. 523; FAA Sec. 634A; Sec. 653(b).

(a) Describe how authorizing and appropriations committees of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that amount)?

A Congressional Notification has been prepared and has expired.

Yes.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,00, will there be

(a) engineering, financial or other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?	(a) N/A (b) Yes.
3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?	N/A
4. FAA Sec. 611(b); FY 1982 Appropriation Act Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as set forth in the Principles and Standards for Planning Water and Related Land Resources, dated October 25, 1973? (See AID Handbook 3 for new guidelines.)	N/A
5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?	N/A

6.	FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.	No.
7.	FAA Sec. 601(a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.	(a), (d), and (f) N/A (b) The project will promote non-governmental organization in their agricultural development and resource conservation activities. (c) and (e) The project will encourage farmers' cooperative efforts to implement new soil conserving technologies.
8.	FAA Sec. 601(b). Information and conclusions on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).	N/A

9.	FAA Sec. 612(b), 636(h); FY 1982 Appropriation Act Sec. 507. Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars.	The project contemplates the use of local currency generations under the Title III program.
10.	FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release?	No.
11.	FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise?	Yes.
12.	FY 1982 Appropriation Act Sec. 521. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity?	N/A
13.	FAA 118(c) and (d). Does the project comply with the environmental procedures set forth in AID Regulation 16? Does	Yes.

the project or program take into consideration the problem of the destruction of tropical forests?

14. FAA 121(d). If a Sahel project, has a determination been made that the host government has an adequate system for accounting for and controlling receipt and expenditure of project funds (dollars or local currency generated therefrom)? N/A

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(b), 111, 113, 281(a). Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and

The project is directed to grassroots level peasant farmers, male and female, to whom it will extend technologies which will safeguard the productivity of their land. The regional focus of the project enables peasants to help themselves with the assistance of local, private development groups who will extend the results of innovative farming systems technologies throughout the southeast region.

otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?

b. FAA Sec. 103, 103A, 104, 105, 106. Does the project fit the criteria for the type of funds (functional account) being used?

Yes.

c. FAA Sec. 107. Is emphasis on use of appropriate technology (relatively smaller, cost-saving, labor-using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor)?

Yes.

d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activitiy with respect to which the assistance is to be furnished (or is the latter cost-sharing requirement being waived for a "relatively least developed" country)?

N/A; the country is a RLDC.

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Best Available Document

Yes.

Yes.

The majority of the Haitian population practises subsistence farming on hillsides which are rapidly degrading in their capacity for agricultural production. While other aspects of the Mission strategy promote development through employment alternatives to agriculture, the

institutional development; and supports civil education and training in skills required for effective participation in governmental processes esential to self-government	project seeks to improve the sustainability of agricultural production, both as a food source for the entire nation and as a viable private sector enterprise.
2. Development Assistance Project Criteria (Loans Only)	
a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan, at a reasonable rate of interest	N/A
b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?	N/A
c. ISDCA of 1981, Sec. 724 (c) and (d). If for Nicaragua, does the loan agreement require that the funds be used to the maximum extent possible for the private sector? Does the project provide for monitoring under FAA Sec. 624(g)?	N/A
3. Economic Support Fund Project Criteria	
a. FAA Sec. 531(a). Will this assistance promote economic or political	N/A.

	stability? To the extent possible, does it reflect the policy directions of FAA Section 102?	
b.	FAA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities?	N/A
c.	FAA Sec. 534. Will ESF funds be used to finance the construction of the operation or maintenance of, or the supplying of fuel for, a nuclear facility? If so, has the President certified that such use of funds is indispensable to nonproliferation objectives?	N/A
d.	FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made?	N/A

STANDARD ITEM CHECKLIST

Listed below are the statutory items which normally will be covered routinely in those provisions of an assistance agreement dealing with its implementation, or covered in the agreement by imposing limits on certain uses of funds.

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A. Procurement

1. FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of commodities and services financed?	Yes.
2. FAA Sec. 604(a). Will all procurement be from the U.S. except as otherwise determined by the President or under delegation from him?	Yes.
3. FAA Sec. 604(d). If the cooperating country discriminates against marine insurance companies authorized to do business in the U.S., will commodities be insured in the United States against marine risk with such a company?	Yes.
4. FAA Sec. 604(e); ISDCA of 1980 Sec. 705(a). If offshore procurement of agricultural commodity or product is to be	N/A

	financed, is there provision against such procurement when the domestic price of such commodity is less than parity? (Exception where commodity financed could not reasonably be procured in U.S.)	
5.	FAA Sec. 604(g). Will construction or engineering services be procured from firms of countries otherwise eligible under Code 941, but which have attained a competitive capability in international markets in one or these areas?	No.
6.	FAA Sec. 603. Is the shipping excluded from compliance with requirement in section 901(b) of the Merchant Marine Act of 1936, as amended, that at least 50 per centum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S. flag commercial vessels to the extent that such vessels are available at fair and reasonable rates?	No.
7.	FAA Sec. 621. If technical assistance is financed, will such assistance be furnished by private enterprise on a contract basis to the fullest extent practicable? If the facilities of other	Yes.

	Federal agencies will be utilized, are they particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs?	
8.	International Air Transport. Fair Competitive Practices Act, 1974. If air transportation of persons or property is financed on grant basis, will U.S. carriers be used to the extent such service is available?	Yes.
9.	FY 1982 Appropriation Act Sec. 504. If the U.S. Government is a party to a contract for procurement, does the contract contain a provision authorizing termination of such contract for the convenience of the United States?	Yes.

B. Construction

1.	FAA Sec. 601(d). If capital (e.g., construction) project, will U.S. engineering and professional services to be used?	N/A
2.	FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable?	N/A

3. FAA Sec. 620(k). If for construction of productive enterprise, will agggregate value of assistance to be furnished by the U.S. not exceed $100 million (except for productive enterprises in Egypt that were described in the CP)?	N/A
C. Other Restrictions	
1. FAA Sec. 122(b). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter?	N/A
2. FAA SEc. 301(d). If fund is established solely by U.S. contributions and administed by an internatioal organization, does Comptroller General have audit rights?	N/A
3. FAA Sec. 620(h). Do arrangements exist to insure that United States foreign aid is not used in a manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of the Communist-bloc countries?	Yes.
4. Will arrangements preclude use of financing:	
a. FAA Sec. 104(f); FY 1982 Appropriation Act Sec. 525: (1) To pay for performance of abortions as a method of family	Yes.

planning or to motivate or coerce persons to practice abortions; (2) to pay for performance of involuntary sterilization as method of family planning, or to coerce or provide financial incentive to any person to undergo sterilization; (3) to pay for any biomedical research which relates, in whole or part, to methods or the performance of abortions or involuntary sterilizations as a means of family planning; (4) to lobby for abortion?	
b. FAA Sec. 620(g). To compensate owners for expropriated nationalized property?	Yes.
c. FAA Sec. 660. To provide training or advice or provide any financial support for police, prisons, or other law enforcement forces, except for narcotics programs?	Yes.
d. FAA Sec. 662. For CIA activities?	Yes.
e. FAA Sec. 636(i). For purchase, sale, long-term lease, exchange or guaranty of the sale of motor vehicles manufactured outside U.S., unless a waiver is obtained?	Yes.
f. FY 1982 Appropriation Act, Sec. 503. To pay pensions, annuities, retirement pay, or	Yes.

adjusted service compensation for military personnel?	
g. FY 1982 Appropriation Act, Sec. 505. To pay U.N. assessments, arrearages or dues?	Yes.
h. FY 1982 Appropriation Act, Sec. 506. To carry out provisions of FAA section 209(d). (Transfer of FAA funds to multilateral organizations for lending)?	Yes.
i. FY 1982 Appropriation Act, Sec. 510. To finance the export of nuclear equipment, fuel, or technology or to train foreign nationals in nuclear fields?	Yes.
j. FY 1982 Appropriation Act, Sec. 511. Will assistance be provided for the purpose of aiding the efforts of the government of such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights?	Yes.
k. FY 1982 Appropriation Act, Sec. 515. To be used for publicity or propaganda purposes within U.S. not authorized by Congress?	Yes.

ANNEX D G.O.H. REQUEST FOR ASSISTANCE

DATE RECEIVED
AUG 5 - 1986

ACTION COPY

REPUBLIQUE D'HAITI

MINISTERE DE L'AGRICULTURE, DES RESSOURCES NATURELLES
ET DU DEVELOPPEMENT RURAL

No. A-2 : 2204 Port-au-Prince, le 28 Juillet 1986

OFFICIAL FILE

Monsieur Gérald ZAAR
Directeur de la USAID
En ses Bureaux

Monsieur le Directeur,

Le Ministère de l'Agriculture, des Ressources Naturelles et du Développement Rural (MARNDR) sollicite formellement par la présente le soutien de l'USAID pour le financement d'un projet d'Aménagement des Bassins-Versants du Sud'Ouest d'Haïti particulièrement dans la zone Sud du Pic Macaya. L'exécution de ce projet devrait être coordonnée par l'Administrateur du District agricole des Cayes et complétée par des organisations privées locales. Des actions complémentaires dans la zone visée seront également entreprises à travers un financement additionnel à partir des ressources du PL-480 Titre III.

Vous trouverez ci-joint l'accord portant sur le financement du projet ainsi que celui du Secrétariat Technique pour l'Agriculture de Montagne (SHAG).

Le projet inclue un support technique et logistique au Secrétariat Technique à l'aménagement des Bassins-Versants pour l'agriculture en montagne nouvellement formé; le secrétariat facilitera l'échange d'idées et proposera des solutions aux problèmes d'aménagement de bassins-versants auxquels font face le Ministère et les Organisations volontaires privées intervenant dans le domaine.

L'USAID a entrepris dans la zone cible de nombreux projets dans le domaine de l'aménagement des bassins-versants et nous accueillons le projet proposé comme la suite logique des programmes que votre organisation a financé dans le pays à cette date.

Je vous saurais gré des suites que vous accorderez à cette requête, et vous prie de croire, Monsieur le Directeur, à l'assurance de ma haute considération.

Gustave MENAGER, Agr.
Ministre

ANNEX E LAND CAPABILITY ANALYSIS

The problem and its proposed solution. Relentless pressure on the soil resources of the targetted watershed has brought the production potential of the region to a very low point. Hillside farming in the area has resulted in a severe and widespread loss of top soil. Consequently, the yield potential of the soil has decreased due to a decrease in soil fertility, and agricultural risk has increased due to a decline in the soil's moisture retention capacity. The loss of ground cover and soil from the targeted watershed has also adversely affected the reliability of the baseflow of streams and rivers draining the watershed and has caused the siltation of reservoirs, streams, and irrigation works, and possibly the accelerated deterioration of hydro-electric generators.

The scope and rate of degradation of the targeted watershed's soil resource have not been systematically measured. However, the process is proceeding rapidly enough to have become a matter of concern to the hillside farmers themselves. This awareness, the significant extent of potentially responsive soil resources remaining in the region, and the watershed's abundant and well distributed rainfall serve as the basis for the project's potential for success.

The goal of this project is to replace the processes which have degraded the soils of the targeted watershed with processes which will regenerate and protect these resources. Consequently, the criteria for a proposed intervention will not be limited to its techncial capacity to minimize soil loss but rather will be based on a combination of its capacity to conserve soil, increase yields, decrease risks and thereby benefit from a substantial spread effect among the farmers of the targeted watershed.

Boundaries and description of the watershed. The TWAMP Project area lies between latitudes 18°1' and 18°23' North and Longitudes 73°32' and 74°13' West in Haiti's Departement du Sud. It extends from the eastern edge of the Cavaillon catchment area to the western edge of the Les Anglais catchment. The watershed includes many lesser catchments but is dominated by the two previously mentioned as well as La Grande Ravine du Sud, l'Acul and the Port au Piment catchments. West of the Les Anglais catchment the Tiburon catchment as well as the Nan Cosse branch of the Les Anglais catchment are excluded from the Targeted Watershed. Within this region, all land with a slope of 8% or less is excluded from the watershed. These details can easily be seen on, for example, a US Air Force map with a 1:250,000 scale.

The southern slopes of the Massif de la Hotte and of the Monts du Plymouth form the northern boundary of the Targeted Watershed. Pic Macaya, at 2,347 meters the highest mountain the the region, is a part of the Massif de la Hotte. The Carribean Sea forms the southern boundary of the targeted watershed. The project area covers about 80,000 ha of which about 30,000 ha are being used for farming.

The dominant topography of the region is very steep slopes at elevations less than 1,000 m. However, elevations within the targeted watershed reach to the top of Pic Macaya (2,347m). Topography accounts for climatic changes within short distances and for the general innaccessibility of much of the region.

The rainfall pattern of the targeted watershed is among the most favorable to be found in Haiti and despite the fact that most of its soils are severly

degraded and found on slopes which should not even be considered for farming, the targetted watershed has the most extensive hillside soils in Haiti which are likely to respond well to soil conservation and management interventions. The condition of the targeted watershed is serious enough to make it a valid demonstration of what can be done to conserve the threatened and degraded soil resources of a region and good enough to provide a realistic context for the possible success of a project.

Projections based on periodic analyses of air photographs predict that at present rates of land clearing and soil degradation 20 to 40 years will be required to reduce the targeted watershed to a level of soil loss and sterility matching the worst cases of soil misuse to be found in Haiti.

Climate and soils. Rainfall is a function primarily of elevation and ranges from 1,200mm at the driest sea level zones in the southwest of the project area to nearly 4,000mm (some sources report 6,000mmrainfallon Pic Macaya) at the highest elevations of the Massif de la Hotte.

Although most of Haiti has a bimodal rainfall pattern with concentrations of precipitation in April-May and September-October, only low elevation areas of the targetted watershed have this characteristic seasonality in rainfall while the rest of the region has only a winter dry season and has sufficient rainfall to support vegetative growth for the rest of the year. Hargreaves and Samani (1983) show three-fourths of the region with 7-12 months of rainfall and half of this area with at least two months of excessive rainfall. Rainfall intensity is usually not a problem except in the case of the occasional severe tropical storm. The low elevation southwest zone of the targeted watershed is shown to have a bimodal rainfall pattern of three and four months.

Soil moisture regimes are predominantly udic with major inclusions of ustic moisture regimes strongly skewed towards the udic. Ustic soil moisture regimes are transitional between udic soil moisture regimes which are dry less than 90 cumulative days in a year and can support a wide range of rainfed agriculture and aridic soil moisture regimes which do not have sufficient moisture to support crop growth. Soils with an ustic moisture regime would be dry between 90 and 180 days in a year.

Depending on aspect, slope, soil texture and distance from high mountains, ustic soil moisture regimes will be found interspersed among the predominant udic regimes up to an elevation of about 500m.

Within the context of Holdridge life zones represented in the targeted watershed, ustic moisture regimes dominate the 10 per cent of the region classified as subtropical dry forest in the Southwest. Major ustic inclusions would be found in the 40 percent of the targeted watershed classified as subtropical moist forest zones and minor ustic inclusions would be found in the 40 percent of the targeted watershed classified as sub-tropical wet forest zones. The 10 percent of the targeted watershed classified as Sub-Tropical Wet Forest and Sub-Tropical Rain Forest would have only udic moisture regimes.

Temperatures in the targeted watershed have a mean from the mid to high twenties (Celsius) throughout the year and vary from about 15 to 35 degrees celcius. All soil temperature regimes below 1,000m are classified as isohyperthermic. At elevation greater than 1,000m the soil temperature regime is isothermic. The fact that grapes are grown as a cash crop at sea level in the southwest zone of the watershed would indicate that the comparative dryness

of this region is accompanied by more fluctuation in temperature, especially lower minimum temperatures than those found at sea level in the rest of the watershed. Arabica coffee is also grown at sea level in the Southwest.

Most of the parent materials of the watershed are calcareous, primarily karst but with some crystalline limestone as well. Non-calcareous parent materials are basalts. Basalts are the dominant parent material in the southwest part of the targeted watershed and are also found throughout the watershed at upper elevation where the calcareous rocks have completely worn away.

Under udic moisture regime conditions, the soils of the entire region are highly weathered with Ultisols and Oxisols on stable landscapes and Inceptisols or Entisols on steep slopes. The soils developed from calcareous materials under these conditions will have a high base saturation and those developed from basaltic parent materials will have a low base saturation.

In areas with a moisture regime tending toward the ustic, Mollisols have developed on the calcareous parent materials and are found on a wide range of slopes including those steeper than 50 percent. In similar areas soils developed on basaltic parent materials will be Ultisols and Inceptisols or Entisols where the moisture regime is less humid or the landscapes less stable.

Since the best soils work in the targeted watershed was done in the l'Acul catchment which is a moist zone where Oxisols and Ultisols are dominant, most reports on the region convey the idea that the soils of the targeted watershed are highly weathered tropical soils. However, about 35 percent of the soils of the targeted watershed are young soils, Mollisols. These are found at lower elevations, in dryer zones, and on calcareous parent materials. The highly weathered red tropical soils for which nutrient status is highly dependent upon organic matter are those described as having 90 percent of their nutrients in the upper 10 cm of the top soil. The black Mollisols would not only have a good organic matter level, they would also have active clays throughout the profile and thus a superior nutrient status and responsiveness to management vis-a-vis the red soils.

The primary distinction made by farmers in describing their soils is done on the basis of color, red and black, with the black soils, Mollisols, being considered the most desirable. Another important color distinction was made for "white" soils. These are primarily Mollisols (Calciustolls) which have eroded down to the point that the calcic horizon is influencing the color of the surface soil. Some soils, mostly from basaltic parent materials with an ustic moisture regime, were described as "sandy" or "droughty". This was the only local distinction among soils which related to the moisture status of the soil.

Hillside farmers in the targeted watershed also speak of soils as being "hot" or "cold". In spite of close questioning on the subject it was not possible to link this distinction to soil moisture balance. Rather, it was seen as affecting the time to maturity for crops and was a function of aspect. The importance of aspect is apparent in many locations throughout the watershed. What is not so clear is why aspect is apparently considered important primarily for its influence on temperature and crop growth and not for its impact on soil moisture status. It is easily observable that slopes with a southern aspect are warmer and drier than those with a northern aspect.

It was also noted that young soils, even when very stony ok interspersed in

pockets within rock outcrops, were considered superior to nearby soils which were comparatively deep and stoneless but highly weathered.

The evidence indicates that fertility status rather than moisture stress is the primary limiting factor for crop production on the hillsides. Of course, drought stress is a well-known risk factor throughout the watershed and would certainly take on even greater importance within the context of any attempt to achieve good, reliable returns on efforts to improve the available nutrients in the soils. However, based on the limited sampling possible, it would seem that in spite of the fact that most of the hillside soils are extremely shallow and well-drained, the unfavorable moisture balance which would be expected as a result is at least partially avoided because of rainfall distribution and the permeability of much of the parent material of the region.

The same crops are grown across virtually all of the zones of the watershed so it is not possible to use cropping patterns as an indicator of climate or soil condition. Short cycle (about 65 days) beans are the most prevalent crop and are grown as many as three times a year where conditions are suitable. Yam is grown only on the best soil. Manioc and sorghum are grown as low risk crops but always in association with other crops. No areas were observed in the watershed where moisture stress required the growing of sorghum to the exclusion of corn or beans. Sorghum was grown as a monoculture on soils which were considered depleted. It has been reliably reported that corn does not do well at elevations above 700m in the watershed. Temperature does not seem to be the likely constraint because sweet potatoes do well at elevations over 700m. Bean production is apparently limited to one cycle per year at elevations over 1,000m because of excessive moisture and cloud cover during all but the dryest winter months. These same factors could play a role in limiting satisfactory maize production to elevations under 700m.

High elevation areas (greater than 1,000m) have the most acidic soils of the targeted watershed with pHs as low as 3.5 on Oxisols derived from basaltic parent materials. This could also be an important element in limiting crop growth at high elevations.

Capability classes. The soils of the watershed have been separated into six capability classes based primarily on their probable response to management and secondarily on the risk involved in any attempt to introduce vegetative soil conservation and management interventions in the watershed. The criteria used to classify the soils of the targeted watershed were, in the order of their priority, weathering, slope and depth, fragility, and elevation.

Weathering: Significant differences in the weathering stage of soils can result in variations in crop yield ranging from 40 to 60 percent. The purpose of this criterion is to provide a means of isolating on the basis of management requirement the "black" comparatively unweathered Mollisols from the rest of the soils of the region and most importantly from the highly weathered "red" Oxisols and Ultisols.

The information available on the soils of the targeted watershed is not sufficient to provide any certainty as to where criteria should be established. In this instance a clay fraction Cation Exchange Capacity (CEC) of 24 was estimated as the line of demarcation which would be most likely to isolate the Mollisols.

The other major factors influencing yield potential: pH, organic matter, and

base saturation were all known to have important areas of overlap between the Mollisols and Oxisols/Ultisols of the region.

The most significant inclusion in the above would be brown or grey acidic Entisols and Inceptisols derived from basaltic parent materials under an ustic moisture regime. These soils would not be highly weathered but they would have management characteristic more similar to those of the highly weathered Oxisols and Ultisols than those of the Mollisols.

Slope and Depth. The criteria of 25 percent slope and 50cm soil depth were established to isolate moderate risk soils. If a soil has either slope greater than 25 per cent or a depth of less than 50cm it should be considered a high risk soil. These relate primarily to the moisture retention capacity of the soil and to a lesser extent its vulnerability to erosion. As soil conservation and management interventions are introduced, the risk of failure will be much greater on steep slopes and shallow soils where establishment, maintenance, and significant response will all be much more difficult to achieve.

It should be noted here that an estimated 70 percent of the hillside soils of the targeted watershed fail to qualify as moderate risk soils and most of these fail to qualify by wide margins. Most high risk soils would be on slopes of 40-60 percent and have a depth of less than 30 cm.

Extreme fragility. This criterion was established to isolate soils which require immediate reclamation efforts. They have been misused to the point that no native vegetation grows on them when they are abandoned. Consequently, the areas covered by these soils are in immediate danger of being rendered permanently sterile by the erosion of a continually exposed, very shallow soil.

Elevation. The criterion of elevation greater than 1000m was established to isolate the zone where protection of existing ground cover is an important consideration and where well-managed perennial crops, coffee and plantains could possibly compete with such annual crops as beans. Cloud cover as a limiting factor to crop growth in all but the driest winter months also becomes an important consideration.

The soils themselves play very little role in isolating this zone. They are highly weathered, low pH (as low as 3.5), "red" Oxisols which are very strongly expressed examples of red soils.

The crucial consideration is to protect existing ground cover or, if agricultural exploitation is inevitable, attempt to direct it towards perennial rather than annual crops.

There are three climatic zones in the watershed. The largest of these is a warm, wet zone usually extending from about 200m to 1,000m elevation and bordered at upper elevations by the zone being described here and at lower elevations by a drier zone which is often characterized by a bimodal rainfall pattern, higher temperatures, and Mollisols on calcareous parent materials.

The low elevation climatic zone was not not seperated out as a classification criterion because it does not correspond with any change in land use; there would be wide variation around any elevation criteria established and this dryer climatic zone is essentially isolated by the criteria of weathering which is used to isolate Mollisols.

SUMMARY OF THE LAND CAPABILITY CLASSIFICATION

CATEGORY	SLOPE %	DEPTH cm	ELEV. m	pH	% OF AREA
1. RECLAMATION SOILS	VARIABLE	<50	VARIABLE	VARIABLE	5
2. HIGH RISK RED SOILS	>25 &/OR	<50	<1000	4.5 - 7.3	30
3. HIGH RISK BLACK SOILS	>25 &/OR	<50	<1000	6.6 - 8.4	25
4. MOD. RISK RED SOILS	<25	>50	<1000	4.5 - 7.3	10
5. MOD. RISK BLACK SOILS	<25	>50	<1000	6.6 - 8.4	20
6. HIGH ELEV. SOILS	VARIABLE	VAR.	>1000	3.5 - 5.5	10

Proposed Intervention. The central concept which must prove sound if the project is to succeed is that vegetative soil conservation and management interventions can be proposed which will have as their impact increasing yield, decreasing risks and conserving soil all at the same time. The basic conflict within this proposal is that conservation implies decreased agricultural intensity and decreased agricultural intensity implies decreased income, and decrease income explains why conservation interventions are not more popular with farmers.

The vegetative conservation and management intervention approach to restoring the hillsides of the targeted watershed should be seen as defining large areas of complementarity between soil conservation and farm management in subsistence hillside agriculture. Conservation and farm management are combined so that the result is greater than the sum of its parts. Break the link between conservation and farm management and the vigor of the system is lost.

Specifically, conservation must be a by-product of the farmer managing his own fields in a manner which corresponds to the farmers own immediate self-interest. Good examples of this principle are the terraced systems which have been maintained for thousands of years in arid and semi-arid regions of the Middle East. The systems were designed primarily to harvest and conserve water in these dry areas. The immediate benefit to the farmer was to release a moisture constraint to crop survival and yield. Excellent soil conservation results were also realized from these systems, but they were a long-term byproduct of managing the terraced land for the purpose of exploiting available sources of moisture.

In the interventions being proposed for the watershed, soil conservation will be a long-term byproduct primarily of the farmer's managing his land for the immediate purpose of improving soil fertility. All other elements of this program--trees, fruit trees, livestock, forage, improved varieties, commercial fertilizer, and credit programs--must be developed with this idea clearly in mind or their effectiveness will be diminished accordingly.

The impact of the vegetative interventions can be analyzed in three stages:

(1) **Immediate Impact (yrs 1-3).** This is the most crucial period in the implementation process. A demonstration of the positive effects which vegetative interventions can have on crop yields will require a minimum of two years. The results are likely to be highly significant. The question is whether or not they will be dramatic enough to motivate hillside farmers to start placing them on their land.

The proposed intervention can surely be made to work but their widespread, rapid acceptance is not a foregone conclusion. The attention of project personnel will have to be focused on making every effort to assure that increased crop yields resulting from the proposed interventions are arrived at as quickly and impressively as possible. The agro-forestry and forage legumes must be carefully established and well-managed (inoculation, phosphorus, molybdenum) and, if possible, integrated with hillside livestock production. Well-directed programs using credit or fruit trees could be employed to accelerate and strengthen the program during this first stage.

(2) **Mid-term Impact (Years 4-6).** At this stage in the development of the conservation/management interventions, the nutrient effect should be well established. Reduction of risk in the form of diversification of income and improved moisture status of the soils should, at this point, start to complement the nutrient effect as a motivation for establishing and maintaining the vegetative interventions.

(3) **Long Term Impact (years 7-20).** This would be a period of steady incremental benefits in terms of soil nutrient status, soil moisture balance, soil structure, and general diversification and strengthening of the farm enterprise.

If farmers once start participating in the project and see the initial benefits improved upon year after year on their fields, it is unlikely that they will lose interest in the interventions proposed.

The project has three possible avenues of failure. It could fail to stir any interest at all, it could become an agroforestry project, or it could become a farming practices project.

From the technical standpoint, the project has only one possible avenue of success. Link farming with conservation so that they reinforce each other's benefits and provide results of such a striking nature that their adoption throughout the targeted watershed will be rapid and widespread. Social scientists will have to make a major contribution to the design of interventions that will not be handicapped by an insensitivity to the customs and attitudes of hillside farmers.

One of the most serious potential pitfalls of this project is that in the course of its implementation people could get so involved with the important work being done planting trees and distributing fertilizer and new varieties that they will never forge the link between conservation and farming in a program which could actually solve the soil erosion and degradation problem of the targeted watershed.

Some further general comments on the characteristics of the proposed interventions would be as follows:

Linkages between conservation and farming. The following are examples which might prove useful in project implementation. Their purpose here is to illustrate what is meant by linkages between conservation and farming.

Examples of a strong linkage would be: improved maize varieties grown with legume hedgerows; a livestock credit program in conjunction with forage crop development; or supplying yam plant materials on the basis of soil improvement efforts. In all of these there is a direct natural link between farming and conservation.

Examples of weak or non-existant linkages would be: improved bean seed grown with legume hedgerows, or widespread use of commercial fertilizers and agricultural chemicals. These are poorly linked because there is no agronomic reason to use the conservation practice to complement the production practice.

An example of a useful incentive which provides no direct linkages is the use of fruit trees to encourage the planting of vegetative conservation management interventions. If this approach helps to launch the project, that is good, but the interventions are not necessary for the growing of good fruit trees.

Divisibility. It is not necessary that a farmer commit his entire farm to the program at once. Rather the elements of the package can be added piecemeal as their effectiveness becomes apparent. This approach will allow the project to reach more farmers more quickly and will also allow a farmer to become accustomed to the intervention before committing his entire arm. Also, fallow or poor ground can be committed to the project first without any adverse consequences to the prospects for showing good results. There are many practices already present on the hillsides which would be component of a conservation management intervention. These include living fences, tethering livestock, and fallowing land.

Vegetative conservation management. A generally accepted sequence of decreasing soil management intensity, with a corresponding decrease in income and increase in soil conservation, would be annual crops - perennial crops - livestock - forestry for wood. However, there is a great deal of room for manipulation within this sequence. Livestock can be a major source of the erosion problem by overgrazing or a major source of erosion control as part of a forage production system. Both livestock and woodlots can be major sources of income. The following is a list of forestry and farming elements which could play a role in a soil conservation/management project using vegetative interventions.

Forest trees. Leguminous trees used for alley cropping or hedgerows will play a major role in most of the proposed interventions. There will also be a role for non-palatable varieties on reclamation soils. Some benefits from trees are plant nutrients, forages, lumber, poles, charcoal, and erosion control.

Fruit Trees. Oranges, avocadoes, and mangoes have been proposed. These will serve a minor direct role in conservation but can serve as an important incentive to participation, as well adapted element for the hedgerows proposed for Mollisols and as a source of animal feed. In the past, surplus mangoes and avocados have been used as feed.

Illustrations by Zimmerman (1985) are included at the end of this annex to show the design and placement of vegetative conservation/management interventions. On extremely shallow soils, distances between hedgerows must sometimes be reduced to two meters because of restricted hedgerow growth. In this case, the distance is not related to slope but to soil depth.

Forages. Both legume and grass forages should play an important role in the regeneration of degraded soils. By keeping the ground covered and permeating it with a network of roots, forages become the most effective crop available to improve soil organic matter content, nutrient status, and soil structure. Legume forages have the added benefit of fixing nitrogen. (Because of their short growth cycle, limited root system and the fact that most of the nitrogen-fixed fixed is removed as protein at harvest, the beans now grown by hillside farmers have no positive effect on the soils. Legumes gained their reputation as soil builders growing as forages, not grain crops). Ideally, forages would be cut and carried to livestock rather than grazed except when the time comes in a rotation to kill out the forage and plant another crop.

An important factor is year-round availability. There is an workshop near Camp Perrin which is working on a triangular forage drying stand which could play an important role in a forage program.

Given the nutrient status of the soils, forage legumes will probably be more important than forage grasses but the latter may have an important role to play along trails etc. which are very subject to erosion. Forages actually offer an opportunity to intensify production where weed fallows are currently practiced.

Livestock. Until the advent of inexpensive nitrogen into U.S. agriculture some 35 years ago, animals were an absolutely necessary component of most U.S. farm for the same reason that their utilization on Haitian hillside farms is being proposed here - field maintenance and low risk income. Forage legumes build soil structure and improve soil nutrient status. Forage grasses improve soil structure. Animals eat the forages and produce meat, milk and power as well as manure which is used to improve soil nutrient status.

Animals serve to import, concentrate, and recycle plant nutrients on a farm. Also, they are essential to the profitability of soil-building forages. Feeding animals nirogen rich legume forage or concentrates, as in the case of swine, would mean that the efficient use of manures would have a dramatic positive effect on crop yields). For greatest positive benefit, animals should be tethered, corraled or confined as well as fed and watered on fields as an integral part of the crop rotation and soil building program of the hillside farm, if a system to accomplish this can be devised.

Chemical inputs. Care must be taken here not to introduce practices which can be separated from the packages and then used to intensify the annual cropping which is already the source of the soil problem of the hillsides. The most serious threat from this problem would be in areas higher than 1000m where the introduction of chemical plant nutrients could give annual cropping a boost vis-a-vis perennial crops. Phosphorus fertilizer, inoculum, and perhaps molybdenum would be likely candidates for an agronomic package which could give the legume forages and trees of the conservation/management intervention help without there being much risk of this package being applied outside the context of the interventions.

Improved Varieties. Since most improved varieties are better at responding to

management than they are at withstanding stress, improved varieties which do well where interventions have improved growing conditions will serve to reinforce and strengthen the impact of the project. Crops and varieties which respond strongly to management will be required to exploit and demonstrate the full impact of soil improvement. One of the imponderables of the proposed interventions is what the effect will be of the fact that beans are the most important crop in the watershed. Beans will not show the response to the proposed interventions that maize would show.

Structural Interventions. Attempts to implement structural conservation interventions as a means of combatting Haiti's soil erosion problems have not been successful. However, there are locations in the Targeted Watershed where extensive areas of structural interventions - mainly drywall - have been installed. Because this effort is worth preserving and using and because it may prove useful in the establishment of the vegetative conservation/management interventions it should be used.

Within this context, composting is sometimes mentioned but this is a very costly and inefficient way of attempting to accomplish what can be done much more effectively with forages and livestock. Trenches are also mentioned quite frequently. These may have a role in dryer areas for the establishment of hedgerows etc. In most cases surface layers of rocks should not be disturbed because on steep hillsides these rocks are protecting and holding the soil. Various types of basins and checkdams could be useful within the context of the vegetative interventions. Some f these are illustrated in the material by Zimmerman (1985) attached to this annex.

Keying interventions to land capability classification. The primary purpose in keying proposed interventions with the six land capability categories is to clarify the concepts of the land categories and the proposed interventions. While this exercise is important for understanding the characteristics of the land and interventions involved, it is well known that a process of modifying and recombining interventions should be encouraged and that finally some hybrid intervention will probably emerge which will be the most useful across the entire watershed and will be used accordingly just as the bean/corn cropping combination is adapted widely throughout the watershed.

(1) Reclamation Soils; INTERVENTION: Low Intensity Forestry/Ground Cover. The soil exposed on these sites is from deep in the profile, thin and non-productive to the point of presenting problems for the establishment of the perfectly adapted native varieties of the region. These are abandoned soils on which nothing will grow unless an effort is made to establish hearty, well-adapted plants on them. In this case it is suggested that a combination of non-palatable native forest trees and vetiver be planted on this land. Non-palatable trees should be used so that a minimum of effort will be required to protect them once they are established. Vetiver should be used because of its reputation for establishing itself on soils where nothing else will grow. Vetiver also has a fibrous root system and top growth configuration which gives it excellent soil retention characteristics.

In the past vetiver has been severely criticized in Haiti as a major source of problem for soil erosion. The criticism was justified because vetiver is harvested destructively for its roots with the result that poor fields are left completely bare after the vetiver harvest. However, if managed properly and harvested in alternate strips, vetiver has an important role

to play in soil conservation both because of its growth characteristics and its ability to establish where no other plants will grow. The main potential problem with vetiver on these soils is that under the pressure from economic crises the farmer would harvest the entire field and the vulnerability of the soil would immediately become extreme again.

Forest trees and vetiver would provide some small income from this land but probably not enough to cover the costs of getting the soils protected. The idea is to get the soils covered as inexpensively as possible. Income may eventually meet cost but only over a long period of time without inputs beyond the initial cost of establishing ground cover on these soils. Ideally, three rowed bands of vetiver 1 1/2m wide would be spaced at 4m intervals on the contour with the trees planted at 4m intervals along the top of the band. But this would be expensive on a per hectare basis so it will have to be modified on site requirement basis.

(2) High Risk Red Soils; INTERVENTION: Alley Cropping. Not only are these soils shallow, steep and acidic, they also have a low inherent fertility and a low capacity for retaining nutrients which are applied. Consequently, alley cropping is well adapted to the needs of this soil because it provides a means of injecting small but repeated amounts of nutrients into the system. The lines of leguminous trees would be direct seeded on the contour at distances from four to eight meters depending on slope and economic factors. The clippings from the trees would be incorporated on a regular basis into the soil of the alleys. No commercial nutrients would be applied until soil conditions had improved to the point that these inputs could be used without a high risk of their loss by crop failure.

(3) High Risk Black Soils; INTERVENTION: High Yield Hedgerows. At their worst these are the "white" soils found on steep slopes in dryer areas. Whether or not they are "white", they will always be thin and located on steep slopes. The crucial difference between these soils and the High Risk Red Soils is that these soils are much less weathered and therefore have more active clays and with that the capability of retaining the effects of any intervention applied. Consequently, the interventions proposed here will be longer term and more intense than those proposed for High Risk Red Soils.

Legume forage to be used on a cut and carry basis would be an important part of the system and would be maintained at a given site in the rotation for at least two years. The High Yield Hedgerow would be essentially an attempt to transfer to the field the tree growing and soil fertility charastectics of the homesteads of the hillside farmers. Again, the basic intervention would be a closely spaced line, or lines at a distance of 4m; planted on the contour. When the trees had sufficiently matured to be beyond danger of destruction by livestock, animals would either be tethered immediately above the single line of trees or corraled between the two lines of trees and fed there - for months if necessary - until controlled erosion and the presence of the animals had resulted in a comparatively deep, rich bench of soil against the lower line of trees. This soil would then be planted to crops which would respond well to the improved soil condition. Annual crops like maize in association with plantains until the latter reached maturity would be one possibility. A wide array of fruit, grain, or vegetable crops could be grown where the soil had been improved but the goal would be to install high return perennials.

In this system, the soil building resources of the entire farm are focused on a small part of the farm until a major improvement in soil condition has been achieved and then the focus would be shifted to another site in conformity with conservation and management consideration. The presence of forage legumes in the rotation would provide the only extensive soil building factor in this system.

(4) Moderate Risk Red Soils; INTERVENTION: Alley Cropping plus agronomic package. The initial intervention on these soils would be the same as that for the High Risk Red Soils. However, these soils can be used much more intensively than the high risk soils so a complete agronomic package of varieties and chemicals could be used here. The crucial development to observe would be whether the introduction of the agronomic package increased or decreased the importance of the conservation/management intervention in the opinion of the farmers.

(5) Moderate Risk Black Soils; INTERVENTION: High Yield Hedgerows plus agronomic package. The basis intervention for these soils would be the same as that for the high risk black soils. As in the case of the Moderate Risk Red Soils, these soils can be used immediately much more intensively than the same soil classed as high risk. Consequently, an agronomic package could be considered at an early time on these soils also with close attention to the impact of the package on farmer attitudes towards the conservation/management intervention.

(6) High Elevation Soils; INTERVENTION: Improved Management of Perennial Crops. Ideally these soils would be left entirely undisturbed except for forestry. In fact they are being cleared for annual crops. However, there is some possibility that with proper management perennial crops could compete with annual crops at high elevations. Consequently, properly managed perennial crops would be promoted not to cause the clearing of more land but to displace annual crops at these elevations. Care must be taken that agronomic packages introduced at lower elevations are not applied here to make annual crops a more attractive option.

Demonstration sites. The sites listed below are at locations where one or more of the elements of the land classification system used in this report are strongly expressed. The accessibility of the sites, their proximity to easily identified landmarks, and their adaptability for efficient use for demonstration purposes were also considered. The distribution of the proposed demonstration sites throughout the watershed is such that they could easily be distributed among the local PVOs which have shown an interest in the project. However, the proposed sites listed here should be considered only as indicative of the characteristics of a well-adapted site and not as the final word on where local PVOs should place their demonstrations.

CAVAILLON CATCHMENT

(1) Cavaillon: Cavaillon is located 20 kms northeast of Les Cayes. The soils of interest are on the hills around Cavaillon and on the hills along the road between Cavaillon and Les Cayes, but closer to Cavaillon. The elevation is 100m. There are calcareous, black and gray soils (Calciustols with some vertic characteristics. Severely eroded in the case of the gray soils.) on hilly topography with a moderate range of elevation. The area has a Sub-Tropical Dry Forest climate and an ustic soil moisture regime. The

demonstration site is category 3: high risk black soil.

(2) Carrefour Bonne Fin. About 14 kms north of Cavaillon in the vicinity of the Baptist Hospital on the Cavaillon-Changieux Road. The area of interest would be within a one km radius of Carrefour Bonne Fin. Elevation is 200-300m. There are red and black soils on calcareous parent materials in a steeply dissected area with slopes up to 60% and ranges in elevation moderate. The area has a Sub-Tropical Moist Climate with soil moisture regimes transitional between ustic and udic. The Demonstration sites are category 3, high risk black; and category 2, high risk red.

(3) Carrefour Trois Mangues. About 20 kms northeast of Cavaillon, just east of an Eglise Protestante on the Cavaillon-Changieux Road. The area of interest extends for about 1.5kms along the road in each direction from Carrefour Trois Mangues. Elevation: 500m. There are red soils on calcareous parent materials in a steeply dissected area with slopes up to 60% and ranges in elevation moderate. Soils deeper than 50cm are common. The area has a Sub-Tropical Moist climate and udic soil moisture regimes. Demonstration sites are one category 2, high risk red soil, and one category 4, moderate risk red soil.

(4) Eglise Catholique Janvier: About 45kms northeast of Cavaillon on the Cavaillon/Chanieux Road in the immediate area of the Eglise Catholique Janvier. Elevation: 500m. This site has black soils on calcareous parent materials on land ranging from hilly to steeply dissected with slopes from 15% to 60% and changes in elevation moderate. This is a comparatively dry area within a region dominated by a Sub-Tropical Moist climate and udic moisture regimes. Demonstration sites are one high risk black soil and one moderate risk black soil.

(5) Fond des Freres. About 20kms north of Les Cayes, via the Maniche Road and a lesser track. The area includes current activity by the ADS II project and was, some ten years ago, the site of an FAO soil conservation Project. Immediately to the south of the location of the ADS II Project, there is a steep slope with a large area of secondary growth (about 10 years) immediately adjacent to intensively farmed red soil. The site is easily accessible by foot from Fond des Freres, even though it cannot be seen from there. The site can be seen from the road several hundred meters from Fond des Freres in the direction of the Maniche Road. Elevation is 200m. Soils are stony black soil and red soil in an area characterized by calcareous parent materials. The topography is steeply dissected with moderate changes in altitude and slopes from 30 to 60%. The climate of the area is a weakly expressed Sub-Tropical Moist Climate. The soil moisture regimes are transitional between ustic and udic. Demonstration sites: one high risk black soil without structural interventions; one high risk black soil with structural interventions; one high risk red soil next to ten year secondary growth.

GRANDE RAVINE DU SUD

(1) Camp Perrin Area. About 30kms northwest of Les Cayes on the Jeremie road, starting at the area of the Protestant PVO pig project and continuing for a one km toward Marcelline. Elevation: 400m. The zone has red soils on non-calcareous parent materials in a hilly area with a moderate range of elevation. Most slopes vary around 30% and soils are comparatively deep. The clmate is Sub-Tropical Moist and soil moisure regimes are udic.

Demonstration sites: one high risk red soil; one moderate risk red soil.

(2) Marcelline area. About 35 kms northwest of Les Cayes on the Jeremie road. About 2 kms east of the Eglise de Dieu in Poste Avancee. Elevation: 500m. There are gray soils derived from calcareous parent materials are found on extremely steep slopes (80%) in a steeply dissected mounainous area with a great range in elevation. The climate is Sub-Tropical Moist and soil moisture regimes are udic. Demonstration sites: one high risk black soil.

ACUL CATCHMENT

(1) Platons. 37 kms northwest of Les Cayes, via a very poor track. The area has an extensive, recently built dry-wall conservation system and terraces which have been in place for several years. Elevation: 700m Soils are strongly expressed Oxisols (red soils) overlying calcareous rocks. Most of the topography is rolling with slopes less than 20%. However, at the edges of the plateau, the topography becomes mountainous with slopes steeper than 60% and a great range in elevation. The climate is Sub-Tropical Moist and soil moisture regimes are udic. Demonstration sites: one moderate risk red soil with dry wall; one moderate risk red soil with bench terraces; one moderate risk red soil; one high risk red soil.

PORT A PIMENT, LES ANGLAIS AND WESTERN REGION OF THE WATERSHED

(1) Carrefour Masson and Salomon. About 25kms southwest of Les Cayes on the Port Salut Road. Elevation: 150m. There are black or severely eroded black soils on calcareous parent materials in a hilly area with slopes in the 40% range and moderate differences in elevation. The climate is Sub-Tropical Dry Forest and soil moisture regimes are ustic. Demonstration sites: one reclamation soil; one high-risk black soil; one moderate risk black soil.

(2) Damassin. The slopes immediately behind the CECI nursery about 30 kms south of Chardonnieres. Elevation is 50m. There is black, stony soil derived from calcareous parent materials on hilly land with a very moderate range in elevation and slopes varying around 40%. The climate is Sub-Tropical Dry. The soil moisture regime is ustic. Demonstration sites: one high risk black soil.

(3) Rendel. One hour north of Chardonnieres by car track. The elevation is 200-250m Parent materials are variable derived from calcareous or basaltic rocks or a mixture of the two. Soils are black or brown. The brown soils are an inclusion under red soils. The topography is hilly with slopes to 40% with moderate differences in elevation. Mountainous topography is also present in the immediate area. The climate is Sub-Tropical Moist Forest and soil moisture regimes are ustic. Demonstration sites: one high risk red soil; one high risk black soil; one moderate risk red soil; one moderate risk black soil.

(4) Douillette. 1.5 hours North of Rendel by mule in the Port a Piment Watershed. Elevation is 800m. The soil is variable, but derived from calcareous parent materials and classed as black. Topography is mountainous with slopes 40-50% and a great range in elevation. The climate is Sub-Tropical Moist Forest and soil regimes are udic. demonstration sites: one high risk black soil; one moderate risk black soil.

(5) Cosar. 3 hours north of Rendel by mule. Elevation: 1200m. Red soils on

mountainous topography with steep slopes and wide ranges in elevation. Sub-Tropical Wet climate with an udic soil,moisture regime. Demonstration sites: four sites devoted to management of perennial crops.

(6) La Chaine. 0.5 hour northwest of Les Anglais. Elevation: 300m. Red soils on hilly topography with slopes varying around 40% and the range in elevations being moderate. Sub Tropical Dry Climate with an ustic soil moisture regime. Demonstration sites: one high risk red soil.

Soil testing. At present, the facilities for testing soils in Haiti are very limited. However, a local fertilizer company is in the process of setting up a soils laboratory which will be capable of handling both chemical and textural analyses. The laboratory should be functioning by the time implementation of the project has started. If these facilities are not ready by then it will be necessary to arrange for sending soil samples outside the country for testing.

Climatic Data. Equipment to record maximum and minimum temperatures as well as rainfall--an automatic recorder and pluviograph, so that intensity as well as quantity could be recorded--would be very useful at sites throughout the watershed. However, locations for stations would need to be selected on the basis of reliability of on-site monitoring and probability of continuation after completion of the project, as well as on the basis of its data requirements.

Air photos. A 1:20,000 basic photo map of the watershed could be used by the implementation team to establish base-line data in targeted areas. This work should be accomplished during the first year of project implementation. As required, a follow-up set of photos of seleted areas should be made after five years as a part of the evaluation process. The total cost for photos and interpetation should not exceed $250,000. Techniques using video cameras might be used to cut the cost of the work.

Downstream effects of soil erosion. In order to establish quantitatively the costs incurred from the deteriorating situation on the hillsides of the targeted watershed - or, conversely, to show that the situation is improving - one would have to collect the following data consistently over a period of 20 years or more:

(1) costs of clearing the secondary and tertiary canals of all irrigation projects in the watershed of accumulated silt and other water-borne debris;

(2) costs of equiment detioration at power-plant sites and irrigation projects due to silt abrasion;

(3) costs of crop failures or yield reductions on the plains tied directly to diminished and/or erratic stream flows in the watershed;

(4) costs of damage associated with any flash-flooding in the watershed; and

(5) costs of irregular stream flows and reservoir siltation on the quality of life in urban areas.

These costs should be balanced against the beneficial effects of soil received on downstream fields due to erosion on the hillsides.

The documentation of these costs and benefits would require both a data

collection system and a statistical analysis capacity well beyond anything the GOH possesses at present. Both systems would have to be put in place and maintained consistently over a period of 20 years or more to begin to have accurate results for an analysis.

In order to measure the flow of major streams, gauges would need to be placed at relevant and accessible locations where stream flow levels can be recorded throughout the year. Estimated costs would be $12,000 to $15,000 per station installation costs and $2000 per year per station upkeep costs. Five years is usually considered the minimum time required to calibrate the system. Consultants could be used to set up the system, but monitoring the system would be a full-time job. Several US universities as well as the United States Geological Survey offer training programs in this field.

Finally, it should be remembered that there is always the distinct possibility that careful monitoring and analysis would demonstrate that neither the downstream costs nor the benefits of the erosion of the hillsides is very important economically.

Annex F AGRONOMIC ANALYSIS

Background. The project site is located in the Southwestern part of Haiti in the region of Les Cayes. It includes six watersheds, representing approximately 4.5% of the total land mass of the country. All watersheds flow more or less South from Pic Macaya (elev. 2347m) into the Les Cayes plains, with the exception of Les Anglais and Port-A-Piment which flow in a Southwest direction. For the purpose of defining the working area of this project, the watersheds include any of the basins located from the foothills (around 100m) to the crest of the respective watershed basins.

Accurate precipitation data for the watershed area are lacking, but the annual rainfall figure generally used for the Les Cayes plains exceeds 1500mm per annum (Hargreaves). The rainfall occurence exibits a bimodal pattern with the lowest precipitation during the months of October through February, and again in June and July. The pattern is not as pronounced in the summer as in the winter months.

The target area is accessable by road only in a limited portion of the basin. In most of the zone one must travel by foot or pack animal. Commodities produced in these outlying areas are either head-carried or transported by animals to the local *marche*, often located several miles from the production site. The limited accessibility of the mountain regions and the time constraint on the study team curtailed the team's coverage of the project zone. However, the team visited as many sites as possible and saw a large, representative sample of the variations of the watersheds.

It has been reported in many studies that less than 30% of the land in the targeted watershed is suitable for agricultural production. Yet it is evident that a substantial proportion of the remaining 70% of the land is also utilized for producing basic commodities, thus creating an unmanageable land situation. Subsistence farming is the main occupation of the populace.

The area is generally looked upon as severely eroded, intensively farmed and over-populated with an approximate density of 200 persons per square kilometer. Population statistics for the area are at best unreliable and often non-existent. Villages are generally located in the lower elevations of the foothills while residential and make-shift dwellings are scattered throughout the six basins. Electricity and other amenities are essentially absent from the area.

Principal crops are divided into three broad categories: grains (maize, sorghum), grain legumes (bean etc.) and tubers (yam, cassava, sweet potato) which are farmed all year round. Livestock is found throughout the area, and is generally tethered and moved periodically. Pigs, recently re-introduced, are also found in many villages. The smaller animals (goats and sheep) are sometimes seen moving about freely, equipped with especially adapted wood collars to prevent them from wandering through fenced areas.

According to a recent World Bank study, the area is deficient in maize and sorghum - the major staples of the local diet. In general, the yields of the deficient grain staples have been in decline for several years, while a slight increase in tuber production (sweet potato, cassava) has been noted. A portion of the commodities produced on the farms is autoconsumed and a portion is sold.

Forestry projects, sponsored by various donor agencies which include

distribution of *Leucaena* spp. and establishment of forest nurseries, have obtained good results. The impact of these projects is noticeable and should be encouraged.

Introduction. Countless reports have been written on the predicament of the Haitian farmer and his role in promoting erosion and loss of soil fertility. Suffice it to say that the gravity of the situation is apparent to anyone who takes the time to walk around the hillsides above the plains of Les Cayes. The situation needs to be rectified with a sensible plan that can be implemented by the farmers with minimum interuption in his farming system and at minimum cost. The agronomic work plan will focus on introducing erosion control and agronomic techniques that are simple and practical and which will yield results within a reasonably short period of time. The method of introducing these techniques will be of paramount importance: the peasant farmer must recognize that the innovations will be to his own advantage.

The technical package presented here is by no means a simple solution to a very complex problem, which is further complicated by social and political nuances. It is rather a series of alternative choices that can be adopted gradually or all at once depending on the confidence and the ability of the farmer and his willingness to take small risks. The success of the following interventions will greatly depend on the ability of the *animateur* to relate to the local farmers and on his understanding of the agricultural program. The role of the *animateur* is crucial to the the success of this program.

Existing farming systems. Six crop rotations represent approximately 90% of all the situations encountered in the diverse watersheds. The six types of rotation are located on the major soil types encountered in the area. In addition, the typical peasant farmer generally has more than one *jardin* varying in size from one *seizieme* to several *carreaux* (one *seizieme* is equal to 1/16 of a *carreau*; 1.29ha = one *carreau*). He often has as many as 4 or 5 *jardins* located on various soils, with different slopes and at varying altitudes.

The tabular summary below is an average composite of various sites found in the area. The classification is broad enough to encompass the majority of the land in the targeted watersheds. Within each site several crop rotations have been observed and, for the sake of simplicity and the ease with which a rotation can be described, one traditional rotation scheme has been selected for each land classification and extended the rotation for a period of 20 years. The following examples are not paper models but actual crop events practiced by the farmers.

The criteria used in describing each soil type (slope, soil depth) are typical situations well described in the literature and accepted as standard soil descriptions. The sites were further sub-classified by slopes because the proposed interventions will be different and the response will be variable according to slope. Crop yield information for the hillsides located within the proposed project area are non-existent. The yields of the most commonly found crops (maize, bean, sorghum,sweet potato, congopea, cassava) in the farming system are based upon several years of field research and on-farm trials done in the Jacmel hillside area by Agronome Luc Pierre-Jean.

Crop selection. Generally the tradional farmer has several *jardins* for reasons that include spreading of risk among several farming plots; availability of time required to devote to his farming activities; avoiding crop failure due to diseases, insects or other biological factors; seasonal labor availability;

market judgements; and seed availability. One other factor is that he may not have a choice but to cultivate what he has. It is a rare exception to come across a monoculture. In most cases, crops are grown in various associations. General comments include:

(1) Several crops are found in most of the *jardins*: maize, beans (red and black), sorghum, sweet potato, congo peas and cassava. These crops are found on most soil types and slopes (up to 80%) below 700 meter elevation. Above 700 meters, beans and sweet potato are commonly found in association with bananas and in recently established coffee plantations. In the latter case, the annual crops are grown for a period of 2-3 years or until a canopy has developed that shades out most of the ground. The bottom of ravines are generally occupied by bananas and plantains, *Cassia* spp. or other types of trees. The latter are not cultivated in the traditional orchard manner.

(2) Farmers are cognizant of the fact that weeding does produce additonal yields. It appears that in a favorable year of high moisture availability, weeding is favored at the time maize and beans are planted in association. If the field is weeded, the subsequent crop of sorghum is planted using the hill method (sometimes referred to as pocket method) where several seeds are planted in one location. If the field is not weeded, sorghum is sown by the broadcast method.

(3) The availablity of moisture also influences other agronomic practices. In a good year with adequate moisture, maize is favored over sorghum and extra care is given to the maize crop which can yield twice as much as sorghum under most hillside conditions. In a dry year, sorghum is favored over maize and during the course of the season the maize leaves are cut off the plants gradually for animal fodder. Sorghum is more drought tolerant and will produce a small quantity of grain even under severely limited moisture availability.

(4) Fruit trees are generally planted near the house for safekeeping. It is difficult to determine the varieties since most trees are not grafted and were planted from common fruit trees. Mangoes best examplify the preceding observation. Avocados and papayas were not found in abundance. Plantains are common but are not grown with good agronomic pratices. Sour oranges are found in abundance and are used in sauces.

(5) Fertilizers, whether they are organic or inorganic, do not appear to be used extensively. Animal manure near pig sties is generally dumped into a pit and not used in the fields. Farm outlet general stores are located in major population centers and are not readily accessible in the countryside. Farmers go to weekly markets in nearby towns to buy necessities and sell produce.

(6) Farmers recognize that bean, yam and plantains can be sold for a higher value than any other farm crops. The cost of planting material for yam and the scarcity of high yielding, disease resistant bean varieties are but a few of the reasons why these crops are not grown more extensively and are not producing to their potential.

(7) The traditional system of shifting cultivation that includes to some extent a cut-slash-burn approach is only viable as long as there is enough available land to start new cycles, so a marked shift from extensive to

intensive agriculture has exacerbated the problem of land pressure. The scarcity of undeveloped land has resulted in farming on less and less desirable land thus creating in part the problem agriculture faces today.

(8) Haitian farmers are innovative and open to change if consulted. Project personnel must consult with and encourage them to participate in decisions that affect the ways they earn their living.

Land classification table. The following table illustrate the major elements of the various soil orders and soil order associations found in the project area. Soil depth and slope are used to gauge the risk involved in farming a soil. Weathering determines the classification of a young or old soil which in turn indicates its potential response to management. The Mollisols are considered young responsive soils and have not been subjected to a long weathering period. The Oxisol/Ultisols have been exposed to a longer period of weathering and are considered old unproductive soils. The weathering effect has a direct relationship to the potential of the soil to produce a crop yield. Severely weathered soils can reduce the yield potential in excess of 50%. In the following table we took a more conservative approach and did not exceed 30%.

The degree of risk associated with a particular soil combines factors including slope and soil depth. The latter is directly related to the water retention capacity of a soil. As an example, an Oxisol/Ultisol with a soil depth of less than 50cm or on slopes greater than 25% represents a high risk soil. Water retention is the ability of a soil to hold and store water, generally expressed as inches of water per foot of soil depth. The sum of these characteristics are taken into consideration when arriving at an estimated yield reduction factor. High risk soils that have low water retention capacity, a depth of less than 50cm., or are located on slopes greater than 25%, will not support high crop yields. The proportion of each soil type found in the project area is indicated but does not represent 100% because 5% of the area is described as reclamation land and is not included in the table. These latter sites are no longer productive because of excessive soil loss, low fertility and limited water retention capacity.

LAND CLASSIFICATION

	MOLLISOL	OXISOL	OXISOL ULTISOL	MOLLISOL	OXISOL ULTISOL
DEGREE OF RISK	MODERATE	MODERATE	MODERATE	HIGH	HIGH
% OF AREA	20	10	10	25	30
YIELD REDUCTION			10%	-20%	-30%
SOIL DEPTH (CM)	>50 &	VARIABLE	>50 &	<50 &/or	<50 &/or
SLOPE	<25%	VARIABLE	<25%	>25%	>25%
WATER RETENTION	HIGH	MED	MED	MED	LOW
EROSION	MED	LOW	LOW	HIGH	MED
ELEVATION (METER)	<1000	>1000	<1000	<1000	<1000

YIELDS KG/Ha

MAIZE	1400	0	1260	1120	980
SORGHUM	800	0	720	640	560
BEAN	600	600	540	480	420
PIGEON PEA	370	0	330	295	260
COW PEAS	400	0	360	320	280
SWEET POTATO	1500	1500	1350	1260	1050
YAM	3690	0	3320	2950	0
CASSAVA	0	0	1500	1200	1260
COFFEE	250	250	0	0	0
PLANTAIN	5000	5000	4500	4000	0
AVOCADO	7000	7000	6300	5600	0
MANGO	7600	7600	6840	6080	0
CITRUS	9000	9000	8100	7200	0
PINEAPPLE	0	0	19600	0	15240
PAPAYA	9000	0	8100	7200	0
SUGAR CANE	0	0	31500	28000	24000
VETIVER	0	0	0	0	1575

Traditional crop rotation. The folowing crop rotation is an example of how one hillside farmer would farm his small landholding, assuming that he owns an average size holding of approximately 1.6 hectare. As previously stated the holding is divided into small *jardins* that could be located on any combination of slopes and soil types. For the purpose of our illustration, our typical farmer owns 4 to 6 *jardins*. The rotations presented in the example are typical for the moment, however some assumptions had to be made in order to extend the rotation time frame to 20 years. It was assumed that under the present farming conditions where soil erosion practices are ignored, the yields will continue to decline and in most fields the fertility level will decline to a non-supportive crop level and soil depth will be reduced appreciably. In addition, farm management interventions that are proposed will take some time and it is inconceivable to expect a quick turn around especially in situations where severe land abuse has been practiced for many years.

For the most part maize, bean and sweet potato vine cuttings are planted in the spring followed by sorghum and, in some instances, another crop of beans in June or July. The local black bean variety is harvested in less than 90 days. Maize is harvested prior to planting sorghum. Sweet potato is harvested 8 to 10 months from the time the vine cuttings are planted. Pigeon pea, depending on the variety and whether or not it is day-neutral, is harvested after 5 months. Some day-neutral determinant types are harvested in 4 months. Cassava is a long maturing crop generally harvested after 16 to 18 months.

FIELD #1: RECLAMATION SITE

Soil capability group: Any of the above soils that have eroded and have very low moisture holding capacity. Very high risk soils.

Estimated Annual Income: YEAR 1: 0 YEAR 20: 0

Description: Field No.1 is the worst case scenario. The field has lost all its productive capacity including most of its top soil and it is undergoing severe erosion. The land is farmed with sweet potato between fallow periods and eventually abandoned by the farmer after five or six years of very low return on his efforts. Some livestock grazing takes place during the fallow period. The site will be regenerated under the proposed intervention program.

CROPS

	Fallow	Sweet potato	Sweet potato/fallow
YEAR 1	XXX		
YEAR 2		XXX	
YEAR 3	XXX		
YEAR 4	XXX		
YEAR 5			XXX

YEAR 6 THRU YEAR 8 - SAME AS YEAR 5

YEAR 9 PASTURE FALLOW LAND

YEAR 10 THRU YEAR 20 LAND IS FALLOWED WITHOUT PASTURE OR CROPS.

FIELD #2: HIGH RISK RED SOIL SITE

Soil capability group: High risk Oxisol/Ultisol with depth less than 50 cm. and/or slopes greater than 25%. Medium erosion with low water retention capacity.

Estimated Annual Income: YEAR 1: $18 YEAR 20: $16

Description: Notably absent from this type of rotation are the high return traditional crops such as maize and black beans. On this site the soils tend to be shallow and located on steep slopes, adding to the erosion problems while reducing the capacity of the soil to retain soil moisture. Gradually, sweet potato, sorghum and pigeon pea diminish in importance and are dropped from the

rotation altogether after year 11. Cassava is the remaining crop while the land is increasingly left aside in a fallow condition. The land is continously losing fertility and at the end of the 20 year period it can only support a fallow condition. The land will remain in this condition until natural vegetation rejuvenates soil fertility and at that point the cycle could repeat itself.

CROPS

	Sweet potato	Pigeon pea	Sorghum	Cassava	Fallow
YEAR 1				XXX	XXX
YEAR 2	XXX	XXX	XXX	XXX	
YEAR 3				XXX	XXX
YEAR 4 THRU YEAR 7 - SAME AS YEAR 3					
YEAR 8 AND 9					XXX
YEAR 10				XXX	XXX
YEAR 11	XXX	XXX	XXX	XXX	
YEAR 12				XXX	XXX
YEAR 13 THRU YEAR 16 SAME AS YEAR 12					
YEAR 17 AND 18					XXX
YEAR 19 AND 20				XXX	XXX

FIELD #3: HIGH RISK BLACK SOIL SITE

Soil capability group: High risk **Mollisol** with depth less than 50 cm and/or slopes greater than 25%. Has high erosion and medium water retention capacity.

Estimated Annual Income: YEAR 1: $61 YEAR 20: 0

Description: The Mollisol are potentially very productive but under this system where ecological abuse has been going on for many years, the natural fertility has declined rapidly. Under this system the cropping sequence is essentially the same as in field no. 2 but the soil has a higher erosion potential and water rention capacity. Approximately half-way through the 20 year cycle, because of the site conditions previously described, the land is left fallow and is no longer an income producing unit. The land still has the capacity to respond to management interventions under watchful supervision.

CROPS

	Sweet potato	Pigeon pea	Sorghum	Cassava	Fallow
YEAR 1	XXX	XXX	XXX	XXX	
YEAR 2				XXX	XXX
YEAR 3 THRU YEAR 4 - SAME AS YEAR 2					
YEAR 5	XXX	XXX	XXX		
YEAR 6	XXX	XXX			XXX
YEAR 7 THRU YEAR 11 - SAME AS YEAR 6					
YEAR 12					XXX
YEAR 13 THRU YEAR 20 SAME AS YEAR 12					

FIELD #4: MODERATE RISK BLACK SOIL SITE

Soil capability group: Moderate risk **Mollisol** with soil depth greater than 50 cm. and on slopes less than 25%. Medium erosion and a high water retention capacity.

Estimated Annual Income: YEAR 1: $46 YEAR 20: $28

Description: This is the same soil type as described in the field no.3. It has the same soil physical characteristics. Because of its high water retention capacity and its inherent fertility a number of additional high value crops can be grown successfuly namely: maize and bean. These fields are potentially the most productive and are located in many cases near homes. A fallow system is not incorporated into the rotation nor is the culture of cassava. The latter is generally found in a fallow system or at the very end of the fertility cycle. The obvious characteristics of this sytem is declining yields unless some new mode of intervention is put in place.

CROPS

	Maize	Bean	Sweet potato	Pigeon pea	Sorghum
YEAR 1	XXX	XXX	XXX	XXX	XXX
YEAR 2 THRU YEAR 20 SAME AS YEAR 1 (YIELD DECLINING 2%/YEAR)					

FIELD #5: MODERATE RISK RED SOIL SITE

Soil capability group: Moderate risk **Oxisol/Ultisol** with soil depth greater than 50 cm. and slope less than 25%. Low erosion and a medium water retention capacity. These soils have a high degree for potential erosion in the future if continuously exposed to the same farming practices.

Estimated Annual Income: YEAR 1: $107 YEAR 20: 0

Description: These fields have good depth and are located on slopes less than 25%. Potentially they will be responsive to management interventions. Maize is not productive on these soils unless the fertility level is adequate. A leguminous crop such as beans will produce a crop but will not reach its potential unless a complementary fertility program is adopted. After six years beans are dropped from the rotation while sweet potato is the only remaining subsistence food crop. Even this is eventually dropped after the seventh year. Some livestock grazing takes place on the fallow field but it is difficult to determine its level of intensity. The field is abandoned very early in the cycle and will most likely remain a non-productive unit. Another possibility is that after the field has been abandoned or fallowed for a few years, it could be used as pasture once again. These soils are ideally suited for long term perennial cropping.

CROPS

	Bean	Sweet potato	Fallow	Fallow/pasture
YEAR 1	XXX	XXX		
YEAR 2		XXX	XXX	
YEAR 3				XXX
YEAR 4	XXX	XXx		
YEAR 5	XXX	XXX		
YEAR 6	XXX	XXX	XXX	
YEAR 7		XXX		

YEAR 8 THRU YEAR 20 FIELD ABANDONED

FIELD #6: MODERATE RISK COOL SITE

Soil capability group: Moderate risk cool, climate Oxisol with variable soil depth and slope. Low erosion and medium water retention capacity. Site located above 1000 meters.

Estimated Annual Income: YEAR 1: $9 YEAR 20: $5

Description: These soils are nearly identical to those found in field no.5 but are located at higher elevation (above 1000 meters) in the project area. As in the previous field, some grazing takes place wih the fallow rotation. The cropping of bean is abandoned early in the cycle while the remaining sweet potato crop yield declines steadily in the fallow rotation.

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CROPS

	Bean	Sweet potato	Fallow	Fallow/Pasture
YEAR 1		XXX	XXX	
YEAR 2				XXX
YEAR 3	XXX	XXX		
YEAR 4		XXX	XXX	
YEAR 5 THRU YEAR 15		SAME AS YEAR 4 (YIELD DECLINING 2%/YEAR)		
YEAR 16		XXX		
YEAR 17 THRU YEAR 20		SAME AS YEAR 16		

Proposed farming systems. The proposed interventions for the following six fields are designed specifically to control erosion and at the same time increase soil fertility and net income to the farmer. The proposed package is not the definitive answer to all the existing hillside agricultural problems in Haiti. It is merely a starting point from which one can proceed. Many alternatives were considered and it became obvious from the start that if all the worthwhile cropping systems were considered, there would be too many options. It would have created an impossible task to present the information in a logical manner.

In arriving at an ideal farming system that exhibits simplicity, effectiveness and ease of implemention, the rotation assumed that the peasant farmer is familiar with some of the crops in the system. Consideration was given to the peasant farmer's habits, nd This had an influence on the choice of crops incorporated in the interventions. Foremost in choosing an appropriate intervention were the soil characteristics of the example site, and its potential response to a given set of interventions.

The livestock sector plays an important role in the traditional farming system and makes a significant contribution to farm income. We have not purposely omitted its role in the proposed interventions and it is discussed in the context of alley cropping. It is difficult to design a farming system that places emphasis first on prevention of soil erosion and increase of soil fertility while at the same time giving due consideration to all other factors that represent an ideal farm system. The alternatives presented have the optimal chance of succeeding under very trying conditions.

Hopefully the team implementing these changes will improve and refine the techniques presented. We have foreseen that in the near future the system will have to be modified to keep up with the dynamics of cropping patterns, farmers preferences, market influences, etc. The project team will require individuals with imagination and determination to initiate the program on a sound basis.

Proposed interventions. In assessing which interventions should be introduced, full consideration must be given to whether or not it fits into the present farming system and how difficult it will be to implement any changes. One way to introduce a new idea is to incorporate the new technique into present method of farming and give the farmer ample guidance and reassurance. Methods used in

extending interventions are discussed in details under extension methodology.

The proposed major interventions include: alley cropping, improved food crop varieties, fruit trees, firewood species, forage species, adapted agronomic practices, perennial cropping methods and inorganic fertilizers. A number of interventions are site specific (coffee) while other interventions are adaptable to many sites and soil types (Black bean). The common denominator for all interventions is to increase profitability as a result of practicing sound soil erosion control methods and promoting soil fertility concurrently.

Alley Cropping. The International Institute of Tropical Agriculture (IITA) located in Ibadan, Nigeria has developed a farming system that is commonly referred to as "Alley cropping" or hedgerow farming. The system evolved as a result of seeking alternative methods to the centuries old custom of shifting cultivation and bush fallow agricultural production. This latter type of system works as long as an unlimited supply of land and labor exist. In Haiti the availability of uncropped land is presently a major constraint that must be solved. Very little land is left fallow intentionally; the pressure to produce is immense, consequently land that should be left in a fallow state is farmed because the owners have no other alternatives. The results are obvious: loss of good soil, excessive erosion and decreasing soil fertility. The peasant farmer practiced the fallow system because it restored fertility, and controlled, to some extent, weeds, diseases and insect pests. From an agronomic point of view, the fallow system gives an opportunity for the regrowth of the deep rooted trees and shrubs that recycle plant nutrients and build up soil organic matter. During this period the plant cover and litter protect the soil against the impact of raindrops and bind the soil, increase water infiltration and reduce soil erosion and runoff. In addition, plant cover and litter reduce soil temperature, maintain soil moisture for a longer period of time which, in turn, creates a favorable environment for the growth of soil micro-organisms.

A solution to the traditional shifting cultivation alluded to earlier is to reduce the fallow period and increase the production period. One way to begin to accomplish this difficult task is to introduce alley cropping in the production system. Alternative methods such as intensive use of agrochemicals and machinery are not appropriate in Haitian conditions.

The alley cropping production method is acknowledged to be beneficial for the following reasons: (1) it produces green manure and mulch for the companion food crops; (2) it acts as a vegetative barrier to control soil erosion and reduces the speed of surface water, when planted on contours on steep slopes; (3) it acts as a vegetative weed control method when prunings are applied as a mulch to reduce the weed population; (4) it provides an option to the farmer to use the prunings as cut-and-carry fodder; (5) trees can be selectively cut for poles or used as nurse trees; (6) it adds biologically fixed nitrogen to the soil to be used by a companion crop; and (7) it promotes micro-biological activities.

Species selection. In theory, any leguminous tree or shrub capable of producing nitrogen by means of *Rhizobium* can be used in the alley cropping system. However, very litle applied research has been done outside of using *Leucaena* as the basic recommended species. Much has been done with this species in Nigeria, Taiwan, the Philippines, Thailand, Indonesia and the USA, just to mention a few countries. We would recommend at this point that *Leucaena* be utilized in Haiti as the leading candidate for alley cropping until

such time as additional information is developed regarding the use of other species. Using a single species is risky. An insect attack or diseases could wipe out a stand of *Leucaena* in a short period of time unless some preventative methods are used. However, for the moment we do not have a better alternative.

Leucaena spp. has been used in alley cropping with maize, rice, yam, cassava and cowpeas. In most instances, a significant increase in yields has been noted (IITA). Research conducted at IITA on *Leucaena* biomass production showed that 5 to 6.5 tons of dry matter (15 - 20 tons fresh prunings) yielded over 160 kg N, 15 kg P, 150 kg K, 40 kg Ca and 15 kg Mg/ha/year.

Leucaena species are numerous so these varieties are best referred to by numbers. Recomended varieties known as giant types are K8 (Mexico), tall and (late seeder), K28 (Salvador) K67 (Salvador), shorter of the two and early seeder. *Leucaena diversifolia* and *L. pulverulenta* are recommended for higher elevation. For more information on the location of seed dealers, contact Leucaena Research Reports (NFTA), P.O. Box 680, Waimanalo, HI. 96795.

Additional species that should be considered and tested under Haitian conditions are *Sesbania grandiflora* (pea tree), *Casuarina equisetifolia* (Australian pine), *Cassia siamea*, *Gliricidia sepium* (Mexican lilac), *Calliandra calothyrsus* (Caliandra) *Mimosa scabrella* (Higher elevation potential) *Prosopis* spp. and *Bois Blanc*.

Method of Establishment, *Leucaena* seed must be treated prior to direct seeding or planting in a nursery. The simplest scarification method as recommended by the Nitrogen Fixing Tree Association (NFTA) is to soak the seed for 5 minutes in 80 degree Celsius (176 degres Fahrenheit) water and rinsed with cold water. Seeds must be inoculated with a specific strain of *Rhizobium* otherwise poor germination and growth will result, especially on soils that have not previously grown *Leucaena*. *Rhizobium* information and inoculant can be obtained from the NifTal Project, P.O. Box O, Paia, Maui, Hawaii, 96779.

Row width will vary according to slope and the intended companion crop. Single or double rows are generally planted on the contours. In a single row configuration the distance from plant to plant within the row is 10cm.-20cm with plants established in a diamond shape pattern. With direct seeding, 2-3 seeds per hill or hole is recommended. In a double row configuration, the spacing between rows is approximately one meter or less and the spacing of plants within the row remains the same as in a single row. One kilogram of seed can plant 10 hectares if spacing is approximately 1m x 1m.

Cropping method. In between the *Leucaena* rows, depending on the slope of the terrain, a distance of 4 or more meters is reserved to produce a food crop. On gentle terrain the distance between *Leucaena* rows can be increased up to 8 to 10 meters. The key to using the system effectively is to time the pruning of the hedgerows so that the coppice growth does not shade out the planted crop. Secondly trees must be cut back before a crop of seeds is produced to lessen the risk of creating a potential *Leucaena* weed problem in the cropping area. The exact timing to coordinate these activities can be established at the time a production system is being considered with the cooperating farmer. For optimum results it is recommended that the hedgerows not be trimmed for an initial period of 14 to 18 months, to firmly establish deep roots. Thereafter the hedgrows can be clipped as often as every 4 - 6 weeks depending on the site condition and the objective of the demonstration program. The trees should be cut back to a height of one meter or slightly less for easier subsequent

trimming. The prunings are left on site for mulch and to benefit the companion food crop. Studies have shown that in order to obtain a yield increase in corn equivalent to 100 kg/ha of ammonium sulfate (20% N.) one needs to apply and incorperate approximately 3 t/ha of fresh cut *Leucaena* foliage (NFTA).

Leucaena hedgerow prunings can be also used as an excellent cut and carry fodder. Care must be taken not to feed livestock too large a quantity of *Leucaena* over a long period of time. *Leucaena* fodder contains a toxic amino acid called mimosine which can affect the animal's metabolism also cause a loss of hair. Ruminants can be continously fed a ration containing 40% *Leucaena* by dry weight without suffering side effects, while non-ruminants will not tolerate a ration in excess of 10% *Leucaena* by dry weight (Benge).

A portion of the hedgerow can be kept for pole production and harvested in 4 - 6 years. Population density and soil type will influence the yearly growth rate. A spacing distance of .25m to 2m will produce a tree with a diameter 3.6cm. to 7.6cm repectively in the period indicated above.

Leucaena trees have also been used as live staking (nurse trees) to support a vine crop such as yams or beans. In such a system the main stem must be cut back to within an easy reach of subsequent prunings. The deep tap rooted *Leucaena* does not interfer with the tuber crop cultural operations.

Leucaena has been used as an erosion control species for many years in South East Asia especially in the Philippines. The trimmings from the hedgerows are allowed to dry on the surface of the soil and after a few days the leaves are shaken off the branches and the latter are placed on the uphill side at the base of the hedgerow. After several years these strips form vegetative terraces which act as soil catchments and minimize soil loss on steep slopes. As previously discussed, the distance between hedgerows will depend on the steepness of the slope and the soil type.

Leucaena is also planted extensively for fuelwood and charcoal production. One green ton of *Leucaena* is equivalent in heating value to 3/4 of a barrel of oil (National Academy of Sciences). On very poor sites it is estimated that *Leucaena*, planted in pure stand, could yield 12 cubic meters of wood per year per hectare. It takes approximately 8 cubic meters of wood to make one ton of charcoal.

Improved Crop Varieties. An important intervention to assure project success and acceptibility by peasants is the introduction of improved crop varieties. A quick impact can be attained in a very short period of time providing the germ plasm is readily available. Under a separate section of this report the seed multiplication issue is discussed in detail. Suffice it to say at this point that in order to get the agricultural activities off to a quick start and demonstrate to the farmers the intent of the project, a sufficient quantity of certified seed must be available immediately. AID should immediately take the necessary steps to start a small seed multiplication program with contract farmers. This is especially important for the multiplication of yam planting material. It has been suggested that farmers in the Haut Cap Rouge region could start the multiplication right away and the following year, farmers in the project area could start participating in the program. This can be accomplished with TWAMP funding or under the Agroforestry project by contracting with local PVOs to supervise the multiplication program with the farmers. Once the project advisors are on site they must be ready to implement the project and to have the necessary supplies on site. The demonstration

effect of improved seed is a major intervention that can be extended to the peasant farmer quickly while the other major interventions are being tested and evaluated.

The following is a list of improved varieties that are recommended for use until higher yielding varieties are released. All varieties are available and have been tested and recommended by many organizations. There is an element of controversy regarding maize varieties La maquina 7928 and 7827. Although highly recommended in the plains, but not altogether accepted by the farmers, they have not been tested on the hillsides of the watersheds. Before committing the project to large scale increase of these varieties, the project personnel should undertake extensive testing on the hillsides under farmers' conditions. The grain and pulse varieties are available but in limited quantity. Seed multiplication of these varieties must be undertaken as top priority. Sweet Potato planting material is readily available. However, a concerted effort will have to be made to increase the availability of yam planting material. Most fruit tree varieties are available from the Organization for the Rehabilitation of the Environment (ORE). In addition, a reliable source of good germ plasm has been located in the Jacmel area.

Pineapple is potentially a good income crop, however, a reliable source of planting material will have to be located. At the moment planting material is scarce. Forage grass seeding material is available locally, and with the exception of Buffelgrass seed which will have to be obtained from abroad but can be increased in Haiti. Forage legumes are included on the list and will be considered seriously after the project gets under way. Establishing a forage legume program requires a good seed source and a dependable supply of inoculant. Forage legumes require very specific inoculation treatment and until such time as the project can obtain inoculum and have it safely shipped to Haiti without losing its viablity in transit, the program will have to take a cautious approach. Inoculated seed for hedgerow species is readily available from abroad and isolated seed multiplication blocks should be started even before the project is officially sanctioned.

CROP VARIETIES

Grains. Maize (Zea mays, La maquina 7928 or 7827); Sorghum (Andropogon sorghum, M 50009);

Pulses. Black bean (Phaseolus vulgaris, Tamazulapa, Salagnac 86); Pigeon peas (Cajanus cajan, UW-17); Cowpea (Vigna sinensis, African red or Local);

Tuber crop. Sweet potato (Ipomoea batatas, Negsale local variety); Manioc (Manihot spp. , Local variety); Yam (Dioscorea spp. , Alata white flesh, Cayenensis yellow flesh)

Fruit trees. Avocado (Persea americana, Local variety); Mandarin (Citrus nobilis); Orange (Citrus sinensis, Sweet orange) Mango (Mangifera indica, Local variety); Plantain (Musa paradisiaca, Banane muske, Banane cochon); Papaya (Carica papaya, Local variety)

Miscellaneous crops. Coffee (Coffea arabica var. typica, Catura); Vetiver (Anatherum zizanoides); Pineapple (Ananas sativus, Local variety);

Forage grasses. Elephant grass (Pennisetum purpureum); Napier grass; Guatemala grass (Trypsacum laxum); Guinea grass (Panicum maximum); Pangola

grass (Digitaria decumbens); Buffelgrass (Cenchrus ciliaris);

Forage legumes. Brazilian alfalfa (Stylosanthes gracilis); Stylo Centro (Centrosema pubescens); Horse gram (Dolichos biflorus); Dolique; Kudzu (Pueraria phaseoloides); Velvet bean (Stizolobium deeringianum);

Wood species. See the species listed under the alley cropping section.

Intensive agronomic practices. To implement any of the above major interventions will take time and a change in agronomic practices. The project will not recommend costly engineering works such as constructing dry rock walls or digging deep contour trenches. These activities have been undertaken in the past and have met with very limited success. If farmers are actively involved in these activities, the project should provide technical expertise in promoting vegetative terraces in conjunction with these activities to further promote soil erosion control. The rock wall undertaking produces no income and is very costly. The vegetative alternative methods are cheaper and produce income. The emphasis will be placed on utilizing natural vegetation (crop, forage, and tree) as the principal soil erosion control intervention. In selecting a specific vegetation type, first consideration will be given to plants which have the ability to fix nitrogen and thus reduce the need to rely on the introduction of inorganic fertilizers for increase crop yields.

The introduction of the alley farming concept is not totally new to Haiti. It is already practiced to a limited extent under various names. The method will require more labor input from the farmer but the resulting benefits will more than pay for the additional labor time. The Hedgerows will have to be trimmed (pruned) perhaps as much as 2 to 3 times per year, pruning material will have to be placed along the hedgerows for erosion control, or a partial load of prunings will have to be carried away as cut and carry fodder. All these activities amount to extra labor input.

The introduction of improved varieties will require a careful approach to: maintaining proper plant density, correct time of sowing and harvesting, eliminating competing weeds, timely application of fertilizers (if recommended) and access to marketing outlets.

The non tillage cultivation system, commonly referred to as "No-Till", was considered in the light of the conditions encountered in the watershed basins. It would not be appropriate at this time to introduce this concept because the complexity of the system requires intensive management, additional supervision from the Technical Assistance team, knowledge of herbicides and timing of application. It is costly and too sophisticated.

The innovative farming approach suggested requires farmers to incorporate more plant material into the soil and stop burning crop residue. They will be instructed on how to build vegetative contours on the level and build and maintain vegetative terraces. Where peasants are farming sweet potatoes, manioc or yams on small contour mounds, they will be encouraged to use and place all plant material as mulch in the furrows (trenches) as a further measure of erosion control. Under a seperate section, the extension phase of this program is presented in detail including the methods of implementation.

Site Specific Interventions. The criteria in selecting interventions were based upon the following conditions: (1) farmers must be familiar with most of the varieties used in the rotation; (2) the program should be easy to implement

and maintain; (3) quick results are expected; (4) increasing soil fertility and retention of available water; (5) preventing soil erosion; and (6) increasing the farm income appreciably.

Rationale. The following were the guiding points in selection of rotations:

(1) All factors related to the physical characteristics of the soils including; slopes, soil depth, water retention potential, soil type and elevation.

(2) Available rainfall data.

(3) The opinions of farmers, agronomists, researchers, PVO representatives and individuals residing in the PPMS watershed area.

(4) Available data pertaining to the cropping history of the area including; cropping rotations, crop preference by location and elevation, food preferences, changes over time, market conditions and integration of forestry and livestock.

(5) Farmers' field methods were observed and the following were noted; method of seeding, spacing, cultivating, weeding, harvesting, transporting and marketing.

(6) The introduction of innovations from the point of view of local customs.

(7) Visits to many *marches* to look at crops being sold, how they are transported to the market, which varieties are preferred and at what price they are sold.

(8) Alternative rotation methods, different cultural practices, introduction of new varieties and crops, and possible difficulties that may be encountered in the implementation stage.

Arriving at the best agronomic solution for a particular situation involves choosing among many alternatives of which more than one may be correct. Within a very small radius are a multitude of cropping methods practiced by the peasants. The choice of cropping methods appears to be based on many complicated external factors. The ultimate goal of the proposed interventions is to slowly convert the hillsides to perennial cropping systems while obtaining satisfactory yields from largely annual crops in the interim.

Reclamation site. Field no. 1 is envisioned in the hills West of Les Cayes before arriving at Port Salut. The area is barren and with the exception of an occasional field of cassava little else is grown. Vetiver is cultivated and marketed nearby. The area is ready for a major reclamation program. Peasants who need cash will cultivate vetiver under any conditions so the crop must be included in the reclamation scheme. If not, they will still continue in their traditional ways, and vetiver will contribute to accelerated erosion of the soils. There are two cash crops, along with well managed, non-destructive vetiver cultivation: fuelwood and poles along with fodder and pasture for livestock. The fields are not capable of supporting any high income annual cash crop. The process of rebuilding has to start from this point and in this case we see no other alternatives. With project interventions these fields could possibly be used once again as productive units, while reconstituting soil fertility for the long term.

High risk red soil site. Field type No. 2 is located on a high risk red soil in the Platons area, near the top of the Acul watershed. At the top of the basins, dry walls have been constructed for erosion control. The principal crops grown are sweet potatoes, cassavas, beans and some maize. This same type of situation can be found in Camp Perrin or Trois Mangues on the road to Changieux. The introduction of alley cropping in these fields is the first step toward restoring productivity and stabilizing the erosion process. The choice of species to use in the alley cropping system was a difficult one to make. Very little information is available on the adaptibility of nitrogen-fixing species under these conditions. The soils are potentially acidic but thre is no accurate laboratory information. *Leucaena* is the preferred species to establish at the begining of the rotation.

If the soils are too acid, or if elevation is too high, Sesbania or Casuarina would be good substitutes. The use of *Sesbania* in hedgerows is untested. *Casuarina* cannot be direct seeded, and is therefore not necessarily a good choice for hedgerows. The introduction of a pineapple crop is a logical choice for these acid soils. The crop has potential for generating a high cash income. Pineapple will be used as a vegetative barrier and its root system as a soil binder. The crop may show signs of iron deficiency but that can be corrected with the proper applications of inexpensive micro-nutrients. Pineapples have been cultivated by Haitians peasants and it is not regarded as an exotic species. The crop can be transported to the market place with minimum bruising and spoilage. The market price is excellent and the potential gains outweigh the risk. Other crops suggested in the rotation are improved varieties of standard annual food crops and are expected to do very well as companion crops in the nitrogen-fixing *Leucaena* alley cropping system.

High risk black soil site. Field No. 3 could be located in any of the following areas; Les Anglais, Bonne Fin, Fond des Freres or Marcelline on the road to Jeremie. The Bonne Fin sites near the hospital are rocky but generally have good vegetative cover. These high risk black soils (Mollisols) are located in an area predominantly surrounded with slopes above 25%. The sites are easily accessible and are ideally located for the demonstration of project interventions. These soils are basically fertile and have the potential to respond dramatically to management inputs. Alley cropping or hedgerow contours will have to be spaced very closely (less than 4m apart in some cases) and used not only as forage and nitrogen producers but also as vegetative terraces. The primary objective on these soils is to stop and reverse the erosion process. The introduction of papaya trees, and of improved varieties of maize, black beans and sorghum will produce good results. Fruit trees and firewood species will grow well in the many ravines associated with these sites. Because of the inherent ability of these soils to produce good yields, any number of different crop varieties could be introduced safely. The choice of crops was based on the past cropping history of the area and on potential cash income. To further protect these soils against further farming abuse, the project will establish small bands of forage legumes or grass cover next to the yam plantings. *Leucaena* live stake trees will be introduced as support for the vine and as a nitrogen companion crop.

Moderate risk money maker site. Many of these number 4 type sites are located on the road from Cavaillon to Changieux-l'Asile. Typically these sites are medium risk black soils (Mollisol), located on sites that have a soil depth in excess of 50cm. and on slopes that are less than 25%. These soils have good water retention capacity, and could potentially produce higher yields than any others in the project zone. Our concern on these sites is to bring the soil

fertility level to its full potential and introduce a crop rotation that is in concert with the project erosion intervention measures. Plantains and Papayas are ideally suited for planting in the small ravines and borders of the fields. These sites are destined to be the most profitable, but because of the present cost of yam planting material, the net return is $140 less per year than site No.3 at the end of year 20. The cost of yam tubers (planting seed) will drop considerably once the project starts its seed multiplication program. If the project can produce low cost planting material, these sites will generate the highest yearly cash return. If yam planting material cannot be produced at an affordable price, maize, black beans and fruit trees be increased proportionately.

ANNEX G ANIMAL HUSBANDRY ANALYSIS

CONSTRAINTS. In order to illustrate the complexity of problems involved in animal husbandry activities in Haiti, it is useful to highlight the constraints that have been encountered by various livestock projects and services. The constraints are not listed in any particular order of importance:

(1) Farmers not aware of nutritional requirements of animals and are thus reluctant to invest in balanced rations;

(2) Indigenous goats often do not produce enough milk for their kids;

(3) The major problem in livestock (and especially goat) production is lack of management;

(4) Extension education is needed;

(5) Medicine for liver fluke control is difficult to obtain and expensive;

(6) Farmers do not bring their female animals to stud stations to be bred as expected, and often allow the goats to inbreed.

(7) Some projects have failed because they were not reproducible by the Haitian small farmer and would have required continued outside funding;

(8) The attitude that "no free breeding service can be of value" was encountered.

(9) There is poor demand for beef to be exported to the US;

(10) A high percentage of animals brought in for processing is condemned for diseases: formerly 30 percent of the hog carcasses.

(11) The nutritional quality of the pasture plants is unknown;

(12) Experience with goats revealed that pulmonary diseases, intestinal disorders, and parasites were major problems;

(13) People are not aware of the benefits of balanced rations;

(14) Foreign exchange is a constraint. All soybean meal and most corn, as well as phosphorus and other nutrient additives, are imported;

(15) Most goats are not provided adequate salt;

(16) Packs of feral dogs have been reported to kill goats;

(17) Among diseases noted are soremouth (especially in the the Central Plateau), diarrhea, and screw-worm infestations.

(18) The condition of cross-bred Brahman cattle is less than desirable due to poor quality of native pasture grasses.

(19) Buckets given to keep water in pens for goats were often taken for personal use;

(20)Cut-and-carry feeding systems are not regularly practiced, and tethering is used instead. There is varying agreement among local farmers as to what constitutes good feed, not only with respect to wild forage plants but also for sugar-cane tops, and rice bran and hulls. Feed is often put on the ground rather than in the specially constructed feeders. Pens are not kept especially clean;

(24)Goat producers do not seem to be able to detect when their does are in heat, so the breeding program utilizing a central Nubian buck is not working well.

(22)There is a lack of available rangeland on the small island, due to its high human population density and physical landscape;

(23)The small size and dispersed nature of the average peasant family landholding impose additional constraints. The level of production is not adequate for investment in livestock. The uncertainty of land tenure does not generally promote land resource improvement practices such as planting better forage plants. Third, the combination of a large number of small farms and the small number of animals kept per farm poses severe problems for any cost-effective input delivery system, such as regular veterinary services, distribution of processed feeds or nutritional supplements.

(24)The shortage of investment capital from public or private sources that is available on acceptable credit terms, especially for the small farmer, is likely to hinder any expansion into modern livestock technologies requiring capital investments.

(25)The virtual absence of a physical infrastructure in rural Haiti, most notably serviceable secondary roads and convenient water supplies, is a major limiting factor to livestock development.

(26)The need to generate export commodities for foreign exchange imposes another constraint on the development of a Haitian livestock industry. Since there is a ready international market for many of the agricultural by-products produced in Haiti (e.g., soybean oil meal, molasses, wheat bran, and cottonseed meal), these important ingredients used in balanced livestock rations are generally unavailable at a reasonable cost to all but the larger and more efficient livestock producers.

(27)The fact that poor people do not consume substantial quantities of animal products simply because they are too expensive is perceived as a long-term constraint that will remain until either the Haitian economy grows to the point where rural people have adequate disposable income to purchase these products, thus creating a local demand, or a more substantial export market develops.

(28)The absence of a comprehensive livestock subsector plan and of any coordinated action program in the country is certainly counterproductive. This lack is exemplified by the unwillingness or incapacity of the appropriate authorities even to collect and analyze basic livestock demographic data.

(29)The absolute lack of personnel for livestock research, training, and extension work, combined with very poor animal health services throughout the country, is recognized as a major roadblock. Explicit examples include

the high incidence of poultry loss to Newcastle's Disease, and the necessity of eradicating the entire swine population because disease detecton and quarantine procedures were completely non-functional. In a country the size of Haiti, this situation is difficult to explain rationally.

(30)The strong role played by private agencies in the area of livestock development can be considered as an impediment to a coordinated national livestock program. Although these groups definitely have the ability to implement at the local level, their technical expertise is often inferior; their disparate activities do not assist in national coordination; and many are either not financially viable or not designed for long-term continuity.

RATIONALE AND APPROACH TO LIVESTOCK DEVELOPMENT

Essentially, grazing land management and soil conservation are complementary activities as long as two potential impacts are avoided. The first is overgrazing. When this occurs, the protective ground cover is removed, the force of rainfall striking bare soil physically dislodges particles, and there are no surface plants or litter, or even residual roots, to prevent the soil from being washed away. Within the targeted watersheds, however, with some exceptions, the combinaton of sufficient annual precipitation, predominantly perennial herbaceous plants, especially grasses, and low numbers of animals has deterred overgrazing.

The second harmful impact of grazing on soil conservation is the possibility that free-ranging animals will cause trails that act to channel surface runoff and promote gully erosion. This can be especially detrimental on steep slopes. Again, within the targeted watersheds, the low stocking rate, together with the practice of tethering livestock rather than allowing them to roam freely, has effectively precluded this problem.

Livestock husbandry within the project area is certainly compatible with the primary goals of the project, to achieve soil and water conservation without reducing the current level of agricultural productivity. In this respect, there is reason for optimism. Not only can current production be maintained, but it can be substantially augmented. Increased animal production can be achieved simply by improved nutritional regimes throughout the annual cycle, and by basic animal health practices. Animal nutrition can be improved by better coordinating the use of available wild forage plants and local agricultural residues. As an example, cutting and conserving the wild grass either as hay or silage when it is abundant for later use during the dry seasons would produce a major improvement in animal nutrition.

Simple and inexpensive animal health measures, such as treatments for internal and external parasites, would certainly improve production, without necessarily entailing more animals. An animal that is not undernourished for two months of the year, and that does not have to contend with debilitating diseases, will reach a marketable size faster and be sold, and another, younger, animal will be purchased to replace it. If one looks ahead to the possibility of such practices as planting forage crop rows to conserve steep slopes and increase available forage, one can envision increased stocking rates as well. The main question is how to design a viable program that can both protect the watershed and promote livestock production.

GUIDELINES FOR LIVESTOCK DEVELOPMENT.

The peasant household is the basic livestock production unit. The inventory of animals per household is very small, and, although not every household owns animals, many non-owners are engaged in animal caretaking arrangements. Most animals are tended individually, and "herds" are not encountered outside a very few PVO cooperative establishments or commercial enterprises such as dairy herds. Pasture or rangeland relegated solely or primarily to livestock grazing is virtually nonexistent in the targeted watersheds. Instead, there is a complex system for feeding livestock, which involves tethering along paths and other noncultivated areas; cut and carry of native forage plants, and use of crop residues, either by grazing in the field after harvest or by cut and carry. Most areas appearing as pasture or rangeland are fields in between plantings of crops. This short-term fallow is usually a period of only a few months.

The small farmer livestock holder has developed an intricate system of agriculture which, in his viewpoint and experience, is the best insurance for meeting the food and cash needs of his household. Due to the extremely small amount of land available to the average farmer, there is little margin for error and risk-taking. Production of various crops is the first priority for both land use and labor allocation, and livestock assumes a secondary place. It is therefore unrealistic to recommend removing sizable areas of land from agricultural crop production in order to establish grazing areas, even though this might be the best resource use. At the household level, the vast majority of peasants do not have adequate land to allocate solely for grazing; at the community level, the complexity of the land tenure and use system would be a major obstacle to overcome. Even on "state" lands, a wholesale decree transferring land into grazing areas would deprive peasants of their subsistence base.

If it could be demonstrated that some of these marginal lands could produce greater returns to the peasant farmer under livestock production than under subsistence crops, it might be possible to promote a land-use change. However, it would be unreasonable for the peasant to attempt this transition without the assurance that he will not have to absorb the short- or mid-term risks. Nor can he assume the mid-term risks such as disease or falling market prices. Facing such risks, he will undoubtedly elect to continue current practices. There is also great danger that in establishing a land-use change, the small farmer will be forced out by a combination of state decrees and wealthier individuals or groups who can afford to invest in such an operation.

The ultimate success of the project will be determined by the true adoption of appropriate technology at the small farmer level, and not simply by temporary compliance during the life of the project, when additional money and support are available. Practices that are perceived, either intuitively or from demonstrations, to be of direct benefit and economically feasible to the individual peasant will probably be adopted. This realization is crucial if one considers that even over a ten-year period, only a small percentage of the entire watershed can be actually impacted. Thus the long-term success will depend on transfer of the technology from peasant to peasant.

If the technology transfer is to be made at the peasant level, one must understand why he does things the way he does, and what criteria are used in his decision-making. The new technology must fit into this system. A

critical aspect of any additinal work task (cutting and storing forage as hay or silage, for instance) must take into consideration the availability of labor at the required time.

Land tenure and use relationships are an important controlling factor in the peasant farming and animal husbandry strategy. It will be necessary to define these relationships and to understand how they affect decisions regarding the suggested technological interventions.

One of the major advantages of working within the Haitian livestock sector is that people want to have animals. Whether or not the "walking bank account" concept is economically sound might make a worthy academic debate, but it is currently an integral aspect of the peasant economy. The strong preference for animals will surely be a useful focal point for technology transfer.

EXTANT LIVESTOCK MANAGEMENT IN THE WATERSHEDS

Types of animals held. In typical Haitian peasant survival strategy, the small farmer maintains as wide a diversity of livestock as possible. Livestock types currently available in the targeted area include beef and dairy cattle; goats and sheep; horses, mules, and donkeys; assorted poultry; and rabbits. Swine, a former favorite of the Haitian farmer, were eradicated from the country as a result of an African Swine Fever epidemic, but an intensive repopulation effort is well under way. Numerous Secondary Multiplication Centers are established within the project area and the progeny of these animals are now beginning to reach individual peasant farmers.

Although diversification is the general rule, there is a variety of husbandry specialties. Preferences for one type of stock over another can be dictated by financial resources, success in former husbandry endeavors, access to animals, and other factors. Specialties include, for example, the use of horses, mules, or donkeys if the owner is engaged in various rural transport activities.

With respect to livestock breeds, the Haitian animals are a unique melange that has evolved over time from a combination of introduced stock and the natural selection of the Hatian environment and livestock management system. The appelation of "Creole" varieties for both cattle and goats is indeed appropriate. There are also an important number of pure-bred and cross-bred exotic stock in the country. These include Zebu (*Bos indicus*) as well as a variety of dairy breeds, including Holstein, Jersey, and Brown Swiss. Alpine and Nubian are the preferred exotic goat stock.

Number of animals held. The absence of reliable livestock statistics in Haiti is well known. For this report, and the projections of the benefits and costs of the recommended implementation, average livestock holdings are based on 1982 census data. Specifically, the numbers are derived from the Department of Grande-Anse, which lies immediately to the west of the proposed project area. These data are presented in Table 1. Table 2 gives the results of a survey conducted in Dubreuil in the Cayes Plain basin. Using the Grande-Anse census data and assuming a total number of households in the targeted watershed of 75,000, from a total population estimate of 375,000, Table 3 presents the total estimated population of livestock for the project area.

TABLE 1
LIVESTOCK STATISTICS FOR THE DEPARTMENT OF GRANDE-ANSE, 1982

TYPE OF ANIMAL	NUMBER	SUBTOTAL	AVG/HOUSEHOLD*
Cows	14,705		
Bulls	44,371		
Subtotal adult bovines		59,076	.67
Goats (male)	45,385		
Goats (female)	101,689		
Total Caprines		147,074	
Estimated No. Adults		51,476[1]	.58
Sheep (adult)	2,401		.03
Sheep (young)	4,530		
Total Sheep		6,931	
Horses	16,000		
Mules	9,579		
Donkeys	10,062		
Total Equines		35,641	.25
Estimated Total Adults		22,454[2]	
Combined Poultry	359,590		4.07

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*Total number of households = 88,431

[1]No distinction was made in the census report between adult and subadult goats. Sheep were so enumerated, and only 35% were classified as adult. This same percentage figure was used to estimate the number of adult goats.

[2]Equines were also not differentiated by age class. An estimate was derived from the bovine age distribution, in which 63% were adult.

TABLE 2
LIVESTOCK HOLDINGS PER HOUSEHOLD* FOR DUBREUIL

TYPE OF ANIMAL	NUMBER	AVG/HOUSEHOLD
Cattle	35	0.51
Goats	34	0.50
Sheep	38	0.56
Equines	16	0.24
Poultry	132	1.94
Rabbits	64	0.94

* The number of households is 68. The data are from J. Jaffe (1985).

TABLE 3
ESTIMATED LIVESTOCK NUMBERS IN THE TARGETED WATERSHEDS

TYPE OF ANIMAL	ESTIMATED NO. OF ADULT ANIMALS	ESTIMATED NO. OF ANIMAL UNITS (UBTs)
Cattle	50,250	50,250
Goats	43,500	8,700 *
Sheep	2,250	450 *
Equines	18,750	18,750
Total Animal Units		78,150

*Five sheep or goats are equivalent to Animal Unit.

If these numbers are considered in terms of the total area involved--approximately 110,000 hectares--the stocking rate is .71 Animal units per hectare.

Systems for the control of livestock.

(1) ***Tethering.*** Because the average farmer maintains a small inventory of animals, he is able to devote a considerble amount of time per head of livestock. As a result of limited landholdings and substantial penalties for trespassing onto neighboring lands, tethering of animals is the prevalent system of confinement. Although some reports claim that the animal is moved several times a day, movements are more probably related to the proximity of the person to the animal. If the animal is kept near the house, it might well be moved several times. If it is tethered along a path to a distant field, it will more likely be tied on the way to the field and brought back to the compound toward the end of the workday. In addition, the longer the rope, the less frequently the animal must be moved. Watering of livestock is generally accomplished during these moves.

This intensive system of husbandry can be beneficially exploited in

management improvement programs. If, for example, stock handlers are better trained to observe when females are ready to breed, or are due to parturate and should be closely watched for possible complications, or to recognize certain maladies, this habit of personal daily attention to each animal will be a substantial advantage. The major disadvantages of the tethering system is the occasional loss of an animal by strangulation or broken neck, the infrequest access to water, and sometimes the poor quality of feed within reach.

(2) ***Free-ranging.*** Occasionally goat and sheep can be observed running free. Considering the penalties that can be imposed for damaging neighbors' crops, this is not a frequent sight. Some individual animals do exhibit tendencies not to roam widely and stay near the compound, and it is suspected that these are the ones seen running free. It is quite likely, too, that at certain seasons when native forage is abundant or crop residues are available in fields between plantings damage to agricultural crops is rare. No cattle were observed to be free ranging in the project area, possibly due to the value of these animals. All classes of poultry were commonly seen free ranging.

(3) ***Yokes.*** Goats and sheep can often be seen fitted with triangular wooden neck yokes, in and around villages. This allows them to forage freely along roads and other areas, but prevents them from entering fenced garden or field plots.

(4) ***Herding.*** This method was noted in some reports, but was not observed in the targeted watersheds. There are no major livestock owners in the upland areas, and no form of community herd seems to exist.

Commercial operations. Within the project area are several examples of capital-intensive operations. These include several small dairy farms and least one irrigated pasture. These operations are invariably situated in the Cayes Plains area and are not directly germane to the task of protecting the soil and water resources of the steep slope, upland areas.

Small farmer participation in animal husbandry. There appears to be no separation of livestock ownership or husbandry in the small farmer household. Animals can be owned by either men or women, and are cared for in various combinations by men, women, and children. Although women do not lead animals, they probably participate in cut-and-carry feeding practices.

There are people who hire out to trek animals long distances to markets such as Port-au-Prince. Others, who do not own livestock or who have the time but not the capital to invest in additional animals, may enter into a sharecropping arrangement with a livestock owner. In this arrangement, the sharecropper tends the animal, moving it to forage sites and water, in exchange for a portion of the profits when sold, around 50 per cent or for the second offspring produced. In the case of cattle, this would require a minimum of five years. This fact is significant because it reveals that livestock activities can be viewed as long-term investments.

Breeding programs. Livestock breeding in Haiti, with the exception of the major swine and goat improvement programs, is one of the significant weak links in the overall production system. Breeding systems can be divided into three categories.

(1) ***Traditional mating and selection.*** Traditional breeding practices display a considerable degree of ignorance. Many farmers either do not recognize when animals are in heat, or do not take special steps to insure that they are bred; virtually no castration is practiced; deliberate weaning to recycle females is not practiced; and inbreeding occurs frequently.

Certainly not all small farmer breeding and selection criteria are haphazard. Discussions with several men at the Chantal market revealed that there is selection for size, certain other conformation traits, and even the quality of offspring produced by [illegible] matings. At the same time, however, personal preferences for such traits as hair color were also mentioned. Thus, since only a limited number of traits can be selected for in a specific breeding program, and not all traits are compatible, it is unlikely that any beneficial progress is being achieved. Furthermore, culling is not practiced according to progressive breed improvement techniques, but more likely as a result of short- and mid-term economic necessities.

Although this is an area where substantial improvements can be made, at least at the local level, over the long term, an essential prerequisite to implementing any specific program will be a better understanding of the criteria and exigencies that are presently in operation.

(2) ***Improved breed stud services.*** Numerous organizations maintain one or more studs of exotic breeds, including Zebu, Holstein, Brown Swiss, and other beef and dairy breeds of cattle. Alpine and Nubian seem to be the common introduced goat breeds.

A typical operation consists of a PVO cooperative unit that has a stud bull at a central location, to which members can bring their cow to be bred. Since no systematic records of progeny performance could be found, an evaluation of the real benefit from these programs is not possible. It is reasonable to assume, however, that even if genetically superior capabilities are being transmitted, the characteristically poor nutritional regime would preclude substantial expression. It is recommended that the organizations concerned institute a program to record substantive data that can be used to evaluate the programs. Ear-tagging of the female and offspring, together with period height and girth measurements and general observations on the next generation produced would constitute a minimal program. It would probably be necessary to provide a modest incentive such as veterinary treatments for the farmer to bring his animals back for subsequent measurements and ear-tagging.

(3) ***Major animal improvement programs*** - The Swine Repopulation and Winrock Goat Improvement Projects are two major breeding programs well established in Haiti. The swine program is literally repopulating the country with crossbred US-origin hogs. It includes identification (ear notching) and dispersed breeding programs for multiple generations, if project guidelines are followed. The Winrock Goat Project, based in the Central Plateau, is primarily producing crossbred bucks for distribution. It is less clear what long-term breeding program is planned once the bucks leave the production farm. Fewer than 100 animals have been disseminated.

Management of the new swine. As long as the repopulation project exercises control of the distribution via the Secondary Multiplication Centers, such management features as cement floor confinement houses, balanced rations

composed of local foodstuffs plus necessary additives, and planned breeding will be evident. Once the swine have repopulated sufficiently to appear on the local market, management practices are unpredictable, but one can assume that those who can afford the improved system or part of it will adopt it; others will revert to more traditional practices.

Livestock marketing practices. The vast majority of all animals and animal products produced eventually are sold for cash or transferred under sharecropping arrangements. Meat from all animals, even rabbits and chickens, is rarely consumed by the producer. Milk from lactating cows is occasionally used, but goats in the Cayes region reportedly were not milked. Livestock of all types are used as a depository for available funds, and possibly even as a method of accruing limited interest (i.e., growth). Animal holdings are not static, and some individuals engage in active buying and selling.

Chantal, in the Acul watershed, is a major animal market, receiving animals from as far away as Les Anglais. From Les Cayes, animals not kept in the locality are generally sent to Port-au-Prince. Live animals are shipped by vehicle or trekked the entire distance. Some carcasses are shipped via refrigerated truck.

Effect of tether grazing on forage resources. Tethering of individual animals is the grazing system most commonly used by the typical small farmer. Under the conditions of low animal inventory and small landholdings, and considering the absence of sizable rangeland areas or community herds, it is a reasonably adapted system.

The entire tether grazing and forage feeding system, however, is more complex than simply staking out an animal. It changes throughout the annual cycle depending on native forage supplies, residual crop and weeds in fields following harvest, and other crop by-products and residuals available for cut and carry. The precise pattern followed by a particular farmer with his livestock will vary according to the amount of land he farms or has access to; the particular cropping and harvesting schedule he is following for that year; the general density of neighboring households, farms, and livestock; the precipitation pattern for the year; and the moisture-holding capacity of the soils.

Most areas within the targeted watersheds, (with the exception of the lower Les Anglais region), receive sufficient rainfall each year to allow essentially continuous growth of herbaceous plants so long as the soil can provide water. The tethering system promotes more complete utilizaton of the forage because the animal is forced to consume all within its reach rather than selecting preferred and more palatable species. This was regularly observed in the field.

This uniform utilization, as opposed to selective feeding, has no doubt been instrumental in maintaining the forage resources in good condition, at least as far as impacted by grazing (as opposed to farming, burning, and other land-use practices). Under uniform utilization, favorite species are not overused, which eventually would lead to a decrease in their density. This is good forage management. The fact that the area is not overstocked obviously contributes to the satisfactory condition of the range as well. In an effort further to verify this observation, inquiries were made of local farmers as to whether better or different grasses used to be present. The negative replies suggest that preferred species are not decreasing, and the forage resources

are in a stable trend. In spite of this favorable review, it is possible that some areas are overused. Field visits during this study were made just after the rainy season, when most native species were growing well. Nevertheless, it is felt that overused areas are not extensive and are the exceptions. It is also believed that there is good potential for improving forage resources, particularly if better types of grass and legumes are introduced.

Effect of the foraging system on animal nutrition. General livestock nutrition in the targeted watersheds is inadequate and constitutes perhaps the most limiting factor to livestock production. This situation exists for two reasons. First, the native forage species are not especially nutritious, which is typical of many tropical settings. Second, most the crop residue is fed in too dry a state (essentially straw), which substantially reduces its nutritive value.

In addition, farmers accept a temporary weight loss in livestock during the dry season from December to February rather than practice better management alternatives, such as planting grass strips. Such an attitude, although it might seem reasonable to the farmer, is detrimental to the animal, especially if it is a pregnant female. The practice of storing forage as hay for the dry season was not observed or reported. One particular advantage of the tether grazing system is the minimal distance traveled by the animal. Free-ranging animals require additional feed each day simply to provide sufficient energy for movements. Another advantage of the regularly moved tether stake, when compared to a corral situation or to too-intensively used pasture, is the reduced opportunity for disease or internal parasite transmission.

Lack of free access to water is another major limitation on animal production. In some areas that actually have available water (e.g., a stream) access can be restricted by tether grazing. Thus, an animal might well be tied as little as five meters away from an accessible water supply and yet be allowed to drink only when being moved. In areas where water is not locally available the tether system has little impact.

AGRICULTURAL RESIDUES AND BY-PRODUCTS AVAILABLE AS FEEDSTUFFS.

A reasonably wide variety of agricultural residues and by-products is produced in Haiti. Many of these potential feedstuffs, nutritious in terms of digestible energy (i.e., carbohydrates), protein, and important elements such as calcium or phosphorus, can make significant contributions toward more balanced livestock rations. In a more practical sense, however, the expense and difficulty of transporting some of these products from processing facilities to the rural farmer, especially to the hillside farmers of the targeted watersheds, dictate that these products be separated into two categories: on-farm agricultural residues and by-products, and agro-industrial by-products.

Crop residues and agricultural by-products available on small farms. The residues and by-products of agricultural crops grown on or near the typical small farm obviously constitute the most readily available source of animal feedstuffs besides natural forage plants. Furthermore, these products usually do not cost the farmer anything other than the time to harvest them. For the most part, these materials include the dried aerial portions (stems and leaves) of such prevalent crops as corn, sorghum, various beans and peas, manioc, and sweet and starch potatoes. Certain fruit and tuber crop residues and wastes, such as citrus rinds and banana leaves and peels, are also

available. One product that appears to be underutilized in many areas is the green tops of sugarcane. The following list summarizes the on-farm by-products available and their value as livestock feedstuffs.

(1) ***Stover, haulms, and leaves.*** Residues from harvested plants, such as corn, sorghum, and beans. Usually low in both digestible nutrients (40-55%) and protein (2-4%). These materials, fed alone, provide only a low maintenance ration for ruminants and are virtually useless for monogastrics. If combined with protein supplements or small amounts of molasses or urea, these residues can form good roughage base for ruminants.

(2) ***Fruit and tuber byproducts.*** Bananas, plantain, yam, sweet potato, cassava, citrus and similar by-products are acceptable feeds for cattle and swine, but provide only medium-to-low feeding value (mostly as carbohydrate source) if unsupplemented.

(3) ***Brans, meals, and cracked grain residues.*** Products of household processing or village-based mills, these are the most valuable feed supplements available to the small farmer, providing excellent digestible protein and nutrient profiles. Since only small quantities are available, the most efficient use would be as short-term fattening rations for poultry or swine, or lactation rations for cattle.

(4) ***Sugarcane tops.*** Good ingredient for silage, but considerable quantities are destroyed when cane residues are burned.

(5) ***Poultry litter.*** Economical protein source available to the small farmer.

(6) ***Citrus pulp and rind.*** Suitable roughage material.

Although the majority of these crop residues is currently being utilized, these materials still constitute a major resource that can be improved as livestock feedstuffs. For example, corn stalks, if ensilaged, are slightly more nutritious and substantially more digestible than if fed in a dried state. Many of these materials can be fed in different combinations than are presently being used in order to provide somewhat more balanced rations.

Agroindustrial by-products. Many of the byproducts of Haiti's agricultural industry would provide excellent livestock feed materials. There are two reasons why these feedstuffs can be considered essentially unavailable to the small farmer of the targeted watersheds. The first is that the majority of these materials are derived from processing mills and plants in Port-au-Prince. The second is that many of these products can be exported to world markets as a source of foreign exchange. The net result is that the cost is prohibitive to the small farmer. A summary listing of the major agro-industrial by-products is presented below. Table 4 provides a 1983 estimate of the quantities produced annually in Haiti. Even though these materials are essentially unavailable at present to the small farmer, it may be feasible to develop certain concentrated feedstuffs required to balance rations and devise distribution system.

(1) ***Wheat Mill Feed.*** A combination of all wheat by-products: wheat bran, wheat germ, wheat middling and shorts. An excellent quality product, but subject to nutrient loss in hot weather if producers do not have proper storage facilities.

(2) ***Rice Bran.*** Also a combination of all processing by-products. Because of a high oil content, it must be limited to 10 percent of swine rations. The product also turns rancid easily and is difficult to store.

(3) ***Cottonseed Meal.*** Availability fluctuates with cotton production. In general of poor quality; it has a 30-35 percent crude protein content, high fiber and fat content; also contains high levels of toxic gossypol and aflatoxins.

(4) ***Peanut meal.*** Only small quantities are produced in Haiti; considered to be very low quality due to aflatoxins.

(5) ***Soybean meal.*** Excellent feed supplement, with 44 percent crude protein, but the majority produced in Haiti is exported for foreign exchange.

(6) ***Molasses.*** Good, economical, energy source, but generally exported for foreign exchange or used in the rum industry.

(7) ***Bagasse.*** Good, bulk roughage, which is widely available but generally not utilized.

(8) ***Brewer's grain.*** Protein source.

(9) ***Poultry and Large Animal Offal.*** When bio-fermented, can be used in feedlots to reduce the cost of concentrates.

(10) ***Cacao Pod Wastes.*** Does not seem to be used in Haiti.

(11) ***Coffee Hulls and Pulp.*** Does not seem to to be used in Haiti.

(12) ***Limestone.*** Abundant and high quality (38-40 percent Ca).

TABLE 4
ESTIMATED QUANTITIES OF FEEDSTUFFS AVAILABLE IN HAITI (1982)

Feedstuff	Estimated Quantity Available (metric tons per year)	Location
Wheat Millings	35,000	Port au-Prince
Rice Bran	10,000	Artibonite Valley
Molasses	15,000	Port-au-Prince
Soybean Meal	80,000	Port au-Prince
Cottonseed Meal	500	Port-au-Prince
Citrus Rinds	20,000	Many sites
Brewery Wastes	100	Port-au-Prince
Sunflower Cake	unknown	Port Dauphin/Jacmel
Wet Cocoa Pods	30,000	Cap Haitien
Sugarcane Bagasse and Top	unknown	Many sites

Nutritional Values of Available Feedstuffs. Improved nutrition of livestock through the design of better feeding rations is central to the success of the livestock component of this project. Since the availability of feedstuffs

changes considerably throughout the year, and to a lesser extent with different geographical settings even within the project area, this will entail an innovative and coordinated juggling act. The objects to be juggled include natural forage plants + improved forage grasses and legumes + local farm crop residues + conserved feedstuffs (hay or silage) + essential nutrient additives and concentrates from ag-industry by-products.

The near-term goal is not necessarily to achieve completely balanced rations. Rather, it will be a significant step simply to improve the status quo. In particular, efforts can be directed to formulate more specific rations for different classes of animals, such as a better maintenance ration for the dry months; a lactation or gain ration; or a ration for monogastrics. There is a substantial amount of data available concerning the chemical and nutrient analysis of these feedstuffs but little work has been done in Haiti prior to an ongoing project conducted by Florida A & M University. There are considerable variations in the results of the proximate analyses of feedstuffs. Accordingly, it is recommended that systematic analyses be conducted of the feedstuffs in the project area prior to final ration formulation.

There is another sideline to this development of improved feedstuffs and better rations. Data from the ADSII questionnaires indicate that many farmers do purchase or sell feedstuffs. Thus, the possibility exists that new cash crops might evolve as part of an expanding livestock industry. This possibility should be kept in mind during project development and implementation.

RECOMMENDATIONS.

The remainder of this annex presents recommendations to improve livestock production within the scope of the project. Explanatory comments are included to better define the basis of the recommendation.

Baseline data and research. The paucity of reliable data in Haiti is well known. Basing major implementations or specific components on estimations or extrapolations from other geographic areas will undoubtedly limit the success of the overall project. The following items are perceived as the minimal, but essential, requirements for new information derived directly from the watersheds.

(1) *Land Use.* At present, human population estimates for the project area can only be derived from regional censuses. Detailed land use data are not available, and the most reliable data base, the 1978 aerial photographs, will be at least eight years old before the project begins. Livestock holdings can only be estimated based on the average number of animals per farm household. The distributions of people, land-use practices, and animals are only known in the most general sense.

Land use information is essential for several reasons. The design and eventual expansion of appropriate solutions from trial sites to the entire watershed will require site-specific land-use and demographic information. Two examples can be given: (1) adjusting the seasonal stock rate of animals is a sound practice to maximize use of forage supplies production during the rainy season. In order to exploit this technique, areas of livestock concentrations must be

identified as a source of stock; (2) sugarcane residues provide an excellent base for livestock rations, but most of this residue is not being utilized effectively. If upland cane fields are located, and the quantities of residues determined, this can serve as the focal point of a local farm livestock system designed to promote the use of this locally available resource. Finally, any activities designed to monitor the progress of the project will necessarily require an accurate geographic data base.

It is recommended to acquire these data via a proven aerial survey technique developed by the International Livestock Center for Africa (ILCA) and other workers in East Africa. This method uses a low-flying aircraft and specially trained crew to observe and tabulate such land use data as current crop, number and type of dwellings, water sources, types and age classes of livestock, access roads and other parameters. Data are collected along a systematic grid, and are suitable for statistical analysis and thematic map presentation. Additional ground truth can readily be incorporated. Due to the relatively small size of the project area, it is further recommended that 100 percent of the area be surveyed.

(2) *Socioeconomic Baseline Data.* If modifications in existing farming and livestock practices and new techniques are to be successfully introduced, it is essential that technical discipline specialists have a clear understanding of how and why current practices are used. In other words, what might make sound technical sense might be completely impractical for the local farmer. As a single example, some farmers do not want larger litter sizes of swine because they do not have the time or resources to feed and care for them. The following have been identified as data deficits. It is emphasized that these data must be specific to the targeted watersheds.

(a) *Attitudes of small farm livestock holders.* It is widely reported that Haitians use animals as living bank accounts, but what specific attitudes and reasons result in decisions to buy and sell, and to select animals? Such data will be necessary to evaluate such possibilities as seasonally adjusting stocking rates in a coordinated manner, or determining if increased lactation capabilities in cows or goats will or will not be advantageous. If surplus production of superior animals, i.e., the amount not required by the nursing animal, is not milked off daily, it becomes a liability, in terms of both the extra forage required and the health of the animal.

(b) *Traditional animal breeding.* Although random, uncontrolled breeding is prevalent, some livestock holders do select for specific traits of interest, such as size, the quality of previous progeny, and hair color. A better understanding of traditional practices and preferences is a prerequisite to introducing new genetically sound practices.

(c) *Marketing networks, strategies, and values.* Seasonal adjustments of stocking rates not only require a source of animals, but also a market that can absorb the off-take at the proper time. Any recommended forage or livestock production improvement practice will be carefully considered by the farmer in terms of his costs and the anticipated returns. The primary justification for this particular survey is that the costs and

benefits from the farmer's viewpoint will likely differ from the technical costs and benefits. Since we can expect the farmer to make decisions from his experience, or perhaps alter them if the project can demonstrate the advantage in terms the farmer can relate to, this survey is essential. Another factor to consider is the timing of economic decisions throughout the annual cycle, or even longer term periods. This survey must address the networks and strategies involved, not only the prices.

(d) *Agricultural cycles (crop calendars).* Information on agricultural cycles, compiled at the local level, based on environmentally stratified samples, is essential if efficient used of crop residues for more balanced livestock rations is to be accomplished. Different areas within the watersheds vary in the dates and crops used in the crop calendar. Farming and livestock systems will have to be tailored to each of these variations if optimal use of the residues is to be achieved.

(e) *Analysis of Labor Resources.* There is a labor shortage during many times of the year. New practices recommended during this project will be much more acceptable to the farmer if the work does not compete with his usual, and perhaps more important, activities. For example, planting and weeding corn is undoubtedly more important than feeding a third or fourth goat. Thus, not only must a new technology sound reasonable to the farmer and provide an augmented return with no additional risk, but he also must have time to undertake the activity. It is assumed that much of the labor- demand data will be elucidated during the survey designed to identify local cropping sequences. A fully detailed time-allocation study is not required. Rather, what must be determined are the times of the year that are available for new activities, and whether it is possible during periods of more intensified labor to add other minor, but regular, chores.

(3) ***Applications Research.*** Several kinds of information must be generated under actual site-specific field conditions. These conditions include the physical environment (soil type, micro-climate, etc.), as well as certain social practices that are central to acceptance of the mew technology. It must be obvious that no appropriate technology for sustained conservation of the watershed will be adopted if it does not work. Furthermore, improper selection of the "best" species, or mistaken estimates of actual production, if too frequent during the initial phases of the project, might have time to be redone, but the credibility gap between farmer and technician might well be irresolvable. The following applications research activities are recommended in order to minimize the chance of major technical errors during implementation.

(a) *Seasonal nutritional analyses.* Variations in soil fertility, length of time that crop residues (e.g., corn stalks) remain in the field, the maturity of a natural forage grass, and many other factors affect the actual nutrient content of the forage. These factors dramatically change palatability and digestibility as well as the actual crude protein or energy value. If an objective of this project is to make the best use of these materials to improve the nutritional regime of livestock, such data are essential. They can be used not only to select the best mixture of available materials, but to recognize where minor changes in harvest timing or practices might make significant contributions. For each ecological type identified within the various farming systems, samples of

all plant materials used as animal feedstuffs should be analyzed for nutrient content and digestibility for the primary classes of animals. Samples should be collected throughout the annual cycle.

(b) *Storage of Feedstuffs.* Storage of surplus feedstuffs for use during periods of forage scarcity is one technique central to the goal of improving livestock nutrition. Plant materials can be stored either as hay or silage. Although the technology is not especially difficult, it is a major depart[illegible] from well-established Haitian practices. Accordingly, it is recommended that sufficient adaptive research and trials be undertaken to insure the best possible chance for the ultimate adoption of this new technique.

(c) *Trials and demonstrations of forage species.* In order to produce sufficient seed and plant materials for reproduction, nurseries will have to be established. Some of these might be in the irrigated Cayes Plains, to maximize production, but trial sites must be directly analogous to the specific areas intended for establishment. It is recommended that a minimum of 100 sites be selected. These need not be large areas: plots 10 x 10 meters should be adequate for evaluations of from three to five of the species considered most appropriate for the setting. Numerous small sites are recommended in order to increase the range of conditions that will be encountered.

Probably the best way to acquire the test plots is to locate lands during preliminary field surveys (or during the proposed soil survey) that are reasonably accessible, and arrange to rent the plots. This is not considered a participation incentive payment because the farmer will actually be taking land out of production to allow the trials. It will probably be necessary to fence these plots. In addition to species suitability testing, plots should be arranged so that preliminary data on actual production can be measured--both total annual yield and maximized yield with cutting every 30 to 40 days. Obviously, grazing trials will not be possible at this stage. Eventually these plots, or expanded plots, can be used to evaluate pasture mixtures and perhaps yield with fertilization. Even legumes might need an initial boost with phosphorous and potassium. This should be evaluated in the field trials.

Beyond the purely research aspects of these trials, the plots should be used from the start as demonstration activities designed to involve the local community directly. This will be the first opportunity to begin local extension work and to establish a working relationship between the project and the peasant.

Recommendations for improved forage plants. The native forage plants in Haiti seem to be of low nutritive value, however, scientific investigations have not been conducted. While these proximate analyses should be undertaken in order to provide a sound basis for ration formulation from available feedstuffs, two facts are already evident: (a) the biomass productivity of the native species is not impressive; and (b) the land-pressure situation dictates that any major improvement in livestock production (which will absolutely require a better feeding program) will have to be founded on either intensive pasture-type management or on even more intensive cultivation of small forage areas. Accordingly, it is recommended that the most appropriate forage crops--many of which have already been introduced into Haiti--be selected. Since forage crops

provide excellent ground cover, such a recommendation is well in line with the conservation objectives of the project. Prior to itemizing plant species that can be used for these dual objectives, several fundamental tenets of pasture management and/or forage production should be understood:

- Improved forage species with high yield potential are characterized by their ability to effectively utilize the elements of the environment. Most of the grasses, however, require nitrogen for maximized yields (Molasses grass is a notable exception to this). Few soils of the Caribbean have been capable of producing high forage yields without fertilization. Where soils are acidic, liming may also be required.

- If legumes are incorporated in the stand, nitrogen requirements decrease, but higher levels of phosphorus and potassium are required. Shallow or sandy soils tend to yield less biomass because of moisture deficiences during the dry seasons. (Guinea and Star grasses are best adapted to this condition.)

- The type of pasture management system is another production variable. Under zero-grazing (i.e., cutting or mowing). Napier grass produces the highest yields, followed by Guinea, Star, and Pangola. With grazing, stargrass is preferred because it establishes quickly and is high yielding, easy to manage, and resistant to insects. Guinea grass is also better suited to grazing than cutting. Other grazable species include Napier, Pangola (which is sometimes severely attacked by insects), and Molasses (which is suitable only for grazing).

- Mixed stands of grass and legume are often difficult to establish and maintain. Usually the grass predominates after a few years even with good management, and the legume must be replanted.

- Direct grazing of forage grassed by livestock will provide better nutrition for the animal than will cutting, and especially hay-making. Although it will not be possible in all situations (especially where grasses are planted on dirt terraces within agricultural fields), direct grazing should be the harvest method of preference. An additional benefit of grazing is that nutrients can be more easily returned to the soil in the form of feces and urine.

Many other aspects of improved grass and grass/legume pasture management affect the yields for forage and rate-of-gain of livestock in the tropics. The publication by Vicente-Chandler et al., Intensive Grassland Management in the Humid Tropics of Puerto Rico (1974) is at least one reference that should be carefully consulted.

Numerous other studies and projects involved in improved forage production were identified during the course of this assignment. Among them are the AGRO 21 Program in Jamaica, the CARDI projects in Barbados and other Caribbean islands, and more recent investigations conducted at the Agricultural Experiment Station in Puerto Rico. It is strongly recommended that coordinated visits be made to these and other pertinent projects dealing with forage production in the Caribbean to assess fully the current state-of-the-art before final implementation of the project is undertaken.

(1) *Grasses for Improved Forage Production.* Table 5 (at the end of the annex) summarizes the characteristics of eleven species/varieties of

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grasses that should be appropriate selections for improved forage production in the project area. Most of these grasses have been introduced into Haiti but have not been systematically tested and developed for forage programs. The table provides information on basic physical requirements (rainfall, elevation, soil types, etc.); on the most suitable management system(s); on dry matter production with and without fertilizer; and on such other subjects as propagation techniques, susceptibility to pests and diseases, etc.

The most appropriate grasses for the predominant conditions in the watershed include both Star and Coastal Cross-1 Burmuda grasses; Napier grass (Merker variety); Caribbean Guinea grass; and Molasses grass. Other likely adaptable grasses include Pangola and Guatemala grass. Species that might be required for special situations (heavy clays, waterlogged conditions, high elevations, and semi-arid zones) include Common Buffel grass, Kikuyu, and Brachiaria decumbens.

Although Vetiver is a grass commonly cultivated for thatching material and/or its root oil, and it has been used in contour strip plantings for erosion control, it is not a species highly recommended for the hillsides. Even though the erosion control plantings are not reported to be harvested for oil (which entails digging out the roots), it is likely that economic necessity will eventually promote such a harvest, thus destroying the conservation benefit.

(2) *Legumes for Improved Forage Nutrition and Soil Fertility.* Table 6a (at the end of this annex) summarizes the characteristics of eleven species of leguminous plants that are suitable for planting trials at various sites within the targeted watersheds. The data are presented using the same format as for the grasses; physical requirements, management systems, biomass production, and other salient facts on propagation, etc. Among the most promising of these legumes, based on results in other areas, are Leucaena leucocephala, Tropical Kudzu, Siratro, Centrosema, several species of Desmodium and Stylosanthes.

Leucaena, an extremely versatile plant, appears best suited for the lower elevations (500m) on alkaline soils. it can be adapted to acidic soils with the appropriate Rhizobium inoculation, and should be evaluated for higher elevation suitability. The possibility of competition with herbaceous plants (including crops) for soil moisture in shallow soils also should be determined. Leucaena is known to have a toxic compound, mimosine, which can limit its use as feed for ruminants and especially monogastrics. Tropical Kudzu, Siratro, and Centrosema are all climbing legumes that reportedly mix well with tall, upright grasses such as Napier and Guinea, although fertility/productivity trade-offs should be recognized, as discussed previously. Several species of Desmodium, a palatable and nutritious shrub, might well prove to be the most useful legume, either in mixed stands, as coppiced hedgerows, or protein banks (for grazing or cutting). These plants are adapted to acidic soils and higher elevations. Velvet Bean, a weak perennial, might be appropriate to assist in the initial establishment of grasses on poor soils, as a green manure crop or as a forage species.

Table 6b lists (at the end of this annex) sixteen other leguminous species that the CARDI Forage Legume Project feels are promising plants for more intensive goat production (and presumably other livestock as

well) in the caribbean.

In general, legumes such as Lablab (Lablab purpureus or Dolichos lablab), which can be used for human food as well as livestock feed, are not recommended at this time.

(3) ***Recommendations for Grass and Legume Forages for Each EMZ/Soil Type.*** The previous tables in this section present selected species that are suitable as improved forage plants for the proposed project area. Table 7 (at end of this annex) provides recommendations for initial forage establishment trials for each of the general soil types identified within the Environmental Management Zones (EMZs). The recommendations are based on such physical characteristics as elevation, percent slope, soil texture, level of fertility and water holding capacity, and land management/use objectives. For instance, on highly fertile, flat slopes, the primary use should be for agriculture. A limited secondary use might be for irrigated pasture. In the case of the black clay, saturated soils, the grass Brachiaria and legume Desmodium gyroides are two of the plants suggested because of their tolerance of waterlogged micro-habitats.

In general, if the soils are at least moderately fertile and subject to moderate or low erosion hazard, their primary use should be for agriculture. On fertile soils, more subject to erosion, agriculture with contour forage strips is recommended. In addition to these parameters, the kind of management system (i.e., grazing; cut-and-carry or zero-grazing; use as green chop, hay, or silage; and whether forage should be monoculture grass or protein bank, or mixed grass/legume pasture) are all variables considered during the selection of the forage species.

It must be emphasized that these are only initial forage trial plot recommendations, based on limited data for both the plant species and the physical setting. Additionally, the examples of management options can be considerably expanded and refined.

Farm Management Systems. The following recommendations are designed to improve the overall efficiency of peasant farm animal feeding. Although the current system of livestock feeding is diversified in its attempt to maximize the use of available materials, substantial improvements may be achieved by (a) introducing small areas of forage plantings that can yield better quantity and quality of feedstuffs; (b) more closely coordinating the utilization of all feedstuff available, both natural forage plants and crop residues; (c) introducing storage systems to conserve surplus production for other periods of scarcity; (d) combining these materials to provide more balanced rations. There is another system that can possibly be introduced to utilize better the poor crop producing upland areas: changing the land use pattern to open grazing land. This would entail the organization of community cooperatives, and is discussed under the heading: Hillside Livestock Producers Associations.

(1) ***Small Farm Livestock Holders.***

(a) *Current utilization of wild & cultivated plant resources.*

The current system of livestock feeding which utilizes a combination of wild forage and crop residues with a predominant tether system of confinement is well adapted and diversified under the current level of technology. There is a substantial amount of cut and carry feeding, and as noted previously, the tethering system promotes more complete (rather

than selective) use of all forage species within reach. Table 8 (at end of this annex) summarizes the major crop and wild forage types available, seasonal variations, current livestock management systems and recommendations for improvements.

A variety of crop residues available at the small farm are used as livestock feeds. A partial list, emphasizing the more important crops includes

- ***Corn and sorghum stover.*** Generally available at different times of the year; fed in overly dried state (because grain is left to dry on the stalk as long as possible); provides a low maintenance ration for ruminants only.

- ***Legume hay (bean, peanut & pea).*** available during many times of the year, but only in small quantities and in too dry a state; minor supply of crude protein.

- ***Potato vines.*** only small amounts, but availabe in a fresher (green) state.

- ***Fruit tree byproducts.*** Banana peels, leaves, possibly small amounts of spoiled fruit; citrus peels; mango seeds with fiber; etc. Only small quantities provided per animal; minor contribution to nutritional profile.

- ***Sugar cane tops.*** This basic maintenance roughage material is underused in the plains where it is grown extensively; but probably moderately well used in the uplands where smaller quantities are available.

In order to maximize utilization and nutritional benefits of small farm crop residues, it is recommended to acquire the following data: (1) a complete identification of all plants used for animal feeding; (2) a systematic survey of the distribution of these plants in the watershed, along with estimations of abundance; (3) the seasonal availability of the residue material; and (4) nutritional analyses, used to develop the most balanced ration possible.

(b) *Augmentation of Forage Production.*
The year-long availability and quality of livestock feedstuffs is inadequate to maintain a good nutritional profile. Although some adjustments can be made in combining currently available materials to provide more balanced rations (e.g., providing the more nutritious legume residues to gestating or lactating animals rather than those requiring only maintenance diets), or in conserving materials during surplus production periods, significant improvements can only be made by augmenting forage production. This can be accomplished by contour planting grass and/or legume strips as part of the crop system. The potential of this recommendation are illsutrated by the following calculations:

(1) The minimal production of the grass species recommended in Tables 8 through 10 is approximately 10,000 lbs/acre or 25,000 lbs /hectare of dry matter (D.M.) per year with no fertilizer. (2) If 0.10 hectares were converted to forage grass, 2,500 lbs. D.M. could be produced per year.

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(3) Assuming a large cow 1000 lbs (450 kg) would require 25 lbs D.M. per day, the new grass would provide feed for 100 days.

For the average small farm livestock operator, this should more than supplement the existing feed supplies, thus maintaining a more consistent nutritional plane.

A major advantage of this recommendation is that grass planting is already practiced in several scattered areas throughout the watersheds. Plantings of vetiver (grown for oil, thatching), Napier, and Guinea grasses were observed. Some of these (i.e., vetiver) are planted as combination cash and soil conservation crops. The other species were planted primarily for forage. Although many of these plantings were accomplished under the auspices of government or private sector programs, several appeared to be individual initiative. Furthermore, according to ADSH project data, 60 percent of the 60 people queried at Maniche practiced some form unspecified of forage cultivation; 67 percent of those actually planted forage. Although these numbers may not accurately represent the population of the targeted watersheds, it is clear that forage cultivation is known to the inhabitants, and efforts should be made to expand the practice. Some people reported buying or selling forage crops. Thus, the possibility exists for another cash crop. The site specific details including species selection, management system and attendant extension need to be defined by the project.

(c) *Matching Forage Production with Livestock Numbers.*
Assuming that maximum utility is being made of the various crop residues locally available, some additional improved forage is being produced, and the most judicious ration mixtures have been determined, there are only two other methods for regulating the optimal carrying capacity: (1) adjust the number of animals to the seasonal availability of forage, (2) conserve surplus seasonal forage to be fed out during periods of shortage.

Adjustments in the Seasonal Stocking Rate. There is a considerable amount of buying and selling of animals for a multitude of reasons, most having to do with the current need for cash. (Commonly cited reasons include rent payments, funerals, school tuitions and supplies, etc.) There is also a certain degree of what might be considered as speculation (short term holdings with the hope of making a quick profit). Because of these practices, it may be possible to promote the concept of buying additional animals when forage is plentiful, and selling when forage is in short supply. The details of such a program will be rather complex, but could be a partial solution for at least some livestock operators. Some of the variables that might contribute to this system include: (1) differing dates of crop maturity within the watersheds especially considering sugar cane harvests (2) the ability of some people to conserve surplus feedstuffs; (3) the entrepreneurial possibility of some individuals establishing pasture areas that will support additional animals, especially during the dry seasons; (4) the fact that some people will have surplus cash to invest. The possibility of a feedlot finishing operation established near Cayes might also contribute to this system.

This recommendation is based on the concept that these watersheds do not have to operate as a self-contained system. It is anticipated that if well nourished animals are sold off from this geographically small area, there will be a market between Les Cayes and Port-au-Prince; conversely, if there is a requirement for additional animals, there will be areas outside the watershed that can provide these.

Feedstuff-Storage Techniques. This is an new technique for the area, but one that can dramatically increase the livestock production. It simply entails the storage of forage materials produced during surplus periods and using it during the months of scarcity. Fortunately, there is a precedent for this practice in the storage of human foods by the local inhabitants. There are two techniques available for storing animal feeds: haying and ensilaging.

HAYING. Drying green cut forage into hay is diffcult in the humid tropics due to the heavy and variable rainfall and high humidity. This should be especially evident if one considers that the period of maximum growth, and thus the surplus forage production which should be conserved, is during the rainy season. Hay-making requires that 80 per cent of the moisture content be reduced by drying in the field.

For the small farm operation, however, this method is not entirely impractical, primarily because he or she is handling only small quantities. In practice, a small amount of material will be cut regularly, with the hope that a non-rainy day can be forecast. If, however, it does rain, all is not lost because that amount can be fed to the animals the next day as green chop (cut and carry). Drying of green cut forage can also be aided (especially if it is partially field dried) by spreading it out under a metal roof, which acts as a solar heat collector and drying oven. The metal roof should be a multi-purpose addition to the small farm (animal shelter; quarantine bay; rain water catchment). Once the hay is dried, it can be kept in mounded hay stacks preferably with some type of cover to protect from the rain and sun (such as overlapped banana leaves, etc.) to avoid wastage.

The method selected for storing surplus forage is a fundamental decision for the small farmer in terms of selecting the most appropriate species. (This is another justification for the trial plots). Coarse stem grasses, such as napier, although they produce large quantities of biomass and make excellent green chop or fair quality silage, are not suitable for hay. Pangola or Stargrass on the other hand do make excellent hay (Vincente-Chandler, et al. 1974:125-127). Management of grass for hay is similar to that for fresh-cut feeding (green chop). It should be cut on a 30-60 day cycle, but not allowed to overmature. In the case of the Haitian farmer, it would not be necessary for him or her to cut the entire grass strip at the same time. In view of the need to (1) feed fresh grass to the standing stock and (2) cut some quantity for drying as hay, it would seem more reasonable to cut along each strip in a step-wise progression.

ENSILAGING. This method offers certain advantages in terms of the nutrient content of the final product. The composition of silage is generally similar to that of fresh forage, although 10-20 percent of nutrients, principly carbohydrates, are lost in the fermentation process. (More nutrients are lost in converting green forages to hay than to silage). Certain poor feedstuffs (e.g., dried corn stalks) can be more digestible as silage. Furthermore, silage tends to be a very palatable product relished by livestock which promotes increased feed intake and growth.

Silage making in the tropics is not easy, and losses to spoilage can be high. These losses are dependent on the kinds of materials used, proper packing, and airtightness of the silo or pit. Ideally, a chopper is used for preparing the materials, although other techniques are possible. In addition to the initial cost of the chopper ($250 Brazil style; $750 India style) which could be absorbed by a large group of people who could all use it, the actual energy involved, either hand-powered or motorized, is substantial. Experience in Haiti by Winrock International with choppers has not been encouraging (Ed Geers, 1985, personal communication). There are several options concerning the actual structure used (silos; pits, ground trenches; surface mounds, cement bunkers; plastic bags; metal drums) but each has important advantages/disadvntages. This is an important area for appropriate technology research and development.

A very important consideration is matching the size of the pit to the number of animals. If the feed-out rate is too slow, the silage will spoil. If a pit or mound is used, a minimum of 20 head of cattle should be available. Approximately 1.5 cubic ft (or 90 lbs) of silage is required per cow day; 1.5 cu.ft per day for a 600 pound steer. In Haiti, this would certainly require a cooperative community effort. Long and narrow pits, if possible, might minimize this particular problem.

A variety of materials can be ensilaged. Vegetable wastes, citrus wastes, and cane tops ensile well to reduce dependency on costly grains. Other materials include pasture grasses, young growing weeds, fruits, and chicken litter. Molasses makes an excellent energy contribution to the mass. Napier grass produces good silage, as does Guinea and Pangola. Ensiling can be used to improve the intake of low quality roughage (corn and sorghum straw), especially with the addition of 0.9 percent Formic Acid as a preservative.

Because of the variations in products that can be used and in processes employed, sufficient testing of finished products should be done to ascertain the average nutrient value. Current applied research on ensilaging methods in the Caribbean is being done at the CARDI Station in Barbados and the Agro-21 Program in Jamaica.

The practice of storing feedstuffs for livestock, whether by hay making, ensilaging, or a combination of the two, is central to improving the annual nutritional regime of Haiti's livestock. As such, sufficient effort should be directed to this subject to develop truly practical and operational techniques.

(d) *Availability of Labor.*
The preceding discussion on improving forage and farm management systems to augment livestock production has recommended a variety of new, or expanded practices. These include planting forage species, buying and selling animals, and storing feedstuffs. Although these recommendations were based on careful assessment of peasant conditions based on available reports, discussions with knowledgeable people, and numerous inquiries of peasants in the field, success is by no means guaranteed. One of the biggest concerns is whether there is sufficient labor available at the proper time of the year to undertake these activities. For example, in Dubreuil, March does not appear to be a demanding month. Besides harvesting beans, there is no other major agricultural activity (i.e., field preparation, planting, or cultivating) scheduled. Accordingly, this might be an appropriate month for planting forage plants. Data from neighboring Chantal indicates that there is adequate available moisture in the ground during March, and then the main rainy season starts in April. Later in the year, November appears as an "open" month, so preparation of hay or silage for the Jan-Feb dry period might be feasible. This analysis does not, of course, take into consideration what non-agricultural activities might be involved. Nonetheless, baseline studies of the labor allocation, followed by analyses such as the above example, are essential if implementation of the new technologies is to be possible.

(2) ***Hillside Livestock Producers Associations (HILPAS).*** It has been suggested that the steep slopes should be used for grazing lands and livestock production rather than crop production. For soil and water conservation, herbaceous ground cover is more effective for erosion control than trees, in spite of the fact that reforestation seems to be the major activity directed at stabilizing Haiti's hillsides. In the Phillipines, it was observed that Leucaena trees planted at 1x1 m intervals actually increased erosion, but when planted with 3 m wide bands of leguminous ground cover on the contour, 100 percent protection was achieved. However, it is unlikely that peasants will convert their hillsides to forage plants without a direct return in the form of grazing their animals. Furthermore grazing of steep slopes requires careful management, lest trailing develop, or over-utilization occur, which can quickly lead to severe gully erosion.

An assessment of the project area with this objective in mind resulted in the following observations: (a) There are no open rangelands. Areas that have the appearance of grassland were invariably fields in a short fallow period (2-3 months, between the spring harvest and the fall planting season). Numerous inquiries of local residents confirmed this fact. Animals are allowed to use these "farmlands" between cropping periods, to graze on both crop residues and adventitious grasses and forbs ("weeds"). The only areas that might be construed as solely grazing land are a limited number of irrigated pastures in the plains, and a desert scrub (cf., *Prosopis*) vegetation type that occurs at the lower elevations near Les Anglais). (b) there are no "herds" of animals. The largest concentration of beef/dairy cattle observed was ten animals. Upon inquiry, it was learned that most of these belonged to different people. With goats and/or sheep, ownership groups tend to be a little larger, but 10-15 animals belonging to the same person is

quite uncommon. A more typical number of small ruminants is 3-4. (c) Animals are not free-ranging. With some exceptions, mostly around living areas, the animals are tethered. (d) Land-use is characterized by very small parcels of land (typically less than 1 ha.), under management by different people. A land-user in the uplands with 3-4 hectares is considered well off. Thus, even though there may be an "area" that might be better suited for grazing than farming, it will invariably have multiple users, and for some of these farmers, it might well constitute their only land holding. If a "decree" were made that certain classes of steep slope land could only be used for grazing, this would effectively displace many small farmers who do not own animals and/or who could not subsist on the production of a single animal, in favor of wealthier individuals who have adequate capital to invest in a small ranching operation. (e) The carrying capacity of unimproved, native grass pastures is estimated to be two to three hectares per tropical livestock unit per year.

Under these circumstances, developing a rangeland grazing program would be difficult. Nonetheless, since some of these lands could be better used -- at least ecologically -- as rangelands under a well-managed system, an effort was made to devise a possible solution to this dilemma. The result, after many iterations, is the Hillside Livestock Producers Associations. Since this idea, within the context of Haiti, is unique and new, the developmental steps, both in concept and implementation, are described below.

Problem Statement: Although certain land areas on the steep mountain slopes could be managed in an ecologically sound manner as rangelands, these rangelands do not presently exist as an entity that is not confounded by a crop land use pattern of varying intensity, and a very intensified (small parcel) land tenure system. Furthermore, even if the land were available, stocking the area with animals that could be managed as a herd would be difficult because of the disparate, small-livestock holdings and the inherently individualistic nature of the Haitian peasant.

Inquiries made at a major livestock market within the project area (Chantal) revealed several intriguing attitudes. Some hillside farmers claimed they had more forage available than livestock to use it. When asked what they could do to better utilize this grass, they claimed they needed more money to buy additional animals. The response made was that they did not need more money because they had an underutilized resource like grass. Why not allow somebody with an animal, but not enough grass, to use this surplus in exchange for a portion of the production?

This concept was expanded to include several adjacent land-users with very marginal crop land (some with land and no animals, some with animals but no land in this area, others with both.) "The Project" had not yet offered to contribute anything (especially cash) other than resource management advice. Interest by those in the discussions continued.

The question "How would the increased production be divided among the participants?" was easily answered by the peasants by expanding the well-defined concept of "Gardiennage" (share-cropping of animals) to this situation. When queried if they would be willing to re-invest, as a group, some of the "profits" into improving the operation (developing

a water source or renting an improved bull were suggested), the answer was affirmative.

In general, the attitudes and thoughtful replies suggested the possibility of pursuing this approach, and the Hillside Livestock Producers Association (HILPAS) was conceived. Since the idea of combining both lands and animals into a "community" management scheme is somewhat alien to the Haitian farmer (at least in practice), the task must be approached open-mindedly and slowly.

A crucial step is selecting those people who will eventually participate in these HILPAS. If initial inquiries and discussions take place at the livestock markets, this restricts the audience to those dealing with animals. Ideally, for those people (be they large or small operators) who have a knack for animals should be identified and approached. From these initial contacts, arrangements can be made to meet inspect the land for suitability, and meet the other potential participants. This becomes one of the first steps in the autonomous leadership of the HILPAS: The initial livestock market contact organizing a small, general meeting with his or her land-using neighbors.

After this initial meeting, additional organizational tasks will be suggested, and another meeting scheduled. This interim period will be used for the locality to begin to consolidate a HILPAS council, and determine who wants to participate (either with animals, land, or both). Several iterations of this phase might be necessary. The project will serve as a technical guide, but the interest and organization must be of local origin. As the organization develops, a survey needs to be conducted to ascertain land tenureship, at least in a general sense. This is necessary to avoid big surprises at a later date.

Once the organization seems established and operational, it will be time to prepare a detailed "range plan." This plan will include development of water points, pasture improvement (species), utilization of farm residues, feedstuff storage if necessary, carrying capacity and stocking rate management (including off-take schedule), and breeding programs.

Thus far, nothing has been spent other than the time of the specialist to assist in the organization of the HILPA. It is at this point that rewards or incentives might be appropriate to capitalize the implementation, such as developing a water point or supplying the grass. The mere fact of the organization arriving at this point, a new direction for the Haitian peasant, almost merits a reward. This incentive money would have to be used judiciously, so as not to jeopardize future work without compensation. For instance, if the project provided the grass, the members would have to agree to plant it on their own time. Another approach, if for instance, fencing is required to better manage the pastures on a rotational grazing system, is to offer credit, which would be scheduled for repayment as the investment matures. This could even include an additional incentive in the form of low interest rates, but the association members are still investing their time, and ultimately, their money.

The HILPA should be now operational, and technical management assistance will be the major input necessary. An example of technical assistance is devising and monitoring the appropriate grazing system.

This will likely be in the form of high intensity, short duration, or a modification of the Savory Controlled Grazing System. Multiple species grazing will probably be advantageous for better utilization and brush control. Veterinary treatments should be scheduled. Proper breeding methods can also be introduced, along with record keeping and possibly superior genetic stock.

It is recommended that 5-10 of these HILPAS be organized simultaneously in different portions of the project area. This serves two purposes: there is a wider developmental impact, and, experiences learned from each attempt at HILPAS organization will benefit the others. This concept might be appropriate, especially as a demonstration exercise, in the Pic Macaya buffer zone. Such a practice would undoubtedly be preferable to the possibility of dispossessing people from the fragile slopes by an official decree. It is highly recommended that the main thrust of the program is directly at the small peasant farmer, because this is the level that will ultimately adopt and utilize appropriate, economical methods long after the project is completed, thus achieving the goal of sustained conservation and production within the watersheds.

In summary, there can be little doubt that these slopes cannot be better conserved and productive under a well-managed, improved-pasture grazing system. The technological package is possible, but the implementation by the local peasant is a big question, principally because it is a radical social change. However, if this concept is developed slowly, with understanding and flexibility, it has a reasonable chance for success.

Recommendations for Improvements in Livestock Watering. Contrary to statements made in some reports, Haitian peasants do not believe that their animals do not require water. What they have learned in some cases is the minimum amount an animal needs to survive. If the animal happens to be feeding on lush green growth, they will be less inclined to walk it any substantial distance to water. Unfortunately, even though the animal might survive, this is not good animal husbandry. Thus the problem is not complete ignorance; the problem is a serious lack of water in many parts of the watershed at certain times of the year. A situation which imposes major constraints on animal health and production.

The solution is not simply to develop water points for livestock. If there is not adequate water for people, it can certainly be expected that they will meet their own needs from new water developments before tending to their stock. In spite of this dilemma the following recommendations can be made concerning techniques to provide water for animals. If these techniques end up providing enough water for both people and animals, then a truly significant accomplishment will have been made. If not, then a much larger infrastructural problem of providing water to the rural population will have to be addressed.

The availability of water can be an important factor in environmental balance. Opening new water points for livestock has historically tended to expand environmental degradation, rather than dilute it. Sometimes people act much the same as livestock. Accordingly, as with any sound development program, it is often beneficial to move slowly, and monitor the results. In the specific context of the targeted watersheds, with land-use pressure so intense, it is not anticipated that wholesale degradation would increase if

water were more available.

Rainfall is substantial throughout the area, usually greater than 2000 mm/yr except in the Les Anglais locality, which can be as low as 1000 mm/yr. It is much higher at the upper elevations. Accordingly, since there is usually rainfall each month, and no exceptionally long dry seasons, catchment areas of relatively small size can make important contributions.

One square meter of a water catchment roof constructed of rustic materials (i.e., palm fronds) could collect between 1000 and 1200 liters per year in an area with only 1200 mm rainfall per year. Since a goat requires only 6 liters per day, this is a significant amount. Obviously the roof area can be increased, and if corrugated metal was used, the catchment would be more efficient. This idea is already used by many households in Haiti to collect water for human use and would be technologically easy to expand.

Another technique that may be appropriate in the upland areas is the construction of stone check dams across the drainageways. These would act to slow down flowing water, causing it to deposit much of the transported sediment. This material acts as an effective aquifer, releasing the water much more slowly. This aquifer water can be tapped with a pipe and fed via gravity flow to a trough. Since all of the aquifer water is within the sediment, essentially underground, evaporation loss is minimized. The major drawback to this sytem is the permeability of the drainageway bottom. Field surveys would have to be conducted for proper site location. If this system proved to be appropriate, many of these structures could be constructed, even in the same drainageway, to hold additional water and provide better distribution. Although there would be competition for the stored water, the trapped sediments would likely be excellent garden crop soil. Certainly, some crops, like fruit trees, could be planted below the dam to take advantage of seepage, and not compete for the aquifer water directly.

A last method for capturing water is ground surface aprons. These are typically constructed of cement or asphalt, but plastic and even some chemical land treatments have been used successfully. On these steep slopes, even the natural ground surface might suffice. The water striking the apron is channeled into an underground or covered cistern, which prevents loss to evaporation. Water from the cistern is fed via a gravity flow valve to a trough.

Implementation of any of these water point development ideas would require the short-term services of a specialist to survey the area and prepare design guidelines.

Recommendations for Improvements in Animal Health. Livestock Health It is an important aspect of improved animal production in Haiti. Fortunately, the most destructive likestock diseases, with the exception of Anthrax are not prevalent, and there is a vaccination program for Anthrax that at least occasionally does reach into the hills of the watershed. The FAO has prepared a summary of Livestock Diseases in Haiti and additional information is included in Matter 1983:128-139.

The more insidious problems are debilitating diseases, especially the internal and external parasites. Screw-worm infestations can occur on any animal and saddle sores on equines are common.

A basic level animal health program should be included in the Project. Such a program could include, for example, periodic treatments for internal parasites. This will not only make a substantial improvement in animal health and therefore production, but these improvements will be quite apparent to the livestock owner, and will be valuable in establishing a relationship for further technology transfer.

This health service can be accomplished by training veterinary nurses to administer these basic treatments, providing each with medications and a mule, and establishing a "district" for each to service. It will probably be necessary to provide supplementary funds, until the value of the service is accepted, and these "Itinerant Vets" can establish their own private business.

Other Considerations. Three other ideas can be expressed concerning augmenting the livestock sub-sector production in the project area. These ideas will definitely need to be further elaborated in follow-up studies.

(1) ***Small Commercial Dairy Operation.*** Although the benefits of these operations are not greatly advantageous they should not be discouraged. These operations are not perceived as an integral component of this proposed project (which is directed more towards soil and wqter conservation on the steeper hillsides and livestock management improvements at the small-farmer level) becuase these enterprises are typically situated in the plains and are heavily capitalized. Nonetheless, the concept is laudable, and at sometime in the future as the local need develops, these experienced operations will be able to make a substantial contribution, both to the economy, and to the protein intake of the populace.

(2) ***Feedlot Finishing Operation.*** In most livestock production systems, particularly those where animals are brought in from widely diversified sources, there is often a place for a finishing operation. The end result is a more regular and uniform product, which is generally of interest to marketers/consumers further down the line. There exists in the Les Cayes plains sizeable tracts of irrigable lands for which no irrigation water is available. It is suggested that the benefits of establishing a well for irrigation water be investigated. Such water would be able to produce hayable pastures, which, in conjunction with sugar cane residues and by-products (e.g., molasses) and minor other additives, could produce excellent quality finishing rations. Another advantage of a feedlot operation is that it might well assist the seasonal stocking rate adjustments for the small farmer.

(3) ***Commercial Tannery and Leather Fabrication.*** It has been suggested that one method of alleviating the intense land pressure is to provide urban jobs. Haiti exports a substantial quantity of raw hides each year, so one possibility is to process them in-country, and then carry the operation one step further into an artisanal enterprise. The cost of leather worldwide is ridiculously exorbitant, and a well-run, quality leather product industry could easily compete (especially considering the cost of labor). This is certainly a topic that would require more in-depth analysis.

TABLE 5: SUMMARY OF CHARACTERISTICS OF SUITABLE GRASSES FOR IMPROVED FORAGE PRODUCTION

Scientific/Common Name	Physical Requirements/ Limitations	Management	Production (Dry Matter)	Comments
Digitaria decumbens Pangola Grass	Requires at least 40" (1016 mm) annual rainfall	Digestibility of dry matter and energy increases to 5 weeks, then declines; crude protein 15% at 3 weeks, declines to 8.5% at 5 weeks. Sterility of seeds produced during the summer reduces nutritional value during that period. Due to exceptional palatability, it can be difficult to maintain in mixed pastures. Might be particularly well suited for fertilized dairy pasture.	10,000 lbs/acre to 30,000 lbs/acre with fertilizer.	Widely adaptable, persistent, and palatable grass; must be vegetatively propagated, but can be planted in association with corn for establishment. Requires copper, manganese, and zinc trace elements; responds well to nitrogen and potassium fertilizer. Problems with aphids, army worms, spittle bugs, and a stunt virus have been recorded. Low, creeping perennial growth-form well adapted for erosion control. In general, easy to establish and manage at individ. farm level.
Cynodon plectostachyus and C. nlemfuensis "Star Grasses"	Prefers alkaline soils; up to 2500 m	Tends to be a more nutritious grass than Pangola, with 4-wk crude protein levels at 15.1%, 6-wk at 13.9%; corresponding dry matter percentages: 27.3 and 30.1. Star grasses exhibit decreased nutritional profiles during the dry season. Difficult to grow in grass/legume mixes due to its aggressiveness.	10,000 lbs/acre without nitrogen; 14,000 lbs/acre with nitrogen. Seems to slightly outperform Pangola in liveweight gain of animals, especially in unfertilized conditions.	Propagated vegetatively and spreads rapidly with vigorous surface runners providing good ground cov. Responds well to nitrogen fertilizers and limestone. Not susceptible to stunt virus; resistant to sugar cane aphid. Reported high cyanide content has not resulted in any ill effects during trials in Jamaica. A certain degree of drought tolerance is exhibited, but leaf-to-stem ratio decreases. Probably best suited to lowland irrigated pastures, but some results suggest it should be evaluated under other conditions as well.
Cynodon Dactylon "Bermuda Grass" variety Coastal Cross-1	Alkaline soils	Pasture or cutting.	10,000-12,000 lbs/acre without fertilizer	
Pennisetum purpureum Napier or Elephant Grass - Merker variety	Requires over 40" annual rainfall; tolerant to wide range of soils, but not to waterlogging	Can be used as green chop, silage, or grazing, but not for hay due to thick stems. Jamaican experience suggests the need for fertilizer under grazing conditions.	15,000 Kg 10^3/ha/yr (no fertilizer). 40,000 lbs/acre with fertilizer.	Tall bunch grass deep rooted perennial; propagated by stem cuttings. Merker variety is resistant to fungus. Napier grass is currently used in some local areas of Haiti.

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TABLE 5: SUMMARY OF CHARACTERISTICS OF SUITABLE GRASSES FOR IMPROVED FORAGE PRODUCTION, cont.

Scientific/Common Name	Physical Requirements/ Limitations	Management	Production (Dry Matter)	Comments
Panicum maximum Guinea Grass Caribbean, not Giant variety	35"-plus annual ppt.; drought tolerant on deep soils due to deep rooting; must be well drained.	Grazing can be continuous or rotational. Mixed results have been reported when combined with Tropical Kudzu in pastures.	13,000-40,000 lbs/acre, depending on soil, moisture conditions, & fertilizer amts. Live-weight gains less than for Pangola or Star grasses.	Erect growing perennial bunch grass; propagated by seeds (viability of seeds tends to be low) or root sets, but does not spread well vegetatively. Probably the most productive "wild grass" in Haiti targeted watersheds, and well known to farmers.
Trinsacum Laxum Guatemala Grass	Good drought resistance	Reasonably good for silage or green chop.		1974 FAO report claims the grass is available but used; some plantings were observed in the targete watersheds. In general is poorer in nutritive value than Napie grass.
Pennisetum (Cenchrus) ciliare Common Buffel Grass	Lower and dryer zones (especially around Les Anglais). Best in sandy loam to medium texture soils	Grazing, cutting		Warm season, perennial bunch grass which is very aggressive; very drought tolerant; useful also as ground cover for erosion control; limited by excessive moisture. Quality tends to be poor in humid climates.
Panicum culorarum Kleingrass		Grazing, cutting		Spreads by seed, tillers, rhizomes; node rooting. Tolerant to intensive grazing in well-managed pas good ground cover.
Pennisetum clandestinum Kikuyu Grass	Over 1200 m (appropriate for the higher elevations)	Grazing, under controlled system	Low production in natural grasslands, but high yields can be achieved with fertilizer.	Aggressive grass that reproduces by seeds and vegetatively.

TABLE 5: SUMMARY OF CHARACTERISTICS OF SUITABLE GRASSES FOR IMPROVED FORAGE PRODUCTION, cont.

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Tripsacum Laxum Guatemala Grass	Good drought resistance	Reasonably good for silage or green chop.		1974 FAO report claims the grass is available but used; some plantings were observed in the targete watersheds. In general is poorer in nutritive value than Napie grass.
Pennisetum (Cenchrus) ciliare Common Buffel Grass	Lower and dryer zones (especially around Les Anglais). Best in sandy loam to medium texture soils	Grazing, cutting		Warm season, perennial bunch grass which is very aggressive; very drought tolerant; useful also as ground cover for erosion control; limited by excessive moisture. Quality tends to be poor in humid climates.
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Pennisetum clandestinum Kikuyu Grass	Over 1200 m (appropriate for the higher elevations)	Grazing, under controlled system	Low production in natural grasslands, but high yields can be achieved with fertilizer.	Aggressive grass that reproduces by seeds and vegetatively.

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TABLE 5: SUMMARY OF CHARACTERISTICS OF SUITABLE GRASSES FOR IMPROVED FORAGE PRODUCTION, concluded

Scientific/Common Name	Physical Requirements/ Limitations	Management	Production (Dry Matter)	Comments
Brachiaria decumbens	Suitable for heavy clay soils that restrict use of other grasses		19,000-22,000 lbs/acre, but liveweight gains lowest of all grass species in this listing.	Trailing perennial grass that forms a dense ground cover; propagated by seeds, cuttings, or stolons. Resistant to stunt virus. Sodium content low and supplementary salt blocks are advisable.
Melinis minutiflora Molasses Grass	900-2500 m; grows in acid soils and those low in phosphorus	Does not respond well to nitrogen, burning, or heavy grazing. Does mix well with Tropical Kudzu.	10,000 Kg 10^3/ha/yr, without fertilizer.	Perhaps the best seed producer of tropical grasses, so cost of establishment is less than for most oth grasses.

Sources: Vicente-Chandler 1974; promotional literature from G. E. Pogue Seed Company; brief notes on grasses prepared by D. S. McLeod, AGRO-21 Jamaica (n.d.).

TABLE 6a: RECOMMENDED IMPROVED LEGUME FORAGE PLANTS - SUMMARY OF CHARACTERISTICS

Legume Species	Physical Requirements	Management	Production (Dry Matter)	Comments
Leucaena leucocephala varieties: "Peru" or "Cunningham"	600-2300 mm rainfall per year is optimal range. At elevations greater than 500 m, growth retardation is noticeable. Adaptable to wide range of substrates--sandy to heavy clay soils, rock and coral outcrops. Salt tolerant. Not tolerant of flooded or waterlogged conditions. Grows best in neutral or alkaline soils. Can be grown in some acid soils if seed is lime-pelleted and inoculated with adapted rhizobium strains.	Leucaena can be established in a long-term balanced mixed pasture with Guinea, Pangola or elephant grass. Mixed pastures are best planted in alternating strips with a ratio of 30% leucaena, 70% grass. The nitrogen-fixing ability of leucaena reduces the need for supplementary fertilizer. Solid leucaena stands or protein banks probably are the best management systems, and are especially suitable for marginal lands. Utilization can be either short-period free grazing (30-60 min/day) or cut & carry (green chop). Note: leucaena should not exceed 30% of daily forage intake. Coppicing is recommended, especially for steep &/or poor lands; harvest by cut-&-carry method. Maximum production and protein yield achieved with 4 cuttings/year, taking 75% of the leaves.	Marginal cropping soils, no insect control: 8,000-13,000 kg/ha; Marginal soils, with insect control: 10,000-16,000 kg/ha; Skeletal soils, no insect control: 4,000-10,000 kg/ha; Skeletal soils, with insect control: 5,000-12,000 kg/ha.	Leucaena develops a substantial taproot, which enables it to reach water unavailable to most other plants, thus avoiding drought stress. Degree of competition with other plants for water, in shallow soils, is unclear and should be evaluated. Associated rhizobium nodules capable of fixing 500 kg nitrogen/ha/yr. Generally exhibits high resistance to pests and diseases. (The two most prevalent insect pests have been reduced by biological control in Barbados; damping-off of seedlings can be minimized with fungicide treatments.) The effects of the uncommon amino acid "mimosine" have varied between different geographical locations. Problems are rare if leucaena does not exceed 5-10% of the diet for non-ruminants; 30% for ruminants. Since higher consumption rates without side effects have been reported, testing should be done in Haiti.
Pueraria Phaseoloides: "Tropical Kudzu"	Less than 3,000 ft (900 m)	Grows best in mixes with Molasses, Guinea, or Napier grass (not Pangola or Star). Does not hold up well under heavy grazing. Even if well managed, Kudzu mixes need to be replanted every 8-10 years.	Tropical Kudzu-Molasses mix, unfertilized: 1.0/au/acre/yr; Tropical Kudzu-Napier mix, fertilized with all nutrients except N: 12,200 lbs./acre/yr.	Can be propagated by seed. FAO found this plant difficult to establish in Haiti, and water/fertility seemed to limit its use; other workers elsewhere report better success. Does not do well in areas with extended dry periods.

TABLE 6a: RECOMMENDED IMPROVED LEGUME FORAGE PLANTS - SUMMARY OF CHARACTERISTICS, cont.

Legume Species	Physical Requirements	Management	Production (Dry Matter)	Comments
Macroptilium Atropurpureum Phaseolus Atropurpureum "Siratro"		Grows best with upright grasses, such as Guinea or Napier. Good in intensive, mixed pastures.	Dry matter produced per acre from 3 cuttings during a 9.5 month period: 9,000-10,000 lbs.	Climbing type legume.
Centrosema Pubescens		Same as above		Climbing type legume; established easily by seed.
Desmanthus Virgatus	Similar to Leucaena	Tolerant of heavy grazing. Can be cut 4 times/year, with each root crown producing up to 50 slender stems.	15,000 lbs/ha	Small (2-3 m) browse shrub, native to the tropical new world. Proven to be palatable, aggressive, and persistent. Can be propagated by seed. Not toxic to livestock, as is Leucaena (mimosine content).
Desmodium spp.				So palatable and nutritious as to be called the "alfalfas of the tropics;" all perennial shrubs.
D. Discolor	Grows best in deep, fertile soils, but will grow in acid sandy to loamy soil.	Requires one year to be established. Can be grazed or mowed (cut - up to up to 5 times/yr. Makes excellent green chop, hay, or silage.	12,000 lbs. dry matter/ha/yr have been recorded.	Native to South America; introduced successfully to South Africa and Fiji. Propagated by seed. Protein content: 15%.
D. Distortum	Successfully grown in acid (ph 4.1) soils.		14,000 lbs. dry matter/ha/yr recorded. Yielded nearly 2,000 lbs/ha in 2 cuttings within only 5 months after planting.	Protein content: 22-24%.
D. Gyroides	Grows vigorously in poor soils (both acidic & alkaline). Up to 1,000 m. Drought tolerant 2-3 months. Tolerates waterlogged sites.	Coppices readily, but must be well established.		Native to S & SE Asia. Established readily from seed. Nontoxic to animals.

TABLE 6a: RECOMMENDED IMPROVED LEGUME FORAGE PLANTS - SUMMARY OF CHARACTERISTICS, concluded

Legume Species	Physical Requirements	Management	Production (Dry Matter)	Comments
D. Nicaraguense	Grows abundantly in wet or or dry situations, and on rocky hillsides.	Can be killed if overgrazed. If properly managed, can be cut up to 7 times/year. Can be used as green chop, hay, or silage. Competed well with vigorous grasses.		Easily established by seed, transplants, or cuttings. Foliage contains 27% crude protein.
Other species/varieties include: Desmodium spp CIAT 335; D. Tortuosum D. Intortum D. Uncinatum				
Stylosanthes Hamata		Some reports indicate plant is persistent when grazed hard.		Native to Central America. Non-climbing legume. Well utilized by goats.
Stilozobium Deeringianum "Velvet Bean"		Difficult to maintain balance in mixed pastures (either grass or bean tends to dominate).		Easy to multiply, annual legume; the only legume with which FAO experienced good results in Haiti. When mixed with sugarcane, produced a balanced ration.

Sources: Proverb (n.d.); Vicente-Chandler 1974; Johnson (n.d.); NAS 1974.

TABLE 6b OTHER RECOMMENDED LEGUMINOUS FORAGE SPECIES FOR THE CARIBBEAN

I.	Desmodium spp. CIAT 335 D. tortuosum Codariocalyx gyroides	promising shrub legumes
	Acacia nilotica A. tortuosa A. macracantha Albezzia lebbek Calliandra spp. Cassia glandulosa Haematoxylum campechianum Parkinsonia aculeata Pithecellobium unguiscati Prosopis chilensis Sesbania grandiflora S. bispinosa S. exaltata	other endemic and naturalized leguminous shrubs in the Caribbean

Source: Keoghan (1982)

II.	Clitoria ternatea Teramnus labialis Neontonia (c.f. Glycine) wrightii	climbing type legumes; suitable in intensive, legume-based pastures with Napier or Guinea grass

Source: FAO/UNDP (1979)

TABLE 7: INITIAL FORAGE TRIALS RECOMMENDED FOR VARIOUS EMZ/SOIL TYPES

Environmental Management Zone (EMZ)	Elevation Range	Percent Slope	Soil Type (Percent of EMZ)	Fertility	Moisture Capacity	Management/Use Options	Grass	Legume
Delta	<50 m	0-1%	Black clay (80%)	High	Saturated	Primary use: irrigated agriculture		
						Limited* secondary use: irrigated pasture or hay fields	a) Cynodon spp[1] b) Pangola[1] c) Brachiaria[2]	a) Desmodium gyroides[3]
	<100 m	1-5%	Black silty clay (10%)	High	Moderate	Primary use: agriculture Secondary use: Pasture/green chop (Napier) Pasture/hay (Cynodon)	a) Napier[4] b) Cynodon[6] c) Pangola	a) See footnote 4 b) Leucaena[5] c) Siratro d) Centrosema e) Desmodium discolor[6] f) Stylosanthese[6] g) Velvet Bean[6]
Undulating Lands	<50 m	0-1%	Black clay (35%)	High	Saturated	[.....SAME AS FOR DELTA EMZ.....]		
	<100 m	1-5%	Black silty clay (60%)	High	Moderate	[.....SAME AS FOR DELTA EMZ.....]		
	<100 m	5-20%	Deep red clay loam (5%)	Medium	Moderate	Most appropriate primary use is for rainfed agriculture, but moderate erosion potential suggests grass contour strips would be appropriate addition	a) Napier[7] b) Cynodon[8] c) Guinea[9]	a) Leucaena[10] b) Desmodium distortum[11]
						Secondary use for grazing pastures in in limited* areas	d) Napier e) Cynodon	c) Leucaena or D. distortum as above d) Mixed herbaceous pastures not recommended (See footnotes 4 and 12)

*The term limited is used because this land is best suited for human agricultural food production and cannot be justifiably converted to grazing-pasture land except under limited circumstances.

TABLE 7: INITIAL FORAGE TRIALS RECOMMENDED FOR VARIOUS EMZ/SOIL TYPES, cont.

Environmental Management Zone (EMZ)	Elevation Range	Percent Slope	Soil Type (Percent of EMZ)	Fertility	Moisture Capacity	Management/Use Options	Grass	Legume
Rolling Hills	<100 m	1-5%	Black silty clay (10%)	High	Moderate	[.....SAME AS FOR DELTA EMZ.....]		
	<1,000 m	5-20%	Deep red clay loam (40%)	Medium	Moderate	Soil conservation/forage production strips in agricultural land use areas	Same grasses as for corresponding soil type in undulating land EMZ	a) D. distortum[11] b) Leucaena[11]
	100-1000 m	5-20%	Deep very red clay (30%)	L[illegible]	Good	Low fertility of these soils suggests forage production, especially with grass/legume mix might be viable alternative use. If land is left in crop production, legume strips would be appropriate addition.	Grass/Legume Mixes a) Napier[14] b) Guinea[14]	a) Tropical Kudzu b) Siratro c) Centrosema
							Pure Stands or Strips a) Molasses[15] b) Cynodon[16]	a) Desmodium distortum or Gyroides[17] b) Leucaena[17]
	<1000 m	20-50%	Moderately deep, black clay (10%)	Moderate	Moderate	Moderate fertility can permit cropping if adequate erosion control (vegetative strips) incorporated.	a) Napier	No legume[6]
						Pasture management only.	a) Napier b) Guinea, with..... c) Cynodon (?) d) No grass	No legume a) Kudzu, Siratro, or Centrosema No legume b) Desmodium, Desmanthus, or Stylosanthes?
						Rapid establishment of grass cover on eroding, steep slopes	a) Molasses[18] b) Guinea[18]	No legume With legumes[18] as above

TABLE 7: INITIAL FORAGE TRIALS RECOMMENDED FOR VARIOUS EMZ/SOIL TYPES, cont.

Environmental Management Zone (EMZ)	Elevation Range	Percent Slope	Soil Type (Percent of EMZ)	Fertility	Moisture Capacity	Management/Use Options	Grass	Legume
Steep, Rolling Hills	<1000 m	5-20%	Deep red clay loam (20%)	Medium	Moderate	[SEE RECOMMENDATIONS FOR SAME SOIL TYPE IN UNDULATING LANDS AND ROLLING HILLS EMZs]		
	100-1000 m	5-20%	Deep, very red clays (5%)	Low	Good	[.....SEE ROLLING HILLS EMZ RECOMMENDATIONS.....]		
	<1000 m	20-50%	Moderately deep black clay loam (40%)	Medium	Moderate	[.....SEE ROLLING HILLS EMZ RECOMMENDATIONS.....]		
	<1000 m	>50%	Thin, shallow black clay loam (10%)	Low	Low	Low fertility and high erosion potential suggests rapid conversion to forage plant cover crop.	a) Molasses Grass[19] b) Buffel Grass[20]	a) Desmodium Nicaraguense[21]
	>100 m	>40%	Thin, saprolitic red loam (20%)	Medium	Moderate	Steep slopes and moderate erodability suggests the use of grass strips with other crops (fertility at least marginally suitable for agriculture)	a) Napier b) Guinea c) Cynodon	a) Leucaena hedges at low elevations b) Desmodium spp at high elevations c) Siratro, Centrosema, Kudzu can be mixed with Guinea or Napier if fertility too low
Low Mountains	<1000 m	5-20%	Deep red clay loam (10%)	Medium	Moderate	[.....SEE UNDULATING LANDS EMZ.....]		
	<1000 m	20-50%	Moderately deep black clay loam (15%)	Medium	Moderate	[.....SEE ROLLING HILLS EMZ.....]		
	<1000 m	>50%	Thin, shallow black clay loam (40%)	Low	Low	[.....SEE STEEP ROLLING HILLS EMZ.....]		
	>100 m	>40%	Thin saprolitic red loam (20%)	Medium	Moderate	[.....SEE STEEP ROLLING HILLS EMZ.....]		

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TABLE 7: INITIAL FORAGE TRIALS RECOMMENDED FOR VARIOUS EMZ/SOIL TYPES, concluded

Environmental Management Zone (EMZ)	Elevation Range	Percent Slope	Soil Type (Percent of EMZ)	Fertility	Moisture Capacity	Management/Use Options	Grass	Legume
Low Mountains, cont.								
	500-1000 m	>40%	Thin, shallow saprolitic brown loam (10%)	Low	Moderate	Low fertility, steep slopes, moderate erodability, and moderate water-holding capacity suggests these soils be converted to pasture. Eroded areas requiring immediate protection · Development of mixed pasture Protein Banks	a) Molasses Grass b) Napier or Guinea Grass	a) Kudzu b) Siratro c) Centrosema d) Desmodium spp e) Desmanthus virgatus f) Stylosanthes hamata
High Mountains	>1000 m	>40%	Thin, shallow, saprolitic brown loam (50%)	Low	Moderate	[.....SEE LOW MOUNTAIN EMZ.....]		
	>1000 m	>40%	Thin, saprolitic red loam (30%)	Medium	Moderate	[.....SEE STEEP ROLLING HILLS EMZ.....]		
	>1000 m	>5-20%	Deep red clay loam (10%)	Low	Moderate	Same land use objectives as for undulating lands EMZ if moderately fertile. If fertility low, this type should be converted to pasture.	a) Molasses[22] b) Cynodon[22] c) Kikuyu[22]	See footnote 23

Note: Numbered footnotes appear on following pages.

FOOTNOTES

TABLE 8-12: INITIAL FORAGE TRIALS RECOMMENDED FOR VARIOUS EMZ/SOIL TYPES

1 Pangola well suited for dairy pasture, but subject to insect and viral damage.

2 Brachiaria - Lowest production of liveweight gains, but is suitable for heavy clay soils that restrict the use of other grasses.

3 D. gyroides is tolerant of waterlogged conditions.

4 Napier grass grown under fertile conditions substantially out-produced Napier/Tropical Kudzu mixed pasture in both total dry matter and protein per acre yearly:

Forage	Dry Matter Produced	Protein Produced
Napier	23,650 lbs.	1,770 lbs.
Napier/Kudzu	12,200 lbs.	965 lbs.

(Vicente-Chandler 1974:132)

5 Leucaena/Napier mixed pasture or Leucaena protein banks. Inoculate with proper Rhizobium on acidic soils.

6 Manage as pure stands. Not well suited for grass/legume mixes.

7 Napier best suited for zero grazing (cut and carry) operations to be used as green chop or silage.

8 Cynodon for zero grazing operations (green chop, silage, or hay) on alkaline soils.

9 Guinea grass for green chop, silage, or hay on more acidic soils.

10 Leucaena is best suited for alkaline soils and can be planted as hedgerows in agricultural fields.

11 Desmodium distortum is a high-yielding, high-protein leguminous shrub suitable for hedgerow planting on acidic soils.

12 On moderately fertile soils, legumes (other than shrub hedgerows) would not be as productive as pure grass; Cynodon would out-compete any herbaceous legume.

13 Leucaena is recommended for alkaline soils less than 500 feet ASL. Can be inoculated for acidic soils, and should be evaluated for maximum suitable elevation within project area.

14 If hay-making will be part of management system, Guinea grass is recommended.

15 Molasses grass requires the least nitrogen input; best suited for higher elevations.

16 Cynodon should be tried on alkaline soils. If fertility is adequate, Cynodon is more productive and nutritious than Molasses grass.

[Footnotes, Table 8-12, cont.]

17 Leucaena at lower elevations (- 500 m); inoculate for acid soils if necessary.

18 All these plants can be propagated by seed.

19 Molasses grass can be established by seed (possibly from aerial seeding) and tolerates low fertility; low moisture availability might be a limitation.

20 Buffel grass can be seeded and is very drought tolerant; elevation might be limiting.

21 Desmodium nicaraguense can grow in dry, shallow soils, and can be seeded. Might be appropriate companion legume for Molasses or Buffel grass, or as initial preparation for a better grass species, e.g., Guinea.

22 These grasses are known to perform well at higher altitudes, but Molasses and Kikuyu are not especially nutritious. Trials should include other species such as Guinea, Guatemala, and possibly Napier.

23 Various species should be tried at higher elevations to determine suitabilty.

Table 8: Current Farm Management Practices and Livestock Mnagement Recommendations

Environmental Mngt. Zone	Agricultural Crops: Types	Agricultural Crops:	Sequence	Wild Forage Availability	Current Livestock Management	Comments/Recommendations
(1) Delta	Irrig. Rice Sugar cane corn beans pasture	Rainfed Corn	Continuous in the predominately irrigated areas	Due to the value of this land type for irrigated Ag. natural vegetation types, except along roads & paths are rare	Livestock, especially cattle are more concentrated due to year-long availability of crop residues forage Several small dairy operations	. The high number of livestock probably reflects not only the availability of forage, but also the affluence of the owners of this prime land as well as the more highly capitalized cooperatives established. . There is reasonable access to feed additives such as molasses from local processing facilities, and even feed concentrates produced in Port-au-Prince. . Sugar cane plus concentrates should form the major livestock feed. . The existence of some irrigated pastures abundant cane residues, and access to concentrate suggests the possibility of a feedlot finishing operation
(2) Undulating Lowlands	Irrigated Rice (L'Acul) Cane (R. De Sud) Tobacco Beans	Rainfed Corn Sorghum Sweet Potato Beans, Peas Manioc Peanuts S. Cane	The major rainfed crop sequence is corn planted in the early spring & harvested mid to late summer; followed by sorghum which is harvested around Dec. Beans are usually intercropped during both plantings. Irrigated crops are produced more regularly throughout the year, especially cane.	Since the highland portions of these undulating hills are not irrigated, there is considerable land in rainfed Ag and a small portion in non-Ag. Landuse (e.g., weeded areas, etc.) in addition to natural vegetation along paths & other non-use areas. There is a substantial amount of volunteer herbaceous re-growth in rainfed fields, especially between crop plantings	Essentially the same as for Delta EMZ, but small ruminants become more common as the percentage of small farm households increases in the upland areas.	. Much of the livestock in this zone can still be fed on a base ration of cane residue, supplemented with small farm residues, wild forage and some nutrient additives (The proximity to major roads and the number of organized cooperatives makes some feed concentrates a possibility). . Plantings of forage grasses is not widely recommended because the predominance of the fertile black silty clay soils and low erosion hazard indicate these lands are best suited for crops. The incorporation of protein banks (e.g. Leucaena hedges) would improve small farm livestock nutrition.

Table 8 con't: Current Farm Management Practices and Livestock Management Recommendations

Environmental Mngt. Zone	Agricultural Crops: Types	Agricultural Crops: Sequence	Wild Forage Availability	Current Livestock Management	Comments/Recommendations
Low Rolling Hills less than 100m ASL	All rainfed: multiple cropping throughout the year with intensive intercropping. Major crops include corn & Sorghum; various beans & peas (legume fodder) manioc; potatoes Banana, plaintain and small areas of cane and upland rice occur	Similar to rainfed Ag. in EMZ #2, Corn stover available in the fall; Sorghum Jan-Feb. Some Bean fodder available in each harvest period	More important in this and higher elev. EMZ's but little leguminous material besides Prosopis near Les Anglais. Water stress and drying of plants occurs Dec-Feb (esp. in Camp Perrin, Chantal; Port-a-Piment; Les Anglais localities)	Increasing small farm holdings, many with a few animals; animals tethered whenever forage is available (roadside; fallow field) with cut & carry supplement. Cattle and goats predominant in most of project area; sheep more abundant in Les Anglais area.	Since most of the Red Clay Loam soils have moderately fertility and only moderate erosion hazard, they are still best suited to crop production. Animal nutritional regimes can be improved by (a) planting some strips or small areas to protein banks (either Leucaena hedge or green manure/forage legume) (b) introduce feed storage for dry season; ensilaging corn stover available in Sept-Oct should be tried. (c) access to EMZ or 2 cane residues might also be feasible in some areas.
(3b) Plateau Rolling Hills 500-1000 ASL	All rainfed; multiple crop seasons and intensive intercropping. The Platon locality crops include: corn, sorghum, sweet potato, irish potato, manioc, cocoyam, jaro yams, beans, banana	As above	Similar as above, but possibly with less dry forage periods due to better water holding capacity of Red Clay Soils.	As above, small holder cattle and goats, some sheep. Horses, mules, donkeys become more prevalant for mountain transport.	Low fertility of Very Red Clay soils suggest conversion of some lands to forage crops (both grasses and legumes) might actually increase Ag. product off-take and would certainly improve livestock nutrition. Crude protein content of introduced legumes would definitely help monogastric horses & mules.

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Table 8 con't: Current Farm Management Practices and Livestock Management Recommendations

Environmental Mngt. Zone	Agricultural Crops: Types	Agricultural Crops: Sequence	Wild Forage Availability	Current Livestock Management	Comments/Recommendations
(4) Steep Rolling Hills	Rainfed, multiple season intercropping of: yams, congo peas, pigeon peas, peanuts, sorghum, bananas, manioc, cocoyam; Small coffee areas. Predominance of sorghum to corn attests to the harsh growing conditions.	Similar as above	Areas of wild forage plants increase in the higher elev. EMZ as more land is unsuitable for cropping either due to steep slope, too shallow soils, or exhausted fertility. There are some forested areas, particularly in drainageways and some secondary forest growth. Small areas of unimproved pasture occur in this EMZ.	Small farm livestock holders; Cattle, goats & equines predominate.	The moderate fertility and moderate to high erosion potential of the predominant Black Clay Loams and Thin Saprolitic Red Loams and low fertility of the Very Red Clays suggests alternative management system. Grass strips can be introduced to both control soil erosion and provide forage (species will depend on elevation and harvesting system - see 8.32). Water holding capacities of these soils appear to be satisfactory for year round production with expected average rainfall. Leucaena can be planted for multiple uses, including erosion control, fuelwood and protein forage at least at the low elevations (less than 500m), with other legumes at higher elevations. These plantings would improve livestock nutrition. This EMZ would also be a target area for community grazing programs
(5) Low Mountains (500 - 1000M; slope more than 50%)	Same as above (Steep rolling hills)	Same as above	Same as above	There are less small farm resident animals in this type because few people actually reside on such steep slopes. The major use of this area by animals are those brought up and tethered each day.	The Thin Shallow Black Clay Loams (40%) have low fertility and are very susceptible to erosion; the other soil types, Thin Saprolitic Red Loam (20%) and Moderately Deep Black Clay Loams (15%) have moderate fertility and moderate to high erosion potential. These soil types, combined with the high slopes (50%) indicate alternative management strategies. Since the human and animal population density is low in this setting, emphasis should be made on stabilizing these areas with ground cover as well as forest vegetation, and converting the land use to predominantly livestock production via community grazing cooperatives Although the soil water holding capacity is low to moderate, the bimodal and greater rainfall is expected to provide for continuous production of grass. It is cautioned that on these very steep slopes improper livestock management could result in severe "trailing" and more erosion. Rotational, controlled grazing emphasizing small ruminants is initially recommended.

Table 8 con't: Current Farm Management Practices and Livestock Management Recommendations

Environmental Mngt. Zone	Agricultural Crops: Types	Agricultural Crops: Sequence	Wild Forage Availability	Current Livestock Management	Comments/Recommendations
High Mountains (over 50% slopes; less than 1000MASL)	The Agronomy Report Stated this zone is predominantly trees (developed & secondary forest growth) but does include small patches of clean cultivated crops (unspecified). Of the major forage producing crops, sorghum is expected. However the estimations of percentage of land use by EMZ/Watershed indicate zero km² trees, secondary forest or monoculture. Rather, mixed farming, grass and fallow predominate. Ground observations made for this report suggest that mixed farming and both primary/secondary forest growth are well mixed, but grass areas and fallow fields are essentially the same land use (i.e., volunteer wild herbaceous material rapidly developed in fields between planting periods.)			As for EMZ 5, human and animal densities are much lower than for other EMZ's. People with no access to lower "pasture" areas, or those working in the high mountains will bring animals to tether graze. Goats and cattle predominate; equines (for transport) are common.	Essentially, most of this EMZ includes the new National Park and proposed buffer zone. Since the government will exercise land use control authority (discussions of displacing people are common), and external monies are available for developing/rehabilitating these lands, it is highly recommended that the buffer zone be developed as a model of sound multiple use (soil and water conservation; reforestation; limited and proper farming practices; grazing programs). Since available manpower probably limits cut & carry of forage, controlled grazing via community cooperatives is the only feasible system. Such a system implemented on these steep slopes will have to be closely monitored to determine if it can indeed be accomplished.

ANNEX H SOCIAL SOUNDNESS ANALYSIS

[*Note: The author of the social soundness analysis concluded that managing a credit program within the project would be worth the problems noted herein. The mission concluded that it will be more practicable to utilize inputs as incentives rather than credit, and to utilize the services of the Bureau de Credit Agricole (BCA) to provide credit to target farmers. Therefore, the analysis below has been edited to delete the credit program design. Any reader wishing to examine the original analysis should query the mission's project files.*]

Profile of the watershed population. In assessing the social feasibility of the proposed Project, the best beginning point is a brief anthropological profile of the beneficiary population living in the Pic Macaya watersheds. In the absence of detailed ethnographic analyses of any rural communities in that part of Haiti, the profile is based on the information gathered in brief field visits combined with a thorough review of anthropological studies carried out on hillside farming communities in other parts of Haiti.

Beneficiary Population. Though credible census data are hard to come by, it has been estimated that there are some 400,000 people living in the general area where the Project will function. Perhaps as many as 85% of this population depend on hillside farming as their principal means of support. Conservatively estimating that 300,000 people fall into the hillside farmer category, and using the rough average of 5 persons per household that has been found valid for most of rural Haiti, one arrives at an estimated beneficiary population of some 60,000 families. If successful in its objectives, the project will involve at least a third of these families directly in altered land use strategies.

This population of 60,000 families is deployed over the watersheds in residentially dispersed clusters of households related principally through patrilateral and affinal kin ties, through exchange labor relationships, and through intricate patterns of intracommunity land rental and sharecropping arangements. These land and labor sharing arrangements will be discussed at length below.

Ethnic homogeneity. In some settings, project implementation is encumbered by ethnic or tribal heterogeneity within the beneficiary population. There are no such ethno-racial distinctions to be found within the rural Haitian population. Despite diversity in place of African origin, there is absolutely no trace in Haiti of any socially recognized pre-colonial tribal differences by which people might distiguish themselves from other groups. Furthermore even the black/mulatto distinction that plays such an important role at the higher levels of Haitian society is irrelevant as a group marker in the rural areas. Racially all members of the beneficiary group are of distinct African-derived phenotype. Though there are lighter skinned individuals to be found within villages, no hillside farmers are viewed by their neighbors, or view themselves, as belonging to the "mulatto" group based in the towns and cities. One's particular color shade in rural Haiti is viewed, not as a marker of group membership, but as an individual characteristic, not unlike eye or hair color in Western Caucasian settings. In short, there are no ethnic distinctions in rural Haiti that correspond, for example, to the Indian/Mestizo distinction that complicates project design in Latin American highland settings.

Language. From the viewpoint of both peasant and implementing PVO, Creole

should be the language of the Project. All expatriate employees should either be fluent in Creole on their arrival or be given a rapid immersion in Creole as soon as they arrive in country.

Socioeconomic levels in rural Haiti. The ethnic and linguistic homogeneity of the population does not mean that there are no relevant internal socioeconomic groupings. The town/country distinction found in other cultures is present in Haiti as well. Large concentrated landholdings of several hundred hectares are found in the plains. In the mountain areas, a private holding of 10 *carreaux* would be large, and it is rare to find such holdings. Data collected in different contexts over the past three decades suggests a trend toward declining holding size. A careful study of land tenure carried out in Dubreuil by Jaffe shows an average holding size of about one and a quarter hectare, which is slightly less than the 1.5 ha. average that tends to prevail in other settings. What is most impressive about the Dubreuil data is the degree of inequality in holdings. The bottom 40% of the households own less than 5% of the land. Dubreiul, however, is a premontane setting with irrigated land and the land distribution patterns in such communities are quite different from those in the mountains.

Though there are few generalizable quantitative data on the land distribution patterns in the region, the following propositions correspond to the general thrust of anthropological findings.

(1) The average holding size may be about 1.5 hectares.

(2) Land ownership is acquired both by inheritance and by purchase.

(3) Most individuals probably inherit less than a hectare of land and most males probably purchase at least one small plot of land in the course of their lives. It is rare for an individual to have accumulated through inheritance and purchase more than 3 hectares of land.

(4) There has been a demographically induced intergenerational shrinkage of holdings down to their present size.

(5) All over rural Haiti there is an active land market but the low productivity of mountain land under traditional technology has produced a situation in which there has been little if any concentration of hillside holdings.

(6) Despite recent emigration from the Project region, there is relatively little absentee ownership in the hills.

Role of women. There are two conjugal modes, *mariaj* (legal marriage) and *plasaj*, a conjugal union that has not been religiously or civilly legitimized but in which both partners are publicly recognized as spouses and viewed as jointly responsible for the economic support of the offspring. Though no statistics are available for the region, probably some six out of ten conjugal unions are of the informal type. The importance of this for the spread effect of the Project is to be found in land tenure. Women in plasaj retain ownership of any land which they have inherited or purchased. Care must be taken to ensure that the percentage of Project-benefitted gardens owned by females is representative of their general statistical importance in the landholding regime of the entire community.

Families are organized into nucleated households, the norm being a husband, a wife, and their offspring. There are however many variations on this theme. Of great importance is the sexual division of labor. Rural Haitian women are not only responsible for child care, cooking, washing, and other domestic tasks. In addition they are the major actors for certain phases of the agricultural cycle, principally planting, weeding, and marketing of the harvest. It could very well be that they, not the males, might be the principal decision makers with respect to placing vegetative interventions of erosion control on hillside plots.

Religion in rural Haiti. Given the demoninational character of most local PVOs, an equally important benefit distribution issue focuses on religious affiliation. Broadly speaking, there are three major religious clusters in rural Haiti: Catholics, Protestants, and those who serve the *loua* of the Voodoo pantheon. (This latter group continues to practice Catholicism, at least in regard to the major rites of passage). Statistics are lacking on the population of the Project region. Protestants may account for 15% of the population, Catholics who have publicly rejected Voodoo perhaps 40%, and Catholics who continue to serve the *loua* the remainder. The folk-religious practices of the latter group are done much more secretly in the Project region than in some other areas of Haiti, perhaps because of the very preponderance of PVO mediated development activities.

Local Leadership Structures. Despite recent political events, there has as yet been no formal readjustment of rural authority patterns. There traditionally has been, and there continues to be, a gap between the administrative arrangements called for in Haitian law and the actual reality of village life. In Haitian law the population is organizd into Communes, consisting of a head city (Fr: *ville*/HC: *vil*) or town (Fr: *bourg* / HC: *bouk*) with its outlying rural sections. Technically Haitian peasants live in rural sections. But in reality the section is an arbitrary administrative unit which may have several dozen villages and hamlets in which people actually live. Each rural section is under the authority of a chef de section. This figure answers neither to the town civilian authorities nor to the soldiers in the town, but directly to the commander of the military district in which the commune is located.

Paradoxically, the communities in which people actually live have no legal or administrative status. They are hamlets which may have only a few dozen people. The *chef de section* may have little to do with the hamlets, delegating his authority to a local unpaid assistant (who traditionally generates his fees by charging both plaintiff and defendant for his services). The most frequent occasion for police intervention appears to be the capture of stray livestock doing damage to neighbors' gardens.

The fluidity of the current political situation, and the low profile and conciliatory stance which local authorities are currently taking and will probably continue to take in the foreseeable future endow this and other projects with an unprecedented degree of freedom to interact directly with peasants. In this sense recent political events must be seen as highly positive from the point of view of developmental activities in the Haitian countryside.

Informal Authority Patterns. There was a period of breakdown of local authority in the Project area following the departure of Duvalier. During this period the local population depended on informal leaders for information and guidance. Because of its role in paving the way for the disappearance of the

old regime, the credibility and moral authority of the Catholic Church among peasants has enjoyed and still enjoys an upsurge. Several Catholic PVOs in the Project area have had an impressive track record in organizing peasants, either into groupman in the case of DCCH or into cooperatives in the case of UNICORS long before the departure of Duvalier. The local prestige and influence of these organizations has been enhanced even further by recent political events.

The following section presents a profile of the rural economy.

Elimination of Fallow. The destructive impact of current hillside farming technology must be seen at least partially in the light of recent demographic pressures. In times past cropping technieques were founded on a local variant of the shifting cultivation sequence found in many parts of the tropical world. In this sequence land was cleared of arboreal vegetation, the vegetal debris was allowed to dry and was burned, covering the plot with grey ash. Crops were planted and harvested, and the land was allowed to fallow. After several years of brush and small tree growth, larger secondary growth would emerge restoring the fertility of the soil,and the cycle would begin again. Under conditions of land abundance, such a system is not inherently damaging to the environment.

Population growth, however, has wreaked havoc on the viability of this land use system by reducing land availability and by forcing a concomitant shortening, and eventual elimination, of the regenerative fallow cycle. Under current land use practice, there is at most a period of a year's rest given after several years of cropping. And even during the fallow period, animals are turned into the plot to graze on crop residues and the herbaceous vegetation that eventually emerges. The result is an eroded, overworked, and in many parts treeless landscape. It goes without saying that the elimination of an effective fallow cycle has been produced, not by peasant ignorance, but by simple land scarcity.

Absence of indigenous erosion control strategies. The above discussion suggests that the regenerative fallow cycle used to be present in Haiti but has disappeared under mounting pressures. Precisely the opposite is true of erosion control measures. There is no evidence that systematic soil conservation was ever practiced in postcolonial Haiti. One sees little evidence in Haiti of the indigenously derived terracing systems that appear in various parts of West Africa. There is no reason to assume that these technologies did not cross the Atlantic. They were simply lost in the wake of extractive colonial and postcolonial land use practices, the get-rich-quick land use policies learned by slaves from their French masters.

Pressures felt in recent years have witnessed the emergence of what appears to be a spontaneous evolution of erosion control behaviors, in the form of small ramps of vegetal debris laid across the contour. But in general it must be said that there have never been strong traditions of erosion control behavior among Haitian peasants. Fallowing was a part of traditional practices that has been lost because of stress. Erosion control, in contrast, was never really part of traditional practices, and is only now slowly beginnng to make its way in.

Individualized Economic Organization. The preceding discussion focused on Haitian peasant technology. To introduce change, however, the Project must have a clear grasp of the economic motives that move Haitian hillside farmers. There have been changes in this motivational structure over time. The micro-economic premises on which Project interventions are based must dovetail with

current Haitian peasant lifeways, not the lifeways of the ethnographic past. Under older patterns of post-marital virilocal residence, brothers and their wives and children would live in close proximity to each other in family compounds (*lakou*) and continue to function at least to some degree under the economic control of their father. Long term patterns of monetization and individualization, however, have rendered such an arrangement a thing of the romantic past. Now many couples establish neolocal residence on land which they purchase. And even in compounds where houses are built on family land, individual nuclear families carry out their own separate productive and consumption activities. The design of this project is explicitly based on this monetized, individualized model of peasant decision making and is thus in close tune with the reality of contemporary Haiti.

Cash cropping. Peasants around the world are now involved in cash markets, both as outlets for their agricultural produce and as sources of various commodities that are not produced locally. Many observers have correctly noted that the Haitian peasants may be more cash-oriented than most. The colorful and much-studied internal market system of Haiti, capitalized and staffed by energetic female traders, is a product and symptom of the cash-oriented basis of rural Haitian life. Though there are regional differences in cash involvement, the following three propositions would apply to the project region as well as to most regions of Haiti.

(1) Farmers grow only part of the food which they consume. There is widespred dependence throughout the project region on cash purchases for food, especially during certain parts of the year.

(2) Local families consume only part of what they grow. They depend on the cash which they produce from the sale of part of their harvest. Under cash crops are included not only export crops, but also internally consumed crops such as rice and beans and most other foodstuffs.

(3) Farmers have demonstrated their willingness to try out new crops, but only if these new crops stand a chance of augmenting their cash income. The most dramatic example of this is the planting of fast growing wood trees in the Agroforestry Project. The Project being proposed here must introduce its inputs in the context of potential cash returns. Projects that enter with ecological rather than economic messages rarely trigger off enthusiastic responses among peasants.

Some observers have viewed this strong cash orientation as a weakness of the Haitian peasant economy. Some have recommended interventions which would make the peasant more self-sufficient, less dependent on or oriented to a cash market. Such schemes, however, while sound at one level, are going against the current of post-colonial Caribbean history. The approach being proposed in this Project, in contrast, is to accept the cash orientation of the Haitian peasant and to harness the economic energy derived from this orientation to the task of elaborating and implementing a new type of hillside land use behavior.

Current emphasis on annuals rather than perennials. Some advisers envision the future of the watersheds in terms of a shift toward the use of hillsides for perennials. Unfortunately for this model, the traditional hillside farming system goes in the opposite direction. The culturally preferred and economically most lucrative crop in most parts of the watershed are beans. When queried peasants may tend to describe their economic options principally in terms of increments to their bean production. Though less lucrative, corn

and millet planting is also a central part of the economy.

In contrast the role of perennials (with the exception, of course, of coffee) in the current economy must be viewed as marginal, both objectively and subjectively to the peasants themselves. Nobody queried (except expatriate fruit producers) spontaneously mentioned improved fruit as a promising bet for the future.

This downplaying of fruit appears to reside less in market obstacles than in other factors. Farmers and marketwomen who were questioned about the role of fruit insisted that a producer of fruit would never lack buyers who would compete to pay a decent price. And the yields calculated with farmers from a hypothetical plot of ground planted in improved citrus exceeded yields from most other uses of that same hypothetical plot. When queried as to why, therefore, people did not count on the planting of fruit trees as a major economic option, several answers were given:

(1) Though in theory a farmer could make a killing on fruit, in reality the income derived was less. The farmers have pressing cash needs which either force them to sell the fruit ahead of time to intermediaries who advance them the money, or to harvest the fruit before its optimal season.

(2) Pest infestation destroys a large part of the traditional citrus harvest, drastically reducing income yields.

(3) *Nou pa gen pwofesyon-sa.* We don't have that habit. People seemed theoretically excited by the idea, but it was simply alien to their current economic habits. They would do it, according to some informants, if somebody in their community were to take the lead and show the profitability of the venture.

The project design accepts each of these reasons and has devised a solution for each barrier.

(1) Incentives will be structured in such a way as to open to project participants a way out of the need to engage in disadvantageous pre-harvest crop sales.

(2) The use of grafted fruit and chemical inputs will reduce pest infestation.

(3) The project will not enter the region with a crash emphasis on perennials. Rather, the emphasis will at first be on combining an increase in grain production with the introduction of soil conservation measures which defuse the economic dangers attendant on such an intensification. Fruit trees will, however, be introduced on a smaller scale to each participating farmer. The underlying model is to encourage a gradual, evolutionary shift to the improved perennials as they begin to demonstrate both their botanical and economic feasibility in the project region.

In short, the project is based upon an intervention package which recognizes the current annual food crop orientation of the hillside farmer and which programs a shift to perennials over time. The engine of this shift will be, not principally educational exhortations on the part of project staff, but inceasing economic returns from grafted fruit.

Rotating Exchange-Labor Squads. One of the most striking features of the

organization of labor in rural Haiti, and one of the most promising organizational models for the project, is the presence of exchange labor groups. In times past much labor was reportedly carried out with the *kounbit*, a work party with several dozen participants, accompanied by the rhythms of drums and bamboo trumpets (*vaksinn*). Such work parties have disappeared.

The current strategy is for the farmers to organize themselves into groups of about 10 and to rotate to each others' plots of round. Most heavy labor is performed, not by lone individuals, but by these rotating labor squads. Family labor, of course, continues to be imortant for certain phases of the agriculural cycle. But in the contemporary peasant economy, it is absolutely essential to a farmer's survival that he be able to mobilize, in addition to family labor, the labor of these rotating labor squads.

The matter has been complicated by the process of monetization and commercialization which is so central a feature of the local economy. Many groups and individuals actively sell their labor to their neighbors. Much of the labor performed by these squads is wageless exchange labor; but perhaps as much as half of their labor is also sold. Though the internal microeconomic logic of these arrangements has yet be worked out ethnographically, farmers assured us that most people in the region are both purchasers and sellers of labor and that it is now impossible to farm in the region without having capital to purchase labor. And the payment to the laborers must be made the same day, on termination of the task.

The presence of these commercialized rotating labor squads has at least two important implications for the project.

(1) The presence of small, self-selected acephalous groups provides the raw materials for a groupments, a strategy that has been found to work elsewhere in Haiti. The presence of rotating labor squads in the region is an anthropological asset that Project implementers should try to capitalize on.

(2) The role of monetization in the mobilization of even peasant labor means that some production incentive should be earmarked, or at least opened up to, the provision of labor. We heard repeatedly the assertion that somebody with access to material and labor inputs can get access to as much land as he needs in the context of local land tenure arrangements. The major constraining factor is the capital needed to work the land. If this is true, then the facilitating of inputs, if linked to the simultaneous performance of erosion control behaviors, will act as a strong incentive for accelerated participation by the local population in the activities of the Project.

Haitian Peasant land tenure. Land tenure dynamics will exert a critical impact on the acceptability and feasibility of the project. By the same token, the project itself, if successful, might exert an impact on land tenure arrangements in the Project region. For this reason a discussion of Haitian peasant land tenure is in order.

Land in Haiti is viewed as something which, under normal conditions, is "owned" by an individual. There is no tradition, either legally or informally based, of "community" owned land. There are instances of plos of ground which inheriting children do not bother to divide up into discretely owned plots. But these are exceptional collective arrangements applied for the most part only to

agriculturally marginal land which will be used either for grazing or for residential compounds. Productive land will be divided up and placed under the control of individuals.

Even in the case of State land, the State is considered as the "owner". Access to the land is viewed as contingent on paying rent, much as one does to a private owner. It is very unlikely that anybody in the project region will make project-recommended improvements on land that he does not have ownership rights over, either juridically or customarily defined.

Bilateral, partible inheritance. A major vehicle for land movement in Haiti is the inter-generational transmission of land at the death of parents. Two practices found elsewhere are militantly resisted in Haiti: the favoring of one heir over others (as through primogeniture), or the favoring of males over females (as through dowry substitutes for land inheritance). By law and by militant custom, all children of both sexes inherit equally. A parent is not allowed to disinherit a child, nor even to specify in a will that more land will be left to certain children. Legally mandated differences in inheritance rights come into play when the parent has children both of a legal and extralegal conjugal union. But the guiding principle is that all children inherit equally.

Land as an alienable commodity. Unlike in tribal settings, access to land is not only inherited in Haiti. It may also be purchased. In fact the purchase of land is culturally mandated in rural Haiti. Entry into incipient adulthood is achieved with mating and offspring. But entry into full respected adulthood is achieved only through the purchase of land. Project personnel are interested in the long term decision making processes of project participants. In this light it is critical to understand that in traditional Haiti, the long term economic strategy for moving up in the world has been one, not of increasing yields through improved technology, nor of protecting land through erosion control measure, but rather one of increasing one's landholdings through the purchase of land. Peasants will, of course, do everything possible to increase yields. But in terms of a long-range survival strategy, the traditional emphasis has been on acquiring more land through purchase. The current situation of stress opens the door for an evolutionary change in that orientation, toward a strategy of more intensive cultivation of the land which one already has. But such a shift is still in the future. Project personnel should have a sense for what the traditional long-range game plan of the peasant has been.

Though land has been a marketable commodity since the colonial and post-revolutionary period, population growth and the delay of access to inheritance land has created an intensification of the land market throughout rural Haiti. This movement appears to apply to the Project region as much as to other regions in Haiti. Though quantitative data are lacking on this matter, the impression was generated that the land differentials existing in the Project region are as much a product of land purchases and sales by individuals as they are of differences in the amount of land which was inter-generationally transmitted.

Land and Haitian Law. A great deal of Haitian law, based on the French Napoleonic Code, focuses on questions of land rights. Much of the activity that goes on in courts in Haiti is oriented to settling disputes over land. Haitian peasants know that access to land is subject to review by government and courts and know that their access to land is strongest when their rights

are supported by pieces of paper. They consequently feel nervous about their land ownership rights when they cannot point to some piece of paper, if not in their possession, at least in the possession of an older relative, that validates their particular right, or the right of their family, to claim ownership of the land.

The proper procedures for getting legalized pieces of paper entail calling in a government surveyor whenever land is transmitted, either through inheritance or through purchase. The surveyor measures the plot and place down official boundary markers. The inheritor or purchaser then receives a legalized deed for that specific plot of ground.

Such formal procedures were respected in the past. But surveyor fees have always been high; many people would pay the surveyor, not in cash, but rather by giving him a specified portion of the land being surveyed. And suspicion was always felt concerning the vulnerability of surveyors to bribes from one's neighbors on contiguous plots to measure in their favor. Though plots have become smaller over time, surveyors' fees have increased. With smaller plots comes greater pressure from neighbors. The result has been the emergence among peasants of informal mechanisms of land transmission. These informal procedures lead to an absence of plot-specific deeds. The question arises as to whether the absence of deeds will serve as a disincentive to participation in land-improvement activities on plots so acquires. The matter merits brief discussion.

Informal, extralegal land customs. Two types of informal land maneuvers can be identified that fall at least partially outside the scope of formal law and play a critical role in shaping the real life tenure situation prevalent in any given community. Project personnel should be aware of these patterns, and of the implications which they have for tenure security, and the concomitant willingness to invest in land improvements.

(1) ***Informal land partition by siblings.*** Many sibling groups will avoid the costs and risks of surveyors by simply dividing up the land among themselves using, not a surveyors chain, but a rope. In most areas of Haiti, such informal divisions are done in the presence of elderly comunnity witnesses. Informants in the project region indicated that no witnesses are called in there. In either case, after the partition, each inheriting child treats the land as though it is his or hers, and the community recognizes that person's exclusive rights over the parcels, even to the extent of being able to sell it. Because the partition was done without a surveyor, the inheritor will nor receive a legal deed for that particular plot.

(2) ***Notarized land sales.*** An analogous shortcut is used in the case of land purchase. It is in the interest of both buyer and seller to bypass the surveyor. The buyer may wish to avoid surveying costs; the seller may wish to have a surveyor intrude on land which he, the seller, may not have had surveyed when he acquired it through inheritance or purchase. The procedure is for a price to be agreed upon. Both parties then go to a notary, who witnesses the transaction and who charges a small fee for issuing a notarized record of the land sale. The notarization itself is considered necessary; the buyer fears that the heirs of the seller may claim that the land was not sold but merely rented. The buyer retains, and passes to his heirs, not a surveyed deed, but a simple record of transactions.

There are two types of deedlessness in rural Haiti: first, the radical deedlessness produced by the absence of genuine ownership rights in a plot of ground. Such deedlessness would affect the children of those who first acquired the land by squatting and who have not claimed prescription rights after the legally stipulated period of time. Second, the relative deedlessness of those who have used one of the above informal land acquisition maneuvers. Those who fall into the latter category may not be able to produce a deed for the plot of ground which they are claiming as theirs. But what they can often produce is the very old "master deed" which may date back from the 19th century, kept carefully in the possession of a trusted family elder or respected community member. The person's secuity of tenure rests on that particular paper, indicating legal acquisition by an ancestor to whom he can trace lineal descent.

Landlords and Tenants in Rural Haiti. Fortunately for the peasants, there are yet other extralegal, traditional channels by which people may get access to land. For example, sharecropping and renting occur within the peasantry itself. At different times in the career of an individual, he might depend more on sharecropped land, inherited land, or purchased land. And later in life, as he acquires more land, he may himself begin letting others work one or two of his plots as a tenant.

The very categories of "owner-operator", "tenant", and "landlord" make little sense in Haiti as ways of classifying individuals. At any given moment in time, the same individual may be cropping one of his inherited plots, one purchased plots, and two plots which he is sharecropping from a neighbor. This same individual may also have a plot farther away which he is giving out to another farmer to sharecrop. Thus this individual is simultaneously an inheritor, a purchaser, a tenant, and a landlord.

The Food-for-Work subculture in rural Haiti. Peasants are willing to pay projects for whatever they receive as long as three conditions are met:

(1) the project is providing something that is genuinely useful to them;

(2) the beneficiaries can afford what is being offered; and

(3) the payment is structured in such a way that individuals do not fear that they are paying for goods from which others will benefit as much as or more than they themselves.

Food for Work has been used by projects in cases where violation of one of these conditions has made peasants unwilling to participate and has forced project staff to resort to wage labor to generate participation.

In the building of dry-wall erosion control terraces on peasant-owned land, condition one is violated. Because of the space which they take up, the dry walls are believed neutral, or even negative, to the short term cash-flow interest of the peasant. In the case of road building or school building projects, people insist on payment in food or cash because condition 3 is being violated. In both of these cases the nature of the exchange is being redefined by the peasants; they are exchanging their labor for wages or quasi-wages. They are not expecting a free lunch; rather the project is viewed as wanting certain outputs for its own reasons, and the peasants insist on being paid for cooperating.

The key question now is: Can the project be structured in such a way that people will purchase the inputs, instead of receiving a free subsidy, as in the case of the trees? The answer to this is a tentative but optimistic yes. But it will take some negotiating between project and peasant. The secret is to begin with a recognition of the two fundamentally different types of purchase modes that exist. Under one mode the buyer pays cash up front. Under another purchase mode, he acquires now but pays later. This brings us to a discussion of the very difficult and controversial topic of credit

The Question of Credit. One of the most hotly debated topics that has surfaced during the project design stage is credit, and there are at least ten objections that have been raised against the use of credit in this project.

(1) ***Administrative costs.*** The inclusion of a serious credit component in the project would entail the allocation of a substantial chunk of project time and resources toward managing that credit in all its phases: soliciting, receiving, screening, and processing applications, disbursing the credit, setting up tracking measures for each portfolio, implementing supervisory measures to ensure that the credit is used for the earmarked purposes, receiving and processing payments, dealing with delays and defaults. Credit is, in short, a major administrative undertaking.

(2) ***High failure rate.*** The list of failed rural credit programs is much longer than the list of successes. Many projects have been badly burnt by well-intentioned but poorly conceived plans to make project resources available to peasant communities. Why build a guaranteed headache into the project?

(3) ***Alien to watershed management.*** There appears to be no intrinsic linkage between access to credit and the carrying out of erosion control measures. The vegetative interventions proposed by the project should be so inexpensive that the farmers will be able to implement them without going into debt.

(4) ***Erosion control inputs can be furnished free.*** The seed or vegetal material for nitrogen fixing hedgerows could justifiably be furnished free of charge by the project.

(5) ***Objections to bribery as a development tool.*** The use of credit as an incentive could create a situation in which credit-needy farmers carry out erosion control interventions, not for their own sake, but as a means of getting access to the credit. This is tantamount to "bribing" cash-needy peasants to accelerate their participation in the project. Would not a much healthier development strategy be to wait until the changed land use behaviors have proven their worth and are spontaneously accepted by the farmers on their own merit.

(6) ***Insufficient funds for meaningful credit lines.*** If $1 million is allocated to credit, and the potential beneficiary population is numbered around 50,000, each potential recipient would qualify for the grand total of $20. Subtracting the $10 or so that it would take to administer each portfolio, this reduces the per capita credit line to a level that would seem absurd even to a cash-needy Haitian peasant.

(7) ***Ecological backfiring.*** The infusion of a sudden amount of credit into the watersheds could have the effect of triggering off a sudden intensification

of agricultural activities. Rather than protecting the watersheds, this could constitute the ecological *coup de grace* and cause the entire project to backfire.

(8) ***Impossibility of enforcing earmarked uses.*** The project would not be able to enforce the use of credit for earmarked purposes. Farmers might simply use the credit for consumption or recreational purposes. Even worse, given the current astronomical interest rates at which traditional credit is lent, it might be economicaly rational for farmers simply to take project credit and lend it out to their neighbors at higher interest rates. TWAMP staff would be unable even to detect, let alone prevent, the occurence of such maneuvers.

(9) ***Elimination of incentives in Agroforestry.*** The Agroforestry Outreach project, suspecting that peasant interest in planting wood trees might be very low, built in an incentive arrangement in which tree planters would receive a labor stipend for each tree still alive after a year. Comparing peasant responses in regions where the incentive was applied with responses in regions where no such incentive was applied, the project could detect no difference in peasant willingness to plant or care for trees as the result of an incentive. Because peasants were interested in the trees themselves, the incentive mechanism was gradually eliminated from the project. TWAMP should learn from AOP and assume that the technical packages being recomended by the project will sell themselves.

(10) ***PVOs as banker-and-police.*** The allocation of credit to its clients could transform the relation between a local PVO and the peasants or *groupement* with whom it has built up relations of trust. The dual rual of moneylender and chaser after defaultees could weaken or destroy the relationship between the PVO and its clients.

The dangers and objections have been carefully recorded. But the entire dilemma, and the important program decisions that hinge on the resolution of this dilemma, will remain murky unless certain basic patterns are aired. Despite the weight of the above-listed objections, the project might never get off the ground, or might fall on its face once launched, unless credit arrangements are instituted, or unless other routes are found for carrying out the functions that credit could achieve.

Even in the traditional land use system, it is capital, rather than land, that is viewed and felt by the actors within the system to be their major immediate constraint. Even in the traditional system less land is worked, fewer beans are planted, than the maximum possible because of the inability of the cultivator to pay for the seed and labor. If no provisions are made for this dilemma two results are possible:

(1) Potentially interested farmers might simply dismiss the undertaking as something viable only for the wealthy.

(2) The participants and beneficiaries might in fact come only from the wealthier sectors of the local population.

Effective credit arrangements are one way out of this bind.

Credit is not, of course, a cure-all. The project must make other steps as well. Because some of these inputs are non-traditional to the region--special

improved seed to be produced under contract, fertilizer and other modern agronomic inputs--the project itself must open up the supply channels. To do this significant portions of the project budget must be earmarked for purchasing and stocking these non-traditional inputs and for making them available under project auspices (either umbrella agency or local PVO) to the beneficiary population.

One option is to give "free samples" of fertilizer and improved plant material, much in the manner in which the Agroforestry project gives away free seedlings. But a much better long-term strategy will be to make these inputs available to farmers on a credit basis, to be repaid to the project after the harvest. But whether it choose the "free sample" model or the credit model, AID should insist that a substantial portion of the budget be earmarked for purchasing the inputs without which peasants will neither be able nor inclined to implement the project activities on their own plots of ground.

Reference here is not being made to the inputs on project-managed demonstration plots, which of course will come out of the project budget. Reference is being made to inputs which the peasants themselves will apply to their own land. The project must acquire them and make them available, either as free samples or, preferably, in the form of credit. It would be an exercise in institutional fantasy to expect that the hillside peasants of the southern watersheds will, with their own cash and on their own initiative, rush to Les Cayes to purchase the capital intensive inputs that adoption of project recommended hillside packages presupposes. The lessons of the Agroforestry and Swine Repopulation projects have been cited as relevant. Neither of these projects made the unrealistic assumption that project participants themselves would spontaneously seek out the trees or import the pigs. Rather the projects themselves made budgetary provisions for activating an outward flow of these material inputs.

Credit, however, has other potential developmental functions. The payoffs from a successful credit program would be multiple in character.

[*Note: The following arguments generally aply to material inputs (capital) as incentives, as well as credit; therefore, they remain relevant to the project as approved.*]

(1) **Long-term resolution of the cash-flow dilemma.** This function of credit has just been discussed. Even if farmers are convinced of the income generating potential of project-recommended interventions, to the degree of being willing to invest capital without any additional "incentive", most of them simply lack the capital to participate. To keep credit properly lodged in the context of hillside farming, its "incentive" value should not be overemphasized. Its principal function is the old fashioned garden variety function of providing access to needed capital for already-motivated participants who happen to lack up-front cash resources. Failure to take this cash-flow blockage into account could hamstring and sabotage the project.

(2) **Incentive to apply vegetative interventions.** However we can assume that in the beginning most hillside farmers will not be convinced of the value of what is being proposed. They will be skeptical. And despite the enthusiasm of project staff, there will probably be no popular rush to line the hillsides with nitrogen fixing hedgerows or other vegetative interventions. To avoid this backfire effect, the project could legitimately decide to promote accelerated planting of nitrogen fixing

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hedgerows in the project region even before people are spontaneously convinced of their utility. The best alternative to the failed Food for Work incentive strategy might be to make access to credit contingent on a would-be borrower protecting at least one of his parcels with project-approved vegetative interventions. This use of credit might accelerate attention to and interest in this project among peasants. Hundreds and perhaps thousands of individuals who might choose to wait for years to begin experimenting, for example, with nitrogen fixing hedgerows, might move into immediate preparatory action if the project announced that inputs would be available on credit, but only for use on plots that have been protected with vegetative interventions.

(3) *Credibility of project technicians.* There is yet a third potential program payoff from the creation of a credit portfolio. Few sights are as sad as the sight of a qualified and highly motivated technician sent out to a village with neither authority nor resources, with nothing but his vehicle, his smile, and his messages. The ability of a technician to get his job done stems not only from his technical capacity. It also stems from the authority he has to allocate real-life resources to those with whom he is interacting. Villagers quickly see through technicians who have no command of resources. One of the most convincing and powerful resources with which TWAMP could arm its technicians, Haitian as well as expatriate, is the authority to allocate a credit line to those farmers who are willing to engage in risky new land use behaviors.

[*The description of the credit program has been deleted since it will not be implemented in this project. Project beneficiaries will be encouraged to utilize credit through the Bureau de Credit Agricole (BCA). The mission will in turn encourage the BCA Regional Office in Cayes to expand its operations into the target area, and to coordinate with the LORGs in extending group loans.*]

ANNEX I ECONOMIC ANALYSIS

[NOTE: The summary tables for this analysis, including the multiyear calculations of the IRR (Tables K1 throug K4), are found at the end of this annex.]

Introduction. The economy of Haiti has made notable progress in the past fifteen years, especially in improving the physical infrastructure of the country, including roads, ports, and communication systems, and in providing social services such as schools and medical facilities. Investment in labor-intensive light industry has also provided jobs in urban areas for a small but significant proportion of rural migrants, although labor productivity in these industries has declined since 1980. All of this is indicative of some encouraging forward movement in certain sectors of the economy.

The performance of the agricultural sector over the same period, however, has been poor and stands in vivid contrast to limited progress made elsewhere. By all accounts, agricultural output across the board has stagnated or is in decline when judged in absolute terms or *per capita*. Agricultural exports have been particularly affected in the last two decades. Coffee exports have declined even faster than the decline in overall production. Exports of cocoa, cotton and essential oils have stagnated. Haiti is now a net importer of sugar where historically it had been a major exporter. Inhabitants of the rural areas of Haiti are already among the poorest in the Western Hemisphere. They are getting poorer in real terms as population growth outstrips agricultural productivity and the terms of trade, particularly for export crops, have turned against them.

These rural people are losing ground vis-a-vis urban Haitians whose incomes have roughly kept pace with inflation over the last decade. Agricultural productivity and output in Haiti have failed to keep pace with domestic demand and the country has failed even to maintain the market shares it once held for its export crops. This poor agricultural performance has its roots in many constraints, some structural and many self-inflicted.

Structural Constraints. The structural constraints affecting agricultural productivity and output are numerous. Haiti has a limited natural endowment of flat, fertile agricultural land, about 350,000 total hectares on the plains, of which only 45,000 hectares are fully irrigated for a population in excess of 6,000,000 inhabitants. Approximately eighty per cent of the country, inland from these few coastal plains, is denuded hills with moderate to steep slopes. Many of these slopes are covered with shallow and relatively infertile soils. Virtually all of them are naturally subject to erosion over time but the process has been greatly accelerated in this century by man's misuse of the land. This is evidenced, among other things, by the fact that only 3.6 per cent of these slopes as now covered with forests, whereas up to 60 per cent of the land was forested as late as the 1920s. This misuse of the land can be explained in large measure by the interaction of high human population densities per square kilometer of cultivated land, with attendant livestock, and the primitive crop and livestock techniques employed by rural families. Much of the land in the hills is clearly not suitable for sustained cultivation of annual crops and does not respond well to the additional pressures of grazing and animal traffic.

It is estimated by the World Bank (1985) that 40 per cent of the total hillside area of Haiti has been denuded of soil, becoming essentially wilderness with

little or no vegetation. It is estimated that 10 to 15,000 hectares are lost to soil erosion annually as a result of poorly placed food crop plantings and the felling of forests for fuel and construction materials. This is the case on the 50 per cent of the land area with a slope greater than 40 per cent that is suitable ecologically only for forest cover. Another constraint to increasing agricultural production uniformly over large areas is the high variability in the spatial and temporal distribution of annual rainfall. Although annual rainfall in many areas seems to be more than adequate for sustained crop production, distribution of the rains is often problematic. Violent storms often cause extensive crop damage and, conversely, droughts can occur at critical periods in crop cycles. Finally, misuse of the land has lowered the soil moisture retention capacities in many areas to the point where much of the precipitation that is available simply runs off, causing sheet, rill and gully erosion, instead of being conserved for productive purposes.

At the level of the farmer, structural barriers to agricultural progress include

(1) the fractionalization of fields through inheritance rules, coupled with considerable uncertainties about the occupant's tenure status;

(2) the pattern of extremely small and often widely dispersed fields to allow the farmer to take advantage of different microclimates and other factors on the hillsides; and

(3) the lack of adequate farm-to-market roads in the hills which raises the marketing costs for all crops produced and all inputs and services available to farmers.

As stated above, there is heavy population pressure per hectare of available arable land in Haiti. The situation is further complicated by the fact that only about 45 per cent of the agricultural labor force is composed of independent peasant farmers and their families. The remainder of the effective rural labor force is composed of landless wage laborers and farmers under different types of rental and share cropping arrangements with landowners, local or absentee. These various land use arrangements have different impacts upon the attractiveness of agricultural innovations.

Most independent peasants live on the hillsides are caught in a particularly vicious circle. Their incomes are very low. *Per capita* rural GDP was estimated in FY 1983 to be around $ 125, compared to a national average of $318. The cash needs of these farm families are relatively high in relation to their incomes and yet all evidence indicates that these cash incomes are declining. With income levels so low and the cash crisis so severe, there is virtually no peasant saving or investment.

Technology levels and labor productivity remain strikingly low: farm implements and production techniques remain essentially medieval by any western standards. Most farmers on the hillsides possess only hand tools. They use essentially no improved seeds and purchase no significant quantities of any other modern agricultural inputs. Productivity increases are therefore minimal and do not come close to keeping pace with the growth in the population.

The proportion of all farms with 1.6 hectares or less increased from an estimated 39 per cent in 1950 to 71 per cent in 1971 and has undoubtedly increased further since. Conversely, the proportion of farms with more than 4

hectares fell from 16 per cent to 5 per cent by 1971. Therefore, the economic size of total land holdings is a major problem. This is further complicated by the fact that Haitian farms are usually fragmented into several fields, often at considerable distances one from the other. Many of these farms are now obviously too small to support family subsistence requirements, much less generate income flows to internally finance significant agricultural modernization.

To counter the decline in their effective purchasing power, most peasants are forced to plant higher and higher percentages of their land to food crops and to sell increasingly larger percentages of those crops at the expense of family subsistence needs. This trend has three principal consequences: first, it increases exploitation of more and more marginal land; second, it increases farmer indebtedness; and, finally, it aggravnates existing mal,nutrition in the rural population. Recent estimates show a nationwide average caloric deficit of 14 per cent and a protein deficit of 32 per cent, when present intakes are compared with FAO/WHO recommended levels. These average deficits among rural inhabitants are estimated at 40 per cent and 50 per cent, respectively.

Technical, Institutional and Policy Constraints. While the structural constraints mentioned above set the outer bounds of the feasible area for agricultural intervention and can only be released by long-term interventions, if at all there are several other constraints which are amenable to change in the short term and medium term.

The Government of Haiti is not efficient in providing any useful agricultural services for the bulk of Haitian peasants. The government agricultural research program appears to be severely underfunded, has little direction, and shows no noticeable results in terms of useful agricultural intervention packages. Agricultural input delivery systems, other than the limited ones run by individual donor efforts and some private companies, are virtually nonexistent in the rural areas in general, and on the hillsides in particular. The agricultural extension service exists mainly on paper. Those agents who actually are located in the field, and not behind desks at the Ministry of Agriculture, often have no transport or any other support services to allow them to perform adequately. In addition, they often have nothing of value to communicate to local farmers and cannot facilitate farmer access to any government services which would be useful to them.

If the government's deficiencies in providing useful services to the sector were merely neutral, there might have been some scope for private initiatives in agriculture. Unfortunately, however, government policies have compounded the difficult situation in peasant agriculture in a negative way. They have resulted in inappropriate incentives to certain farm enterprises and provided others with little or no incentives or support for raising their productivity. The most striking example on the hillsides is the plight of the coffee growers. At least one million people on the hillsides depend on this crop for a significant portion of their annual incomes. Yet coffee, which is a well-adapted perennial crop for the hillsides, has been subjected to a high export tax that has siphoned off large amounts of revenue from the coffee trade and significantly reduced producer prices for the crop. Low producer incentives inevitably lead to extreme peasant reluctance in renovating old coffee stands and result in extremely low per hectare yields of 200 kilograms or less from the old stands. In the recent past, similarly high export taxes have reduced effective producer prices for cocoa, sisal and essential oils and ruined producer incentives and virtually destroyed these export industries.

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Trade and importation control policies also distort agricultural producer incentives and lead to misallocations of resources to crops which could be more appropriately purchased in part on the world market. Of particular relevance to the hillsides is the government's restrictive import policies on food grains. By restricting imports of maize and rice in the face of growing domestic demand for food, the government appears to have further turned relative prices strongly against export crops like coffee and toward increased production of annual food crops on erosive hillsides that cannot sustain increased cultivation pressures. These price trends have been accentuated by the government's policy of giving inordinate protection to inefficient parastatal food processing industries, therefore driving food prices up further.

Finally, in addition to the harmful distortions created by state fiscal, pricing, and marketing policies, the public agricultural investment and credit programs have been diffuse and unfocussed. The program until recently consisted of a very large projects which did not correspond to any set of clearly defined sector objectives and so were not ranked in any order of priority. The World Bank (1985) estimates that there were as many as 65 donor-financed projects under implementation in FY 1984 and another 30 in some stage of preparation, not to mention domestically-financed activities of the Ministry. This has been an unrealistic workload for the Ministry staff and not surprisingly actual disbursements for useful activities have been limited. Furthermore, recurrent expenditures were often not adequately considered in advance nor were available funds disbursed when necessary. Arrangements for agricultural credit in Haiti have been designed less to strengthen the financial structure of viable farm enterprises than to meet credit needs indiscriminately. The two existing government institutions, BCA and BNDAI, have responded to general credit demand without clear production-oriented guidelines and staff.

Because of this, several rural development schemes have chosen to provide credit directly to farmers through a series of ad hoc and uncoordinated credit programs. Credit has generally not been channelled toward the farm enterprises with the most potential for major production and productivity gains and such programs are generally unsustainable after the particular sponsoring project terminates. In short, there is a virtually no rural capacity to move large amounts of credit to farmers for productive enterprises or to provide the technical and supervisory services necessary to see that successful loan applicants use their credit appropriately in enterprises which will allow them to repay their loans on time.

Existing farming systems. The project will deal with some of the deficiencies in the present agricultural system as they affect the hillsides. The details of the project have been outlined elsewhere. The remainder of this analysis deals with the viability of the existing hillside agricultural system and sets the basis for comparisons with the interventions proposed under the project.

An assessment of the existing traditional cropping systems in the project area is essential to set the basis for any economic analyses of proposed project interventions. In the case of the Pic Macaya watersheds, the existing cropping systems were defined for project purposes as those of farm families engaged in crop agriculture above 100 meters of elevation on the hillsides. Interventions on the plains in the Les Cayes and other adjacent areas were precluded from consideration but there was no upper altitude limit placed on agricultural

enterprises.

Exclusion of the plains as a target for project interventions negated the usefulness of almost all of the existing agricultural literature on the watershed area for purposes of economic analysis. What has been written on Haitian agriculture on the southern peninsula is almost entirely focused on irrigated and rainfed cropping on the flat, coastal plains and has little relevance to hillside situations. Moreover, most of the literature reports on crops grown and analyzed in mono,cultures, whereas virtually all crops on the hillsides are grown in associations or in relay cropping over the year.

Given the extreme deficiencies in the existing literature, we were forced to build a picture of the dominant cropping system on the hillsides from a very limited number of relevant secondary sources and from personal interviews and working sessions with the few Haitian agricultural technicians with actual work experience on the hillsides of the target watersheds.

The cropping system assumes a farm having six fields and a total crop area of 1.6 hectares. The farm family is assumed to plant these fields with crop associations tailored to their individual production capacities. In order to simulate a realistic farm situation over time, indicative crop association budgets were calculated for each field over a twenty year period and then aggregated to present an indicative farm cropping budget for each year of the period. In all, crop association budgets were calculated for all slots in the 6 by 20 matrix where crop production actually took place to establish the traditional farm base case. Examples of one of those budgets for each field are presented below to give the reader an idea of the specific assumptions of each type of crop association budget. Presentation of all the crop budgets would require the inclusion of about 200 pages of calculations in the project paper, which was deemed unnecessary.

Tables 1 to 6 quantify the results obtained from implementing the six different intervention packages on Fields 1 to 6 of the traditional farm. Results are as specified in the technical annex for each intervention package.

As can be seen from the tables, net cash returns are highly variable and range from a high of $88.53 in the fifth year to a low of $5.78 in the twentieth year, when the fertility of three fields is assumed to have been completely exhausted and the other three have suffered long-term yield declines of approximately 2 per cent per year. Total returns from the farm (net of production costs but including an imputed cost for unpaid family labor, follow a similar pattern. Finally, total returns per day of labor on crops show the greatest consistency over time. In every year, they are above the imputed cost of agricultural wage labor in the hillside areas of the watersheds ($0.70 per man-day).

This last result--that the total returns per day of labor on one's own fields is higher than the commonly accepted opportunity cost of one's labor on another farmer's field--may be one explanation why many farmers continue to exploit seemingly hopeless cropping situations, rather than work as wage laborers in the immediate vicinity of the farmsteads during the cropping season. The present system obviously reflects the risks associated with hillside agriculture in several ways:

(1) dispersion of fields with different crop associations on each field;

Table 1

INDICATIVE CROP BUDGET

(Calculated in U.S. Dollars per Hectare)

CROP : Sweet Potatoes in Monoculture
LEVEL OF TECHNOLOGY : Traditional
FIELD AND YEAR : # 1 - Year 3 (Reclamation Site)

CASH COSTS		CASH REVENUES	
Seed	$ 10.00	Sale of Crop	$ 5.00
Fertilizer	0		
Insecticides	0		
Herbicides	0		
Hand Tools	12.08		
TOTAL CASH COSTS	$ 22.08	TOTAL CASH REVENUES	$ 5.00
NON-CASH COSTS		REVENUES IN KIND	
Family Labor:			
Land Preparation	$ 23.10	Farm Crop Consumption	$ 45.00
Crop Planting	7.70		
First Weeding	13.30		
Second Weeding	0		
Fertilization	0		
Chemical Treatments	0		
Harvesting	1.40		
Post-Harvest	0		
TOTAL NON-CASH COSTS	$ 45.50	TOTAL REVENUES IN KIND	$ 45.00
TOTAL COSTS	$ 67.58	TOTAL REVENUES	$ 50.00

NET CASH RETURNS PER HECTARE:	$ - 17.08
NET CASH RETURNS PER DAY OF LABOR:	$ - 0.26
TOTAL RETURNS PER HECTARE:	$ - 17.58
TOTAL RETURNS PER DAY OF LABOR:	$ 0.43
TOTAL MAN/DAYS OF LABOR PER HECTARE	65

(Table 1, continued)

ASSUMPTIONS USED IN INDICATIVE CROP BUDGET

1. Field is 100 percent sweet potatoes.

2. Sweet potato planting rate is 7500 shoots per hectare at $ 10.00 per hectare.

3. No fertilizer is used in the traditional association.

4. No insecticides are used in the traditional association.

5. No herbicides are used in the traditional association.

6. Hand tools used are 2 machetes, 2 hoes, 2 picks and 2 sickles. Tool prices are estimated at $ 6.00 per machete, $ 8.00 per hoe, $ 5.00 per pick, and $ 10.00 per sickle. Total hand tool investment is $ 58.00. Hand tools can be used for three years. Annual tool cost is pro-rated for a 1.6 hectare farm.

7. Family labor expenditures for the association are estimated at:

   A. Land preparation at 33 man/days per hectare.

   B. Sweet potato planting at 11 man/days per hectare.

   C. Crop weeding at 19 man/days per hectare.

   D. Sweet potato harvesting at 4 man/days per metric ton of tubers.

   E. Imputed opportunity cost of family labor at $ 0.70 per man/day.

8. Estimated yield of sweet potatoes is 500 kilograms per hectare.

9. Estimated crop sales are 10 percent of the sweet potatoes harvested.

10. Estimated market price for sweet potatoes is $ 0.10 per kilogram.

Table 2
INDICATIVE CROP BUDGET

(Calculated in U.S. Dollars per Hectare)

CROP : Sweet Potatoes, Pigeon Peas, Sorghum, and Manioc in Association
LEVEL OF TECHNOLOGY : Traditional
FIELD AND YEAR : # 2 - Years 2 and 3 (High Risk Oxisol/ Ultasol Site)

CASH COSTS		CASH REVENUES	
Seed	$ 5.89	Sale of Crop	$ 25.25
Fertilizer	0		
Insecticides	0		
Herbicides	0		
Hand Tools	12.08		
TOTAL CASH COSTS	$ 17.97	TOTAL CASH REVENUES	$ 25.25
NON-CASH COSTS		REVENUES IN KIND	
Family Labor:			
Land Preparation	$ 23.10	Farm Crop Consumption	$ 91.63
Crop Planting	4.13		
First Weeding	13.30		
Second Weeding	0		
Fertilization	0		
Chemical Treatments	0		
Harvesting	2.15		
Post-Harvest	0.91		
TOTAL NON-CASH COSTS	$ 43.59	TOTAL REVENUES IN KIND	$ 91.63
TOTAL COSTS	$ 61.56	TOTAL REVENUES	$ 116.88

NET CASH RETURNS PER HECTARE: $ 7.28

NET CASH RETURNS PER DAY OF LABOR: $ 0.12

TOTAL RETURNS PER HECTARE: $ 55.32

TOTAL RETURNS PER DAY OF LABOR: $ 1.59

TOTAL MAN/DAYS OF LABOR PER HECTARE: 62

(Table 2, continued)

ASSUMPTIONS USED IN INDICATIVE CROP BUDGET

1. Field is split 20 percent in sweet potatoes, 30 percent in pigeon peas, 30 percent in sorghum, and 20 percent in manioc.

2. Sweet potato planting rate is 7500 shoots per hectare at $ 10.00 per hectare.

3. Pigeon pea seeding rate is 4.5 kilograms per hectare at $ 0.66 per kilogram of seed.

4. Sorghum seeding rate is 10 kilograms per hectare at $ 0.20 per kilogram of seed.

5. Manioc planting rate is 30 bunches per hectare at $ 12.00 per hectare.

6. No fertilizer is used in the traditional association.

7. No insecticides are used in the traditional association.

8. No herbicides are used in the traditional association.

9. Hand tools used are 2 machetes, 2 hoes, 2 picks and 2 sickles. Hand tool prices are estimated at $ 6.00 per machete, $ 8.00 per hoe, $ 5.00 per pick, and $ 10.00 per sickle. Total hand tool investment is $ 58.00. Tools can be used for three years. Annual tool cost pro-rated for 1.6 hectare farm.

10. Family labor expenditures for the association are estimated at:

    A. Land preparation at 33 man/days per hectare.

    B. Sweet potato planting at 11 man/days per hectare.

    C. Pigeon pea planting at 4 man/days per hectare.

    D. Sorghum planting at 1 man/days per hectare.

    E. Manioc planting at 11 man/days per hectare.

    F. Crop weeding at 19 man/days per hectare.

    G. Sweet potato harvesting at 4 man/days per metric ton of tubers.

H. Pigeon pea harvesting at 5 man/days per metric ton of peas.

I. Sorghum harvesting at 5 man/days per metric ton of grain.

J. Manioc harvesting at 4 man/days per metric ton of tubers.

K. Post-harvest preparation of pigeon peas at 8 man/days per metric ton of peas.

K. Post-harvest preparation of sorghum at 4 man/days per metric ton of grain.

L. Imputed opportunity cost of family labor at $ 0.70 per man/day.

11. Estimated sweet potato yield is 1050 kilograms per hectare. Estimated pigeon pea yield is 260 kilograms per hectare. Estimated sorghum yield is 560 kilograms per hectare. Estimated manioc yield is 1260 kilograms per hectare.

12. Estimated crop sales are 10 percent of the sweet potatoes; 5 percent of the pigeon peas; 10 percent of the sorghum; and 50 percent of the manioc.

13. Estimated market price for sweet potato is $ 0.10 per kilogram. Estimated market price for pigeon peas is $ 0.40 per kilogram. Estimated market price for sorghum is $ 0.16 per kilogram. Estimated market price for manioc is $ 0.15 per kilogram.

Table 3

INDICATIVE CROP BUDGET

(Calculated in U.S. Dollars per Hectare)

CROP : Sweet Potatoes, Pigeon Peas, Sorghum, and Manioc in Association

LEVEL OF TECHNOLOGY : Traditional

FIELD AND YEAR : # 3 - Years 1 and 2 (High Risk Mollisol Site)

CASH COSTS		CASH REVENUES	
Seed	$ 5.89	Sale of Crop	$ 25.08
Fertilizer	0		
Insecticides	0		
Herbicides	0		
Hand Tools	12.08		
TOTAL CASH COSTS	$ 17.97	TOTAL CASH REVENUES	$ 25.08
NON-CASH COSTS		REVENUES IN KIND	
Family Labor:			
Land Preparation	$ 23.10	Farm Crop Consumption	$ 99.44
Crop Planting	4.13		
First Weeding	13.30		
Second Weeding	0		
Fertilization	0		
Chemical Treatments	0		
Harvesting	2.28		
Post-Harvest	1.03		
TOTAL NON-CASH COSTS	$ 43.84	TOTAL REVENUES IN KIND	$ 99.44
TOTAL COSTS	$ 61.81	TOTAL REVENUES	$ 124.52

NET CASH RETURNS PER HECTARE:	$ 7.11
NET CASH RETURNS PER DAY OF LABOR:	$ 0.11
TOTAL RETURNS PER HECTARE:	$ 62.71
TOTAL RETURNS PER DAY OF LABOR:	$ 1.70
TOTAL MAN/DAYS OF LABOR PER HECTARE:	63

(Table 3, continued)

ASSUMPTIONS USED IN INDICATIVE CROP BUDGET

1. Field is split 20 percent in sweet potatoes, 30 percent in pigeon peas, 30 percent in sorghum, and 20 percent in manioc.

2. Sweet potato planting rate is 7500 shoots per hectare at $ 10.00 per hectare.

3. Pigeon pea seeding rate is 4.5 kilograms per hectare at $ 0.66 per kilogram of seed.

4. Sorghum seeding rate, is 10 kilograms per hectare at $ 0.20 per kilogram of seed.

5. Manioc planting rate is 30 bunches per hectare at $ 12.00 per hectare.

6. No fertilizer is used in the traditional association.

7. No insecticides are used in the traditional association.

8. No herbicides are used in the traditional association.

9. Hand tools used are 2 machetes, 2 hoes, 2 picks and 2 sickles. Hand tool prices are estimated at $ 6.00 per machete, $ 8.00 per hoe, $ 5.00 per pick, and $ 10.00 per sickle. Total hand tool investment is $ 58.00. Tools can be used for three years. Annual tool cost is pro-rated for a 1.6 hectare farm.

10. Family labor expenditures for the association are estimated at:

    A. Land preparation at 33 man/days per hectare.

    B. Sweet potato planting at 11 man/days per hectare.

    C. Pigeon pea planting at 4 man/days per hectare.

    D. Sorghum planting at 1 man/days per hectare.

    E. Manioc planting at 11 man/days per hectare.

    F. Crop weeding at 19 man/days per hectare.

    G. Sweet potato harvesting at 4 man/days per metric ton of tubers.

(Table 3, continued)

H. Pigeon pea harvesting at 5 man/days per metric ton of peas.

I. Sorghum harvesting at 5 man/days per metric ton of grain.

J. Manioc harvesting at 4 man/days per metric ton of tubers.

K. Post-harvest preparation of pigeon peas at 8 man/days per metric ton of peas.

K. Post-harvest preparation of sorghum at 4 man/days per metric ton of grain.

L. Imputed opportunity cost of family labor at $ 0.70 per man/day.

11. Estimated sweet potato yield is 1120 kilograms per hectare. Estimated pigeon pea yield is 295 kilograms per hectare. Estimated sorghum yield is 640 kilograms per hectare. Estimated manioc yield is 1200 kilograms per hectare.

12. Estimated crop sales are 10 percent of the sweet potatoes; 5 percent of the pigeon peas; 10 percent of the sorghum; and 50 percent of the manioc.

13. Estimated market price for sweet potato is $ 0.10 per kilogram. Estimated market price for pigeon peas is $ 0.40 per kilogram. Estimated market price for sorghum is $ 0.16 per kilogram. Estimated market price for manioc is $ 0.15 per kilogram.

Table 4

INDICATIVE CROP BUDGET

(Calculated in U.S. Dollars per Hectare)

CROP : Maize, Black Beans, Sweet Potatoes, Pigeon Peas, and Sorghum in Association

LEVEL OF TECHNOLOGY : Traditional

FIELD AND YEAR : # 4 - Year 1 (Moderate Risk Mollisol Site)

CASH COSTS		CASH REVENUES	
Seed	$ 43.30	Sale of Crop	$ 198.22
Fertilizer	0		
Insecticides	0		
Herbicides	0		
Hand Tools	12.08		
TOTAL CASH COSTS	$ 55.38	TOTAL CASH REVENUES	$ 198.22
NON-CASH COSTS		REVENUES IN KIND	
Family Labor:			
Land Preparation	$ 23.10	Farm Crop Consumption	$ 149.78
Crop Planting	8.05		
First Weeding	13.30		
Second Weeding	0		
Fertilization	0		
Chemical Treatments	0		
Harvesting	5.70		
Post-Harvest	4.58		
TOTAL NON-CASH COST	$ 54.73	TOTAL REVENUES IN KIND	$ 149.78
TOTAL COSTS	$ 110.11	TOTAL REVENUES	$ 348.00

NET CASH RETURNS PER HECTARE:	$ 142.84
NET CASH RETURNS PER DAY OF LABOR:	$ 1.83
TOTAL RETURNS PER HECTARE:	$ 237.89
TOTAL RETURNS PER DAY OF LABOR:	$ 3.74
TOTAL MAN/DAYS OF LABOR PER HECTARE	78

(Table 4, continued)

ASSUMPTIONS USED IN INDICATIVE CROP BUDGET

1. Field is split 20 percent in maize, 40 percent in black beans, 20 percent in sweet potatoes, 10 percent in pigeon peas, and 10 percent in sorghum.

2. Maize seeding rate is 20 kilograms per hectare at $ 0.20 per kilogram of seed.

3. Black bean seeding rate is 50 kilograms per hectare at $ 2.00 per kilogram of seed.

4. Sweet potato planting rate is 7500 shoots per hectare at $ 10.00 per hectare.

5. Pigeon pea seeding rate is 4.5 kilograms per hectare at $ 0.66 per kilogram of seed.

6. Sorghum seeding rate is 10 kilograms per hectare at $ 0.20 per kilogram of seed.

7. No fertilizer is used in the traditional association.

8. No insecticides are used in the traditional association.

9. No herbicides are used in the traditional association.

10. Hand tools used are 2 machetes, 2 hoes, 2 picks and 2 sickles. Hand tool prices are estimated at $ 6.00 per machete, $ 8.00 per hoe, $ 5.00 per pick, and $ 10.00 per sickle. Total hand tool investment is $ 58.00. Tools can be used for three years. Annual tool cost is pro-rated for a 1.6 hectare farm.

11. Family labor expenditures for the association are estimated at:

    A. Land preparation at 33 man/days per hectare.

    B. Maize planting at 4 man/days per hectare.

    C. Black bean planting at 20 man/days per hectare.

    D. Sweet potato planting at 11 man/days per hectare.

    E. Pigeon pea planting at 4 man/days per hectare.

(Table 4, continued)

F. Sorghum planting at 1 man/day per hectare.

G. Crop weeding at 19 man/days per hectare.

H. Maize harvesting at 9 man/days per metric ton of grain.

I. Black bean harvesting at 16 man/days per metric ton of dry beans.

J. Sweet potato harvesting at 4 man/days per metric ton of tubers.

K. Pigeon pea harvesting at 5 man/days per metric ton of peas.

L. Sorghum harvesting at 5 man/days per metric ton of grain.

M. Post-harvest preparation of maize at 4 man/days per metric ton of grain.

N. Post-harvest preparation of black beans at 20 man/days per metric ton of dry beans.

O. Post-harvest preparation of pigeon peas at 8 man/days per metric ton of peas.

P. Post-harvest preparation of sorghum at 4 man/days per metric ton of grain.

Q. Imputed opportunity cost of family labor at $ 0.70 per man/day.

12. Estimated maize yield per hectare is 1400 kilograms. Estimated black bean yield per hectare is 600 kilograms. Estimated sweet potato yield per hectare is 1500 kilograms. Estimated yield of pigeon peas per hectare is 370 kilograms Estimated yield of sorghum per hectare is 800 kilograms.

13. Estimated crop sales are 50 percent for maize, 70 percent for black beans, 10 percent for sweet potatoes, 5 percent for pigeon peas, and 10 percent for sorghum.

14. Estimated market prices are $ 0.18 per kilogram for maize, $ 1.00 per kilogram for black beans, $ 0.10 per kilogram for sweet potatoes, $ 0.40 for pigeon peas, and $ 0.16 per kilogram for sorghum.

Table 5
INDICATIVE CROP BUDGET

TWM (521-0191

(Calculated in U.S. Dollars per Hectare) Page I-17

CROP : Sweet Potatoes and Black Beans in Association
LEVEL OF TECHNOLOGY : Traditional
FIELD AND YEAR : # 5 - Year 1 (Moderate Risk Oxisol/ Ultasol Site)

CASH COSTS		CASH REVENUES	
Seed	$ 73.00	Sale of Crop	$ 295.65
Fertilizer	0		
Insecticides	0		
Herbicides	0		
Hand Tools	12.08		
TOTAL CASH COSTS	$ 85.08	TOTAL CASH REVENUES	
NON-CASH COSTS		REVENUES IN KIND	
Family Labor:			
Land Preparation	$ 23.10	Farm Crop Consumption	$ 122.85
Crop Planting	12.11		
First Weeding	13.30		
Second Weeding	0		
Fertilization	0		
Chemical Treatments	0		
Harvesting	5.37		
Post-Harvest	5.29		
TOTAL NON-CASH COSTS	$ 59.17	TOTAL REVENUES IN KIND	$ 122.85
TOTAL COSTS	$ 144.25	TOTAL REVENUES	$ 418.50

NET CASH RETURNS PER HECTARE:	$ 210.57
NET CASH RETURNS PER DAY OF LABOR:	$ 2.49
TOTAL RETURNS PER HECTARE:	$ 274.25
TOTAL RETURNS PER DAY OF LABOR:	$ 3.24
TOTAL MAN/DAYS OF LABOR PER HECTARE	85

(Table 5, continued)

ASSUMPTIONS USED IN INDICATIVE CROP BUDGET

1. Field is split 30 percent sweet potatoes and 70 percent black beans.

2. Sweet potato planting rate is 7500 shoots per hectare at $ 10.00 per hectare.

3. Black bean seeding rate is 50 kilograms per hectare at $ 2.00 per kilogram for seed.

4. No fertilizer is used in the traditional association.

5. No insecticides are used in the traditional association.

6. No herbicides are used in the traditional association.

7. Hand tools used are 2 machetes, 2 hoes, 2 picks, and 2 sickles. Tool prices are estimated at $ 6.00 per machete, $ 8.00 per hoe, $ 5.00 per pick, and $ 10.00 per sickle. Total hand tool investment is $ 58.00. Tools can be used for three years. Annual tool cost is pro-rated for a 1.6 hectare farm.

8. Family labor expenditures for the association are estimated at:

   A. Land preparation at 33 man/days per hectare.

   B. Sweet potato planting at 11 man/days per hectare.

   C. Black bean planting at 20 man/days per hectare.

   D. Crop weeding at 19 man/days per hectare.

   E. Sweet potato harvesting at 4 man/days per metric ton of tubers.

   F. Black bean harvesting at 16 man/days per metric ton of dry beans.

   G. Post-harvest preparation of black beans at 20 man/days per metric ton of dry beans.

   H. Imputed opportunity cost of family labor at $ 0.70 per man/day.

9. Estimated sweet potato yield is 1350 kilograms per hectare. Estimated black bean yield is 540 kilograms per hectare.

(Table 5, continued)

10. Estimated crop sales are 30 percent of the sweet potatoes harvested and 75 percent of the black beans.

11. Estimated market price for sweet potatoes is $ 0.10 per kilogram and $ 1.00 per kilogram for black beans.

Table 6
INDICATIVE CROP BUDGET

(Calculated in U.S. Dollars per Hectare)

CROP : Sweet Potatoes and Black Beans in Association
LEVEL OF TECHNOLOGY : Traditional
FIELD AND YEAR : # 6 - Year 3 (Moderate Risk Oxisol Site)

CASH COSTS		CASH REVENUES	
Seed	$ 73.00	Sale of Crop	$ 328.50
Fertilizer	0		
Insecticides	0		
Herbicides	0		
Hand Tools	12.08		
TOTAL CASH COSTS	$ 85.08	TOTAL CASH REVENUES	$ 328.50
NON-CASH COSTS		REVENUES IN KIND	
Family Labor:			
Land Preparation	$ 23.10	Farm Crop Consumption	$ 166.50
Crop Planting	12.11		
First Weeding	13.30		
Second Weeding	0		
Fertilization	0		
Chemical Treatments	0		
Harvesting	5.96		
Post-Harvest	5.88		
TOTAL NON-CASH COSTS	$ 60.35	TOTAL REVENUES IN KIND	$ 166.50
TOTAL COSTS	$ 145.43	TOTAL REVENUES	$ 495.00

NET CASH RETURNS PER HECTARE:	$ 243.42
NET CASH RETURNS PER DAY OF LABOR:	$ 2.82
TOTAL RETURNS PER HECTARE:	$ 349.57
TOTAL RETURNS PER DAY OF LABOR:	$ 4.75
TOTAL MAN/DAYS OF LABOR PER HECTARE	86

ASSUMPTIONS USED IN INDICATIVE CROP BUDGET

1. Field is split 30 percent sweet potatoes and 70 percent black beans.

2. Sweet potato planting rate is 7500 shoots per hectare at $ 10.00 per hectare.

3. Black bean seeding rate is 50 kilograms per hectare at $ 2.00 per kilogram for seed.

4. No fertilizer is used in the traditional association.

5. No insecticides are used in the traditional association.

6. No herbicides are used in the traditional association.

7. Hand tools used are 2 machetes, 2 hoes, 2 picks, and 2 sickles. Tool prices are estimated at $ 6.00 per machete, $ 8.00 per hoe, $ 5.00 per pick, and $ 10.00 per sickle. Total hand tool investment is $ 58.00. Tools can be used for three years. Annual tool cost is pro-rated for a 1.6 hectare farm.

8. Family labor expenditures for the association are estimated at:

   A. Land preparation at 33 man/days per hectare.

   B. Sweet potato planting at 11 man/days per hectare.

   C. Black bean planting at 20 man/days per hectare.

   D. Crop weeding at 19 man/days per hectare.

   E. Sweet potato harvesting at 4 man/days per metric ton of tubers.

   F. Black bean harvesting at 16 man/days per metric ton of dry beans.

   G. Post-harvest preparation of black beans at 20 man/days per metric ton of dry beans.

   H. Imputed opportunity cost of family labor at $ 0.70 per man/day.

9. Estimated sweet potato yield is 1500 kilograms per hectare. Estimated black bean yield is 600 kilograms per hectare.

10. Estimated crop sales are 30 percent of the sweet potatoes harvested and 75 percent of the black beans.

11. Estimated market price for sweet potatoes is $ 0.10 per kilogram and $ 1.00 per kilogram for black beans.

Table 7
SUMMARY OF RESULTS FOR THE PROPOSED FRUIT TREE INTERVENTION

YEAR	UNDISCOUNTED BENEFITS	UNDISCOUNTED COSTS	UNDISCOUNTED NET BENEFITS	NET BENEFITS DISCOUNTED AT 14 PERCENT
		(in U.S. $)		
1	0	607840	- 607840	- 533076
2	0	844240	- 844240	- 649221
3	18000	1080640	-1062640	- 717282
4	72000	1317040	-1245040	- 737064
5	196000	1553440	-1357440	- 704511
6	424000	1182000	- 758000	- 345648
7	806000	1182000	- 376000	- 150400
8	1332000	1182000	150000	52650
9	1918000	1182000	736000	226688
10	2530000	1182000	1348000	363960
11	3054000	1182000	1872000	443664
12	3440000	1182000	2258000	469664
13	3664000	1182000	2482000	451724
14	3792000	1182000	2610000	417600
15	3824000	1182000	2642000	369880
16	3840000	1182000	2642000	324966
17	3840000	1182000	2642000	285336
18	3840000	1182000	2642000	250990
19	3840000	1182000	2642000	219286
20	3840000	1182000	2642000	192866
			$ 21056800	$ 232072

NET PRESENT VALUE DISCOUNTED AT 14 % = $ 232,072

ESTIMATED INTERNAL RATE OF RETURN = 14.2 %

(2) extremely low capital investment per hectare in cultivation, essentially limited to hand tools and unimproved plant materials;

(3) primary dependence on unpaid family labor in return fo subsistence consumption of crop yields and limited cash income from crop sales; and

(4) predominant emphasis in crop allocations to annual food crops reflective of family consumption needs and relative price trends in recent years.

To allow comparison with the indicative traditional cropping system detailed above, six field intervention packages were proposed by the design team technicians to respond to the specific characteristics of the six different field situations assumed for the traditional farm. The intervention packages are detailed in the project paper technical annex. The objective is simply to quantify the output-input relationships of the proposed intervention packages and to compare the result with those from the indicative traditional situation.

In addition to the promotion of the intervention packages on farmers' fields, the project proposes a fruit tree development and extension program as described in the technical annex. This program is projected to affect 25,000 farm families. It will provide 30,000 nursery-grown fruit trees annually and will graft improved citrus stock on existing sour orange trees on farmers' land. Table 7 presents this program in terms of its projected costs and benefits.

Donor Perspective. Having analyzed the value of the proposed project interventions in terms of the direct benefits to the farmers in the last two sections of this annex, we turn here to a calculation of the value of the overall project from the donor's viewpoint. In order to make calculation an estimate of the spread effect of the project interventions during and after the project's life is needed. This estimate is presented below, as given by the design team technicians, for the spread of the intervention packages an the fruit tree program.

Table 8
ADOPTION OF FRUIT TREE PACKAGES

Project Year	Farmers Adopting Intervention Packages	Farmers Participating in the Fruit Tree Program
1	0	500
2	500	500
3	1000	500
4	3500	500
5	5000	500
6	10000	
	---	---
TOTALS	20000	2500

Due to the fact that the intervention packages are structured in such a way that disaggregation into specific crop production interventions and soil conservation interventions is not really possible, farmers adopting the intervention packages are assumed to adopt the whole package. Although this will almost certainly not be the actual case as the project is implemented, this assumption at least gives the reader an idea of the outer bound in the net

project benefits to be derived from project implementation.

Summary and recommendations. The economic analysis summarizes in quantitative terms of benefits assumed to flow from the project's two major activities at the farm level: the six intervention packages for crop improvement and soil conservation and the fruit tree development and extension program. It then compares these benefits with the projected private and public costs of implementing the proposed activities.

In the case of the six proposed intervention packages, the analysis finds, subject to the assumptions in the technical annex, that the estimated net present value of benefits from intervention packages adoption is $ 347.79 when discounted at 50 per cent. The estimated internal rate of return for package adoption is greater than 50 per cent at the farmer level. And, the projected benefit-cost ratio discounted at 50 per cent is 1.28. These indicators were derived assuming a participating farm family population of 20,000 over the life of the project.

In the case of the fruit tree development and extension program, the estimated net present value of benefits from the program is $232,072 when discounted at 14 per cent. The estimated internal rate of return is 14.2 per cent for the program, under the assumptions in the technical analysis. The projected beneficiary population for this program is 25,000 farm families over the life of the project. In terms of the overall project analysis, the estimated internal rate of return is 31.3 per cent.

It should be recognized in reviewing these results that they are based upon many technical assumptions by design team technicians and what useful information could be derived from an extremely deficient national data base on hillside agriculture. The actual results of project implementation activities and farmer adoption of the proposed interventions may be very different from those projected in the analysis. The project makes provision for an on-the-ground project monitoring and evaluation unit during the life of the project to collect both reliable baseline information on existing farming systems on the hillsides and comparable information on the value of the project interventions as they were developed and extended. Only as this improved information base is developed and analyzed can one have much confidence in the projected benefits and costs of the proposed interventions.

FARMTRAD

TABLE K-1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TRADITIONAL FARM																				
FIELD NO. 1: 0.08 Hectares																				
Net Cash Returns from Field	$0.00	($1.37)	$0.00	$0.00	($0.69)	($0.69)	($0.69)	($0.69)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Returns from Field	0.00	(1.41)	0.00	0.00	(0.71)	(0.71)	(0.71)	(0.71)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Man/days of Labor for Field	0.00	5.20	0.00	0.00	2.60	2.60	2.60	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Returns per Day of Labor on the Field	0.00	0.03	0.00	0.00	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIELD NO. 2: 0.48 Hectares																				
Net Cash Returns from Field	8.64	(5.23)	8.64	(5.23)	8.64	(5.23)	8.16	0.00	0.00	(6.10)	7.51	(6.20)	7.21	(6.30)	6.92	0.00	0.00	(6.49)	6.36	(6.59)
Total Returns from Field	17.28	15.14	17.28	15.14	17.28	5.91	16.32	0.00	0.00	2.4	15.28	1.14	14.69	0.00	14.10	0.00	0.00	(2.25)	12.96	(3.54)
Total Man/days of Labor for Field	0.50	29.70	0.50	29.70	0.50	29.30	0.40	0.00	0.00	29.10	0.40	29.00	0.40	28.90	0.40	0.00	0.00	28.90	0.30	28.90
Total Returns per Day of Labor on the Field	37.50	1.14	37.50	1.14	37.50	0.87	37.00	0.00	0.00	0.78	39.60	0.74	38.25	0.70	36.73	0.00	0.00	0.62	38.59	0.59
FIELD NO. 3: 0.40 Hectares																				
Net Cash Returns from Field	(11.62)	7.56	(11.62)	7.56	(3.92)	(4.71)	(4.74)	(5.02)	(5.05)	(5.09)	(5.12)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Returns from Field	18.23	15.12	18.23	15.12	12.27	3.81	3.51	1.10	1.65	1.30	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Man/days of Labor for Field	61.00	0.40	61.00	0.40	24.70	12.70	12.60	14.60	13.30	13.30	13.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Returns per Day of Labor on the Field	1.00	37.80	1.00	37.80	1.20	1.00	0.98	0.78	0.82	0.80	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIELD NO. 4: 0.16 Hectares																				
Net Cash Returns from Field	22.85	22.22	20.95	20.67	20.39	19.79	19.20	18.63	18.09	17.56	17.04	16.51	15.98	15.50	15.03	14.55	14.08	13.60	13.18	12.75
Total Returns from Field	38.06	36.99	35.92	34.81	33.85	32.81	31.84	30.85	29.93	29.04	28.14	27.25	26.36	25.54	24.74	23.92	23.10	22.31	21.88	20.84
Total Man/days of Labor for Field	12.50	12.40	12.40	12.40	12.30	12.30	12.20	12.20	12.10	12.10	12.10	12.00	12.00	11.90	11.90	11.80	11.80	11.80	11.70	11.70
Total Returns per Day of Labor on the Field	3.74	3.68	3.68	3.52	3.46	3.38	3.31	3.24	3.14	3.11	3.03	2.97	2.90	2.84	2.79	2.72	2.66	2.60	2.56	2.47
FIELD NO. 5: 0.32 Hectares																				
Net Cash Returns from Field	67.38	1.01	0.00	65.46	63.53	31.77	(3.33)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Returns from Field	87.76	14.52	0.00	85.11	82.44	41.22	15.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Man/days of Labor for Field	27.20	10.90	0.00	27.10	27.00	13.50	21.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Returns per Day of Labor on the Field	3.94	2.03	0.00	3.84	3.74	3.74	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIELD NO. 6: 0.16 Hectares																				
Net Cash Returns from Field	0.87	0.00	38.95	0.65	0.58	0.00	32.64	0.37	0.31	0.00	28.44	0.09	0.03	0.00	24.23	(0.19)	(0.24)	(0.29)	(0.34)	(0.39)
Total Returns from Field	5.40	0.00	55.93	4.71	4.48	0.00	42.60	3.80	3.59	0.00	36.63	2.88	2.70	0.00	30.84	1.97	1.80	1.64	1.48	1.32
Total Man/days of Labor for Field	10.60	0.00	13.80	10.50	10.50	0.00	13.20	10.50	10.50	0.00	13.20	10.50	10.40	0.00	13.00	10.40	10.40	10.40	10.40	10.40
Total Returns per Day of Labor on the Field	0.88	0.00	4.75	0.81	0.79	0.00	3.93	0.73	0.71	0.00	3.47	0.64	0.62	0.00	3.08	0.55	0.53	0.52	0.50	0.49
TOTALS																				
Net Cash Returns from Farm	88.12	24.19	56.92	89.11	88.53	40.28	51.24	13.29	13.35	6.37	47.87	10.40	23.22	9.20	46.18	14.36	13.84	6.82	19.20	5.78
Total Returns from Farm	166.73	78.36	127.36	152.89	149.61	82.14	108.65	35.04	35.17	32.74	81.02	31.27	43.75	25.54	69.68	25.89	24.90	21.70	36.32	18.80
Total Man/days of Labor for Crops	111.80	58.60	87.70	80.10	77.60	70.40	62.60	39.90	35.90	54.50	39.00	51.50	22.80	40.90	25.30	22.20	22.20	51.10	22.40	51.00
Total Returns per Day of Labor from Crops	2.17	1.99	2.17	2.56	2.58	1.85	2.40	1.47	1.57	1.30	2.79	1.24	2.48	1.32	3.48	1.70	1.66	1.06	2.09	0.99

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INTERVENTION PACKAGE NO. 1 ON FIELD NO. 1 (0.08 HECTARES)

TABLE K-2, page 1/2

	unit value	1	2	3	4	5	6	7	8
. AREA COVERED BY CROP (in Hectares)									
a. Leucaena		0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
b. Vetiver							0.024	0.024	0.024
c. Bufflegrass		0.064	0.064	0.064	0.064	0.064	0.040	0.040	0.040
. ESTIMATED YIELDS BY CROP (IN KILOGRAMS)									
a. Leucaena (in poles)		0	0	0	0	32	0	0	0
b. Vetiver		0	0	0	0	0	0	19	37
c. Bufflegrass		0	192	192	192	192	120	120	120
. ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN U.S.$)	unit value								
a. Leucaena (per poles)	$0.50	$0.00	$0.00	$0.00	$0.00	$16.00	$0.00	$0.00	$0.00
b. Vetiver (per kilogram)	$0.12	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.28	$4.44
c. Bufflegrass (per kilogram)	$0.02	$0.00	$3.84	$3.84	$3.84	$3.84	$2.40	$2.40	$2.40
. ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR (IN US$)		$0.00	$3.84	$3.84	$3.84	$19.84	$2.40	$4.68	$6.84
. ESTIMATED CASH PRODUCTION COSTS BY CROP (IN US$)									
a. Pro-rated Hand Tool Cost		$0.97	$0.97	$0.97	$0.97	$0.97	$0.97	$0.97	$0.97
b. Fertilizer Cost		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
c. Leucaena Seed ($15./kg x 12.5 kg/ha)		$3.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Vetiver Clumps ($60.00/hectare)		$0.00	$0.00	$0.00	$0.00	$0.00	$4.80	$2.40	$2.40
e. Buffle Grass Seed ($15/kg x 5 kg/ha)		$4.80	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
. ESTIMATED CASH PRODUCTION COSTS FOR FIELD (IN US$)		$8.77	$0.97	$0.97	$0.97	$0.97	$5.77	$3.37	$3.37
. ESTIMATED NET RETURSN TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		($8.77)	$2.87	$2.87	$2.87	$18.87	($3.37)	$1.31	$3.47

INTERVENTION PACKAGE NO. 1 ON FIELD NO. 1 (0.03 HECTARES)

TABLE H-2, page 2/2

	Unit value	9	10	11	12	13	14	15	16	17	18	19	20
• AREA COVERED BY CROP (in Hectares)													
a. Leucaena		0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
b. Vetiver		0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
c. Buffalograss		0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
• ESTIMATED YIELDS BY CROP (IN KILOGRAMS)													
a. Leucaena (in poles)		0	32	0	0	0	0	32	0	0	0	0	32
b. Vetiver		37	38	39	40	41	41	43	44	45	46	47	48
c. Buffalograss		120	120	120	120	120	120	120	120	120	120	120	120
• ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN U.S.$)													
a. Leucaena (per poles)	$0.50	$0.00	$16.00	$0.00	$0.00	$0.00	$0.00	$16.00	$0.00	$0.00	$0.00	$0.00	$16.00
b. Vetiver (per kilogram)	$0.12	$4.44	$4.56	$4.68	$4.80	$4.92	$4.92	$5.16	$5.28	$5.40	$5.52	$5.64	$5.76
c. Buffalograss (per kilogram)	$0.02	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40
• ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR (IN US$)		$6.84	$22.96	$7.08	$7.20	$7.32	$7.32	$23.56	$7.68	$7.80	$7.92	$8.04	$24.16
• ESTIMATED CASH PRODUCTION COSTS BY CROP (IN US$)													
a. Prorated Hand Tool Cost		$0.97	$0.97	$0.97	$0.97	$0.97	$0.97	$0.97	$0.97	$0.97	$0.97	$0.97	$0.97
b. Fertilizer Cost		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
c. Leucaena Seed ($15./kg x 12.5 kg/ha)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Vetiver Clumps ($60.00/hectare)		$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40
e. Buffalo Grass Seed ($15/kg x [illegible] kg/ha)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
• ESTIMATED CASH PRODUCTION COSTS FOR FIELD (IN US$)		$3.37	$3.37	$3.37	$3.37	$3.37	$3.37	$3.37	$3.37	$3.37	$3.37	$3.37	$3.37
• ESTIMATED NET RETURN TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		$3.47	$19.59	$3.71	$3.83	$3.95	$3.95	$20.19	$4.31	$4.43	$4.55	$4.67	$20.79

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TABLE K-3, p1/2
INTERVENTION PACKAGE NO. 2 ON FIELD NO. 2 (0.48 HECTARES)

		1	2	3	4	5	6	7	8
1. AREA COVERED BY CROP (IN HECTARES)									
a. Leucaena		0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072
b. pineapples		0.012	0.024	0.024	0.024	0.024	0.024	0.024	0.024
c. Sweet Potatoes		0.192	0.192	0.192	0.192	0.192	0.096	0.096	0.096
d. Black Beans		0.096	0.096	0.096	0.096	0.096	0.192	0.192	0.192
e. sorghum		0.096	0.096	0.096	0.096	0.096	0.144	0.144	0.144
f. Cassava		0.096	0.096	0.096	0.096	0.096	0.048	0.048	0.048
g. Maize							0.048	0.048	0.048
2. ESTIMATED YIELDS BY CROP (IN KILOGRAMS)									
a. Leucaena (in poles)		0	0	0	0	145	0	0	0
b. pineapples		0	0	294	294	294	294	294	294
c. Sweet Potatoes		202	206	302	308	314	160	163	167
d. Black Beans		40	41	60	61	62	127	130	132
e. sorghum		54	55	81	83	84	129	131	134
f. Cassava		0	121	123	181	185	188	94	96
g. Maize		0	0	0	0	0	58	59	60
3. ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN US$)	unit value								
a. Leucaena ($0.50/pole)	$0.50	$0.00	$0.00	$0.00	$0.00	$72.50	$0.00	$0.00	$0.00
b. pineapples ($.40/kilogram)	$0.40	$0.00	$0.00	$117.60	$117.60	$117.60	$117.60	$117.60	$117.60
c. Sweet Potatoes ($0.10/kilogram)	$0.10	$20.20	$20.60	$30.20	$30.80	$31.40	$16.00	$16.30	$16.70
d. Black Beans ($1.00/kilogram)	$1.00	$40.00	$41.00	$60.00	$61.00	$62.00	$127.00	$130.00	$132.00
e. sorghum ($0.16/kilogram)	$0.16	$8.64	$8.80	$12.96	$13.28	$13.44	$20.64	$20.96	$21.44
f. Cassava ($0.15/kilogram)	$0.15	$0.00	$18.15	$18.45	$27.15	$27.75	$28.20	$14.10	$14.40
g. Maize ($0.18/kilogram)	$0.18	$0.00	$0.00	$0.00	$0.00	$0.00	$10.44	$10.62	$10.80
4. ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR		$68.84	$88.55	$239.21	$249.88	$324.69	$319.88	$309.58	$312.94
5. ESTIMATED CASH PRODUCTION COSTS BY CROP									
a. Pro-rated Hand Tool Cost		$5.80	$5.80	$5.80	$5.80	$5.80	$5.80	$5.80	$5.80
b. Fertilizer Cost (200kg of 20-20-10/ha)		$30.69	$30.69	$30.69	$30.69	$30.69	$30.69	$30.69	$30.69
c. Leucaena Seed ($15 x 12.5kg/ha)		$18.50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Pineapple Tops ($1,750/ha)		$21.00	$21.00	$21.00	$21.00	$21.00	$21.00	$21.00	$21.00
e. Sweet Potatoes Vines ($10/ha)		$1.92	$1.92	$1.92	$1.92	$1.92	$0.96	$0.96	$0.96
f. Black Bean Seed ($2 x 50kg/ha)		$9.60	$9.60	$9.60	$9.60	$9.60	$19.20	$19.20	$19.20
g. Sorghum Seed ($0.20 x 10kg/ha)		$0.19	$0.19	$0.19	$0.19	$0.19	$0.29	$0.29	$0.29
h. Cassava Cuttings ($12/ha)		$1.15	$1.15	$1.15	$1.15	$1.15	$0.58	$0.58	$0.58
i. Maize Seed ($.50 x 20kg/ha)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.48	$0.48	$0.48
6. ESTIMATED CASH PRODUCTION COSTS FOR FIELD		$89.85	$70.35	$70.35	$70.35	$70.35	$79.00	$79.00	$79.00
7. ESTIMATED NET RETURNS TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		($15.01)	$18.20	$168.86	$179.48	$254.34	$240.88	$230.58	$233.94

TABLE K-3, p 2/2
INTERVENTION PACKAGE NO. 2 ON FIELD NO. 2 (0.43 HECTARES)

		9	10	11	12	13	14	15	16	17	18	19	20
1. AREA COVERED BY CROP (IN HECTARES)													
a. Leucaena		0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072
b. pineapples		0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
c. Sweet Potatoes		0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096
d. Black Beans		0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192
e. sorghum		0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144
f. Cassava		0.048	0.048										
g. Maize		0.048	0.048	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120
2. ESTIMATED YIELDS BY CROP (IN KILOGRAMS)													
a. Leucaena (in poles)		0	145	0	0	0	0	145	0	0	0	0	145
b. pineapples		294	294	294	294	294	294	294	294	294	294	294	294
c. Sweet Potatoes		170	173	42	43	44	44	46	47	48	49	50	51
d. Black Beans		135	138	176	179	183	188	190	194	198	202	205	210
e. sorghum		136	139	142	145	148	140	154	156	159	162	165	169
f. Cassava		93	100	0	0	0	0	0	0	0	0	0	0
g. Maize		62	63	157	160	163	166	170	173	177	180	184	188
3. ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN US$)	unit value												
a. Leucaena ($0.50/pole)	$0.50	$0.00	$72.50	$0.00	$0.00	$0.00	$0.00	$72.50	$0.00	$0.00	$0.00	$0.00	$72.50
b. pineapples ($0.40/kilogram)	$0.40	$117.60	$117.60	$117.60	$117.60	$117.60	$117.60	$117.60	$117.60	$117.60	$117.60	$117.60	$117.60
c. Sweet Potatoes ($0.10/kilogram)	$0.10	$17.00	$17.30	$4.20	$4.30	$4.40	$4.40	$4.60	$4.70	$4.80	$4.90	$5.00	$5.10
d. Black Beans ($1.00/kilogram)	$1.00	$135.00	$138.00	$176.00	$179.00	$183.00	$188.00	$190.00	$194.00	$198.00	$202.00	$205.00	$210.00
e. sorghum ($0.15/kilogram)	$0.15	$21.76	$22.24	$22.72	$23.20	$23.68	$23.68	$24.64	$24.96	$25.44	$25.92	$26.40	$27.04
f. Cassava ($0.15/kilogram)	$0.15	$14.70	$15.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
g. Maize ($0.18/kilogram)	$0.18	$11.16	$11.34	$28.26	$28.80	$29.34	$29.88	$30.60	$31.14	$31.86	$32.40	$33.12	$33.84
4. ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR		$317.22	$393.93	$348.78	$352.90	$358.02	$358.56	$439.94	$372.40	$377.70	$382.82	$388.28	$466.03
5. ESTIMATED CASH PRODUCTION COSTS BY CROP													
a. Prorrated Hand Tool Cost		$5.80	$5.80	$5.80	$5.80	$5.80	$5.80	$5.80	$5.80	$5.80	$5.80	$5.80	$5.80
b. Fertilizer Cost (200kg of 20-20-10/ha)		$30.69	$30.69	$30.69	$30.69	$30.69	$30.69	$30.69	$30.69	$30.69	$30.69	$30.69	$30.69
c. Leucaena Seed ($15 x 12.5kg/ha)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Pineapple Tops ($1,750/ha)		$21.00	$21.00	$21.00	$21.00	$21.00	$21.00	$21.00	$21.00	$21.00	$21.00	$21.00	$21.00
e. Sweet Potatoes Vines ($10/ha)		$0.96	$0.96	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
f. Black Bean Seed ($2 x 50kg/ha)		$19.20	$19.20	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00
g. Sorghum Seed ($0.20 x 10kg/ha)		$0.29	$0.29	$0.29	$0.29	$0.29	$0.29	$0.29	$0.29	$0.29	$0.29	$0.29	$0.29
h. Cassava Cuttings ($1/ha)		$0.58	$0.58	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
i. Maize Seed ($.60 x 2kg/ha)		$0.48	$0.48	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
6. ESTIMATED CASH PRODUCTION COSTS FOR FIELD		$79.00	$79.00	$83.22	$83.22	$83.22	$83.22	$83.22	$83.22	$83.22	$83.22	$83.22	$83.22
7. ESTIMATED NET RETURNS TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		$238.22	$314.93	$265.56	$269.68	$274.80	$275.34	$356.72	$289.18	$294.48	$299.60	$305.06	$382.81

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TABLE K-4, p 1/2
INTERVENTION PACKAGE NO. 3 ON FIELD NO. 3 (0.40 HECTARES)

		1	2	3	4	5	6	7	8
1. AREA COVERED BY CROP (IN HECTARES)									
a. Leucaena		0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
b. Maize		0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120
c. Black Beans		0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160
d. Sweet Potatoes		0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
e. Sorghum		0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120
f. Yams		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
g. Papaya		0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
2. ESTIMATED YIELDS BY CROP (IN KILOGRAMS)									
a. Leucaena (in poles)		0	0	0	0	72	0	0	0
b. Maize		134	137	339	345	352	359	367	374
c. Black Beans		77	78	115	118	120	122	125	127
d. Sweet Potatoes		101	103	151	154	157	160	164	167
e. Sorghum		77	78	115	118	120	122	125	127
f. Yams		0	0	0	0	0	0	0	0
g. Papaya		40	60	64	68	72	76	80	80
3. ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN US$)	**unit value**								
a. Leucaena ($0.50/pole)	$0.50	$0.00	$0.00	$0.00	$0.00	$36.00	$0.00	$0.00	$0.00
b. Maize ($0.18/kilogram)	$0.18	$24.12	$24.66	$61.02	$62.10	$63.36	$64.62	$66.06	$67.32
c. Black Beans ($1.00/kilogram)	$1.00	$77.00	$78.00	$115.00	$118.00	$120.00	$122.00	$125.00	$127.00
d. Sweet Potatoes ($0.10/kilogram)	$0.10	$10.10	$10.30	$15.10	$15.40	$15.70	$16.00	$16.40	$16.70
e. Sorghum ($0.16/kilogram)	$0.16	$12.32	$12.48	$18.40	$18.88	$19.20	$19.52	$20.00	$20.32
f. Yams ($0.15/Kilogram)	$0.15	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
g. Papaya ($0.50/Kilogram)	$0.50	$20.00	$30.00	$32.00	$34.00	$36.00	$38.00	$40.00	$40.00
4. ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR		$143.54	$155.44	$241.52	$248.38	$290.26	$260.14	$267.46	$271.34
5. ESTIMATED CASH PRODUCTION COSTS BY CROP									
a. Pro-rated Hand Tool Cost		$4.83	$4.83	$4.83	$4.83	$4.83	$4.83	$4.83	$4.83
b. Fertilizer Cost (200kg of 20-20-10/ha)		$25.57	$25.57	$25.57	$25.57	$25.57	$25.57	$25.57	$25.57
c. Leucaena Seed ($15 x 12.5kg/ha)		$6.75	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Maize seed ($0.50 x 20Kg/ha)		$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
f. Black Bean Seed ($2 x 50kg/ha)		$16.00	$16.00	$16.00	$16.00	$16.00	$16.00	$16.00	$16.00
e. Sweet Potatoes Vines ($10/ha)		$0.80	$0.80	$0.80	$0.80	$0.80	$0.80	$0.80	$0.80
g. Sorghum Seed ($0.20 x 10kg/ha)		$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
h. Yam tubers (2000 grams/ha x $0.50/yam)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
i. Papaya Trees ($0.50 per tree)		$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00
6. ESTIMATED CASH PRODUCTION COSTS FOR FIELD		$57.39	$50.64	$50.64	$50.64	$50.64	$50.64	$50.64	$50.64
7. ESTIMATED NET RETURNS TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		$86.15	$104.80	$190.88	$197.74	$239.62	$209.50	$216.82	$220.70

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TABLE K-4, p 2/2
INTERVENTION PACKAGE NO. 3 ON FIELD NO. 3 (0.40 HECTARES)

		9	10	11	12	13	14	15	16	17	18	19	20
1. AREA COVERED BY CROP (IN HECTARES)													
a. Leucaena		0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
b. Maize		0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120
c. Black Beans		0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160
d. Sweet Potatoes		0.080	0.080	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
e. Sorghum		0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120
f. Yams		0.000	0.000	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
g. Papaya		0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
2. ESTIMATED YIELDS BY CROP (IN KILOGRAMS)													
a. Leucaena (in poles)		0	72	0	0	0	0	72	0	0	0	0	72
b. Maize		381	389	397	405	413	421	429	438	447	455	465	474
c. Black Beans		130	132	135	138	140	143	146	149	152	155	158	161
d. Sweet Potatoes		170	174	0	0	0	0	0	0	0	0	0	0
e. Sorghum		130	132	135	138	140	143	146	149	152	155	158	161
f. Yams		0	0	480	640	640	720	800	800	800	800	800	800
g. Papaya		80	80	80	80	80	80	80	80	80	80	80	80
3. ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN US$)	unit value												
a. Leucaena ($0.50/pole)	$0.50	$0.00	$36.00	$0.00	$0.00	$0.00	$0.00	$36.00	$0.00	$0.00	$0.00	$0.00	$36.00
b. Maize ($0.18/kilogram)	$0.18	$68.58	$70.02	$71.46	$72.90	$74.34	$75.78	$77.22	$78.84	$80.46	$82.08	$83.70	$85.32
c. Black Beans ($1.00/kilogram)	$1.00	$130.00	$132.00	$135.00	$138.00	$140.00	$143.00	$146.00	$149.00	$152.00	$155.00	$158.00	$161.00
d. Sweet Potatoes ($0.10/kilogram)	$0.10	$17.00	$17.40	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
e. Sorghum ($0.16/kilogram)	$0.16	$20.80	$21.12	$21.60	$22.08	$22.40	$22.88	$23.36	$23.84	$24.32	$24.80	$25.28	$25.76
f. Yams ($0.15/kilogram)	$0.15	$0.00	$0.00	$72.00	$96.00	$96.00	$108.00	$120.00	$120.00	$120.00	$120.00	$120.00	$120.00
g. Papaya ($0.50/kilogram)	$0.50	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00
4. ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR		$276.38	$316.54	$340.06	$356.98	$372.74	$389.53	$442.53	$411.68	$416.78	$421.88	$426.98	$468.03
5. ESTIMATED CASH PRODUCTION COSTS BY CROP													
a. Pro-rated Hand Tool Cost		$4.83	$4.83	$4.83	$4.83	$4.83	$4.83	$4.83	$4.83	$4.83	$4.83	$4.83	$4.83
b. Fertilizer Cost (200kg of 20-20-10/ha)		$25.57	$25.57	$25.57	$25.57	$25.57	$25.57	$25.57	$25.57	$25.57	$25.57	$25.57	$25.57
c. Leucaena Seed ($15 x 12.5kg/ha)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Maize seed ($0.50 x 20kg/ha)		$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
f. Black Bean Seed ($2 x 50kg/ha)		$16.00	$16.00	$16.00	$16.00	$16.00	$16.00	$16.00	$16.00	$16.00	$16.00	$16.00	$16.00
e. Sweet Potatoes Vines ($10/ha)		$0.80	$0.80	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
g. Sorghum Seed ($0.20 x 10kg/ha)		$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
h. Yam tubers (2000 yams/ha x $0.50/yam)		$0.00	$0.00	$80.00	$80.00	$80.00	$80.00	$80.00	$80.00	$80.00	$80.00	$80.00	$80.00
i. Papaya Trees ($0.50 per tree)		$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00
6. ESTIMATED CASH PRODUCTION COSTS FOR FIELD		$50.64	$50.64	$129.84	$129.84	$129.84	$129.84	$129.84	$129.84	$129.84	$129.84	$129.84	$129.84
7. ESTIMATED NET RETURNS TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		$225.74	$265.90	$210.22	$227.14	$242.90	$259.74	$312.74	$281.84	$286.94	$292.04	$297.14	$338.24

TABLE K-5, p 1/2

INTERVENTION PACKAGE NO. 4 ON FIELD NO. 4 (0.16 HECTARES)

		1	2	3	4	5	6	7	8
1. AREA COVERED BY CROP (IN HECTARES)									
a. Plantain		0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
b. Maize		0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037
c. Black Beans		0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
d. Yams		0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
e. Sorghum		0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
f. Papaya		0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
2. ESTIMATED YIELDS BY CROP (IN KILOGRAMS)									
a. Plantain		0	40	41	60	61	62	64	65
b. Maize		52	53	131	134	136	139	142	145
c. Black Beans		48	49	72	73	75	76	78	79
d. Yams		192	224	256	288	320	320	320	320
e. Sorghum		38	39	58	59	60	62	63	64
f. Papaya		30	45	48	51	54	57	60	60
3. ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN US$)	unit value								
a. Plantain ($0.50/Kg)	$0.50	$0.00	$20.00	$20.50	$30.00	$30.50	$31.00	$32.00	$32.50
b. Maize ($0.18/Kg)	$0.18	$9.36	$9.54	$23.58	$24.12	$24.48	$25.02	$25.56	$26.10
c. Black Beans ($1.00/Kg)	$1.00	$48.00	$49.00	$72.00	$73.00	$75.00	$76.00	$78.00	$79.00
d. Yams ($0.15/Kg)	$0.15	$28.80	$33.60	$38.40	$43.20	$48.00	$48.00	$48.00	$48.00
e. Sorghum ($0.16/Kg)	$0.16	$6.08	$6.24	$9.28	$9.44	$9.60	$9.92	$10.08	$10.24
f. Papaya ($0.50/Kg)	$0.50	$15.00	$22.50	$24.00	$25.50	$27.00	$28.50	$30.00	$30.00
4. ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR		$107.24	$140.88	$187.76	$205.26	$214.58	$218.44	$223.64	$225.84
5. ESTIMATED CASH PRODUCTION COSTS BY CROP									
a. Pro-rated Hand Tool Cost		$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93
b. Fertilizer Cost (400kg of 20-20-10/ha)		$20.46	$20.46	$20.46	$20.46	$20.46	$20.46	$20.46	$20.46
c. Plantain Shoots ($0.20/shoot)		$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80
d. Maize seed ($0.50 x 20Kg/ha)		$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37
e. Black Bean Seed ($2 x 50kg/ha)		$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00
f. Yam tubers (2000 yams/ha x $0.50/yam)		$32.00	$32.00	$32.00	$32.00	$32.00	$32.00	$32.00	$32.00
g. Sorghum Seed ($0.20 x 10kg/ha)		$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10
h. Papaya Trees ($0.50 per tree)		$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50
6. ESTIMATED CASH PRODUCTION COSTS FOR FIELD		$67.16	$67.16	$67.16	$67.16	$67.16	$67.16	$67.16	$67.16
7. ESTIMATED NET RETURNS TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		$40.08	$73.72	$120.60	$138.10	$147.42	$151.28	$156.48	$158.68

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TABLE K-5, p 2/2
INTERVENTION PACKAGE NO. 4 ON FIELD NO. 4 (0.16 HECTARES)

		9	10	11	12	13	14	15	16	17	18	19	20
1. AREA COVERED BY CROP (IN HECTARES)													
a. Plantain		0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
b. Maize		0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037
c. Black Beans		0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
d. Yams		0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
e. Sorghum		0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
f. Papaya		0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
2. ESTIMATED YIELDS BY CROP (IN KILOGRAMS)													
a. Plantain		65	68	69	70	72	73	75	76	78	79	81	82
b. Maize		148	150	153	157	160	163	166	169	173	176	180	183
c. Black Beans		81	83	84	86	88	90	91	93	95	97	99	101
d. Yams		320	320	320	320	320	320	320	320	320	320	320	320
e. Sorghum		65	67	68	69	71	72	74	75	76	76	80	81
f. Papaya		60	60	60	60	60	60	60	60	60	60	60	60
3. ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN US$)	unit value												
a. Plantain ($0.50/Kg)	$0.50	$33.00	$34.00	$34.50	$35.00	$36.00	$36.50	$37.50	$38.00	$39.00	$39.50	$40.50	$41.00
b. Maize ($0.18/Kg)	$0.18	$26.64	$27.00	$27.54	$28.26	$28.80	$29.34	$29.88	$30.42	$31.14	$31.68	$32.40	$32.94
c. Black Beans ($1.00/Kg)	$1.00	$81.00	$83.00	$84.00	$86.00	$88.00	$90.00	$91.00	$93.00	$95.00	$97.00	$99.00	$101.00
d. Yams ($0.15/Kg)	$0.15	$48.00	$48.00	$48.00	$48.00	$48.00	$48.00	$48.00	$48.00	$48.00	$48.00	$48.00	$48.00
e. Sorghum ($0.16/Kg)	$0.16	$10.40	$10.72	$10.88	$11.04	$11.36	$11.52	$11.84	$12.00	$12.16	$12.16	$12.80	$12.96
f. Papaya ($0.50/Kg)	$0.50	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00
4. ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR		$229.04	$232.72	$234.92	$238.30	$242.16	$245.36	$248.22	$251.42	$255.30	$258.34	$262.70	$265.90
5. ESTIMATED CASH PRODUCTION COSTS BY CROP													
a. Prorrated Hand Tool Cost		$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93
b. Fertilizer Cost (450kg of 20-20-10/ha)		$20.46	$20.46	$20.46	$20.46	$20.46	$20.46	$20.46	$20.46	$20.46	$20.46	$20.46	$20.46
c. Plantain Shoots ($0.20/shoot)		$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80
d. Maize seed ($0.50 x 20kg/ha)		$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37
e. Black Bean Seed ($2 x 50kg/ha)		$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00
f. Yam tubers (2000 yams/ha x $0.50/yam)		$32.00	$32.00	$32.00	$32.00	$32.00	$32.00	$32.00	$32.00	$32.00	$32.00	$32.00	$32.00
g. Sorghum Seed ($0.20 x 10kg/ha)		$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10
h. Papaya Trees ($0.50 per tree)		$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50
6. ESTIMATED CASH PRODUCTION COSTS FOR FIELD		$67.16	$67.16	$67.16	$67.16	$67.16	$67.16	$67.16	$67.16	$67.16	$67.16	$67.16	$67.16
7. ESTIMATED NET RETURNS TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		$161.88	$165.56	$167.76	$171.14	$175.00	$178.20	$181.06	$184.26	$188.14	$191.18	$195.54	$198.74

TABLE K-6, p./2
INTERVENTION PACKAGE NO. 5 ON FIELD NO. 5 (0.32 HECTARES)

		1	2	3	4	5	6	7	8
1. AREA COVERED BY CROP (IN HECTARES)									
a. Coffee			0.224	0.224	0.224	0.224	0.224	0.224	0.224
b. Plantain		0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
c. Black Beans		0.112	(0.064)	(0.064)					
d. Sweet Potatoes		0.112	(0.064)	(0.064)					
e. Citrus Trees		0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
2. ESTIMATED YIELDS BY CROP (IN KILOGRAMS)									
a. Coffee			0	0	0	0	34	45	56
b. Plantain		0	400	408	416	424	432	440	448
c. Black Beans		90	32	13	0	0	0	0	0
d. Sweet Potatoes		274	91	26	0	0	0	0	0
e. Citrus Trees		0	0	0	0	0	32	64	96
3. ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN US$)	unit value								
a. Coffee (per Kg)	$0.90	$0.00	$0.00	$0.00	$0.00	$0.00	$30.60	$40.50	$50.40
b. Plantain (per Kg)	$0.50	$0.00	$200.00	$204.00	$208.00	$212.00	$216.00	$220.00	$224.00
c. Black Beans (per Kg)	$1.00	$90.00	$32.00	$13.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Sweet Potatoes (per Kg)	$0.10	$27.40	$9.10	$2.60	$0.00	$0.00	$0.00	$0.00	$0.00
e. Citrus Trees (per Kg)	$0.30	$0.00	$0.00	$0.00	$0.00	$0.00	$9.60	$19.20	$28.80
4. ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR		$117.40	$241.10	$219.60	$208.00	$212.00	$256.20	$279.70	$303.20
5. ESTIMATED CASH PRODUCTION COSTS BY CROP									
a. Pro-rated Hand Tool Cost		$3.87	$3.87	$3.87	$3.87	$3.87	$3.87	$3.87	$3.87
b. Fertilizer Cost (500kg of 20-20-10/ha)		$51.15	$51.15	$51.15	$51.15	$51.15	$51.15	$51.15	$51.15
c. Coffee Plants ($0.50/plant)		$0.00	$168.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Plaintain Shoots ($0.20/shoot)		$28.80	$28.80	$28.80	$28.80	$28.80	$28.80	$28.80	$28.80
e. Black Bean Seed ($2.00 x 50kg/ha)		$11.20	$6.40	$6.40	$0.00	$0.00	$0.00	$0.00	$0.00
f. Sweet Potato Vines ($10.00/Ha)		$1.12	$0.64	$0.64	$0.00	$0.00	$0.00	$0.00	$0.00
g. Citrus Trees ($8.15/tree)		$32.60	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
h. Pesticide cost on citrus ($3.00/tree)		$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00
i. Fertilization cost on citrus ($1.00/tree)		$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
6. ESTIMATED CASH PRODUCTION COSTS FOR FIELD		$144.74	$274.86	$106.86	$99.82	$99.82	$99.82	$99.82	$99.82
7. ESTIMATED NET RETURNS TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		($27.34)	($33.76)	$112.74	$108.18	$112.18	$156.38	$179.88	$203.38

TABLE K-6 p 2/2
INTERVENTION PACKAGE NO. 5 ON FIELD NO. 5 (0.32 HECTARES)

		9	10	11	12	13	14	15	16	17	18	19	20
1. AREA COVERED BY CROP (IN HECTARES)													
a. Coffee		0.224	0.224	0.224	0.224	0.224	0.224	0.224	0.224	0.224	0.224	0.224	0.224
b. Plantain		0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
c. Black Beans													
d. Sweet Potatoes													
e. Citrus Trees		0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
2. ESTIMATED YIELDS BY CROP (IN KILOGRAMS)													
a. Coffee		79	90	112	134	137	140	142	145	148	150	153	156
b. Plantain		456	464	472	480	488	496	504	512	520	528	536	544
c. Black Beans		0	0	0	0	0	0	0	0	0	0	0	0
d. Sweet Potatoes		0	0	0	0	0	0	0	0	0	0	0	0
e. Citrus Trees		128	150	163	166	170	173	176	179	182	186	189	192
3. ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN US$)	unit value												
a. Coffee (per Kg)	$0.50	$70.20	$81.00	$100.80	$120.60	$123.30	$126.00	$127.80	$130.50	$133.20	$135.00	$137.70	$140.40
b. Plantain (per Kg)	$0.50	$228.00	$232.00	$236.00	$240.00	$244.00	$248.00	$252.00	$256.00	$260.00	$264.00	$268.00	$272.00
c. Black Beans (per Kg)	$1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Sweet Potatoes (per Kg)	$0.10	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
e. Citrus Trees (per Kg)	$0.30	$38.40	$48.00	$48.90	$49.80	$51.00	$51.90	$52.80	$53.70	$54.60	$55.80	$56.70	$57.60
4. ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR		$336.60	$361.00	$385.70	$410.40	$418.30	$425.90	$432.60	$440.20	$447.80	$454.80	$462.40	$470.00
5. ESTIMATED CASH PRODUCTION COSTS BY CROP													
a. Pro-rated Hand Tool Cost		$3.87	$3.87	$3.87	$3.87	$3.87	$3.87	$3.87	$3.87	$3.87	$3.87	$3.87	$3.87
b. Fertilizer Cost (500kg of 20-20-10/ha)		$51.15	$51.15	$51.15	$51.15	$51.15	$51.15	$51.15	$51.15	$51.15	$51.15	$51.15	$51.15
c. Coffee Plants ($0.50/plant)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Plaintain Shoots ($0.20/shoot)		$28.80	$28.80	$28.80	$28.80	$28.80	$28.80	$28.80	$28.80	$28.80	$28.80	$28.80	$28.80
e. Black Bean Seed ($2.00 x 50kg/ha)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
f. Sweet Potato Vines ($10.00/Ha)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
g. Citrus Trees ($8.15/tree)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
h. Pesticide cost on citrus ($3.00/tree)		$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00
i. Fertilization cost on citrus ($1.00/tree)		$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
6. ESTIMATED CASH PRODUCTION COSTS FOR FIELD		$99.82	$99.82	$99.82	$99.82	$99.82	$99.82	$99.82	$99.82	$99.82	$99.82	$99.82	$99.82
7. ESTIMATED NET RETURNS TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		$236.78	$261.18	$285.88	$310.58	$318.48	$326.08	$332.78	$340.38	$347.98	$354.98	$362.58	$370.18

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TABLE K-7, p 1/2
INTERVENTION PACKAGE NO. 6 ON FIELD NO. 6 (0.16 HECTARES)

		1	2	3	4	5	6	7	8
1. AREA COVERED BY CROP (IN HECTARES)									
a. Coffee		0.000	0.136	0.224	0.224	0.224	0.224	0.224	0.224
b. Plantain		0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
c. Citrus Trees		0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
d. Black Beans		0.068	(0.048)	(0.048)	(0.048)				
e. Sweet Potatoes		0.068	(0.048)	(0.048)	(0.048)				
2. ESTIMATED YIELDS BY CROP (IN KILOGRAMS)									
a. Coffee		0	0	0	0	0	0	27	34
b. Plantain		0	40	41	42	42	43	44	45
c. Citrus Trees		0	0	0	0	0	32	64	96
d. Black Beans		54	29	19	10	0	0	0	0
e. Sweet Potatoes		167	85	52	19	0	0	0	0
3. ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN US$)	unit value								
a. Coffee (per Kg)	$0.90	$0.00	$0.00	$0.00	$0.00	$0.00	$18.00	$24.30	$30.60
b. Plantain (per Kg)	$0.50	$0.00	$20.00	$20.50	$21.00	$21.00	$21.50	$22.00	$22.50
c. Citrus Trees (per Kg)	$0.30	$0.00	$0.00	$0.00	$0.00	$0.00	$9.60	$19.20	$28.80
d. Black Beans (per Kg)	$1.00	$54.00	$29.00	$19.00	$10.00	$0.00	$0.00	$0.00	$0.00
e. Sweet Potatoes (per Kg)	$0.10	$16.70	$8.50	$5.20	$1.90	$0.00	$0.00	$0.00	$0.00
4. ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR		$70.70	$57.50	$44.70	$32.90	$21.00	$49.10	$65.50	$81.90
5. ESTIMATED CASH PRODUCTION COSTS BY CROP									
a. Pro-rated Hand Tool Cost		$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93
b. Fertilizer Cost (300kg of 20-20-10/ha)		$15.34	$15.34	$15.34	$15.34	$15.34	$15.34	$15.34	$15.34
c. Coffee Plants ($0.50/plant)		$0.00	$102.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Plaintain Shoots ($0.20/shoot)		$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80
e. Citrus Trees ($8.15/tree)		$32.60	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
f. Pesticide cost on citrus ($3.00/tree)		$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00
g. Fertilization cost on citrus ($1.00/tree)		$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00
h. Black Bean Seed ($2.00 x 50kg/ha)		$6.80	$4.80	$4.80	$4.80	$0.00	$0.00	$0.00	$0.00
i. Sweet Potato Vines ($10.00/Ha)		$0.68	$0.48	$0.48	$0.48	$0.00	$0.00	$0.00	$0.00
6. ESTIMATED CASH PRODUCTION COSTS FOR FIELD		$75.15	$142.35	$40.35	$40.35	$35.07	$35.07	$35.07	$35.07
7. ESTIMATED NET RETURNS TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		($4.45)	($84.85)	$4.35	($7.45)	($14.07)	$14.03	$30.43	$46.83

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TABLE K-7, p 2/2
INTERVENTION PACKAGE NO. 6 ON FIELD NO. 6 (0.16 HECTARES)

		9	10	11	12	13	14	15	16	17	18	19	20
1. AREA COVERED BY CROP (IN HECTARES)													
a. Coffee		0.224	0.224	0.224	0.224	0.224	0.224	0.224	0.224	0.224	0.224	0.224	0.224
b. Plantain		0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
c. Citrus Trees		0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
d. Black Beans													
e. Sweet Potatoes													
2. ESTIMATED YIELDS BY CROP (IN KILOGRAMS)													
a. Coffee		48	54	68	82	84	85	87	89	90	92	93	95
b. Plantain		45	46	47	49	49	49	50	51	52	53	53	54
c. Citrus Trees		123	160	163	166	170	173	176	179	182	185	189	192
d. Black Beans		0	0	0	0	0	0	0	0	0	0	0	0
e. Sweet Potatoes		0	0	0	0	0	0	0	0	0	0	0	0
3. ESTIMATED GROSS VALUE OF PRODUCTION BY CROP (IN US$)	unit value												
a. Coffee (per Kg)	$0.50	$48.20	$48.60	$61.20	$73.80	$75.60	$76.50	$78.30	$80.10	$81.00	$82.80	$83.70	$85.50
b. Plantain (per Kg)	$0.50	$22.50	$23.00	$23.50	$24.00	$24.50	$24.50	$25.00	$25.50	$26.00	$26.50	$26.50	$27.00
c. Citrus Trees (per Kg)	$0.30	$36.90	$48.00	$48.90	$49.80	$51.00	$51.90	$52.80	$53.70	$54.60	$55.50	$56.70	$57.60
d. Black Beans (per Kg)	$1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
e. Sweet Potatoes (per Kg)	$0.10	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
4. ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELD BY YEAR		$104.10	$119.60	$133.60	$147.60	$151.10	$152.90	$155.10	$159.30	$161.60	$165.10	$166.90	$170.10
5. ESTIMATED CASH PRODUCTION COSTS BY CROP													
a. Pro-rated Hand Tool Cost		$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93	$1.93
b. Fertilizer Cost (200kg of 20-20-10/ha)		$15.34	$15.34	$15.34	$15.34	$15.34	$15.34	$15.34	$15.34	$15.34	$15.34	$15.34	$15.34
c. Coffee Plants ($0.50/plant)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Plaintain Shoots ($0.20/shoot)		$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80	$2.[illegible]	$2.80	$2.80	$2.80
e. Citrus Trees ($6.15/tree)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
f. Pesticide cost on citrus ($3.00/tree)		$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00
g. Fertilization cost on citrus ($1.00/tree)		$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00
h. Black Bean Seed ($2.00 x 50kg/ha)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
i. Sweet Potato Vines ($10.00/Ha)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
6. ESTIMATED CASH PRODUCTION COSTS FOR FIELD		$35.07	$35.07	$35.07	$35.07	$35.07	$35.07	$35.07	$35.07	$35.07	$35.07	$35.07	$35.07
7. ESTIMATED NET RETURNS TO FAMILY LABOR MANAGEMENT AND LAND WITH INTERVENTION PACKAGE ON FIELD		$69.03	$84.53	$98.53	$112.53	$116.03	$117.83	$121.03	$124.23	$126.53	$130.03	$131.83	$135.03

ANNEX TABLE K-8, 1/2

	1	2	3	4	5	6	7	8	9	10
1. ESTIMATED NET RETURNS TO FAMILY LABOR, MANAGEMENT AND LAND WITH INTERVENTION PACKAGES:										
a. FIELD #1	($8.77)	$2.87	$2.87	$2.87	$18.87	($3.37)	$1.31	$3.47	$3.47	$19.59
b. FIELD #2	($15.01)	$18.20	$168.86	$179.48	$254.34	$240.88	$230.58	$233.94	$238.22	$314.90
c. FIELD #3	$86.15	$104.00	$190.88	$197.74	$239.62	$209.50	$216.82	$220.70	$225.74	$265.90
d. FIELD #4	$40.08	$73.72	$120.60	$138.10	$147.42	$151.28	$156.48	$158.68	$161.88	$165.56
e. FIELD #5	($27.34)	($33.76)	$112.74	$108.18	$112.18	$156.38	$179.88	$203.38	$236.78	$261.18
f. FIELD #6	($4.45)	($84.85)	$4.35	($7.45)	($14.07)	$14.03	$30.43	$46.83	$69.03	$84.53
TOTAL FARM	$70.66	$80.98	$600.30	$618.92	$759.36	$768.70	$815.50	$867.00	$935.12	$1,111.66
2. ESTIMATED NET RETURNS TO FAMILY LABOR, MANAGEMENT AND LAND WITH TRADITIONAL PRACTICES:										
a. FIELD #1	$0.00	$0.16	$0.00	$0.00	$0.05	$0.05	$0.05	$0.05	$0.00	$0.00
b. FIELD #2	$18.75	$33.86	$18.75	$33.86	$18.75	$25.49	$15.12	$0.00	$0.00	$22.64
c. FIELD #3	$61.00	$15.12	$61.00	$15.12	$29.64	$12.70	$12.35	$11.39	$10.91	$10.64
d. FIELD #4	$46.75	$45.63	$44.64	$43.65	$42.56	$41.57	$40.38	$39.53	$37.99	$37.63
e. FIELD #5	$107.17	$22.13	$0.00	$104.06	$100.98	$50.49	$30.24	$0.00	$0.00	$0.00
f. FIELD #6	$9.33	$0.00	$65.55	$8.51	$8.30	$0.00	$51.68	$7.67	$7.46	$0.00
TOTAL FARM	$243.00	$116.90	$189.[illegible]	$205.20	$200.28	$130.30	$150.02	$58.64	$56.36	$73.91
3. ESTIMATED NET RETURNS FROM INTERVENTION PACKAGES										
a. FIELD #1	($8.77)	$2.71	$2.87	$2.87	$18.82	($3.42)	$1.26	$3.42	$3.47	$19.59
b. FIELD #2	($33.76)	($15.66)	$150.11	$145.62	$235.59	$215.39	$215.46	$233.94	$238.22	$292.26
c. FIELD #3	$25.15	$89.68	$129.88	$182.62	$209.98	$196.80	$204.47	$209.31	$214.83	$255.26
d. FIELD #4	($6.67)	$28.09	$75.96	$94.45	$104.86	$109.71	$118.10	$119.15	$123.89	$127.93
e. FIELD #5	($134.51)	($56.89)	$112.74	$4.12	$11.20	$105.89	$149.64	$203.38	$236.78	$261.18
f. FIELD #6	($13.78)	($84.85)	($61.20)	($15.96)	($22.37)	$14.03	($21.45)	$39.16	$61.57	$84.53
TOTAL FARM	($172.34)	($35.92)	$410.36	$413.72	$558.08	$638.40	$665.48	$808.36	$878.76	$1,040.75

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ANNEX TABLE K-8, p 2/2

	11	12	13	14	15	16	17	18	19	20
1. ESTIMATED NET RETURNS TO FAMILY LABOR, MANAGEMENT AND LAND WITH INTERVENTION PACKAGES:										
a. FIELD #1	$3.71	$3.83	$3.95	$3.95	$20.19	$4.31	$4.43	$4.55	$4.67	$20.79
b. FIELD #2	$255.55	$269.68	$274.80	$279.76	$356.72	$289.22	$294.48	$299.60	$305.06	$382.85
c. FIELD #3	$210.22	$227.14	$242.90	$259.74	$312.74	$281.84	$236.94	$292.04	$297.14	$338.24
d. FIELD #4	$167.76	$171.14	$175.00	$178.20	$181.06	$184.26	$188.14	$191.50	$195.54	$198.74
e. FIELD #5	$285.83	$310.58	$318.48	$326.08	$332.78	$340.23	$347.93	$354.98	$362.58	$370.18
f. FIELD #6	$99.53	$112.53	$116.03	$117.83	$121.03	$124.23	$125.53	$130.03	$131.63	$135.03
TOTAL FARM	$1,031.66	$1,094.90	$1,131.16	$1,165.55	$1,324.52	$1,224.24	$1,243.50	$1,272.70	$1,296.82	$1,445.84
2. ESTIMATED NET RETURNS TO FAMILY LABOR, MANAGEMENT AND LAND WITH TRADITIONAL PRACTICES:										
a. FIELD #1	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
b. FIELD #2	$15.92	$21.46	$15.30	$20.23	$14.69	$0.00	$0.00	$17.92	$11.53	$16.76
c. FIELD #3	$10.24	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. FIELD #4	$35.66	$35.64	$34.80	$33.80	$33.20	$32.10	$31.39	$30.68	$29.95	$28.90
e. FIELD #5	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
f. FIELD #6	$45.80	$6.72	$6.45	$0.00	$40.04	$5.72	$5.51	$5.41	$5.20	$5.10
TOTAL FARM	$108.62	$63.82	$56.55	$54.03	$87.93	$37.82	$36.90	$54.01	$46.72	$50.76
3. ESTIMATED NET RETURNS FROM INTERVENTION PACKAGES										
a. FIELD #1	$3.71	$3.83	$3.95	$3.95	$20.19	$4.31	$4.43	$4.55	$4.67	$20.79
b. FIELD #2	$249.64	$248.22	$259.50	$259.53	$342.03	$289.22	$294.48	$281.68	$293.48	$366.10
c. FIELD #3	$199.98	$227.14	$242.90	$259.74	$312.74	$281.84	$236.94	$292.04	$297.14	$338.24
d. FIELD #4	$131.10	$135.50	$140.20	$144.40	$147.85	$152.16	$156.75	$160.82	$165.59	$169.84
e. FIELD #5	$285.83	$310.58	$318.48	$326.03	$332.78	$340.33	$347.93	$354.98	$362.58	$370.18
f. FIELD #6	$52.73	$105.81	$109.58	$117.83	$80.99	$118.51	$121.02	$124.62	$126.53	$129.93
TOTAL FARM	$923.04	$1,031.03	$1,074.61	$1,111.53	$1,236.59	$1,186.42	$1,211.60	$1,218.69	$1,250.09	$1,395.08

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TABLE K-9, P 1/3

SUMMARY OF RESULTS FOR INTERVENTION PACKAGE APPLICATIONS

YEAR	ESTIMATED GROSS VALUE OF PRODUCTION FROM FIELDS WITH INTERVENTION PACKAGES						
	1	2	3	4	5	6	TOTAL
1	0.00	68.84	143.54	107.24	117.40	70.70	507.72
2	3.84	88.55	155.44	140.88	241.10	57.50	687.31
3	3.84	239.21	241.52	187.76	219.60	44.70	936.63
4	3.84	249.83	248.38	205.26	208.00	32.90	948.21
5	19.84	324.69	290.26	214.58	212.00	21.00	1,082.37
6	2.40	319.88	260.14	218.44	256.20	49.10	1,106.16
7	4.68	309.58	267.46	223.64	279.70	65.50	1,150.56
8	6.84	312.94	271.34	225.84	303.20	81.90	1,202.06
9	6.84	317.22	276.38	229.04	336.50	104.10	1,270.18
10	22.96	393.98	316.54	232.72	361.00	119.60	1,446.80
11	7.08	348.78	340.06	234.92	385.70	133.60	1,450.14
12	7.20	352.90	356.98	238.30	410.40	147.60	1,513.38
13	7.32	358.02	372.74	242.16	418.30	151.10	1,549.64
14	7.32	362.98	389.58	245.36	425.90	152.90	1,584.04
15	23.56	439.94	442.58	248.22	432.60	156.10	1,743.00
16	7.68	372.40	411.68	251.42	440.20	159.30	1,642.68
17	7.80	377.70	416.78	255.30	447.80	161.60	1,666.98
18	7.92	382.82	421.88	258.66	454.80	155.10	1,691.18
19	8.04	388.28	426.98	262.70	462.40	166.90	1,715.30
20	24.16	466.08	468.08	265.90	470.00	170.10	1,864.32

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TABLE K-9, p. 2/3

YEAR	ESTIMATED CASH PRODUCTION COSTS BY FIELD FOR INTERVENTION PACKAGES						
	1	2	3	4	5	6	TOTAL
1	8.77	83.85	57.39	67.16	144.74	75.15	437.06
2	0.97	70.35	50.64	67.16	274.86	142.35	606.33
3	0.97	70.35	50.64	67.16	106.86	40.35	336.33
4	0.97	70.35	50.64	67.16	99.82	40.35	329.29
5	0.97	70.35	50.64	67.16	99.82	35.07	324.01
6	5.77	79.00	50.64	67.16	99.82	35.07	337.46
7	3.37	79.00	50.64	67.16	99.82	35.07	335.06
8	3.37	79.00	50.64	67.16	99.82	35.07	335.06
9	3.37	79.00	50.64	67.16	99.82	35.07	335.06
10	3.37	79.08	50.64	67.16	99.82	35.07	335.14
11	3.37	83.22	129.84	67.16	99.82	35.07	418.48
12	3.37	83.22	129.84	67.16	99.82	35.07	418.48
13	3.37	83.22	129.84	67.16	99.82	35.07	418.48
14	3.37	83.22	129.84	67.16	99.82	35.07	418.48
15	3.37	83.22	129.84	67.16	99.82	35.07	418.48
16	3.37	83.22	129.84	67.16	99.82	35.07	418.48
17	3.37	83.22	129.84	67.16	99.82	35.07	418.48
18	3.37	83.22	129.84	67.16	99.82	35.07	418.48
19	3.37	83.22	129.84	67.16	99.82	35.07	418.48
20	3.37	83.22	129.84	67.16	99.82	35.07	418.48

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TABLE K-9, p 3/3

YEAR	COST OF PRODUCTION FOREGONE FROM TRADITIONAL CROPPING SYSTEM TOTAL	TOTAL GROSS BENEFITS	TOTAL COSTS	UNDISCOUNTED NET BENEFIT	DISCOUNTED AT 50% TOTAL GROSS BENEFITS	DISCOUNTED AT 50% TOTAL COSTS	DISCOUNTED AT 50% NET BENEFITS
1	243.00	507.72	680.05	(172.34)	338.85	453.60	(114.95)
2	116.90	687.31	723.23	(35.92)	305.17	321.11	(15.94)
3	189.94	936.63	526.27	410.35	277.24	155.76	121.48
4	205.20	949.21	534.49	413.72	187.75	105.83	81.92
5	200.28	1,042.37	524.29	518.08	142.87	69.21	73.66
6	130.30	1,135.16	487.76	638.40	97.34	41.15	56.18
7	150.02	1,150.56	485.08	665.48	67.89	28.62	39.26
8	58.54	1,202.06	393.70	808.36	46.83	15.35	31.53
9	56.35	1,270.18	391.42	878.76	33.02	10.17	22.85
10	70.91	1,445.80	405.05	1,040.75	24.60	6.90	17.70
11	108.52	1,450.14	527.10	923.04	17.40	6.33	11.07
12	53.82	1,513.93	482.90	1,031.08	12.11	3.86	8.25
13	55.55	1,546.64	475.03	1,074.61	7.75	2.38	5.37
14	54.03	1,584.04	472.51	1,111.53	4.75	1.42	3.33
15	87.93	1,743.00	505.41	1,236.59	3.49	1.01	2.48
16	37.82	1,642.68	455.30	1,186.23	1.64	0.46	1.18
17	36.90	1,655.56	455.35	1,211.30	1.66	0.45	1.20
18	54.01	1,671.18	472.49	1,218.69	1.63	0.47	1.32
19	46.73	1,715.30	465.21	1,250.09	0.00	0.00	0.00
20	50.76	1,664.32	483.24	1,395.08	0.00	0.00	0.00
					1,571.83	1,224.10	347.73

ESTIMATED IRR = >50%

NPV AT 50% = $347.79
B/C RATIO = 1.28
AT 50%

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ANNEX TABLE K-10

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TREES PLANTED BY YEAR																				
- Citrus	20,000	20,000	20,000	20,000	20,000															
- Avocado	5,000	5,000	5,000	5,000	5,000															
- Papaya	2,000	2,000	2,000	2,000	2,000															
- Other Fruits	3,000	3,000	3,000	3,000	3,000															
TREES GRAFTED BY YEAR																				
- Oranges	20,000	20,000	20,000	20,000	20,000															
SURVIVING TREES BY YEAR (cumulative)																				
- Citrus	16,000	32,000	48,000	64,000	80,000															
- Avocado	40,000	80,000	120,000	160,000	200,000															
- Papaya	1,600	3,200	4,800	6,400	8,000															
- Other Fruits	2,400	4,800	7,200	9,600	12,000															
SUCCESSFUL GRAFTS BY YEAR (cumulative)																				
- Oranges	18,000	36,000	54,000	72,000	90,000															
ESTIMATED COSTS FOR TREES BY YEAR																				
1. Tree Costs:																				
-Citrus (@ $8.15/tree)	$163,000	$163,000	$163,000	$163,000	$163,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Avocado (@ $8.85/tree)	44,450	44,450	44,450	44,450	44,450	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Papaya (@ $8.95/tree)	17,900	17,900	17,900	17,900	17,900	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Other Fruits (@ $5.85/tree)	17,475	17,475	17,475	17,475	17,475	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Planting Cost (@ $1.10/tree)	2,000	2,000	2,000	2,000	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Marking Cost (@ $2.45/tree)	5,600	11,200	23,800	32,400	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000
4. Pruning Cost (@ $0.10/tree)	2,420	4,850	7,200	9,600	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000
5. Mulching Cost (@ $2.20/tree)	4,800	9,600	14,400	19,200	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000
6. Fertilizer Cost on Citrus (@ $1.00/tree)	48,000	96,000	144,000	192,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
7. Fertilization Cost (@ $1.00/tree)	24,000	48,000	72,000	96,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
8. Harvesting/Marketing Costs (@ $1.5/tree)	36,000	72,000	108,000	144,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000
9. Grafting Cost for Oranges (@ $4.25/tree)	125,500	125,500	125,500	125,500	125,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10. Weeding Cost (@ $0.45/tree)	7,200	14,400	21,600	28,800	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000
11. Pruning Cost (@ $0.10/tree)	1,800	3,600	5,400	7,200	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000
12. Mulching Cost (@ $1.20/tree)	3,600	7,200	10,800	14,400	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
13. Fertilizer Cost (@ $1.00/tree)	54,000	108,000	162,000	216,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000
14. Fertilization Cost (@ $1.00/tree)	18,000	36,000	54,000	72,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000
15. Harvesting/Marketing Costs (@ $1.5/tree)	27,000	54,000	81,000	108,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000
TOTAL COST	$677,245	$744,245	$1,022,445	$1,019,245	$1,552,445	$1,122,000	$1,122,000	$1,122,000	$1,122,000	$1,122,000	$1,122,000	$1,122,000	$1,122,000	$1,122,000	$1,122,000	$1,122,000	$1,122,000	$1,122,000	$1,122,000	$1,122,000
Average Cost per Participating Farm Family	121.57	89.42	72.04	63.85	62.14	47.28	47.28	47.28	47.28	47.28	47.28	47.28	47.28	47.28	47.28	47.28	47.28	47.28	47.28	47.28

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ANNEX TABLE K-11

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
VALUE OF TREE PRODUCTION BY YEAR																				
1. First Year Trees																				
-Citrus	0	0	0	0	16,000	48,000	96,000	160,000	240,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000
-Avocado	0	0	0	0	0	0	12,000	16,000	24,000	32,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000
-Mango	0	0	0	0	0	0	1,600	3,200	6,400	9,600	12,800	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000
-Other Fruit	0	0	0	0	0	0	2,400	4,800	9,600	14,400	19,200	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000
-Grafted Oranges	0	0	18,000	54,000	108,000	180,000	270,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
2. Second Year Trees																				
-Citrus		0	0	0	0	16,000	48,000	96,000	160,000	240,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000
-Avocado		0	0	0	0	0	0	12,000	16,000	24,000	32,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000
-Mango		0	0	0	0	0	0	1,600	3,200	6,400	9,600	12,800	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000
-Other Fruit		0	0	0	0	0	0	2,400	4,800	9,600	14,400	19,200	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000
-Grafted Oranges		0	0	18,000	54,000	108,000	180,000	270,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
3. Third Year Trees																				
-Citrus			0	0	0	0	16,000	48,000	96,000	160,000	240,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000
-Avocado			0	0	0	0	0	0	12,000	16,000	24,000	32,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000
-Mango			0	0	0	0	0	0	1,600	3,200	6,400	9,600	12,800	16,000	16,000	16,000	16,000	16,000	16,000	16,000
-Other Fruit			0	0	0	0	0	0	2,400	4,800	9,600	14,400	19,200	24,000	24,000	24,000	24,000	24,000	24,000	24,000
-Grafted Oranges			0	0	18,000	54,000	108,000	180,000	270,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
4. Fourth Year Trees																				
-Citrus				0	0	0	0	16,000	48,000	96,000	160,000	240,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000
-Avocado				0	0	0	0	0	0	12,000	16,000	24,000	32,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000
-Mango				0	0	0	0	0	0	1,600	3,200	6,400	9,600	12,800	16,000	16,000	16,000	16,000	16,000	16,000
-Other Fruit				0	0	0	0	0	0	2,400	4,800	9,600	14,400	19,200	24,000	24,000	24,000	24,000	24,000	24,000
-Grafted Oranges				0	0	18,000	54,000	108,000	180,000	270,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
5. Fifth Year Trees																				
-Citrus					0	0	0	0	16,000	48,000	96,000	160,000	240,000	320,000	320,000	320,000	320,000	320,000	320,000	320,000
-Avocado					0	0	0	0	0	0	12,000	16,000	24,000	32,000	48,000	48,000	48,000	48,000	48,000	48,000
-Mango					0	0	0	0	0	0	1,600	3,200	6,400	9,600	12,800	16,000	16,000	16,000	16,000	16,000
-Other Fruit					0	0	0	0	0	0	2,400	4,800	9,600	14,400	19,200	24,000	24,000	24,000	24,000	24,000
-Grafted Oranges					0	0	18,000	54,000	108,000	180,000	270,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
TOTAL VALUE OF HARVESTED FRUIT	0	0	18,000	72,000	144,000	414,000	828,000	1,332,000	1,918,000	2,530,000	3,054,000	3,442,000	3,694,000	3,792,000	3,854,000	3,940,000	3,940,000	3,940,000	3,940,000	3,940,000
AVERAGE VALUE OF FRUIT PER PARTICIPATING FARM FAMILY	0.00	0.00	1.20	2.65	7.84	16.96	32.24	53.28	76.72	101.20	118.70	137.60	144.56	151.68	152.96	157.40	157.60	157.60	157.60	157.[illegible]

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ANNEX TABLE K-12, p1/3

	1	2	3	4	5	6	7	8
1. GROSS BENEFITS TO PARTICIPATING FARM FAMILIES FROM								
A- INTERVENTION PACKAGES:								
a. 500 families	$0.00	$253,650.00	$343,655.00	$467,315.00	$474,105.00	$541,185.00	$553,030.00	$575,280.00
b. 1000 families	$0.00	$0.00	$507,720.00	$637,310.00	$936,630.00	$948,210.00	$1,032,570.00	$1,105,160.00
c. 3500 families	$0.00	$0.00	$0.00	$1,777,020.00	$2,405,585.00	$3,278,205.00	$3,318,735.00	$3,788,295.00
d. 5000 families	$0.00	$0.00	$0.00	$0.00	$2,538,600.00	$3,436,550.00	$4,683,150.00	$4,741,050.00
e. 10000 families	$0.00	$0.00	$0.00	$0.00	$0.00	$5,077,200.00	$6,673,100.00	$9,566,300.00
B- FRUIT TREE PROGRAM								
TOTAL BENEFITS ANNUALLY	$0.00	$0.00	18,000.00	$72,000.00	$196,000.00	$424,000.00	$806,000.00	$1,332,000.00
C- ESTIMATED TOTAL BENEFITS TO FARM FAMILIES	$0.00	$253,650.00	$859,375.00	$3,004,645.00	$6,550,920.00	$13,705,550.00	$17,316,435.00	$20,507,685.00
D- ESTIMATED PRIVATE COST TO FARM FAMILY ADOPTERS:								
1. INTERVENTION PACKAGES CASH COSTS								
a. 500 families	$0.00	$218,530.00	$303,165.00	$168,165.00	$174,645.00	$162,005.00	$163,730.00	$167,530.00
b. 1000 families	$0.00	$0.00	$437,060.00	$505,330.00	$335,330.00	$329,430.00	$324,010.00	$327,450.00
c. 3500 families	$0.00	$0.00	$0.00	$1,529,710.00	$2,122,155.00	$1,177,155.00	$1,152,515.00	$1,134,035.00
d. 5000 families	$0.00	$0.00	$0.00	$0.00	$2,185,500.00	$3,031,550.00	$1,681,650.00	$1,645,450.00
e. 10000 families	$0.00	$0.00	$0.00	$0.00	$0.00	$3,470,600.00	$5,062,350.00	$3,355,300.00
2. LOSS OF TRADITIONAL PRODUCTION ON FARMS ADOPTING INTERVENTION PACKAGES								
a. 500 families	$0.00	$121,500.00	$58,450.00	$94,970.00	$102,600.00	$100,140.00	$55,150.00	$75,010.00
b. 1000 families	$0.00	$0.00	$243,000.00	$116,900.00	$189,940.00	$205,200.00	$200,280.00	$130,300.00
c. 3500 families	$0.00	$0.00	$0.00	$850,500.00	$409,150.00	$564,750.00	$718,200.00	$700,980.00
c. 5000 families	$0.00	$0.00	$0.00	$0.00	$1,215,000.00	$584,500.00	$646,700.00	$1,026,000.00
e. 10000 families	$0.00	$0.00	$0.00	$0.00	$0.00	$2,430,000.00	$1,169,000.00	$1,899,400.00
3. FRUIT TREE PRODUCTION CASH COSTS								
a. 500 families	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00
b. 1000 families	$0.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00
c. 3500 families	$0.00	$0.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00
d. 5000 families	$0.00	$0.00	$0.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00
e. 10000 families	$0.00	$0.00	$0.00	$0.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00
E- ESTIMATED PUBLIC COST OF PROJECT IMPLEMENTATION								
1. LONG-TERM TECHNICAL ASSISTANCE	$700,000.00	$700,000.00	$700,000.00	$700,000.00	$700,000.00			
2. SHORT-TERM TECHNICAL ASSISTANCE	$255,000.00	$135,000.00	$135,000.00	$127,500.00	$0.00			
3. TECHNICAL ASSISTANCE SUPPORT	$273,500.00	$67,500.00	$73,500.00	$82,000.00	$84,000.00			
4. SITE DEMONTRATIONS	$60,000.00	$60,000.00	$65,000.00	$60,000.00	$60,000.00			
5. FRUIT TREE OUTREACH	$368,440.00	$368,440.00	$368,440.00	$368,440.00	$368,440.00			
6. EVALUATION AND MONITORING	$90,400.00	$144,400.00	$81,600.00	$81,600.00	$81,600.00			
7. UMBRELLA AGENCY	$50,750.00	$47,750.00	$48,250.00	$48,200.00	$48,750.00			
8. LOCAL PVOs	$311,025.00	$225,050.00	$255,740.00	$303,600.00	$302,600.00			
9. MINISTRY SECRETARIAT	$175,600.00	$251.00	$251,600.00	$201,600.00	$201,600.00			
10. ON-FARM TRIALS	$60,000.00	$80,000.00	$107,000.00	$109,000.00	$60,000.00			
11. TRAINING	$84,000.00	$194,000.00	$244,000.00	$208,000.00	$134,000.00			
12. CREDIT PROGRAM	$75,000.00	$175,000.00	$325,000.00	$500,000.00	$0.00			
13. CONTINGENCIES	$125,186.00	$122,138.00	$132,807.00	$139,500.00	$103,100.00			
F- ESTIMATED TOTAL COST	$2,798,901.00	$3,251,218.00	$4,240,612.00	$6,976,065.00	$9,740,210.00	$11,718,330.00	$13,342,535.00	$11,330,465.00

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ANNEX TABLE K-12, p2/3

	9	10	11	12	13	14	15	16
1. GROSS BENEFITS TO PARTICIPATING FARM FAMILIES FROM								
A- INTERVENTION PACKAGES:								
a. 500 families	$601,050.00	$635,090.00	$723,400.00	$725,070.00	$756,690.00	$774,820.00	$792,020.00	$871,500.00
b. 1000 families	1,150,560.00	$1,202,060.00	$1,270,[illegible]20.00	$1,446,300.00	$1,450,140.00	$1,513,360.00	$1,549,640.00	$1,534,040.00
c. 3500 families	3,871,560.00	$4,026,960.00	$4,207,210.00	$4,445,630.00	$5,063,600.00	$5,075,490.00	$5,296,880.00	$5,423,740.00
d. 5000 families	5,411,650.00	$5,530,800.00	$5,752,800.00	$6,010,300.00	$6,350,920.00	$7,234,000.00	$7,250,700.00	$7,566,900.00
e. 10000 families	9,482,100.00	$10,823,700.00	$11,051,600.00	$11,505,600.00	$12,020,600.00	$12,701,800.00	$14,468,000.00	$14,501,400.00
B- FRUIT TREE PROGRAM								
TOTAL BENEFITS ANNUALLY	1,918,000.00	$2,530,000.00	$3,054,000.00	$3,440,000.00	$3,654,000.00	$3,792,000.00	$3,824,000.00	$3,840,000.00
C- ESTIMATED TOTAL BENEFITS TO FARM FAMILIES	12,435,100.00	$24,748,610.00	$26,069,190.00	$27,573,400.00	$29,306,130.00	$31,091,490.00	$33,181,190.00	$33,767,530.00
D- ESTIMATED PRIVATE COST TO FARM FAMILY ADOPTERS:								
1. INTERVENTION PACKAGES CASH COSTS								
a. 500 families	$167,520.00	$167,530.00	$167,570.00	$209,240.00	$209,240.00	$209,240.00	$209,240.00	$209,240.00
b. 1000 families	$335,060.00	$335,060.00	$335,060.00	$335,140.00	$418,480.00	$418,480.00	$418,400.00	$418,400.00
c. 3500 families	1,131,110.00	$1,172,710.00	$1,172,710.00	$1,172,710.00	$1,172,690.00	$1,464,680.00	$1,464,680.00	$1,464,680.00
d. 5000 families	1,620,050.00	$1,637,300.00	$1,673,300.00	$1,675,300.00	$1,675,300.00	$1,675,700.00	$2,092,400.00	$2,092,400.00
e. 10000 families	3,292,900.00	$3,240,100.00	$3,374,600.00	$3,350,600.00	$3,350,600.00	$3,350,600.00	$3,351,400.00	$4,184,800.00
2. LOSS OF TRADITIONAL PRODUCTION ON FARMS ADOP INTERVENTION PACKAGES								
a. 500 families	$29,320.00	$29,180.00	$35,455.00	$54,310.00	$31,910.00	$23,275.00	$27,015.00	$42,955.00
b. 1000 families	$150,020.00	$58,640.00	$55,360.00	$70,910.00	$103,620.00	$53,820.00	$56,500.00	$54,050.00
c. 3500 families	$455,050.00	$525,070.00	$205,240.00	$197,260.00	$249,195.00	$380,170.00	$222,370.00	$197,925.00
d. 5000 families	1,001,400.00	$651,500.00	$750,100.00	$289,200.00	$281,830.00	$384,550.00	$543,100.00	$319,100.00
e. 10000 families	1,082,000.00	$2,002,800.00	$1,303,000.00	$1,500,200.00	$585,400.00	$583,600.00	$709,100.00	$1,085,800.00
3. FRUIT TREE PRODUCTION CASH COSTS								
a. 500 families	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00
b. 1000 families	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00
c. 3500 families	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00
d. 5000 families	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00
e. 10000 families	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00	$170,000.00
E- ESTIMATED PUBLIC COST OF PROJECT IMPLEMENTATION								
1. LONG-TERM TECHNICAL ASSISTANCE								
2. SHORT-TERM TECHNICAL ASSISTANCE								
3. TECHNICAL ASSISTANCE SUPPORT								
4. SITE DEMONTRATIONS								
5. FRUIT-TREE OUTREACH								
6. EVALUATION AND MONITORING								
7. UMBRELLA AGENCY								
8. LOCAL PVOs								
9. MINISTRY SECRETARIAT								
10. ON-FARM TRIALS								
11. TRAINING								
12. CREDIT PROGRAM								
13. CONTINGENCIES								
F- ESTIMATED TOTAL COST	1,135,440.00	$10,719,820.00	$9,925,395.00	$9,703,870.00	$3,933,520.00	$9,359,115.00	$9,945,255.00	$10,920,740.

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ANNEX TABLE K #2, p3/3

	17	18	19	20
1. GROSS BENEFITS TO PARTICIPATING FARM FAMILIES FROM				
A- INTERVENTION PACKAGES:				
a. 500 families	$821,340.00	$833,340.00	$845,550.00	$857,650.00
b. 1000 families	$1,743,000.00	$1,642,680.00	$1,666,680.00	$1,691,130.00
c. 3500 families	$5,544,140.00	$5,100,500.00	$5,749,280.00	$5,833,330.00
d. 5000 families	$7,748,200.00	$7,920,200.00	$8,715,000.00	$3,213,400.00
e. 10000 families	15,133,800.00	$15,436,400.00	$15,840,400.00	$17,430,000.00
B- FRUIT TREE PROGRAM				
TOTAL BENEFITS ANNUALLY	$3,840,000.00	$3,840,000.00	$3,840,000.00	$3,840,000.00
C- ESTIMATED TOTAL BENEFITS TO FARM FAMILIES	34,830,430.00	$35,853,120.00	$36,657,050.00	$37,855,510.00
D- ESTIMATED PRIVATE COST TO FARM FAMILY ADOPTERS:				
1. INTERVENTION PACKAGES CASH COSTS				
a. 500 families	$209,240.00	$209,240.00	$209,240.00	$209,240.00
b. 1000 families	$418,400.00	$418,400.00	$418,400.00	$418,400.00
c. 3500 families	$1,464,680.00	$1,464,680.00	$1,464,680.00	$1,464,680.00
d. 5000 families	$2,092,400.00	$2,092,400.00	$2,092,400.00	$2,092,400.00
e. 10000 families	$4,184,800.00	$4,184,800.00	$4,184,800.00	$4,184,800.00
2. LOSS OF TRADITIONAL PRODUCTION ON FARMS ADOPTING INTERVENTION PACKAGES				
a. 500 families	$18,910.00	$18,450.00	$27,005.00	$23,355.00
b. 1000 families	$37,950.00	$37,820.00	$35,500.00	$54,010.00
c. 3500 families	$189,105.00	$307,755.00	$132,370.00	$129,150.00
d. 5000 families	$282,750.00	$270,150.00	$439,650.00	$189,100.00
e. 10000 families	$638,200.00	$565,500.00	$540,300.00	$379,300.00
3. FRUIT TREE PRODUCTION CASH COSTS				
a. 500 families	$170,000.00	$170,000.00	$170,000.00	$170,000.00
b. 1000 families	$170,000.00	$170,000.00	$170,000.00	$170,000.00
c. 3500 families	$170,000.00	$170,000.00	$170,000.00	$170,000.00
d. 5000 families	$170,000.00	$170,000.00	$170,000.00	$170,000.00
e. 10000 families	$170,000.00	$170,000.00	$170,000.00	$170,000.00
E- ESTIMATED PUBLIC COST OF PROJECT IMPLEMENTATION				
1. LONG-TERM TECHNICAL ASSISTANCE				
2. SHORT-TERM TECHNICAL ASSISTANCE				
3. TECHNICAL ASSISTANCE SUPPORT				
4. SITE DEMONTRATIONS				
5. FRUIT TREE OUTREACH				
6. EVALUATION AND MONITORING				
7. UMBRELLA AGENCY				
8. LOCAL PVOs				
9. MINISTRY SECRETARIAT				
10. ON-FARM TRIALS				
11. TRAINING				
12. CREDIT PROGRAM				
13. CONTINGENCIES				
F- ESTIMATED TOTAL COST	$10,436,415.00	$10,419,195.00	$10,395,745.00	$10,494,445.00

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ANNEX TABLE-13

SUMMARY OF PROJECT BENEFITS AND COSTS

YEAR	UNDISCOUNTED TOTAL BENEFITS	UNDISCOUNTED TOTAL COST	UNDISCOUNTED NET BENEFITS	TOTAL BENEFITS	TOTAL COST DISCOUNTED AT 31 PERCENT	NET BENEFITS
1	$0.00	$2,798,901.00	($2,798,901.00)	$0.00	$2,135,561.00	($2,135,561.00)
2	$253,860.00	$3,251.00	($2,997,358.00)	$147,746.00	$1,835,208.00	($1,744,462.00)
3	$869,375.00	$4,340,612.00	($3,471,237.00)	$386,005.00	$1,927,232.00	($1,541,229.00)
4	$3,004,645.00	$6,976,065.00	($3,971,420.00)	$1,018,575.00	$2,364,886.00	($1,346,311.00)
5	$6,580,920.00	$9,740,210.00	($3,159,290.00)	$1,696,698.00	$2,522,714.00	($826,016.00)
6	$13,705,550.00	$11,718,530.00	$1,987,020.00	$2,699,934.00	$2,306,511.00	$393,423.00
7	$17,316,435.00	$13,342,535.00	$3,973,900.00	$2,914,782.00	$2,014,723.00	$900,059.00
8	$20,903,085.00	$11,330,465.00	$9,578,620.00	$2,904,545.00	$1,803,004.00	$1,101,541.00
9	$22,435,100.00	$11,135,440.00	$11,299,660.00	$1,[illegible]74,286.00	$979,916.00	$994,370.00
10	$24,748,610.00	$10,719,890.00	$14,028,720.00	$1,659,157.00	$718,333.00	$935,924.00
11	$26,059,100.00	$9,925,335.00	$16,143,765.00	$1,329,529.00	$506,195.00	$823,334.00
12	$27,523,400.00	$9,738,870.00	$17,664,530.00	$1,075,[illegible]	$378,046.00	$696,717.00
13	$29,306,130.00	$8,933,525.00	$20,372,605.00	$849,[illegible]	$255,073.00	$593,605.00
14	$31,091,490.00	$9,359,115.00	$21,732,375.00	$694,0[illegible]	$205,[illegible]	$478,118.00
15	$33,181,150.00	$9,545,215.00	$23,635,935.00	$564,080.00	$169,070.00	$395,010.00
16	$33,787,580.00	$10,930,740.00	$22,856,840.00	$439,239.00	$141,970.00	$297,269.00
17	$34,830,480.00	$10,436,415.00	$24,394,065.00	$348,[illegible]06.00	$104,364.00	$243,541.00
18	$35,933,120.00	$10,419,195.00	$25,413,925.00	$250,[illegible]52.00	$72,555.00	$177,897.00
19	$36,657,050.00	$10,395,745.00	$26,261,305.00	$123,235.00	$41,928.00	$121,307.00
20	$37,065,610.00	$10,494,445.00	$27,571,165.00	$151,462.00	$41,977.00	$109,485.00
	$398,123,010.00	$148,026,756.00	$250,096,254.00	$20,476,734.00	$20,099,099.00	$377,625.00

ESTIMATED IRR = 31.3%

ESTIMATED NPV DISCOUNTED AT 31% = $377,625.00

ESTIMATED B/C RATIO DISCOUNTED AT 31% = 1.02

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(2) extremely low capital investment per hectare in cultivation, essentially limited to hand tools and unimproved plant materials;

(3) primary dependence on unpaid family labor in return fo subsistence consumption of crop yields and limited cash income from crop sales; and

(4) predominant emphasis in crop allocations to annual food crops reflective of family consumption needs and relative price trends in recent years.

To allow comparison with the indicative traditional cropping system detailed above, six field intervention packages were proposed by the design team technicians to respond to the specific characteristics of the six different field situations assumed for the traditional farm. The intervention packages are detailed in the project paper technical annex. The objective is simply to quantify the output-input relationships of the proposed intervention packages and to compare the result with those from the indicative traditional situation.

In addition to the promotion of the intervention packages on farmers' fields, the project proposes a fruit tree development and extension program as described in the technical annex. This program is projected to affect 25,000 farm families. It will provide 30,000 nursery-grown fruit trees annually and will graft improved citrus stock on existing sour orange trees on farmers' land. Table 7 presents this program in terms of its projected costs and benefits.

Donor Perspective. Having analyzed the value of the proposed project interventions in terms of the direct benefits to the farmers in the last two sections of this annex, we turn here to a calculation of the value of the overall project from the donor's viewpoint. In order to make calculation an estimate of the spread effect of the project interventions during and after the project's life is needed. This estimate is presented below, as given by the design team technicians, for the spread of the intervention packages an the fruit tree program.

Table 8
ADOPTION OF FRUIT TREE PACKAGES

Project Year	Farmers Adopting Intervention Packages	Farmers Participating in the Fruit Tree Program
1	0	500
2	500	500
3	1000	500
4	3500	500
5	5000	500
6	10000	
TOTALS	20000	2500

Due to the fact that the intervention packages are structured in such a way that disaggregation into specific crop production interventions and soil conservation interventions is not really possible, farmers adopting the intervention packages are assumed to adopt the whole package. Although this will almost certainly not be the actual case as the project is implemented, this assumption at least gives the reader an idea of the outer bound in the net project benefits to be derived from project implementation.

Summary and recommendations. The economic analysis summarizes in quantitative terms of benefits assumed to flow from the project's two major activities at the farm level: the six intervention packages for crop improvement and soil conservation and the fruit tree development and extension program. It then compares these benefits with the projected private and public costs of implementing the proposed activities.

In the case of the six proposed intervention packages, the analysis finds, subject to the assumptions in the technical annex, that the estimated net present value of benefits from intervention packages adoption is $ 347.79 when discounted at 50 per cent. The estimated internal rate of return for package adoption is greater than 50 per cent at the farmer level. And, the projected benefit-cost ratio discounted at 50 per cent is 1.28. These indicators were derived assuming a participating farm family population of 20,000 over the life of the project.

In the case of the fruit tree development and extension program, the estimated net present value of benefits from the program is $232,072 when discounted at 14 per cent. The estimated internal rate of return is 14.2 per cent for the program, under the assumptions in the technical analysis. The projected beneficiary population for this program is 25,000 farm families over the life of the project. In terms of the overall project analysis, the estimated internal rate of return is 31.3 per cent.

It should be recognized in reviewing these results that they are based upon many technical assumptions by design team technicians and what useful information could be derived from an extremely deficient national data base on hillside agriculture. The actual results of project implementation activities and farmer adoption of the proposed interventions may be very different from those projected in the analysis. The project makes provision for an on-the-ground project monitoring and evaluation unit during the life of the project to collect both reliable baseline information on existing farming systems on the hillsides and comparable information on the value of the project interventions as they were developed and extended. Only as this improved information base is developed and analyzed can one have much confidence in the projected benefits and costs of the proposed interventions.

ANNEX J ADMINISTRATIVE ANALYSIS

Introduction. The project seeks to discover and then extend an integrated agricultural approach to hillside farm management in six watersheds flowing south of Pic Macaya in the south of Haiti. This approach should encourage increased agricultural production on the hillsides and thus increased income and improved quality of life for small-holding farmers who are already living there. It should do this in a way that not only slows and eventually stops the accelerating erosion of land in these watersheds, but also contributes to reversing the erosive trend and begins the regeneration of hillside soils.

To succeed in this undertaking TWM must establish an institutional base which will permit the long-term sustainibility of its accomplishments. Bringing in a well-financed, well staffed expatriate team; hiring a well-paid and highly motivated Haitian staff, and setting up an independent institution to carry out the program might lead to remarkable achievements during the few years of project operation. But it would be very unlikely to yield long-term sustainable benefits.

On the other hand, simply presenting local organizations with the material and funding to carry out the project would also raise problems. Local organizations do not have the administrative or technical capacity to carry out a hillside applied research/extension program. They could not respond to AID's needs for accounting and bureaucratic propriety. They would find it difficult to resist government agencies asking to use their new resources in ways inconsistent with project goals and methods.

Thus TWM will try to combine the advantages and avoid the pitfalls of both of the above approaches to the establishment of an institutional setting for Project activities. An independent institutional base will permit program flexibility and implementation efficiency, with the most efficient use of expensive technical assistance. Locally based Haitian institutions will ensure effective contact with the target population, a long-term perspective and a home for extension and research personnel. The project proposes to use both types of institutions, by setting up an umbrella agency to provide technical assistance, funding, and materials for project work and by carrying out that work through private Haitian organizations (PVOs or private firms) already working in the chosen watersheds.

This approach to development has proven its effectiveness in rural Haiti during the four years of successful operations of the Pan American Development Foundation (PADF) Agro-Forestry Outreach Project and the Interamerican Institute of Cooperation on Agriculture (IICA) Swine Repopulation Project.

TWM must operate from an institutional base that will allow it to achieve sustainability on two fronts:

(1) agricultural and soil conservation innovations must reach the farmers in the six designated watersheds effectively and convincingly to achieve beneficiary sustainibility; and

(2) the LORGs or private entities with which the project works must reach a state of administrative, technical and financial autonomy to achieve institutional sustainability.

The combination of an umbrella organization which can channel assistance to increase the technical and administrative capacities of the private Haitian entities, while dealing with USAID and the GOH on their behalf; with locally-based, locally known organizations which already work in the watershed areas and with the people who farm them provides the best hope for achieving long-term success and sustainability for the TWM.

The umbrella organization should be an American PVO or private firm which meets the criteria below for selection. The recommendation for the choice of an outside organization stems from the following reasons: (1) the umbrella should disappear at the end of the project, leaving competent, autonomous local PVOs and firms behind, ready to carry on the work; (2) choosing one local PVO to supervise others could create more problems than it would solve and might drive several effective organizations out of the project. This is particularly true in the targeted area where many of the PVOs with which we will work are sectarian; and (3) the project can avoid these problems by using an expatriate organization whose role is to prepare the way for its own departure at the end of the project.

Role of the umbrella organization:

(1) work with the Secretariat for Watershed Management Agriculture (STAB) of the Directorate of Natural Resources (DRN) in the Ministry of Agriculture, Rural Development and Natural Resources (MARNDR) of the GOH to establish national policies toward hillside agriculture and soil conservation;

(2) provide technical assistance to the intermediary PVOs and firms to enable them to carry out the research and extension tasks called for by the project;

(3) provide funding and materials to the LORGs and firms for their work connected with the project;

(4) help the intermediaries establish financially viable mechanisms for generating revenues to help finance hillside agriculture and soil conservation after the withdrawal of AID support;

(5) help the LORGs identify other sources of funding for their agricultural and soil conservation activities and to obtain funding from those sources;

(6) establish an accounting, inventory control and reporting system with the LORGs that satisfies AID requirements for disbursement of funds and materials. At the same time, this system must conform to Haitian accounting standards and the internal procedures of the LORGs. The umbrella organization will be responsible for all financial, accounting, and inventory reporting to AID;

(7) determine the role of the agricultural GOH District personnel in the project and assume all responsibility for coordinating the activities of government agents with those of the LORGs and firms;

(8) ensure that the intermediaries carry out the terms of their contracts with the Project in a satisfactory way;

(9) organize, plan and execute training programs for intermediary organizations' personnel in: agriculture, including animal husbandry,

forage crops, fruit, forestry, vegetables, cereals; storage; financial planning and administration; use of micro-computers; data gathering and analysis; marketing; soil conservation, including vegetative and mechanical structures, water use, and forestry; and other topics;

(10) perform all liaison work between the intermediaries and AID, the GOH, and other centrally located interlocutors.

Role of the LORGs:

(1) establish the program for accomplishing the goals of the TWM;

(2) administer a given number of demonstration sites in the targeted watersheds, according to the instructions of the umbrella agency;

(3) conduct outreach and extension activities to spread successful innovations from the demonstration sites to surrounding farmers, working through groups or individuals as appropriate;

(4) administer a credit program for participating farmers, tied as a motivating incentive to soil conservation activities;

(5) hire and train the technical and administrative staff to run the programs called for by PSTO;

(6) participate in meetings and seminars organized by PSTO to set policies and plan activities for all the intermediary organizations working with the Project;

(7) send personnel to project-organized or -financed training activities, in Haiti or abroad.

To carry out these tasks, the agencies that wish to act as intermediary organizations will have to:

(1) have worked in the targeted area for a significant period of time before the beginning of the TWM;

(2) have demonstrated competence in organizing farmers for innovative activities, such as agroforestry or swine repopulation;

(3) have other activities in the area besides those financed by the TWM;

(4) demonstrate a determination to achieve financial autonomy in all activities and thus a capacity to carry on TWM activities beyond the PACD;

(5) have a core staff that includes personnel trained in and working on agricultural or soil conservation activities;

(6) have core administrative services which can handle hiring new personnel, maintaining vehicles, preparing reports, and the like; and

(7) demonstrate through past work a commitment to improving agriculture and soil conservation practices through small farmers.

There are at least four organizations working in the targeted area seem to

fulfill these criteria:

ORE, *Organisation pour la Rehabilitation de l'Environnement*

DRI, *Developpement Rural Integre* (Baptist Missions)

DCCH, *Developpement Communautaire Chretien d'Haiti* (Catholic Mission)

UNICORS, *Union des Cooperatives de la Region du Sud* (Catholic Mission, Oblate fathers)

As the Project develops, other organizations may present themselves as candidates for participation in the TWM program. Their credentials should be evaluated using the above criteria and those which qualify should be able to work with the TWM on the same basis as those mentioned above.

Details of the institutional capacity of the four organizations we have identified so far are given below, but all four have worked in the targeted area for a number of years and have carried out agricultural activities with small farmers. All have worked closely with the agro-forestry outreach program and all but ORE have worked with the swine repopulation program. All have other sources of funding and all are making efforts to generate funds with their own activities. They are all committed to improving the life of small farmers on the hillsides of southern Haiti by increasing these farmers ability to get an adequate return from their land without destroying the land's future potential. All have agriculturally trained staff, including agronomists, agronomic technicians and people trained on-the-job as extensionists and communtiy organizers.

Among them, the four cover a good part of the TWM targeted zone. ORE is established in the Grande Ravine du Sud, and has just set up secondary nurseries and extension centers in the Acul and Cavaillon watersheds. IRD concentrates its activities in the Cavaillon, l'Islet and Grande Ravine du Sud Watersheds, but has some activities in Acul, too. DCCH has its home in the Grande Ravine du Sud, but also works in Cavaillon and l'Islet, as well asin the Acul watershed. UNICORS works exclusively on the South Coast, including the watersheds of Les Anglais, Port a Piment, Roche a Bateaux, and Coteaux.

1. ORGANIZATION FOR THE REHABILITATION OF THE ENVIRONMENT (ORE)

The ORE is headquartered in the watershed of the Grand Ravine du Sud, at Levy, near Camp Perrin. Established on land owned by its Director, Sean Finnegan, ORE works now in grafting fruit trees, but has more important amitions for the future.

Goals. ORE wants to disseminate grafted fruit trees, especially improved varieties of citrus, avocado and mango to small-holding farmers in the Les Cayes Region. They produce graftedtrees at a central nursery at Levy and also do on-site grafting. They eventually hope to create local capacity to graft and care for improved fruit trees all over the region.

ORE also wants to enter the field of soil conservation and general agricultural extension. They will use fruit and hard-wood trees in this endeavour,along with annual and perennial crops.

Approach. ORE is registered as a Haitian PVO and acts as a non-profit

enterprise. It feels that improved, grafted fruit trees will contribute significantly to the improvement of small-holders' income and thus quality of life in the hillsides. They concentrate on training and extension aimed at dissemination of grafted trees. As fruit trees are owned by individual farmers ORE works largely with individuals.

ORE's approach to hillside agriculture and soil conservation is based on leucaena hedgerows and fruit trees. They will work with groups as well as individuals in this program.

Current activities. ORE's main focus of activities is on their central nursery in Levy. This nursery was established with a grant from USAID. On land belonging to Sean Finnegan, the organization's Director. ORE has the space, shade, and water to produce up to 100,000 grafted trees at a time. ORE now operates on two contracts funded by USAID. The AOP and PADF have contracted for 24,000 grafted fruit trees, of which 12,000 are for DCCH and 12,000 for IRD. The two local PVOs receive the trees free, but have to come get them and transport them to the farmers who will plant them. The farmers pay $0.40 per tree, which covers transport costs. USAID pays ORE $1.50 per tree. Thus far, each PVO has received 5,000 trees and planted them out through individual peasants. The PVOs take care of all follow-up and training in the care of the trees.

ORE has also prepared 1000 trees for the ADS II project. A portion of these trees are ready. ADS II is distributing these trees free to their participating farmers, which has led to some problems for the PVOs which are asking farmers for payments to cover transpot costs.

ORE has just begun a USAID-funded prorgam to plant 20,000 grafted trees, including 15,000 citrus, 4,000 avocado amd 1,000 mango in three hillside areas: Duchitty, Platons, and Saut Mathurine The latter two are in the TWM area. They have received a grant of $200,000 for this undertaking, as well as an additional $10,000 to perform on-site grafting of 10,000 trees. ORE has hired personnel to carry out this program (see below).

Financing. ORE is entirely financed by AID, although the money for the DCCH and IRD trees is channeled through PADF. There is no direct sale of grafted trees to private farmers, as the nurseries capacity is absorbed in fulfilling ORE's contracts with AID projects.

Staff. ORE has two expatriate staff. Sean Finnegan, the Director, is a self-taught agriculturalist who is interested in fruit and has learned to graft and care for the trees. He concentrates on the administrative and extension aspects of the organizations program. Jean-Paul Eldin is an agricultural technican, whose specialty is fruit trees and who is an expert at grafting and caring for tropical species.

The nursery employs about 20 workers, including foremen. Most of these people have learned how to do nursery grafting and can be trusted with most tasks at Levy. They are paid with nursery revenues from the PADF contract. Their salaries average around $100/month.

For the new hillside fruit tree program, ORE has hired an extension supervisor at $400/month. He has some post-secondary eduction, but no formal agricultural training. They have one zone extensionist for each area at salaries between $120 and $200/month. Thesemen have secondary diplomas and can read and write in

French. Finally, each zone extensionist supervises 3 assistants, who are paid $60/month. These latter are local people, who have no formal agricultural training.

Equipment and installations. In addition to the nursery facilities at Levy, ORE is constructing housing for its extensionists in the field, depots and courtyards for storage at each of the extension centers (Duchitty, Platons and Saut Mathurine).

They are creating budwood sources in each area through the on-site grafting program and at Levy.

Credit. ORE does not administer any kind of credit program at present.

Cooperation with other agencies. ORE works closely with the Ateliers du Camp Perrin and with DCCH. They do not receive fianncing from outside sources beyond USAID.

Relations with the GOH. ORE says that the District and regional agronomists neither visit them nor request information from them. They do exchange visits and informal support with the agronomists at the Levy Farm, which just down the road from ORE.

Administrative assessment. ORE has successfully established its central nursery facility and produced grafted fruit trees to order for USAID funded projects. They have trained their nursery workers to carry out this task effectively. They are only beginning their extension program in the hills and have just recently put their staff in place on the Platons. Thus their ability to reach, organizeand motivate peasants and peasant groups has yet to be proved. In addition, their ability to deal with an integrated agricultural package has yet to be proved. Their will to become a self-financed, autonomous group has yet to show itself in practice.

Nonetheless, ORE is a viable candidate to carry out fruit tree educatuion and training in the TWM area and should be given a chance to try its ability to run the Project's demonstration sites in the Les Platons area, where they are the only organization currently planning to work with small-holding farmers.

2. INTEGRATED RURAL DEVELOPMENT (IRD)

Integrated Rural Development (IRD) is a Haitian PVO sponsored by the Evangelical Baptist Missions of Southern Haiti (MEBSH). They work in agriculture, water, health and literacy in the Cavaillon, Grande Ravine du Sud and Islet watersheds in the TWM area.

Goals. IRD seeks to to improve the quality of life for farmers in South Haiti by all means available to them. They are eager to work with any group which will help them achieve this end. They are now able to cover approximately 50% of their adminisrtative and operating costs from their own revenues and hope to be fully self-sufficient in 5 years. They work within the context of Protestant missionary organizations, but are willing and ready to help all farmers, regardlessof their religious affiliation.

Approach. IRD organizes farmers for action. They act as liaison with groups which finance rural projects. They do not finance these projects themselves. They help communities to organize themselves, train local leaders, and promote

cooperation and farmer groups. They respond to the needs of local groups, helping to define projects, find strategies, and contacting potential sources of funding. Although they tend to help peasants organize around specific issues,like swine repopulation or reforestation, they intend all groups they form to serve all the needs of their members.

Current activities. IRD has been one of the most effective interlocutors of the USAID-funded Swine Repopulation Project. They have organized farmers to construct 65 piggeries, of which about 30 are in the TWM area. As of now, 54 of these piggeries have received sows and boars from the Swine Project.

IRD has set up a reforestation nursery under the supervision of PADF and the AOP. They have an extension network organized in accordance with PADF standards.

They have an extension network that organizes farmers groups, does agricultural extension, animal production extension, literacy and vocational education. Most of their animal activities are centered on pigs, but they also extend rabbit production tecniques.

IRD publishes manuals for agricultural and organizational extension and runs a welding shop. They have a small well-drilling rig and are expecting a rig that can drill to 200 feet in the near future. They train villagers in group organization, leadership, and techncial subjects. They have run spring-capping and potable water projects in the past.

Financing. IRD generates about 50% of its annual operating and administrative budget of $32,000/year from its own enterprises, including sale of publications, nursery operations, welding, and the like.

The rest of its funds come from the MEBSH, which channels contributions from American and European Baptist congregations into its development activities, and from overseas Protestant PVOs (see list below). For specific project actviities, IRD approaches potential donors and obtains funds for specific activities.

STAFF. IRD has 20 full-time employees. These include:

1 Director (Chavannes Jeune)
1 accountant
1 secretary
5 alphabetization/vocational education extensionists
10 agronomic technicians for extension work
2 expatriates (1 veterinarian, 1 nurse) paid for by World Concern

The agronomists have 2 years of agricultural training and a good deal of experience. They work in rural animation, reforestation, animal husbandry and general agriculture. They make between $150 and $250 per month. The salaries of all full-time personnel are covered by general IRD revenues and by a World Concern subsidy.

In addition, IRD has 29 part-time forestry extension workers whose payments come from PADF subsidies to the IRD tree nursery. They are paid according to how many farmers they contact and convince to plant trees, how many trees they deliver, and how many follow-up visits they make to each planter. Payments range from $40 to $120 per season. There are two seasons in a year.

IRD also has trained 8 extension workers to follow up the groups which have constructed piggeries for the Swine Repopulation Project. These people receive $5-10/month from each piggery they supervise. Each piggery has a manager and an administrator, trained by the IRD agronomists. These people are paid by the piggery group and are usually members of that group. IRD also has welders, who are paid on a piece-work basis.

Equipment and installations. IRD is based in a two-story building on the outskirts of Les Cayes, along the road to Camp Perrin. There it has modest offices and its welding shop along with its central piggery. At Chavannes Jeune's house in Bercaud, IRD has its PADF nursery and a demonstration hillside plot, where itis testing soil conservation measures, including tree plantings, living fences, and perennial crops.

Credit. IRD has tried a number of credit programs but so far has not been very successful with them. They offer credit to farmer groups to buy pig feed for their new piggeries. This credit is delivered in kind and so far there has been no problem with repayments.

However, they have tried to work with the BCA in the past with disappointing results. At St. George, the farmers refused to have anything to do with the BCA and at Plaisance administration was so bad the agency closed down. The problems have all been with management more than with farmers refusing to pay back their loans. In more than one case, the manager of the credit program simply stole the money.

IRD would be very eager to work with a credit program, if they could hire experienced people and receive training in credit administration. They receive regular requests from farmers for credit for: pig feed, sty construction, inputs such as fertilizer, insecticides and seeds, renting mechanical cultivators, mills, huskers, and tools.

Cooperation with other agencies. IRD works or has worked with a large number of international donors. These include:

World Concern, a Protestant group based in the US, which contributes to their general perating fund and provides two expatriate technicians;

World Relief,another US-based Protestant PVO, which has funded seminars and training for farmers and IRD staff;

ACDI, the Canadian bilateral aid agency, which has provided technical assistance, training for nursery personnel, funding for a spring capping program, and the purchase of a well-drilling apparatus which has not yet arrived in Haiti;

CARE, an American non-sectarian PVO, has funded a potable water project through IRD;

PADF has funded the establishment of the tree nursery and the agroforestry extension workers;

IICA implements the swine repopulation program with which IRD has worked very successfully;

Harvest International, a Protestant PVO from Phoenix, has provided agricultural and agroforestry assistance;

CODEPLA, a Haitian Protestant PVO, works with IRD on small agro-industry projects in the Les Cayes area and is available for projet planning and to help identify funding sources;

MEBSH represents IRD to the international Bapist community, raises funds for the organization's work, and provides an institutional home when IRD needs one. MEBSH facilities at the Cite Lumiere near Les Cayes are available to the IRD when needed, for training or seminars and meetings. MEBSH personnel participate in IRD programs when their technical background warrants such cooperation.

Relations with the GOH. IRD only works directly with the GOH agronomic district on an irrigation project in the plain at Masse. IRD has heped organize the water user associations on this project and the GOH Agriculural District is represented on the board of the association.

Relations with the current Agronome de District, Mr. Bannatte, are very good and IRD has said that it will collaborate happily with him. But on the whole, they prefer to work apart from the GOH and to avoid direct government participation in their activities.

Administrative assessment. IRD seems to be an effective, goal-oriented organization, which has a good record for working with farmers and organizing them for specific tasks. They seem less ideologically motivated than their Catholic counterparts, but seem, nonetheless to be able to discern peasant needs and to take steps to meet these needs. Their agronomic and extension staff seems dedicated and energetic.

So far, their activities in the hillsides have been limited to reforestation and piggery construction, with associated extension activities. But they are interested in working with hilside agriculture and have begun a demonstration program near Les Cayes on one hillside. IRD seems to have the minimal administrative capaity to cope with the demands of running demonstration sites for the TWM, organizing the extension system the project will need, and beginning to work with credit.

3. DEVELOPPEMENT COMMUNAUTAIRE CHRETIEN D'HAITI (DCCH)

DCCH is a Haitian PVO based in Laborde, about 15 kms north of Les Cayes on the road to Camp Perrin. It is affiliated with and supported by the Catholic Diocese of Les Cayes, which assigns Priests to direct its programs. The current Director is of the Companions of St. James, but this congregation does not have a direct role in deciding DCCH's policies or programs. DCCH works in the Grande Ravine du Sud, Cavaillon, Islet, Torbek and Acul Watersheds in the TWM area.

Goals. DCCH seeks to improve the quality of life for farmers in rural Haiti by helping them gain control of their lives economically, socially, and politically. By organizing farmers into groups, they intend to create a structure which will enable rural people to interact effectively with all interlocutors, to elucidate and communicate their needs, and to identify appropriate means for the satisfaction of those needs. DCCH is also very interested in the preservation of the environment in rural Haiti.

Approach. DCCH has adopted a specifically Christian approach to development work. They attempt to establish a sense of family among all the people with whom they collaborate, and a spirit of team effort in all groups which work for and with DCCH. They keep bureaucracy and office staff to minimum, in order to use most of their resources for field work. All of their people must do field work. DCCH works entirely through farmer *groupements*, each of which encompasses from 7 to 15 individuals or families. These *groupements* are the basis of all DCCH approaches to economic and social development.

The PVO has established a system of permanent and on-going evaluation of all their work. All those involved participate in these evaluation procedures, especially the farmers and other beneficiaries of their programs. For example, farmer groups judge their own animators and try to improve their performance. If animators do not work well, the farmers groups can remove them and request training and supervision for a replacement.

Groupements are meant to work with all aspects of rural life, including agriculture, health, animal health and production, education and literacy, women, agroforestry and soil conservation. Keys to their success are the farmers' expression of their own needs and their estimation of their own abilities. But DCCH evaluates the needs they express in terms of economic, financial, administrative, and technical realities. Then both parties collaborate to establish a program.

DCCH would like to become financially self-sufficient, particularly on the level of the parishes with which they work. But so far they have made little progress toward establishing activities that generate income. They intend to move toward this goal and some parishes have begun purchasing fields to grow crops for sale to generate income for other projects.

DCCH works with farmers of all religious confessions and hires staff without regard to denominational orientation.

Current activities. DCCH farmer groups have established 14 piggeries under the conditions of the Swine Repopulation Project. Of these, 10 have so far received pigs. They have not been very happy about their collaboration with ICCA, saying that ICCA has been slow to deliver pigs and, especially, feed to their groups. DCCH farmers are very interested in this program and there is more demand than the PVO feels it can meet.

DCCH has two nurseries that it runs with subsidies from PADF and the AOP.These are in Laborde and in Camp Perrin. They do agro-forestry extension through their groupements. The technicians that work on their nurseries are paid with PADF funds.

DCCH sells fertilizer and cement to its adherents. Currently they are selling $6,000 worth of fertilizer and 100 sacks of cement per week. All of these transactions are in cash.

A DCCH agronomist, M. Elancie, is carrying out a survey of hillside agriculture around Camp Perrin. He is looking at land tenure, soil types, cropping patterns, and peasant attitudes toward innovations.

Based in Laborde, a Miserior team of two German technicians, an agronomist and an engineer, works through DCCH to restoreand maintain the Canal d'Avezac Irrigation system, which uses the water of the Grande Ravine du Sud.

DCCH has about 400 *groupements* under its supervision. These are organized to the specific end of mastering their own production without resort to intermediaries. They purchase tools and inputs otgether, including plows. They purchase and raise animals, including pigs,cattle and transport animals. The market crops and other products together. DCCH has agronomists who help them and offer training and supervsiion when necessary (see below). In addition, each groupement has an unpaid animateur, who is trained by DCCH at Laborde. Most of these grouepments are in the plains for now, but DCCH would like to work more in the hillside areas.

Financing. DCCH functions entirely on contributions from outside sources. All of its income generating aspirations have to do with the parishes with which it works. AID finances the DCCH agroforestry program. IICA subsidizes pigfeed through the first weanings for DCCH as it does for all other organizations with which it works. Secours Catholique de France provides $120,000 per year for operating costs. Miserior finances the Davezac irrigation projet and some reforestation activities. A number of embassies in Port au Prince have financed small development projects, like potable water, community buildings and the like.

Staff. The Director of DCCH, Father Pierre le Beller, is assigned to the organization by the bishop of Les Cayes. An assistant, Father Wilner Stylus, has recently been assigned to help Father Le Beller.

DCCH has a total of 80 employees, including those working in the PADF-sponsored nurseries and in their own piggery. Of these, seven are agronomists, paid from DCCH general funds. All of these latter hold university dogrees in agronomy (licence) or else have been to the Ecole moyenne agricole at Laborde. Their salaries average $300/month. They are placed at:

Laborde/Sacre Coeur (Grande Ravine du Sud watershed)
Maniche (Cavaillon)
Camp Perrin/Marcelline (Grande Ravine du Sud)
Cavaillon/Pliche/Plaisance (Cavaillon)
Ducis/Chantal (Acul)
Vieux Bourg/Bousy
St Jean du Sud/Arniquet (Acul)

All but the last two are in TWM watersheds, although they now work more in the plains than in the hills. Each one supervises 4 to 6 animateurs in each of the parishes in which he works. For example, in Laborde there are 6 animateurs and in Sacre Coeur there are 4. Animateurs are not paid by DCCH. Each group of animateurs can choose a coordinator who then comes for further training at Laborde. Coordinators are not paid by DCCH.

Equipment and installations. At Laborde, DCCH has a piggery, a PADF nursery, housing for its Miserior technicians and for the core staff of the organization, including Fathers Le Beller and Stylus. There are facilities for receiving trainees for short periods of time. DCCH also has some storage capacity in Laborde and has access to Diocese resources for storage, training and lodging in Les Cayes. At Camp Perrin, DCCH works closely with the Ateliers of Camp Perrin, which are run by Mr and Mrs Jean Sprumont, who used to belong to DCCH as volunteers. In addition, they have a PADF nursery there.

Credit. DCCH feels that cheap credit is vitally necessary to enable poor

farmers to break out of the cycle of debt and poverty which encompasses their world now. They regularly receive requests for credit to purchase plows, animals, agricultural inputs such as fertilizers and seeds, and to hire labor to accomplish certain tasks on the farm.

For the moment, DCCH does not have the funds to establish a general credit program for their farmer *groupements*. The BCA has not proved a viable alternative for most poor farmers. DCCH has given credit on a regular basis to its own employees for agricultural as well as social uses, including land purchases, housing construction, medical emergencies and the like. Repayment rates have been nearly 100%, although there have been occasional problems, too. There is also a credit program funded by Miserior for artisans at the Ateliers of Camp Perin. This progam is also working well.

Cooperation with other groups. DCCH works closely with a wide range of donors and collaborators. Most, but by no means all, of these are Catholic.

MISEREOR - based in Germany, this Catholic PVO supplies technical assistance and financing to DCCH for irrigation, reforestation and other efforts.

Secours Catholique de France - supplies funds and goods.

Caritas - this international PVO, based in Rome, supplies funds and goods.

PADF/AOP/USAID - funds and materials for the agro-forestry outreach project.

IICA/USAID - funds and materials/feed for the Swine repopulaion Projet.

Diocese of Les Cayes - supplies personnel and funds as well as access to infrastructure.

Relations with the GOH. To the extent possible, DCCH has always avoided all direct contact with the GOH and the District Agricole. Now that the GOH has changed, DCCH is waiting to see what the new structures and attitudes ofpublic servants will be before making any decisions about how to work with them. For the moment, DCCH only works with the government agricultural service when they find themselves together on the board of the Water Users' Association for the Canal d'Avezac irrigation system. Despite this, DCCH personnel like the current District Agronomist, Mr.Bannatte, and have no objection to working with him.

Administrative assessment. Of the PVOs with which TWM proposes to work, DCCH has what seems to be the most extensive network of farmer groups and the most intensive structure for direct contact with those groups. They admit that some of the 400 groups they claim are non-functional and are weeding them out as best they can. But many of them are valid structrues for approaching the farmers of the area and DCCH's experience in organizing these groups, motivating and training their members and passng through them information to improve the lives and livelihoods of local farmers is impressive.

DCCH, like the other PVOs, will have to improve its administrative and managerial capacities to cope with the increased personnel and resonsibilities that will come with participation in the TWM agricultural and credit programs, but they have the basis for absorbing ths personnel, assimilating it, and

helping train it in an effective and integrative manner.

4. UNION DES COOPERATIVES DE LA REGION DU SUD (UNICORS)

UNICORS is a Haitian PVO headquartered in Chardonnieres, on the south coast of Haiti, about 3 hours drive west from Les Cayes. Founded and advised by the Oblate Fathers of the Catholic Diocese of Les Cayes, UNICORS coordinates the activitiesof 8 cooperatives of coffee planters along the south coast from Port Salut in the East to Tiburon in the West.

Goals. UNICORS seeks to improve the income generating capacity and the quality of life of small-holding farmers on the plains and hillsides of the South Coast of Haiti by organizing them into cooperatives. They feel that cooperative economic and social activities have the best chance to ensure the farmers control of their own production and can best mediate their access to goods and services from outside sources.

Approach. UNICORS approaches the problem of economic and social development in rural Haiti by assuming that people organized into cooperative associations can express their needs and mobilize resources to achieve their goals more effectively than can individuals. They try to instill in all the members of the UNICORS cooperatives a feeling of belonging to one large family, whose interests are inextricably linked and who thus must work together to attain their ends. Thus, for example, all extension activities are undertaken after consultation with the farmers who belong to the cooperatives and in association with them.

UNICORS has chosen to work with cooperatives rather than groupements because they feel that larger units are more effective in making the voice of the farmer heard. They have preferred official structures, such as cooperatives recognized by the GOH, to unofficial ones like *groupements* to permit their members to have a voice in national policy questions and to have access to a wide gamut of sources of assistance and cooperation.

UNICORS is working toward financial and economic viability for all its activities. Though it depends heavily on external aid now for many of the activities that support the cooperatives and while most major investment programs by the cooperatives have to be financed from the outside, all the cooperatives undertake new activities on the basis of their potential for independent sustainibility.

UNICORS and its constituent cooperatives emphasize income generating projects above all others. They will undertake social welfare activities only when they are assured of sufficient revenue to cover their costs.

Current activities. UNICORS' main activity is encouraging the development of its constituent cooperatives and purchasing coffee from them for resale to the CCH in Port au Prince. Each of the 8 cooperatives in UNICORS is divided into sections and each section represents 4 to 6 groups of 50 members. People join UNICORS as individuals and thus in any given family, some or all of the adults may belong to their local cooperative or not. Each cooperative is regionally based, and headquartered in one of the main towns of the South Coast:

COSAR	RENDEL	10	SECTIONS	3000 members
CAVDAC	CHARDONNIERES	5	SECTIONS	1500 members
CADA	LES ANGLAIS	8	SECTIONS	2400 members
CATI	TIBURON	6	SECTIONS	1800 members
COAP	PORT A PIMENT	4	SECTIONS	1200 members
COCAM	DAMASSIN	5	SECTIONS	1500 members
COTECOPS	PORT SALUT	3	SECTIONS	900 members
COTADEC	COTEAUX	3	SECTIONS	900 members
ROCHE A BATEAUX		9	SECTIONS	2000 members

The population of each cooperative listed above is estimative only. All cooperatives seem to be growing quickly. Approximately 60% of the members of the cooperatives are men.

UNICORS has three medium size trucks (10T) of which 2 are in working order. These trucks transport coffee from the South Coast to Port au Prince. The cooperative which loads its coffee on them pays the cost of the trip. On the return oyage, the truck may bring back fertilizer, consumer goods, food, or whatever else is wanted.

The cooperatives have installed about 60 8' high by 12' diameter sheet metal storage bins for grain in villages and towns in the coffee area. Most of the cooperatives have mills for grinding corn or sorghum for food. Some also have rice husking facilities. These mills are run in a commercial manner.

Each cooperative has purchased land for coffee plantations. This land is managed by the cooperative itself and labor on it is paid for with WFP food-for-work rations or else with the produce of cooperative fields dedicated to annual food-crops. The cooperatives prefer the WFP rations, which permit them to sell the products of their own fields on the market and generate revenue for the cooperative. Some cooperatives have undertaken potable water projects, housing projets,cooperative stores, sewing machine distribution projets, animal husbandry activities and coffee and grain storage activities.

UNICORS supervises 4 coffee nurseries at Rendel (2), Grande Plaine and Cadish. In cooperation with PADF/AOP, cooperatives at Damassin, Rendel, Chardonnieres and Les Anglais have set up nurseries to supply seedlings for agro-forestry outreach. These nurseries are funded by the AOP as for other PVOs througout Haiti, but have the advantage of technical assistance and financial support from CECI, a Candian PVO which has a team of three experts,including a forester working with UNICORS now. UNICORS members have consrtucted 46 piggeries throughout their zone with the assistance of and to the standards of the ICCA/USAID Swine Repopulation Project.

Although UNICORS and the constituent cooperatives spend energy, time and scarce resources on the above activities, the main thrust of their program is to purchase coffee from their member farmers and to resell it to the CCH at a profit. Before UNICORS began organizing this activity, the local coffee growers were at the mercy of speculators who came into the region and bought coffee at the lowest possible prices. Now, throughout the year, there is active competition between those speculators who have remained in business and the UNICORS cooperatives to purchase coffee. The speculators' prices are often a bit higher than those of the cooperatives, but this difference is made up at the end of each season, when the cooperatives distribute a portion of their profits to their members. This rebate was between $0.07 and $0.10 per pound last year, depending on the cooperative involved.

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The amount of coffee sold to UNICORS and thus to CCH has grown steadily since UNICORS was founded. In 1984, it was well in excess of 500,000 pounds annually.

Financing. UNICORS' cooperatives cover their own staff and administrative costs from their part of coffee sales and the products of their other enterprises. However, most investment costs and most of the costs of the UNICORS staff come from outside sources. With the notable exception of staff salaries, UNICORS itself covered from its own receipts 221,467.82 gourdes of a total budget of 257,106.86 gourdes. The deficit was covered from other sources.

To pay its personnel and for investment purposes, UNICORS receives aid from a great variety of sources, the most important of which have been:

FENU for the purchase of lands by the constituent cooperatives;

CECI for extension personnel for agro-forestry, technical assistance, cooperative leadership training and general UNICORS administrative costs;

PADF for agroforestry extension and nursery creation and upkeep;

IICA for pigfeed; and

PAM for Food for Work rations.

Staff. Each of UNICORS's constituent cooperatives has its own staff, paid from its own funds, as well as some personnel paid by external donors. Below are two examples of cooperative staffing structures. UNICORS itself has the following personnel:

No	TITLE	FUNDING
1	Coordinator of Projects	CECI
1	Secretary	CECI
1	Head animator	CECI
1	Accountant	CECI
1	Directress of Rural Women	FREP
1	Reforestation agent	CECI
1	Agricultrual Technician	CECI
1	Administrative Agent	UNICORS
1	PAM Warehouseman	UNICORS
1	PAM Manager	PAM
1	Nursery Technician	CECI
1	Mechanic	UNICORS
1	Guest House Manager	UNICORS
1	Cashier	UNICORS
10	Cooperative Trainers (1 per coop, except 2 at Rendel/Les Anglais)	CECI
7	Responsables of piggeries (1 per coop, except Port Salut)	FREP
1	CCH Regional Manager	CCH

The CADA Cooperative at Les Anglais has the following personnel:

1 Accountant
1 Cashier
1 Responsable for coop lands
1 Coffee Transporter (fields to town)
3 Mill Operators
1 Storage Manager
1 Coffee Manager
1 Coffee Buyer

The COSAR Cooperative at Rendel is the largest and oldest of the UNICORS family:

1 Accountant
1 Cashier
1 Warehouseman
1 Responsable for coop lands
2 Coffee Buyers
1 Cabinet-maker + 25 Workers at carpentry shop
1 Miller
1 Potable Water Manager
1 Piggery Responsable + 20 Managers (of whom 10 are women)
1 Reforestation Agent paid by CECI
1 Ag Extension Agent paid by MARNDR, after training at Damien financed by COSAR

Equipment and installations. Each UNICORS cooperative has its own infrastructure as does the parent organization in Chardonnieres. UNICORS has constructed a lage building in Chardonnieers which contains its offices, a Guest-House with Kitchen, and a large meeting hall.

The cooperative CADA in Les Anglais has a building for offices and accounting operations. It also has 179 carreaux of coffee lands in the hills. It has a complex which contains a corn/sorghum mill, storage facilities for coffee and food grains and seed. It has several piggeries and a PADF nursery. It also stores fertilizer which it buys and resells to its members. Other cooperatives have such infrastructure as potable water networks, including installations in private homes; housing on lease or sale to members; meeting rooms, though often they meet in the churches of their parish; carpentry shops; other ateliers; etc. The Oblate Training Center at Silde, near Camp Perrin is available for short courses.

Credit. UNICORS and its constituent cooperatives have received credit from numerous sources and have a good record of paying it back. However, the cooperatives have not entered into individual credit operations so far. Some have tried advancing seeds, fertilizer or tools to members, but this has not worked very well as the agricultural operations did not generate enough surplus production to permit a real profit. Advancing goods such as sewing machines has also failed in a few cooperatives as people either broke the machines, took them and went away, or failed to make enough money off them to pay back their loans. Most programs have been dropped as of now.

Cooperation with other agencies. UNICORS has been very successful at generating outside support for its cooperatives and for its own programs. They work with the following organizations:

CECI - Candian PVO whoch provides technical assistance (1 forester, 1

agronomist, 1 team leader/cooperation specialist)

FENU - loans to buy land and equipment for the cooperatives

OIT - UN Labor Office. Training, technical assistance,finance.

FAO - loans, technical assistance

CNC - training for cooperative officials,loans

BCA - loans

MARNDR - training for personnel, cooperation with staff

TPTC - infrastructure construction and maintenance

CCH - coffee purchase and bonus

IICA - Swine Repopulation Project

PAM - food for work rations

PADF - nursery subsidies

Relations with the GOH. UNICORS has always maintained cooperative relations with the GOH. Although the District Agronomist almost never comes to visit their operations, they work with the National Council of Cooperatives (CNC) and with the Public Works Ministry (TPTC). The GOH doesnot work directly on agriculture with the members of the cooperatives except through those cooperatives.

Administrative assessment. UNICORS and its constituent cooperatives are the best managed of the PVOs with which TWM proposes to work. They keep auditable accounts and are making a real effort to becme financially autonomous. The cooperatives are profitable and membership as well as coffee sales are growing each year.

UNICORS's agricultural improvement programs depend on external technical assistance and on external financing. But the cooperatives have a good number of agricultural personnel and have the capacity to use more without putting undue strain on their administrative capacities. Given the presence of CECI expatriate technical assistance, UNICORS seems more than capable of participating in the TWM program.

4. OTHER INSTITUTIONAL ACTORS

The TWM will not be able to operate in a convenient vacuum, separated from all other development authorities and activities in Haiti. The umbrella agency and the intermediary agencies will have to establish relationships with a variety of private concerns, other projects, and GOH organisms in the course of their efforts to accomplish the TWM's ends. These organizations will include private agricultural input supply firms, like Agro-Technique and Agrisupply; The DRN and the SHAG of the MARNDR, the other directorates of the MARNDR, particularly Production Animale (DPA), Production Vegetale (DPV) and Developpement rural (DDR), the MARNDR's Directrict and Regional Agriculture offices and personnel, ADS II, The Agro-Forestry Outreach Project and PADF, PDAI and the dry-rock-wall

program on the platons, MEBSH and CODEPLA, CCH, BCA, ORE (for fuit culture training), and CIMMYT.

Private agribusiness. Private agri-business companies could play a key role in the success of TWM's efforts to become a sustainable, economically viable activity. Several companies now import agricultural inputs to Haiti. Their business includes fertilizers, insecticides, herbicides, seeds and tools, among other things. They have links with US-based supply companies and warehousing and transport facilities within the country. There is no reason to establish a separate agriculture input supply network for TWM. Once the umbrella agency and the intermediaries have determined finally what the inputs to be imported will be, these companies should bid for the contract to bring them into Haiti and to deliver them to the intermediary organizations or to the umbrella as appropriate.

Although the project might be able to provide the same imports more cheaply by bringing them in itself and profiting from tax exemptions, it is preferable to pay real-market prices for these inputs to suppliers who will be able to continue importing long after the PACD - if the market warrants it! The TWM should subsidize inputs to small farmers at a rate of 50% for the first two years of project operations, 25% for the third and 00% for the fourth year and thereafter. It may be appropriate to permit individual farmers to benefit from three years of subisidized inputs, no matter when they begin to use them, but this could lead to major administrative problems. It is thus recommended that the subsidy be limited in time, no matter when a given farmer begins using fertilizer.

As the private companies bring inputs into the market for the targeted area, it will be in their interest to train farmers to use these inputs in a pofitable, rational way. Though short-term interests may dictate a hard-sell approach, trying to convince any and all farmers to buy their goods, an eye to long-term viability should demonstrate that only certain farmers in certain conditions should use fertilizers, insecticides, and the like. The private supply companies should take the responsibility for training farmers to recognize the circumstances in which modern inputs are profitable.

Thus, as the TWM demonstration sites show the best way to use modern inputs as part of an integrated package to improve hillside agricultural productivity and soil conservation, the private supply companies should undertake training programs for intermediary organization personnel to teach them how best to use their products in the field. These courses would include choice of product, the soil-water relationship, site conditions (slope, soil type, altitude, etc.), crop mix and rotation, application schedule, calibration, recognizing deficiencies, recognizing signs of badly used products, cost calculations, and test plot techniques.

For the first three years of project operations, TWM will finance and supervise these seminars and provide personnel to help deliver them. Thereafter, the private firms will provide such training *gratis* as part of the service they render their customers. The price of the fertilizer to the clients will reflect the cost of the training.

Seed multiplication. A reliable source of good quality seed for improved varieties of annual and perennial crops will be essential to the success ofthe project. Although many of the slopes on which farmers in the targeted watersheds work are more appropriate for perennial tree crops than for annual

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grain and root crops, the Project will not attempt to transform the agriculture which affords the watershed farmers their daily bread in a few short years. While working toward a climax of perennial tree crops, the project will propose improved varieties of annual food crops to participating farmers, along with improved methods of cultivation of those crops, use of appropriate inputs to increase yields, and methods to improve soil fertility and water retention throughout the exercise. In addition, much of the land in the targeted area is appropriate to annual food crop agriculture, if carried out properly. Of all the interventions proposed in the project package, the improved varieties of traditional grain and root crops should have the most immediate and dramatic impact on farmers' perception of the project and its ability to help them.

Short-term, dramatic improvements in yields of food crops and thus in both available nutrition and available income will attract farmers to the project and encourage them to undertake longer term, but equally profitable measures to improve agricultural production and soil fertility on their hillside fields. To accomplish these goals, a source of reliable and affordable, high quality seed in South Haiti is vital to the projet's hopes for success.

Useful sources of seed for farmers must be:

free of foreign material and noxious weed seed;

up to minimum germination rate standards;

uniform in color and size;

packaged in various size containers for ease of transport and marketability;

readily available in all watersheds at prescribed planting periods;

verifiably representative of tested and approved varieties;

affordable;

produced under acceptable agronomic conditions and to acceptable scientific standards; and

supplied by sources permanently established in the area.

In order to undertake broad extension of its technical package, the project will need access to regular supplies of seeds and other genetic material for maize, beans, sorghum, yam, sweet potatoes, cassava, leucaena, leguminous forage crops, and grasses. Other species for which seed is necessary will be identified as the project proceeds with its experimentation and extension activities.

At this time, there is no organized seed industry in Haiti. There is some dissemination of improved coffee varieties from Thiotte and the tobacco company Comme Il Faut has begun producing maize seed in addition to tobacco seed. But these operations take place on a small scale and in an unsystematic way. Most Haitian farmers purchase seed from fellow peasants, at local and regional markets, or, occasionally from importers who have acquired stocks from the US or other countries. Prices for this seed seem to range from double to five times the price of food of the same type at harvest time.

But while a market for reliable, high quality seed clearly exists, few entrepreneurs have moved to fill this profitable niche. Only the tobacco company, Comme Il Faut, has begun a small maize seed program in the Cap Haitien area, under the name Agro-Semence. AID has launched a National Commercial Seed Industry Program in Haiti with the collaboration of the Industial Council for Development (ICD). The ICD has recommended that the public sector assume the tasks of research on appropriate crops and varieties for seed programs and that the private sector should undertake multiplication for distribution to farmers.

The project aproach is perfectly compatible with that of the ICD, in that the Project will finance the adaptive research to test new crops and varieies on hillside conditions through its demonstration/trial/outreach sites. However, actual multiplication of seed for distribution to farmers will be entrusted to private entities which will profit from thisacivity or cease to engage in it. While the project will help market seed in the hillsides of its targeted watersheds, if necessary, multipliers who choose to sell their own seed can sell it wherever they wish, including to farmers in the plains or even outside the Les Cayes region.

The project will encourage three types of entities to engage in seed multiplication. It will offer starter seed, technical advice and supervision, and credit to LORGs and contract farmers, as necessary, though under different conditions.

Peasant contract seed growers. Given proper materials and supervision, small farmers have proven themselves effective and economic small-scale seed multiplication entrepreneurs in many other countries of the third world. As Haitian peasants have proven themselves innovative and enterprising in other contexts, such as swine repopulation and agro-forestry, the project will count on them for a certain proportion of seed supplies in the targeted area. To qualify for the small-farmer seed multiplication program, peasants must satisfy the following conditions:

possess, rent or share-crop a field of at not less than one third of a hectare;

the field must satisfy prescribed soil moisture conditions;

the field must satisfy isolation requirements, when appropriate;

the farmer must have a reputation for hard work, honesty and competence;

accessibility to transport for collection and distribution of the crop;

the field must be free of noxious weeds;

agree to accept project and intermediary PVO technical advice and superision and to follow allinstructins to the letter;

agree to sell the crop to the appropriate intermediary PVO at a pre-arranged price.

The project, through the intermediary PVOs will guarantee to buy seed only if it meets standard prescribed norms. Examples of good seed must be shown to farmers before signing the cotnract to multiply seed for the project.

The project will provide, through the intermediary organizations:

starter seed, which will be reimbursed at a rate of 2 lbs for each pound given at the beginning of the season;

technical advice and supervision to assure maximum yields from multiplication fields

appropriate inputs, including fertilizer, labor, etc.;

guaranteed purchase of acceptable seed at a price 25% above current market prices for the crop in question;

Once contract farmer candidates have been identified by intermediary PVO field agents, these latter will visit the proposed fields in concert with technical assistance personnel. They will also interview the farmer candidate to ascertain his capacity and willingness to undertake seed multiplication. The project representative will take this opportunity to train the intermediary staff members in choosing seed multiplication sites.

When all parties reach agreement on the conditions of the contract, all will sign a document in Creole establishing the terms of the contract. The intermediary agency will deliver the starter seed and the inputs to the contract farmer. Their agents will visit the seed multiplication fields regularly and TA personnel will visit at all crucial periods, including planting, fertilizer applications, thinning, roguing, and harvest. During the first year, TA personnel will also attend seed selection sessions and train intermediary agents in choosing proper seed for sale and distribution.

That portion of the contractor's crop which does not meet the criteria for selected seed belongs to the contract farmers. He is free to dispose of it as he wishes, but cannot represent it to his fellow farmers as selected seed.

Intermediary agency seed multipliers. If the intermediary agencies working with the project wish to act as seed multipliers, the project will encourage them. However, they must agree to operate their seed farms as commercial entities, for which subsidies may be available. The intermediary agencies will present fields which satisfy the same conditions for acceptance as those of the contract farmers. These fields can be on hillsides or in the plains, as long as the required varieties can grow there. Project agronomists will judge the suitability of these fields, which can be owned or rented by the intermediary agency.

The project will provide, through the umbrella agency directly to the PVO, starter seed, inputs including labor, land rental if necessary, tools and administrative costs. The inputs may be decreasingly subsidized through the life of the project.

TA personnel will provide advice and supervision for the seed multiplication operations, while training intermediary agency personnel to carry out all operations on their own. The project will guarantee purchase of all selected seed producedby the intermediary agencies and assist with commercialization of this seed for the first three years of the operation. Afterwards, the intermediary agencies will have to undertake comercialization on their own and will be encouraged to use BCA for credit as needed.

Private seed multipliers. The project will encourage private companies like Comme Il Faut, Agrisupply and Agro-Technique to undertake comercial seed multiplication activities in the Les Cayes area. It will provide the same technical services to these companies as it provides to the intermediary PVOs. The project will inspect fields proposed as seed multiplication sites and approve them. The relationship between the private company and the land used is immaterial as long as they have clear rights to cultivate that land. The land can be in the plains or on the hillsides, as long as the required varieties can be grown there. The project will provide technical advice and supervision gratis. It will guarantee a market for pre-arranged quantities of selected seed at a price 25% above the current market value of the food. The project will consider the seed produced by the companies as an acceptable guarantee for any loans.

The private companies will agree to multiply varieties chosen by the project and to adhere to technical requirements dictatedby project personnel. Agronomists will participate in seed selection after harvest for a period of two years and provide free certification for selected seed. Afterwards, the companies will pay for this service, either from the project or from GOH agencies.

1. COMME IL FAUT:

Comme Il Faut is the name of the company which manufactures cigarettes in Haiti. Since 1971, it has produced a good part of the tobacco it uses in its factory in-country. In 1985-86, Comme Il Faut, which belongs to an American consortium based in Louisville, Kentucky, tried for the first time to produce maize seed at the request of commercial agricultural supply company called Agro-Technique. The seeds are marketed under the name Agro-Semences. They planted 15 hectares near Cap Haitien in the north of the country and got about 20 tons of good quality seed of the variety Maquina 7829. They sold the seed to the dealer at $0.40/lb. The dealer resold it at nearly twice that price. They also carried out variety trials for beans, sorghum and corn.

Comme Il Faut is well-established in Les Cayes, where its staff supervises 35 farmers who grow tobacco on 110 irrigated hectares in the plain near Gerard. Last year they produced over 380,000 lbsof Burley Ky 17 tobacco. They produce all their own seed locally on a closely supervised one carreau field near those of their contract growers.

Comme Il Faut rents land in the plains for some farmers or works with those who own their own land. They provide all inputs to the farmer including seed, fertilizer, insecticide, fungicide, soilpreparation with the company's tractors, and, if necessary, cash advances to see the farmers through the growing season. Farmers repay these advances with the proceeds of their crop. If the crop fails for reasons beyond the control of the farmers, Comme Il Faut pardons them. If the farmer fails toproduce becauseof lazinessor incompetence, or if he sells his crop on the local market where he can get 3 to 6 times the company price, he is simply stricken from the register of contractfarmers the next year.

Comme Il Faut has realized that it can get more production from fewer farmers if they are more closely supervised. Thus in 1980 they had 180 farmers on 250 hectares and got less tobacco than they get from their 35 farmers and 110 hectares this year. To carry out this supervision, Comme Il Faut has the

following staff:

1 Director (trained in tobacco agronomy on the job)
1 agricultural technician
2 tractor operators
1 office manager
1 office boy

All financial and accounting as well as all mechanical operations are carried out in Port au Prince. The office in Les Cayes touches no money at all. They have two tractors and a four-wheel-drive car, as well as a motorcycle.

They choose their farmers by reputation, land location and quality, land tenure status (verified with a lawyer), and they place an upper limit to begin of three hectares per farmer. If they do more, the farmer often has technical and financial problems.

Farmers have to build a dryer 100' long for each hectare they put in tobacco. Comme Il Faut gives them the tin for the roof.

The staff of Comme Il Faut, both in Les Cayes and Port au Prince, would be interested in getting into seed multiplication for food crops in the south. They have the basic staff and infrastructure, including storage, scales, pallettes and the like to undertake the activity on a small scale. The Port au Prince office could provide regular technical back-up and additional resources, if justified. They have proved their ability to produce high quality agricultural goods in Haiti, as their Burleytobacco is exported to the US since 1984. This year, there is more demand for this tobacco than Comme Il Faut can satisfy. For the beginning of the prorgam at least, they would need aguarantee from the project of the the quantity of seeds needed of each variety and of the minimum price they could expect.In return, they would promise to deliver the seed to the project, whatever the market price at the time of the sale.

For the moment, Comme Il Faut seems to be the only private company interested in undertaking seed multiplication in the Les Cayes area and able of doing so efficiently. All other private companies and land-owners consulted in Les Cayes referred us to the tobacco company.

The DRN of the MARNDR and the STAB. The project will conduct all of its relations with the GOH through the Secretariat for Watershed Management (STAB) of the MARNDR. The STAB falls within the Directorate of Natural Resources (DRN) and the Director of the DRN is also the Director of the STAB. The STAB will name one of its staff members as the permanent interlocutor of the umbrella agency and this person will respond, using all the resources of the STAB, to queries and requests for assistance from the project. The STAB will have no direct contact with the intermediary organizations at all.

The project will send copies of all reports, both technical and administrative to the STAB, which will centralize information from all hillside agricultural projects in Haiti. The STAB will digest and summarize the lessons learned, both positive and negative from these projects and disseminate them to the projects it supervises. In addition the STAB will organize twice-yearly seminars which representatives of all projects will attend, to discuss these lessons, share ideas and agree on general policies toward implementing hillside agricultural projects. The project will finance half or five of these seminars during its five-year life. They will take place on the site of one or another of the

hillside projects, not in Port-au-Prince.

The STAB will participate in the evaluations of the project. It will propose an evaluation plan and method to USAID three months before each evaluation called for in the PP and offer one Haitian and one expatriate expert to join the evaluation team. The project will assume the travel costs for the Haitian member of the team.

The STAB will provide input to all base-line and follow-up studies conducted by the project. They will ensure that data gathered by the project is compatible and comparable with data gathered by other hillside projects. This will facilitate comparison of the impact and success of these projects based on methods, technical packages and administrative/managerial styles and lead to improved implemenation of hillside projects. The STAB will not carry out these studies, but may send observers to ensure proper collection and analysis of data. The STAB will preside at the meetings of the Advisory Board of the umbrella agency.

The TA team's Chief of Party will meet with STAB staff once a month to discuss policy and coordination issues. One of the COP's primary chores will be to keep the STAB current on project activities, accomplishments and problems. The project will provide an agricultural economist to the STAB to reinforce its monitoring and evaluation capacity.

The STAB will advocate in the GOH policy reforms which appear necessary to facilitate the improvement of agricultural and soil conservation practices, and the increase of farm yields and incomes on the watershed hillsides on which the project works. A list of such policies isincluded in the Project Paper. Within 60 days of the start of the project, the COP and the project will meet to discuss these policy reforms and to decide which of them to advocate, before what audience, and with which tactics and strategy. They will submit a joint plan of action which will include actions to be taken by the project staff, by the STAB, and by AID and the MARNDR.

Other MARNDR directorates. The project is an integrated agricultural project, working with annual and perennial food crops, industrial crops, animals, forage, trees, soil conservation structures, community organization, and extension. It is not an integrated rural development project as it will have no health, literacy, construction or other social welfare programs. However, its activities concern the domains of all the technical directorates of the MARNDR. The DPA, DPV, and DDR will participate in the task of coordinating the project's work with that of projects undertaking similar tasks in other parts of the country. However, this activity will take place entirely through the STAB. The Directors of the DPA, DPV, and DDR will have no offical contact directly with the project staff. All communications, field visits, and directives will have to pass through the STAB to avoid contradictory instructions, confusing procedures and general diffuseness of purpose and direction.

The DPA, DPV, and DDR will name members of their staff to the STAB Board of Directors (*Conseil d'Administration*). They will participate in discussions of STAB policies, in the elaboration of data-gathering methods and questionnaires, and in lobbying for the adoption of agricultural and soil conservation policies by the GOH. The STAB can call on their personnel, as well as that of the DRN to participate in monitoring trips to the project, in evaluation missions, conferences and training seminars and workshops. Their personnel are also

eligible for the long-term training grants mentioned above, under the criteria for eligibility which will be proposed by the STAB to USAID and the umbrella agency, which wil administer the training grants, both long and short-term. The STAB will circulate project reports to the other MARNDR directorates, solicit comments on them and transmit them to the project as it sees fit.

MARNDR district and regional offices in Les Cayes. The MARNDR has an extensive network of agents in the Southern Region, which includes the Agricultural Districts of Les Cayes, Jeremie and Fonds des Negres. The project's watersheds are all in the Les Cayes District. The personnel of the Les Cayes Agricultural District (DA) will be be kept informed of the activities of the project umbrella and intermediary organizations but will not participate directly in the execution of the project program.

The District Agronomist (AD) will act as a counterpart to the project COP in Les Cayes. He will coordinate communications between the project and the MARNDR, as the COP will coordinate communications between the project and the STAB. He will:

(1) participate in the elaboration of project policies and strategies for technical and managerial innovations, as well as extension and training activities;

(2) advise on data-gathering and analysis activities to assure objectivity, awareness of local conditions, and compatibility with nationally determined categories of information;

(3) advise the project umbrella staff on matters of extension methods and peasant organization;

(4) make periodic visits, accompanied by project umbrella staff members to the intermediary organizations to assist them with their tasks of managing the demonstration/outreach sites and extending the elements of the new package to interested farmers; and

(5) attend periodic meetings and seminars to discuss national hillside strategies, technical packages and extension methods.

DA staff wil be eligible to participate in all training programs sponsored by the project, including training in Haiti, the US and Third countries.The budget for this training is included in the STAB and project umbrella training budgets.

Advisory board. During the first 90 days of the implementation, the umbrella agency will convene the projet's advisory board (*Conseil Consultatif*) for the first of its twice yearly meetings in Les Cayes. The exact composition of this board will be determined by the umbrella agency, but suggested members might include the STAB, the District Agronomist of Les Cayes, ADS II, AOP, intermediary PVOs, AID, and the COP of the TA team. They will coordinate research and extension strategies, review project plans for the coming semester, share research results and experiences, plan coordinated training activities, and offer advice on project implementation strategies.

The advisory board will have no decision making power over the umbrella agency or over the intermediary PVOs. Its role is purely consultative. Its main goal is to coordinate development activities in the targeted area and to offer

advice to the project staff.

ADS II. The ADS II Project is a farming systems research and extension effort funded by USAID through the MARNDR. Within the Directorate of Natural Resources (DRN) and the STAB it has established an automated CRIES system to compile, analyze and disseminate geographical, topological, and pedological information about Haiti. In the field ADS II maintains two stations in the project area. One of these, at Fonds des Freres, concerns hillside agriculture. The other, based at Maniche, but working at several sites in the irrigated areas of the Les Cayes plain, works only with low altitude crops grown under irrigated conditions.

The ADS II CRIES system should remain in place under the supervision of the STAB. The project should incorporate into its own research strategy the collection of the data the CRIES system needs, just as the CRIES staff should consult with the project staff to establish what sorts of information the project needs for its own monitoring and evaluation. Meetings to effect this coordination should take place under the aegis of the STAB within 60 days of the project's start-up and a workable plan submitted to the STAB, ADS-II and USAID within 90 days of the project's start-up.

In the field ADS II should concentrate its activity on work in the irrigated areas of the targeted watersheds, leaving the demonstration activities on the hillsides to the project. ADS II hillside activities should be limited to on farm trials using innovations and approaches to farmers coordinated with those of the project.

The ADS-II agronomist in the Les Cayes area should sit on the Advisory Board of the project umbrella and should participate in the final elaboration of implementation plans for the sites in the Fonds des Freres areas. At formal monthly meetings of the project agronomic staff with the MARNDR's Regional and District agronomists, the ADS II agronomists should participate and contribute to the evolution of the project's hillside strategy.

As the ADS II staff determine agricultural or soil conservation innovations that could be fruitfully tried, tested and extended in the targeted area, they will communicate their proposals to the project umbrella staff, who will analye their ideas, decide how to incorporate them in the outreach program them and transmit them to the intermediary organizations for implementation.

The project will not take over ADS II operations in any general way in order to avoid diluting the project's concentration on hillside agriculture with work in the plains and because ADS II works in other parts of the country than the Les Cayes watersheds. The CRIES system should be given a permanent home, such as the STAB, and Haitians should be trained to operate the system as quickly as possible, just in case the ADS II project is NOT extended after March 1988. That the CRIES lives in the STAB is no reason to separate it from ADS II, of course.

PADF. The Agroforestry Outreach Project (AOP) in the Les Cayes area is supervised by the Pan American Development Foundation (PADF). They work with one expatriate forester, one Haitian 'agronome' (this man has no formal agronomic training but is very experienced and very efficient), one research assistant, two administrative assistants, one secretary and one guard. In addition, through local PVOs they pay around 120 *animateurs* to do part-time extension of fast-growing hardwood trees on a piecework basis. The AOP is now

funded through December 1986, but will probably be extended for three years beyond that date.

The AOP works in the Les Cayes area through the same four PVOs that project will use - DCCH, ORE, IRD, and UNICORS. These organizations contract to produce a given number of trees for PADF for a fixed sum of money per tree ($0.08), which they then distribute free to farmers who plant them. The costs of nursery materials, such as root-trainers, imported peat mix, shade structures, etc. are subtracted from the sum paid the PVOs. The PVOs use part of this money to cover the costs of the animateurs, who work for them, not for PADF.

The PADF expatriate forester in Les Cayes, with his Haitian counterpart, has to cover the entire southern penninsula of Haiti, including the South Coast, Jeremie, Miragouane, and Fonds des Negres as well as Les Cayes. This is a huge area and with their part-time extension workers, they have not achieved the rates of success in tree survival that they had hoped for. The best solution to this problem is to switch to full-time, better paid extension agents and to increase the density of their supervision.

The project should finance an integrated extension service in the targeted watershed area. Thus PADF/AOP would continue to supervise contracts with participating PVOs for nursery operation, conduct forestry research in collaboration with the project agronomists, import and distribute nursery materials, including peat mix, root-trainers and net-house materials, monitor and evaluate the results of peasant tree plantings, and prepare and disseminate instructional materials on tree planting.

In addition, AOP/PADF personnel will contribute to the training of project extension agents in reforestation techniques, attend the monthly project coordination meetings, and regularly visit the project demonstration/outreach sites to assist in the supervision of the forestry components of these sites and the extension of agro-forestry activities from them to interested farmers.

In return, the project will consult AOP experts on all forestry-related matters, including research, demonstrations, and extension, integrate AOP's tree species into the project extension, demonstration and trial package, in the context of the AOP theme of trees as a cash crop, and inform the AOP personnel of farmers responses to forestry extension activities. To the extent possible and appropriate, they will encourage the PVOs currently using the part-time piece-work agroforestry extension agents to hire these same agents as full-time demonstration site managers and extension agents for the project. The project will carry out agro-forestry extension programs in accordance with AOP norms and standards, using trees from AOP-sponsored nurseries, and work actively toward the economic and financial sustainibility of the PVO-managed nurseries, by encouraging the purchase of trees by project farmers.

The AOP and the project must work in very close colaboration in the Les Cayes area. All principal fnctions of oth projects - research, demonstrations, extension, ideology, management - must be closely cordinated in order to maximize benefits passed on to the farmers of the Projects' zone of operations.

PDAI and the dry-walls of the Platons. The Integrated Agricultural Development Project (PDAI) of USAID and the MARNDR works in the irrigated plains of Les Cayes, but also has constructed dry walls of rock on approximately 550 hectares of and in the Les Platons area of the Acul Watershed. These rock walls,constructed along the contours of the gently

sloping, deep, red soils of Les Platons, and in the few ravines running between slopes are meant to conserve soils and improve agricultural productivity in the area. They were constructed using paid labor and more labor will be paid to plant grassand trees along them, although in late April, this second operation had not yet begun.

The utility of such mechanical structures should be empirically assessed by demonstration or outreach activities on comparable soils with and without the dry walls. The completion of the 550 hectares will exhaust the PDAI funding for this activity, if in fact there will be money left to continue the program, at all. Thus all extension in the Les Platons area will depend on project agents. As we intend to place a minimum of 4 sites in this area, under the supervision of a PVO. project accepts the responsibility for funding and supervising extension work in the PDAI areas of Les Platons. However, the DA of Les Cayes, which supervised the heroic labors of the Amenagiste du Dist. 'ct Agricole who built the walls, declined to undertake the supervision of any of the sites in Les Plaons, preferring to remain in a supervisory, coordinating position.

The project will work with the people who planned and carried out the PDAI program in Les Platons in their capacities as members of the DA staff and of USAID's Agriculture Office. project will replace PDAI as the implementing organism for agricultural extension/demonstration/trials in Les Platons.

MEBSH AND CODEPLA. *Les Missions Evangeliques Baptistes du Sud-Haiti* (MEBSH) is the organization which sponsors the IRD (Integrated Rural Development), one of the PVOs which will carry out the project's extension/demonstration/trial program. While the IRD informs the MEBSH of its activities and solicits funding from external donors from the MEBSH and receives part of its funds directly from the mission, it can make decisions independently of the MEBSH. In this light, project will interact operationally with IRD rather than with MEBSH or CODEPLA. The MEBSH belongs to the Concile des Eglises Evangeliques de Haiti (CEEH). The CEEH encourages the development activities of its constituent missions through the Comite de Development et de Planification (CODEPLA), which is based in Port au Prince. The CODEPLA does not currently work in the Targeted Watershed area, although it has a Cashew Nut Development Project (EDEN) in St. Jean du Sud and works with IRD on the irrigation project f the plain of Masse, near Les Cayes. They also run the Nubian Goat Project at Tiverny. All of their projects in the south are mediated through IRD.

CODEPLA should be considered, and is interested in being considered, as a resource for IRD's project planning, for seeking external financing for activities following on those of project, and for any activities that project might sub-contract to Haitian institutions. It should NOT be considered as a PVO which might join in the implememnation of project.

CCH. Les Cooperatives de Cafe de Haiti (CCH) processes and markets coffee produced by growers cooperatives, such as UNICORS in the project area. UNICORS is a part-owner of CCH and is thus represented on their Board of Directors. Through UNICORS, the project will be able to contribute to dialogue on policies regarding coffee production, treatment and sales in Haiti, but the project need have no direct relationship to CCH.

Through UNICORS and through USAID, the project should encourage the CCH to improve its adminstrative and technical capacities in order to achieve maximum coffee production with maximum benefit to coffee growers. experts and

consultants shoud visit the UNICORS area as often as possible to encourage effective communications and exhanges between the organizations. UNICORS should be encouraged to play an important role in determining CCH policy and activities.

The Agricultural Credit Bureau. The Agricultural Credit Bureau (BCA) is the only official agency extending credit to small farmers in rural Haiti. The Banque Nationale de Developpement Agricole et Industrielle lends money only to large landholders, whereas the BCA lends to farmers with 1 to 5 hectares of land, as long as they clearly need only cash to achieve production goals. If the farmers also needs technical assistance, the BCA may extend credit but not technical supervision. The BCA prefers to make loans to groups of farmers at 12% interest, plus 4% fee used by BCA for a natural disaster fund and a fund for write-offs. Individual farmers can receive loans at 15% interest, plus the 4% fee. Loans are for one year only. BCA's repayment rates vary from region to region. In Les Cayes, they have been excellent - over 90% - but on other parts of the country they have been from mediocre to bad.

ORE. The project will conclude two separate arrangements with the ORE: As this organization wants to operate demonstration sites they will bid for these as would any other intermediary organization, particularly as the district agricultural office of the GOH has said they are not able to carry out implementation work on the Platons sites, where the ORE is installed and has a competitive advantage. If ORE is finally chosen as an intermediary organization, they will carry out a program based on project staff recommendations after consultation with ORE staff, under the same terms as other intermediary organizations.

The project will also establish a contract with ORE to do the following:

(1) Train all the personnel assigned to run or supervise demonstration sites by participating intermediaries in grafting, care and propagation of fruit trees. This training will include seminars/workshops sponsored by the project as well as regular visits to all the demonstration sites run by intermediary organizations. Training will include on-site grafting as well as nursery techniques. ORE wil supply all personnel, nursery materials, training materials and fruit tree materials (budwood, rootstock. grafted trees, etc.) for this training. The intermediary PVOs will supply the sites and the project will provide financing and logistic support. Within 60 days of the beginning of project implementation, the umbrella organization will present a plan for this training including content of the courses, duration and timing, materials, and costs.

(2) establish secondary nurseries in at least two project watersheds. These nurseries can be smaller than the one at Camp Perrin/Levy, but should be able to supply fruit trees in accord with demand in the project area. One of these nurseries should be on the coast, somewhere between Damassin and Les Anglais. The other should be in a site to be determined by need and demand - possibly around Cavaillon;

(3) train UNICORS or other personnel to run the nursery on the coast in an independent and financially sustainable way;

(4) provide, from ORE nurseries, fruit trees and, on demand, other trees for all demonstration sites and outreach programs run by other intermediary organizations. The project will pay for these materials on a per-tree

basis. We expect demand for demonstration sites and extension to amount to around 50,000 trees, including citrus, avocado, [illegible] and others. This includes 30,000 trees grafted in the nurseries and transplanted onto farmers' fields and 20,000 trees grafted on-site. Tree costs, including extension and trainingof site managers and intermediary PVO personnel are expected to average about $7.37/tree;

(5) provide fruit trees for extension by intermediaries off their sites and provide on-site grafting services as required by other intermediaries. The project will finance these services, but will establish a realistic schedule for ending subsidies for grafted fruit tree planitings on farmer operated lands within five years of project operations. After that point, the nurseries and on site grafting services will have to finance themselves. A separate budget for this operation in included in the Project Paper.

The total budget for the fruit tree component of the project is estimated at $1,500,000, including trees, extension, training, transport, and nursery operations.

In order to avoid confusion and to promote fairness, project will establish two seperate contracts with ORE. The first one will cover the operation of demonstration sites and would be similar/identical to those governing project relations with other intermediaries. Obtaining this sort of contract would give ORE the right to be represented on the umbrella organizations advisory board. The second contract will be awarded on a sole-source basis, as ORE is clearly the only organization in the Cayes area with any capacity for the development of grafted fruit trees.

CIMMYT. CIMMYT has conducted agricultural trials of maize varieties and cultural practices in the Les Cayes plain for a number years. These trials are held at the Levy State Farm, near Camp Perrin. They have a staff of trained agronomists, adequate field area, tractors, storage facilities, and other appropriate equipment and infrastructure. These facilities are all in the plain of the Grande Ravine du Sud, not in the targeted watersheds. While trials so far are of limited use for hillside agriculture, CIMMYT has announced plans to begin experiments using maize varieties and other crops in watersheds across Haiti.

CIMMYT's research plans and strategy should be coordinated closely with those of project, in order to avoid duplication, competition and wasted time and resources. project should agree to carry out on-farm trials for CIMMYT in the targeted watersheds and to include CIMMYT varieties and techniques, as appropriate on the demonstration/outreach sites run by the intermediary PVOs.

CIMMYT will provide copies of its research reports to project umbrella staff and perform initial bulking of seed of recommended varieties for distribution/sale to contract seed multipliers furnishing material to the project intermediaries and farmers.

ANNEX K PESTICIDE RISK-BENEFIT ANALYSIS*

Introduction

Hillside farming in Haiti is currently faced with severe problems of erosion and low soil fertility, a situation which largely results from the ever-increasing population pressure on the land and the associated desire to produce more and more food on constantly shrinking acreages. As a consequence, arable land is not fallowed whe it should be and land generally not considered suitable for agricultural production is used for this purpose. In order to reverse this trend, farming practices which have resulted in the erosion and degradation of hillside soils must be replaced with farming practices which regenerate and conserve those soils. This is what USAID/Haiti is proposing to do through the Targeted Watershed Management Project (TWM; 521-0191).

The target zone is located in the Southwestern part of Haiti, in the region of Les Cayes, and includes six watersheds flowing south from Pic Macaya. This area represents 4.5% (60,000 ha) of the total land mass of the country and encompasses a population of ca. 400,000 people.

The proposed interventions include: alley cropping, improved food crop varieties, fruit trees, firewood species, forage species, adopted agronomic practices, perennial cropping methods, inorganic fertilizers and pest management. With the alley cropping system, nitrogen-fixing leguminous trees or shrubs, such as Leucaena sp., are planted along the contours of land holdings on steep slopes and act as vegetative barriers to control soil erosion and reduce speed of surface water. In addition, these trees add biologically-fixed nitrogen to the soil and produce green manure and mulch for the companion crops.

However, because the alley cropping system implies that a certain portion of a farmer's land cannot be used for food crop production (that portion is occupied by trees), a peasant may be expected to adopt this system only if crop yields, on the remaining portion of his land, are increased. This can be achieved, in part, through the use of high-yielding varieties, fertilizers and pest management.

The task of implementing those technologies at the farm level will be given to four private volunteer organizations (PVOs) which are already working in the target area (ORE, DRI, DCCH, and UNICORS). An umbrella NGO will supervise this work and provide technical assistance, equipment and funds to the PVOs while coordination with other groups doing similar work in Haiti will be the role of the Secretariat for Hillside Agriculture (SHAG; part of the ministry of Agriculture,

*Cusson, Michel, Environmental assessment for the Targetted Watershed Management Project and assessment of the need for pesticide use in the Agroforestry Outreach Project, October 1986.

List of Abbreviations and Acronyms

AOP	:	Agroforestry Outreach Project.
APHIS	:	Animal and Plant Health Inspection Service.
CICP	:	Consortium for International Crop Protection.
COOP	:	Cooperative.
DAI	:	Development Alternatives Inc.
DARNDR	:	Département de l'Agriculture, des Ressources Naturelles et du Développement Rural (GOH).
DCCH	:	Développement Communautaire Chrétien d'Haiti.
DRI	:	Développement Rural Intégré.
EA	:	Environmental Assessment.
GOH	:	Government of Haiti.
IEE	:	Initial Environmental Examination.
IPM	:	Integrated Pest Management.
LAC	:	AID Bureau for Latin America and the Caribbean.
LOP	:	Life of Project.
NGO	:	Non Governmental Organization.
ORE	:	Organization for the Rehabilitation of the Environment.
PADF	:	Pan-American Development Foundation.
PAP	:	Port-au-Prince.
PID	:	Project Identification Document.
PMS	:	Pest Management Specialist.
PP	:	Project Paper.
PVO	:	Private Volunteer Organization.
RDO	:	Rural Development Officer.
REMS/CAR	:	Regional Environmental Management Specialist/Caribbean.
RPAR	:	Rebuttable Presumption Against Registration.
SHAG	:	Secretariat for Hillside Agriculture (Composed of DARNDR staff)
SNPA	:	Service National de la Protection Agricole (GOH).
ST	:	AID Bureau of Science & Technology.
TWAMP	:	Targeted Watershed Management Project.
UNICORS	:	Union des Coopératives de la Région du Sud.
(US)AID	:	US Agency for International Development.
(US)EPA	.	US Environmental Protection Agency.
WHO/FAO	:	World Health Organization/Food and Agriculture Organization.

DARNDR). More details regarding the various technical and social aspects of this project can be found in the PP draft as well as in the PID.

The PID includes an Initial Environmental Examination (IEE) conducted by Mr. James J. Talbot REMS/CAR/USAID/Haiti, in which it is made a requirement that a risk/benefit analysis be conducted if pesticides are to be procured or used by the TWM. I was contracted to perform this analysis, i.e. Environmental Assessment (EA), which is in the appendix of this document. Also in the appendix is an assessment of the need for pesticide use in the Agroforestry Outreach Project (AOP; 521-0122), a program which has been underway for five years in Haiti and the goal of which is reforestation. It works through PVOs, some of which are also expected to participate in the TWM.

The following paragraphs give general observations regarding current pest control practices as well as recommendations for anticipated pesticide use and for the development of pest management programs in the target area.

2- General observations

2.1 Ministry of Agriculture (DARNDR). Because of the unfavorable political and social atmosphere which has prevailed in Haiti for several years, the DARNDR has experienced frequent personnel changes and, as a consequence, its activities have been characterized by a lack of long-term planning, follow-up, organized and integrated research, control policies and data publications. This explains the near absence of reasonably recent and dependable literature on common pests of major crops and trees in Haiti as well as on crop loss assessments.

2.2 Pest identification. Depending on the level of expertise of the various people involved in making decisions or recommendations regarding the selection of "appropriate" pesticides, the pest problems are usually identified in one of the following three ways:

a) In some PVOs, when crude identification of the pest is not possible, any broad-spectrum insecticide such as Carbaryl or Malathion is applied if the pest is an insect and any broad-spectrum fungicide such as Captan is applied if the pest is a fungus.

b) In most PVOs, however, pesticide applicators can perform a crude identification of the pest, i.e. caterpillars, ants, crickets, aphids, scale insects, snails, mites, leaf spots, damping-off, anthrocnose, etc..., and usually select a pesticide which is known to be effective against a particular group of pests, e.g. Chlordane for ants or Dicofol for mites. Hill (1975) published tables which indicate the effectiveness of various insecticides against different groups of insects.

c) Agronomists working for the DARNDR or private pesticide suppliers may go a little further and compare a specimen to descriptions given in reference books printed in Mexico (CIMMYT), Puerto Rico (de Malguez 1974), the Dominican Republic (Rosario 1970), and Haiti (Wolcott 1927). Occasionally, positive identification is possible and more specific recommendations can be given.

2.3 Plant Quarantine. At the present time Haiti does not have plant quarantine facilities at any of its various points of entry. DARNDR officials distribute forms which should be filled out by anyone who wishes to take plant material in or out of the country. Permits are issued if inspection of the plant material by personnel at the SNPA does not reveal the presence of any pathogen or insect which may be injurious to Haiti's agriculture (imported material) or any other country's agriculture (exported material). A certain number of legislations were passed regarding the introduction of specific plant materials (e.g. coffee because of the threat of the leaf rust, Hemileia vastatrix, a devastating disease which does not presently occur in Haiti) but there are always provisions made for special cases of importation which, with a lack of proper quarantine facilities and a lack of rigor when the inspections are conducted, may lead to the introduction of serious diseases and insect pests in Haiti. Based on discussions that I had with various people who, in recent years, have been involved in the introduction of plant material into Haiti, it appears that inspections are usually very superficial and that the SNPA staffs who conduct those inspections are generally not well qualified for this type of work. The risks of introducing pests of major importance are therefore very high.

The coffee leaf rust, mentioned above, is a particularly critical issue in the context of the TWM. This disease could easily wipe out coffee plantations in Haiti which, because of their heavy shade, provide very favorable conditions for the rust

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organisms and, because of their physiologically old or weak conditions, are very susceptible to attack by rust which occurs in 24 identified races of varying virulence. At the present time, the DARNDR issues a poster showing what the rust looks like and indicating (in Creole) that any similar symptoms that are observed in Haiti should be reported for immediate destruction of infected material. However, I did not see this poster anywhere but in the DARNDR office in PAP and, in any case, "it is a dangerous illusion to believe that the rust organism can be contained or eradicated once introduced into the country" (see Development Alternatives, Inc. 1977 for more details).

2.4 Use of R- and C-pesticides (see Table 3 in appendix 1). Some EPA Restricted and/or Cancelled pesticides are currently used in all PVOs except DRI and none of the applicators have received proper training. Two technicians (at UNICORS and DCCH) have received some form of training but it cannot be considered adequate.

2.5 Use of protective clothing and safety measures (see Table 3 in appendix 1). Protective clothing is used in only one of the PVOs (ORE). In the others, little attention is paid to the hazards of pesticides: applicators ("aspergeurs") often apply dangerous chemicals bare foot and wearing shorts and no shirt. At one of UNICOR'S DDOPs, seed treatment with Lindane and Malathion is conducted on a concrete surface where children often play in bare feet not long after the application.

2.6 Use of pesticides by peasants. It is unrealistic to expect the average Haitian peasant to use pesticides properly or, in many cases, to use pesticides at all. First, he often cannot afford a back-pack sprayer (ca. $75 US) and some of the costly pesticides that would be required for effective pest control. Secondly, if his house is made of bamboo and straw with a thatched roof, we cannot expect him to build a pesticide storage area which would be considered safe by North American standards. Finally, the water necessary to clean up the equipment may not always be readily available around the house. In sum, the peasant's general standard of living will need to be raised before he can use pesticides safely.

2.7 Rodents. People who work and live in the target area claim that rats are the most injurious pests to food crops, more than insects and diseases together. This is a particularly serious problem in rice fields.

3- General recommendations

3.1 Pest management and the TWM. The development of sound pest management practices within the TWM should mean more than merely establishing a list of pesticides considered safe for use in the project. In view of the problems dealt with in section 2.6, every effort should be made to steer away from the reliance on chemical pesticides to manage pest problems on hillside farms. Pesticide-application-related assistance will likely be provided during the LOP but consideration must be given to the fate of pest management practices after the completion of the project, when such assistance may need to be discontinued. Three pest management approaches are particularly suited to the present agricultural situation in the target zone: 1) use of crop varieties which show acceptable levels of resistance to the local pests, 2) biological control, and 3) cultural control. These methods are environmentally sound and require no capital investment on the part of the farmers.

3.2 Pest catalogue. The development of sound pest management practices usually requires, as a starting point, that the target pest species be properly identified. If reliable information on pest identification became available in Haiti, it would then be possible to conduct a thorough literature search through the various data bases available in the U.S. and through correspondance with pest management specialists working in neighboring countries which may share some of Haiti's pest problems. Such a review of the literature may then reveal that, for some of the pests under consideration, there exist: 1) data on crop loss assessment, 2) effective monitoring techniques, 3) data of efficacy of various chemical and non-chemical pesticides, 4) parasites and predators candidate for introduction as biological control agents, 5) data on plant resistance, 6) data on cultural methods, and 7) data on other pest management components not included in the above list. Although few of the pest insects and pathogens which attack crops and trees in Haiti have been properly identified, some of them have received final or tentative identification. The following is a list of references which may

contain Haiti-related information on 1) insects: Wolcott 1927; Jean Baptiste 1945; Ward 1975; Allen 1979, Becker 1981; Solis & Samedy 1980, and 2) pathogens: Solis & Samedy 1980.

Some insect pest species have been formally or tentatively identified by Mr. Bertrand Derouillères, entomologist at the Faculté d'Agronomie. Damien They include: Plutella macolipennis Trichoplusia ni and Myzus persicae on cabbage, Spodoptera fugiperda and Ostrinia nubilalis (??) on maize, Anthonomus grandis and Pectinophora gossipiella on cotton, Leucoptera coffeella on coffee, and Cylas formicarius on sweet potatoes. One corn disease, Phyllachora maydis, has been tentatively identified by Mr. Jean-Yves Banatd, agronomist for the DARNDR in Les Cayes Further discussions with other professionals working in the field of agriculture in Haiti would very likely yield more of this type of unpublished information.

In order to provide Haiti and particularly the target area, with a good base for the elaboration of IPM programs, I recommend that 8 months of short-term TA in the pest management disciplines (entomology, plant pathology, weed and vertebrate pest management) from individuals with extensive experience in the Caribbean, and a good knowledge of tropical crops and their commonly associated pests, be provided for during the 5-year LOP This would lead to the development of a Haiti-specific pest catalogue and the initiation and orientation of IPM research in the project area. It is recommended that the project explore the possibility of procuring the full-time services of a Peace Corps volunteer to coordinate these efforts.

Scope of work

a) Gather all information already available on the identification of major pests and confirm or correct identification when necessary
b) Visit PVOs and farmers and ask about commonly encountered pests. When not previously identified, collect specimens and attempt identification or send to a U.S. laboratory for identification
c) Perform a literature search as described above
d) Describe all currently available management approaches, based on the literature search and on interviews with DARNDR's agronomists and pesticide suppliers, both of whom may conduct small-scale field trials on pesticide efficacy.

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e) Produce a pest catalogue with recommendations on currently available control measures.

f) Assist the DARNDR, PVOs, private companies, or other organizations which may be indirectly involved in the project, in conducting crop loss assessment studies and small-scale research aimed at developing alternative pest management strategies.

g) Prepare a research and extension program for the Ph.D.-level US-trained plant protection specialist (see 3.3) when this one returns from the U.S.

h) Any other task mentioned in the EA.

3.3 Ph.D training in plant protection In the PP draft, provisions are made for the financing of long-term training at the Master's and Ph.D levels in U.S. universities for SHAG personnel (p. III-12). I suggest that the individual who receives Ph.D. training in agronomy do his/her research work in crop protection, possibly entomology (at the "Section de Protection des Végétaux" of the DARNDR there is currently one plant pathologist but no entomologist). The trainee may then be able to continue the work undertaken during the 8 months of short-term TA.

3.4 Training for pesticide applicators See section 11 of the EA.

3.5 Improved varieties and susceptibility to pests. A number of new, improved varieties are being considered for utilisation in the TWM. It is imperative that consideration be given to potential pest outbreaks when selecting among candidate varieties. Some of these improved varieties may be more susceptible to local pests than the local, low-yielding varieties. Such enhanced susceptibility may offset the yield increases expected from the introduction of new varieties. Alternatively, it may accelarate pesticide use. The varieties being considered should be screened by PVOs or other organizations before being released for use on farms. The collaboration of Mr. Amal Chatterjee (Winrock International), who is currently doing such screening, should be sought.

3.6 Plant quarantine. If new coffee varieties are introduced during the LOP to replace the old, low yielding Coffea arabica var. typica, which represents nearly 99% of all coffee trees in Haiti, it is imperative that the selected varieties be resistant to the rust (preferably "horizontal" resistance which is not strain-

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specific) and that special precautions be taken when introducing coffee plant material not to introduce infected parts. Special consideration must be given when selecting the donor country with respect to: 1) the occurence of the disease in that particular country, and 2) the existence of plant quarantine and inspection facilities in that same country.

Mr. Julio Bartholemy, head agronomist at the DARNDR's plant protection section in PAP, has indicated to me that the GOH has plans for the construction of plant quarantine facilities in PAP and Cap Haitien in the coming year. This project appears to be more than a "politician's promise" since Mr. Bartholemy was able to show me detailed documentation relative to this project. Six DARNDR technicians will be assigned to those facilities. However, one can suspect that such technicians will never receive adequate training without assistance from external sources. At least two of these staff members should receive short-term training at the USDA-APHIS station at Hyattsville, Maryland, and the cost of such training should be born by USAID/TWM funds.

3.7 Rodent control. The solution to the rat problem in Haiti requires a sustained national effort which should come from the GOH. This is a vast operation which is not feasible within the context of the TWM. Punctual, temporary efforts are doomed because of subsequent immigration to areas where control measures have been applied from areas where they have not. Rodenticide tests are currently conducted at the DARNDR but no national organized control plan seems to be underway. TWM's director should strongly encourage the GOH to adopt a permanent national rodent control program.

3.8 Storage and disposal of pesticides. A system for safe storage of pesticides and disposal of pesticide containers or unused pesticides should be established at each participating PVO as described by Parasram et al. (1980).

APPENDIX I

ENVIRONMENTAL ASSESSMENT

Introduction

Because AID's financing of pesticides for any project must conform to the provisions of AID Regulation 16 (22 CFR Part 216), it is required that an analysis of pesticide use (EA) be conducted as a condition precedent ot the disbursement of AID funds into the TWM.

In this EA, a list of pesticides, the use of which is anticipated during the LOP, is reviewed to determine their acceptability for use in the project. Factors considered for this evaluation are listed in paragraph 216.3 (b) (1) (i) of Regulation 16 and include, as a highly determinant criterion for selection, the USEPA registration status of each pesticide under consideration. World Bank guidelines for pesticide use are also taken into account in this analysis.

I- Basis for selection of the requested pesticides.

Because of the current lack of : 1) published information on pest identification and, 2) research data on pesticide efficacy in Haiti (see section "General observations" in the attached report), the pesticides which DAI/TWM has requested for use in the project have not strictly been selected on the basis of accurate knowledge of present or anticipated pest problems, but mainly on their availability at two agrochemical suppliers in the Les Cayes area and on their current use for the control of various, unspecified pest problems in the same area. To this list I have added other pesticides which are currently used by four PVOs that have indicated their willingness to participate in the TWM. Most of these pesticides are applied on seedlings of fruit tree and forest tree species which are being considered for adoption in the TWM. Some of these pesticides may not be available in the Les Cayes area but they may all be purchased in PAF Approaches to selection of pesticides vary among the different PVOs but are generally based on crude identification of the pest problems (e.g. aphids, crickets, ants, leaf spots, broad-leaf weeds, etc...) and on information contained in books and booklets

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published in other countries and/or obtained from pesticide suppliers (see attached report for more details).

Finally, the fungicide Metalaxil (Ridomil) was added to the list because of its anticipated use for the control of Phyllachora maydis, a corn disease recently identified in Haiti. Field tests conducted by the DARNDR have apparently shown that Metalaxil is very effective in controlling this disease. Consult Table 1 for details on the origin of the requests.

2- The USEPA registration status of the requested pesticides.

Table 2 indicates whether each requested pesticide is registered by USEPA for General Use (G), Restricted Use (R), or whether it has been Cancelled (C) for use in agriculture. Restricted pesticides may be purchased and used only by certified applicators because of their very high toxicity and/or environmental hazard. General-use pesticides may be purchased and used by the general public. Table 2 also gives LD_{50} values and World Bank acceptability for each of the requested pesticides.

Most of the pesticides that are currently used by the PVOs are not applied on food crops and therefore do not pose residue tolerance problems (DPI and DCCH run forest tree nurseries whereas OPE runs a fruit tree nursery). Only UNICORS currently uses pesticides on some food crops, notably Malathion and Trichlorfon on corn and Trichlorfon on tomatoes, cabbage and carrots. The latter are not presently being considered for use during the LOP. With regard to corn, new varieties will be introduced during the LOP and use of Malathion may continue based on established EEC tolerances.

It is not known, at the present time, which of the pesticides requested by Mr. J. St-André (DAI/TWM) will be used on each of the food crops considered for adoption in the project. It is important that the pesticides authorized for the project be applied only on crops which 1) have an EPA registration and/or 2) have established WHO/FAO residue tolerances, especially in the case of crops which are destined for export. For domestic crops, WHO/FAO residue tolerance levels and/or registration for the same or similar use in selected other countries (e.g. EEC countries) may be considered sufficient. Since TA is provided for in this project AID/W through ST/AGR/AP and its pest management contractor, the CICP will provide specific guidance on appropriate crop/pesticide combinations and assistance in obtaining any needed residue/efficacy data.

Specific recommendations with reference to Table 2.

The EPA has ruled that some organochlorine insecticides cannot be used for agricultural purposes in the US (i.e. cancelled registration) because of their excessive persistence and propensity for bioaccumulation in human tissues and biomagnification in food chains. Three of the pesticides considered for use in the TWM are among those cancelled by EPA, namely Chlordane, Dieldrin and Aldrin.

In the Targeted Watershed, where Chlordane is generally used for the control of ants, Orthene (Acephate) may be a suitable replacement. Dieldrin is currently employed for rat control by at least one of UNICORS' COOPS but should not be used during the LOP. See the attached report (section 3.7) for recommendations regarding rodent control. Aldrin has been requested by DAI for use in the TWM but, since details regarding its anticipated use have not been given, no substitute can be suggested at the present time. The same comment applies to Toxaphene which is registered for Restricted use only by EPA. Toxaphene should therefore not be used in this project. Suitable alternatives to Toxaphene should be sought with the help of ST/AGR. Lindane also belongs to the organochlorine family and, although it is registered for use as a seed treatment, it should not be used in this project because of its high acute toxicity and its negative classification based on World Bank standards (it should by pointed out, however, that those standards are based on the toxicity of formulated pesticides while most LD_{50} values available are determined for technical products). Malagrain, a Malathion-based powder recommended for seed treatment, may be used as a substitute to Lindane (Lindagrain).

Methomyl (Lannate) is a highly toxic insecticide and is registered for restricted use only by EPA. It is currently applied on fruit tree seedlings (ORE) for the control of caterpillars in addition to Malathion. If effective, the latter should be considered as a satisfactory alternative. Use of Dipel (Bacillus thuringiensis) to control Lepidoptera larvae on fruit tree seedlings should also be explored.

The use of herbicides on peasants' farms is not anticipated at the present time since weeding is usually done by hand. However, herbicides are currently used for the mass production of fruit tree seedlings at the ORE nursery and their use may be expected to continue during the LOP when such seedlings are produced for the TWM. Only two herbicides -- Glyphosate and Picloram -- are presently

used and one of them, Picloram, has been classified as Restricted by EPA for reasons which include hazards to nontarget organisms, specifically nontarget plants, both crops and noncrops. The very high phytotoxicity of Picloram can lead effictively to soil sterilization. Its use therefore should be avoided. Other safer, general-use herbicides should prove effective for most nursery weed problems. If glyphosate alone does not give good control, other substitutes may need to be sought. The herbicide 2,4-D is a good candidate. However, low-volatility esters of 2,4-D should be used to reduce similar problems with phytotoxicity. The IPPC at OSU should be consulted for advice on suitable alternatives and the specific formulations

3.- <u>The extent to which the proposed pesticide use is part of an integrated pest management program</u>

IPM programs are rudimentary to non-existent in Haiti. Little information is available on the specific and most important pest problems and their economic status. The lack of this very basic information may account for the more or less haphazard use of pesticides and absence of alternative methods

Table 3 illustrates the current status of pesticide management and alternative measures in Haiti. At only two of the four PVOs are alternative measures employed and these are minimal at best. At DCCH, neem seed extract (obtained by soaking seeds in water) is applied to forest tree seedlings to protect them from insect attack (although the technician I interviewed believed it was for disease control). The extract of the neem tree, <u>Azadirachta indica</u>, known as azadirachtin, in an insect antifeedant, i.e. a substance which has been shown to be deterrent to several species of phytophagous insects. It does not kill insects but prevents damage by inhibiting insect feeding. Although laboratory tests have clearly shown its antifeedant effects, these same effects have not been well documented by field studies (see Barnays 1983 for a detailed discussion). However, the ease with which it can be obtained and its low cost, warrant some research regarding the potential use of this product. Some PVOs might be interested in conducting field tests. At present, neem seeds are produced in very low quantities and may only marginally meet nursery needs. If <u>A. indica</u> is grown as part of a reforestation and agroforestry effort, small farmers could gain some economic benefit if the project were to explore and promote: 1) the use of neem

seed extract by farmers to meet their own pest management needs, 2) possible collection and extract of neem seeds for commercial production of azadiractin and 3) improved methods of extraction to be used both by small farmers and commercial ventures and the testing of relative efficacy of varying concentrations of azadiractin.

At one of UNICORS' COOPs, table salt is applied along the margin of crop plots to prevent snails from reaching the plants. Snails lose a large amount of water and die after crawling over salt. Tests should be conducted to determine whether such salt applications have visible detrimental effects on crop health and yields, and soil and water quality.

To comply with AID's environmental regulations, procurement and use of pesticides should be done as part of integrated pest management programs and where capabilities are weak, efforts should be made to augment crop protection activities. The two activities described above represent a very small emphasis on non-chemical pest management and do not require accurate identification of the pest species nor knowledge of pest management. Other strategies such as biological control depend on accurate identifications, and these capabilities are weak in Haiti. It is thus important to provide extensive technical assistance in entomology, plant pathology and weed science to stress non-chemical alternatives, safe pesticide use and handling, and pesticide management.

The strong emphasis on extension in this project provides a suitable vehicle through which to develop and implement training programs in IPM. With the assistance of ST/AGR, a series of short-term training and technical assistance will be developed through their cooperative agreement with CICP/OSU-IPPC. Over the 5-year LOP, ten 2-4 week visits (twice yearly) will be arranged for technical assistance by plant protection specialists. The length of stay will gradually decline starting at four weeks in the first two years, decreasing to three weeks each in years 3 and 4, and two weeks in year 5. These individuals will: 1) identify the nature and magnitude of existing pest management problems, 2) assist in the design and identification of a testing/evaluation program on appropriate pesticide use and efficacy, 3) design a system of pesticide field trials and evaluation which will include some system of crop insurance for participating farmers, 4) identify appropriate person(s) to monitor and evaluate the field testing programs, and 5) monitor and evaluate the success of the extension programs in pest management from a safety and acceptability perspective and the ability of the program to sensitized farmers to the important safety and environmental issues.

Training modules in IPM, safe pesticide use and handling will also be developed for extension officers and promoter associated with the NGO and the DARNDP. Training activities should commence after major problems are identified and the monitoring and testing/evaluation programs are begun with participating farmers. Sometime in year 2, a two-week course in IPM will overlap with the TA to take advantage of demonstration and field trials. The cost of the TA and training will be born by the TWM and the specific SOW will be developed cooperatively by the Mission and ST/AGR to include: 1) the IPM approach, 2) current pesticide use and safety, and 3) demonstration of pest protection aspects of on-farm storage of agricultural commodities.

There is a serious need to identify the pests of major economic importance to crops and trees adopted by the TWM. The TA consultant will advise on this issue. It is suggested that the project explore the possibility of identifying a Peace Corps volunteer with some background in crop protection (e.g. entomology, plant pathology).

In addition, given the very similar interests, concerns and implementing PVOs in the TWM and AQP, efforts to obtain and fund TA and training should be coordinated between these two projects.

4- <u>The proposed methods of application, including availability of appropriate application and safety equipment.</u>

All liquid formulations of pesticides will be applied with hydrolic backpack sprayers. Each PVO owns at least one such sprayer and the purchase of extra sprayers for PVOs should be borne by the project. If the application granular formulations becomes, at any point, necessary, such formulations should be applied with appropriately adapted shakers, and not broadcasted with bare hands. The use of fumigants is not anticipated at the present time (see section 11 of this EA for more details).

The reader may consult Table 3 for information on the current use of protective clothing and devices among the PVOs' pesticide applicators. All pesticide applicators involved in the project should be encouraged to wear protective devices and clothing -- gloves, boots, masks, long-sleeve shirts, long trousers, etc.-- whenever possible. Also, the project should provide such equipment.

For risks of contamination, care should be taken not to clean equipment and clothing directly in streams or rivers, especially where people may be expected to swim and/or drink the water.

5- Acute and long-term toxilogical hazards, either human or environmental associated with the proposed use and measures available to minimize such hazards

LD_{50} values (oral and dermal) for all requested pesticides are given in Table 2. LD_{50} values give an idea of how acutely toxic pesticides are but, because such values are based on tests conducted with pure or technical products, they may not be very good indicators of how acutely toxic formulated pesticides really are. The LD_{50} is, by definition, the amount of a chemical necessary to kill 50% of a test animal population (usually laboratory rats). It is a value expressed as the weight of pesticide per unit weight of body (mg/kg) when swallowed (oral LD_{50}), or absorbed through the skin (dermal LD_{50}). A low LD_{50} indicates high acute toxicity whereas a high LD_{50} indicates a low acute toxicity.

Although all chemical pesticides are potentially hazardous to humans and the environment, and should be treated with caution, none of the authorized pesticides listed in Table 2 present unusual acute or long-term hazards to the applicators, to the general public, or to the natural environment if applied according to their labels.

With regard to long-term effects, special precautions should be taken when mixing and loading some of the authorized fungicides for which EPA has issued RPARs (temporary status given to some pesticides for which recent data indicate that they may present some hazards to humans or the environment. This status is meant to stimulate research and public debate until a final decision is made regarding the registsration status of such pesticides). Those pesticides include Captan, Maneb, Mancozeb and Methyl thiphanate, all of which are suspected of causing tumors and/or genetic changes. Label instructions should be followed particularly closely when using these pesticides.

6- Efficacy and residue tolerances of the selected pesticides for proposed use

Among the pesticides authorized for use in this project, those selected by

DAI were not necessarily selected on the basis of their effectiveness against specific pests in Haiti. However, those pesticides which are authorized and currently in use within the PVOs, are apparently effective at controlling most pest problems encountered in the PVOs' respective environments. As pest identification progresses during the five years of the LOP, specific pesticide efficacy tests will be designed by the TA consultants as discussed in section 3. which may then be conducted by the DARNDR, pesticide suppliers such as ASSA, or the PVOs. Such tests should be supervised by individuals from the umbrella NGO, identified by the TA consultant.

7- <u>Compatibility of pesticides with target and non-target ecosystems.</u>

Although mammalian toxicity is a very important criterion in selecting a particular pesticide for a given use, effects of pesticides on honeybees, fish, wildlife, and beneficial organisms (i.e. which may help prevent pest outbreaks), should also be considered.

Table 4 gives indications on the periods of the day during which one should apply a particular pesticide in order to protect honeybees when the target crop is in bloom. The same Table also shows that the selected pesticides for which bird toxicity data are available are not very toxic to avian species, with the possible exception of Diazinon which has an LD_{50} (oral) of 3.5 when tested on Mallard ducks.

With regard to fish toxicity, many of the proposed pesticides are highly toxic to fish, including most fungicides. This aspect should not, however, pose any problem if precautions are taken to avoid drift or accidental spills in rivers and streams.

Finally, in any well designed pest management program, a high priority is given to preserving beneficial organisms such as insect predators and parasites. This requires the use of narrow-spectrum pesticides which are toxic to only particular taxonomic groups of pests (here, again, key target pest species and, if possible, their principle natural enemies must first be properly identified). Unfortunately, most of the insecticides authorized for use in this project are broadly toxic to insects. It is therefore imperative that measures be taken to reduce the number of pesticide applications to a minimum. Such measures include the use of monitoring techniques, and action thresholds, cultural methods, etc., most of which need yet to be developped by the TA working with the umbrella NGO in collaboration with the DARNDR.

8- Conditions under which the pesticides are to be used, including climate, flora, fauna, geography, hydrology and soils.

The TWM area lies between latitudes 18.1 and 18.23 N and longitudes 73.32 and 74.13 W in Haiti's Département du Sud. It extends from the eastern edge of the Cavaillon catchment area to the western edge of the Les Anglais catchment. The southern slopes of the Massif de la Hotte and of the Monts du Plymouth form the northern boundary of the Targeted Watershed. Pic Macaya, at 2,347 m the highest mountain in the region, is part of the Massif de la Hotte. The Caribbean Sea forms the southern boundary of the Targeted Watershed.

The dominant topography of the region is very steep slopes at elevations less than 1,000 m. However, elevations within the target zone reach to the top of the Pic Macaya (2,347 m). Topography accounts for climatic changes within short distances and for the general inaccessibility of much of the region.

Rainfall in the Targeted Watershed is a function primarily of elevation and ranges from 1,200 mm at the driest sea-level zones in the southwest of the project area to nearly 4,000 mm at the highest elevations of the Massif de la Hotte. High-elevation areas have only a winter dry season and have sufficient rainfall to support vegetative growth for the rest of the year. In low-elevation areas, rainfall follows a bimodal pattern with concentration of precipitation in April-May and September-October.

The soils of the Targeted Watershed are highly weathered tropical soils. However, ca. 35% of the soils are young soils, Mollisols. These are found at lower elevations, in dryer zones and on calcareous parent materials. The highly weathered red tropical soils for which nutrient status is highly organic-matter dependent are those described as having 90% of their nutrients in the upper 10 cm of the top soil. Black Mollisols have a good organic matter level as well as active clay throughout their profile which gives them a superior nutrient status vis-a-vis the red soils.

With regard to flora and fauna, there are about 5000 plant species in Haiti but their endangered/threatened status is uncertain. Of those 5000 plant species, there are 600 species of ferns and 300 species of orchids. Among animals, of particular importance are the 220 species of birds and the recently discovered species of molluscs in the national parks.

Because pesticide applications will generally be punctual (i.e. will cover very small areas), major environmental contaminations resulting from blanket pesticide applications should not be a concern. However, the steep slopes and the heavy rainfalls observed during the rainy season could cause local problems of surface runoff and leaching into water supplies. Such problems should be lessened by the proposed introduction of good soil conservation practices which would not only reduce soil erosion but which would also reduce the movement of pesticides in surface water. In addition, some pesticide formulations may be preferable to others due to varying degrees of mobility in surface water and propensity to leach and contaminate ground water (see Merkle & Bovey 1974). If there is doubt regarding the appropriateness of a given pesticide when applied in conditions where the potential for surface runoff and water supply contamination is high, TWM personnel should consult AID/ST/AGR for advice.

9- <u>The availability and effectiveness of other pesticides or non-chemical control methods.</u>

There are currently several other pesticides available in Haiti, some of which might be more effective at controlling the anticipated pest problems than those which have been authorized for the project... Among such pesticides, however, there are some which are more persistent in the environment and/or more toxic to mammals and to other non-target organisms than the proposed pesticides. Once the major economic pests have been identified, a need for the adoption of some of those other available pesticides may, nevertheless, arise.

Two available non-chemical control methods have already been discussed in section 3 of this EA. Some other non-chemical control approaches which have a high potential for success in this project include: 1) the use of <u>Bacillus thuringiensis</u>, a bacteriological insecticide of very low mammalian toxicity which is effective in the control of various lepidopterous larvae (caterpillars), 2) the introduction of parasites and/or predators for the control of various scale insects which occur in Haiti, 3) the introduction of predatory mites for the control of injurious mites on fruit trees, 4) the introduction of a coccinellid predator for the control of a psyllid insect which attacks <u>Leucaena leucocephala</u>, a tree that has been recommended for the alley-cropping technique that will be used in the TWM, and 5) the use of resistant <u>L. leucocephala</u> varieties. Webb and Webb (1986) recently reported psyllid damage as being very serious in the Northwest of Haiti.

Although I did not observe many psyllids in the Southwest, the problem may be expected to reach epidemic proportions in this area at one point.
Leucaena sp. is native to Central America where the psyllid Heteropsylla cubana is kept under check by its natural enemies. In many of the countries where Leucaena has been introduced, this psyllid was (accidentally) introduced as well. In Hawaii, the coccinellid Curinus coerulus, which was introduced there in 1922 to control the coconut mealybug, has become an efficient predator of the psyllid (McFadden 198?). If the psyllid species found in Haiti turns out to be the same as that found in Hawaii, introduction of C. coerulus into Haiti should be seriously considered. The TA consultants are expected to take the necessary steps to determine if the above options are feasible.

10- The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticides.

The GOH does not have a pesticide control board nor does it have any law or regulation designed to control the use of pesticides in its country. One such law is apparently in preparation but the recent political events in Haiti have, at least temporarily, interrupted further development of this law. In any case, the ability of the GOH to enforce such a law remains questionable.

Therefore, in the context of the TWM, it will be the role of the umbrella NGO to verify and control the distribution, storage, use and disposal of the requested pesticides. This should not pose any problem in the early phase of the project when, as recommended in section 11, the handling and application of pesticides is done by trained PVO technicians only. Control may become more difficult, however, if, later in the LOP, peasants begin applying pesticides themselves.

There is one particular control issue over which the umbrella NGO may experience difficulty: The issue of labelling. When a whole bag or container of pesticide is purchased, the product is normally properly labelled but not in a language (usually English) which most Haitians can read. When pesticides are purchased in smaller quantities, they are transfered into paper bags or into containers which do not have any label at all. The salesman may simply write the name of the pesticide on the bag or the container and give verbal instructions relative to the use of the purchased pesticide. Often those bags get ripped or wet and the identification disappears. One solution to this problem lies in the production of stickers printed with Creole translations of the original labels.

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ASSA, a fertilizer company which will soon begin distributing pesticides in Haiti, may be interested in getting such stickers produced. It will be the role of the umbrella NGO to make arrangements with the pesticide distributors in order to ensure that pesticides purchased by AID/TWM are labelled as described above. Assistance to the umbrella NGO will be provided by ST/AGR with regard to minimum acceptable standards for repackaged pesticides.

11- <u>The provisions made for training of users and applicators.</u>

Since many of the peasants will not be able to afford the purchase of a backpack sprayer, I suggest that, at least initially pesticide applications for on-farm trials be carried out by trained technicians from the PVOs. UNICORS currently employs such a system although its applicators are not properly trained. This institution supervises 8 CDCPs, each of which is divided into a certain number of sections (e.g. 5). A given CDCP has a technician who, in theory, is well trained and qualified to apply pesticides. This technician trains at least one person in each of the sections and this person applies pesticides on private farms when such measures appear necessary.

Adequate training in pesticide application/handling/disposal should be provided for at least two technicians in each of the four PVOs. These technicians should then be able to teach other applicators the safe handling of pesticides. If the timing is right, I suggest that DCCH and DRI technicians participate in one of the two 1-day courses which will be offered this fall by a pest management specialist hired by USAID/Haiti Cooperative Agreement for Fruit Tree Production. This course will be offered at ORE which is relatively near DCCH and DRI. Travel would need to be provided for two UNICORS technicians.

If the decision is made, later in the LOP, to transfer the responsability of applying pesticides to the farmers, it would be wise to develop and implement basic education programs (through the extension/promoter system) in pesticide safety, handling and potential environmental impacts.

12- <u>The provisions made for monitoring the use and effectiveness of the pesticides.</u>

The umbrella NGO will have the responsability of monitoring the use of pesticides in the TWM and ensure that they are handled correctly and safely. The

TA consultants, and later a US-trained agronomist/entomologist (see the Recommendation section 3.3 in the attached report) of the SHAG, will be responsable for routinely taking crop samples in order to conduct pesticide residue analyses for use of pesticides on crops for which residue tolerances have not been established by either EPA or FAO/WHO. Funds have been provided for residue analyses in the attached budget. Additional analyses may be performed by private chemical companies that are providing the pesticides. To the extent possible, analyses will be performed in Belizean laboratories where capabilities exist. This will be particularly important in the case of crops exported to foreign countries which may have specific standards regarding pesticide residues.

Table 1. List of requested pesticides and origin of requests.

PESTICIDE		ORIGIN OF REQUEST					
Common name	Commercial name (if different)	DAI	ORE	DRI	DCCH	UNICORS	Author
Aldrin		X					
Benomyl	Benlate	X					
Captan		X		X	X	X	
Carbaryl	Sevin	X	X	X		X	
Chlordane			X		X		
Deltamethrin	Decis		X			X	
Diazinon	Basudin	X					
Dicofol	Kelthane	X	X				
Dieldrin						X	
Glyphosate	Round-up		X				
Lindane	Lindagrain					X	
Malathion		X	X		X	X	
Mancozeb	Dithane M45			X		X	
Maneb	Manzate		X				
" + Metiram	Molosse		X				
" + Methyl-thiophanate	Pelta		X				
Metalaxyl	Ridomil						X
Methomyl	Lannate		X				
Picloram	Tordon		X				
Thiram			X				
Toxaphene		X					
Trichlorfon	Dipterex				X	X	

Table 2. EPA registration status and toxicity of requested pesticides.
A low LD_{50} indicates high acute toxicity

PESTICIDE Common name	ACTION[1]	EPA REG. STATUS[2]	LD_{50}[3] oral/dermal mg/kg	WBA[4]	SIGNAL[5] WORD	PROJECT[6] AUTHORIZATION
Aldrin	I	C	40-60/50-100	NO	Warning	-
Benomyl	F	G	>10000/>10000*	OK	Caution	+
Captan	F	G	9000/ -	OK	Caution	+
Carbaryl	I	G	500/>2000*	OK	Caution	+
Chlordane	I	C	367-515/>200, >2000*	OK	Warning	-
Deltamethrin	I	G	>5000/>2000*	OK		+
Diazinon	I	G	300-400/3600*	OK	Caution	+
Dicofol	A	G	684-809/1000-1230	OK	Caution	+
Dieldrin	R[7]	C	40-60/50-100	NO		-
Glyphosate	H	G	4900/ -	OK	Warning	+
Lindane	I	G	88-125/1000	NO	Warning	-
Malathion	I	G	10090-1375/4100*	OK	Caution	+
Mancozeb	F	G	>8000/ -	OK	Caution	+
Maneb	F	G	7990/ -	OK	Caution	+
" + Metiram	F	G	7990-10000/ -	OK	Caution	+
" + Methyl-thiophanate	F	G	7990-9700/>8000*[8]	OK	Caution	+
Metalaxyl	F	G	669/>3100	OK	Warning	+
Methomyl	I	R	17-24/5880*[9]	NO	Danger/Poison	-
Picloram	H	R	8200/ -	OK	Caution	
Thiram	F	G	780/ -	OK	Caution	+
Toxaphene	I	R	69/ -	NO	Warning	-
Trichlorfon	I	G	150-400/>500	OK	Warning	+

1 A = Acaricide, F = Fungicide, H = Herbicide, I = Insecticide, R = Rodenticide.

2 C = Cancelled, G = General, R = Restricted.

3 Based on technical product unless otherwise indicated. From: Farm Chemical Handbook 1985. Meister Publishing Co., Willoughby, Ohio, USA.

4 WBA = World Bank Acceptability: if a pesticide is in category Ia or Ib of the WHO Recommended Classification of Pesticides by Hazard, this pesticide is considered unacceptable. Categories Ia and Ib include all pesticides which fall in the following toxicity categories: LD_{50} (rat) oral: solid < 50 mg
liquid < 200 mg
dermal: solid < 100 mg
liquid < 400 mg

5 See ref. cited in footnote 3 p. C234 for classification criteria.

6 -: not authorized, +: authorized.

7 Usually classified as an insecticide but used as a rodenticide by UNICORS.

8 Datum for Methyl thiophanate only.

9 Based on 24% liquid formulation.

* Rabbit instead of rat.

Table 3. Summary of pesticide management in the PVOs

CATEGORY	PVO			
	ORE	DCCH[1]	UNICORS	DRI
Use of C-pesticides	YES	YES	YES	NO
Use of E-pesticides	YES	NO	NO	NO
Basis for selection of pesticides	CIP[2]	CIP	±Haphazard and some CIP	CIP
Safety equipment				
mask	YES	NO	NO	Cloth mask
gloves	YES	NO	NO	NO
boots	NO	NO	NO	NO
other	Plastic coat	NO	NO	NO
Storage area	Locked & Safe	Locked & Safe	Locked but also used as a warehouse for grain	Locked & Safe
Identification of pesticides in storage area	GOOD	No pesticide when visited	NOT GOOD	NOT GOOD
Disposal	In an outdoor toilet	Bags are burned	Empty bags are washed and re-used for seed transport	Empty bags are burnt
Use of alternative pest management methods	NO	Use of neem seed extract	Use of table salt to control snails	NO
Particular problems			Seed treatment done on a concrete surface where many children often walk bare foot	Broadcast of pesticides with bare hands
Particularly good feature	Creole guy on CIP, pesticide selection and dosages			

[1] Based on previous use; temporary ban on pesticide use at DCCH.

[2] CIP = Crude Identification of Pest.

Table 4. Toxicity of pesticides to non-target organisms.

PESTICIDE	BEES[1]	BIRDS[2] LD_{50} (mg/kg) Mallard; oral	FISH[3]
Aldrin	1-A	520	
Benomyl			T
Captan			T
Carbaryl	1-A	2179	T
Chlordane	1-C	1200	
Deltamethrin	1-C		
Diazinon	1-A	3.5	T
Dicofol	1-D		
Dieldrin	1-A		
Glyphosate			
Lindane	1-A	2000	
Malathion	1-B	1485	T
Mancozeb			T
Maneb			T
" " + Metiran			T
" " + Methylthiophanate			T
Metalaxyl			
Methomyl	1-D		T
Picloram		[illegible]	
Thiram			T
Toxaphene	1-C		
Trichlorfon	1-C	700-800*	

1 1-A: do not apply on crops in bloom, 1-B: apply only during late evening when crops in bloom, 1-C: apply only during late evening or early morning when crops in bloom, 1-D: can be applied at any time with reasonable safety to bees. From: Handbook for pesticide applicators and pesticide dispensers, 1980. Province of B.C., Ministry of environment, Pesticide Control Branch, Victoria, B.C., Canada.

2 Same source as that cited in footnote 1.

3 T: highly toxic.

* Quail instead of mallard duck.

Illustrative budget

Technical Assistance -- 8 months Crop protection and pesticide safety and handling:	$ 150,000
Training of two plant quarantine specialists (DARNDR staff) at APHIS:	$ 12,000
Residue analyses 200 samples at $150.00/sample	$ 30,000
Participants per diem:	$ 10,000
Travel:	$ 2,000
Purchase of protective devices and safety equipment:	$ 1,000
Purchase of additional back-pack sprayers (ca. 20) at $75.00/sprayer	$ 1,000
Training supplies:	$ 5,000
Total:	$ 211,000

(Ph.D. training for a DARNDR staff has already been budgeted).

APPENDIX 2

ASSESSMENT OF THE NEED FOR PESTICIDE USE IN THE AGROFORESTY OUTREACH PROJECT

Introduction

Prior to the initiation of the AOP in 1981, an IEE prepared by Mr. William Sugrue, indicated that the use of pesticides in CARE and PADF nurseries would not be necessary. Therefore, AID funding of the AOP was approved with the special condition that pesticides would not be used during the LOP. However, several pest problems have since then emerged which may require the use of pesticides in order to avoid substantial losses due to diseases and insect pests.

Technicians in CARE and PVO nurseries of PADF have taken it upon themselves to initiate pesticide treatments in view of the evergrowing pest problems. The purpose of this report is to analyse pesticide use and pest management practices in CARE and PVO nurseries of PADF involved in the AOP.

This report is based on a meeting with Steve Goodwin, project coordinator for PADF in PAP, visits of two of the PVO nurseries of PADF (DCCH and DRI), and a meeting with Rick Scott, project coordinator for CARE in PAP. Because of a lack of time, none of the five CARE nurseries, which are located in the N/ of Haiti, were visited.

1- List of pesticides proposed for use in the AOP.

Common name	Commercial name	Users		Authorization
		CARE	PADF	
Benomyl	Benlate		X	YES
Captan		X	X	YES
Carbaryl	Sevin	X	X	YES
Chlordane			X	NO
Malathion		X	X	YES
Mancozeb	Dithane M45		X	YES
Menet + Methyl-thiophanate	Peltar		X	YES
Trichlorfon	Dipterex		X	YES

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The reader should refer to the EA/TWM for a detailed analysis of these pesticides. Chlordane, the only pesticide not authorized for use in the AOP because of its Cancelled EPA status, is normally used for ant control in tree nurseries. Orthene (Acephate) may be a suitable substitute.

2- Use of IPM principles by PADF and CARE.

PADF produces a nursery manual titled The Small Container Nursery Manual for Rootrainer Fives. This document, printed in both Creole and English gives control recommendations based on crude classification of pests: damping-off, fungus, crickets, caterpillars, aphids, and ants. Pesticides recommended are all broad-spectrum. The only non-chemical methods recommended are for: 1) crickets: hand weeding around the nursery, and 2) damping-off: reduced watering and increased ventilation. However, at the two PVO nurseries visited, the technicians did not appear to be using the manual and, when asked whether they were using non-chemical methods for pest control, they did not mention the two above methods. At DCCH, however, they do use neem seed extract for the protection of tree seedlings against insect attack (see EA/TWM for a complete discussion).

With regard to CARE nurseries, Rick Scott claims that pest problems are not too important at the present time and that all pest problems are controlled with three broad-spectrum pesticides which are relatively safe to use (see table). No non-chemical methods are presently being used. (The reader should consult the EA/TWM for more details on potential alternative control methods as some of them also apply to the AOP).

The AOP and the TWM share some basic pest management-related problems, including the lack of knowledge on what the pest problems are and how serious these problems really are. A short-term consultancy (ca. 6 weeks) aimed at identifying the most pressing problems on the commonly grown tree species (i.e. Cassia siama, Eucalyptus camaldulensis, Casuarina equisetifolia, Catalpa longissima, and Leucaena leucocephala) is necessary before further actions are taken. A pest management specialist with experience in nursery IPM should be hired to identify major pest species and propose non-chemical control methods where appropriate. The most important insect problems include 1) caterpillar and

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aphids which cause damage to leaves, 2) ants which carry off seeds of Casuarina and Eucalyptus, and 3) seed bugs which burrow into seeds of Leucaena. With regard to plant diseases, damping off is the most apparent problem.

3- Need for training of pesticide applicators

Based on visits at the DCCH and DRI nurseries, the level of training of PADF pesticide applicators appears somewhat low (see section 2.4 in attached report). It has already been recommended that two technicians in each of DCCH and DRI attend one of the two 1-day pesticide application training courses which will be offered shortly by AID/Haiti Cooperative Agreement for Fruit Tree Production in Camp Perrin (see EA/TWM section 11). PADF includes several other PVO nurseries, however, and pesticide application training should be provided for at least one technician in each of those nurseries. The pest management specialist hired for the training course offered by AID/Haiti Cooperataive Agreement for Fruit Tree Production, should be rehired for additional training sessions for the various nurseries involved in the project, including those of CARE. The period required for this TA will depend on 1) how many nursery technicians working in different geographical areas can travel to a common point to attend a course and as a consequence, on 2) how many locations the consultant will need to travel to.

4- Final recommendation

With the condition that: 1) Chlordane is not used by PADF or CARE during the remaining part of the LOP, 2) major pest problems are identified and IPM methods adopted when possible, and 3) proper pesticide application training is provided for PADF and CARE nursery technicians, the authorized pesticides are recommended for use in the AOP.

Illustrative budget

Six-week TA in pest identification and development of IPM methods:	$ 8,400
Three weeks of pesticide training courses for PADF and CARE nursery technicians:	$ 4,000
Travel:	$ 3,000
Purchase of protective devices for all PADF and CARE nursery technicians:	$ 2,000
Participants per diem:	$ 4,000
Teaching material:	$ 1,000
Total:	$22,400

APPENDIX 3

Itinerary in Washington, D.C. and Haiti

Date (July 1986)	Activities
6/Sun.	Air travel between Quebec City, Canada, and Washington, D.C.
7/Mon.	Briefing with Mr. Carroll Collier, crop protection specialist at the AID/ST Office of Agriculture, and with Mrs. Marea E. Hatziolos, Deputy Environmental Officer at the AID/LAC Bureau.
8/Tue.	Air travel to PAP, Haiti. Arrival at 15:45. Met with Mr. James J. Talbot REMS/CAP/Haiti and discussed my itinerary in Haiti and details regarding my assignment.
9/Wed.	Spent morning at the AID Mission in PAP to organize my schedule. Visited their library and went through pest management literature which might be related to Haiti. Spent part of the afternoon at the DARNDR office of plant protection, making first contacts and getting appointments with Mr. Julio Bartholemy, Mr. Paul Samedy and Mr. Guy Hallman who were impossible to reach by telephone. Went back to the AID Mission and read reports pertinent to my assignment.
10/Thu.	9:00 Met with Mr. Philippe Mathieu of ASSA, a fertilizer/pesticide supplier in Bon Repos near PAP. 11:00 Met with Mrs. Anne Hauge of Agri-Supply Co. in PAP. 13:00 Spent some time at the library of the Faculté d'Agronomie, going through pest management literature related to Haiti. 14:00 Met with Mr. Bertrand Derouillère, entomologist at the Faculté d'Agronomie, Damien. 15:00 Met with Mr. Guy Hallman, USDA pest management specialist working on a West Indian Fruit Fly quarantine problem.

16:00 Met with Mr. Julio Bartholemy, agronomist and director of the DARNDR's plant protection section.

11/Fri. 9:30 Met with Steve Goodwin, AOP coordinator for PADF in PAP.
11:00 Met with Rick Scott, AOP coordinator for CARE in PAP.
13:00 Returned to the AID Mission and had a discussion with Jean Finnigan of ORE. Spent the rest of the afternoon getting organized for my trip to Les Cayes and Chardonnière

12/Sat. Morning: travelled to Les Cayes (ground transportation)
Afternoon: met with Mr Gérard Léger, agrochemical supplier for ASEA in Les Cayes

13/Sun. Morning: read TWM's PP draft and rested
Afternoon: read TWM's PP draft and met with Mr. Amal Chatterjee of Winrock International (Les Cayes).

14/Mon. Morning: visited the ORE fruit tree nursery at Camp Perrin. Met with Sean Finnigan again
Afternoon: visited the ORE forest tree nursery in Bergaud and met with Mike Bannister of PADF

15/Tue. Morning: travelled to Laborde to visit DCCH forest tree nursery but was unable to meet the nursery technician. Worked on EA instead.
Afternoon: 14:00 Met with Mr. Jean-Yves Banatd, DARNDR agronomist in Les Cayes.
16:00 Left for Chardonnière. Arrived there at 22:00

16/Wed. Morning: travelled to Les Anglais and met with Mr. Jean St-Cyr, president of the "Coopérative Agricole Des Anglais", one of 8 COOPs coordinated by UNICOPS. Discussed pesticide use by the COOP.
Afternoon: travelled to Randel to visit another COOP but was unable to meet with the pesticide application technician. Took advantage of being there to visit a couple of peasant farms. Stayed overnight in Chardonnière

17/Thu. Morning: travelled back to Les Cayes.
Afternoon: went back to DCCH nursery and met with Mr. Gilbert Picrd, the technician in charge of pesticide application.
16:30 Left Les Cayes for PAP

18/Fri. Morning: went to the AID Mission for short debriefing and went back to the Mission's library to look up new references.
Afternoon: 13:00 Met with Mrs. Fabienne Latortue of Darbouco an agro-chemical supplier in PAP. Spent the rest of the afternoon working on EA.

19/Sat. Worked on EA and CICP report.

20/Sun. Worked on EA and CICP report.

21/Mon. Morning: made a few telephone calls to some of the people contacted earlier to ask further questions. Called Carroll Collier in Washington D.C.
Afternoon: had a debriefing session with Mr. Robert Wilson at the AID Mission.

22/Tue. Typed the EA at the AID Mission.

23/Wed. Submitted a draft of the EA to Messrs John Lewis and Robert Wilson at the AID Mission. Travelled back to Canada.

APPENDIX 4

List of major contacts in Haiti

USAID/Haiti (PAP)

Mr. James J. Talbot REMS/CAR
Mr. Robert J. Wilson RDO
Mr. John V.D. Lewis RDO

DARNDR

Mr. Julio Bartholemy, agronomist (PAP)
Mr. Paul Samedy, agronomist (PAP)
Mr. Jean-Yves Banatd, agronomist (Les Cayes)

PADF

Mr. Steve Goodwin, ADP coordinator (PAP)
Mr. Mike Bannister (Les Cayes)

CARE

Mr. Rick Scott, ADP coordinator (PAP

Winrock International

Mr. Amal Chatterjee (Les Cayes)

ORE

Mr. Jean Finnigan, director (Camp Perrin)

Darbouco, S.A. (Agricultural supply)

Mrs. Fabienne Latortue, agronomist (PAP)

Agri-Supply Co.

Mrs. Anne Hauge, general manager (PAP)

Agricultural Services S.A. (ASSA)

Mr. Philippe Mathieu, agronomist (PAP)

Faculté d'Agronomie, Universite d'Haiti, Damien

Mr. Bertrand Derouilleres, entomologist.

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