AN ECONOMIC ANALYSIS OF THE MAISSADE, HAITI, INTEGRATED WATERSHED
MANAGEMENT PROJECT

By

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Working Paper No. 2, 34 pages, July 1992

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ABSTRACT

An economic analysis was conducted of the Maissade Integrated Watershed Management Project in Haiti. This project, implemented by the Save the Children Federation, differs from conventional watershed management projects by investing heavily in the development of peasant organizations in order to gain voluntary and sustained adoption of soil conservation, forestry and community development innovations. Conventional projects have relied on monetary and commodity incentives in order to encourage technique adoption, and are widely viewed to have failed to achieve sustained watershed management.

The goal of the economic analysis was to determine if a project representative of the new, participatory approach was economically efficient from donor and peasant perspectives. The aggregate project has a NPV of $336,600 at a 12% discount rate, a benefit-cost ratio of 1.5 and an economic rate of return of 19%. Analyzed separately, the hillside soil conservation component is economically efficient at the project level while the other components (forestry, ravine treatment and group investment) are not. Project value is most sensitive to changes in project outlay inputs and hillside treatment benefits. Both the aggregate project and all separate project components are economically efficient from the perspective of project participants, and all but the group investment component have internal rates of return exceeding 200%. Benefit-cost ratios vary from 2.5 to 30 for participation in the different project components. Investment in hillside soil conservation treatment yielded what was by far the greatest return. This analysis demonstrates that watershed management projects in Haiti which utilize peasant organization approaches can be economically efficient.

CONTENTS

INTRODUCTION: PURPOSE AND METHOD OF THE ANALYSIS

Purpose of the Analysis

An earlier version of this analysis was conducted in March 1989
and included in a watershed management plan prepared by Save the
Children Federation (SCF) for the Maissade area. The purpose of

that analysis was to determine the economic efficiency of the Maissade Integrated Watershed Management Project, and estimate its economic impact in the Maissade area. It was conducted from the international donor's perspective to permit comparison with the economic performance of other similar rural development projects. The purpose of this new version of the analysis is: i) to update the original with recent field data; ii) to analyze the economic efficiency of separate project components; iii) and to examine the project's economic attractiveness from the peasant participant perspective. Accordingly, the following assessment questions will be answered in the analysis:

* Is the project economically efficient at the aggregate level?
* Are each of the (quantified) project components economically efficient?
* Is the aggregate project economically attractive to participating peasants?
* Are each of the (quantified) project components economically attractive to participating peasants?

Basic Assumptions and the Method of Analysis

The analysis was conducted (and this paper is organized) as per the economic assessment process proposed by Gregersen and Contreras (FAO 1979): consideration of overall project inputs and outputs (Section 3); identification of the physical flows of measurable inputs and outputs (Section 4); determination of input and output values (Section 5); comparing costs with benefits and sensitivity analysis (Section 6); and formulation of conclusions (Section 7). A brief description of the context and history of the Maissade project has been included (Section 2).

The Maissade project was originally funded for a three-year period, 1986 to 1989. Because of low expenditures, a no-cost extension was granted to July 1991. Though SCF-supported development activities have continued beyond July 1991, for the purposes of this analysis, we assumed that external financing would cease on that date. Despite the termination of external assistance, significant costs and benefits are projected to continue, and to diffuse to areas outside of those addressed by the project, beyond the period of direct project intervention. For this reason the project is treated as a "time-slice" of the local development which it facilitated. These two project phases ("during" and "after" project intervention) are combined and appraised as one project in this analysis.

Economic rate of return (ERR) and project net present value (NPV) measures serve as indicators of economic efficiency. Sensitivity and risk analysis are calculated [note 1] for the separate project components and the aggregate project. The basic farm conditions for each participating farmer are assumed to be identical, and the technical treatments are therefore expressed on a per hectare, rather than an individual farm, basis.

In order to remain consistent with the analysis standards of the organization funding the project, the United States Agency for International Development (USAID), a 12% real discount rate was used. All costs and benefits are in real terms and it was assumed that there would be no relative price variations, for either costs or benefits, during the period of analysis. Due to the small scale of the project, it was also assumed that the project itself would result in no secondary benefits or costs, and have no effect on price levels. Similarly, it was assumed that there would be no economic cost to the domestic economy. Except in the case of the unskilled labor volunteered by participating farmers, market prices are assumed to provide an appropriate measure of economic value. Voluntary labor was shadow priced at the average value (across all seasons) of foregone earnings.

The results of this analysis should not be viewed as a precise indicator of total project value as only feasibly quantifiable costs and benefits (principally those associated with agricultural production) are factored into the calculations. Significant external benefits such as peasant organization and overall environmental rehabilitation are not considered as their determination requires substantial supposition. It is possible that the value of these external benefits exceed those that are quantified.

CONTEXT AND HISTORY OF THE MAISSADE PROJECT

Approaches to Watershed Management in Haiti

Rural Haiti has witnessed numerous rural development, reforestation, soil conservation, and agriculture development projects. The majority have, by most accounts, produced disappointing results. Watershed management projects (including reforestation and soil conservation projects) in Haiti have predominantly utilized the "equipement du territoire" approach to environmental rehabilitation. This approach has been characterized by large-scale prescriptions for land and ravine treatment, mechanical rather than biologic structures, and monetary and commodity incentives to attract peasant participation (Lilin and Koohafkan 1987). Highly degraded and steep lands have often been primary targets for intervention. The use of this approach for the treatment of privately held lands, which constitute the vast majority of upland watershed lands, has been criticized by many development professionals for its disregard of indigenous conservation practices, social institutions, and land tenure complexities; for creating dependencies; and for failing to result in the sustained adoption and maintenance of the techniques promoted (Murray 1979 and Lilin 1986).

An "agricultural parcel" approach to watershed management, which
exploits internal peasant motivations to increase agricultural
yields, was developed during the mid-1980's to complement and
serve as an alternative to the "equipement du territoire"
approach (Smolikowski 1989). Projects which use the
"agricultural parcel" approach generally employ classic
agricultural development strategies: training and hiring field
extension agents; integrating basic agricultural goals into
extension programs oriented primarily towards resource
conservation; and conducting basic agricultural research. Such
projects also tend to include or be associated with programs in
community development or public health and have often carried the
title of "integrated" watershed management projects.

The Maissade Integrated Watershed Management Project

Project History

The Maissade Project, designed in 1985, was one of USAID/Haiti's
pilot efforts in integrated watershed management and one of the
first such projects in the country. Searching for new models for
watershed management, project planners combined two embryonic yet
promising extension strategies: i) the formation of "groupement"
[note 2] for peasant mobilization; ii) economic benefit oriented
tree planting (embodied in USAID's Agroforestry Outreach
Project). The "groupement" were to form the basic unit through
which the project functioned, and were to be promoted not as ends
in themselves, but rather as the organizational means by which
social, economic, and ecological problems would be addressed (SCF
1985).

SCF was awarded a cooperative agreement with USAID and began
field activities in January, 1986. First year activities
consisted of identifying and training local staff and organizing
"groupement". Public meetings were held on a regional basis in
1987 in which the participants identified local environmental
problems and proposed strategies for their resolution.
Responding to local requests, the project initiated technical
assistance programs in hillside treatment (including agriculture,
agroforestry, and soil conservation practices); ravine treatment
(soil conservation techniques); forestry; animal husbandry; and
small-scale infrastructure development.

Key Project Themes

Long-term commitment. SCF began investing private funds in local
community development efforts simultaneous to the initiation of
the USAID sponsored watershed project. Despite the relatively
low total amount of private funds available, confidence in their
long-term availability has permitted SCF to make a long-term
commitment to the project. This has allowed for the utilization
of methods and the initiation of project activities which would
not have been possible had only the short-term funding provided

by USAID (though considerably larger in total amount) been
available. SCF plans to build local capabilities to manage
future development and to gradually transfer the management of
existing development activities to local institutions (SCF 1989).

Low level of investment in materials. In order to encourage a
sense of responsibility for their own development on the part of
local peasants, SCF operates in such a way that they will not be
perceived as the provider of subsidies, material goods, or
answers to local development problems. Rather, SCF seeks to
maintain the role of educator, catalyst, and liaison between
peasant groups and external agents. Accordingly, SCF has not
invested in project-maintained infrastructure such as centralized
tree nurseries, grain storage facilities, and credit programs.
Similarly, SCF has acquired few vehicles, constructed few project
buildings, and utilized expatriate assistance judiciously. A
direct result of this approach has been low rates of
expenditures, and the consequent no cost three year extension
made possible for the project (Gaddis and Smucker 1988).

Utilization of participatory development approaches. Peasants,
as "groupement" representatives, play a key role in project
decision functions: program planning, execution, and evaluation.
Participation by peasants is voluntary; SCF provides no external
incentives for their investment of time and materials. Peasants
regularly volunteer as local extension agents in agroforestry,
soil conservation, animal husbandry, and nursery management.
Peasants also participate by conducting on-farm trials.

Project Components

Farmer organization and training is the foundation for all
project activities and is both an end in itself (forming the
basis for sustained locally-driven development) and the means to
achieve environmental rehabilitation goals. For this reason,
farmer organization and training activities are not treated as a
separate component in this analysis. The costs and benefits of
these activities have been separated into those that support
technical program objectives and those that support peasant
organization objectives. As a percentage of group investment,
capital is the only quantifiable benefit from the peasant
organization activity. This component has been renamed "Group
Investments" in this analysis. The "technical" project
components include: hillside treatment, ravine treatment,
forestry, animal husbandry, and small-scale infrastructure
development. The benefits of the animal husbandry and
small-scale infrastructure components have not been identified
and quantified and thus these components are not included in
this economic analysis (Figure 1).

Figure 1. Project Structure: Components Included in this Analysis

Support Activities   (Joint Costs)   Components

                                        hillside treatment

local	peasant	
		ravine treatment
administration	organization	
		group investments
costs	& training	
		forestry

PROJECT COSTS AND BENEFITS

Costs

The economic costs associated with the Project include those
incurred by the executing agency as well as those incurred by
local participants. Major direct costs are: external financing
for project operation; voluntary local manpower for participation
in training activities, and the establishment of technical
treatments; and the opportunity cost of the land area invested in
technical interventions. This opportunity cost is assumed to be
zero because of the relatively small amount of land occupied and
its relatively low value. Each of the other costs have been
quantified and included in the analysis. No significant indirect
costs associated with the Project were identified.

Benefits: Direct and Indirect

Benefits of the Project Resulting from Technical Treatments

Within the overall goals of environmental rehabilitation and
community development, the principal project objective is the
attainment of sustainable increases in agricultural yields
through soil conservation. On-site effects of the technical
interventions include increased agricultural productivity,
increased use of moisture demanding crops, and decreased property
damage. Off-site external effects include reduced channel and
reservoir sedimentation downstream, and reduced deposition of
sediment on agricultural lands. For example, a 1990 SCF study
found that 335 checkdams (33% of the checkdams constructed that
year) held 1173 cubic meters of sediment (SCF 1990).
Improvements in streamflow pattern and quantity, and in water
quality, may be consequent external benefits. Due to the lack of
empirical data relating watershed treatments to specific
hydrological responses, the value of these potential benefits
have not been quantified.

With increases in agricultural production, other secondary
benefits such as employment generation and population
stabilization are expected to occur. However, the value of these
secondary benefits have not been included in this analysis.

Benefits of the Project Resulting from Peasant Organization

The Maissade Project utilizes a methodology emphasizing peasant
organization and mobilization to achieve specified environmental
rehabilitation goals. This method produces social benefits in
addition to and distinct from those occurring directly due to
technical interventions. Such benefits include an organized and
mobilized population which can function to resolve local problems
whether agricultural or social in nature. For example, as of
August 1988, there were 154 pre-cooperative farmer groups
("groupement") in Maissade engaged in various activities such as
organizing local elementary schools, developing potable water
sources, providing free agricultural counsel, and developing
local public health committees. Though significant, the value of
these types of activities cannot be quantified with precision and
have not been included in this analysis.

Collective economic investments are a major activity of all
farmer groups. These include grain storage and marketing,
livestock rearing, and farming. A "lumpiness" [note 3] exists in
investment opportunities. Because of cash scarcity, collective
investment is often necessary. Peer pressure among group members
to contribute funds and effort to collective activities also
exists. Group members state that these funds would probably not
have been invested productively if each member had acted
individually. Largely because of investment opportunity
"lumpiness", group investments have regularly proven to be more
productive than the sum of individual investments of the same
amount. Though it is not possible for other benefits accrued due
to peasant organization, project records of group investments by
group by year permit the quantification of this activity.

Other Project Benefits

There are a number of other project benefits whose value cannot
be readily quantified, and have not been for this analysis. In
keeping with the project's "pilot" role, conservation oriented
techniques and implementation strategies are regularly tested and
evaluated. Donor organizations along with other development
workers in Haiti benefit from the lessons learned in Maissade.
The Project also directly benefits the Maissade area by providing
employment and on-the-job training to approximately 40 local
inhabitants. This employment increases the possibility of future
and enhanced employment opportunities for the participants, and
local merchants clearly benefit from both official and unofficial
expenditures in the local area. This "multiplier effect" results
in the support of a substantial, albeit unknown, number of local
families.

Table 1. Physical Inputs and Outputs: Participant Perspective

Item	Units	Year			
		1	2	3	4

```
Inputs
Group Investment      p-d/yr    279.3    558.6   1117.2   1173.1
Hillside Treatment
  Training            p-d/yr        0   1591.5   1591.5   1591.5
  Construction        p-d/yr        0    263.8   1098.8   1950.0
  Maintenance         p-d/yr        0     87.0    449.6   1093.1
Ravine Treatment
  Training            p-d/yr        0    954.9    954.9    954.9
  Construction        p-d/yr        0      100    274.4      320
  Maintenance         p-d/yr        0       30    112.3    208.3
Forestry
  Training            p-d/yr        0    636.6    636.6    636.6
  Tree Planting       p-d/yr        0     1040     1560     1950

Outputs
Hillside Treatment    ha/yr         0     21.1     87.9      156
  Increased Corn Prod.
                      kg            0     5501    28856    71834
  Increased Sorghum Prod.
                      kg            0     8921    46799   116500
Ravine Treatment      #/yr          0      250      686      800
  New Productive Area
                      ha            0      0.2      0.7      1.4
  Rice Produced       kg            0      200      749     1389

Forestry
  Trees Planted       #/yr          0    80000   120000   150000
  Poles Produced      #/yr          0        0        0        0
```

Item	Units	Year			
		5	6	7	8

```
Inputs
Group Investment      p-d/yr   1231.7   1293.3   1358.0   1425.9
Hillside Treatment
  Training            p-d/yr   1591.5   1591.5        0        0
  Construction        p-d/yr   2477.5   3200.0    312.5    312.5
  Maintenance         p-d/yr   1910.7   2966.7   3069.8   3173.0
Ravine Treatment
  Training            p-d/yr    954.9    954.9        0        0
  Construction        p-d/yr      406      600      100      100
  Maintenance         p-d/yr    330.1    510.1    540.1    570.1
Forestry
  Training            p-d/yr    636.6    636.6        0        0
  Tree Planting       p-d/yr     1235     1300      130      130

Outputs
Hillside Treatment    ha/yr     198.2      256       25       25
  Increased Corn Prod.
                      kg       129252   206331   228981   251872
  Increased Sorghum Prod.
                      kg       209619   334625   371358   408483
Ravine Treatment      #/yr       1015     1500      250      250
  New Productive Area
                      ha          2.2      3.4      3.6      3.8
  Rice Produced       kg         2201     3401     3601     3801
Forestry
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    Trees Planted      #/yr    95000   100000    10000    10000
    Poles Produced     #/yr        0        0    20000    30000


Item                 Units                   Year
                                  9       10       11    12-14
Inputs
Group Investment     p-d/yr   1497.2   1572.0   1650.6   1821.2
Hillside Treatment
  Training           p-d/yr        0        0        0        0
  Construction       p-d/yr    312.5    312.5    312.5    312.5
  Maintenance        p-d/yr   3276.1   3379.2   3482.3   3688.6
Ravine Treatment
  Training           p-d/yr        0        0        0        0
  Construction       p-d/yr      100      100      100      100
  Maintenance        p-d/yr    600.1    630.1    660.1    720.1
Forestry
  Training           p-d/yr        0        0        0        0
  Tree Planting      p-d/yr      130      130      130      130


Outputs
Hillside Treatment   ha/yr       25       25       25       25
  Increased Corn Prod.
                     kg       273771   293763   310562   344348
  Increased Sorghum Prod.
                     kg       443998   476421   503665   558459
Ravine Treatment     #/yr       250      250      250      250
  New Productive Area
                     ha          4.0      4.2      4.4      4.8
  Rice Produced      kg         4001     4201     4401     4801
Forestry
  Trees Planted      #/yr     10000    10000    10000    10000
  Poles Produced     #/yr     37500    23750    35000    17708


Item                    Units                  Year
                                        15-17    18-20
Inputs
Group Investment        p-d/yr        2108.3   2440.6
Hillside Treatment
  Training              p-d/yr             0        0
  Construction          p-d/yr         312.5    312.5
  Maintenance           p-d/yr        3998.0   4307.3
Ravine Treatment
  Training              p-d/yr             0        0
  Construction          p-d/yr           100      100
  Maintenance           p-d/yr         810.1    900.1
Forestry
  Training              p-d/yr             0        0
  Tree Planting         p-d/yr           130      130


Outputs
Hillside Treatment      ha/yr            25       25
  Increased Corn Prod.  kg           389026   429645
  Increased Sorghum Prod.kg          630918   696793
Ravine Treatment        #/yr           250      250
  New Productive Area    ha            5.4      6.0
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  Rice Produced            kg             5401        6001
Forestry
  Trees Planted            #/yr          10000       10000
  Poles Produced           #/yr          19167       15583
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Notes:
1. The shadow price of labor is based on a 5 hour work day.
2. For periods of combined years, average annual values are
displayed.

PHYSICAL FLOWS OF INPUTS AND OUTPUTS

Group Investments

Project experience indicates that approximately 25% of group
meeting time is spent on managing economic activities. The
remaining time is focused on other concerns which have not been
quantified for either this or the other project components.
Aggregate peasant input for this component is thus a product of
the total number of groups and the total number of meetings held
each year. This information was calculated by the project (see
Annex 1) for the year 1988 and totaled 1117 person-days/year.
The authors assume that inputs for the years preceding and
following 1988 are proportional to the 1988 cost based on the
number of farmer groups existing in each of those years. Based
on trends observed subsequent to 1988, it is estimated
(conservatively) that there will be a 5% annual growth rate in
the number of farmer groups after project termination, and it is
assumed that the number of meetings per year is directly
proportional to the number of groups. Group investment component
outputs, which constitute a fixed percentage of total investment
capital, is presented in the value flow table (Table 4). In the
without project scenario it is assumed that the time allocated to
the management of these activities would not have been more
productive than ordinary individual activities.

Hillside Treatment

Inputs

Inputs in the hillside treatment component of the project which
could be quantified and were contributed by project participants
include: participation in technical training activities, and the
establishment and maintenance of soil conservation measures.
These inputs are measured in person-days per year. Data and
consequent projections are derived from project reports and are
presented in Table 1.

Participation in technical training includes farmer participation in field seminars, the work of volunteer extension agents, and participation in formal training events. Project records indicate that in 1988 peasant participation in technical training activities summed to a total of 3183 person-days (see Annex 1 for calculations). Records also indicate that approximately 50% of this participation focused on hillside treatment activities (1592 person-days), 30% on ravine treatment, and 20% on forestry activities. Project training efforts remained approximately constant from 1987 until 1990. It is assumed that this effort will remain at the same level in 1991. No technical training activities and no hillside treatments were conducted in 1986.

Hillside treatments ("i.e.", hedgerows planted on the contour, trash barriers, and rock walls) were established and maintained [note 4] by approximately 750 farmers between 1987 and 1990. Project time studies indicate the amount of time required to construct and maintain (on an annual basis) each linear meter of structure. This data was used to calculate the actual input (in person-days) for the hillside treatments (see Annex 1 for calculations).

Outputs

The average inter-structure spacing was used together with the actual amounts of contour structures established each year to calculate a total hectare measure of hillside treated (Annex 1). The authors assumed that 25 hectares of land would be treated annually via spontaneous peasant initiative following project termination. A corn/sorghum inter-cropping system is the dominant cropping system on lands where soil conservation treatments are being constructed. Project records indicate that corn and sorghum production on non-treated plots averages 1185 and 1510 kg/ha respectively. An agricultural yield study conducted by the Project in 1988, a year of poorly timed rainfall, indicated that lands treated with trash barriers produced an average of 51% more corn and 28% more sorghum than non-treated plots. The difference between the means was significant at the 95% level.

A similar yield study in 1989, a more normal year, indicated that treated plots produced an average of 22% more corn and 32% more sorghum than non-treated plots (SCF 1990). For the purposes of this analysis the lower of the percent yield increase figures for each crop ("i.e.", 22% for corn, 28% for sorghum) were used to predict first year yield increases following the construction of hedgerows and trash barriers. It was assumed that yields would continue to increase 5% per year from the second to the fifth years following treatment due to improved moisture regime as the terrace formed by sediment deposited upslope of the hedgerow and trash barrier gradually stabilizes. It was also assumed that yields would increase a further 2% per year from the second through the tenth years following treatment as organic matter and nutrient cycling reach new (higher) equilibrium levels. These increases compare with a no treatment scenario ("i.e.", without the project) for which it was assumed that agricultural yields

would decrease 1% per year due to soil erosion.

Ravine Treatment

Inputs

Ravine treatment inputs include the person-days invested in
technical training and in establishing and maintaining gully
plugs (see Table 1). Participation in technical training
(including time spent as volunteer extension agents, and
participating in field seminars and formal training events) was
estimated to be 955 person-days in 1988. The effort invested in
project training remained relatively constant from 1987 through
1990, and is expected to remain at the same level in 1991. No
technical training activities were conducted and no ravine
treatments were implemented in 1986. Ravine treatments began in
1987, totaling 250, and increased each year to a total of 1,015
in 1990. The authors estimate that 1500 structures will be built
in 1991 and that 250 structures will be constructed each year
following project termination. Project time studies show an
average construction time of 0.4 person-days per structure.
Maintenance was estimated to require 30% of construction effort
(i.e., 0.12 person-days).

Outputs

Ravine treatments result in the slowing of sediment-laden
overland flow, leading to sediment deposition and the consequent
creation of enriched microsites upslope of each gully plug.
During the dry season farmers regularly plant more moisture
demanding crops in these areas, such as rice, bananas, taro, and
market vegetables. The difficulty in quantifying yields with and
without treatment, and of establishing the economic value of crop
diversification, led the authors to employ the simplifying
assumption that 50% of all structures resulted in new 16 m2 of
rice production areas. SCF surveys indicate that average rice
yield in ravines in the Maissade area is 0.1 kg/m2. The authors
assumed that in a without project scenario, cropping patterns and
yields would remain constant.

Not included as a benefit from the ravine treatment, due to the
lack of data necessary to quantify it, is the avoidance of the
further loss of productive land caused by continued gully
downcutting and headcutting which would occur without the
treatment.

Forestry

Inputs

Inputs for the forestry component include the time invested (in person-days) in technical training and in tree planting (see Table 1). Participation in technical training (including time spent as volunteer extension agents, and participating in field seminars and formal training events) was estimated to be 382 person-days in 1988. The effort invested in project training remained relatively constant from 1987 through 1990. It is assumed that this effort will remain at the same level in 1991. No technical training activities and no forestry activities were conducted in 1986.

Tree planting inputs are a function of the number of trees planted each year and the effort expended per tree. The number of trees planted from 1986 to 1990 are known from project records, as is the fact that the average amount of time required to plant an single tree is 4 minutes. The Project plans to plant a total of 100,000 trees in 1991. Due to significant effort at training farmers in low input tree propagation, the accessibility of seed, and a growing demand for tree seedlings and wood products, the authors estimate that approximately 10,000 trees will be planted per year following project termination. No maintenance or harvest inputs are assumed because of their low relative cost.

Outputs

The primary economic output of the forestry component is construction poles. The authors estimate that 25% of trees planted will survive until the fifth year after planting [note 5], all trees surviving after the fifth year will be harvested for posts, 50% of trees harvested will coppice, and each tree that has coppiced will be harvested for posts 4 years following the initial harvest. It is assumed that 40% of those trees will coppice again, and again be harvested after a further 4 years. It is further assumed that 30% of those trees will coppice and be harvested for a final time after an additional 4 years.

VALUE FLOWS OF INPUTS AND OUTPUTS

Project Agency Outlays

The Maissade Project was initially financed by USAID with a total of $900,000 for three years (August 1, 1985 to July 31, 1988). Based on the mid-term evaluation team's recommendation, the project received a no-cost extension of one year to July 31, 1989. Mid-way through fiscal year 1989, it was realized that substantial funds remained, potentially permitting another no-cost extension to July 1990. An additional $200,000 in local funds (PL480) was made available to SCF by USAID in February 1989 raising the total external financing cost to $1,100,000. In 1990

SCF planned to continue project operations at lower annual budget
levels, thus permitting project extension for a sixth year, to
July 1991 (see Table 2).

Table 2. Project Outlays ($1000/year)

Component	Year					
	1986	1987	1988	1989	1990	1991
Total Project Expenditure						
	90	140	200	250	220	200
Infrastructure						
	7.2	19.8	17.8	32.2	31.5	31.0
Animal Husbandry						
	7.2	6.3	17.8	18.7	18.0	17.5
Hillside Treatment						
	23.4	38.0	60.6	94.3	71.8	63.8
Ravine Treatment						
	7.2	6.3	30.3	36.6	40.4	35.9
Forestry	16.2	44.3	56.2	47.2	40.3	35.8
Group Investment						
	28.8	25.3	17.3	21.0	18.0	16.0

Note: All components include 15% overhead, 20% local
administration, and peasant organization and training costs.

Project expenditures on farmer organization and training
activities have been separated into the amounts supporting each
project component. Experience indicates that about 60% of all
expenditures for organization and training support technical
activities (20% for hillside treatment, 10% each for ravine
treatment, forestry, infrastructure, and animal husbandry), while
40% supports organizational goals (represented by the group
investment component). Since infrastructure development and
animal husbandry do not directly contribute to the benefits
included in this analysis, the direct costs of those components,
as well as the associated overhead (15%) and local administration
(20%) costs, have been subtracted from the total annual project
expenditures. What remains are the net expenditures on the
watershed management portion of the project. Project budgets
were used to disaggregate net watershed management expenditures
(comprised of salaries and materials) into separate components
(hillside treatment, ravine treatment, forestry, and group
investments). No outputs (benefits) are returned to the project.

Costs and Benefits for Project Participants

Group Investments

Costs of the group investment component (see Table 3) is derived
from the number of person-days invested (from Table 1) and the
opportunity cost of that labor (from Table 3). Benefits of the
component are represented by a percentage of the group investment

profits. Project records indicate that total group capital
equaled $2,600 in 1987, $6,400 in 1988, and $10,542 in 1989 (SCF
1988 and SCF 1990). The authors estimate that group capital will
grow 30% per year during the period of project intervention, and
10% per year thereafter. Group investments are assumed to be 10%
more productive than the average investments made by individual
farmers due to the lumpiness in investment opportunities. In
essence, it is assumed that without the project investments made
by individual group members would have produced 10% less capital.

Table 3. Economic Prices

Item	Price
Inputs:	
Unskilled labor	$0.60/day
Outputs:	
Corn	$0.22/kg
Sorghum	$0.26/kg
Rice	$0.88/kg
Wood Poles	$0.40/pole

Hillside Treatments

The aggregate cost of the hillside treatment activities is the
sum of costs of participation in training events, and the
establishment and maintenance of soil conservation measures.
Values presented in Table 4 are a product of economic prices
presented in Table 3 and the physical inputs of Table 1.
Aggregate benefits equal the financial value of increased
agricultural yields and are calculated using output prices
presented in Table 3.

Table 4. Value Flow: Participant Perspective

Item	Year				
	1	2	3	4	5
Costs					
Group Investment	167.6	335.2	670.3	703.8	739.0
Hillside Treatment					
Training	0	954.9	954.9	954.9	954.9
Construction	0	158.3	659.3	1170.0	1486.5
Maintenance	0	52.2	269.8	655.9	1146.
Ravine Treatment					
Training	0	572.9	572.9	572.9	572.9
Construction	0	60.0	164.6	192.0	243.6
Maintenance	0	18.0	67.4	125.0	198.1
Forestry					
Training	0	382.0	382.0	382.0	382.0
Tree planting	0	624	936	1170	741
Net Costs	168	3158	4677	5927	6464
Benefits					
Group Capital	0	260.0	640.0	1054.2	1370.5
Hillside Yields	0	3530	18516	46093	82936

Ravine Yields	0	176.0	658.9	1222.1	1936.7
Forestry Yields	0	0	0	0	0
Net Benefits	0	3966	19815	48369	86243
Net Returns	(168)	809	15138	42443	79779

Item	Year				
	6	7	8	9	10
Costs					
Group Investment	776.0	814.8	855.5	898.3	943.2
Hillside Treatment					
Training	954.9	0	0	0	0
Construction	1920.0	187.5	187.5	187.5	187.5
Maintenance	1780.0	1841.9	1903.8	1965.6	2027.5
Ravine Treatment					
Training	572.9	0	0	0	0
Construction	360.0	60.0	60.0	60.0	60.0
Maintenance	306.1	324.1	342.1	360.1	378.1
Forestry					
Training	382.0	0	0	0	0
Tree planting	780	78	78	78	78
Net Costs	7832	3306	3427	3550	3674
Benefits					
Group Capital	1781.6	1959.8	2155.7	2371.3	2608.4
Hillside Yields	132395	146929	161618	175669	188497
Ravine Yields	2992.7	3168.7	3344.7	3520.7	3696.7
Forestry Yields	0	8000	12000	15000	9500
Net Benefits	137169	160058	179118	196561	204302
Net Returns	129337	156751	175692	193012	200628

Item	Year			
	11	12-14	15-17	18-20
Costs				
Group Investment	990.4	1092.8	1265	1464.4
Hillside Treatment				
Training	0	0	0	0
Construction	187.5	187.5	187.5	187.5
Maintenance	2089.4	2213.1	2398.8	2584.4
Ravine Treatment				
Training	0	0	0	0
Construction	60.0	60.0	60.0	60.0
Maintenance	396.1	432.1	486.1	540.1
Forestry				
Training	0	0	0	0
Tree planting	78	78	78	78
Net Costs	3801	4064	4475	4914
Benefits				
Group Capital	2869.3	3482.3	4635.0	6169.2
Hillside Yields	199276	220956	249624	275688
Ravine Yields	3872.7	4224.7	4752.7	5280.7
Forestry Yields	14000	7083.3	7666.7	6233.3
Net Benefits	220018	235746	266678	293371
Net Returns	216217	231683	262203	288457

Note: For periods of combined years, average annual values are

displayed.

Ravine Treatments

Aggregate ravine treatment costs equal the sum of person-days
invested in technical training, and the construction and
maintenance of gully plugs. Values presented in Table 4 are a
product of physical inputs (Table 1) and their economic price
(Table 3). Increased rice yields represent benefits from
treatment.

Forestry

Forestry treatment costs are based on person-days invested in
technical training, the number of trees planted annually (Table
1), and the effort expended per tree. Component benefits are
based on the value of poles produced from the planted trees
(Table 3).

Results of the Economic Analysis

As stated in the introduction, the purpose of this analysis is to
answer the following questions:

* Is the project economically efficient at the aggregate level?
* Are each of the (quantified) project components economically
efficient?
* Is the aggregate project economically attractive to
participating peasants?
* Are each of the (quantified) project components economically
attractive to participating peasants?

Table 5. Measures of Economic Efficiency for the Aggregate
Project and for Each Component: Donor Perspective

Project Component	Net Present Value ($1,000)		
	8%	12%	16%
Aggregate Project	732.1	336.6	104.7
Hillside Treatment	1076	671.4	425.5
Ravine Treatment	-100.3	-94.5	-88.0
Forestry	-150.3	-149.1	-144.7
Group Investment	-93.2	-91.2	-88.2

Project Component	Benefit/Cost Ratio	Periods to Pay Back at Discout Rate (years)	Real Economic Rate of Return (%)
Aggregate Project	1.50	12	18.81
Hillside Treatment	3.46	7	41.05
Ravine Treatment	0.17	>19	Not Calculated

Forestry	0.19	>19	Not Calculated
Group Investment	0.15	>19	Not Calculated

Notes:
1. Benefit/Cost Ratio, Payback Periods, and Economic Rate of Return are based on a discount rate of 12%.
2. All values are in 1988 dollars.

The answers to these questions are discussed in the following section and are organized from both the donor and the peasant perspectives. In the donor perspective analysis, all costs (both those accrued by the project agency and participating peasants) are included. This analysis was conducted for the aggregate project (treating each project component as a separate input), and for each component (treating each component as a separate project with participant and project outlays as inputs). Only costs incurred by participants were included in the participant perspective analysis. This analysis was conducted for both the aggregate project (permitting comparison of the relative economic attractiveness of the different components) and for the separate components (permitting a more detailed analysis of activity costs and benefits).

Economic Efficiency From the Donor Perspective

Analysis of the Aggregate Project

The positive present net value (NPV) and the benefit/cost ratio of 1.5 indicate that, considering only the inputs and outputs quantified and included, the aggregate project is economically efficient (see Table 5). The aggregate project may be considered to be a desirable investment as long as the opportunity cost of capital (or the real interest rate) does not exceed the economic rate of return of 18.81% (see Table 5). Analysis of the sensitivity of NPV to 10% changes in input and output values demonstrates that the hillside component has the greatest influence upon the efficiency of the project (see Table 6). Overall, inputs have a fairly balanced impact on project outcome (they range from 10.70 to 27.28), whereas there is great disparity in the sensitivity of outcome to changes in the output values for the different project components (with a range of 1.58 to 94.42). Hillside benefits far outweigh those of ravine treatment, forestry, or group investment in terms of their affect on the economic efficiency of the aggregate project.

Table 6. Sensitivity of Aggregate Project NPV to 10% Changes in Inputs and Outputs: Donor Perspective

Project Component	Inputs ($1,000)	Outputs ($1,000)
Hillside Treatment	27.28	94.42
Ravine Treatment	11.41	1.95
Forestry	18.48	3.57

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Group Investment                      10.70                      1.58
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The sensitivity analysis also indicates that the value of project outputs and inputs would have to fluctuate to a far greater degree than 10% to drive NPV to zero. Therefore, the estimates of input and output values can deviate from actual values by an amount far exceeding 10% without significantly affecting the net outcome of the project.

In order to analyze each component as a separate project, project outlay costs were included in the separate component costs for the sensitivity analysis discussed above (and presented in Table 6). In addition to understanding relative component efficiency, donors might also be interested in knowing the relative weight of project outlays when compared to peasant inputs and net project returns. In this case, each component is treated as a different project input, as is project outlay. When project outlay costs are subtracted from component costs, the remaining value is that which is contributed by participating peasants. To better demonstrate performance sensitivity to specific changes in project outlay costs, another sensitivity analysis was conducted (see Table 7).

This analysis further demonstrates the prominence of hillside treatment relative to other peasant inputs in influencing project performance. This analysis also clearly indicates that project outlay cost and hillside treatment benefits are by far the two most important factors affecting project efficiency. All other inputs and outputs pale by comparison. It is also striking to note that project NPV is more sensitive to changes in hillside treatment outputs than to project outlay inputs. This indicates that hillside treatments are worthy of greater project investment.

Table 7. Sensitivity of Aggregate Project NPV to 10% Changes in Inputs and Outputs: Donor Perspective (With Project Outlay as a Separate Input)

Project Component	Inputs ($1,000)	Outputs ($1,000)
Peasant Inputs		
Hillside Treatment	1.82	94.42
Ravine Treatment	.50	1.95
Forestry	.47	3.57
Group Investment	.63	1.58
Agency Inputs		
Project Outlay	64.44	--

Analysis of Separate Project Components

Results of the analyses conducted for each separate component are
presented in Table 5. The benefit/cost ratio of 3.46 and
economic rate of return of 41.05 obtained for the hillside
treatment component demonstrate that it is economically efficient
and a good social investment. In fact, the returns to hillside
treatment are probably conservative. The figures used to predict
increases in corn and sorghum yield in the first year following
treatment were based on the lower of the two yield increase
figures obtained for each crop, not on either the average or the
higher of the two. Further, in determining the total number of
hedgerows and trash barriers constructed, project technicians
counted only those which had been constructed using a level. One
project document purported these "correctly constructed"
structures comprised only approximately 50% of all structures
built by peasants. Presumably, some of those not counted were at
least partially effective at reducing overland flow, causing
sediment deposition, and, consequently, increasing crop yields.
If included, then these "sub-optimal" structures might have
doubled project NPV.

Benefit/cost ratios for the other components are all well below
1, demonstrating that with the inputs and outputs quantified for
this analysis, these components are not independently
economically efficient. The high rate of return from hillside
treatments obviously makes up for the less productive components,
and drives the aggregate project measures positive. This poor
performance does not necessarily mean that these components are
not worthy of donor investment. It should be remembered that
only a portion of benefits from each component were quantified
(e.g., in addition to increased rice production, ravine
treatments permit the cultivation of other diverse, nutritious
and higher valued crops such as bananas and taro, and reduce
further loss of cultivable land to gully erosion). This analysis
does clearly indicate, though, that activities which enhance
agricultural productivity have a greater net benefit and internal
rate of return than ravine, forestry, and group economic
investment activities.

Table 8. Sensitivity of NPV for Separate Project Components to
10% Changes in Inputs and Outputs: Donor Perspective

	Hillside	Ravine	Forestry	Group Investment
	Component	Component	Component	Component
Costs				
Training	0.34	0.21	0.14	---
Establishment & Maintenance				
	1.47	0.29	0.33	0.63
Agency Outlay	25.46	10.91	18.01	10.07
Benefits	94.42	1.95	3.57	1.58

Notes:

1. Values are based on a real discount rate of 12%.
2. All values are in thousands of 1988 dollars.

Although the forestry component had the second highest
benefit/cost ratio (Table 5), that ratio was only marginally
greater than that for either the ravine treatment or group
investment components. Aggregate NPV was also more sensitive to
changes in forestry inputs and outputs than to changes in the
other two components (Table 6). It is clear that forestry inputs
were high relative to forestry outputs [note 6], and that the
bulk of forestry costs were born by the project agency, rather
than by peasants participating in the project. High project
outlay costs for the forestry component are due to the cost of
tree seedlings ($0.07/seedling), transport, and the salaries of
agency personnel concerned with the forestry component. Less
capital intensive methods ("i.e.", local production of seedlings,
use of low input propagation techniques, and less monitoring)
might have been more efficient, but would not necessarily have
achieved the same result of catalyzing local demand and
production.

The low value of poles ($0.40--Table 3) is also responsible for
the relatively low benefit/cost ratio of the forestry component.
Wood products are not scarce in the Maissade area; demand for
them has not risen significantly in recent years. In fact, there
is currently limited export of charcoal and high valued timber
from the region.

Analysis of the sensitivity of NPV to 10% changes in the values
of inputs and outputs for each of the separate project components
(Table 8) further reveals the relative importance the hillside
treatment component to the outcome of the overall project.
Although costs (project agency outlay, and the costs of training
and structure establishment and maintenance incurred by project
participants) are highest for the hillside treatment component,
they are still within approximately the same range as those for
each of the other three project components. By contrast, the
benefits obtained from the hillside component are far greater
than those for the other three components combined, exceeding
them by over 1,200%. Benefits from the hillside component are
approximately 2,500% higher than those from forestry, and almost
5,900% higher than those for group investment.

Table 9. Measures of Economic Efficiency for the Aggregate
Project and for Each Component: Participant Perspective

Project Component	Net Present Value ($1,000)		
	12%	24%	50%
Aggregate Project	981	384	101
Hillside Treatment	926	284	99.0
Ravine Treatment	14.6	5.1	.9
Forestry	31.0	8.4	.6
Group Investment	9.4	3.1	.5

Project Component	Benefit/Cost Ratio	Periods to Pay Back at Discount Rate (years)	Real Economic Rate of Return (%)
Aggregate Project	29.68	1	>200
Hillside Treatment	51.95	1	>200
Ravine Treatment	3.93	4	>200
Forestry	7.56	7	>200
Group Investment	2.49	4	87.9

Notes:
1. Benefit/Cost Ratio, Payback Periods, and Economic Rate of Return are based on a discount rate of 12%.
2. Values presented are in 1988 dollars.

Economic Efficiency From the Participant Perspective

Analysis of the Aggregate Project

Peasant participation in the project is economically efficient. This is clearly evidenced by the overall benefit/cost ratio of 29.68, and the economic rate of return of over 200% (see Table 9). Participation in project activities (in the form of labor) pays full return on investment within a year (at the 12% discount rate). This is important in light of the widely held belief that poor peasants place a much greater emphasis on obtaining returns on their investments in a short period of time than do wealthier individuals, and in light of the high usury rates (30% per month) common in the Maissade area. Capital is scarce, consistently so in the form of money, and at times in the form of labor, as well.

For this reason, discount rates of 24 and 50% were also used in the analysis. Interestingly, based on the assumptions made, the project provides adequate returns to peasant investment ("i.e.", is economically justified) even when analysis is performed using a 50% discount rate.

The sensitivity of aggregate project NPV to changes in input and output values is presented in Table 10. Again, project performance is most affected by changes in hillside treatment inputs and outputs. This activity is apparently a better use of peasant time in terms of potential to yield economic returns than are the ravine treatment, forestry, or group investment components.

Table 10. Sensitivity of Aggregate Project NPV to 10% Changes in Inputs and Outputs: Participant Perspective

Project Component	Inputs ($1,000)	Outputs ($1,000)
Hillside Treatment	1.82	94.42
Ravine Treatment	0.50	1.95
Forestry	0.47	3.57

Group Investment   0.63   1.58

Notes:
1. Values are base on a real discount rate of 12%.
2. All values are in 1988 dollars.

Analysis of Each Separate Project Component

Measures of the economic efficiency of each separate component
are presented in Table 9. From the perspective of project
participants hillside treatments show the greatest benefit/cost
ratio (51.95), paying back investment within one year.
Investment in forestry activities has the second highest ratio
(7.56), but requires seven years for a full return on
investments. It may be noted that this is so despite the fact
that during the course of the project peasants receive seedlings
for free, and thus incur none of the costs of tree production
other than their time invested in training and their labor
invested in planting. Investments in both ravine treatment and
group investment activities show lower benefit/cost ratios than
forestry, but pay back within four years.

As was the case for the donor's perspective, sensitivity analysis
conducted for each individual project component further
demonstrates that investment in hillside treatment ("i.e.",
participation in training activities, and the establishment and
maintenance of structures) yields the greatest relative return
(see Table 11). It is clear that the dominant element in this
economic analysis, and hence in the success of the project, is
the hillside treatment component of the project.

Table 11. Sensitivity of NPV for Separate Project Components to
10% Changes in Inputs & Outputs: Participant Perspective

	Hillside Component	Ravine Component	Forestry Component	Group Investment Component
Costs				
Training	0.34	0.21	0.14	---
Establishment & Maintenance				
	1.47	0.29	0.33	0.63
Benefits	94.42	1.95	3.57	1.58

Notes:
1. Values are based on a real discount rate of 12%.
2. All values are in thousands of 1988 dollars.

CONCLUSIONS

Throughout this analysis, estimates of project benefits are
conservative, whereas, by contrast, estimates of costs are

relatively realistic. On top of that, only a portion of all
project benefits have been analyzed. Therefore, it is likely
that the true aggregate NPV of the project (from the donor
perspective) is actually greater than that calculated ($336,600
at a 12% discount rate) and that the true benefit/cost ratio
(also from the donor perspective) is wider than that presented
(1.5). Analyzed separately, the hillside treatment component is
economically efficient while the other components (forestry,
ravine treatment, and group investments) are not. As the
sensitivity analyses demonstrate, project outcomes are most
sensitive to changes in project outlay inputs and hillside
treatment benefits.

Both the aggregate project and all separate project components
are economically efficient from the perspective of project
participants, and all but the group investment component have
internal rates of return exceeding 200%. Investment in hillside
treatment yielded what was by far the greatest return.

Investment in activities which serve to increase agricultural
production ("i.e.", hillside and ravine treatments) appears
substantially more worthwhile in economic terms than does
investment in forestry activities. As these sorts of treatments
also appear to achieve more in terms of environmental protection
than the forestry treatments employed in this project, the
results of this analysis strongly suggest that project efforts
should place more of an emphasis on environmentally protective
and sustainable agricultural production [note 7] than on forestry
activities.

This analysis also demonstrates that the fiscally conservative
low profile approach to watershed management, emphasizing peasant
organization and training, employed in the Maissade Integrated
Watershed Management Project, can be economically efficient.
Similar economic analyses of other watershed management projects
and strategies utilized in Haiti should be conducted to permit a
comparative evaluation.

APPENDIX

Annex 1: Physical Flow Calculations [note 8]

Participation in Technical Training

1) Participation in technical seminars in 1988:
(175 seminars x 3 hr/seminar x 15 participants/seminar)/
(5 hr/person-day) = 1575 person-days

2) Volunteer extension agents:
(20 volunteers x 36 wk/yr x 3 hr/wk)/(5 hr/person-day) =
432 person-days/year

3) Participation in formal training:
(196 participants x 30 hr/participant/yr)/(5 hr/person-day) =
1176 person-days/year

4) Total technical participation in 1988 = 3183 person-days

Group Investments Inputs

1) Group investments in 1988:
(1862 meetings x 1.5 hr/meeting x 8 participants x 0.25)/
(5 hr/person-day) = 1117 person-days

Hillside Treatment Inputs and Outputs

Table A1. Hillside Treatments Implemented Each Year (SCF 1988
and SCF 1990)

Structure Type	Quantities Constructed by Year [note a]					
	1986	1987	1988	1989	1990	1991
trash barrier	0	20,280	91,866	150,000 [note b]	200,000 [note b]	250,000 [note b]
hedgerow	0	4,160	6,568	25,000 [note b]	43,167	65,000 [note b]
rock wall	0	2000 [note b]	11,486	20,000 [note b]	4,545	5,000 [note b]
total	0	26,440	109,920	195,000	247,712	320,000
total hectares [note c]	0	21.1	87.9	156.0	198.2	256.0

Notes:
a. Presented in linear meters.
b. Project data not available, authors' projection.
c. Based on 1250 linear meters per treated hectare.

1) Contour structure establishment requires 3 minutes/linear
meter. With an inter-row spacing of 8 meters, 1250 linear meters
were treated per hectare.
(3 min/linear m x 1250 linear m/ha)/(60 min/hr x 5 hr/person-day)
= 12.5 person-days/treated hectare.

2) Annual maintenance includes hedgerow lopping and trash barrier
reconstruction. These tasks are estimated to require 33% of
establishment effort.

Annex 2: Description of Treatments

Hillside Treatments

Hillside treatments include trash barriers, hedgerows, and rock walls, with trash barriers and hedgerows frequently implemented together. All three structures are established on the contour with an average spacing of 8 meters between structures. Surveying is accomplished with the use of an A-frame level.

Trash barriers are established by digging a ditch approximately 20 cm. deep, piling the soil into a ridge downslope. Stakes are placed approximately 10 cm. upslope of the of the ditch and crop residue ("e.g.", corn and sorghum stalks) is piled perpendicular to, and upslope of the stakes. Another ditch is dug upslope to the trash barrier and the soil is piled over the barrier. This is done to make the barrier less permeable to water flow, as well as to keep rats from nesting in the barrier. Such barriers require annual repair and reconstruction.

If a hedgerow is established in conjunction with the trash barrier "Leucaena leucocephala" seed (at the rate of approximately 100 seeds/m.) is planted on the upslope side of the ridge formed downslope of the first ditch. In the second year after establishment, instead of repairing the trash barrier in place, crop residue is piled directly against the leucaena and the stalks used the previous year are removed or allowed to decay in place. Soil is piled over the trash barrier as before. Annual maintenance is also required.

Ravine Treatments

Ravine treatments include: trash barriers with support stakes capable of reproducing vegetatively; hedgerows of "Leucaena leucocephala, Pennisetum purporeum", and "Saccharum officinarum;" and rock checkdams. To improve structure efficiency and durability, more than one treatment is often implemented at a given site.

The structures average 0.75 meters in height and 3 meters in width. On an annual basis, approximately 30% of the structures require reconstruction following the rainy season. All structures require some annual maintenance. The non-vegetative portion of the structure ("i.e.", trash barrier or rock checkdam) is normally constructed during the dry season. If stakes which propagate vegetatively are used, these too are planted towards the end of the dry season. "Pennisetum" and "Saccharum" hedges may be planted downslope of the non-vegetative barrier at any time during the rainy season. If "Leucaena" is planted, seeds are planted towards the end of the rainy season, after high flows have subsided, but before the ravine dries out.

Forestry

The forestry component of the project aimed at encouraging the planting of trees along property boundaries. Species used

include: the indigenous "Catalpa longissima, Columbrina
arborescens," and "Simaruba glauca"; and the exotics "Cassia
siamea, Azadirachta indica", and "Acacia auriculiformis."

Group Investments

The two most common types of group investment were in animal
husbandry and the marketing of agricultural products. Swine
production was an important activity, in which piglets were
farrowed and sold. Marketing was mostly grains and beans, grown
or purchased and stored till the market price reached an
acceptable level.

NOTES

1. Calculations were performed using the Cash Flow and
Sensitivity Analysis Program (CASH) developed by M.L. Belli, D.W.
Rose, C.R. Blinn, and K. Ho, Department of Forest Resources,
University of Minnesota.

2. "Groupement" are pre-cooperative peasant groups based on
traditional social linkages. The groups commonly engage in
collective social and economic activities and average eight
members.

3. "Lumpiness" refers to situations in which certain, presumably
significant, levels of capital are required for investment in a
given activity, and incremental units below that level cannot be
purchased. Investment in cattle, for example, requires the
purchase of at least one animal.

4. For details on the methods of establishment and maintenance
see Annex 2.

5. Average nine-month survival is 53% (SCF 1990).

6. It may be noted that, in this analysis, the benefit flow from
the forestry component was arbitrarily cut off 20 years after the
initiation of the project, despite the fact that benefits from
forestry activities continued to accrue for 17 years beyond that
without further cost. To see the impact of that decision on the
analysis, the data for the entire 37 year period were analyzed.
The resulting benefit/cost ratio was 0.20, and the sensitivity of
NPV to 10% changes in input and output values, -$1469. The fact
that these values differ only slightly from those obtained for
the 20 year period suggests that the decision to analyze only 20
years of data in no way affected the results of the analysis.

7. It should be noted that such an emphasis may be compatible
with, or very likely require, the use of agroforestry systems.
It is not being suggested here that trees are irrelevant, or even

unnecessary, to the achievement of watershed management goals in Haiti. Indeed hillside treatments in the Maissade Project make integral use of trees. Rather, the results of this analysis suggest that the use of trees within agricultural systems, both for environmental protection and to improve agricultural production, may be their most economically advantageous use.

8. The sources for these data are SCF 1988 and SCF 1989.

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