HAITI AGROFORESTRY RESEARCH PROJECT

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ECONOMIC INDICATORS OF AGROFORESTRY II STRATEGY IMPLEMENTATION: FARM INCOME ANALYSIS TO AGRICULTURAL PROJECT ANALYSIS

by

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EXECUTIVE SUMMARY

The strategy of the Agroforestry II Project (AFII) is to bring about sustainable improvements in Haitian hillside farm productivity and farmer net income. AFII and the previous agroforestry program are widely acknowledged as the most successful agroforestry efforts of their kind. However, the project implementation is being reoriented to incorporate a more economic perspective, to consider the sustainability and economic implications of the well documented intervention activities. The purpose of this study is to develop the indicators of economic impact outlined earlier by Karch (1991). He recognized two levels at which one could appropriately measure economic impact: the project level and the farm level.

The fundamental problem at the project level is to develop economic coefficients to transform the existing activity reporting into economic indicators of strategic progress. The farm level challenge is to develop case studies which articulate the economic dynamic of the complex agroforestry land use systems. Both problems are resolved by developing economic models which capture the multifarious interactions and express extension and on-farm activities as economic indicators of progress toward achieving the goal of increased farm productivity and profitability. Ultimately, the two models are closely related. Farm case studies, to the extent that they are representative, can feed directly into the overall project analysis.

Results of the project model are presented as a comprehensive financial and economic projection of AFII (amended). Results of the farm financial model illustrate how net farm income can be readily comprehended, accurately monitored, and expressed in a standardized format, making financial results comparable over time and across regions. The farm case model also functions as an effective on-farm planning tool for more in-depth economic decision-making. Recommendations are offered to provide ways in which economic concerns can be integrated into a successful agroforestry extension program, supplementing an already strong bio-physical focus.

REZIME EKZEKITIF

Plan Pwojé Agwoforestri II (AFII) sé pou poté pi bon randman nan sak kap pwodi nan fémm Haytien ak bénéfis fémié-yo fé. Moun rekonét AFII ak ansien pwogram Agroforestri kom pwogram ki remét ampil randman. Cépandan, bi pwojé-a ap chanjé route pou'l ka gen yon aspé ékonomik kap konsidéré implikasyon ékonomik ak jan yo ka kimbé nan plizié aktivité. Bi étid si-la sé pou dévelopé plizié pouen ékonomik ki gen yon inflians nan zafé vi péyzan an ké Karch té diskité déja (1991). Karch rekonét dé (2) nivo li ka méziré inflians ékonomik lan gen sou péyzan-yo: nivo pwojé-a ak nivo fémm-yo.

Pwoblém ki impotan nan nivo pwojé-a sé pou dévelopé plizié koèfisyan ékonomik kap transfomé aktivité ki èkzisté-yo nan plizié pouen ékonomik. Pou nivo fémm-yo, sé pou dévelopé kék ekzamp modél kap démontrè dinamik ékonomik nan sistém komplex Agwoforestri nan travay fémm. Tou dé (2) pwoblem-yo jouen solisyon-yo nan dévelopman model ékonomik kap gen plizié intéraksyon. Solisyon sa-yo ekxprimè tout ekxtansyon ak aktivité nan jadin kom pouen ékonomik pou rivé nan bi ki ogmanté pwodiksyon ak bénéfis nan fémm péyzan-yo. Si ou gadé byen, tout dé (2) model-yo samblé tankou dé (2) gout dlo. Jadin ki sévi kom ekzamp model ka sévi direk kom enfomasyon nan analiz général pwojé-a nan yon nivo asé representatif.

Prézantasyon rézilta pwojé si-la parét sou yon fóm de pwojeksyon finansyel ak ékonomik AFII (korijé). Rézilta étid finansyel ki té fét nan chaq fémm té démontré ki jan net revenue ka fasilman komprann, kontwolé korekteman ak eksprimé nan yon fóma ki nomal ki fé rézilta finansyel-yo, nan tout temp ak nan tout zón, komparab. Ka model fémm-yo travay komm zouti éfektif dé planifikasyon nan fémm-yo pou pran gwo désizyon ékonomik. Nou bay konsey ak rekomandasyon nan bagay ékonomik kap rentré nan réyisit yon pwogram d'extensyon d'Agwoforestri, kap ajouté nan yon vue bio-physik ki solid tankou roch.

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Kent D. Fleming and G. Edward Karch[1]

I. INTRODUCTION

The primary goal of the amended Agro-Forestry II Project (AFIIa) is to bring about sustainable improvements in Haitian hillside farm productivity and hill farmer net cash income. An analysis of the financial and economic impact of the whole project involves an assessment of the aggregated increases in sustainable productivity and income resulting from AFIIa interventions. Project level financial analysis implies farm level financial analysis. The pertinent indicator of project impact is change in farm production and producer net income, the elemental unit of analysis is the farm entity, and the appropriate method of analysis is a financial case study of the farm (Scherr and Muller, 1991). This paper reports on the development of project and farm level agroforestry strategy implementation indicators in the form of two economic models[2].

This study should be read within the context of Karch, "Haiti Agroforestry II Project Economic Indicator Analysis" (1991). Karch outlines five different levels or "checkpoints" from which the project's impacts, as opposed to activities, can be observed and measured. Direct measurement of impacts are feasible on two elevations of the framework: Level III, the project level adoption of interventions, and Level I, the farm level actions. The project level is where almost all monitoring of activities has been occurring. Multiplying the existing activity indicators by an income index transforms them into financial and economic impact indicators.

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[1] Agricultural Economist and Agroforestry Economist, respectively.

[2] The two economic models developed by this study are Lotus 123 "spreadsheet" templates. A spreadsheet is simply a matrix of cells created by overlapping rows and columns, similar to graph paper. Data, text, or formulas can be entered into the cells. Formulas referring to data in the cells, will be recalculated whenever the data is changed. One of the major advantages of using the spreadsheet format for economic models is transparency. With transparent models the user can see how any particular result is calculated. In contrast, "black box" models use a program written in code and unavailable to the user, ask for input, and then provide a result.

The farm level ("Level I") offers the most direct view of economic impacts, but this level presents great measurement difficulties. Accurate, methodical, timely accounting of all financial and production inputs and outputs would satisfy the measurement needs, but this approach is neither "economically nor socially feasible in Haiti" (Karch, 1991, p. 3)[3]. Surveys are an alternative to direct accounting procedures, but they also have a number of inherent weaknesses. If they are to provide reliable, timely data, they are extremely difficult to perform properly, they are expensive and time-consuming, and they cannot be performed on an on-going basis (Scherr and Muller, 1991). Karch (1991) identified Level I indicators currently being used by the project. These include extension, training, and on-site demonstration activities. Karch also proposed that "snapshot studies" or farm case studies be utilized to determine farm-level economic impacts of interventions, such as hedgerow establishment. This paper critiques existing financial case studies of agroforestry interventions and develops an alternative methodology to perform critically important farm level financial analyses.

The methodology developed depends on a strong extension component and the recommendations in this study assume that this institution has been developed. This assumption appears reasonable based on our field observations in both the northwest (the area in which CARE operates) and the south (the area in which the Pan-American Development Fund (PADF) operates). The rapport between extension staff and farmers appears to be excellent. Over the past ten years[4] CARE and PADF, along with SECID[5], the primary research component of the project, have developed an excellent research-extension delivery system[6]. Wherever we went with extension staff, we were able to meet and to talk openly with the farmers. Staff and

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[3] Indeed, even in more advanced commercial agricultural economies, such as the U.S., it is estimated that less than 5% of all commercial producers keep adequate financial and production records.

[4] The initial agro-forestry project was the Agroforestry Outreach Project (AOP), starting in 1981 and concluding in December 1989. The AOP was replaced by the Agro-Forestry II (AFII) project in January 1990.

[5] The Southeast Consortium for International Development/Auburn University.

[6] Based on comprehensive experience with other agricultural extension systems, we believe that the system now in place would be the envy of many countries far more developed than Haiti.

farmers were very positive about AFII[7] and felt intuitively that farmers had benefitted. However, little effort had been made to quantify the farm-level economic benefits.

Project emphasis until now has clearly been on bio-physical production aspects as opposed to economic considerations. A reflection of this problem is that none of the published research adequately documents farm-level economic impacts. The current study recommends that a strong economic component be injected into both the on-going project reporting and the research-extension activities. This study provides two economic models to help accomplish this task.

One reason the economic component has been weak, is the inherent difficulty of visualizing project bio-physical intervention in terms of the economics associated with on-farm implementation. Project level reporting has not been, but needs to be, expressed as economic impact. The project model developed will facilitate reporting the economic impact of activities. At the farm level the failure to report economic impact stems from the inadequate research/extension attention to the economics of on-farm production and marketing. The on-farm economic model offers a methodical, analytical approach to the whole-farm analysis of the agro-forestry land-use systems under consideration. Use of the model can facilitate rapid financial appraisals of specific farm interventions and provide concise but comprehensive summary budgets in a standard format.[8]

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[7] While the current analysis is primarily a projection of the impact of AFIIa, obviously all of our farm visits were observations of impacts of AOP and AFII interventions.

[8] The farm financial model offers two practical benefits. First, an individual farm can be considered "as is" before intervention and then reconsidered as it would be in a few years after the intervention. If the farm already had incorporated the improved practice, it could be analyzed as it now is. It could then be compared either to how it would have been had the farmer not adopted the recommended practice or to another local farm not practicing the intervention. In either case, the financial benefits would be graphically demonstrated for farmer, agent, project administrator, and donor.

A second important potential benefit of using a model is access to a group of comparable case studies. The case studies of similar farms can be used to develop a set of production and financial "benchmarks." When farms are analyzed in a similar manner and described according to a standard format, they will have a common denominator and be comparable. Over time a set of production and financial expectations will emerge. All parties involved will come to view farms similarly for financial purposes, and the project's economic and financial impacts will

II. PREVIOUS WORK

Karch (1991) reviewed the literature relevant to the overall development of AFIIa project indicators. SECID has published two sets of financial case studies (Bellerive, 1991 ; Street, et al., 1990) relevant to farm-level economic indicators of changes in Haitian hillside farm productivity and producer income. The economists who undertook to develop these case studies attempted an important but difficult task. However, as Karch noted, they largely failed in their efforts. This section of the study provides: (a) a review of the "component" literature, studies which can contribute to the development of a Haitian hill farm financial case studies, and (b) a critique of the two existing farm case studies. The critique is intended to clarify the direction AFIIa should take regarding farm level economic indicators.

A. Component studies:

Component studies examine the costs associated with one of the elements of a farming system. An example of a component study is the analysis of the maize production segment of a mixed crop and livestock farming system or the marketing phase of a charcoal operation. SECID has published three component studies directly relevant to the development of whole-farm analyses (Street, 1989a; Street, 1989b; Street & Bellerive, 1989). The first of these is a general socio-economic study, but it includes useful information about labor profiles. The second study is a valuable study of charcoal marketing costs. The third study examines the marketing aspects of the pole industry. These three studies are particularly worthwhile because they are based on empirical research.

Much of the economic work conducted under AID's Agricultural Development Support II (ADS-II) project during the mid-1980's, relates to the formation of an economic model of the hillside farm. The ADS-II project's agricultural economics/farm management module functioned for less than a year and it focused on conditions in the south, but it achieved a great deal in terms of generating cost of production (COP) research results. These COP budgets are reported in Taylor (1984). The budgets must be used with caution because the projected results are to a degree region specific, but the format is sound regardless of the site. These budgets and those produced by other members of the ADS-II team (e.g., Pierre, 1987), when adjusted for location, can feed into an economic model of a hillside farm.

B. Farm case studies:

Case studies of on-farm activities are the foundation of a whole-farm financial analysis. Partial budgeting or enterprise

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become more readily apparent and more easily and accurately described.

cost-benefit exercises are useful to the extent that they provide specific data on the costs and returns. They are inevitably limited because they examine only one ingredient of the total system. Considering the importance of changes in farm productivity and income as indicators for evaluation of project impact, there is a dearth of empirical economic research. Case studies (Bellerive, 1991; Street,et al., 1990) appraise 14 of the 250,000 farms which have been involved with one or more agroforestry extension interventions over the past ten years.

1. Bellerive, P.A. (1991) "A Financial Analysis of Selected Hedgerow Operations in Haiti's Southern and Northwestern Regions."

These case studies are fraught with a wide range of methodological and data collection and presentation problems. The overall study reveals a fundamental misunderstanding of the purpose and implementation of the NPV method. Nine farms were visited, but it is impossible, from the data collected, to determine past, present, or future production or income of any of these farms. These studies were not intended to consider whole farm income, but of course that is exactly the source of their predicament. The nature and severity of these problems will be apparent from a cursory review of the first two cases.

<u>Case 1: Nan Suzan Farm (Table 1)</u>: We are told that the farm is 806 square meters, and that production consists of 279.1 meters of Leucaena hedgerows intercropped with a maize-pigeon pea mix. Hedgerows are arranged in "four rows at five meters each," so presumably we are already up to 1395 square meters (279 * 5).

One cycle[9] of maize returns are reported to be $25.00. With only 526 square meters available, the yield from one season of maize alone appears to be over two tons per hectare ($25/$0.22 = 114 kgs. of maize and 114 kgs. divided by 526/10,000 ha. = 2,167 kgs/ha.) Two tons is absurdly high for a hill farm with reportedly "low fertility" and a very low seeding rate.[10] The farmer also has

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[9] It is unclear how many cycles there are per year. If there is only one, this fact should be stated. If there are more than one, as is often the case, the number should be stated and the income calculated.

[10] The person collecting the on-farm data must have realized as the farmer spoke that something was not quite right. The researcher must have known as he performed his analysis and wrote his report that his results were impossible. And yet no one questioned this information, and it has consequently been published as serious economic research. Should this research be used to confirm that the introduction of hedgerows increased productivity and farmer income? If the interviewer/researcher had

pigs, but we are not told how many. Therefore it will be impossible to calculate the feed requirements, the income from this enterprise, or the fodder value of the Leucaena.

Variable costs are fairly straight forward. Since the maize planting costs involve only maize seed and labor, and since the seed cost is reported to be $1 and the total planting cost is $2, labor must be $1 or about one man-day (about 5 hours.) Land preparation, weeding, and harvesting labor brings the total variable costs to $15.00.

TABLE 1. Bellerive (1991) Table 1 reproduced.

Net Present Value (NPV) for the Nan Suzan Farm at a 30 Percent Discount Rate for Maize Production. (Values in Dollars)

Year	Cost	Benefit	P.V.Cost	P.V.Benefit	Net P.V.Benefit
0	180.00	0.00	180.00	0.00	(180.00)
1	18.00	90.00	13.85	69.23	55.38
2	21.60	108.00	12.78	63.91	51.12
3	25.92	129.60	11.80	58.99	47.19
4	31.10	155.52	10.89	54.45	43.57
5	37.32	186.62	10.05	50.26	40.21
6	44.79	223.95	9.28	46.40	37.12
7	53.75	268.74	8.57	42.83	34.26
8	64.50	322.49	7.91	39.53	31.63
9	77.40	386.98	7.30	36.49	29.19
10	92.88	464.38	6.74	33.69	26.95
11	111.45	557.26	6.22	31.09	24.88
12	133.74	668.71	5.74	28.70	22.96
13	160.49	802.45	5.30	26.49	21.20
14	192.59	962.94	4.89	24.46	19.57
15	231.11	1155.53	4.52	22.58	18.06
16	277.33	1386.63	4.17	20.84	16.67
				NPV	339.95

Land is figuratively "purchased" in the first year, but since it is not "sold" at the end of the project, it presents problems of interpretation. First, the land is obviously used for other enterprises, such as the pigs. It was not in fact purchased literally for the hedgerows, so it is a "committed" or "sunk" cost.

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access to this model, he/they would have known immediately that the data input was incorrect. With the model in mind the results could have been estimated before the farmer finished providing his on-farm data.

(Alpin, et al., 1972) Second, Bellerive states that the opportunity cost of the land was zero, so he could not have intended the $100 to be an opportunity cost (Alpin, et al., 1972), and in any case he needs to account for it at the end of the project, i.e., in 16 years. (As will be noted later in the methodology section, the land investment problem can be simplified by treating net income as a return to land.)

The actual total investment for the purposes of the investment analysis consists of the cost of labor to plant the hedgerows in year zero. Unfortunately, given the data from the single observation of hedgerow planting (Bellerive, 1991, p. 4), the cost could be either $0.20/meter or $0.29/meter. At $1.00 per five hour day, or $0.20 per hour per man, this rate would be equivalent to 0.7 to 1.0 meter per hour per man. In either case this cost appears high. PADF (1991) reports that hedgerows are planted at the rate of 5 meters per hour per man ($0.04/meter), and CARE (1991) reports a rate of 20 meters per hour per man ($0.01/meter.) This case study may be overstating the cost by a factor of 29[11]. This relatively high rate is utilized throughout the nine case studies, compounding the problem of basing an entire study on a sample of one observation.

Initial year costs and returns were $15 and $79 respectively. Presumably the intercrop is also planted in the first year, but curiously there is no crop income. However, there are far more serious problems. In the process of being entered but before they are discounted, the costs and returns become inflated by 20% for no apparent reason. Equally surprising is that both income and expenses continue to increase at this arbitrary rate for each of the subsequent 15 years. Is the 20% intended to reflect the inflation rate for the next 16 years? We are never told, but regardless, we have a problem. If there is also to be a precisely equal appreciation rate, as suggested here, then the two events would cancel out and should not have been reported. Since inflation has already been accounted for in the 30% discount rate, raising the costs and benefits by 20% in effect discounts the resulting stream of cash flows by only about 10%.

Benefits are limited to the savings on pig feed ($54) and the sale of maize ($25), including the maize produced for home consumption. It would have been preferable to express the value of the Leucaena as a function of (a) the value of pigs, and (b) the nutritive value to the hedgerow clippings and intercrop residual. A whole farm approach, as opposed to looking at the

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[11] Technically, the cost of seed should also be included in order to determine the complete cost per meter of hedgerow establishment. PADF is planting about 100 seeds per meter with the hope that 50 will become established. CARE plants up to double this amount.

hedgerow intercrop enterprise alone, would better enable one to capture the interactive benefits of agroforestry.

A complex system has been portrayed as a simple production situation. The analytical advantage is that a condition has been created which is nothing more than an annuity problem. However, the simplicity has been obscured by the convoluted process of adjusting all the costs and returns. Table 1 is unnecessarily confusing and methodologically incorrect. Table 2 below provides the corrected NPV with a concise illustration of the process for calculating the NPV. The original data is utilized in this calculation.

TABLE 2. Corrected NPV of Hedgerow-Intercropping Intervention (based on data from Bellerive, 1991.)

Year 1 - 16:	Annual benefit	$79
Year 1 - 16:	Annual cost	-15

FV of annual net benefits (years 1 -16) =		$54/year
PV of stream of net benefits discounted @ 30% =	3.2832 * $54 =	$177.29
less initial investment:		80.00

NPV of investment in hedgerow-intercropping =		$97.29

It is not immediately apparent how the result of the analysis should be interpreted. We are told that "hedgerows make a substantial profit for the farmer" (Bellerive, 1991, p. 9). On an annualized basis this "substantial profit" is $6.07/year ($97.29/16 years), not really that substantial or impressive.

It is interesting to note that if the land cost were considered as it is in Table 1, the NPV would have been negative. On the other hand, if we leave the land price out, as we should, and use CARE's establishment cost, the NPV is $174.50 ($177.29 - $2.79). Now the value of hedgerows has only been overstated by a factor of two. Ultimately, if we were to continue in this vein and were to include all of the actual benefits and costs of Leucaena, we might well conclude that the NPV of the hedgerow is in fact close to the $340 originally reported.

This wide discrepancy between the case study estimates and the corrected calculations, becomes particularly significant for project-level analysis. A project's anticipated outcomes will differ, to the degree of the multiplier effect, depending on which farm level result is considered to be representative. The point of this critique is not that hedgerows may have been overvalued in this instance, but rather that questionable methodology and data quality will preclude credibility for <u>any</u> conclusion generated by this quality of farm-level analysis.

Can the farmer relate to the case farm results? Understandably, these farmers are extremely focused on current cash flows. A farmer's planning horizon is shortened in proportion to short-term survival needs. One should not underestimate the degree to which these producers are market-oriented, rational economic decision-makers. But given their orientation, they are not going to be giving a great deal of attention to breaking even in year four or to the NPV of 16 year capital investment decisions. Economic decisions will be more influenced by immediate returns from relatively low risk operations. The economic model will provide more relevant information for making farm-level economic decisions.

This case study is a classic example of how one can become confounded by an elementary discounted cash flow (DCF) problem when one is unclear about the fundamentals of investment analysis. For our purposes it is also a sad commentary on how limited research resources can be squandered when one does not have a clear vision of which methodology needs to be utilized and what data needs to be collected. Hopefully, an economic model can provide the necessary guidance to prevent this lamentable waste.

<u>Farm case 2: Madeque Farm</u>: The NPV of hedgerows is again incorrect[12]. However, this case adds another error to the inventory of miscalculations. In the previous case the opportunity cost was

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[12] In order to avoid again referring to the fundamental methodological errors of Bellerive's study, we can quickly recalculate the NPV's, given his admittedly unreliable data:

TABLE 3. Corrected NPVs of Bellerive (1991).

Case:	B	-	C	=	FV of NB * 3.2832 =	PV of NB	-	INVEST.	=	NPV
1	$79	-	15	=	$54	$177.29	-	80	=	$97.29
2	211.60	-	30	=	181.60	596.23	-	57.50	=	538.73
3	110	-	26	=	74	242.96	-	44.66	=	198.30
4	113	-	47	=	66	216.69	-	33.25	=	183.44
5	57.20	-	18	=	39.20	128.70	-	19.20	=	109.50
6	33	-	11	=	22	72.23	-	27.43	=	44.80
7	84	-	29	=	54	180.58	-	46.30	=	134.28
8	30	-	5	=	25	82.08	-	15.84	=	66.24
9	4	-	4	=	0	0.00	-	9.77	=	(9.77)
AVE.=	80.20	-	20.55	=	59.64	195.82	-	37.11	=	158.71

assumed to be zero. In this case it is calculated to be $10. The $10 is correctly recognized as a cost and deducted in the first year. However, it is never deducted again. This cost does not disappear and must be deducted in each of the subsequent years (Alpin, et al., 1972).

Problems in the collection of relevant, reliable data are again evident in the land area measurement effort. It is incorrect to assume, as is apparently done in these case studies, that we are only attempting to measure increases in gross farm productivity and that assessing the productive land area is some how secondary. If we make this assumption, production per farm could be increased simply by enlarging or merging farms. Net income could be raised simply by raising product prices or lowering input costs. Farm-level results which are not expressed in productivity or net income per unit of land will not be as useful for project-level analysis. Given the limited land resource, the intent of the AFIIa project is to increase productivity and income per unit of land. Therefore, income should be viewed as a return to the most limiting resource, land. The actual area of productive or potentially productive land is required to make sensible projections of improved productivity and income.

The second case farm begins by reporting that the area could not be determined because the farmer failed "to volunteer" the information. In that case it would be useful to <u>ask</u> the farmer the size. If he did not know the area (unlikely), one could measure it for one's self. If he refused to allow one to calculate this data, one might seriously question whether this farmer is the type of person with whom we should be working.

Similar data collection and methodological problems recur throughout the remaining seven case farms of this study. The increased effort to collect the essential data for a whole farm analysis would have been minimal. This data could then have been used for a variety of analyses, all of which would have been more useful and of greater interest.

2. Street, D.R., A.G. Hunter and P.A. Bellerive (1990)
   "Tree Operations in Haiti's Northwest and
   Central Plateau"

The published results of the Street study are clearly expressed, reveal a genuine concern with the quality of the data, and are not burdened by arithmetic errors. The Street study also contains fewer conceptual problems. For example, the "purchase" of land is not included in the NPV calculations, farmers on these farms incur costs upon planting, and the opportunity cost is calculated meticulously and utilized correctly.[13]

However, the two studies do share a major problem: costs and returns are inflated by 20% for no apparent reason. Again, this approach leads to unnecessary confusion and to varying degrees of distortion. For example, the case of neem borders in Mirebalais utilized for poles (Street, et al., 1990, Table 3, p. 15) is calculated to be the most profitable pole operation sampled. If we ignore the redundant 20% adjustments, the NPV is not $119.60, as reported but rather $22.75. The difference, given the case data, is a five-fold overstatement of the actual benefit. The effective discount rate is not 30%, as claimed, but only about 10%. Consequently, some of the scenarios that are portrayed as having positive NPVs, can in fact become negative, and all are closer to being negative than one is led to believe. As a further example, the subsequent case (Street, 1990, Table 4) is depicted as having an NPV of $27.91 when in fact it is just under $11.00.

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[13] One serious problem shared with the Bellerive study, is the failure to clear establish the area of production. The opportunity cost is based on one hectare. But it is unclear how large the actual field is. If the NPV is meant to be on a per hectare basis, as we assume it must be, then this assumption needs to be stated explicitly.

III. METHODOLOGY

A. Economic and Financial Analysis of the Reoriented Project:

The methodology utilized to produce the project analysis is to convert the reported project activities into economic impacts. This procedure requires economic coefficients for each of the agroforestry interventions. The coefficients were developed from a wide range of data sources. Collecting reliable, useful data is always a major concern, but it is particularly difficult in this instance because economic impacts have only recently been emphasized. Unfortunately, farm case studies, an obvious starting point, were not available as a useable resource.

The analysis itself follows the approach outlined in AID Handbook Three (USAID, 1987). Net benefits were calculated for each practice for the various participants: farmers, project donor, and society. These benefits were projected for 20 years, and then discounted at 30% for farmers and 10% for others.

A DCF helps one evaluate a particular capital investment proposal over a relatively long future period of time. If one can determine an appropriate time value of money (i.e., a "discount rate"), the DCF method can help one decide if an initial capital investment is financially and/or economically justified by the subsequent stream of income directly generated by this investment. If the net present value (NPV) of this stream of income is greater than the present value of the investment, the project is deemed feasible.

An economic model was developed to facilitate the project analysis. The results which are reported in section IV of this paper were derived directly from the model. The model itself is not printed out, but a modified form is available to CARE and PADF to simplify future reporting of economic impacts.

B. Financial Analysis of Farm Case Studies

Case study methodological questions were raised in the literature review. However, a more fundamental methodological question needs to be asked: is the discounted cash flow (DCF) the most appropriate analytical method for the farm case situation? Does a DCF provide a better understanding of the farm-level agroforestry farming system dynamics, than any other method of analysis available to us? Some readers of these studies may have asked themselves, "What was the author's point? What more do I understand about the economics of the farming system in question?" In short, is the DCF method relevant here?

The project level model calculates the NPV of the various AFIIa practices and the project as a whole. The project model can help a donor agency decide whether a set of benefits received over a 20 year period (given the agency's time preference for money) justifies a multi-million dollar investment. But is this the situation for a Haitian peasant farmer deciding whether or not to plant a hedgerow? With a minimal investment of labor (perhaps only 3 minutes or $0.01 per meter) he can establish a crop which will shortly (within a year or two) provide increased productivity and income. Does it increase our understanding of the income effect of the hedgerow intervention to know that the NPV of a few hours planting and weeding, is $11.00, given a 16 year planning horizon with a discount rate of 30%? How does the farmer or the extension staff person interpret the difference between this $11.00 NPV and an NPV of $6.85 or of negative $1.25? Is the NPV of this intervention a good farm-level economic indicator of progress toward the achieving the AFIIa project's goal?

1. Whole-farm budget vs. partial budget:

A farm operations budget, as opposed to a capital investment budget, is a better farm-level economic indicator of intervention effect on whole-farm productivity and dollar income. Unfortunately whole-farm budgets are difficult to do by hand. With a spreadsheet economic model of the farm operations, any adjustment in production practices, production costs, or market prices, will immediately be reflected in a change in farm productivity and/or income. For example, in Table 6 below, the addition of a livestock enterprise is immediately reflected in the annual whole-farm net income. Without a whole-farm economic model, one would likely limit one's analysis to a partial budget.

The whole farm budget approach demands better data than a partial budget. If the partial budget analysis were comprehensive, the partial budget approach would initially arrive at the same result with slightly less cost and effort. The advantage of the whole-farm economic model becomes apparent when a second alternative intervention is contemplated. The marginal cost of this second analysis will be substantially lower because the relevant on-farm data will already have been collected and organized into useful information for economic decision-making. When dealing with a complex system, such as agroforestry systems tend to be, one usually wants to consider multiple interventions simultaneously.

2. Terminology:

The whole-farm budget presented for consideration is in fact a whole-farm "gross margin[14]" budget, that is, the gross revenue for the farm minus all variable costs. "Variable" or "operating costs" are usually defined as those operation costs which vary with reasonably small changes in the level of production. They are in contrast to "fixed" or "ownership costs," costs which will be incurred whether or not there is any production. The difference between the gross margin and the ownership or fixed costs, is "net

[14] ADS-II publications use the identical measure, gross revenue minus variable costs, but refer to it as "gross profit" rather than gross margin.

farm income." Since the "fixed costs" are minimal to non-existent, we may ignore them, and the gross margin becomes the net income.

Three costs are problematic within the Haitian hill farming socio-economic context: the costs associated with (a) unpaid family labor, (b) management, and (c)"family living." Let us set aside "family living" for a moment. Normally for the purposes of whole farm budgeting, the "costs" of paid labor and management may be considered as either variable or fixed costs. If we were always to account for all labor (including "unpaid family labor") as "paid labor," even if its opportunity cost were at times equal to zero, a return to all labor would automatically be included in the variable cost section. The net income then becomes a return to land and management (including risk-taking) or "entrepreneur-ship." The model default is to pay all labor at the rate specified by the user. However, since there are differences of opinion on this procedure, the user has the option to switch "off" one or more types of labor (cf. Results 1 and 2 below.)

Some allowance should be made for management.[15] It would be convenient simply to ignore it. A practical compromise is to value this resource as another residual. The gross margin, in the absence of fixed costs, is in effect a return to land. We can broaden this return to land to include a return to management and risk. We now have two residuals, which together constitute the returns to land and management. The market value of land is its income generating potential. The income potential is largely a function of management. Since the return to management is conceptual, it will simplify matters to acknowledge that a return to the land resource implies an unspecified return to management.

We can now return to the "family living" expense item. On a strictly commercial farm, "family living" would not be a major issue. Technically, the allocation for that "family living" which is not covered by "paid family labor," should be a draw from net farm income. However, the reality of the hill farm situation is that household consumption often is taken earlier. Often a third of total production is utilized for on-farm consumption. Consequently, reported yield or reported farm production is often actually production net of household consumption, the amount available to be marketed in one way or another. If yield is reported in this way, it should be adjusted back to gross yield. The actual or estimated actual yield figure should be used in the crop budget. This harvested production is entered into the budget as the "production amount." This amount is subsequently multiplied by a conversion factor (determined by the user) to provide a marketable yield. The conversion factor accounts for the total amount of loss due to

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[15] A convention which is often used, but which would be impractical and arbitrary here, is to assign a percentage of gross production, say 5%, as a reward to management.

processing, drying or family consumption. It is the amount available to be marketed in one way or another. (Rural Haiti is a strongly market-oriented economy, albeit one with many market imperfections.)

The return to land (and by implication, to management and risk) and the actual production (i.e., total farm yield) together constitute the two-fold target of the project. The goal is to increase the production and income, but the actual indicators themselves usually can not be measured directly. The question has been raised as to what one should monitor? The answer usually is to collect data about the secondary indicators, such as labor hours (in person-days), other costs, if any, actual yields, and market prices. Usually the two primary indicators, production (marketable yield) and income, move together. Ideally both production and income will increase. However, production is an important part of the income equation, because if price were to drop and consequently net farm income were to decrease, the project could still be termed successful if production were to increase.

3. Output of the farm-level model:

<u>Income</u>: The model allows one to simultaneously consider up to 12 major individual crops (four tree crops, four hedgerow-intercrop crops, and four other interventions, such as vegetables and gully plugs) and four major livestock enterprises. The model relies on a series of 16 standardized enterprise budgets which can be changed, indeed should be changed to match on-farm experience. These 16 potential sources of income will be adequate in most cases, but further activities within each of the four main categories of enterprises, can be included in aggregate as "other income," for example, as other tree crop income. Other farm income which does not fall within one of these four agroforestry categories is accounted for in another major category: "Other Farm Income." The program then totals all sources of farm income and presents results both on a whole-farm basis and, for efficiency comparisons, on a per hectare basis.

<u>Crop Expenses</u>: The program aggregates all operating costs as they are reported in the underlying crop and livestock budgets. Expenses are printed out as either crop or livestock expenses. Within the crop category, itemized expenses consist of:
(1) actual seed and plant expenses and
(2) total fertilizer and chemical expenses;
(3) labor, which is further sub-categorized in terms of:
   (a) land preparation,
   (b) planting,
   (c) weeding,
   (d) harvest, and

(e) post-harvest labor costs;[16]
(4) marketing, which usually consists largely of labor, but may also include other costs, such as paid transportation and packaging.

Livestock expenses: Neither CARE nor PADF have an explicit livestock activity in their projects. Livestock are an extremely important and often undervalued component of Haitian hillside agroforestry systems. Livestock have been an integral aspect of balanced agroforestry land-use systems for 2,000 years (Von Calowitz, 1989). A recent survey reveals that over 84% of all farms with which CARE currently works, include livestock as an integral component of the farm production system. The many purposes that livestock serve are well documented. These include meat and milk for home consumption or market, transport, and proxy savings accounts.

Perhaps the most important purpose of livestock is to enable farmers to market otherwise unmarketable production. This production includes inedible crops, such as leucaena leaves and branches, an excellent high-protein fodder, and waste products from grain, vegetable, and fruit production, which provide excellent energy sources for balanced livestock nutrition. If this function is over-looked, as it often is, the value of the various crops will be underestimated. The computer model accounts for all contributions by all crops to total fodder and energy available for utilization by livestock. In this way increased carrying capacity can be realistically readjusted and the marginal value product of the relevant agroforestry products can readily be accounted for as a function of the value of the livestock.

Gross margin: Gross margin is gross income minus total variable costs. Gross margin is the "bottom line"in our analysis and can be thought of as a return to land (and by implication, management and risk.) Thus, the economic indicator often referred to as net farm income, can be viewed as a return to the major limiting resource: land.

The final result of this analysis can provide three financial views of the farming operation:
(1) the farm as it was before the intervention,
(2) the farm as it is currently, and
(3) the farm as it might be in one to three years with further interventions. Thus the economic model, when used properly,

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[16] In actuality, labor is often not a cash operating expense. However, as we explained earlier, it is preferable to assign labor a value and consider it an operating expense. (If a user has a particular reason to do otherwise, an on/off toggle switch allows the user to decide when not to include a type of labor in the total farm operating expenses.)

functions as the economic indicator of actual progress and projected progress toward achieving the goal of AFIIa.

IV. RESULTS

A. Project-level Economic Indicators

The financial analysis of the reoriented project is based on the incremental increases in production of marketable commodities resulting from the extension of project practices in the field. As only the increase and not the entire farm is being valuated, a partial budget analysis of only the project inputs and resulting economic impacts is used.

PRACTICES	NPV of Practice
Hedgerows	Positive
Deep tillage	Positive
Ravine	Positive
Tree planting	Positive
Fruit planting	Positive
Fruit top work	Positive
Direct seed	Positive
Trash barriers	Positive
Rock wall	Positive
Bio-intensive gardens	Positive
Improved mgt. practices	Positive
Green manure cover crop	Positive
Livestock	Positive

TABLE 4

The major practices and the major crops were selected for use in the analysis. Animals were included as one of the farm activities used to convert hedgerow biomass to a marketable commodity. Each practice is tested individually for financial viability.

Data for the analysis is from project observations, anecdotes, field observations, prior projects such as ADS-II, parallel projects such as Sove Te, and best estimates from agroforesters, agronomist, animal scientists, and researchers.

Estimates of farmer inputs were calculated per output unit and applied to target projections of economic indicators to arrive at benefits. Costs and benefits were projected for 20 years and discounted to the present to arrive at present day values for the project. These are seen in Table 5. The projected benefits are calculated on a per farmer basis to examine the project purpose of increased farmer income. Taxes are usually included as a cost in a financial analysis, however in this case, there does not appear to be a consistent rural tax structure. Taxes imposed in a future projection would effect the NPV. The magnitude of any tax structure that would drive the NPV to negative would have to be something over a 50% tax rate.

The results of the financial analysis as required in USAID Handbook III (USAID, 1987) is positive. The NPV of the project as a whole is positive, and the IRR is over 50%. The NPV per farmer is positive. The cost per farmer is $105. The present value return is $10.25 for every dollar budgeted by USAID. Breakeven of all project costs and benefits occurs in 1995. Breakeven of farmer costs and benefits occurs in 1991.

The Economic analysis as described in USAID Handbook III (USAID, 1987) is also positive. It differs from the financial in the following points. As the economic analysis considers the investment from the point of view of society as a whole the farmer is not considered separately.

Foreign exchange is shadow priced at 7.5:1 compared to 7:1 in the financial analysis. Internationally marketed commodities are shadow priced at their international market price (Gittinger, 1972). Labor is shadow priced at 50% of the price of rural labor during harvest season.

FINANCIAL ANALYSIS RESULTS	
Farmer's Viewpoint In Haitian Dollars	
NPV	$37,525,020
NPV /Farmer	$240
Annualized NPV	$1,250,834
Annualized NPV /Farmer	$12
IRR	over 50%
Donor's Viewpoint In US Dollars	
NPV	$218,191,513
Annualized NPV	$7,273,050
IRR	over 50%
Cost /Farmer	($121)

TABLE 5

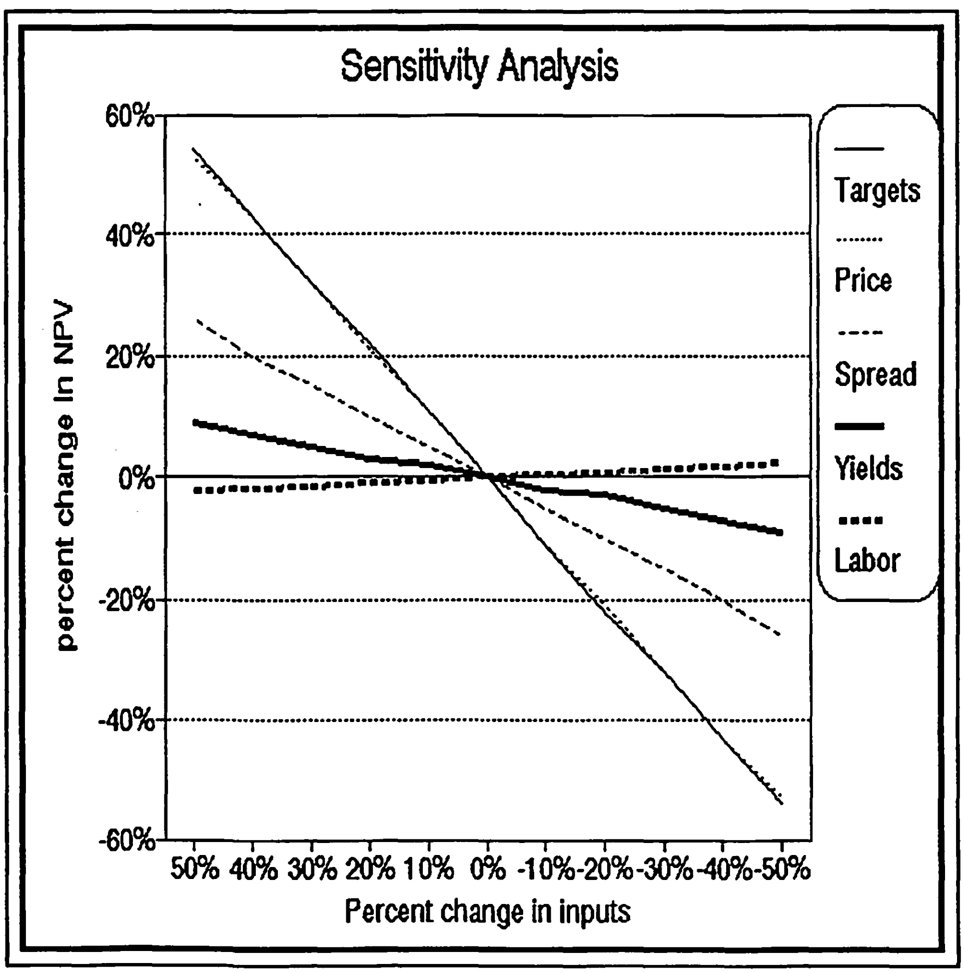
The NPV of the project as a whole is positive and the IRR is over 50%. The present value return is $7.94 for every dollar budgeted by USAID. Breakeven of all project costs and benefits occurs in 1995.

ECONOMIC ANALYSIS RESULTS In $US	
NPV	$194,908,205
Annualized NPV	$6,496,940
IRR	over 50%

TABLE 6

In analyzing the sensitivity of the project to risk and uncertainty, the variables of price, projected targets, labor cost, spontaneous spread rate, and yield response are varied up and down by 50% in 10% increments to see the effect on the NPV. This test shows the project analysis to be the most responsive to change in commodity prices. This finding confirms the importance of the new market orientation of the project.

The next most sensitive variable tested was the change in project targets. This change represents the change in resource allocation within the project. The broadening of project practices alleviates the effect of target shortfall in a tightly focused agenda, again confirming the reorientation of project resource allocation. Less sensitive was the change in spontaneous spread effect. With the large base of farmers involved, and the highly positive returns to project activity, spread has less importance to the project outcome than would normally be expected. Least sensitive to change is the labor rate. It is so low that increases of several magnitude have little effect in the overall project return.



The project is so robust that the usual variation limits of +/- 50% do not push the NPV negative in any case. The worst case scenario, all variables pushed down at once by 50%, pushes the NPV down by nearly 50%. However, even in this extreme case, the project remains positive.

The structure of the analysis is reliable, but the accuracy of these results is a function of the data input. We used the best economic data available, but as the collection of economic data improves, better data will enable one to generate more accurate and reliable results. The purpose of this study is to develop farm and project level indicators; both models should be envisioned as means to execute on-going analyses of economic impact of interventions.

B. Farm-level Economic Indicators

The farm level economic indicator of productivity and net farm income is return to the land resource. The nature of this indicator requires one to perform farm case studies. Earlier efforts to perform farm level analyses were misdirected. Neither the methodology nor the data were appropriate. No existing case studies are capable of generating the required information. The purpose of this study is to develop project and farm level economic indicators and means to measure them. The economic models are methods to measuring the indicators.

It is beyond the scope of this study to develop a case study empirically. One's first inclination is, for illustrative purposes, to utilize data from existing farm case studies. However, problems with the quality of the data preclude this possibility. For example, the model depends on knowing the area of the farm. Land area measurement problems discussed earlier, prevent us from using most of the existing case studies.

The Bombardopolis Farm #1 case (Street, et al., 1990) presents the least data problems. For the purposes of this example we will assume the farm is exactly one hectare. The first step in using the model is to review the underlying budgets. In this case farm the only one of concern is the charcoal budget (Table 7.) The data is entered to conform with what Street reports having observed. In the process it is evident that at least one component of this production system, probably the charcoal processing, is extremely inefficient. Since Street's data does not include information on charcoal processing efficiency or mean annual increment of wood for charcoal produced per year, it is impossible to locate the source of inefficiency.

Great care was taken to count the number and kinds of trees growing and the number of poles produced, and to establish the mean annual increments of charcoal. Tree measurements were taken "to calculate pole volume, main stem volume, crown volume, total volume, stem biomass, crown biomass, and total biomass." (Street et al., 1990, p. 3) Had the study reported this data, it would have

TREE CROP TYPE =>	Charcoal
Productive unit =>	per tree
OUTPUT /year:	
Production cycles/year	0.25
Harvest amt./cycle	4
Harvest units	shoots
Processing efficiency	4%
Marketable amount/year	0.011
Market units	sacks
Additional crop income	$0.20
Fodder produced (kg.DM)	0.48
Feed grain equiv. "	0.00
INPUT /year:	
Seed/plants ($/yr)	0.000
Fertilizer & chemicals	0.000
Land prep.labor (m-d/y)	0.000
Planting labor	0.000
Weeding labor	0.000
Harvest labor	0.017
Post-harvest labor	0.002
Marketing & transport/1	---
Enter plan # => 0	0.000

TABLE 7: Tree Budget for Charcoal

been extremely valuable, especially for calculating the fodder value of the foliage and locating the inefficiencies of charcoal production.

Harvest cost is not reported. It is assumed that harvest labor is excess labor with an opportunity cost of zero. It is claimed that "the benefits from fodder, firewood from trimmings, leaves as green manure and other byproducts offset the harvest cost" (p. 7). Perhaps so, but perhaps not; the reader should be allowed to decide. In fact, the value of these other products overcompensates for the harvest cost, and consequently seriously undervalues the potential income of the crop. Processing costs are also omitted. For a study that proclaimed that one of its two purposes was "to prepare exemplary financial analyses on tree production from selected areas where standing tree crops could be measured" (p. 2), these are serious omissions. One must estimate values of harvest and processing labor, the annual mean increment of foliage, and the other income from these trees.

Given the likely cash flow needs referred to above, given the probability for natural reseeding and for irregular growth differences between trees, and given the likelihood that all the trees were not planted in one week or even one year, there is a good chance that after three or four years, the producer will be harvesting throughout every year and not just once in four years. We will make this assumption since we are trying to present a picture of a typical year. Result 1 (Table 8 below) uses the limited data set (Table 7 above), assumes a relatively continuous flow production of charcoal rather than batch processing every four years, and assumes no labor costs (i.e., labor is switched off.) This print out is simply the gross income, because no costs are recognized. It is not a return to land per se, but rather to land <u>and</u> labor.

The subsequent print-out, Result 2 (Table 9), presents results for the same case but is a more realistic scenario because the labor values are estimated.[17] The bottom line income figure now better approximates the returns to land.

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[17] The only modification was to flip the "PAID?" toggle switch from "N" to "Y".

TABLE 8. RESULT 1.

ANNUAL REVENUE:	Production Total Units /Fm.:	Marketable Units:	a Price /unit:	Farm Total:	Average $/ha.:
TREE CROPS (agroforestry):					
Charcoal	2,250 trees	25.8 sacks	$2.00	$51.56	$51.56
Poles	0 trees	0.0 poles	$1.75	0.00	0.00
Fruit trees	0 trees	0.0	$0.00	0.00	0.00
Border trees	0 trees	0.0	$0.00	0.00	0.00
Additional tree-crop income (calculated)				0.00	0.00
INTER-CROPS:					
Leucaena	0 sq.m.	0 kgs.	$0.00	0.00	0.00
Maize-Pigeon P	0 sq.m.	0.0 kgs.	$0.21	0.00	0.00
Inter/c #2	0 sq.m.	0.0 kgs.	$0.00	0.00	0.00
Inter/c #3	0 sq.m.	0.0 kgs.	$0.00	0.00	0.00
Additional inter-crop income (calculated)				0.00	0.00
OTHER CROPS:					
Grass	0 sq.m.	0.00 t.DM	$0.00	0.00	0.00
Garden	0 sq.m.	0.0 0	$0.00	0.00	0.00
Ravine	0 sq.m.	0.0 0	$2.00	0.00	0.00
Other crop	0 sq.m.	0.0 780	$0.00	0.00	0.00
Additional other-crop income (calculated)				0.00	0.00
LIVESTOCK:					
Goats	0.0 nannie	0 kgs.	$1.10	0.00	0.00
Sheep	0.0 ewes	0 kgs.	$1.00	0.00	0.00
Cattle	0.0 cows	0 kgs.	$0.60	0.00	0.00
Pigs	0.0 sows	0 kgs.	$0.80	0.00	0.00
Additional livestock income (calculated)				0.00	0.00
OTHER FARM INCOME	(enter farm total only)			0.00	0.00
				-------	-------
TOTAL GROSS REVENUE =				$51.56	$52
ANNUAL OPERATING COSTS (calculated):		Man-days/yr:		Farm	Average
ALL CROPS:	PAID?(Y/N):	#:		Total $:	$/Ha.:
Seed & plants (farm total)				$0.00	$0.00
Fertilizer & chemicals "				$0.00	0.00
Land preparation labor	N	0		$0.00	0.00
Planting labor	N	0		$0.00	0.00
Weeding labor	N	0		$0.00	0.00
Harvest labor	N	37		$0.00	0.00
Post-harvest labor	N	5		$0.00	0.00
TOTAL LABOR =		43 man-d/y		0.00	0.00
Marketing & transport (cost)				$0.00	0.00
Additional crop costs (enter farm total)				0.00	0.00
				-----	-----
CROP COSTS SUB-TOTAL =				$0.00	$0
LIVESTOCK:				Farm	Average
(all amounts are farm totals for all l/s units				Total:	$/Ha.:
Breeding				$0.00	$0.00
Vet.& medicine				0.00	0.00
FODDER REQUIREMENT (t.DM):	Needed	0.00			
PRICES: Buy @ $0.00	Produced	1.08			
Sell @ $0.00	Balance	1.08		$0.00	0.00
ENERGY REQUIREMENT (t.DM):	Needed	0.00			
PRICES: Buy @ $0.00	Produced	0.00			
Sell @ $0.00	Balance	0.00		$0.00	0.00
Salt & minerals				0.00	0.00
Livestock supplies				0.00	0.00
Marketing				0.00	0.00
Labor ($/year) PAID?(Y/N): Y		0 p-d/yr.		0.00	0.00
Additional livestock costs (enter farm total)				0.00	0.00
				-----	-----
LIVESTOCK COSTS SUB-TOTAL =				$0.00	$0
TOTAL OPERATING COSTS =				$0.00	$0
TOTAL Annual Gross Margin or RETURN TO LAND =				$51.56	$52

TABLE 9. RESULT 2.

ANNUAL REVENUE:	Production Total	Units	Marketable /Fm.	Units:	Price /unit:	Farm Total:	Average $/ha.:
TREE CROPS (agroforestry):							
Charcoal	2,250	trees	25.8	sacks	$2.00	$51.56	$51.56
Poles	0	trees	0.0	poles	$1.75	0.00	0.00
Fruit trees	0	trees	0.0		$0.00	0.00	0.00
Border trees	0	trees	0.0		$0.00	0.00	0.00
Additional tree-crop income (calculated)						0.00	0.00
INTER-CROPS:							
Leucaena	0	sq.m.	0	kgs.	$0.00	0.00	0.00
Maize-Pigeon P	0	sq.m.	0.0	kgs.	$0.21	0.00	0.00
Inter/c #2	0	sq.m.	0.0	kgs.	$0.00	0.00	0.00
Inter/c #3	0	sq.m.	0.0	kgs.	$0.00	0.00	0.00
Additional inter-crop income (calculated)						0.00	0.00
OTHER CROPS:							
Grass	0	sq.m.	0.00	t.DM	$0.00	0.00	0.00
Garden	0	sq.m.	0.0	0	$0.00	0.00	0.00
Ravine	0	sq.m.	0.0	0	$2.00	0.00	0.00
Other crop	0	sq.m.	0.0	780	$0.00	0.00	0.00
Additional other-crop income (calculated)						0.00	0.00
LIVESTOCK:							
Goats	0.0	nannie	0	kgs.	$1.10	0.00	0.00
Sheep	0.0	ewes	0	kgs.	$1.00	0.00	0.00
Cattle	0.0	cows	0	kgs.	$0.60	0.00	0.00
Pigs	0.0	sows	0	kgs.	$0.80	0.00	0.00
Additional livestock income (calculated)						0.00	0.00
OTHER FARM INCOME (enter farm total only)						0.00	0.00
						-------	-------
TOTAL GROSS REVENUE =						$51.56	$52

ANNUAL OPERATING COSTS (calculated): ALL CROPS:	PAID?(Y/N):	Man-days/yr: #:	Farm Total $:	Average $/Ha.:
Seed & plants (farm total)			$0.00	$0.00
Fertilizer & chemicals "			$0.00	0.00
Land preparation labor	N	0	$0.00	0.00
Planting labor	N	0	$0.00	0.00
Weeding labor	N	0	$0.00	0.00
Harvest labor	Y	37	$37.46	37.46
Post-harvest labor	Y	5	$5.16	5.16
TOTAL LABOR =		43 man-d/y	42.62	42.62
Marketing & transport (cost)			$0.00	0.00
Additional crop costs (enter farm total)			0.00	0.00
			-----	-----
CROP COSTS SUB-TOTAL =			$42.22	$42
LIVESTOCK: (all amounts are farm totals for all l/s units			Farm Total:	Average $/Ha.:
Breeding			$0.00	$0.00
Vet.& medicine			0.00	0.00
FODDER REQUIREMENT (t.DM):	Needed	0.00		
PRICES: Buy @ $0.00	Produced	1.08		
Sell @ $0.00	Balance	1.08	$0.00	0.00
ENERGY REQUIREMENT (t.DM):	Needed	0.00		
PRICES: Buy @ $0.00	Produced	0.00		
Sell @ $0.00	Balance	0.00	$0.00	0.00
Salt & minerals			0.00	0.00
Livestock supplies			0.00	0.00
Marketing			0.00	0.00
Labor ($/year) PAID?(Y/N):	Y	0 p-d/yr.	0.00	0.00
Additional livestock costs (enter farm total)			0.00	0.00
			-----	-----
LIVESTOCK COSTS SUB-TOTAL =			$0.00	$0
TOTAL OPERATING COSTS =			$42.22	$42
TOTAL Annual Gross Margin or RETURN TO LAND =			$8.94	$9

As we review Result 2 a number of potential increases in productivity and income are apparent. For example, one might wish to consider the whole farm effect of modifying the charcoal enterprise assumption, e.g., the current marketing arrangement or the charcoal efficiency factor. These "what if" alternatives can be considered individually or simultaneously by making changes in the enterprise budget and the prices section.

Another set of alternatives is possible by adding one or more enterprises. The trees are producing considerable biomass which cannot be marketed directly. One alternative therefore is to incorporate some combination of livestock through which this production could be marketed. In order to add enterprises, underlying budgets for those enterprises of interest must be available. Budgets for goats and grass are extracted from the livestock and "other crops" budget sections of the model. These budgets are presented as Tables 10 and 11.

LIVESTOCK TYPE =>	Goats
Productive unit =>	/nannie:
OUTPUT:	
Production cycles/year	1.5
Off-spring weaned/cycle	2.0
Replcmts & home use/cyc	0.10
Marketable animals/cycl	1.9
Mkt live wt.(kg)/animal	15
Live wt.(kgs) of culls	25
Culling rate (%/year)	25%
Yield (kgs)/year	49
Additional l/s. income	$0.00
INPUT: IMPROVED? (Y/N)=>	N
Breeding	$0.00
Vet.& medicine	0.00
Fodder 22% c.p.(t.DM/yr	1.00
Grain equiv. (t.DM/yr)	0.00
Salt & minerals	0.00
Livestock supplies	1.00
Marketing (tax, etc.)	0.50
Labor/group (p-days/yr.	6.0
Extra labor/UBT (p-d/y)	2.0

Table 10: Livestock Budget for Goats

	FORAGE:
OTHER CROP TYPE =>	Grass
Productive unit (sq.m.)	100
OUTPUT /year:	
Production cycles/year	3.00
Harvest amt./cycle	278
Harvest	Kgs. fresh
Processing efficiency	20%
Marketable amount/year	0.167
Market	t.DM
Additional crop income	$0.00
Fodder produced (kgs.DM	167.0
Feed grain equiv. "	0.0
INPUT /year:	
Seed/plants ($/yr)	0.00
Fertilizer & chemicals	0.00
Land prep.labor (m-d/y)	0.0
Planting labor	0.0
Weeding labor	0.0
Harvest labor	3.0
Post-harvest labor	0.0
Marketing & transport/2	0.0

Table 11: Crop Budget for Grass

We are now in a position to consider increased productivity and net income resulting from a slight reorganization of the charcoal operation. Result 3 (Table 12) considers the same charcoal operation with goats and a small area of grass. The grass would be utilized in the rainy seasons and the Leucaena in the dry seasons. The user enters the number of goat and grass units, and all of the associated crop and livestock income and expenses will be calculated automatically.

TABLE 12. RESULT 3.

ANNUAL REVENUE:	Production Total	Units	Marketable /Fm.:	Units:	a Price /unit:	Farm Total:	Average $/ha.:
TREE CROPS (agroforestry):							
Charcoal	2,250	trees	25.8	sacks	$2.00	$51.56	$51.56
Poles	0	trees	0.0	poles	$1.75	0.00	0.00
Fruit trees	0	trees	0.0		$0.00	0.00	0.00
Border trees	0	trees	0.0		$0.00	0.00	0.00
Additional tree-crop income (calculated)						0.00	0.00
INTER-CROPS:							
Leucaena	0	sq.m.	0	kgs.	$0.00	0.00	0.00
Maize-Pigeon P	0	sq.m.	0.0	kgs.	$0.21	0.00	0.00
Inter/c #2	0	sq.m.	0.0	kgs.	$0.00	0.00	0.00
Inter/c #3	0	sq.m.	0.0	kgs.	$0.00	0.00	0.00
Additional inter-crop income (calculated)						0.00	0.00
OTHER CROPS:							
Grass	1,000	sq.m.	1.00	t.DM	$0.00	0.00	0.00
Garden	0	sq.m.	0.0	0	$0.00	0.00	0.00
Ravine	0	sq.m.	0.0	0	$2.00	0.00	0.00
Other crop	0	sq.m.	0.0	780	$0.00	0.00	0.00
Additional other-crop income (calculated)						0.00	0.00
LIVESTOCK:							
Goats	3.0	nannie	147	kgs.	$1.10	161.70	161.70
Sheep	0.0	ewes	0	kgs.	$1.00	0.00	0.00
Cattle	0.0	cows	0	kgs.	$0.60	0.00	0.00
Pigs	0.0	sows	0	kgs.	$0.80	0.00	0.00
Additional livestock income (calculated)						0.00	0.00
OTHER FARM INCOME	(enter farm total only)					0.00	0.00
						-------	-------
TOTAL GROSS REVENUE =						$213.26	$213
ANNUAL OPERATING COSTS (calculated):					Man-days/yr:	Farm	Average
ALL CROPS:			PAID?(Y/N):		#:	Total $:	$/Ha.:
Seed & plants (farm total)						$0.00	$0.00
Fertilizer & chemicals "						$0.00	0.00
Land preparation labor			N		0	$0.00	0.00
Planting labor			N		0	$0.00	0.00
Weeding labor			N		0	$0.00	0.00
Harvest labor			Y		67	$67.46	67.46
Post-harvest labor			Y		5	$5.16	5.16
TOTAL LABOR =					73 man-d/y	72.62	72.62
Marketing & transport (cost)						$0.00	0.00
Additional crop costs (enter farm total)						0.00	0.00
						-----	-----
CROP COSTS SUB-TOTAL =						$72.62	$73
LIVESTOCK:						Farm	Average
(all amounts are farm totals for all l/s units						Total:	$/Ha.:
Breeding						$0.00	$0.00
Vet.& medicine						0.00	0.00
FODDER REQUIREMENT (t.DM):			Needed		3.00		
PRICES: Buy @	$0.00		Produced		2.75		
Sell @	$0.00		Balance		(0.25)	$0.00	0.00
ENERGY REQUIREMENT (t.DM):			Needed		0.00		
PRICES: Buy @	$0.00		Produced		0.00		
Sell @	$0.00		Balance		0.00	$0.00	0.00
Salt & minerals						0.00	0.00
Livestock supplies						3.00	3.00
Marketing						1.50	1.50
Labor ($/year) PAID?(Y/N): Y					10 p-d/yr.	10.00	10.00
Additional livestock costs (enter farm total)						0.00	0.00
						-----	-----
LIVESTOCK COSTS SUB-TOTAL =						$14.50	$15
TOTAL OPERATING COSTS =						$87.12	$87
TOTAL Annual Gross Margin or RETURN TO LAND =						$126.14	$126

A relatively slight reorganization of resources causes Result 3 profitability (return to land) to increase dramatically. The difference between Result 3, the charcoal operation with livestock, and Result 2, the charcoal operation without the inclusion of livestock, is $114. In effect Leucaena in Result 1 and 2 had been substantially undervalued because the foliage had not given any value. This shortcoming has been corrected in Result 3.

Street assumes charcoal production returns about $208 every four years, allowing harvest and charcoal production labor to be ignored because it would be off-set by fodder benefits. The NPV of this arrangement (Result 1), including the investment in tree establishment but not for the goats to utilize the fodder, and discounted at 30%, is about $69.00. The NPV of Result 3, the same charcoal operation, but factoring in an investment of $51.50 for purchase of goats and establishment of grass, is about $143.00. The NPV of the Result 1 investment is $74.00 lower than it would have been had the livestock enterprise been properly reported.

V. SUMMARY AND RECOMMENDATIONS

A. Summary

Financial analyses in the form of farm case studies are a potentially important farm-level economic indicator of progress toward achieving the AFIIa project goal to increase agricultural productivity and income on Haitian hillside farms. All case farm financial analyses to date have been capital investment analyses in the form of discounted cash flows to determine the NPV. Capital investment studies have a role, but they must be performed correctly, and they must be appropriate to the research purpose and the farming activity. All of these NPV analyses were performed incorrectly and none were appropriate to the situation. Furthermore, case studies require good data if they are to be useful and reliable indicators. To varying degrees all of these case studies utilized seriously deficient data.

Following earlier recommendations of Karch (1991) the current study designed a more effective methodology for rapid financial analysis of specific Haitian hillside farms. A spreadsheet economic model of a Haitian agroforestry farming system was developed as an integral part of the study and is available to ease the implementation of this methodology. Ease of use and practicality always necessitate some sacrifice of complete accuracy, but the resultant information functions as a useful farm-level economic indicator of progress toward meeting AFIIa goals and a powerful on-farm economic decision-aide tool.

B. Recommendations

1. Many more farm financial <u>case studies</u> need to be performed. In order to be useful economic indicators, they must follow an agreed upon methodology and be reported in a standardized fashion. This approach will facilitate limited longitudinal and cross sectional studies of farm productivity and income, for a particular farm, a region, or the whole project.

2. Use a <u>DCF</u> analysis only when it is called for by the need to make a decision about a longer range (over three years) capital investment. When it is necessary to determine the NPV of a proposal, follow standard capital investment analysis procedures. This procedure is appropriate for project analysis, but not appropriate for annual reporting of farm financial impact.

3. Use the NPV result to determine whether or not a project is feasible, but it is not recommended to use the Internal Rate of Return (IRR) for agroforestry projects (NFTA, forthcoming).

4. Focus on the <u>whole-farm operational budget</u>. If data is collected with this use in mind, the essential data for all other analyses will be collected. If one has collected quality, relevant data, i.e., the data required for the hill farm economic model,

then partial budgets, DCFs, and other analyses as well as project monitoring can be performed adequately and with relative ease.

5. Use the two economic models developed. The farm financial model can be used as a guide to farm case data collection and as a farm-level economic indicator. Farm productivity and income can be evaluated before an intervention, with intervention(s), and with a proposed intervention. Increases in productivity and profitability can thus be demonstrated at each point of contact. This information can feed into the project level model.

Use the project economic model to report project level economic impact. The data used in the model can be updated by inserting annual goals achieved and by revising the economic coefficients.

6. Recognize the economic contribution of livestock to the overall productivity and profitability of agroforestry land-use systems. Livestock per se does not constitute an activity category on which CARE and PADF report, but failure to include the contribution (easily accounted for with the model) undervalues increases in production and income directly attributable to the project.

7. Field test the farm case model to familiarize selected project staff with its potential as a project evaluation tool and as a farm-level economic decision-aide. The model could be modified at this time. We do not see the model presented in this paper as necessarily in its final form. The model must be used to determine if it improves understanding of the farm level experience.

When this field test group is comfortable with the model, provide in-service training for extension and research staff as a whole. Gradually a subset of this group may take an interest in using the economic model or collecting quality data for use in the model. If in fact the model does improve our understanding of the economics of Haitian hillside farm production systems, widespread adoption of this economic indicator would improve the quality and timeliness of subsequent financial and economic appraisals of the AFIIa project. In the process many more agents will become sensitive to the economics of agroforestry and integrate economic concerns into their on-going production-oriented activities.

8. Integrate economics into as many farm-level (Level I) and project level (Level III) activities as possible. We are convinced that the AOP and AFII projects have had an extraordinary positive impact on the target audience. No doubt farm productivity and income have increased, and will continue to increase with AFIIa. However, these earlier projects have not included a strong economic component, and consequently there has been no farm-level economic research which can convincingly demonstrate these improvements.

There is an opportunity with the amended AFII project to integrate the economic perspective with all aspects of the project, including the training of agents and farmers in production and marketing economics. With a greater sensitivity to economic implications of farm-level production and marketing decisions, extension staff and producers will become better able to participate in the AGLINK project.

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DRAFT LETTER TO AARON WILLIAMS, DEPUTY AA FOR AID/LAC, FOR REVIEW BY MASON MARVEL AND HIS GANG

Dear Aaron:

I attach the Haiti AFII project income analysis study, completed last September by Fleming and Karch, which I mentioned to you in our conversation yesterday.

The study concludes that USAID and we have a tiger in AFII, one with a nine digit net present value--something in the $200 million range. However, the time horizon is 20 years for these results to materialize. As of the 1991-95 period, the project is only "breaking even".

This says to me that reductions in project effort today could cost $200 million--hardly "in the convenience of the U.S. Government", or very good for Haiti!

That there might be alternative scenarios for continued SECID collaboration, is something we would be pleased to discuss with you folks.

I look forward to hearing from you.

Sincerely,

Reed Hertford
Executive Director

Attachment
cc: J. Michel
D. Cohen