HAITI AGROFORESTRY RESEARCH PROJECT

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A FINANCIAL ANALYSIS OF SELECTED HEDGEROW OPERATIONS IN HAITI'S SOUTHERN AND NORTHWESTERN REGIONS

by

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EXECUTIVE SUMMARY

The purpose of this study was to select, adapt and apply appropriate methods for a financial analysis of hedgerow and other agroforestry systems in Haiti, and to accomplish a study of some of the farms using such forms of production. After determining an appropriate approach, data from nine farms in two different regions were collected and examined. The farms selected were in the Southern Region around Maniche and in the Northwest Region near the town of Jean Rabel. Net Present Values (NPV) at a 30 percent discount were computed. The crops grown on the farms studied included maize, sorghum, cassava and sweet potatoes. The research presented evaluates the costs and returns for producing those crops within hedgerow systems.

The majority of the farms, (eight out of nine), show a positive NPV. Positive results are achieved when estimations of all the costs involved are included. Such results are consistent even though a conservative approach is used throughout the analysis to assess expenses and profits. There is also evidence for some additional benefits that could not be appropriately evaluated. Hedgerows not only improve soil conservation but also create different products that allow the farm household to: (1) increase its income; and (2) increase the security of its income. The report concludes by offering recommendations for subsequent extension and research activities.

REZIME

Bu travay étid si-la sè chwazi, adapté, ak sèvi ak bon jan métod pou analizè randman financyè ramp vivant ak lot sistem agwoforestri ak rebwazman nan péyi d'Ayiti. Nou eseyè akompli yon étid sou kék fém kap itilizè mwayen pwodiksion sa-yo. Aprè nou fin-n jwen yon jen pou nou fè travay-la, nou pran 9 champ rèkot nan 2 pati pèyi-a é nou pran informasyon nan champ sa-yo pou passè nan peny fin. Champ rèkot ké nou té chwazi té nan rejyon Sid peyè-a nan zon Maniche ak nan rejyon Nö-Wés nan zon ville Jean-Rabel. 30 pousan rabè nan NPV (Net Present Values) té kalkilé nan ètid si-la. Nan Rékot-yo ki pasè nan ètid si-la, wap jwen: mais, pitimi, kasav, patat. Sou rekot-yo, nan sistèm ramp vivant, pri ak rèvèmi tè ètidyè nan ètid sa-a.

NPV-yo tè nan plus pa nan mwens pou pifo champ rèkot-yo. Lè tout pri-yo rentrè nan kalkil-yo, NPV ki nan plus-yo tè soti kom rèzilta. Kèk nan rèlizta-yo tè ègal mème lè nou sévi ak yon analiz ou ètid ki fixè dèpense ak pwofi. Nou tè jwen nan ètid si-la, kèk lot bènèfis kè nou pat ka pasè sou peny fin. Ramp vivant ka non sèlman konsèvè sol-la mé li bay lot pwodui ki pemet femyè-an genyen: (1) plis rèvèni; (2) plis sèkiritè sou rèvèni-yo. Rapo si-la fini pa bay rèkomandasyon pou lot étid sou méme sijet ki ètidyè nan ètid sa-a.

A FINANCIAL ANALYSIS OF SELECTED HEDGEROW OPERATIONS IN HAITI'S SOUTHERN AND NORTHWESTERN REGIONS

I. INTRODUCTION

The Agroforestry II Project (AF II) is a five-year development program that makes use of agroforestry technology to promote reforestation in rural Haiti. An economic analysis is needed to successfully allocate the resources available to the project, and to monitor the effects of the program on the intended beneficiaries, Haitian farm households. This study is part of a continuing effort to provide an understanding of the economic processes of agroforestry systems in Haiti. The data collected for this research came from typical farms of planters cooperating with the Pan American Development Foundation (PADF) and CARE agroforestry programs. All the farms included have steep slopes (over 20 degrees) and had a low soil fertility profile. The present study, which emphasizes the economics of hedgerows, is complementary to a previous one carried out by SECID/Auburn University staff on the economics of tree planting (Street, Hunter and Bellerive, 1990).

Purpose

The purposes of this study were:

1. To determine an appropriate methodology for a financial analyses of hedgerows that are at least four years old, and to use it;
2. To provide a more complete economic analysis of the costs and returns in other types of agroforestry systems.

II. PREVIOUS RESEARCH ON AGROFORESTRY IN HAITI

The economic benefits of agroforestry have generally been shown either by indicating an increase in production yields or by demonstrating the effects of a system in preserving a factor, usually land. Different studies have shown the benefits of agroforestry in particular contexts. Shannon et al. (1989) found that, with regard to maize production, fields with alley cropping produce a higher yield after a fourth season than those without such plantings. Rosseau et al. (1989) calculated that the adoption of hedgerows could save up to 70 tons of soil per hectare per year, and that, with proper management, hedgerows did not affect the yields of associated crops.

Jickling (1989) recently reviewed the available literature on the short-term economic benefits of agroforestry. He concluded that most of the investigations accomplished thus far produced conclusions of modest value and were based either on experiment

station field trial data or tenuous assumptions. He recommended that case studies be undertaken to provide field data that would allow for more accurate and complete economic analyses.

During the Agroforestry Outreach Project (AOP) and its successor, the Agroforestry II Project (AF II), various economic studies have been accomplished. Grosenick (1986) computed Net Present Values (NPV) for farmers participating in the AOP. He found that 15 percent of the farmers participating in the program had a negative Net Present Value. He explained the willingness of those farmers to continue to plant trees by the low opportunity cost of land and the modest amount of labor needed for their agroforestry operations.

Street (1989a) did a socio-economic study of 62 tree planters covering three regions in which CARE and the Pan American Development Foundation were operating. These regions were the Northwest, the Central Plateau and the South. He found that two-thirds of the planters had grown trees for four years or more and that 60 out of 62 respondents were pleased with the results of this enterprise. The planters saw tree planting as a good way to enhance their income, and they seemed very aware of the value of trees as an erosion-control method. They also reported few conflicts between tree enterprises and their field crops in the use of land or labor.

Four other economic studies have been accomplished on agroforestry in Haiti. Two studies examined the two most important wood commodities, charcoal and poles. The first study, by Street (1989b), studied the charcoal market as it functions from the Northwest Region of the country to the city of Port-au-Prince. This study included an examination of marketing margins in the Port-au-Prince metropolitan area market and data on the weight of sacks found in the market. The second study by Street et al. (1989) described the pole market from the Southwest Region to Port-au-Prince. This research examined the pole market in a manner similar to that accomplished for the charcoal market. It provided an analysis of marketing margins, and examined a sample of poles in the market to develop a description of the products available to the consumer. The third study by Goodwin, Street and Reid (1989) was an analysis of the costs of producing tree seedlings using several infrastructures with root trainer techniques. The least expensive method had a cost per seedling of $0.1244. The most expensive had a cost per seedling of $0.1266. The fourth study, by Street, Hunter and Bellerive (1989), was a financial analysis of tree planting operations on four farms. The products examined were charcoal and poles. One farm was located in the Central Plateau and the three others were in the Northwest area. This study computed NPVs with two types of ownership for charcoal and three different prices of seedlings: donated (zero cost), $0.25 each, and $0.50 each. Two factors greatly affected the profitability of tree planting ventures, proper species matching to sites, and the

cost of the seedlings. Under actual conditions of donated seedlings, the farmer retained maximum income when his household processed its own charcoal.

The present study sought to build upon the studies briefly described here to further extend our understanding of agroforestry economics in Haiti. It provides an analyses of hedgerows that are at least four years old, and provides a more complete analyses of the on-farm costs and returns of other systems.

III. METHODOLOGY

The research reported here was conducted in two different parts of Haiti. One region is an area where PADF operates; the other is in the CARE area of operation. The PADF area selected is its Region I, and it is in the Southern Region (Sud) of Haiti. The farms chosen are near the road going from Carrefour Gans to Maniche. The Barbe Pangnol area (Region II), near the town of Jean Rabel, is the second site of the study, which is in the Northwestern Region (Nord-Ouest) served by CARE. The farms selected are around the communities of Barbe Pangnol and Gombo.

1. Site Selection

Several farms of different types in each area were suggested for inclusion in the study by CARE and PADF field personnel. The following criteria were used by the author to make a final selection.

A. The farms should be accessible and the farmers should appear to be cooperative and capable of providing data;

B. The trees and hedgerows in the farm must be three or four years old.

2. Price Determination

The prices used for this study were determined by interviewing the farmers and the "Madam Saras" serving the zone. ("Madam Sara" is the general term in Haitian Creole for a woman trader who buys and sells goods. In this case, it refers to those who buy from farmers to sell to retailers or directly to consumers). Since the areas of the study are served by the same market places, the validity of the values obtained could be easily verified. All the prices are reported in U. S. dollars converted from the Haitian gourde at the official rate of one dollar to five gourdes. It is important to note, however, that in recent years an official parallel market has existed in Haiti. For some months before, during and after the data were collected, the parallel market offered a premium of over 50 percent on the dollar. The amounts reported here were, for the most part, determined in the field.

In the case of the Northwestern Region served by CARE, a very severe drought resulted in the destruction of most of the crops planted between the hedgerows. Because of this problem, the author was obliged to rely on the estimates given by farmers and the CARE staff in the Barbe Pangnol area.

Some of the data required for the financial analysis, such as the time required to establish hedgerows, were not available for all the farms. Information on that factor was secured by monitoring farms that were establishing hedgerows during the period of field research. These farms had physical conditions similar to those found on the farms where the production measurements were made. All of the estimates concerning farm work (planting, weeding, harvesting) were computed on a person-day basis at a salary of five gourdes or one dollar, with a work day lasting five hours. The evaluation of the cost of making a hedgerow is based on data from two farms that were installing hedgerows in those areas at the time of the study.

The farm first examined to secure cost estimates is in the Archambeau area (Southern Region). It has a moderate slope, with a sandy-clay soil. The night before the work on the hedgerows began, mild rains fell which required less than the usual effort to plow the soil. Nine farmers worked during the day as a "kombit," a local cooperative work group which provides for the exchange of labor among its members. Two persons worked with an A-level tool to trace the line for the ditch where the hedgerow was to be built. (An A-level tool is a three to five foot wooden frame in the shape of an A with a string attached to the top. A stone hangs at the bottom of the string to indicate places on the ground to install the plants evenly and form the hedgerow). Seven others used a plow to make the row. In three hours and thirty minutes (from 8 a.m. to 11:30 a.m.), they cut a ditch 31.50m long and 0.30m (one foot) deep.

The second farm that was a source for cost estimates is in the Pitimi area near Barbe Pangnol in the Northwest region. It has a very steep slope, and the soil is considerably eroded and rocky. It is divided into two parts. On the first part, the farmer has already established hedgerows. After being satisfied with the results of the hedgerows, he established a second planting on his other plot. On the first part of the farm, the time required to trim the hedgerows was calculated. Because of the heavy drought in the area, however, the farmer lost the field crop he planted. He then decided to let the trees in his hedgerows grow to have wood and fodder for his animals. At the time of the trimming of the hedgerows, the trees were more than two meters high. It took three days for the farmer, working alone, to trim all the trees of the four hedgerows that are in this farm. On the second part of the farm, which has three hedgerows with an average width of 22.27m, for a total of 66.8m, four people were observed during their second day of work. Their work day lasted from 7 a.m. to 12 noon. The

hedgerows were completely planted during those forty-eight hours. In this case, the tracing of the hedgerows to be planted was made by CARE local staff.

In the South, some farmers also lost crops because of a drought. The drought problem did not, however, occur throughout the entire area as it did in the Northwest.

3. Financial Analysis

The financial study provided here uses a 16-year cycle, the time frame commonly used for forestry systems. Financial costs and returns were calculated with data collected among cooperating farmers. The Net Present Value (NPV), defined by Gittinger (1982) as "the present worth of the Benefits less the present worth of the Costs of a project," is presented for each of the farms examined.

To compute the NPV in this study, the following factors were examined:

A. Evaluation of Cost and Income:

Cost	Income
I. Tangible	
Fixed Costs	
a. Land	i. Selling of Crops
b. Opportunity Cost of Changing Crops	j. Home Consumption
c. Making of hedgerow	k. Fodder from leucaena
	l. Green manure from leucaena
Variable Costs	m. Charcoal or firewood from leucaena
d. Land preparation	
e. Planting	
f. Weeding	
g. Harvesting	
h. Fertilizers or Pesticides	
II. Intangible	
a. Learning hedgerow management	a. Shadowing
	b. Soil Saving[1]
	c. Satisfaction at keeping capital land

[1] Soil savings is not necessarily an intangible since it can be measured. Since it cannot be taken into account for this study, however, it will be considered as intangible.

The intangible costs and benefits, by definition, cannot be computed in terms of dollars and cents. Even if estimates of them are difficult, however, USAID guidelines for project economic analysis indicate that they should be described (USAID, 1987).

A 30 percent discount factor for computing the NPV was used by the author. This rate results from the summing of the 20 percent for projected inflation as calculated by the USAID Mission to Haiti, with 10 percent for the opportunity cost of money. Summing both rates is a normal procedure recommended by most economic analysts (i.e., Barry, 1979). The benefits and costs are presented in the tables in current terms and are then discounted at 30 percent to establish their present values. The rate of discount has a crucial effect on the value of the NPV.

Results may change according to the farms chosen. The selected farms, however, appear to be typical and representative of those which have established and maintain hedgerows.

IV. RESULTS

1. Farms in the Southern Region

The area selected for this study is one of the first places in which international organizations initiated reforestation efforts in Haiti. The United Nations had a tree distribution program in the area during the 1970s. PADF began a program in the early 1980s that included tree distribution and the implementation of erosion control methods. Among the erosion control methods used, one of the most popular is the hedgerow or "ramp vivant," which refers to a "living fence" in Haitian Creole.

What follows is an economic analysis of each of the farms studied in the region.

A. The Nan Suzan Farm

This farm is on a very steep hill (slope of over 35 degrees) and has an area of 806 square meters (1/16 carreau). The hedgerow is made with Leucaena and has four rows at five meters each. The range of the lengths is from 45.80m to 88m, for a total length of 279.10m. Three years before the establishment of the hedgerows by the farmer no production took place, and a cursory examination of the land showed that it had low fertility. The farmer has installed Leucaena hedgerows where he produces corn (Zea mays) and pigeon peas (Cajanus cajan) that are planted at low density[2]. During the time of the study, corn was the only crop whose

[2] The farmer indicates that normally he would plant at 0.30m of distance, but given land condition he planted at 0.60m(two ft).

production was measured because its season runs from March to July. The farmer reported that he intended to sell two-thirds of his harvest and use the rest for home consumption. The farmer's figures are used in our analysis. It was not possible, however, to verify if the farmer divided and used the crop as he reported.

Pigeon peas are planted in the area in December for harvest in February. Work in the field is accomplished by family labor, except for the establishment of hedgerows which were planted by the kombit to which the farmer belongs. The farmer uses Leucaena leaves as mulch and as fodder for his pigs. The cost and income in dollars for one cycle of corn production was calculated, producing the following figures.

Cost		Income	
	I. Tangible		
a.	100.	i.	16.7
b.	0.	j.	8.3
c.	80.	k.	54
d.	10.	l.	NA
e.	2.	m.	0
f.	1.		
g.	2.		
h.	0.		

To determine its cost, the price for the land (a.) was the figure given by the farmer in response to the question: "How much would you be willing to sell your land for now ?" Because of the sensitivity of the land tenure problem in Haiti, the numbers reported must be regarded with caution. We consider the opportunity cost for changing crops (b.) to be zero since the land was fallow before the farmer took over. The cost of making hedgerows (c.) is based on calculations from the first farm described in our earlier discussion of methodology. We obtained that figure by dividing the total length of the hedgerows, 279.10m, by the 31.5m, and then multiplying the number obtained by nine dollars, which would be equivalent to the wages of the nine people, who would almost always be men, working in the kombit (8.8 x 9). The variable costs (d., e., f., g.) are computed according to figures elicited during interviews with the farmer. All such labor (planting, weeding, harvesting) is accomplished by family members which, as noted by Street (1989a), is available in excess. Planting accounts for the cost of one marmite (2.5 kg.) of seeds and labor. The weeding that the plot required was less important this year, however, because the drought made the first two weedings very effective. This farmer used no chemical products, such as fertilizers, insecticides or herbicides. Such products are used by few peasant farmers in Haiti, and many farmers have never seen them.

For the income part of the analysis, the total maize production was determined to be 62.5 kg., which is equivalent to about 25 marmites selling at one dollar each. The "marmite," or "can" in English, is the standard measure for bulk food products sold in Haitian markets. The figure calculated from the field studied is the equivalent to 775 kilograms per hectare. This production rate is consistent with yields normally found under such conditions (Ministere de la Cooperation, Republique Francaise, 1980). The total income would then be $25, $16.7 for the sale of products and $8.30 for the value of products used for home consumption. The value for leucaena as fodder (k.) took into consideration the fact that the farmer was feeding his pigs a mixture of leucaena leaves and a feed called "lactation" which is bought in the local market. This feed mixture was half lactation and half leucaena. The author later corroborated the farmer's report that the price of lactation was $18 per sack in Les Cayes. It was estimated that the leucaena saved the farmer a minimum of three sacks of lactation per year. This figure could be much higher if the female pig has just farrowed. There are no data presently available on the gain on yield that could be expected because of the use of leucaena as mulch (l.). Consultations with different specialists showed that this increment should be substantial. The value as charcoal and firewood (m.) was considered to be zero because the farmer reported that he preferred to use the sticks of wood on his farm for repairing his hedgerows. He relied on another farm for firewood.

Table 1. 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	43.56
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

Table 1 shows a positive NPV of $339.95, indicating that the hedgerows make a substantial profit for the farmer using them. It must be noted that this NPV is obtained with only partial results since the pigeon pea operation is not taken into account. Producing pigeon peas involves having the same fixed cost (year 0) as that for maize production. Consequently, only the variable costs of the yearly operations should increase. The increase in variable costs will be offset by the income coming from pigeon pea production. If maize production only is considered, Table 1 shows that the NPV turns positive only after four years of operation. If the data for pigeon peas is included, this break-even point could be drastically shortened.

Hedgerow cultivation on that farm can also be considered successful since it has permitted the recuperation of fallow land. It must be noted that this farmer is an experienced manager of hedgerows because he has another farm on which he has already used this technique. Consequently, his intangible cost of learning the

management of hedgerows was low. His intangible income, the satisfaction of having salvaged a farm that everybody considered lost, was very high.

B. Madeque Farm

To facilitate our analysis, this farm is best divided in two parts. One part, about 75 percent of the farm, is on a very steep hill. The rest of the farm has a much lower slope. It was not possible to determine the area of the farm since the farmer did not volunteer this information. A reasonable estimate would be that it is about 1/16 of a carreau, which is equal to 806 square meters. This farm has nine rows of "living fence" made with leucaena, the length of which goes from 6m to 26m for a total of 166.30m. Before the establishment of the hedgerows the farmer primarily cultivated vetiver (Vetiveria zizanioides). With the hedgerows, the farm now grows a combination of maize and trees, primarily cedars (Cedrela odorata). The farmer reported that the production that the author weighed during the research would be completely sold to pay for his children's upcoming school tuition. Most of the work on the farm is done by family members. The farmer was using leucaena leaves to feed his animals, most of which were sheep. He claimed to have pigs but none of these were visible during our visits to his farm.

The incomes and costs can be broken down as follows.

Cost		Income	
a.	150.00	i.	89.60
b.	10.00	j.	0.00
c.	47.50	k.	72.00
d.	20.00	l.	NA
e.	4.00	m.	50.00
f.	2.00		
g.	4.00		
h.	0.00		

In determining cost, the price of the land (a.) is based on an estimate made in collaboration with PADF field staff. The farmer was very reluctant to speak about anything even remotely connected with the economics of his land. The opportunity cost for changing crops is based on the production and price of vetiver that was the previous crop previously grown on the farm. The farmer indicated that before establishing hedgerows he formerly had one harvest of vetiver per year that weighed about 50kg. The price received for Vetiver was one gourde ($0.20) per kilogram, for a total income of 50 gourdes or $10. At the time of this writing, the price of vetiver had dropped even further to 0.80 gourde ($0.16). We chose to keep the old price for our analysis because it cannot be determined whether the decrease observed during the research is permanent or temporary. Also, vetiver cultivation, as practiced in

Haiti, is a significant cause of soil erosion. Farmers customarily burn the land before harvesting it. They then cut the grass at soil level, leaving the land bare. If it rains during this period, top soil is lost. Consequently, vetiver has a declining market value coupled with a production that is also declining over time. Unfortunately, this decrease in production has yet to be quantified and it cannot be properly assessed. The cost of making the hedgerow (c.) and preparing the land (d.) were calculated in the same way as were the data for the Nan Suzan farm. Most of the variable costs are accomplished by family labor (e., f., g.). The costs shown are the prices paid if the farmer has to pay a worker.

In examining income, maize (i.) is the main product sold. The production here is superior to that of the first farm, mainly because the planting density was much higher. The value shown is for the crops that were weighed on the farm as well for other production that was not weighed. This last portion of the production was estimated at one-third of the production that was weighed. The weighed production was 168 kg. The revenue generated by maize was accordingly calculated at 168 x $0.40 + (168/3) x $0.40= $89.60. The farmer said that he sells most of his crop to have cash to cover his expenses. The farmer reported no home consumption (j.). His statement, however, should be cautiously evaluated. The only herd observed on the farm was sheep. Although the farmer claimed to have pigs, few sources of customary food for them were seen on the site. To feed them, a big part of the forage for the animals must have come from leucaena leaves (k.). Those leaves cannot be absorbed in large amounts because high consumption is toxic to animals (Pound et al., 1983). The farmer knew that too much leucaena in the diet of his animals would be bad for them. Accordingly, the estimated value of leucaena as fodder is calculated on the basis of its use as complementary feed. It cannot be used as the primary feed. Before cultivating the hedgerows, the farmer used to buy four sacks of lactation feed per year. He has now replaced that feed with leucaena. The remainder of the animal diet is composed of sorghum, maize or anything else that is available and edible. This farmer did not use leucaena leaves as green mulch (l.) so its value as green manure is zero. The hedgerows provide the farmer with all the firewood that is needed for household consumption. He also said that, although he usually does not make charcoal, he occasionally produced it at a friend's request, or if his family urgently needed cash. The farmer had also planted a large amount of cedars on his farm that, after only one year, had grown two meters high. He planned to let them grow for at least five more years to have wood for planks. Planks are in great demand in the region. The estimates provided are based on the value of products for household consumption ($40), and for the estimated five sacks of charcoal that the family made per year ($10).

Table 2. NPV for the Madèque 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	207.50	0.00	207.50	0.00	-207.50
1	36.00	253.92	27.69	195.32	167.63
2	43.20	304.70	25.56	180.30	154.74
3	51.84	365.64	23.60	166.43	148.83
4	62.21	438.77	21.78	153.63	131.85
5	74.65	526.53	20.11	141.81	121.70
6	89.58	631.83	18.56	130.90	112.34
7	107.50	758.20	17.13	120.83	103.70
8	128.99	909.84	15.81	111.54	95.72
9	154.79	1091.81	14.60	102.96	88.36
10	185.75	1310.17	13.47	95.04	81.56
11	222.90	1572.21	12.44	87.73	75.29
12	267.48	1886.65	11.48	80.98	69.50
13	320.98	2263.98	10.60	74.75	64.15
14	385.18	2716.77	9.78	69.00	59.22
15	462.21	3260.13	9.03	63.69	54.66
16	554.65	3912.15	8.34	58.79	50.46
				NPV	1366.21

Table 2 shows a high positive Net Present Value. In one and one-half years the benefits exceed the costs. If we had the value of intangibles, the benefits would easily exceed the costs. The farmer reported that he had no problems mastering hedgerow techniques. He is aware that he had protected his capital land. He had become an active promoter of the use of hedgerows in his area. The results reported are estimated using very conservative income figures. If all the data could have been more precisely measured, it is highly probable that the NPV would be higher.

C. Archambeau Farm (I)

The Archambeau Farm I is the first of three located in the Archambeau area. It is on a moderately steep hill (less than 30 degrees) on which the farmer is cultivating maize. During the period of data collection, the farmer was replacing some of his maize production with Napier grass (Pennisetum purpureum) to provide forage for animals. His hedgerow is made with leucaena and has a total length of 156.30m. This farm was left fallow for two years prior to the establishment of the hedgerow. The farmer previously used it to cultivate rice but diminishing rain caused him to cease that operation.

The income and costs for this operation, are:

Costs		Income	
a.	200.00	i.	47.00
b.	0.00	j.	23.00
c.	44.66	k.	NA
d.	16.00	l.	NA
e.	4.00	m.	40.00
f.	2.00		
g.	4.00		
h.	0.00		

The price of land (a) for one sixteenth (1/16) of a carreau is $200. The price for land is higher than for the other farms because there is a well nearby that provides irrigation during the first two months following the rainy season. There is no opportunity cost (b.) for changing crops since the land was fallowed prior to the establishment of hedgerows. The hedgerow cost was computed in the same way as the previous cases: (156.30:31.5) x 9=$44.65. For the land preparation of this farm the farmer hired a plowman and his implements for $6.00. Two of his sons then worked one day in the places that the plough could not work. Planting, weeding and harvesting (e., f., g.) were determined from data given by the farmers during interviews. This farmer used no chemical fertilizers or insecticides (h.). Before harvesting the fields showed noticeable losses from attack by larvae. The losses were so great that the farmers in that area are seeking insecticides for use during the next season.

The yield on that field (97.50 kg.) was rather low given the apparent fertility of the land. Two factors could account for these results. The first would be the insect attack. Secondly, the production was weighed by the author more than one week after it was harvested. It is possible that the farmer sold or consumed some of the crop during that period. Home consumption is estimated at one-third of the total production. This figure is hard to determine because it varies according to the urgency of the needs of the farmer. The farmers in the area consider maize to be their primary cash-crop. This farmer uses leucaena leaves as fodder, but this use may decrease. He reported a desire to grow Napier grass on his hedgerow. He is using leucaena to supplement his animals' diet. He owned some flat land where most of his herd grazed. The value of leucaena as fodder was not estimated, however, because the quantity of leucaena leaves used could not be determined. Most of the leucaena leaves (l.) are used as mulch. Even if he has been using it this way for some time, no increase in production was apparent. This lack of increase may be due to pest

damage. This farmer reported that he was getting most of his firewood from the hedgerow. The computed value (m.) is based on his monthly consumption of wood.

Table 3. NPV for the Archambeau I 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	244.66	0.00	244.66	0.00	-244.66
1	84.79	132.00	65.22	101.54	36.31
2	101.75	158.40	60.21	93.73	33.52
3	122.10	190.08	55.58	86.52	30.94
4	146.52	228.10	51.30	79.86	28.56
5	175.82	273.72	47.35	73.72	26.36
6	210.99	328.46	43.71	68.05	24.34
7	253.19	394.15	40.35	62.81	22.46
8	303.83	472.98	37.25	57.98	20.74
9	364.59	567.58	34.38	53.52	19.14
10	437.51	681.09	31.74	49.41	17.67
11	525.01	817.31	29.29	45.60	16.31
12	630.01	980.77	27.04	42.10	15.06
13	756.01	1176.93	24.96	38.86	13.90
14	907.22	1412.31	23.04	35.87	12.83
15	1088.66	1694.77	21.27	33.11	11.84
16	1306.39	2033.73	19.63	30.56	10.93
				NPV	96.25

Table 3 shows that the costs for the operation are paid back in six years. This time span is greater than in the preceding cases because of the lower yields coupled with a higher value for land. It would be interesting to see if the cost of any insecticides would be offset by higher production. The farmer reported that he had previously applied an insecticide (dictorèse granulé) that gave him good results. In recent years this product has become unavailable in the Les Cayes area. In spite of such hindrances, the farm's NPV remained positive.

D. Archambeau Farm (II)

This farm is near the first Archambeau farm. The slope is mild (less than 15 per cent). The farmer claimed 1/16 of a carreau, but all others who have seen the farm have concluded that his area is actually larger. Because this farm is at the lower part of a hill, it receives soil eroded from other farms located at the top of the hill. It has only two rows of hedgerows with a total length of 46.35m in the upper part of the farm. The farmer cultivates maize

and sorghum and he plans to grow Napier grass for his herd. Only the maize crop was weighed during this study. This farmer also used chemical fertilizers during the cultivation of this plot (20-20-20 with 45% of Urea). He selected this formula without a soil analysis and simply used the fertilizer because it was given to him by tobacco company agronomists.

The costs and income have the following breakdown:

Cost		Income	
a.	200.00	i.	71.25
b.	20.00	j.	23.75
c.	13.25	k.	18.00
d.	14.00	l.	NA
e.	4.00	m.	NA
f.	2.00		
g.	4.00		
h.	23.00		

The cost of the land (a.) is the price reported by the farmer. The price of land is similar to that of the preceding farm. Given the physical location of the farm and its larger area, the price should be higher. Before installing the hedgerows, the farmer was already cultivating corn, so the value (b.) corresponds to the lost income of the area now occupied by the hedgerows. The price of the hedgerows (c.) was computed using the same method as used in the earlier cases. As with the other Archambeau farm, this farmer is renting the services of a plowman (d). He paid seven dollars for the preparation of his entire parcel. The prices of the farm work (e., f., g.) are based on the numbers given in interviews with the farmer. At the time of this study, the price of fertilizer (h.) in Les Cayes was $23. Because it is an imported product, its price fluctuates considerably according to the rate of gourde to the dollar.

It was not possible to directly weigh the harvest of this farmer during our research. Fortunately, the farmer reported the precise number of marmites that he had harvested. There is a problem, however, with translating the marmite measure into a metric value. Simple experiments with the help of four different respondents resulted in four different metric weights from marmites. The quantities given ranged from 2.5 kg. to 2.9 kg. Following a conservative approach, the lowest value was used. The farmer reported harvesting 95 marmites, which were the equivalent to 237.5 kg. of corn, for a total value of $95.00 (i.). This is a very high yield for a zone that is infested with insects, even if fertilizers are used. This yield tends to confirm that this farm had a greater area than that reported by the farmer. Since the farmer routinely had two harvests a year, the second harvest was

estimated at one-third of the first one. The farmer reported that he was keeping one-fourth of his production for his family. This estimated proportion is low but can be explained by the fact that, at the time of the harvest, the farmer had to assume the funeral expenses of a relative and had an extraordinary need for cash. This farmer had some pigs and uses Leucaena leaves in the feed that he gives them. The estimated price given for the feed is a conservative one since the hedgerows are rather small. The income coming from wood (m.) as energy has not been included since the farmer had no idea how often or in what amount he had taken wood from his hedgerows.

Table 4. NPV for the Archambeau II 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	233.25	0.00	233.25	0.00	-233.25
1	58.80	217.20	45.23	167.08	121.85
2	70.56	260.64	41.75	154.22	112.47
3	84.67	312.77	38.54	142.36	103.82
4	101.61	375.32	35.58	131.41	95.84
5	121.93	450.39	32.84	121.30	88.46
6	146.31	540.46	30.31	111.97	81.66
7	175.58	648.56	27.98	103.36	75.38
8	210.69	778.27	25.83	95.41	69.58
9	252.83	933.92	23.84	88.07	64.23
10	303.40	1120.70	22.01	81.29	59.29
11	364.07	1344.85	20.31	75.04	54.73
12	436.89	1613.81	18.75	69.27	50.52
13	524.27	1936.58	17.31	63.94	46.63
14	629.12	2323.89	15.98	59.02	43.04
15	754.94	2788.67	14.75	54.48	39.73
16	905.93	3346.41	13.61	50.29	36.68
				NPV	910.64

As indicated by Table 4, this farm returns positive income after just two years. This result is achieved by accounting only half of the tangible benefits. The high NPV obtained is due mostly to high income, which is more than 3.5 times the value of the operational costs. This farmer is the only one reporting the use of chemical fertilizers. It would be interesting to know if, for such small operations as his, chemical products are economically justifiable in the production process. Most of the farmers of the area seemed interested in using fertilizers, but they are deterred from doing so by the outlay of cash that such products require.

E. Archambeau Farm (III)

This farm is in the same larger area as the two other Archambeau farms but a greater distance from them. The area of the farm is one-sixteenth of a carreau. It has three rows of leucaena hedgerows for a total of 66.80m. This hedgerow was not in good condition at the time of the study. It had several holes in it and the trees were not pruned. The hedgerows did not cover the entire area being farmed. About one-third of the farm was left for animals to graze upon. Members of the nearby community were trying to convince the farmer to take better care to his hedgerow, and to expand it to the remainder of his farm. The farmer was growing maize, with a production of 73.50 kg. of weighed harvest.

The cost and income breakdown are:

Cost		Income	
a.	150.00	i.	39.20
b.	NA	j.	0.00
c.	19.10	k.	18.00
d.	8.00	l.	NA
e.	4.00	m.	NA
f.	2.00		
g.	4.00		
h.	0.00		

The price of land (a.) is an estimate based on data from other interviews. As is commonly the case, the farmer was very reluctant to address this topic. Before installing the hedgerows, the land was used for grazing by the farmer's herd. The part of the farm that did not have hedgerows showed more bare land than land covered with grass. It is doubtful that the situation was different before the hedgerows were established. For that reason a change in productive activity using the land was not evaluated (b.). The making of the hedgerows (c.) was evaluated as previously. Land preparation (d.) was done by hand and the costs were estimated for two people working for two days. This farmer used no chemical fertilizers or insecticides. The operational costs were based on amounts obtained during interviews.

The value from the sale of the crops reflects the value of the crop weighed plus the estimated value of the farmer's second harvest. The latter harvest is estimated to be one third of the crop weighed (i.). The farmer reported that he was selling the whole crop to obtain cash (j.). Theoretically, his home consumption should be zero. Most of the people in the region believed, however, that he would retain some of the harvest for use by his household. The farmer had a number of animals, mostly sheep and goats, which were responsible for the poor condition of the hedgerows. The farmer himself admitted that he saw the hedgerows

as having greater use as fodder than for anything else. Since he is not buying prepared feed, it is difficult to know the value of the leucaena leaves consumed (k.). The value indicated here is a minimum and corresponds to only one sack of prepared mixed feed per season.

Table 5. NPV for the Archambeau III 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	169.10	0.00	169.10	0.00	-169.10
1	26.40	68.64	20.31	52.80	32.49
2	31.68	82.37	18.75	48.74	29.99
3	38.02	98.84	17.30	44.99	27.69
4	45.62	118.61	15.97	41.53	25.56
5	54.74	142.33	14.74	38.33	23.59
6	65.69	170.80	13.61	35.39	21.78
7	78.83	204.96	12.56	32.66	20.10
8	94.60	245.95	11.60	30.15	18.55
9	113.52	295.14	10.70	27.83	17.13
10	136.22	354.17	9.88	25.69	15.81
11	163.46	425.00	9.12	23.71	14.59
12	196.15	510.00	8.42	21.89	13.47
13	235.39	612.00	7.77	20.21	12.43
14	282.46	734.40	7.17	18.65	11.48
15	338.95	881.28	6.62	17.22	10.60
16	406.75	1057.54	6.11	15.89	9.78
				NPV	135.94

The NPV for this farm is positive, although it takes more than six years for a positive turnover overall. This result can be explained by the fact that several benefits could not be estimated, and because the farmer was not taking good care of his hedgerows. It should be emphasized that this NPV is a minimum and it could easily be increased.

F. Sainte Helene Farm

This farm is on a mild slope near the road to Maniche. It has a one-sixteenth of a carreau where the farmer grew corn in rotation with sorghum (pitimi). This farm has four lines of hedgerows for a total of 96m. The hedgerows did not occupy the whole area of the farm. Associated with the hedgerows were several cedars. Although they are less than two years old, the trees are already two meters high. It is likely that the shadow created by them is reducing the yield of corn.

The breakdown for cost and income is:

Cost		Income	
a.	150.00	i.	23.00
b.	NA	j.	10.00
c.	27.43	k.	NA
d.	4.00	l.	NA
e.	2.00	m.	NA
f.	1.00		
g.	2.00		
h.	0.00		

The cost of the land (a.) is the price at which the farmer would be willing to sell his farm in the region. Before installing hedgerows, the farmer previously cultivated maize on the land. It was impossible to determine the production of the area now occupied by the hedgerows. As a result, the opportunity cost of changing crops was not determined (b.). The cost of making the hedgerows (c.) was computed in the same way as on the other farms. Land preparation was done by hand with family labor. The value here accounted for one land preparation during the year (d.). This farm used no chemical products. Family labor provided for routine operations.

This output was not weighed by the author. The farmer reported that he had obtained 33 marmites of corn in this harvest, and that he kept 10 marmites for himself (i., j.). The other income items were not evaluated. Even if the farmer acknowledged the use of leucaena as fodder and a green manure, he is not using another feed that can be used to provide estimates of his consumption. Furthermore, his herd is not located on the land examined. He used the sticks of wood produced by trimming his hedgerows to repair them and he did not use the sticks for firewood.

Table 6. NPV for the Ste Helène 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	177.43	0.00	177.43	0.00	-177.43
1	10.80	39.60	8.31	30.46	22.15
2	12.96	47.52	7.67	28.12	20.45
3	15.55	57.02	7.08	25.96	18.88
4	18.66	68.43	6.53	23.96	17.42
5	22.39	82.11	6.03	22.12	16.08
6	26.87	98.54	5.57	20.41	14.85
7	32.25	118.24	5.14	18.84	13.70
8	38.70	141.89	4.74	17.39	12.65
9	46.44	170.27	4.38	16.06	11.68
10	55.73	204.33	4.04	14.82	10.78
11	66.87	245.19	3.73	13.68	9.95
12	80.24	294.23	3.44	12.63	9.18
13	96.29	353.08	3.18	11.66	8.48
14	115.55	423.69	2.93	10.76	7.83
15	138.66	508.43	2.71	9.93	7.22
16	166.40	610.12	2.50	9.17	6.67
				NPV	30.55

The NPV is still positive even when several items that are beneficial were not included in the evaluation. Nevertheless, a positive NPV is reached after 13 years. If more data had been available, there is no doubt that this operation would have a higher NPV.

2. Farms in the Northwestern Region

The research conducted in the Northwestern region was impaired by a severe drought that destroyed most of the crops in it. For that reason, the author was obliged to base his study on secondary evaluations. To improve accuracy, the evaluations presented are based on repeated observations and discussions with CARE field staff in region II. Three farms were selected for study.

A. Barbe Pangnol Farm (I)

This farm is in a mildly steep hill just behind CARE's Barbe Pangnol training facility. The farm has an area of about 12,900 square meters (one carreau). The land, by all appearances, had scant fertility. It had 10 lines of hedgerows composed of leucaena

and two lines of hedgerows made of benzolive (Moringa oleifera). The lengths of the rows were from 11.20m to 38.40m, for a total length of 286.4m. The hedgerows were not well maintained. For the most part the trees had a height of more than two meters. The farmer was growing cassava (Manihot utilissima) and sweet potato (Ipomea batatas). He was expecting to harvest his cassava in December. The cassava is an annual plant, so the farmer can only expect one harvest during the year. The breakdown for cost and income is as follows:

Cost		Income	
a.	300.00	i.	84.00
b.	12.00	j.	NA
c.	34.30	k.	NA
d.	14.00	l.	NA
e.	6.00	m.	NA
f.	7.00		
g.	2.00		
h.	0.00		

The cost of land (a.) has seriously depreciated in the last two years because of the drought. Many people are anxious to sell their land to enable them or their relatives to emigrate to the U. S., Canada, other islands in the Caribbean or to the neighboring Dominican Republic. The price shown here was established without actual bargaining. Before the hedgerows were planted on this land, cassava and sweet potatoes were being grown on it. The farmer estimated that, with the establishment of hedgerows (b.), he had lost two "charges" of cassava. The unit of measurement for cassava and potatoes in the region is the "charge." As with many measurement units in Haiti, a "charge" of any product is more a matter of volume than weight. The matter can be further complicated with the "charge" since there is a "mule charge" and a "bourik charge". A "charge" of cassava weighs around 20 kgs. A charge of sweet potato would be of comparable weight, but the crop was not available on the farm during the study.

The farmer's statement that he lost two charges of cassava must be considered with some skepticism. The farmer maintained no records and his memory was faulty and selective. The cost for establishing hedgerows (c.) is based on the method used for the second farm as described in the methodology section. The total length of the farm's hedgerows (286.40m) has been divided by 66.80m, the length of the first hedgerow observed by the author. The result of this division, 4.29, was multiplied by eight, the salary in dollars required by four persons working two days. The value for land preparation (d.) is based on the observations that the task required seven persons working two days, that all the work was done by hand, and that no animal traction was used.

Maintenance work was also done by hand, and the effect of the drought made weeding an easier task. This farmer used no chemical fertilizers or insecticides.

The price for a charge of either cassava or potatoes at the time of the study fluctuated between $6 and $7. Maintaining a conservative stance, the lowest price ($6) was used. The farmer said that he hoped to produce 8 "charges" of cassava and 6 of sweet potatoes for a total income of $84. The portion used for home consumption depends on the cash needs of the farmer at harvest time. Generally, the farmer considers those crops as cash crops. The farmer fed his herd of goats with a mix of mangoes, leucaena leaves and whatever else was available. Since he is not monitoring what he feeds to his animals, it is impossible to make any evaluation of the hedgerow contribution (k.). The farmer also reports using the green leaves as mulch but this practice was not observed by the author (l.). The farmer reported that he uses wood from the hedgerows as firewood for his family and relatives.

The NPV for this operation is shown in Table 7.

Table 7. NPV for the Barbe Pangnol (I) Farm at a 30 Percent Discount Rate for Cassava and Sweet Potato Production (Values in Dollars)

Year	Cost	Benefit	P.V.Cost	P.V.Benefit	Net P.V.Benefit
0	345.30	0.00	345.30	0.00	-345.30
1	34.80	100.80	26.77	77.54	50.77
2	41.76	120.96	24.71	71.57	46.86
3	50.11	145.15	22.81	66.07	43.26
4	60.13	174.18	21.05	60.99	39.93
5	72.16	209.02	19.44	56.29	36.86
6	86.59	250.82	17.94	51.96	34.02
7	103.91	300.99	16.56	47.97	31.41
8	124.69	361.18	15.29	44.28	28.99
9	149.63	433.42	14.11	40.87	26.76
10	179.56	520.11	13.02	37.73	24.70
11	215.47	624.13	12.02	34.83	22.80
12	258.57	748.95	11.10	32.15	21.05
13	310.28	898.74	10.24	29.67	19.43
14	372.34	1078.49	9.46	27.39	17.93
15	446.80	1294.19	8.73	25.28	16.56
16	536.16	1553.03	8.06	23.34	15.28
				NPV	131.32

The Net Present Value for this operation is positive, as shown in Table 7, but a closer examination shows that the NPV turns positive only after nine years. This lag time for returns is primarily because several benefits were not accounted for because of lack of data, while most of the costs are included. The estimates for production were low because of the drought and losses due to insects. At present, the Barbe Pangnol Trial Center of CARE is seeking new varieties of cassava that are reportedly drought and insect resistant. If positive results are obtained, a serious increase in the NPV can be expected.

B. Barbe Pangnol (II)

The second Barbe Pangnol farm is also located near the Barbe Pangnol station, by the side of the market. This farm had an area of a little more than one carreau. The area around the house has been planted with trees, mostly neem and eucalyptus. The hedgerows occupy one-third of the steepest part of the farm. There are three lines of hedgerows for a total length of 132.30m. As in the preceding cases, cassava and sweet potatoes are cultivated on this farm.

The cost and income breakdown are:

	Cost		Income
a.	150.00	i.	30.00
b.	0.00	j.	0.00
c.	15.84	k.	NA
d.	2.00	l.	NA
e.	1.00	m.	0.00
f.	1.00		
g.	1.00		
h.	0.00		

The land of this farmer is in much better condition than that of the preceding farmer. Under normal circumstances, it would have a higher starting sale price, around $350 for the whole parcel. Since the hedgerows occupied more than one-third of the farm, the price for the area occupied by them has been estimated at $150 (a.). In the site where the farmer has now planted his hedgerows, he formerly had leucaena. Because he planted his hedgerows on unoccupied spaces, the opportunity cost is considered to be zero (b.). The cost of making a hedgerow was computed using the same method as on the preceding farm (c.). The land preparation estimate (d.) is based on the time required by the farmer working with a hoe alone. Although the farmer worked by himself on his farm and the area is larger than that of the plots examined in the South, conditions permit him to work faster. Most of the work required to cultivate the system was accomplished by him working

alone. Some of his work requires less than a full day, but we conservatively count it as a full day's work. As with most of the farmers in the area and throughout Haiti, he used no chemical fertilizers or pesticides.

The income (i.) is based on a yield of three charges for cassava and two charges for sweet potato. This yield appears high compared to the preceding farm, but the farm had practically no insect infestation. The hedgerows are in much better shape than were those of the other farmer. The farmer said that the crops obtained in his farm are cash crops, and he is not planning to keep an amount of any value for himself (k.). The farmer fed leucaena leaves to his herd. Since he is not using any commercial product, it is not possible to assign a value to the substituted consumption of the leaves. Since the farm has a well-developed woodlot, the farmer indicated that most of his firewood came from there. He generally used the wood from the hedgerows for farm repairs or gave it to relatives (m.).

Table 8. NPV for the Barbe Pangnol II Farm at a 30 Percent Discount Rate for Cassava and Sweet Potato Production (Values in Dollars)

Year	Cost	Benefit	P.V.Cost	P.V.Benefit	Net P.V.Benefit
0	165.84	0.00	165.84	0.00	-165.84
1	6.00	36.00	4.62	27.69	23.08
2	7.20	43.20	4.26	25.56	21.30
3	8.64	51.84	3.93	23.60	19.66
4	10.37	62.21	3.63	21.78	18.15
5	12.44	74.65	3.35	20.11	16.75
6	14.93	89.58	3.09	18.56	15.47
7	17.92	107.50	2.86	17.13	14.28
8	21.50	128.99	2.64	15.81	13.18
9	25.80	154.79	2.43	14.60	12.16
10	30.96	185.75	2.25	13.47	11.23
11	37.15	222.90	2.07	12.44	10.36
12	44.58	267.48	1.91	11.48	9.57
13	53.50	320.98	1.77	10.60	8.83
14	64.20	385.18	1.63	9.78	8.15
15	77.04	462.21	1.51	9.03	7.53
16	92.44	554.65	1.39	8.34	6.95
				NPV	50.81

Table 8 shows a positive Net Present Value for this operation. The NPV turns positive after just three years. As in the preceding case, some benefits could not be included in the calculations. The results shown can be considered as the minimum that may accrue.

C. The Gombo Farm

This farm is on a very steep hill in the Gombo area that is located immediately before Barbe Pangnol. The area of this farm is one-sixteenth of a carreau. It has four lines of leucaena hedgerows totalling of 81.40m. The farmer initially attempted to grow maize and sorghum, but he lost both crops to the drought. Since he could not find any maize or sorghum seeds, he decided to plant cassava.

The income and cost breakdown for this farm are as follows.

	Cost		Income
a.	80.00	i.	4.00
b.	0.00	j.	0.00
c.	9.77	k.	NA
d.	1.00	l.	NA
e.	1.00	m.	NA
f.	1.00		
g.	1.00		
h.	0.00		

The farmer reported that he would ask $100.00 for his farm. Given the condition and the position of the farm, this price seemed exaggerated, and was scaled down to $80.00 (a.). Before installing the hedgerows, the farm was in fallow. Accordingly, the opportunity cost is zero (b.). The cost of making the hedgerows was computed in same way as for the first Barbe Pangnol farm (c.). The operational cost computed was based on information collected during interviews. It should be again noted that northwestern farmers can generally execute more work in a shorter time than can farmers in the South.

The income of this farm was calculated only for cassava production. The farmer expected a full charge of cassava. Given the condition and the density of the plants, his expectations seemed unrealistic, and the income has been computed for half this quantity (i.). This farmer is planning to sell all his production to obtain cash (k.). Estimates for the other sources of income were not made because of a lack of data from reliable sources. The value of leucaena as fodder is important to this farmer, who lost a big part of his income to the drought. The value of the hedgerows as firewood is undoubtedly high. This farmer reported that he let his trees grow to produce firewood. If those two income sources could be reasonably evaluated, the value of the income would certainly increase.

The NPV for this farm is shown in Table 9.

Table 9. NPV for the Gombo Farm at a 30 Percent Discount Rate for Cassava Production (Values in Dollars)

Year	Cost	Benefit	P.V.Cost	P.V.Benefit	Net P.V.Benefit
0	80.67	0.00	80.67	0.00	-80.67
1	4.80	3.60	3.69	2.77	-0.92
2	5.76	4.32	3.41	2.56	-0.85
3	6.91	5.18	3.15	2.36	-0.79
4	8.29	6.22	2.90	2.18	-0.73
5	9.95	7.46	2.68	2.01	-0.67
6	11.94	8.96	2.47	1.86	-0.62
7	14.33	10.75	2.28	1.71	-0.57
8	17.20	12.90	2.11	1.58	-0.53
9	20.64	15.48	1.95	1.46	-0.49
10	24.77	18.58	1.80	1.35	-0.45
11	29.72	22.29	1.66	1.24	-0.41
12	35.66	26.75	1.53	1.15	-0.38
13	42.80	32.10	1.41	1.06	-0.35
14	51.36	38.52	1.30	0.98	-0.33
15	61.63	46.22	1.20	0.90	-0.30
16	73.95	55.47	1.11	0.83	-0.28
				NPV	-99.44

This farm has a negative NPV, which is consistent with the facts that the income ($3) is less than the operational cost. Production can only result in a loss. As previously mentioned, the results reported are influenced by the fact that many benefits could not be evaluated. It should be further noted that the farmer is particularly pleased at having rehabilitated his land. He is considering planting more trees and increasing the number of his animals. He is planning to pursue these alternatives because it is difficult for him to obtain seeds for other crops.

V. CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

Eight of the nine farms studied had positive Net Present Values in their hedgerow operations. The profitability of hedgerows was proven under different sets of production conditions. The research reported followed a conservative approach in making calculations. Some benefits, which are often very important to the farmer, were underestimated or not assessed.

Three important factors influence the results reported.

1. Hedgerows are often established in fallow land where production has not taken place for several years. Accordingly, the opportunity cost for changing crops is commonly zero.

2. Even if there was production before the hedgerows were planted, it was an annual crop with a declining value. In the South, the area where vetiver production takes place, the price for the crop has declined. The crop is a source of soil erosion.

3. Production with hedgerows makes available additional products such as fodder and firewood. Previously, farmers had a more limited range of products available, usually only one or two.

All the farmers interviewed and observed during the course of the field work, even those who were not included in this report, were pleased with having installed hedgerows on their farms. In the South, many of them have became informal extension agents for other farmers. They are aware of the wide range of benefits obtained with hedgerows. The author was impressed by the way animal husbandry has been integrated with hedgerow systems. These systems should be examined in greater detail. The opportunity for farmers to increase the fodder for animals can be used to interest them in the cultivation of hedgerows.

2. Recommendations

Economic research on agroforestry should be continued to obtain additional information on the processes involved and to develop a larger data base. It is necessary to assess such benefits as the use of fodder, and the home consumption of firewood. To attain these goals the following suggestions are made:

1. A study of the on-farm benefits of hedgerows as fodder and firewood should be accomplished. Several farms with hedgerows are located next to other farms that continue to use older cultivation practices. Two or more case studies comparing such operations could provide useful data.

2. Most, if not all, farms observed during the course of this research use leucaena in their hedgerows. Trials should be conducted to discover which trees produce better fodder for animals. Even if the intoxication of animals by leucaena has not become apparent in an area, one or two cases could have a disastrous effect on the acceptance of such hedgerows. The author was surprised by the fact that very few farmers are aware that leucaena should only be used to complement other feed, and that it can be damaging to animals if they consume too much of it.

3. There is a need for agronomic trials that can determine the effect of leucaena used as green mulch upon crop production. The possible gains in soil saving from the use of the plant should also be determined. This project will allow for a more complete understanding of the economics of agroforestry in Haiti.

4. The results shown here can be simplified and serve as examples to show extension staff and others the benefits of hedgerow production.

5. The data show that the careful and routine management of hedgerows and other elements of the farmer's production system is directly related to it profitability. The link between the efforts of the farmer and profitability should be stressed to participating farmers as well as potential participants. Installing such innovations is not sufficient to produce a profit. Routine care, maintenance and management are crucial factors.

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