Adoption and Management of Alley Cropping in Haiti

Technical Bulletin No. 2004-02
April 2004
United States Agency for International Development
Soil Management Collaborative Research Support Program
Auburn University

Soil Management C•R•S•P

Adoption and Management of Alley Cropping in Haiti

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This work was made possible through support provided by the Global Bureau, United States Agency for International Development (USAID), under terms of Grant No. LAG-G-00-97-00002-00, and by the USAID/Haiti Mission through contracts with the South-East Consortium for International Development (SECID) in the Productive Land Use Systems (PLUS) Project (Contract No. 521-0217-C-00-5031-00). The research was initiated under the Soil Management CRSP in 1997. It continued to receive in-kind support from the PLUS project, through the housing of Soil Management CRSP staff by SECID, which also provided administration and logistical support. The authors would like to thank the USAID/Haiti mission for their patience and support, and the support of former SECID staff: Mrs. Marilyn Louis, former SECID Administrator and Dr. J.D. (Zach) Lea, SECID/Auburn COP from 1997-2001. Recognition is also given to the Center for Agriculture Research and Documentation (CRDA) of the Ministry of Agriculture, Natural Resources and Rural Development (MARNDR), our partners in the Steeplands Project. We express our gratitude to the staff of the PanAmerican Development Foundation (PADF) for their field support in carrying out the research. We also thank Dr. Tom Thurow and Dr. Anthony Juo of Texas A&M for their collaboration and support as Project Leaders for the Soil Management CRSP Project, ***Soil Management Practices for Sustainable Production on Densely Populated Tropical Steeplands.*** The opinions expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Agency for International Development.

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INTRODUCTION

HAITI, a hilly densely populated country, has experienced soil erosion problems for decades. The major impact of soil erosion in Haiti is a reduction of soil fertility that leads to decreasing agricultural productivity. Three-fourths of the country's area is mountainous with a population density of approximately 677 individuals per square kilometers of cultivated land (Jickling and White 1995). Agricultural population density in Haiti is among the highest in the western hemisphere. Agriculture, a major sector of the economy, is practiced by limited resource farmers on hillside plots exceeding 20 percent in slope. More than 60 percent of the land is currently under agricultural use, although only 32 percent of all lands are designated as arable. Almost 70 percent of the Haitian population depends directly on hillside farming (Jickling and White 1995).

Since the mid 1900's, domestic and international organizations have engaged in soil and water conservation campaigns in order to combat severe land degradation in Haiti. Early soil and water conservation efforts focused on techniques such as terraces, rock walls, and tree planting. These techniques have been largely promoted throughout the country in order to reduce soil erosion and increase agricultural production to feed an ever-growing population. Given the limited success of such practices (Paskett and Philoctete 1990), alley cropping was introduced as a technique with the capacity of not only limiting soil erosion, but also improving soil fertility.

Agronomic and economic analyses have shown the potential of alley cropping in several developing countries (Vogel 1986; Hernandez *et al.* 1995). Significant increases in crop yields were reported with the implementation of alley cropping in Africa (Shannon *et al.* 1994; Chirwa *et al.* 1994; Akyeampong and Hitimana 1996). Similarly, research on alley cropping indicated that this conservation practice may reduce soil loss and be more profitable than the traditional farming system (Ehui *et al.*1990; Paningbatan *et al.* 1995). Lea (1996) reported significant crop yield increases with alley cropping in Haiti. A long-term study in Pernier, Haiti showed that alley cropping sustained crops at a higher level than rock walls, contour canals, grass rows and alternative conservation practices promoted in Haiti (Shannon *el al.* 2003). However, a limited number of farmers have implemented alley cropping structure on their farms. Lea (2000) reported an adoption rate of less than 20 percent alley cropping in Haiti. Moreover, established structures are not properly managed in areas where alley cropping is promoted (Pierre *et al.* 1995).

This publication assesses the adoption of alley cropping in two Southern villages in Haiti. This research evaluates the pattern of adoption and management of alley cropping and examines factors influencing farmers' decision to adopt or not to adopt this soil and water conservation techniques.

CHARACTERISTICS OF THE STUDY AREA

Physical characteristics

This publication is based on a survey conducted on 120 farms in Gaita and Bannate, two villages within the Camp-Perrin area, in Southern Haiti (Figure 1). The area varies in elevation from 100 to 300 meters. The area is hilly with steep slopes reaching over 60 percent. The temperature averages 27° C and the average annual rainfall is usually between 1500 and 2000 mm. The rainy season is bimodal with rain occurring from February to May, and from July to November. The characteristics of the soils in the zone are not well studied. However, farmers often mention the low level of soil fertility in the area.

Several institutions, including Pwoje Sove Tè (PST), and Développement Communautaire Chrétien d'Haiti (DCCH), have encouraged planting of forest and fruit trees in the zone in the 1980's. The Pan American Development Foundation (PADF) has promoted alley cropping in both villages for the last decade as a technique for limiting surface erosion and improving soil fertility. While the practice was being diffused, the Productive Land Use System (PLUS) project, and the Soil Management Collaborative Research Support Program (SMCRSP) conducted research on tree species suitable for the conservation structures, and on the effects of alley cropping on crop yields in this, and neighboring areas.

Farming Systems

Small-scale farming dominates the agricultural sector in the zone. Farms are often composed of numerous plots, distributed in different micro-agro-ecological zones. Farmers in Gaita and Bannate operate an average of 3.3 plots within a range of 1.0 to 7.0 hectares. The size of an operated plot averages 0.44 hectare. The size of a farm is on average 1.44 ha, with a minimum of 0.16 ha and a maximum of 5.0 ha. Forty-one percent of farmers operate less than 1.0 ha, 46 percent have between 1.0 and 2.5 ha, and 13 operate more than 2.5 ha (Table 1).

TABLE 1. SIZE OF FARMS IN GAITA AND BANNATE, HAITI, 1999

Size	Percentage of farms
Less than 1 ha	41
1 to 2.5 ha	46
More than 2.5 ha	13

The farms produce a large number of crops, but subsistence food crops dominate agricultural production. The food crops include maize (*Zea mays*), sorghum (*Sorghum vulgare*), cassava (*Manihot cassava*), and beans (*Phaseolus vulgaris*). On some farms, small quantities of cash crops, such as coffee, yam (*Dioscorea spp*) and plantain (*Musa spp*) are produced. Soil fertility is a serious constraint to plant growth in the area. Fallowing and animal waste are the only means for regenerating soil fertility. Fallowing varies from one to three years in the Gaita and Bannate areas. The fallow period is longer on highly nutrient impoverished plots than on less degraded plots. Forest trees, noted on some plots, are vestigial remains of defunct projects and/or tree distribution activities that have accompanied the promotion of alley cropping. These trees represent occasional sources of income for families in Gaita and Bannate.

Livestock is an important activity associated with crop production. Animal production plays an important role in the local economy. For many farmers, the sale of animals represents a source of income that allows families to pay for important farm household expenses. More than 70 percent of farmers are

engaged in animal production. Cattle, chickens, goats, and pigs, are the animals most commonly encountered on the farms (Figure 2). Seventy-one percent of the farms produced chicken, while 68 percent and 46 percent produced cattle and goats, respectively. However, cattle and goats are the dominant animals grazed on fallow plots with or without conservation structures.

Animal production in the research area depends heavily on crop residues and local grass species used for fodder. Between January and March, the cattle and goats obtain feed from grazing on residues of harvested sorghum. The animals feed on maize residues during the months of June and July. Fallow plots are constantly grazed. Nevertheless, food shortage remains a serious problem for a number of farms growing cattle and goats in those regions. Hence, the use of alley cropping structures represents an alternative source of food for cattle and goat production in the zones.

Socioeconomic conditions of the households

A survey was conducted in the areas of Gaita and Bannate to examine the diffusion of alley cropping, and the setting in which the process was taking place. The first aspect of the survey was to evaluate the socioeconomic conditions of peasants in the two villages. The socioeconomic conditions of the areas' residents vary from one household to another. The average size of households in Gaita and Bannate is about 5.37 within the range of one and 25 (Table 2). Forty-two percent of households have a size varying from three to five people, while households with less than three people, and those with more than five people, make up 18 percent and 40 percent, respectively. Many children within the households in Gaita and Bannate are attending school in the community. Seventy percent of households had children in school. On average, each household has two children in school. Forty-seven percent of households have one to three children in school; 23 percent have more than three children in school. Those figures reveal the high level of pressure being exerted on limited household resources in these communities.

TABLE 2. SELECTED CHARACTERISTICS OF HOUSEHOLDS IN GAITA AND BANNATE, HAITI, 1999

Item	Unit	Mean	Minimum	Maximum
Age of head	Years	50	18	84
Size of household	Number	5.37	1	25
Children in school	Number	2	1	5
Workers per ha	Number	3.17	0.19	21
Annual per capita income	Gourdes	2058	80	7895

Family members are the major source of labor for the farms in Gaita and Bannate. The average number of laborers over 15 years old available per hectare of land in a household is 3.17. For all the respondents, per hectare labor availability varies from 0.19 to 21, with 41 percent having less than two workers, and 41 percent between two and five workers. Members of households in the Gaita and Bannate communities diversify their activity in order to improve their standard of living.

Other than agriculture, farmers and family members devote part of their time to numerous non-agricultural activities. While the head of household may not be directly involved in non-agricultural activities, one or more other members usually participate in off-farm activities. Approximately 57 percent of farmers surveyed have off-farm activities that generate substantial revenues. Those activities include small commerce, charcoal making, labor service, arts and crafts, masonry, carpentry, and wood sawing. Farmers participate in those activities on a fairly regular basis. Other members of the family often engage

in off-farm activities, and still work on the farm. About 38 percent of all households in Gaita and Bannate have at least one member with off-farm employment.

All these farm and non-farm activities, including crop and livestock production generate cash revenues to the household. The level and structure of farmers' income in Gaita and Bannate are variable. Figure 3 presents the distribution of household incomes among the various sources.

Crop income in the hillside villages of Gaita and Bannate is the most important source of earnings. The level of crop income averages 3,391 gourdes, (1 gourde = US $0.05) ranging from 285 gourdes to 16,085 gourdes per annum. Including livestock production, the average annual agricultural income in Gaita and Bannate is 4,165 gourdes. Revenues from crops and animal production represent 38 percent and 9 percent of the households' annual income, respectively. Non-agricultural incomes appear to be higher than agricultural revenues. The average income per year from sources other than agriculture is 4,709 gourdes. Non-farm income made up 53 percent of total income. Including all sources, the level of income per year for a household is on average 8,874 gourdes. In terms of per capita, the level of income for a household is on average 2,058 gourdes. Forty-seven percent of the households have per capita incomes between 1,000 and 3,000 gourdes, while only 18 percent have more than 3,000 gourdes.

THE DIFFUSION OF ALLEY CROPPING IN THE STUDY AREA

The concept of alley cropping

Several techniques have been developed in an attempt to mitigate the negative effects of soil erosion in Haiti. One particular technique promoted in the last two or three decades is alley cropping. Alley cropping (Figure 4), as defined in several studies, is slightly different from a simple establishment of hedgerows. Alley cropping consists of growing crops between closely planted and regularly spaced hedgerows of fast-growing trees, usually nitrogen-fixing legumes. It has been suggested as an approach to improve soil fertility, and for controlling erosion. The trees are pruned regularly to minimize shading of associated crops to provide nutrient-rich, fast-decomposing leafy mulch, which, when incorporated into the soil, provides nutrients to the soil and crops (Bannister and Nair 1990; Winterbottom and Hazlewood 1987). In addition, alley cropping provides effective protection against erosion.

In Haiti, farmers have for several generations established hedgerows by planting trees and shrubs on contours, as a means of conserving soil, as windbreaks and/or as demarcation lines between plots. The distinction between contour hedgerows and alley cropping is that in the latter, the hedges are used primarily to maintain soil fertility through the application of prunings to the soil (Isaac *et al.* 1994).

The choice of tree species used in the establishment of alley cropping is particularly important for the improvement of soil fertility (Kang 1993). Trials have been conducted throughout the tropical region to identify tree species suitable for alley cropping. According to several studies cited by Isaac *et al.* (1994), species that have been found to give good results throughout the tropical regions include *Leucaena leucocephala*, *Leucaena diversifolia*, *Gliricidia sepium*, *Calliandra calothyrsus*, *Cassia siamea*, and *Erythrina poeppigiana*. In Haiti, shrub species traditionally used in hedgerows include *Anatherum zisanoides*, *Pennisetum purpureum*, *Agave sisalana*, *Panicum maximum*, *Saccharum officinale*, *Gliricidia sepium*, *Leucaena leucocephala*, and *Leucaena diversifolia* (Chéry 1989). The PLUS project has conducted trials in different environments in

Figure 1. Location of the Study Area

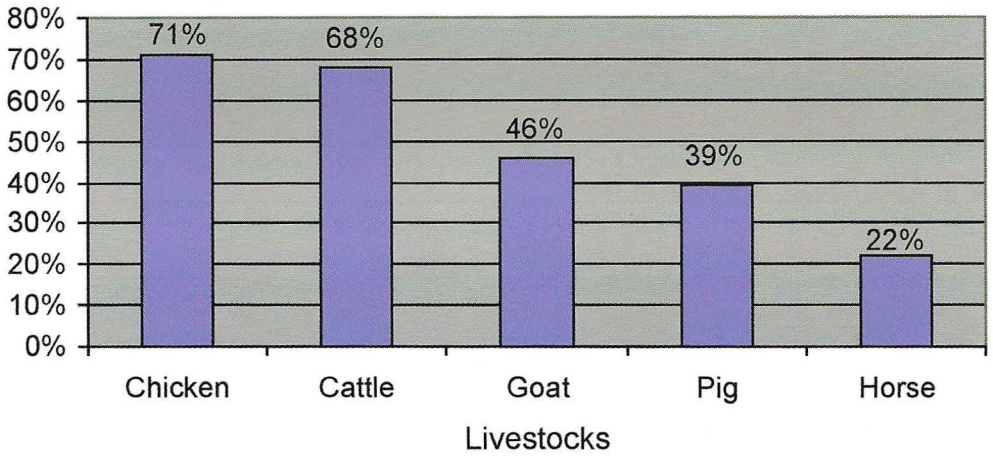

Figure 2. Distribution of Livestock on the Farms in Gaita and Bannate

Haiti to determine tree species adapted to Haitian conditions (Isaac *et al.* 1994). In terms of leaf and stem production, the results suggest that *Acasia angustissima*, *Leucaena* hybrid Kx3, *Leucaena leucocephala* and *diversifolia* are good in high elevation, whereas *Leucaena* hybrid Kx3, *Leucaena leucocephala*, *Leucaena shannonii*, *Leucaena diversifolia*, and *Cassia siamea* perform well on low elevations. In terms of nutrients, *Gliricidia sepium*, *Leucaena shannonii*, *Leucaena*, *leucocephala*, and *Delonix regia* provided adequate nitrogen for maize production in alley cropping at low elevation whereas *Acasia angustissima*, *Leucaena* hybrid Kx3, *Leucaena leucocephala*, *Leucaena diversifolia*, and *Flemingia macrophylla* were the most promising species in high eleva-

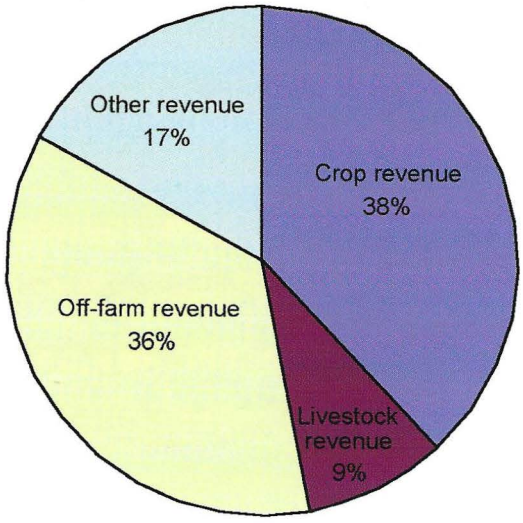

Figure 3. Distribution of Household Income in Gaita and Bannate, Haiti, 1999.

Figure 4. Alley Cropping System in Haiti.

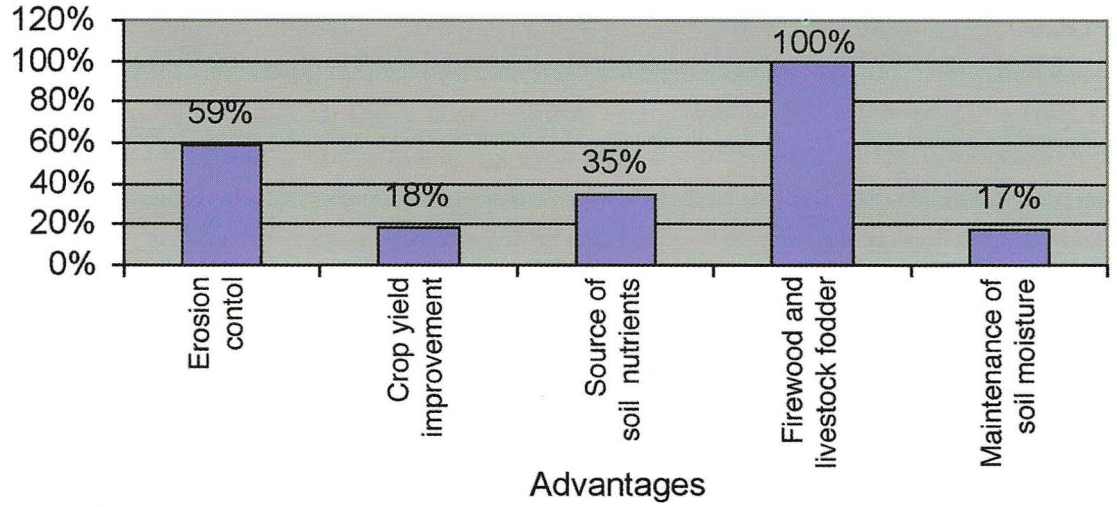

Figure 5. Stated Advantages of Alley Cropping by Adopters.

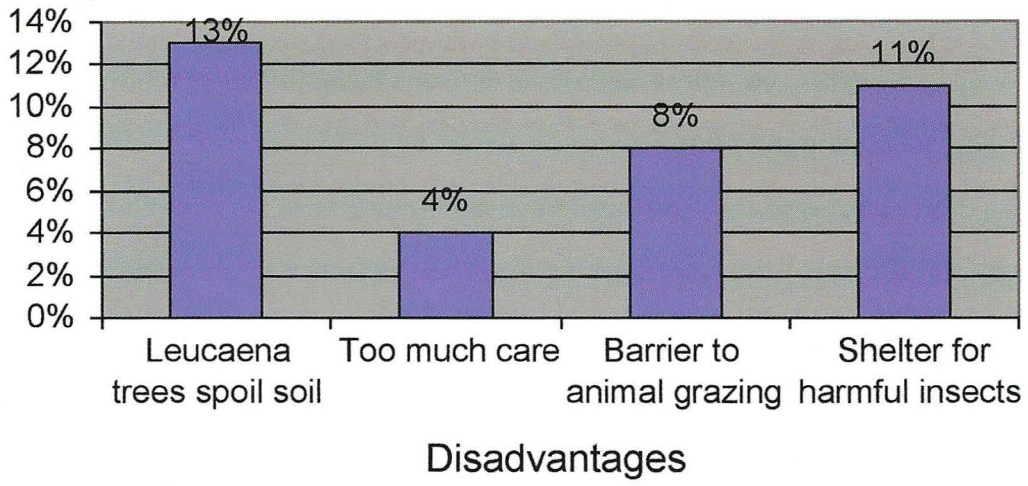

Figure 6. Stated Disadvantages of Alley Cropping by Adopters.

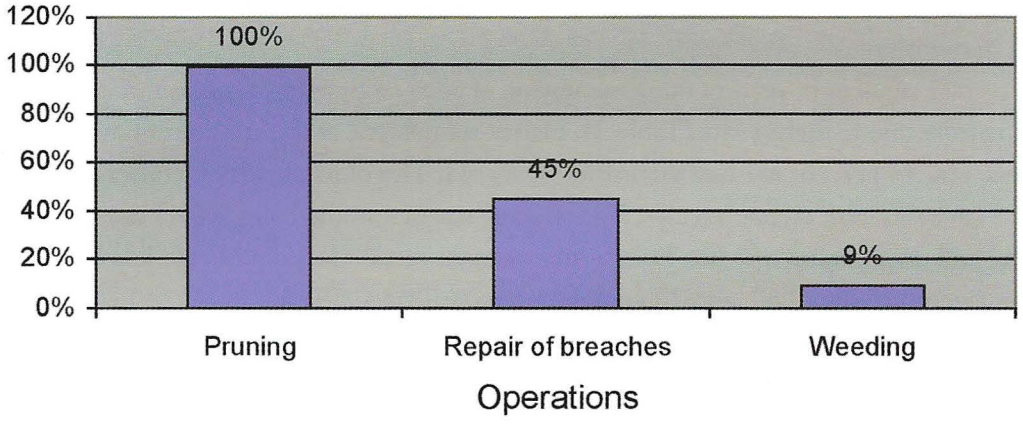

Figure 7. Management Operations by Adopters of Alley Cropping.

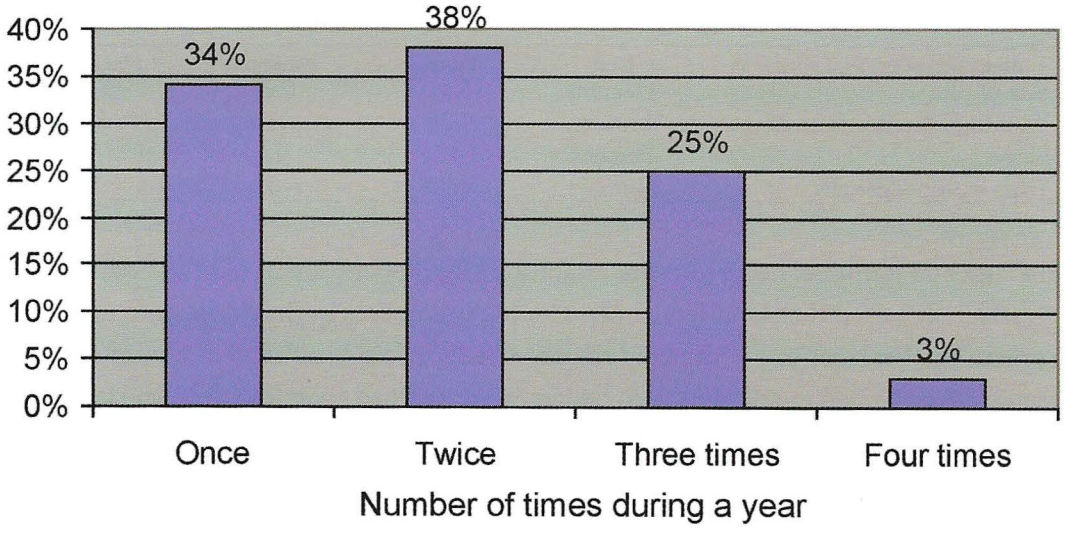

Figure 8. Pruning of Alley Cropping Structures n Gaita and Bannate, Haiti, 1999.

tion (Isaac *et al.* 2000). Nevertheless, trials focusing on the effects of tree species on crop yields rarely reproduced the mixed cropping systems implemented by farmers in the communities.

Pattern of alley cropping adoption

The diffusion of alley cropping as a sustainable soil conservation practice in Gaita and Bannate began more than a decade ago. *Leucaena* is the only species found in the alley cropping structures established in Gaita and Bannate. Alley cropping was diffused among farmers in Gaita and Bannate regardless of their socioeconomic status. All farmers have heard about alley cropping. Farmers interviewed in the area declared that alley cropping was introduced to them by PADF as a way to protect the soil against erosion and to improve soil fertility. PADF provided technical assistance and inputs for the establishment of the structures. Farm operators provided the required labor through peasant organizations participating in the diffusion process of alley cropping. To bolster the adoption of the technology, PADF also developed, with the collaboration of local organizations, a credit program where members who establish alley cropping on their plots obtain seeds on a credit basis for the major crops (beans, maize, and sorghum) produced in the region. Unfortunately, farmers comment on the short life span of the program, which was less than three seasons in duration.

The average number of years of implementation of alley cropping by farmers in Gaita and Bannate is 4.70, ranging from one to eight years (Table 3). Eighty-six percent of the structures have between three and eight years, and 14 percent are less than three years old. The plots on which conservation structures are established have different characteristics. The average size of a studied plot is 0.43 ha, with a minimum size of 0.05 ha, and a maximum of 1 ha. Twenty-five percent of all studied plots are less than 0.25 ha, 45 percent are between 0.25 and 0.50, and 30 percent are more than 0.50 ha.

Approximately 30 percent of the plots can be found in the backyard of the farm homesteads. Backyard plots are the most fertile among plots operated by hillside farmers in Haiti. Farmers make important investments on these plots since they are essential to farm household survival. Forty-two percent of the studied plots are at a distance of five to ten minutes from the household, and 28 percent are located at more than ten minutes walking distance from home.

TABLE 3. SELECTED CHARACTERISTICS OF HEDGEROW TREATED PLOTS IN GAITA AND BANNATE, HAITI, 1999.

Item	Unit	Mean	Minimum	Maximum
Size of plot	Hectare	0.43	0.05	0.70
Walking Distance from home	Minute	9.24	1	30
Slope	Percent	43	11	78
Years with hedgerows	Number	4.70	1	8

In Gaita and Bannate, hedgerows are established on plots irrespective of the nature of land ownership. It is widely believed that land tenure plays an important role in the decision to invest in soil conservation practices. Weak control of the land resources reduces the likelihood of investment in conservation structures. Forty-six percent of plots with hedgerows are owned (purchased) by the farm operators, 21 percent are inherited, and 23 percent are share crop holdings. Given this information, it is tempting to conclude that there is a tendency for farmers in Gaita and Bannate to establish hedgerows on owned-plots. Farmers, however, may establish hedgerows on any plot regardless of ownership rights for two major reasons: first, farmers may want to obtain access to the seeds given on loan through a conservation project, and second, the subsidies provided for installation of the structures are attractive.

The slopes of the plots with conservation structures vary from 15 percent to 78 percent. Twenty-eight percent of studied plots have slopes less than 35 percent. Twenty-two percent of studied plots have slopes between 36 and 45 percent, and 40 percent have slopes greater than 45 percent. Considering the rainfall (1,750 mm per year) on these sites, one can expect serious damages on those sloping plots without barriers. Indeed, accumulation of soil in several locations on studied plots is noted. Observations on surface erosion indicate that 37 percent of the plots are slightly eroded, 48 percent fairly eroded, and 15 percent are highly eroded.

When asked whether alley cropping is beneficial to the environment, 91 percent of all farmers interviewed stated "yes". Only 9 percent, mostly non-adopters, did not think that alley cropping improves the environment. Indeed, adopters of alley cropping with *Leucaena leucocephala* trees noted several advantages of the technique (Figure 5), including soil erosion barrier (59 percent), source of nutrients for crops (35 percent), maintenance of soil moisture (17 percent), provision of organic matter and improvement of crop yields (18 percent). Another advantage cited by all respondents is the use of leucaena leaves for livestock fodder and firewood.

A number of farmers mentioned some disadvantages of alley cropping structures (Figure 6). Thirteen percent of farmers indicated that *Leucaena* spoils their soil. They stated that *Leucaena* easily invades the plots and hinders cultivation. Farmers also mentioned that too much time is needed to maintain the structures, and that alley cropping represents an obstacle to animal grazing. Eleven percent of the alley cropping adopters mentioned that the hedgerows harbor small insects that sometimes cut crop leaves.

Profile of adopters of alley cropping

A total of 120 households were enumerated in both villages. Fifty-nine percent of surveyed farmers have contour hedgerows implemented at least on one plot. Among adopters, female heads of households counted for approximately 20 percent, and males 80 percent. The average age of the adopters is 51 years, with a minimum age of 18 and a maximum of 84 (Table 4). Farmers between 36 and 50 years of age represent 31 percent of all adopters. Adopters less than 36 and more than 50 years old made up 16 and 53 percent of the sample, respectively.

TABLE 4. SELECTED CHARACTERISTICS OF ADOPTERS OF ALLEY CROPPING IN GAITA AND BANNATE, HAITI, 1999

	Percentage of respondents
Age	
Less than 35 years	16
36 to 50 years	31
Above 51 years	53
Marital status	
Married	31
Single	39
Common law union	30
Education	
No schooling	58
Primary school	36
Secondary school	6

Common law is the most frequent form of family union among adopters of alley cropping in Gaita and Bannate. Thirty-nine of all unions are common law, while 31 percent are married. About 30 percent of all adopters state that they are single.

The level of education of farmers is categorized into three different groups. Fifty-eight percent of all adopters have no formal education; thirty-six percent have attended primary school, while approximately 6.0 percent have attended secondary school.

Despite the high level of illiteracy among farmers in the Gaita and Bannate area, a significant amount are trained in soil conservation. According to information collected in the study area, PADF organized training sessions for farmers who are interested in adopting alley cropping on their farms. Approximately fifty-four percent of all farmers received training in soil conservation. Adopters of alley cropping are most likely to receive this training. Seventy-three percent of adopters were trained in soil conservation using alley cropping. Establishment and management of alley cropping structures are the main focus of these training sessions.

Farmers who participated in the training sessions are usually members of local organizations. Sixty-three percent of alley cropping adopters are members of local organizations. The role played by those institutions in the diffusion of this technique is worth mentioning. PADF works closely with two local organizations, the Organisation des Planteurs de Mayou, de Gaita et de Trois Racles (OPMAGAT) and the Organisation des Planteurs de Bannate et de Fogé (OPBAF), to extend this soil conservation practice. Members of these organizations are, therefore, more likely to establish hedgerow structures.

Management of alley cropping

In establishing an alley cropping system, not only does one seek to protect the soil, but also to improve its fertility level. The real benefits of establishing of hedgerows are derived from the management of the structures. Improved management leads to a lasting and more effective soil conservation structure. In diffusing alley cropping, promoters expect farmers to manage the established structures according to certain guidelines. According to information collected in the study area, farmers are advised to prune the leucaena trees and shrubs every two or three months at an average height touching the level of their knees. They are also required to apply leaves and stems to the soil after each pruning. During the first year of hedgerow establishment, local extension agents employed by the project carried out the management of the structures. Then farmers undertake themselves the management operations.

Over 90 percent of the adopters of alley cropping in Gaita and Bannate declare that they continue to maintain the structures on their plots based on instructions they received from the promoters. Farmers who have not formally received instructions on hedgerow management have learned from other farmers in the community. For several seasons, farmers try to meet the requirements in order to continue obtaining some assistance from the project. They maintain the structures, prune the trees, and apply the prunings to the soil. With time, farmers lose interest as program incentives and subsidies are reduced.

Activities carried out to maintain the structures in those areas include pruning, repair of breaches and weeding the hedgerows (Figure 7). The trees and shrubs are also pruned during maintenance period. When asked whether or not they prune the hedgerows, all farmers who stated that they continue to maintain the structures answered yes. Forty-five percent of alley cropping adopters repair breaches and only 9 percent weed them. All farmers who pruned the trees stated that they applied the prunings to the soil.

The number of prunings performed during a calendar year varies from one plot to another. Interviews with farmers in Gaita and Bannate reveal that only three percent of the plots are maintained four times; more than 60 percent of studied plots are maintained once or twice a year (Figure 8). Pruning is carried out especially at the time of soil preparation before planting. At that time, soil preparation for

crop production and for pruning of alley cropping structures are simultaneously performed. Ninety percent of alley cropping adopters prune the hedgerows at the beginning of the cropping season during January and February. This period corresponds to the beginning of the rainy season.

In situations where operations are carried out to maintain the structures, prunings are applied to the soil in different ways. Thirty-nine percent of those who apply the prunings spread them on the whole alley, as recommended by technical agents, while 61 percent apply the prunings to the up-hill side of the hedgerows. Prunings are applied to soil mainly before planting. When prunings are carried out, the application to soil in either way is done before planting, after planting, and during the dry season. Among those who prune the hedgerows, all farmers stated that they applied the prunings before planting only, 41 percent applied them both before and after planting, and 6 percent during the three periods.

The structures are managed according to farmers' own objectives. There exists a real gap between technical requirements and farmers' activities (Table 5). As we mentioned previously, fodder shortage is a constraint to animal production in the zone; leucaena leaves, because of their palatability, are considered high-quality fodder for cattle and goats. All farmers surveyed use the leaves to feed their animals. During fallow periods, animals are placed on plots with alley cropping. During cropping seasons, some farmers occasionally cut the stems and carry them to feed the animals outside the plots. Others leave the shrubs to be grazed after crop harvest. Under such conditions, the amount of leaves applied to soil after the pruning is relatively low. Thus, there is a trade-off between the use of leucaena for animal feed, and the use for the improvement of soil fertility. Nevertheless, the contribution of alley cropping to the farming system is far from negligible.

TABLE 5. FARMERS' COMPLIANCE WITH MANAGEMENT RECOMMENDATIONS

Operation	Technical requirements	Farmers' activities
Pruning of shrubs	4 times/ year on average	2 times/year on average
Repair breaches	After prunings (if necessary)	Rarely
Application of leaves	Between rows after prunings	Use of leaves mostly for animals. In some cases, leaves are applied at different locations
Height of prunings	50 centimeters on average	Less than knee level on average

Factors influencing adoption of alley cropping

In light of the information collected in Gaita and Bannate, alley cropping is used for multiple purposes on the farm. The purpose of this publication was to analyze factors influencing farmers' decision to implement alley cropping structures on their farms. The analysis was conducted using logistic regression procedures. The logit model of adoption used in the study examines the probability that a limited resource farmer in Gaita and Bannate makes the choice of adopting alley cropping techniques. The explanatory variables used in the adoption model include age, gender, marital status, level of education, group membership, training in soil and water conservation practices, per capita income, crop dependency, size of farm, security of land tenure, and the interaction between education and the per capita income. The definition of the explanatory variables is given in Table 6.

TABLE 6. DEFINITION OF VARIABLES USED IN THE ADOPTION OF ALLEY CROPPING

Variable	Definition	Expected effect
1. Age	Number of years of the respondent	(-)
2. Gender	1 for male, 0 otherwise	(+)
3. Marital status	1 for married, 0 otherwise	?
4. Education level	1 for formal education, 0 otherwise	(-)
5. Group membership	1 for group member, 0 otherwise	(+)
6. Soil conservation training	1 for training, 0 otherwise	(+)
7. Per capita income	Annual per capita income of household	(+)
8. Crop dependency	Share of crop revenues in total income	(+)
9. Size of farm	Number of ha of land operated	(+)
10. Security of tenure	Share of owned land out of total operated land	(+)
11. Education*Income	———	?

Results of the model indicate that five variables significantly affect adoption of alley cropping in Gaita and Bannate (Table 7). They include sex, participation in local organizations, training in soil conservation practices, per capita income and the interaction between education and per capita income.

TABLE 7. FACTORS AFFECTING ADOPTION OF ALLEY CROPPING IN GAITA AND BANNATE, HAITI

Variable	Coefficient	Std. error	P-value	Odds ratio
Intercept	-0.49793	1.1841	0.6741	
Age	-0.00597	0.0156	0.7034	0.99
Gender	-1.98396	0.7293	0.0065*	0.14
Membership in local group	1.52202	0.5333	0.0043*	4.58
Training in soil conservation	2.24820	0.5619	0.0001*	9.47
Per capita income	0.00044	0.0002	0.0462*	1.00
Crop dependency	0.18150	0.0002	0.1737	3.26
Education*per capita income	-0.00036	0.6741	0.0679**	1.00

*significant at 5% level, **significant at 10% level

Two institutional factors, namely membership in a local organization and training in conservation practices positively influence adoption of alley cropping in Gaita and Bannate. The probability of adoption of alley cropping in Gaita and Bannate increases with the participation in a local organization. Likewise, training in soil conservation practices increases the probability of adopting alley cropping. The results indicate that farmers who belong to peasant organizations within the community, and those who have received training in soil conservation practices, particularly in alley cropping, are 4.58 and 9.47 times, respectively, more likely than others to establish alley cropping on their plots.

To understand the importance of those factors in the adoption of alley cropping in Gaita and Bannate, it is important to review the diffusion process of this practice. Strategies used to promote alley cropping in Gaita and Bannate involve working closely with local organizations to reach the farmers. The leaders select potential adopters within the organizations. It is reported that non-members of the organizations are contacted by the leaders of the organizations to request their participation in the program.

Under the farm subsidy program, the farmers received leucaena seeds and technical assistance from the project, and labor is supplied by households, and project members. The most important aspect of the subsidy is the loan program where adopters receive credit in the form of seeds for the major crops, namely beans, maize, and sorghum, produced in the zone. Since the credit program is managed by the local organizations, it is obvious that group membership plays a determinant role in the adoption process. In this case, the subsidy that farmers receive, and not group membership, may be the principal factor in the adoption of alley cropping. It is also important to note that training in hedgerow implementation and maintenance is part of the package offered to farmers in the soil conservation program.

Per capita income is also a factor that has played a positive and significant role in the adoption of alley cropping. The probability of adopting alley cropping in Gaita and Bannate increases with the level of per capita income. Thus, as per capita income increases, adoption of alley cropping is more likely to increase. One possible explanation for this result is that high income is associated with resource ownership and control. Farmers with higher income can take the risk of establishing hedgerows on at least one plot.

Two other factors appear to have a significant effect in the adoption of alley cropping. They are gender of the respondents and the interaction between education and per capita income. The results suggest that female heads of households are 1.4 times more likely to adopt alley cropping than males. Although a study by Burton *et al.* (1999) in the United Kingdom supports these results, in the current study on alley cropping, this variable is to be viewed with caution since female farmers make up only 20 percent of the sample. However, this result is an indication that female farmers are highly interested in adopting soil conservation measures in the region.

The interaction between education and per capita income suggest a marginal decrease in the chances of adoption of alley cropping for individuals of high income who are educated. When both the level of education and the per capita income increase, farmers have less incentive to adopt alley cropping. This is particularly true in subsistence farming where resources are scarce. Young, educated rural people, especially are more likely to emigrate from the rural area as their level of education and their income increase. Thus the combination of education with higher income may have a negative influence on the adoption process.

In short, results of the adoption model show that institutional factors, such as membership in a local peasant organization and training in soil conservation practices, socioeconomic factors such as gender, per capita income and interaction between education and per capita income, significantly influence adoption of alley cropping in Gaita and Bannate. The relative importance of each factor on the probability of adoption of alley cropping, changes from one variable to another.

CONCLUSIONS AND POLICY IMPLICATIONS

Haitian hillside farmers are facing serious problems of land degradation. Adoption of conservation structures, such as alley cropping is critical to protect the soils against erosion and to ameliorate the fertility of the impoverished lands. Compared to other techniques, such as rock walls, alley cropping is easy to implement and does not require important financial investment. Results of the study show that farm operators in Gaita and Bannate are familiar with alley cropping. Farmers with different socioeconomic backgrounds have implemented alley cropping structures on their plots. However, information collected in the area suggests that farmers fail to manage the conservation structures as recommended.

Several factors were found to stimulate farmers' decisions to adopt alley cropping in Gaita and Bannate. Group membership, training in soil conservation practices, and per capita income play a significant and positive role in the adoption of hedgerow placement and management. Organized and trained farmers are more likely to develop a positive attitude toward adoption of alley cropping. Those results suggest that efforts to increase adoption should include the participation of local organizations in the development of the programs. Training of farmers should also be an integral part of the program. Whether a project should organize farmers only for soil conservation purposes, or it should work with existing local groups is a question to be considered. In terms of training, farmers need to be informed of the environmental benefits associated with adoption of sustainable agricultural practices. Training should be an ongoing process where other elements of the farming system can be discussed.

Per capita farm household income positively affects adoption of alley cropping. It implies that efforts should be directed toward improving the level of household income. Adoption of alley cropping may be a way for farmers to increase their income. As we have seen, hedgerow prunings are often used to feed animals instead of application as green manure. Therefore, the effects of alley cropping on crop and livestock production are not easily discernible. A solution to this problem will be to use other tree species with soil regeneration capabilities, but at the same time unpalatable to animals. Since animal production plays an important role in the Haitian peasant economy, it is uncertain that farmers will use such species if the system does not allow them to shift to high value crops.

It is also important to consider women's participation in the adoption of alley cropping in Gaita and Bannate. Cultural, social and economic barriers imposed on women by the society did not prevent them from adopting alley cropping. Hence, there is a need for development projects to work particularly with this category of farm operators.

In conclusion, adoption and management of alley cropping in Gaita and Bannate remain a dilemma. Farmers' behaviors are influenced by a number of socioeconomic factors. Farm operators must be given adequate economic incentives in order to encourage adoption of alley cropping and facilitate its proper management.

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