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An Evaluation of Farmer Field School Training on the Livelihoods of Cocoa Farmers in Atwima District, Ashanti Region, Ghana

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The Sustainable Tree Crops Program (STCP) is a joint public-private research and development partnership that aims to promote the sustainable development of the small holder tree crops sector in West and Central Africa. Research is focused on innovations to enhance the environmental, social, productive, and commercial aspects of tree crops. For details on the program, please consult the STCP website http://www.treecrops.org <http://www.treecrops.org/>.

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Sustainable Tree Crops Program

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EXECUTIVE SUMMARY

This report presents findings on the effects of STCP farmer field school training conducted in 2003 with the cocoa farmers of Atwima District of the Ashanti region, Ghana. The focus of the study is on the measurement of changes in behavior with respect to crop husbandry and input usage and the impact on production. The study also measures changes in the participation of children in hazardous tasks which may have occurred as a result of FFS sensitization exercises. The intended utility of this study is to contribute to the further refinement and adaptation of the farmer field school extension approach as applied to the cocoa farming systems of West Africa.

The International Institute of Tropical Agriculture (IITA) and CABI organized and conducted the first FFS training and curriculum development workshop for master trainers in March 2003. At this workshop, in addition to the training of master trainers and the development of country action plans, the core elements of the farmer field school curriculum were developed. Researchers from the Cocoa Research Institute of Ghana (CRIG) and other national institutes provided the scientific backstopping underlying the curriculum targeting the integrated management of the cocoa cropping system to ensure sustainable and socially responsible production. There is a strong curriculum focus on the control of black pod disease but attention is also given to the problem of capsids, post harvest techniques, and the social issues surrounding child labor (which are addressed with the collaboration and participation of the West African Cocoa and Commercial Agriculture Project (WACAP) of the ILO).

One of the problems in developing a regional FFS curriculum for adult education lies in the location-specific and region-specific nature of cocoa agronomic constraints. A much lower incidence of black pod disease faces Ivorian and Ghanaian cocoa farmers as compared to Cameroon and Nigeria, where the more virulent form of the disease exists and the majority of farmers treat with agro-chemicals. As such, the initial Ghanaian training of trainers also included soil fertility management, mistletoe management, cocoa tree thinning, and postharvest issues deemed to be important for Ghanaian cocoa farmers. Following 3 1/2 weeks of training on the curriculum, the facilitators were ready to begin the farmer field school. The program was initiated with 30 schools and 30 facilitators in the Atwima district of Ashanti region in the first year. In 2003 the average number of participants per school was 28. Farmer training occurred on a biweekly basis with the total number of sessions per school ranging from 11 to 15. On average, the session would last four hours. Working in groups, farmers would observe and discuss dynamics of the cocoa's ecosystem and the crop development. Simple experimentation protocols such as the black pod disease zoo helped farmers improve their understanding of ecological functional relationships such as the impact of humidity on disease development.

To achieve the study objectives, a survey was conducted in February 2005 with a random sample of 225 of the 829 farmers trained in 2003 and a control group sample of 165 cocoa farmers who had not participated. All 30 farmer field schools were represented in the sample with the number of participants interviewed per school ranging from five to 21. The field research was conducted in February 2005 and focused mainly on farmer practice during the 2004 growing season. A proportionate number of control farmers were sampled in each of the 30 communities. The differences noted in management practices and production (after controlling for differential resource endowments) between the two groups are attributed to the new knowledge gained through the discovery learning exercises of the farmer field school.

Major findings include:

Children, education and cocoa farming

- Significant reductions were noted in the hazardous employment of children as a result of FFS sensitization methods. Specifically among the 2,800 Atwima cocoa producers sensitized since 2003 it is estimated that there are now 540 fewer children employed in heavy field transport, 440 fewer children employed in clearing fields with machetes, and 170 fewer children employed in pesticide application.
- Based on the above results, scaling up FFS to 50,000 producers in the Ashanti region would result in the voluntary removal of 10,500 children from all hazardous labor tasks with a predicted 3,000 fewer children employed in pesticide application, 9,700 fewer children in heavy load transport and 7,900 fewer children in clearing fields with machetes.
- School enrollment rates were in excess of 90 percent for 6 to 14 year old children.
- Among FFS-trained farmers the level of education was positively associated with production output.

Willingness to pay and knowledge diffusion

- A large majority of control group farmers were willing to pay to attend FFS training.
- The amount of tuition fee that farmers were willing to pay for attending a 15-session FFS training was negatively affected by producer age and positively affected by years of schooling.
- Nearly 9 in 10 trained farmers indicated that they shared information with on average 2 other persons.
- Knowledge on cocoa pruning, shade management and phyto-sanitary harvesting was the most commonly shared.

Tree stock endowments

- The average productivity of FFS farmers' tree stock was more than double that of the control group.
- Notable increases as a result of FFS interventions were registered in the number of producers planting hand pollinated hybrid cocoa seedlings and the area planted to hybrids.
- Farmers acquiring their cocoa farms through share-crop labor exchanges (30% of sample) had substantially lower production.
- Two-thirds of all cocoa farms were established within the last 10 years.
- Low average yields of 112 kg ha^{-1} reflect in part the youthful nature of farmers' tree stocks.

Crop management and production differences

- Increased application of various crop husbandry practices among FFS-trained farmers relative to control group farmers was noted.
- The application of pesticides showed a response 8 times greater than that of the control group.

In sum, FFS training and subsequent changes in management practices are estimated to have resulted in a net production increase of 14% among the 2003 participants. To achieve this increase, producers mainly increased their own labor input and indicated hiring more casual laborers. While the survey was unable to accurately determine the actual change in labor inputs, the additional labor costs required to achieve this increase are real and should be netted out of the 14% increase in estimated gross revenues.

From several different perspectives it is clear that the FFS training received by participants has had measurable impacts on their productive capacity and on their views towards child labor. In support of the significant accomplishments already achieved, several recommendations can be made to potentially improve the performance and impact of FFS training.

- More attention should be given to address the specific needs of women cocoa producers and those acquiring their cocoa farms through a share-cropping exchange. A needs assessment with these two groups is recommended as a first step in adapting the curriculum.

- Given the scarce resources available for training farmers, criteria are needed to select participants so as to maximize expected returns. Age and educational level of the producer are recommended as discriminating factors.

- The positive results seen vis-à-vis child labor participation in hazardous tasks is highly encouraging and warrants increased efforts at sensitization through the farmer field school.

- Given that the majority of producers were applying insecticides to control capsids independent of the government spraying program but with lower use efficiency vis-à-vis the government program, protocols on the safe and rational use of pesticides require more emphasis in the program than they are currently receiving. Additionally, the Ghana program should seek to develop a protocol for the identification and spot spraying of capsid hot spots.

- The facilitation provided by the program in the distribution of improved cocoa planting material substantially increased the area planted to hybrids among participant farmers. This practice is to be commended and should be augmented with additional FFS sessions to deal with nursery techniques and planting/replanting options. These sessions should be added on to the school year for those schools where the majority of producers are interested.

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I. Introduction

In late 2002 the Sustainable Tree Crops Program initiated a pilot extension program for cocoa farmers in Côte d'Ivoire, Ghana, Nigeria, and Cameroon drawing upon the successful experiences in Indonesia with the farmer field school approach. This study reports on the preliminary impacts of farmer field school training on management practices, cocoa production and the frequency of child labor participation in hazardous tasks among households trained in 2003 in Ghana. Similar studies are being conducted for the other three countries.

The farmer field school is a form of adult education that encourages field observation and experimentation, usually in the practice of integrated pest management (IPM). The approach was originally developed for the integrated management of rice pests in Indonesia in 1989 but has since broadened in its objectives. Most FFS today strive to empower farmers through the development of their technical, as well as social, and political capabilities (van der Burg, 2004). This leads to both measurable and immeasurable effects which complicates the process of impact assessment. The main focus of this study is the extent to which crop management practices, production, and pesticide use has changed among the cocoa farmers of Atwima District in Ashanti region following their participation in the FFS. The social and political impacts are also touched upon, but to a lesser extent.

The International Institute of Tropical Agriculture (IITA) and CABI organized and conducted a FFS training and curriculum development workshop for master trainers from the four above mentioned countries in March 2003. Both organizations had had experience in developing FFS programs for other crops and drew up on their expertise for the development of the STCP FFS. At this workshop, in addition to the training of master trainers and the development of country action plans, the core elements of the farmer field school curriculum were developed. Researchers from the Cocoa Research Institute of Ghana (CRIG) and other national institutes provided the scientific backstopping underlying the curriculum. The curriculum targets the integrated management of the cocoa cropping system to ensure sustainable and socially responsible production. There is a strong focus on the control of black pod disease but attention is also given to the problem of capsids, post harvest techniques, and the social issues surrounding child labor (which are addressed with the collaboration and participation of the West African Cocoa and Commercial Agriculture Project (WACAP) of the ILO).

Among the outcomes of the March 2003 workshop was the development of country action plans for the initiation of farmer field schools. Following the workshop, participants returned to their home countries and began to organize the training of facilitators. One of the problems in developing a regional curriculum for adult education lies in the location-specific and region-specific nature of agronomic constraints. From the baseline surveys conducted in 2002, a much lower incidence of black pod was evident for most Ivorian and Ghanaian cocoa farmers as compared to those in Cameroon and Nigeria, where the more virulent form of the disease exists and the majority of farmers treat with agro-chemicals. As such, the initial Ghanaian training of trainers also included training on other subjects deemed to be important for Ghanaian cocoa farmers. These extracurricular topics included soil fertility management, and mistletoe (*Loranthus spp.*) management, cocoa tree thinning, and postharvest issues (see annex one for a list of the topics covered and the discovery learning protocols used in this first training of trainers workshop). The facilitators were exposed to these topics by CRIG researchers at the training. The notes taken during these lectures were used as a reference by the facilitators to animate these topics in the farmer field school sessions. It should be noted that the special topics did not have discovery learning protocols, which were followed uniformly by all field school participants.

Following four weeks of training the facilitators were ready to begin the farmer field school. Each school consisted of the facilitator, who was paid a small stipend and its members. The optimal size of the field school is considered to be 25 participants, but because of excessive demand for cocoa extension, the 2003 average number of participants per school was 28. The program was initiated with 30 schools and 30 facilitators in the Atwima district of Ashanti region in the first year. Farmer training occurred on a biweekly basis with the total number of sessions per school ranging from 11 to 15. On average, the session would last four hours. Participants attended an average of 12 sessions from March through the end of the harvest in December. Working in groups, farmers would observe and discuss dynamics of the cocoa's ecosystem and the crop development. Simple experimentation protocols such as the black pod disease zoo helped farmers improve their understanding of ecological functional relationships such as the impact of humidity on disease development. The objective of these learning processes is to develop farmer expertise in crop management that then enables them to make their own decisions.

One of the objectives of this study is to examine the changes in cocoa management practices and structural changes in the cocoa cropping system that have occurred as a result of the farmer's participation in the STCP farmer field school. An associated objective is to estimate the economic impact of these changes at the household level. The intended utility of this study is to contribute to the further refinement and adaptation of a farmer field school extension approach applied to the cocoa farming systems of West Africa.

To achieve the study objectives, a survey was conducted in February 2005 with a random sample of the 2003 participants and a random control sample of nonparticipating cocoa farmers. The differences noted in management practices between the two groups are attributed to the new knowledge gained through the discovery learning exercises of the farmer field school.

The report is organized as follows: in the subsequent section, the survey design and analytical methodologies are described. In section 3, we present the study findings, which are then discussed in section 4. The last section presents recommendations.

II. Methodology

The Sample Survey

Two groups of cocoa farmers were sampled. A simple random sample was drawn from the 829 cocoa farmers enrolled in the 30 field schools of 2003. The sample size was n=225 and the sampling proportion 27%. A second random sample of 165 farmers was drawn from the population of nonparticipating cocoa growers living in the same villages where the STCP farmer field school programs took place (Table 1). Although choosing the control group from the same community may present a potential bias due to participant farmer to non-participant farmer knowledge diffusion, it was felt that this potential bias was slight due to the short time lag and the relatively complex nature of the knowledge acquired in the farmer field school which would prohibit its easy transfer. On the positive side, selecting control farmers from the same village would tend to eliminate biases due to inestimable village effects such as microclimate, soil type, and pest and disease pressure.

Table 1. Sample Selection for FFS Adoption Study

Village	No. of FFS participants	Farmers interviewed: FFS participants	No. of non-participants	Total
ACHIASE	30	6	4	10
ADOBEWORA	35	7	4	11
ADUPRI	37	5	3	8
AKATANIASE-1	26	6	4	10
AKATANIASE-2	26	5	3	8
AMANGOASE	28	3	2	5
AMPOMA	27	12	7	19
ANIAMOA FFS-2	30	11	7	18
ANIAMOA FFS-1	30	11	7	18
ANYINAMSO	28	7	4	11
BETINKO.	30	7	4	11
BONTESO – I	27	13	8	21
BONTESO II	27	4	2	6
BONTOMURUSO.	31	7	4	11
GOGOIRROM	25	8	5	13
GYENINSO	28	6	4	10
GYENINSO-1	30	10	6	16
KANTANKYIREN	25	7	4	11
KOFI- HIAKROM.	25	10	6	16
KUKUBUSO	26	9	5	14
KWANFINFI.	25	9	5	14
MMOFRAMFADWENE.	21	5	3	8
MPATUOM – 1	25	5	3	8
MPATUOM – 2	28	9	5	14
MPATUOM – 3	26	7	4	11
NKROMA.	25	5	3	8
NTOBROSO FFS-1	26	9	6	15
NTROBROSO – 2	27	9	5	14
PAKYI .	25	3	2	5
SEREBOUSO	30	10	6	16
Total	829	225	135	360

The sample cluster size per locality for non-participants was directly proportional to that of the participant cluster size:

$$n_i^{nonpart} = (n_i^{part} / 225) * 165$$

Where:

$n_i^{nonpart}$ = the clustered subsample of non participants from the locality of farmer field school *i*, and,

n_i^{part} = the subsample of participants from the locality of farmer field school *i*.

The survey teams constructed lists of nonparticipating cocoa farmers for the given locality through interviews conducted with local buying depot agents, chiefs and village elders. As the interest was in cocoa producers with mature, producing cocoa farms, only farmers selling cocoa were included in the sampling frame.

All 30 farmer field schools were represented in the random sample with the sampled number of participants per school ranging from five to 21. The field research was conducted in February 2005 and focused mainly on farmer practice during the 2004 growing season.

Analytical Methodology

Data collection was conducted through structured interviews with cocoa farmers using a questionnaire (see Annex 2) and the data were entered and analyzed using Excel and LIMDEP software packages. Mean sample differences between groups were tested for significant differences using Chi-Square and Student's t-tests under the assumptions of normality and homoskedastic variance. The analysis begins with a comparison of participant and non-participant farmers in terms of their structural makeup and factor endowments, that is, size of farm, household size, age structure. This is then followed by a similar analysis of their management practices and utilization of family children in their cocoa farming system. We also examine the impact of the distribution of hybrid cocoa pods by the FFS program on new plantings of cocoa. We then measure and compare production between the two groups.

A comparison of mean yields between the two groups is not sufficient for establishing the impact of the farmer field school if there are situational differences in farmer field school participants and the control group. If, for instance FFS participants had more productive tree stocks because of a higher proportion of hybrid material, then their yields could be higher independent of any FFS effect. To avoid these confounding effects, a multivariate regression analysis of production is conducted.

III. Results

a. Demographics and Farm Structure

Cocoa Farmers

The participants in the FFS were slightly younger than those in the control group and had significantly more schooling (Table 2). Although the difference was not statistically significant the mean proportion of women cocoa farmers was 8 percent greater among the non-FFS group. About four out of five cocoa farmers interviewed were household heads, the remainder were spouses of the head of household. Over ninety-seven percent of the cocoa farmers indicated that their principal occupation was agriculture with the commercial production of cash crops cited the most frequently.

Table 2. Demographic and human capital measures of the cocoa farmers interviewed in Atwima District, Ashanti Region, 2005

	FFS N=225	Non-FFS N=165	Significance level
Age	45.7	48.3	0.06
No. of years of schooling	6.59	5.34	0.01
% women	26%	34%	n.s.
Household status:			n.s.
Head of household	82%	77%	
Spouse	17%	22%	
Son/daughter	0%	1%	
Principal occupation:			n.s.
Animal rearing	0.0%	0.8%	
agriculture (cash crop)	98.6%	96.2%	
agriculture (food crop)	0.5%	0.8%	
sharecropper	0.0%	0.8%	
Trading	0.5%	0.8%	
civil servant	0.5%	0.0%	
Artisan	0.0%	0.8%	

Household Demographics and Land Acquisition

Table 3 reveals that the age-class distributions between the participant and non-participant household samples are statistically indistinguishable, although participant households were approximately 10% larger (0.6 more persons) in terms of the number of household members (Student's t = 2.05, two-tail prob. = 0.04).

Table 3. Gender-differentiated age structure of participant and non-participant populations, Atwima, Ghana

	Frequency and average per household						
	Participant			Non participant			
Age and Gender Class	Count	% of total	mean	Count	% of total	Mean	
Boys 0-5	77	6%	0.34	36	5%	0.27	Chi test (df=12), prob=0.3987
Boys 6-9	88	7%	0.39	39	6%	0.29	
Boys 10-13	84	7%	0.37	47	7%	0.35	
Boys 14-17	66	5%	0.29	45	7%	0.33	
Boys	315	25%	1.40	167	25%	1.24	
Men 18-54	252	20%	1.12	143	21%	1.06	
Men 55+	48	4%	0.21	35	5%	0.26	
Men	300	24%	1.33	178	26%	1.32	
Girls 0-5	88	7%	0.39	38	6%	0.28	
Girls 6-9	95	8%	0.42	43	6%	0.32	
Girls 10-13	76	6%	0.34	36	5%	0.27	
Girls 14-17	58	5%	0.26	38	6%	0.28	
Girls	317	25%	1.41	155	23%	1.15	
Women 18-54	295	24%	1.31	155	23%	1.15	
Women 55+	28	2%	0.12	24	4%	0.18	
Women	323	26%	1.44	179	26%	1.33	
Total	1255	100%	5.58	679	100%	5.03	

Approximately one in four of the cocoa farmers interviewed were migrants and immigrants to their current place of residence with no appreciable difference between FFS participants and non-participants (Table 4). Among the 93 migrants and immigrants, approximately one-third originated from the Northern Region and microclimate, soil type, and pest and disease pressure.

Table 4. Residential status of cocoa farmers

	Non-participants		Participants	
Migration status	Frequency	% of group total	Frequency	% of total
Autochthones	102	76%	159	71%
Migrant	31	23%	62	28%
Immigrant	2	1%	4	2%

No significant differences in the mode of land acquisition were noted between FFS and non-FFS farmers. However there was a clear difference between the migrant/immigrant group and the native people of Atwima District. Over three-fourths of the migrant respondents (versus one in ten native residents) indicated that they had acquired their land rights through a "sharecropping" arrangement with the landowner (Table 5). This arrangement entails the transformation of either bush fallow or forest land into a cocoa farm. The most typical arrangement is that the landowner provides the land, and any purchased inputs needed, while the sharecropper provides the labor for clearing, planting, and general maintenance until the farm begins to produce. Once the cocoa farm is productive it is divided into shares between the landowner and the sharecropper. At this time, the share allocated to sharecropper is his/her remuneration for having developed the farm. In contrast, land acquisition by inheritance was cited by over three-fourths of the cocoa farmers with their ancestral origin in Atwima versus only 10% of the migrant/immigrant group.

Table 5. Land acquisition methods by residential status

Land Acquisition Method	Migrant/Immigrant (N= 97)	Autochthones (N=261)	All (N=358)
Inherited	10%	76%	58%
"Share Crop"	78%	11%	30%
Gift from Chief	7%	7%	7%
Purchased	2%	3%	3%
Leasing	1%	1%	1%
Other Acquisition	1%	1%	1%
Total	100%	100%	100%

Sources of Information about Cocoa Farming

Farmers were queried about their main sources of technical information. A significantly greater proportion of FFS farmers indicated having no other source of technical information (Table 6).

Table 6. Farmer's principal source of technical information

Source of technical information	Non-FFS	FFS	Grand Total
Extension service	10%	12%	11%
Radio	4%	5%	5%
NGOs	1%	0%	1%
Family and friends	59%	39%	46%
Other	1%	0%	0%
None	26%	44%	37%

Farmer field school participants attended an average of 12.3 sessions during the course of the 2003 field school year. The majority of farmers reported attending either all or most of the sessions as seen in Table 7.

Table 7. Farmer participation in field schools and mean number of sessions attended

Farmer session attendance	Total	Number of sessions attended
All	31%	14
Most	57%	12
About half	5%	8
Less than half	4%	7
Only a few	1%	n/a

Age and Size of Cocoa Farming Enterprises

Cocoa farmers were asked to estimate the size and the age of their farm in acres. The mean estimates (reported here in ha) exhibit no significant differences between the two groups (Table 8). This was not the case for hybrid cocoa. Farmer field school participants reported approximately one-quarter of their farms planted to improved hybrid cocoa materials, which was significantly higher than that reported by the non-FFS farmers ($P < 0.05$). Relative to the age structure of cocoa farms elsewhere in West Africa, the cocoa farms of Atwima District are newly established with over half of the productive acreage less than 10 years old. Twenty percent of all cocoa acreage had been established in the last 3 years and was not yet in production.

Table 8. Comparison of cocoa farm structure between FFS participants and non participants, Ghana 2005

Variable	Non FFS N=135	FFS n=225	Prob (Student t)
No. of farms	1.8	1.8	0.954
Immature 0-3 yr (ha)	0.5	0.6	0.519
Young 4-10 yr (ha)	1.7	1.9	0.662
Mature 11-25 yr (ha)	0.6	0.9	0.134
Older mature 26-40 yr (ha)	0.1	0.1	0.955
Old 41+ yr (ha)	0.4	0.1	0.097
All producing (ha)	2.9	3.0	0.771
All cocoa (ha)	3.5	3.6	0.818
Hybrid producing (ha)	0.4	0.7	0.013
Proportion hybrid	16%	26%	0.005

Source: STCP FFS adoption survey

b. Child Labor and School Enrollment Rates

The participation rates of children (ages 6 to 14) in tasks determined by the ILO to be hazardous to the wellbeing of children and the level of school enrollment were among the social impact parameters measured.

A statistically significant lower participation of children in hazardous tasks among FFS participants was found. Although overall the school enrollment rates were nearly identical between the two groups of cocoa farmers, both preschool and teenage girls living in the households of FFS participants had higher school enrollment.

Child labor impact of FFS sensitization

The survey queried respondents on three specific tasks:

1. clearing/brushing with a machete,
2. pesticide spraying and
3. heavy load field transport

that ILO experts have determined are hazardous to the welfare of children. The participation in these tasks was indicated for each member of the household in the interview process.

Table 9 reports the participation rates for children (ages 6 to 14). Among the three tasks, the largest difference for the 6 to 14 year age cohort was for heavy load transport, followed by field clearing with machetes (Table 9). The participation of children in pesticide application when the cocoa farmer had received FFS training was half again as frequent as among control farmers, however the difference was not significant (P>0.05); a reflection of the low overall frequency with which pesticides are applied by Ghanaian cocoa farmers. In recent years, COCOBOD the Ghanaian cocoa marketing authority, has sent out pesticide spraying teams to control pests and disease with the farmer only obligated to provide the fuel for the motorized mist sprayers used by the government team.

The increased participation of children in these tasks as they mature is generally evident for both groups. The largest differences between FFS and control group children are noted for the 12 to 14 year cohort with a 20 percent differential for field transport topping the list.

Table 9. Participation of children (ages 6 to 14) in hazardous labor tasks by FFS participant households (no. of children = 375) and control households (no. of children =181) in Atwima District, Ghana.

	Participation rates of children living in household of:			
Task by age cohort	FFS-trained farmer	Control	All households	Prob*
Machete clearing				
6 to 8 years	8.9%	3.9%	7.5%	0.252
9 to 11 years	17.3%	21.2%	18.0%	0.596
12 to 14 years	29.3%	47.7%	35.9%	0.013
6 to 14 years	17.3%	26.5%	20.3%	0.012
Pesticide application				
6 to 8 years	3.7%	2.0%	3.2%	0.548
9 to 11 years	4.5%	9.1%	5.3%	0.283
12 to 14 years	3.4%	10.8%	6.1%	0.048
6 to 14 years	3.7%	7.2%	4.9%	0.076

Heavy load transport				
6 to 8 years	14.1%	13.7%	14.0%	0.951
9 to 11 years	33.3%	33.3%	33.3%	1.000
12 to 14 years	47.4%	67.7%	54.7%	0.009
6 to 14 years	30.1%	41.4%	33.8%	0.008
No participation in tasks				
6 to 8 years	83.7%	82.4%	83.3%	0.825
9 to 11 years	62.8%	54.5%	61.4%	0.375
12 to 14 years	44.8%	27.7%	38.7%	0.023
6 to 14 years	65.3%	53.0%	61.3%	0.005

*Probability that child labor participation is independent of farmer field school school sensitization (Chi-square test of independence, 1 df).

School Enrollment Rates

There were essentially no differences in the reported school enrolment of children from FFS versus control group households. Among children of ages 6 to 14, the reported enrollment was 91 percent for both groups. Looking at results disaggregated by gender and age, FFS households had a slightly higher proportion of preschool (<6 years) girls and teen-age (14 to 17 years) boys and girls enrolled as compared to control group farmers (Table 10).

Table 10. School enrollment rates by age and gender groups for participant and non-participant households in Ghana, 2005.

Age and gender group	Non-participant farmers			Participant farmers			Test of independence (Chi- square 1d.f.)
	Total Head Count	Enrolled in 2004/2005	% Group enrolled in 2005	Total Head Count	Enrolled in 2004/2005	% Group enrolled in 2005	
Boys 0-5	36	15	42%	77	29	38%	0.68
Boys 6-9	39	35	90%	88	77	88%	0.72
Boys 10-13	47	43	91%	84	73	87%	0.43
Boys 14-17	45	35	78%	66	57	86%	0.24
Men 18-54	143	11	8%	252	13	5%	0.31
Girls 0-5	38	12	32%	88	38	43%	0.22
Girls 6-9	43	38	88%	95	86	91%	0.70
Girls 10-13	36	34	94%	76	73	96%	0.70
Girls 14-17	38	27	71%	58	46	79%	0.35
Women 18-54	155	13	8%	295	17	6%	0.29
Overall	620	263	42%	1179	509	43%	0.76

Source: STCP Adoption Survey, Ghana, 2005

c. Field Management Practices

In this section, we examine the agronomic practices of cocoa farmers and the differences between our two groups that may have been affected by the farmer field training. Included among the practices examined are pesticide use, pruning, weeding, shade management, and planting of hybrid cocoa seedlings.

Pesticide Use

Overall insecticide use was more frequent than fungicide use and no statistical differences were noted in the frequency of use between groups (Table 11).

In 2002, Ghanaian cocoa authorities launched a nationwide campaign against capsids and cocoa black pod disease. As part of the campaign, spray teams were sent out into the field to treat farmers' cocoa fields. Both fungicides and insecticide were provided free of charge, with the farmer responsible for only the cost of the fuel for the motorized sprayers. Probably because of the atomized nature of the cocoa industry in Ghana, some producers failed to benefit from the program. Among survey respondents, 64% and 20% had their farms treated with insecticide and fungicide respectively by the government program in 2004. Independent of the government program, 54% of the respondents applied insecticides and 18% applied fungicides in 2004. The relatively high frequency of farmers applying pesticides independently highlights the need for more attention to rational pesticide use in the Ghana farmer field schools.

The most common types of insecticide used were imidachloprid (Confidor), Cocostar, and endosulfan (Thionex/Thiodan). Imidachloprid is classified by the Environmental Protection Agency as a General Use Pesticide, while endosulfan is classified as a Restricted Use Pesticide. The latter was exclusively used by farmers on their own initiative and is an extremely hazardous insecticide which can only be utilized in the U.S.A. by specially trained applicators. The most common fungicides used were Ridomil, Champion, and Kocide.

Table 11. Frequency of Pesticide Spraying in Atwima District, Ghana, 2004/2005 Season

Type of pesticide	Type of application	Group	No. of sprayings					
			None	1	2	3	4	5+
Fungicide	Individual	control	83%	12%	3%	1%	2%	0%
		ffs	82%	12%	4%	2%	0%	0%
		all	82%	12%	4%	2%	1%	0%
	govt	control	83%	11%	7%	0%	0%	0%
		ffs	78%	13%	5%	3%	0%	0%
		all	80%	12%	6%	2%	0%	0%
	All	control	70%	18%	9%	1%	1%	1%
		ffs	66%	17%	9%	8%	0%	0%
		all	67%	18%	9%	5%	1%	0%
Insecticide	individual	control	53%	27%	16%	2%	0%	1%
		ffs	40%	36%	13%	11%	0%	0%
		all	45%	33%	14%	8%	0%	0%
	govt	control	41%	41%	15%	2%	1%	0%
		ffs	33%	47%	19%	1%	0%	0%
		all	36%	44%	17%	2%	0%	0%
	All	control	21%	29%	35%	10%	2%	2%
		ffs	15%	21%	38%	19%	7%	0%
		all	17%	24%	37%	16%	5%	1%

The intensity of pesticide use did not vary significantly between groups but the average monetary cost per ha on insecticide was approximately double the expenditure on fungicides among cocoa farmers utilizing these inputs (Table 12).

Table 12. Mean monetary cost per ha of pesticides utilized in 2004/2005 by FFS participant and control groups in Atwima District, Ghana.

Product type	Applied by	Control	FFS	All	Prob
		-----------------cedis/ha----------------			
insecticide	individual	145 808	170 280	161 264	0.694
	govt	118 966	141 943	134 505	0.520
Fungicide	individual	41 333	70 998	63 192	0.301
	govt	59 768	83 738	75 278	0.522

Approximately half of farmers who had not sprayed fungicides, indicated that cocoa black pod disease was not a problem (Table 13). This raises a question about the emphasis of the field school curriculum on black pod disease. For insecticides, the most common reason for not spraying was a lack of financial means with a significantly larger response given by non-FFS farmers suggesting fewer financial resources. This was the second most common response for fungicides as well.

Table 13. Reasons given for not spraying fungicides and insecticides

	Non FFS	FFS	All	Prob
Fungicides				
Lack of financial means	33%	23%	27%	0.382
Lack of availability	4%	3%	3%	
High cost of fungicides	1%	2%	1%	
Blackpod not a major problem on my farm	45%	49%	47%	
Benefited from gov't spraying program	7%	10%	9%	
IPM practices of FFS were effective	0%	2%	1%	
Does not have a sprayer for application	0%	2%	1%	
Young farm not requiring treatment	11%	9%	9%	
Insecticides				
Lack of financial means	65%	41%	51%	0.000
Lack of availability	0%	1%	1%	
High cost of insecticides	0%	1%	1%	
Capsids not a major problem on my farm	0%	13%	8%	
Benefited from gov't spraying program	10%	29%	21%	
IPM practices of FFS were effective	0%	1%	1%	
Does not have a sprayer for application	0%	4%	3%	
Young farm not requiring treatment	25%	9%	15%	

The timing of pesticide application is an important factor in their effectiveness and the productivity of the cocoa farm. Spraying insecticide during the April-to-July fruit setting when pollinators are working can have negative production effects. Over one-third of FFS participants did so at some point during this period (Table 14). With regards to fungicides most are applied during the period of high rainfall when disease pressures are highest, i.e., June to September. More attention needs to be paid to the independent spraying regimes of farmers in the Ghana FFS curriculum.

Table 14. Timing of pesticide applications by cocoa farmers in Atwima District, Ghana, 2004.

	Fungicide					Insecticide			
	Non FFS	FFS	All	Prob		Non FFS	FFS	All	**Prob**
Timing	----------% producers --------					----------% producers --------			
Jan	1%	1%	1%	0.911		1%	4%	3%	0.244
Feb	1%	1%	1%	0.607		2%	1%	1%	0.298
Mar	1%	2%	2%	0.286		4%	6%	5%	0.377
Apr	2%	2%	2%	0.995		2%	7%	5%	0.044
May	2%	4%	3%	0.472		3%	3%	3%	0.931
Jun	3%	10%	7%	0.015		13%	14%	13%	0.737
July	3%	8%	6%	0.070		10%	14%	13%	0.336
Aug	16%	13%	14%	0.570		23%	22%	22%	0.810
Sep	4%	9%	7%	0.060		21%	22%	21%	0.800
Oct	5%	4%	4%	0.604		16%	14%	15%	0.743
Nov	0%	5%	4%	0.002		7%	10%	9%	0.437
Dec	0%	1%	1%	0.271		8%	10%	9%	0.506

Pruning

Pruning is practiced in Ghana, in order to: (1) remove the parasitic mistletoe plant which grows in the upper canopy of the cocoa tree, (2) improve airflow leading to lower disease pressure from black pod, (3) remove diseased or dead tree stock and (4) improve the plant architecture to facilitate crop management. Field school participants pruned their cocoa an average of 3x annually, versus 2x for the control group (Table 15). Both groups of farmers reported pruning essentially their entire farm. The recommended period for pruning is when the tree is resting during the dry season; half of the farmers trained in the FFS implemented pruning during this period, which was substantially higher than the control group. However, we also note that nearly two-thirds of the FFS farmers were implementing pruning during the wet season, which may not be good practice depending on what the farmer pruned.

Table 15. Pruning practices by cocoa farmers in Atwima, Ghana, 2005.

Parameter	Non FFS	FFS	Prob
Frequency and extent of pruning	*n=135*	*N=225*	*(Student's T)*
Average no. of prunings in 2004	1.9	2.8	0.000
Average proportion of farm pruned	87%	89%	0.412
Timing of Pruning	*n=96*	*N=158*	*chi (1 df)*
January	3%	6%	0.349
February	4%	13%	0.019
March	9%	19%	0.037
April	13%	16%	0.391
May	15%	20%	0.297
June	30%	37%	0.290
July	21%	20%	0.815
August	27%	31%	0.554
September	21%	22%	0.805
October	7%	13%	0.178
November	2%	14%	0.002

December	4%	9%	0.118
rainy season	55%	63%	0.183
dry season	21%	50%	0.000

If the farmer pruned diseased branches, chupons, or mistletoe during the wet season, there probably would be little negative effect on production (Table 16). If however healthy fan branches were pruned there could be a negative effect. Approximately, one-third of FFS participants fanned healthy fan branches.

Table 16. Type of pruning conducted by cocoa farmers in Atwima, Ghana, 2005

	Non-participants			Participants		Prob Chi-test (1 df)
Portion of tree pruned	Count	% frequency		Count	% frequency	
Diseased branches	22	18%		50	23%	0.327
Chupons	65	53%		168	76%	0.000
Mistletoe	62	51%		127	57%	0.255
Healthy fan branches	29	24%		71	32%	0.109

The amount of labor required per ha for pruning was estimated at 8.4 person-days with no significant difference between groups.[1] A regression of the amount of labor time per ha reveals a relationship between the portion of the plant pruned and effort, with the pruning of healthy fan branches and chupons the most laborious types of pruning (Table 17).

Table 17. Regression model of pruning labor per ha.

Variable	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	4.287	1.412	3.036	0.003
Disease	1.230	1.409	0.873	0.383
Chupons	2.537	1.274	1.992	0.047
Mistletoe	2.042	1.182	1.727	0.085
Healthy	3.421	1.327	2.577	0.010

Pest and Disease Cultural Control

In the FFS, discovery learning protocols such as the disease zoo are intended to lead farmers to an understanding of the factors influencing the development of black pod. This includes the source of diseases and their proper removal. The main sources of disease are infected pods. As seen in Table 18, prior to the farmer field school training the most common practices were, either to remove the infected pod and throw it on the ground, or to do nothing at all. Following training the vast majority of farmers indicate that they now remove the infected pods from their cocoa farms after harvesting as compared to the control group for whom only a small minority were aware of recommended practices.

[1] Labor monitoring in the farmer field schools in Ghana yields a mean estimate of 7.8 days per ha.

Table 18. Actions taken when blackpod infections noted on cocoa pods, Atwima, Ghana, 2005

Action taken	Participants Pre-FFS	Participants Post FFS	Prob chi (4 df)	Non-participants 2004	Prob chi (3 df)
None	37%	1%	0.0000	20%	0.0000
Leave on tree and treat with fungicide	3%	7%		21%	
Remove and throw on ground	55%	9%		44%	
Remove and carry out (best practice)	4%	83%		15%	
Other actions	1%	0%		0%	

Another factor in the development of blackpod is excess humidity. Farmers are led to an appreciation of the role of excessive shade on humidity levels and subsequently the relative development of the disease. Surprisingly there was no difference in the proportion of farmers associating shade with blackpod disease between the two groups with fewer than half aware of this association (Table 19).

There appeared to be more knowledge about the ecological functions of upper canopy shade among FFS participants relative to the control group. The most commonly perceived beneficial function was protective conservation of humidity during the dry season (Table 19). While only small proportions of farmers recognized the positive role of shade in reducing capsid pressure, providing environmental services and promoting soil fertility there was greater recognition among FFS participants. Unlike Cameroon or Nigeria agroforestry secondary products appear to be of minor consumptive value.

Table 19. Farmer perceptions of the advantages and disadvantages of shade, Atwima, Ghana, 2005

	Non-FFS n=135	FFS n=225	Overall n=360	prob
Shade benefits				
Reduces capsid attacks	4%	8%	7%	0.081
Promotes soil fertility	2%	6%	5%	0.083
Provides timber, fruits and medicines to house	5%	3%	4%	0.215
Provides environmental services	8%	12%	10%	0.303
Conserves humidity during dry season	47%	61%	56%	0.013
No benefits	16%	8%	11%	0.017
Disadvantages				
Increased incidence of blackpod disease	41%	44%	43%	0.492
Lower cocoa yields	53%	50%	51%	0.514

A significantly greater proportion of FFS participants practiced some form of shade management practice (Table 20) although the difference was not large. With the exception of trimming, the shade practices of the two groups are nearly identical.

Table 20. Shade management practices, Atwima, Ghana, 2005

	Non-FFS	FFS	Overall	
	n=135	n=225	N=360	Prob
Conducts shade management	87%	96%	93%	0.002
Trimming/pruning of shade trees	28%	44%	39%	0.003
Girdling of shade trees to kill	26%	27%	27%	0.933
Cut down shade trees	61%	60%	60%	0.881
Fire around base of trees	10%	20%	17%	0.017
Adjusting cocoa shade by pruning	39%	32%	35%	0.206
Planted fruit trees to provide long term shade	8%	8%	8%	0.800
Planted timber trees to provide long term shade	2%	2%	2%	0.726

New Planting with Hybrid F1 Tree Stock

As a service to the farmer field school groups, STCP acquired a limited number of improved hand pollinated F1 hybrid cocoa pods developed by CRIG from the Cocoa Services Division of COCOBOD, which were then distributed to farmers. Normally farmers wishing to plant hybrid cocoa must travel to the nearest seed production facility of the CSD to acquire the cocoa pods, which for farmers in remote areas with poor transport infrastructure can easily take up the whole day. STCP was able to use the structure of its farmer field school groups to determine collective demand, and then facilitate the delivery of cocoa pods. By bringing the hybrid pods closer to the farmer a substantial increase was noted in the number of farmers planting F1 hybrid seedlings. In 2004, 54% of FFS participants indicated receiving F1 cocoa pods versus 16% of the control group farmers. Among the FFS participants receiving F1 cocoa pods, seven in 10 received them through the facilitation of the STCP program. The planted seedling to pod ratio achieved by farmers was 15:1 and 11:1 for the FFS and control groups, respectively. FFS farmers planted an average of nearly 700 hybrid trees in 2003 and 2004 as compared to about 200 trees among the non-participant control group (Table 21). The large difference between these two groups can be attributed to advocacy in the field schools for using the best possible planting materials, better nursery practices and as well the facilitation to these materials provided by the program.

Table 21. Acquisition of F1 hybrid pods and plantings of hybrid seedlings, Atwima District, Ghana, 2005

Variable	Control	FFS	All	Prob
F1 pods '04	9	21	16	0.004
F1 pods '03	8	23	18	0.040
F1 pods '02	7	17	13	0.244
Total F1 pods '02-'04	24	60	46	0.013
F1 seedlings planted '04	83	339	244	0.000
F1 seedlings planted '03	54	212	153	0.040
F1 direct seed '04	39	47	44	0.761
F1 direct seed '03	20	63	47	0.241
Total F1 planted '03-'04	193	658	483	0.001
Seedlings in nursery March '05	29	104	75	0.039

Weeding

Participants put more effort into weeding in 2004 than did non-participants although the difference was not great (Table 22). In terms of timing, a higher proportion of the FFS farmers weeded in the first and second quarters of the year. Weeding/brushing effort depends on the maturity of the cocoa plantation. Once the cocoa canopy has closed, there is often very little weeding required. As most of the cocoa farms tended to be young (over two thirds had been planted within the last 10 years), weeding effort was quite substantial with farmers estimating an average of 13 to 14 labor days per hectare.

Table 22. Weeding efforts by cocoa farmers in Atwima Division, Ghana, 2005.

Variable	Non FFS	FFS	All	Prob
	n=135	n=225	n=360	
Mean weeding frequency				
Weeding frequency in 2004	2.5	2.8	2.7	0.0002
Weeding frequency in 2003	2.4	2.6	2.5	0.07
Area weeded				
Less than half	2%	2%	2%	
About one half	1%	1%	1%	n.s.
Greater than 1/2 but less than all	11%	8%	9%	
All of the trees	86%	88%	88%	
Time of weeding				
1st quarter	41%	50%	46%	0.097
2nd quarter	50%	63%	58%	0.018
3rd quarter	46%	52%	49%	0.302
4th quarter	37%	40%	39%	0.578
Labor requirements per ha (days)	14.0	13.4	13.6	0.688

Labor

FFS trained producers were asked to indicate how they were able to mobilize the additional labor required to implement what they had learned. The most frequent response was that the producer increased his/her own labor input (Table 23). The next most frequent response cited by two-thirds of participants was the additional use of casual hired labor. Less than one in ten producers indicated the additional use of family children in response to the additional labor demands.

Table 23. Labor mobilization in response to additional labor demands following FFS training.

Response	Frequency
Increase in participant's own labor	87%
Increase use of hired casual labours	67%
Increase use of family members—adults	12%
Rotating labour groups (Nnoboa)	8%
Increase use of family children	6%
Increase use of sharecroppers	3%
Increase use of permanent hired workers	1%

On average, FFS participants reported higher cash outlays than the control group although the difference was not significant (Table 24). There was also an increase in outlays from 2003 to 2004 for both groups.

Table 24. Average cash outlays per farm for labor hire (USD$1=8,970 cedis in 2004; $1=8,719 in 2003)

Year	Non FFS n=133	FFS n=223	All n=356	Prob (Student's t)
	---------------(0 000 cedis)-------------			
2004	89.19	118.28	107.41	0.16
2003	77.81	103.64	93.99	0.26

d. A Regression Model of Household Cocoa Production

To explore in more depth the relative contributions of the numerous variables affecting household cocoa production, a regression analysis was conducted using the field survey data. The model specified was:

$$PROD04_i = a_0 + b_1\, EDUC_i + b_2\, GENDER_i + b_3\, HH\_LABOR_i + b_4\, PRUNE_i + b_5\, WEED_i + b_6\, WEED\_SQ_i + b_7\, SHCROP_i + b_8\, HYB4\_10_i + b_9 HYB11\_40_i + b_{10}\, NHYB4\_10_i + b_{11}\, NHYB11\_40_i + b_{12}\, G\_FSPRAY_i + b_{13}\, F\_FSPRAY_i + b_{14}\, G\_INSPRAY_i + b_{15}\, F\_INSPRAY_i + b_{16}\, FERT_i + e_i$$

Where $PROD04_i$ is defined as the quantity of cocoa sold in the 2004\2005 cocoa season by a household *i*.

The independent variables can be grouped into four categories, those related to human capital/labor, management practices, the age and quality of the tree stock, and agrochemicals.

Human Capital and Labor

$EDUC_i$ = the number of years of schooling attained by the cocoa farmer. The hypothesized effect of education on production is positive.
$GENDER_i$ = the gender of the cocoa farmer equal to 1 if male, 0 if female. Given the various demands placed on women outside the productive sphere, we expect that sign of gender coefficient will be positive, i.e. women are less productive than men.
$LABOR_i$ = the adult male equivalents per household i, where children aged 9 to 17 years are equal to 0.6 adult male equivalents, men aged 18 to 54 years are equal to one adult male equivalent, women of the same age are equal to 0.9 adult male equivalents, and the man and women over the age of 54 are equal to 0.7 adult male equivalents. The amount of labor within the household is expected to have a positive impact on production.

Management Practices

$PRUNE_i$ = the number of prunings conducted in the 2004 cocoa season by household i. Given various testimonies concerning the virtues of pruning (see for instance, the STCP video on pruning in Ghana), we expect this variable to be positively related to the production of cocoa.

$WEED_i$ = the number of weeding conducted by household i. The impact of weeding on cocoa production is expected to be nonlinear, that is, initially increasing and then decreasing. Indeed high-yielding cocoa farms with well-developed cocoa canopies require only a minimal weeding of the under story. Low yielding cocoa farms with poorly developed canopies often require multiple weedings.

$WEED\_SQ_i$ = the square of $WEED_i$ with an expected negative regression coefficient to capture the nonlinear effect of weeding.

Quality of Tree Stock and Cocoa Land

$SHCROP_i$ = a dummy variable equal to one if the cocoa farmer obtained his cocoa farm through a sharecropping arrangement as described above, equal to zero if not. We expect that this variable will have a negative impact on production under the hypothesis that sharecroppers receive the lower yielding portion of the farm as payment for their labor in creating the cocoa farm for the landowner.

$HYB4\_10_i$ = the number of hectares planted to F1 hybrid cocoa of age 4 to 10 years. The per ha yield of young F1 hybrid cocoa is expected to exceed that of nonhybrid cocoa of a similar age, based upon the findings of Edwin and Masters (2005).

$HYB11\_40_i$ = the number of hectares planted to F1 hybrid cocoa of age 11 to 40 years. The per ha yield of mature F1 hybrid cocoa is expected to exceed that of any other age class of cocoa.

$NHYB4\_10_i$ = the number of hectares planted to non-hybrid cocoa of age 4 to 10 years.
$NHYB11\_40_i$= the number of hectares planted to non-hybrid cocoa of age 11 to 40 years. The per ha yield of mature nonhybrid cocoa is expected to lie between the yield of young nonhybrid cocoa, and mature F1 hybrid cocoa.

Agrochemicals

An increase in the level of agrochemicals is expected to increase production. However, there could be differences in the level of impact achieved by the government spraying program, relative to the application of pesticides by the individual farmer. It is not obvious a priori which effect should be larger. It is easy to imagine a well-trained and observant farmer applying pesticides in a more efficient and effective manner than government trained workers with little stake in the outcome. On the other hand, farmers with little or no training in the rational use of pesticides would be expected to achieve less efficient outcomes. For these reasons, we have distinguished between applications made by the government and applications made by the individual farmer for both insecticides and fungicides.

G_FSPRAY_i = the number of fungicide applications made by the government spraying program.

F_FSPRAY_i = the number of fungicide applications made by the individual farmer on his/her own initiative.

$G\_INSPRAY_i$= the number of insecticide applications made by the government spraying program in 2004.

$F\_INSPRAY_i$= the number of insecticide applications made by the individual farmer on his/her own initiative.

$FERT_i$ = the total kilograms of fertilizer applied per hectare. Roughly 14% of the farmers interviewed indicated the use of fertilizers in 2004, most having received them through a government program at no cost to the farmer.

e_i = the residual error term.

Descriptive Statistics

A total of 283 out of 360 households were able to provide complete records for the 17 variables in the model. Table 25 provides the summary statistics for the model variables by FFS and control groups. The mean levels of output per producer were 312 and 238 kg for the FFS and control groups respectively in 2004/2005. The representative FFS cocoa farmer had 3.12 ha of productive cocoa, which was sprayed with pesticides an average of 2.5 times. In comparison, the representative control farmer produced with an average of 2.81 ha of cocoa which was sprayed an average of 2.2 times. Dividing production by the average area in production, the calculated yields are 100 and 85 kg per ha for the FFS and control groups, respectively. One of the questions the regression will seek to answer is the extent to which the divergence in yields might be attributable to the FFS training.

There was a higher frequency of weeding and pruning among FFS participants, while in terms of gender, the proportion of women farmers was similar for the two groups. The frequency of cocoa farmers indicating they had acquired their land via a sharecropping labor exchange was greater among the FFS farmers.

Table 25. Descriptive statistics for regression variables.

	Pooled (n=283)		*FFS (n=188)*		*Control (n=95)*	
Variable	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
PROD04	287	401	312	450	238	276
EDUC	6.20	4.36	6.53	4.20	5.55	4.59
GENDER	0.72	0.45	0.73	0.45	0.71	0.46
HH_LABOR	2.61	1.10	2.62	1.09	2.59	1.12
PRUNE	2.42	1.21	2.58	1.09	2.09	1.35
WEED	2.71	0.71	2.81	0.68	2.50	0.71
WEED_SQ	7.83	4.00	8.38	3.95	6.75	3.90
SHCROP	0.29	0.45	0.33	0.47	0.21	0.41
HYB4_10	0.40	0.92	0.48	1.01	0.23	0.70
HYB11_40	0.15	0.52	0.17	0.44	0.12	0.65
NHYB4_10	1.69	2.74	1.57	1.84	1.94	3.96
NHYB11_40	0.77	1.72	0.90	1.81	0.52	1.51
G_FSPRAY	0.31	0.67	0.33	0.71	0.26	0.58
F_FSPRAY	0.27	0.66	0.27	0.63	0.28	0.72
G_INSPRAY	0.88	0.76	0.91	0.74	0.83	0.82
F_INSPRAY	0.93	1.04	0.98	1.02	0.83	1.08
FERT	29.08	87.59	35.52	95.93	16.47	67.05

Model Diagnostics

There is a possibility that the cocoa production technologies may differ across the two groups perhaps as a result of FFS training. To test for this a Chow test for overall parameter stability was conducted for the two groups. The null hypothesis of stable parameters across groups was rejected (Table 26) and therefore, discussion of the results that follows focuses on the group regressions. All three regressions were beset with heteroskedasticity and a consistent procedure for estimating standard errors was implemented. The coefficient of determination was relatively low, which is not uncommon for cross-sectional studies.

Interpretation of Model Results

One of the striking differences between the two regressions is the effect of the education level of the cocoa farmer on production. For FFS graduates the number of years of education was significant and positively related to output. For the control group, years of education had no significant effect. One interpretation of this result is that formal education becomes important when combined with adult education programs such as the farmer field school.

Another noteworthy result is the difference in the magnitudes of the coefficients on the tree stock variables. The coefficients (i.e., yields per hectare) for young and mature hybrid cocoa were significantly larger for control farmers, whereas the coefficients for young and mature nonhybrid cocoa were significantly larger for FFS farmers. To get an overall picture of the average contribution of a hectare to cocoa production, we calculated:

$$AVEYLDHA = \frac{(b_8\,\overline{HYB4\_10} + b_9\,\overline{HYB11\_40} + b_{10}\,\overline{NHYB4\_10} + b_{11}\,\overline{NHYB11\_40})}{(\overline{HYB4\_10} + \overline{HYB11\_40} + \overline{NHYB4\_10} + \overline{NHYB11\_40})}$$

Table 26. Regression model results

	Pooled (n=283)		FFS (n=188)		Non FFS (n=95)	
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Intercept	-39.9	-0.25	-212.2	-0.75	43.1	0.26
EDUC	7.84	1.87	16.46	2.81***	-2.68	-0.58
GENDER	60.2	1.99	62.6	1.49	20.0	0.49
HH_LABOR	7.97	0.47	19.11	0.75	16.6	1.12
PRUNE	20.5	0.85	11.7	0.33	-0.5	-0.06
WEED	-14.9	-0.12	3.03	0.02	57.7	0.44
WEED_SQ	-3.52	-0.18	-7.87	-0.26	-9.86	-0.39
SHCROP	-99	-2.12	-150	-2.49**	-117	-2.93***
HYB4_10	46.7	1.62	37.5	1.38	101.4	2.00**
HYB11_40	189	2.76	96.2	0.94	253	9.25***
NHYB4_10	20.0	1.56	62.0	2.84***	1.9	0.62
NHYB11_40	56.0	2.12	66.3	1.96**	33.5	2.58**
G_FSPRAY	-23.3	-0.80	-31.8	-0.78	-70.0	-2.46**
F_FSPRAY	77.1	1.72	124.1	2.16**	8.5	0.44
G_INSPRAY	109	3.53	168	4.01***	20	0.88
F_INSPRAY	41.6	1.87	51.8	1.92*	29.6	1.03
FERT	-0.423	-1.63	-0.595	-1.87*	-0.016	-0.04
Adj. R squared	0.270		0.296		0.478	
Breusch - Pagan	440.9		252.6		35.4	
Chow test of parameter stability F(17,272)=2.043, p=0.0098						

Significance levels: * P<0.10, ** P<0.05, ***P<0.01

for the two regressions estimated at 61 and 26 kg per hectare for the FFS and control groups, respectively. The relatively low overall yields are a reflection of the young age profile of farmers' tree stock (recall that two-thirds of all cocoa farms are estimated to have been established within the last 10 years).

The negative coefficient on *SHCROP*, the dummy variable indicating that the farm was acquired through a sharecropping exchange, suggests that it is usually the sharecropper who receives the less productive share when the cocoa farm is divided with the landowner.

The pesticide spraying frequency variables also had differential effects. In the control group regression there were no positive significant effects. Indeed the estimated coefficient for government fungicide spraying was negative and significant. In contrast, three of the four pesticide variables had a positive and significant effect on production in the FFS regression. The coefficient of *G_ISPRAY* was considerably larger than the coefficient of *F_ISPRAY* suggesting considerable latitude for increasing the effectiveness of farmer spraying. Calculating the average contribution per spraying to overall production in a similar fashion to that immediately above, it is estimated that each pesticide application resulted in an additional 91 and 11 kg of cocoa per spraying for the FFS and control groups, respectively. As the intensity of pesticide application was not found to differ across the two groups (see table 12 above), this finding suggests that FFS participants were considerably more efficient in the use of pesticide.

The crop management variables, pruning and weeding frequency, were not significant in either of the regressions. For the pruning variable this may be due to lag effects on production. The impact of weeding frequency on output is likely to be nonlinear. Farms with close canopies often do not require any weeding whatsoever, whereas those with semi-closed canopies may require infrequent to frequent weeding depending upon the weed pressures, whereas newly established farms usually require frequent weeding in order to obtain a reasonable yield. If we assume that the parameter differences between the control and FFS group regressions are attributable to the FFS training received, then the estimated production for the representative FFS producer using the control group regression model results in an output of 278 kilograms of cocoa, which is 38 kg less than the actual output achieved with the FFS model. On this basis, we estimate that FFS-trained farmers achieved a 14% production increase relative to their predicted production in the absence of training.

e. Farmer-to-Farmer Diffusion and Willingness to Pay

The propensity to share knowledge gained in the FFS was relatively high with men more likely to receive shared information than women (Table 27). Farmers that shared information did so with an average of two other persons who were most likely to be members of the producer's extended family, neighbors, or friends residing in the participant's own village (Table 27). There was little knowledge diffusion between the field school participant and hired labor, probably reflecting the small scale of cocoa farming operations in Atwima and the lack of permanent hired labor.

Table 27. The Extent of Knowledge Sharing by Gender of Recipient, Atwima Division, Ghana

	Gender of recipient		
	Men	Women	All
No. of persons receiving information	241	136	380
No. of ffs participants sharing info	142	106	194
Percent of sampled participants sharing info	63%	47%	86%
Mean no. of persons per farmer sharing info	1.7	1.3	2.0
Relation of recipient to ffs participient			
Extended family	36%	68%	48%
Fellow villager	29%	17%	24%
Friend	25%	6%	18%
Farm org member	4%	3%	3%
Son/daughter	3%	4%	3%
Unspecified	2%	2%	2%
Hired labor	2%	1%	1%
Residence of knowledge recipient			
Same village	70%	78%	73%
Different village	30%	22%	27%

The interviews also explored what information was shared. FFS graduates were most likely to share information on pruning techniques followed by phytosanitary harvest and shade management (Table 28). Whether the recipient was male or female did not have any appreciable effect on the outcome. On average a total of 2 themes were shared per recipient and according to the participants interviewed only 5% of knowledge recipients did not apply the new information. Time and monetary constraints prevented a closer follow-up with the named recipients to assess actual changes on the farm.

Table 28. Knowledge Shared by Gender of Recipient, Atwima Division, Ghana

	Gender of recipient		
Knowledge Shared	Men	Women	All
Pruning	37%	38%	37%
Phytosanitary harvest	24%	25%	24%
Shade mgt	24%	23%	24%
Weeding	12%	10%	11%
Proper spacing	1.8%	3.6%	2.4%
Nursery	1.7%	0.7%	1.3%
Stemborer elimination	0.4%	0.4%	0.4%
Child labor issues	0.0%	0.4%	0.1%
Stem canker	0.2%	0.0%	0.1%
Grand Total	100%	100%	100%
Average no. of themes per recipient	2.3	2.1	2.2
Total no. of themes shared	545	281	838
Total no. of themes practiced by recipient	519	268	799
Percentage of total	95%	95%	95%

The awareness of FFS training and the willingness to pay for such a service was assessed among the control group farmers. Overall, nearly 100 percent were aware of the cocoa FFS program and approximately 7 in 8 indicated a desire to participate (Table 29). Those expressing an interest in becoming a participant were then asked if they would be willing to pay a tuition fee to participate. Nearly three-fourths of the non-participants indicated a willingness to pay. When asked how much they would pay for a 15 session farmer field school an average amount of over 50,000 cedis was indicated with the mean for men significantly greater than women.

Table 29. Awareness of FFS and Willingness to Pay to Participate, by Men and Women Control Group Farmers, Atwima Division, Ghana.

	Women	Men	All
Aware of FFS	45	84	129
% aware	98%	94%	96%
Wish to participate	36	79	115
% wishing	78%	89%	85%
Willing to pay	33	64	97
% WTP	72%	72%	72%
Average amount WTP (Cedis)	18 591	71 031	53 191

A Tobit regression of the amount, *AWTP,* farmers were willing to pay to attend an FFS was estimated in order to better understand the demand for extension services.

The preferred specification was:

$$AWTP_i = a_0 + b_1 AGE_i + b_2 EDUC_i + b_3 SHARECROP_i + b_1 HEAD_i + e_i$$

Where:

AGE_i = the age in years of the cocoa farmer. As there would be less monetary reward in attending an FFS as the age of the participant increases, the hypothesized sign of age is negative.

$EDUC_i$ = the number of years of schooling attained by the cocoa farmer is expected to be positively correlated with the effective demand for FFS. The hypothesized effect of education on training is positive.

$SHARECROP_i$ = a dummy variable equal to one if the cocoa farmer obtained his cocoa farm through a sharecropping arrangement as described above, equal to zero if not. The expected effect is negative given a working hypothesis concerning the lower quality of sharecropper fields.

$HEAD_i$ = a dummy variable equal to one if the cocoa farmer was also the head of the household. This variable was included to capture the importance of decision-making autonomy in the household economy. The hypothesis is that cocoa farmers who are household heads will have more demand for improving their knowledge of cocoa farming than those who with more limited powers to decide (e.g. spouses) vis-à-vis technical change processes.

Table 30 presents the model results. All variables are significant and with postulated signs with exception of the *SHARECROP* variable.

Table 30. Tobit regression of the Amount WTP by Control Farmers,

	Coeff.	Std.Err.	t-ratio	P-value
Intercept	75406	48355	1.56	0.12
AGE	-2672	844	-3.17	0.00
EDUC	4181	2517	1.66	0.10
HEAD	49236	24608	2.00	0.05
SHARECROP	36021	25424	1.42	0.16

IV. Discussion

Demographics, farm structure, and willingness to pay for FFS

One of the striking demographic findings was the high proportion of women involved in cocoa farming, accounting for one-fourth and one-third of cocoa producers interviewed in the FFS and control group sub-samples, respectively. The roles, responsibilities, and household decision making autonomy of women in rural Ghanaian society differs considerably from men and needs consideration in the design of technology dissemination efforts including FFS. In a somewhat roundabout way the Tobit willingness to pay regression underscores the importance of decision making autonomy and gender. The positive effect of household head status on the amount producers were willing to pay suggests that the control of resources inherent in head of household status increases the producer's expected return from FFS participation and thus the amount that they are willing to pay. Most women cocoa producers (66%) in our sample were not household heads and therefore are less willing to pay as much as the 98% of men producers who were also household heads (see Table 28).

Age and the amount of schooling also affect the producer's willingness to pay for FFS. The older and less educated the producer, the lower the expected return and the lower the demand for FFS. The significant difference in mean educational attainments and age between the FFS and the control group interviewees is a manifestation of these demand factors at play. Age, which was the most significant variable in the WTP regression, could serve as a discriminating factor for participation in the FFS. The level of education which was also highly significant in the production regression for FFS participants is also a prime candidate for use as a discriminating factor for participation.

Given scarce resources for development, it is important that investments in human capital pay the highest potential returns possible with these findings suggesting the use of age and education as potential eligibility criteria.

The most important agricultural factors of production in rural West Africa are land and labor. The average household endowments of labor were slightly in favor of FFS households while there was no difference in overall cocoa holdings. However FFS households did have a significantly larger share of hybrid cocoa land. A recent study by Edwin and Masters (2003) found an increase of approximately 250 kg per ha on lands planted to hybrid cocoa relative to "traditional" varieties under average farmer management. If this result applies to Atwima district, then the larger share of cocoa land in hybrid production among FFS farmers is likely to increase their total output.[2] The program was very successful in facilitating producer

[2] The finding of Edwin and Masters (2003) contradicts results from the Ghana STCP baseline survey conducted in the four principal cocoa growing regions of Ghana. A one-way ANOVA analysis of yield per ha by type of planting material was conducted on information gathered through interviews with 648 farmers concerning 804

access to hybrid cocoa pods. While cocoa land planted to hybrid cocoa was only marginally more productive in the FFS regression, more substantial yield increases were seen in the control group and the pooled regression models. Facilitating access to hybrid cocoa pods and the incorporation of a replanting module that would address nursery management and replanting at the end of the growing season (start of the dry season) would seem logical and cost-effective for the Ghanaian FFS program.

Land tenure especially concerning immigrants has been and remains a contentious issue in many cocoa growing areas. In Ghana this turmoil has in recent times been relatively minor. Perhaps one of the mitigating factors has been the sharecrop/shareland arrangement whereby migrant labor is mobilized to convert forest land to cocoa farms in exchange for use rights to a share of that land. Kasanga and Kotey (2000) report that this tenure institution is robust, with sharecroppers able to transfer this land to their heirs and reported instances of land sales by cocoa farmers utilizing this land acquisition method. We find a relatively high proportion of farmers acquired their land in this fashion and that these farmers were predominantly migrants from the north. We also saw from the regression analysis that if the farmer acquired her land in this fashion it was likely to be of lower productivity. We suppose that this is due to the landowner's ability to dictate which land is shared with the contractual labor used to convert it. However, given the relatively high proportion of farmers acquiring their land in this fashion, further investigation into the specific biophysical causes may be warranted.

Impacts on child labor

Since 2003, the FFS sensitization efforts on child labor have been conducted in Ghana with over 2,800 cocoa producers caring for an estimated 4,800 children (aged 6 to 14 years). On the basis of the survey findings there appears to have been significant reductions in the hazardous employment of children belonging to this age cohort. If we extrapolate the results as reported in table 9 we estimate that the 2800 FFS cocoa producers are employing 170 fewer children in pesticide application, 540 fewer children in heavy load transport and 440 fewer children in clearing fields with machetes as a result of program sensitization efforts to date. This works out to an average of about 11 hazardous tasks in which children were no longer employed per field school.

It is conservatively estimated that scaling up FFS in Ghana to reach 50,000 producers in the Ashanti region would result in the voluntary removal from all hazardous labor tasks of 10,500 children aged six to 14 years, not by the state, but by their parents. A predicted 3,000 fewer children would be employed in pesticide application, 9,700 fewer children in heavy load transport and 7,900 fewer children in clearing fields with machetes following the sensitization of cocoa producers in FFS on child labor.

We believe that the effectiveness of sensitization in removing children from hazardous tasks is even higher than reported here for two reasons. The first reason has to do with the rush to start up the FFS program in 2003. Because of the hurried start up, sensitization messages had

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cocoa plots established after 1984. Farmers, when queried as to the source of planting material used to establish these plots, indicated two types: 1) the farmer's own tree stock and 2) hybrid cocoa pods acquired from the Cocoa Services Division's seed gardens. The plots were planted either exclusively from the farmer's own tree stock, or exclusively with cocoa pods acquired from CSD, or a mixture of the two. The mean yields were equal to 196 (n=473), 189 (n=199) and 236 (n=132) kilograms per ha for plots established from the farmers' tree stock, CSD pods, and the mixture, respectively (F= 1.89, p=0.151).

not been fully developed. The second reason lies with the comparison with the control group. In most cases, control group farmers were located in the same villages as the FSS participants. As such, they may have been subjected to some of the social messages on child labor, resulting in a reduction of their own use of child labor.

The complete eradication of child labor in cocoa farming is probably neither feasible nor desirable in a context where rural poverty is rampant and daily survival a struggle. The sensitization of farmers through the FFS child labor protocols has been shown to be an effective means for reducing hazardous child labor in the six to 14 year age cohort while leaving decision-making to the parents. The question as to whether a 14-year-old boy is capable of clearing a cocoa farm in relative safety is a question that can only be answered by the child's parents. The dexterous use a machete is fundamental to rural livelihoods in the humid lowlands of West Africa and to interdict children from acquiring this skill could jeopardize their futures.

Changes in management and the impact on production

Farmers in FFS are exposed to new methods of discovery including observation and simple experimentation. These methods are used to develop their understanding of cause and effect concerning agronomic problems. These tools are used in a process of discovery learning to illustrate the importance of field management practices such as pruning, shade management, and proper phytosanitary control. Significant changes in farmer management for all of these practices were noted.

One management issue currently neglected by the FFS curriculum in Ghana is the issue of rational pesticide use by individual farmers. The program had supposed that there was no need to emphasize rational pesticide use since there was a government program which intended to spray farmers cocoa farms. However, the study revealed that less than two-thirds of all producers participated in the government spraying program and independent of the government program more than half applied insecticides and approximately 1/5th applied fungicides paid for out of their own pockets. In the regression analysis it was noted that the marginal impact of an independent spraying of insecticide was considerably lower than a government spraying suggesting that producers were less efficient than government spray teams. One area of farmer practice that requires attention may be the timing of insecticide application for the control of capsids. One-third of FFS farmers were spraying during the major fruit setting period. There is also concern over the use of endosulfan to control capsids which is an extremely hazardous insecticide that may be applied only by specially trained applicators in developed countries. More consideration should be given to the FFS curriculum dealing with rational pesticide use, particularly for the control of capsids.

One of the objectives of the farmer field school is to develop cultural control methods for addressing pest and disease problems as alternatives to pesticides. Pruning is an example which was more frequently done by FFS participants. However, it was not a significant determinant of production in the regression model. The reasons for this may lie in a delayed effect and or the difficulty in capturing qualitative differences in pruning regimes from one farm to the next.

The objective of the disease zoo protocol is to lead farmers to discover the relationships between disease, humidity and black pod disease development. This understanding is then reinforced by the protocols on phytosanitary harvesting and shade management. In the former, farmers discover the importance of proper phytosanitary harvesting of infected cocoa pods when sporulating. Whereas prior to FFS training the majority of farmers left sporulating pods either on the tree or on the ground within the cocoa farm; following training the majority indicated that they removed these sources of disease from the farm. The protocol on shade management leads the farmer to recognize situations where excessive shade may be contributing to the development of black pod disease and where too little shade may be contributing to capsid infestation. Farmer knowledge of these relationships was not significantly different between the two groups, suggesting that more emphasis is needed on understanding this critical component of the cocoa production system. The low number of farmers citing the production of secondary products such as fruits as a benefit of shade is in contrast to the Nigerian and Cameroonian experiences.

In addition to the differential effect of education mentioned above, the regression models of production revealed three other major structural differences between the FFS-trained farmers and control farmers. The per hectare productivity of the FFS farmers' tree stock was more than double that of the control group. This may be a reflection of the overall improved crop management of FFS participants. The other striking difference was the production response to pesticide application with the FFS participant farm 8 times more responsive than the control group. Finally, fertilizer response was significantly negative for FFS farmers as compared to the control group which exhibited no significant response. This surprising finding may have been related to the over use of subsidized fertilizers by farmers associated with certain field schools.

In sum, FFS training is estimated to have resulted in a net increase in production of 14% among the 2003 participants. To achieve this increase which was estimated at 38 kg, producers mainly increased their own labor input and indicated hiring more casual laborers. While the survey was unable to accurately determine the actual change in labor inputs, the additional labor costs required to achieve this increase (whether from the family or hired) are real and should be netted out of the 14% increase in estimated gross revenues.

It is interesting to compare 2003 participant on-farm results with results from the ICPM and farmer practice plots in the current Ghana farmer field schools. As of September 2005, the yield on the ICPM plots was estimated to be 41% greater than the farmer practice plots, but required more than a doubling of the labor input. It is unlikely that most farmers would be willing or able to double their labor inputs in order to achieve such a result. Farmers are more likely to selectively apply the set of new practices and knowledge acquired. The corollary is that the productivity gained is likely to be less than that achieved in the field school itself. This explains in part the relatively low production increase seen among 2003 participants.

V. Recommendations

From several different perspectives it is clear that the FFS training received by participants has had measurable impacts on their productive capacity and on their views towards child labor. In support of the significant accomplishments already achieved, several recommendations can be made to potentially improve the performance and impact of FFS training.

- More attention should be given to address the specific needs of women cocoa producers and those acquiring their cocoa farms through a share-cropping exchange.

A needs assessment with these two groups is recommended as a first step in adapting the curriculum.

- Given the scarce resources available for training farmers, criteria are needed to select participants so as to maximize expected returns. Age and educational level of the producer are recommended as discriminating factors.

- The positive results seen vis-à-vis child labor participation in hazardous tasks is highly encouraging and warrants increased efforts at sensitization through the farmer field school.

- Given that the majority of producers were applying insecticides to control capsids independent of the government spraying program but with lower use efficiency vis-à-vis the government program, protocols on the safe and rational use of pesticides require more emphasis in the program than they are currently receiving. Additionally, the Ghana program should seek to develop a protocol for the identification and spot spraying of capsid hot spots.

- The facilitation provided by the program in the distribution of improved cocoa planting material substantially increased the area planted to hybrids among participant farmers. This practice is to be commended and should be augmented with additional FFS sessions to deal with nursery techniques and planting/replanting options. These sessions should be added on to the school year for those schools where the majority of producers are interested.

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ANNEX 1. FFS Curriculum 2003

Topics covered in first training of trainers in Ghana, May 2003.

- INTRODUCTION TO ICPM AND FFS
- GROUP DYNAMICS
- FACILITATION SKILLS
- INTRODUCTION TO AESA
    1. AESA DATA COLLECTION
    2. AESA DATA PROCESSING
    3. ICE BREAKER
    4. AESA PRESENTATION
- INTRODUCTION TO INSECT ZOO
- PREPARATION AND MOUNTING OF INSECT ZOO
- VARIOUS ICE BREAKERS
- CHILD LABOUR
- FARM SANITATION
    1. PRUNING
    2. WEED MANAGEMENT
- MISTLETOE MANAGEMENT
- THINNING
- FARM MANAGEMENT AND RECORD KEEPING
- GROUP DYNAMICS
- COCOA ECO-PHYSIOLOGY
- SHADE MANGEMENT
- DISEASE ZOO
- BLACK POD MANAGEMENT
- SOIL FERTILITY MANAGEMENT
- CAPSIDS MANAGEMENT
- PESTICIDE APPLICATION/CALIBRATION
- ENVIRONMENT/RISK ASSESSMENT
    - HARVESTING AND PROCESSING
    - QUALITY CONROL AND POST-HARVEST MANAGEMENT
    - CHILD LABOUR
    - EVALUATION

Discovery learning protocols used during first workshop:

- AESA
- INSECT ZOO
- CHILD LABOUR
- PRUNING AND SHADE MANAGEMENT
- DISEASE ZOO
- SPRAY DYE EXERCISE
- DISEASE ZOO
- INSECTICIDE SPECIFICITY TEST

ANNEX 2. FARMER FIELD SCHOOL PARTICIPANT QUESTIONNAIRE

Sustainable Tree Crops Program,
International Institute of Tropical Agriculture in cooperation
with Kuapa Kookoo Ltd.
STCP, Private Mail Bag, Kumasi, Ghana
Tel: 051 411 53/57
Fax: 051 411 53
Email: stcp-gh@dslghana.com

The farmer field school was initiated in 2002 by the Sustainable Tree Crops Program which is convened by IITA. The program's main objectives are to improve farmers' analytical and decision making skill, develop expertise in integrated pest management, and reduce pesticide use on cocoa pest and disease. The purpose of this questionnaire is to collect feedback information needed to improve the FFS curriculum. The information collected will be confidential and used only for academic purpose.

Please request that the farmer get his/her Pass Book from COCOBOD so that we may verify the quantities of cocoa produced!!!

Your cooperation will be highly appreciated!

Questionnaire code: |____|____|____|____|

Date of interview: _____/_____/2005

Name of interviewer: Family name:___________________________ First names(s): ______________________

Village: _______________ ______________
District: _______________ ______________

FFS Facilitator : Family name:______________________________ First names(s): ___________

I. SOCIO-ECONOMIC CHARACTERISTICS OF FFS PARTICIPANT AND HOUSEHOLD MEMBERS

1. **Current household composition** (living together and sharing meals for at least 6 out of the last 12 months)

1.1 Name 1.= ffs participant	**1.2 Sex** 1=M 2=F	**1.3 Age** (yr)	1.4 Kinship Status 1=head 2=wife 3=son/ daughter 4=extended family 5=no family relation 6=spouse widowed	**1.5 No. of formal school years received** (years)	*1.6 Principal current activity* 0=none 1=animal rearing 2=agriculture (cash crop) 3=agriculture (food crop) 4=sharecropper 5=trading 6=civil servant 7=retired civil servant 8=student 9=artisan (e.g. carpenter) 10=other (describe)	*1.7 Does this person undertake any of the following cocoa tasks* 0=none 1=clearing/brushing w/machete 2=pesticide spraying 3=heavy load field transport
1.						
2.						
3.						
4.						
5.						
6.						
7.						

1.8	What is your migration status?	Native son/daughter 1 Migrant from other region of Ghana 2 Migrant from outside Ghana 4 Other___________________________ 8	If =1, skip to 1.10
1.9	From where did you migrate?	Eastern region 1 Volta 2 Northern 4 Central 8 Greater Accra 16 Brong Ahafo 32 Western Region 64 Upper East 128 Upper West 256 Ashanti 512 Burkina Faso 1024 Other _________________________ 2048	Skip to 1.10 if native son or daughter from above
1.10	Which methods did you use to acquire the land you are currently farming? (Multiple responses possible)	Inherited from parents 1 Purchased from paramount chief 2 Purchased from previous land owner 4 Land grant from paramount chief 8 "Sharecrop" to establish cocoa farm 16 Leased or hired 32 Other:____________________________ 64	

II –SOURCES OF INFORMATION

2.1	How many FFS sessions did you personally attend?	a) All 1 Most 2 About half 4 Less than half 8 Only a few 16 b) Estimated no. of sessions attended_____	Can be answered from register of facilitator
2.2	Besides the FFS, what has been your principal source of information for technical advice on cocoa farming? (Choose only one!)	Extension service of MoFA 1 Radio 2 Non Governmental Organization (NGO) 4 Farmer organisation 8 Friends/family relations 16 Other _________________________ 32 None 64	

III—FARM CHARACTERISTICS

3.1	How many cocoa farms do you have?	Number of cocoa farms: _______	
3.2	What is the size in acres (and number of trees if known) and the age of these cocoa farms (If two farms fall into same age class, give the sum area total of the two farms).	a) Immature 0-3yrs _____acres or _____trees b) Young 4-10yrs _____acres or _____trees c) Mature 11-25yrs _____acres or _____trees d) Old mature 26-40yrs ____acres or _____trees e) Old > 40 yrs _____acres or _____trees	If farmer has problems giving area in acres see if he can provide tree number
3.3	What is the average spacing between cocoa trees in your farm? (Interviewer to fill in measurement units.)	a) Spacing farm 1: ____ x _____ Units_______ b) Spacing farm 2: ____ x _____ Units_______ c) Spacing farm 3: ____ x _____ Units_______	
3.4	a) How much cocoa did you produce and sell from March 2004 to February 2005? (see Pass Book of farmer or go to purchasing clerk records). b) From March 2003 to February 2004? c) From March 2002 to February 2003? d) What is the source of this information?	a) cocoa 2004/2005____________ kg / bags b) cocoa 2003/2004____________ kg / bags c) cocoa 2002/2003____________ kg / bags d) Source of production records: Nat'l farmers assoc. passbook records 1 Other written record (____________________) 2 Other non written (____________________) 4	Explain clearly the definition of cocoa seasons as described in 3.4 to the farmer
3.5	What type and quantity of fertilizer did you apply to your cocoa farm in 2004, 2003 and 2002?	Year Type Quantity Unit 2004 |______________| |___________| bags kg 2003 |______________| |___________| bags kg 2002 |______________| |___________| bags kg	If no fertilizer applied, write quantity = 0
3.6	Did you spray herbicides on your cocoa farm in 2004, 2003 or 2002?	a) Spray herbicides in 2004?: Yes 1 / No 2 b) Spray herbicides in 2003?: Yes 1 / No 2 c) Spray herbicides in 2002?: Yes 1 / No 2	
3.7	How many acres of your total producing area (see Q 3.2 above) farm consists of hybrid cocoa trees obtained from CRIG/CSD seed gardens? (If unable to provide acreage, try to see if he can give proportion). (n.b. Please make sure that the response applies only to F1 hybrid seed produced by CRIG seed gardens, F2 progeny of F1 seed	Acres of hybrid cocoa ________ (if unable to give acreage see if farmer can estimate proportion) (or) Proportion of hybrid trees from CRIG: 0 % 1 1-25% 2 26-50% 4	Please make sure that the response applies only to F1 hybrid seed produced

	garden parents does not qualify).	51-75% 8 76-99% 16 All 32	by CRIG seed gardens, F2 progeny of F1 seed garden parents does not qualify

IV. ADOPTION OF NEW IPM PRACTICES

PRUNING (INCL. MISTLETOE AND CHUPON REMOVAL)			
4.1	Before you participated in the FFS in 2003, how many times did you prune your trees on a yearly basis?	Prune twice every year 1 Prune once every year 2 Prune every 2 to 3 years 4 Prune every 4 to 6 years 8 Never pruned before FFS 16 Pruned according to need, no fixed interval 32 Other:____________________________ 64	
4.2	Since participating in FFS in 2003, how many times have you pruned your trees in 2003 and then 2004? (Number of complete prunings)	a) Pruning in 2004 season ______ b) Pruning in 2003 season ______ c) Prune according to need 2004 Yes 1 No 2 d) Prune according to need 2003 Yes 1 No 2	if zero, write 0 and then skip to 4.7 if farmer prunes when needed rather than as a complete field operation skip a) and b) and note c) and d)
4.3	If pruning was done last year, how much of your total cocoa farm was pruned?	Less than half of total area 1 About one half 2 Greater than 1/2 but less than all 4 All of the trees in all cocoa farms pruned 8	If =8 then skip question 4.7
4.4	a--How many of your trees on average can be pruned by one labourer in a day (six hours)? b--How many days does it take for one labourer to prune your entire farm? c--How many days does it take for one labourer to prune ONE ACRE of cocoa?	a) No. of trees by one labourer in a 6 hr day____ b) No. of labor days required for all farms ____ c) No. of labor days required per acre ____	Try to get answer to a) and either b) or c) but not both b) & c)
4.5	What part(s) of the tree did you prune in 2004? (multiple choice allowed)	Diseased branches 1 Chupons 2 Mistletoe 4 Healthy fan branches 8 Other ______ _______________ 16	Multiple responses allowed
4.6	During which month(s) of 2004 did you prune your trees?	a) J F M A M J J A S O N D b) Prunes as needed (no particular month 1 Other:___________________________ 2	
4.7	If all the trees on your farm were not pruned this year (Refer to response to question 4.3),	Already good air circulation in farm 1	Multiple responses

	please tell us why you made this decision?	Labor costs are too high 2 Blackpod disease not really a constraint 4 Mistletoe not a constraint 8 Not enough family labor available 16 Trees were pruned in _____(year) and do not require pruning at this time. 32 Other (____________________________) 64	allowed. Skip only if producer pruned all his trees (=8 for Q 4.3)

PHYTOSANITARY HARVEST			
4.8	a) Before you participated in the FFS in 2003, what action would you take if you saw blackpod disease on your cocoa pods? b) Since your participation in the FFS in 2003, what action do you now take if you see a spot of blackpod disease on your cocoa pods?	a) No action taken 1 Leave on the tree and treat with fungicide 2 Remove and throw on ground beneath cocoa 4 Remove from tree and carryout of plantation 8 Other ________________________________ 16 b) No action taken 1 Leave on the tree and treat with fungicide 2 Remove on sight and leave beneath cocoa tree 4 Remove on sight and carry out of farm 8 Other ________________________________ 16	
SHADE MANAGEMENT			
4.9	a) What do you see as the benefits of having shade trees in your cocoa farm? b) What are the disadvantages of having shade trees in your cocoa farm?	**a) Benefits:** Reduces capsid attacks 1 Promotes soil fertility 2 Provides timber, fruits and medicines to house 4 Provides environmental services 8 Conserves humidity during dry season 16 No benefits 32 Other ________________________________ 64 **b) Disadvantages :** Increased incidence of blackpod disease 1 Lower cocoa yields 2 Other ________________________________ 4	Multiple choice allowed
4.10	a) Prior to participating in the farmer field school, had you ever made any adjustment to the shade level in your cocoa farm? b) Since participating in the farmer field school have you made any adjustments to the level of shade in your cocoa farm?	a) Shade adjustments prior to FFS: Yes 1 No 2 b) Shade adjustments since FFS: Yes 1 No 2	if a) and b) are = 2, then skip to 4.12

4.11	Which methods of shade management do you use?	Trimming/pruning of shade trees 1 Girdling of shade trees to kill 2 Cut down shade trees 4 Fire around base of tree 8 Adjusting cocoa shade by pruning 16 Planted fruit trees to provide long term shade 32 Planted timber trees to provide long term shade 64 Planted leguminous trees to help soil fertility 128 Other:_______________________________ 256	Multiple responses allowed
4.12	Why do you not adjust shade in your cocoa farm?	Shade levels are not excessive 1 Shade trees provide secondary income 2 Removing shade increases risk of capsid attack 4 Labor costs are too high 8 Blackpod disease not really a constraint 16 Not enough family labor available 32 Has no shade trees in cocoa farm 64 Young farm with no shade trees 128 Other:_______________________________ 256	Skip if farmer indicated adjusting shade.

PESTICIDE APPLICATION			
4.13	a) Going back to 2002, please tell us how many times your cocoa farm(s) have been sprayed with fungicide to control blackpod disease by both yourself and by government spraying gangs. b) Going back to 2002, please tell us how many times your cocoa farm(s) have been sprayed with insecticides to control capsid damage by both yourself and by government spraying gangs.	a) FUNGICIDE SPRAYINGS No. by farmer No. by govt 2004 sprayings a1) |__________| a2)|__________| 2003 sprayings a3) |__________| a4)|__________| 2002 sprayings a5) |__________| a6)|__________| b) INSECTICIDE SPRAYINGS No. by farmer No. by govt 2004 sprayings b1) |__________| b2)|__________| 2003 sprayings b3) |__________| b4)|__________| 2002 sprayings b5) |__________| b6)|__________|	if no fungicides or insecticides applied, indicate with a zero and then, skip to question 4.16
4.14	a) Which month(s) in 2004 was your plantation sprayed with fungicides for blackpod? b) Which months in 2004 did you spray insecticides against capsids?	a) J F M A M J J A S O N D b) J F M A M J J A S O N D	

4.15	Going back over the last three years, can you tell us what types of pesticides have been applied on your farm **since 2002** including those applied by government gangs, the product unit measure and number of product units applied as well as the cost paid by you for these applications?	Type of pesticide (brand) / Unit Measure / No. of Units 1.|____________________| |_________| |_______| Total cost:________| Year:________| 2. |____________________| |_________| |_______| Total cost:________| Year:________| 3. |____________________| |_________| |_______| Total cost:________| Year:________| 4. |____________________| |_________| |_______| Total cost:________| Year:________|	If pesticides were applied but farmer does not know the type write "unknown" and record any other information e.g. cost and year. If govt paid for the pesticide write "govt" for total cost.
4.16	a) What is the reason you did not purchase and use fungicides to control blackpod? (Multiple choice allowed) b) What is the main reason you did not purchase and use insecticides? (Multiple choice allowed)	a) Lack of financial means 1 Lack of availability 2 High cost of fungicides 4 Not effective 8 Blackpod not a major problem on my farm 16 Benefited from gov't spraying program 32 IPM practices of FFS were effective 64 Does not have a sprayer for application 128 Young farm not requiring treatment 256 Other ______________________________ 512 b) Lack of financial means 1 Lack of availability 2 High cost of insecticides 4 Not effective 8 Capsids not a major problem on my farm 16 Benefited from gov't spraying program 32 IPM practices of FFS were effective 64 Does not have a sprayer for application 128 Young farm not requiring treatment 256 Other ______________________________ 512	
HYBRID COCOA PLANTINGS			
4.17	How many cocoa pods from the seed gardens of CRIG/CSD did you acquire in 2004? 2003? 2002? If pods were received in 2004 and 2003 did you get them thru the FFS? Who was the intermediary used in acquiring these pods in 2002?	Hybrid seed garden pods a1) 2004 |_________| a2) FFS supplied? Yes 1 No 2 b1) 2003 |_________| b2) FFS supplied? Yes 1 No 2 c1) 2002 |______| c2) Intermediary: ___________	If farmer did not acquire pods indicate with a zero, do not leave blank! Applies only to F1 hybrid seed. F2 progeny does not qualify

4.18	a) Approximately, how many nursery seedlings from these pods were planted in 2004? How many hybrid pods were directly seeded at stake? b) How many seedlings from these pods were planted in 2003? How many hybrid pods were directly seeded at stake? c) How many seedlings are currently started in a nursery?	Hybrid nursery seedlings: Hybrid pods direct seeded: 2004 a1) ____________ a2)____________ 2003 b1) ____________ b2)____________ c) Hybrid cocoa seedlings currently in nursery_____	If neither seedlings or pods planted indicate with a zero, do not leave blank!
	WEEDING/BRUSHING THE COCOA FARM		
4.19	Before you participated in the FFS in 2003, how many times did you usually weed your cocoa farm on an annual basis?	Weed 3x yearly 1 Weed 2x every year 2 Weed 1x every year 8 Weed as required, no fixed interval b/w weedings 16 Never weeded before FFS 32 Other:____________________________ 64	
4.20	Since participating in FFS in 2003, how many times have you weeded your farm in 2003 and then 2004?	a) Weedings in 2004 season______ b) Weedings in 2003 season______	If no weeding = 0 & skip to 4.24
4.21	If weeding was done in 2004, how much of your total cocoa farm was weeded?	Less than half of total area 1 About one half 2 Greater than 1/2 but less than all 4 All of the trees in all cocoa farms pruned 8	
4.22	a—How many of your trees on average can be weeded by one labourer in a day (six hours)? b—How many days does it take for one labourer to weed your entire farm? c—How many days does it take for one labourer to weed one acre of your cocoa farm?	a) No. of trees by one labourer in a 6 hr day____ b) No. of labor days required for all farms ____ c) No. of labor days required for one acre ____	
4.23	During which month(s) of 2004 did you weed your farm (if two weedings then two months should normally be circled).	a) J F M A M J J A S O N D b) Weeded as needed (no particular month) 1 Other:___________________________ 2	Skip b) if not applicable
4.24	If all the trees on your farm were not weeded this year (Refer to response to question 4.21), please tell us why you made this decision?	Do not have a problem with weeds 1 Labor costs are too high 2 Not enough family labor available 4 Other (______________________________) 8	Skip only if producer weeded all his trees (=8 for Q 4.21)

V. LABOUR REQUIREMENTS FOR FFS

5.1	What sources of labor have been mobilized to meet the additional labor demands posed by the new practices you have implemented since FFS?	Increase in participant's own labor 1 Increase use of family children 2 Increase use of family members—adults 4 Increase use of hired casual labours 8 Increase use of sharecroppers 16 Increase use of permanent hired workers 32	Multiple responses allowed

		Increase use of rotating labour groups (Nnoboa) 64 Others:________________________ 128	
5.2	a) Have you been able to mobilize sufficient new labor to implement the desired level of new practices since FFS? b) If no, what is the reason(s) for your inability to mobilize adequate labor?	a) Yes 1 No 2 b) Lack of financial means for hiring labor 1 Hired laborers difficult to find 2 Lack of surplus family labor 4 Other:________________________ 8	
5.3	How much did you spend in total on all hired labor in the following years? Note: If labor was paid in cocoa, indicate the quantity of cocoa	Cedis Cocoa Unit a) Labor costs in 2004 ________ _______ bag kg b) Labor costs in 2003 ________ _______ bag kg c) Labor costs in 2002 ________ _______ bag kg	If no labor was hired, then = 0 do not leave blank

VI SUBJECTIVE EVALUATION OF FFS AND PRACTICES BY PARTICIPANT

6.1	Of the following 7 practices or innovations which do you feel has the highest potential for increasing your production? Which has the second highest, etc. Please rank as you have experienced on your farm or in FFS. (1st rank is highest expected benefit)	Rank a) Pruning of mistletoe 1 2 3 4 5 6 7 b) Pruning of chupons 1 2 3 4 5 6 7 c) Phytosanitary harvest 1 2 3 4 5 6 7 d) Shade management 1 2 3 4 5 6 7 e) Hybrid pods from seed garden 1 2 3 4 5 6 7 f) Weeding 1 2 3 4 5 6 7 g) Soil fertility management 1 2 3 4 5 6 7	Only rank practices to which the farmer was exposed in ffs.
6.2	Do you still meet with other FFS participants in groups?	Yes 1 No 2	If no go to 6.6
6.3	How many?	Number of persons in group______________	
6.4	How many times have you met in the last 6 months?	Frequency of meeting______________	
6.5	What does the group do?		
6.6	Overall how would you evaluate the training you received in FFS?	Very poor 1 Poor 2 Satisfactory 4 Good 8 Very good 16	
6.7	How would you evaluate the performance of your facilitator?	Very poor 1 Poor 2 Satisfactory 4 Good 8 Very good 16	
6.8	For each of the following themes,	a) Pruning of chupons _____	N.B. If the

	please score the amount of new knowledge you acquired from participating in FFS according to the following scores: Codes: Already known prior to FFS = 1 Substantial increase in knowledge on theme = 2 New knowledge, never knew prior to FFS = 3	b) Pruning of mistletoe ______ c) Phytosanitary harvest ______ d) Shade management ______ e) Nursery production practices ______ f) Identification of capsids______ g) Causes of blackpod disease______ h) Beneficial insects for cocoa farm______ i) Hazardous child labor_____ j) Proper tree spacing/density_____ k) Identification of stem canker _____ l) Identification of stem borer_____ m) Weeding_____	theme was not included in FFS, then indicate by writing "n.a."
6.9	a) How has your family benefited since your participation in FFS? b) What have been the disadvantages?	a)____ ____ ____ ____ b)____ ____ ____ ____	
6.	What are the weaknesses of FFS?	____ ____ ____ ____ ____ ____	
6.	What suggestions can you make to improve the performance of the FFS training?	____ ____ ____ ____ ____ ____	

VII. KNOWLEDGE DIFFUSION BY FFS PARTICIPANTS

Besides yourself could you please indicate with whom you have shared information/knowledge acquired in farm schools. What information have you shared and to what extent has that person implemented the practice shared? (n.b. if no one received information write "no one" on first line of 7.1).

7.1 Name of person receiving information	7.2 Sex 1=M 2=F	**7.3 Age** (yrs)	7.4 Relationship Son/Daughter = 1 Extended Family=2 Member of same farm organization= 4 Hired labour = 8 Village member =16 Other (describe)= 32	7.5 Location Same village 1 Other village (write name of village/town) 2	*7.6 Info shared* Pruning 1 Shade management 2 Weeding 4 Phyto. harvest 8 Soil fertility mgt 16 ***Others*** ***(specify) 32***	**7.7 Info practised** Pruning 1 Shade management 2 Weeding 4 Phyto. harvest 8 Soil fertility mgt 16 ***Others*** (specify) 32

Thank you for your cooperation in improving our efforts to serve you better!!