Sustainable Cocoa Production in Ghana: a Case Study of Farmer Field School and Integrated Pest Management (IPM)

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Summary

A study was conducted to gather empirical evidence on the effectiveness of Farmer Field School (FFS) and the strengths of the approach in imparting knowledge and empowering farmers. The study was conducted on a cocoa farm where all activities were carried out during Field School sessions for an entire cocoa cropping season. There were 49 participants in the school. The FFS farm was divided into three plots: the integrated crop and pest management (ICPM) plot, ICPM+ fertilizer and farmer practice (FP). Data were collected on the FFS graduates and analysed. This study provides empirical evidence on four issues: the effectiveness of FFS training, the potential contribution of farmer–to–farmer diffusion, the positive change in farm management practices and the social impact of child labour and school enrolment. The results confirm the power of discovery learning and that farmers from the FFS were better informed than those without FFS training. FFS provided farmers with new skills and knowledge on cocoa ICPM and that FFS graduates demonstrated superior knowledge on cocoa ICPM as compared to their level of knowledge prior to the FFS. However, the tendency of FFS participants to retain knowledge and diffuse new skills and practices more than concepts and principles suggests the need to review some aspects of the training and extend it to all cocoa growing areas in the country. Twenty –five FFS graduates spontaneously provided hands-on informal training to seventy–five other farmers on key ICPM practices, demonstrating a tremendous potential contribution of farmer–to–farmer diffusion. The study showed that FFS can be a strong starting point for farmer empowerment, but suggests that the social and technical outcomes can only be sustained if the appropriate local and national level institutions, support systems and policy framework in relation to agricultural extension and research are developed.

Key words

cocoa, Farmer Field School, integrated pest management

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Introduction

In the past, cocoa extension services in Ghana were done by institutions specializing on cocoa. Ghana is the second largest exporter of cocoa in the world after Cote d'Ivoire. It has a reputation for producing some of the highest quality cocoa in the world (COCOBOD, 1998; Kouadjo, et al. 2002). The commodity plays a key role in the Ghanaian economy (Axim, 1988; Acquah, 1999). It is ranked the as fourth agricultural commodity (FAO, 2008). It is the second largest export commodity of Ghana, with export earnings of about US$539,126.4 million in 2007 (FAO, 2008).

The significant growth in cocoa output in recent years is contributing to the reduction of poverty in Ghana, and helping the country to achieve its Millennium Development Goals (MDG's) (Coulombe and Wodon, 2007). In the period 1984-2008, cocoa production contributed to 30% of agricultural growth, although its share of total crop production was only 10% during that same period. Such growth was as a result of deliberate policies, implemented in the end of the 1990s and intended to overcome a reduction in area and production, as well as lower yields, due to the incidence of pests and diseases, a lower price of cocoa and non-adopted production technologies (Agbenyega and Gockwoski, 2002) as well as research recommendations. Projections showed that the output of cocoa in Ghana was to grow from 496,846 to 1,000,000 Mt by 2010/2011 cocoa season (COCOBOD, 2007). The discovery of crude oil in commercial quantities by Ghana in 2007, however, has potentially become a threat to this significant growth achievement made in the cocoa industry and agriculture as a whole. An example test case is how the agricultural sector in Nigeria is no longer thriving as it used to be. Agriculture in Nigeria contributed more than 75 percent of export earnings before 1970 but had since declined to less than 5% in the mid-1990s due to the over dependence on oil (Stock, 2009).

For Ghana to sustain and expand its position within the world cocoa market, she needs to increase or at least maintain its momentum in production. This calls for a very strong extension support to cocoa farmers of which the Farmer Field School (FFS) approach should be the fulcrum. Most FFS today strive to empower farmers through the development of their technical as well as social and political capabilities (Van den Berg, 2004).

The Farmer Field School (FFS) is a participatory approach of diffusing new science – based knowledge and information to farmers. It is deemed expensive because it is season long and involves hands – on activities, but if FFS graduates retain and disseminate their FFS – acquired knowledge and experiences particularly through their informal communication channels – then FFS is a cost – effective and viable approach to agricultural extension on a large scale (Rolas *et al*., 2002).

A historically review of Ghanaian agriculture indicates that over the years many different systems of agricultural extension have been an active feature of agricultural development in Ghana since the early 1900s (Acquah, 1999). Agriculture extension in Ghana has gone through a range of experimentation over the years. Experimentation of various extension approaches were carried out through the 1970s and 1980s either as independent pilot programme or as part of some agricultural and rural development project. Examples are the Upper Regional Agricultural Development Project (URADEP), 1979-1984; Volta Regional Agricultural Development Project (VORADEP), 1982-1988; Agricultural Service Rehabilitation Project (ASIP), 1981-1992 and many others (Seini, 2002).

Based on the experiences and the lessons learnt from the various extension approaches, the government of Ghana deemed it desirable to institute a more pragmatic approach to extension. In 1992, the government established a Unified Agricultural Extension System (UES). The UES was a modified Training and Visit (T&V) extension which sought to redeem the resource poor farmer. According to Rivera and Schram (1987), the basic goal of the T & V approach is to build a professional extension service that is capable of assisting farmers in raising agricultural production and/or income and of providing appropriate support to agricultural development. As asserted by Benor and Baxter (1984), the primary objective of the T & V system was to achieve sustained increases in agricultural production and to improve the nutrition and incomes of smallholder households using one Front Line Agent who has been given multi-disciplinary training.

Over the past 15 years, efforts by the Ghana government in cocoa extension have failed. Extension activities were weak in the major producing areas (Gockowski, 2006). A survey conducted by the Sustainable Tree Crops Program (STCP) in 2005 revealed that the government extension system was the most important source of information for just 13 percent of cocoa farmers in Ghana where only 19 percent had been in contact with an extension agent within a period of three months (David, 2005). The result also revealed that cocoa extension was inadequate at two levels. On one hand, there were few extension agents to take on the task of providing extension. In addition, few of these agents had specialized training on cocoa. On the other hand, the training and visit approach usually used in cocoa extension were inadequate to change farmers' practices or impart new knowledge. The training and visit approach was a top-down approach that sought to transfer recommendations to farmers, paying little attention to farmer knowledge and understanding of concepts and principles behind the recommendations (David, 2005).

As part of World Bank conditionality, Ghana merged COCOBOD's extension service with that of the Ministry of Food and Agriculture (MOFA) in the year 2000. The lapses with this policy were: complaints from cocoa farmers about lack of effective extension support; creation of extension message delivery gap, and lower level of adoption of technology on the part of the cocoa farmer (Amoah, 2007).

The challenge facing agricultural extension in the 21st century is how to develop sustainable approaches that go beyond extending technical knowledge to producers; to play a leading role in helping small-scale farmers organize themselves for production, marketing and advocacy in ways that promote farmer empowerment. The Farmer Field School (FFS) approach, which promotes group learning based on principles of adult education, is seen as one approach that can meet these goals (David, 2005).

While recent studies show that FFS leads to reduced pesticide use, increase productivity and improved farmer knowledge (Braun, et al., 2006; Van den Berg, 2004), critics have pointed to two key challenges in promoting the approach: the high cost of FFS in terms of time, funds and human resources and the difficulty of scaling up FFS in a financially sustainable way (Davis, 2006; Quizon et al., 2001).

Better internalization and retention of knowledge, attributed to the discovery of learning process, coupled with social benefits of FFS training, are key justifications for the relatively high time, human and cost investments required to implement the approach. A number of studies show the effectiveness of FFS as a training method by comparing knowledge test score among the farmers (Godtland et al., 2003). A study conducted in the Philippines suggests that FFS alumni retain knowledge several years after the training (Rolas et al., 2002; Tripp et al.; 2005).

Across the regions, many cocoa farmers rely on radio for technical information of which there is little or no implementation. There is therefore the need to assess any extension approach that proves to be effective to know the extent to which it helps check the stated problems. The objective of this study was to measure the extent to which crop management practices and production have changed among the cocoa farmers in the Bekwai District of Ashanti Region.

Materials and method

Study area

The Bekwai District of the Ashanti Region, Ghana is located within 6º 00'N - 6º30'N and Longitudes 1º00W and 1º 35W. The District covers a total land area of about 633 km^2.

The population is 134,354, according to the 2008 Municipal Population and Housing Census (from MDHS, 2008). The area lies within the forest dissected plateau physiographic region. It has average height between 150 and 300 metres above sea level. The topography is relatively flat with occasional undulating uplands, which rise around 240 m and 300 m. The area is drained by the Oda river and its tributaries. The climate is the semi-equatorial type; characterized by double maxima rainfall. The mean annual rainfall is between 1600-1800 mm. It has fairly high and uniform temperature ranging between 20ºC minimum and 32ºC maximum. Relative humidity is fairly moderate ranging between 70 and 80%. The vegetation has been reduced to secondary forest. The major occupation in the district is agriculture that employs about 58.2% of the labour force and constitutes the main source of income for the people in the District. Some of the major food crops produced in the District include cassava, maize, rice, yam, cocoyam and plantain, while the cash crops include cocoa, citrus, coffee and oil palm (Ghana Districts, 2009).

The Farmer Field School approach

The Farmer Field School (FFS) was conducted by the Sustainable Tree Crops Project. The study was on a cocoa farm where all activities were carried out during Field School sessions for an entire cocoa cropping season. The FFS farm was divided into three plots: the integrated crop and pest management (ICPM) plot, ICPM+ fertilizer plot, and farmer practice (FP) where the normal management practices of farmers were carried out.

Farmers were randomly assigned to farmer groups. Names of groups were kept in a container and shuffled for the forty-nine (49) farmers enrolled in the FFS to pick the group they would belong. The school was composed of 30 males and 19 females. Participants were put into six (6) groups. Members of groups 1 and 2 were allowed to practice on ICPM + fertilizer plot, Groups 3 and 4 on ICPM- only plot and Groups 5 and 6 on Farmer Practice (FP) plot.

The participants made observations on the crop and other aspects of the agro-ecosystem including disease and pest infestation, the weather, weeds and the soil. They made drawings to represent the data they collected and analyzed their findings during presentation. The participants with the help of facilitator agreed to learn more about a special topic. The facilitator led participants through a discovery learning exercise contained in the FFS curriculum.

Agro–ecosystem analysis (AESA) data collection is one of the key instruments in FFS. Farmers monitored cocoa trees and fruits through the collection of AESA data. In cocoa pod monitoring, farmers counted the number of pods below 2 m on each of the ten cocoa trees selected for each of the three FFS plots.

For the adoption study, two groups of cocoa farmers were sampled out of the total of 49 FFS class. A simple random sampling was conducted on 30 male participating farmers enrolled in the field school. The sample size was eighteen (18) males. A second random sample of eleven (11) female participating farmers was drawn from the nineteen (19) female farmers enrolled in the same field school. Data collection was conducted through structured interviews with the farmers. Data was analyzed using SPSS 2007 Software package

Results and discussion

The female participants in the FFS were slightly younger than the male participants but the male participants had significantly more formal schooling than the female participants (Table 1). About three out of every five cocoa farmers interviewed were household heads; the remainders were spouses of the heads of households. Over seventy-nine percent of the cocoa farmers indicated that their principal occupation was agriculture with commercial production of cocoa as their major business. One surprising demographic findings was the high proportion of women involved in cocoa farming and enrolment in FFS. In a

Table 1. Demographic and human capital measures of the cocoa farmers interviewed

	FFS – Men (%) N=30	FFS – Women (%) N=19
Mean Age	42.3	39.7
No. of years of schooling	8.6	6.2
Household status:		
Head of household	62.1	–
Spouse	–	37.9
Principal Occupation:		
Animal rearing	3.5	-
Cash crop farming (cocoa)	51.7	27.6
Food crop farming	–	3.5
Trading	–	6.9
Civil servant	3.5	–
Artisan	3.5	–

Table 2. Gender and household dependents age structure of cocoa farmers in Bekwai District

Age grouping	Percentage per household	
	Males (N=30)	Females (N=19)
0-5	3.2	5.5
6-9	7.5	7.2
10-13	6.5	7.2
14-17	5.4	5.5
18-54	21.5	21.8
55 and above	3.2	3.6
Total	47.3	50.8

Table 3. Residential status of cocoa farmers

Residence status	% of group total	
	Male participants N= 30	Female participants N= 19
Autochthones	72.2	81.8
Migrants	27.8	18.2
Total	100	100

Table 4. Land acquisition methods by residential status

Land acquisition method	Migrants (%) (N = 7)	Autochthones (%) (N = 22)	All (N = 29)
Inherited	0	73	55
Shared cropping	72	14	28
Purchased	14	9	10
Leasing	14	4	7

typical rural Ghanaian society, the roles, responsibilities and household decision making of spouses depend on the household heads that tend to dictate to their spouses. None of the women interviewed was a household head and did not have the autonomy of taking household decisions. This had a negative effect on their attendance at the FFS and farm management practices as women attend to their household chores before attending to FFS and farm. Regarding the rural Ghanaian culture that totally denies the girl child formal education, the average number of years of schooling for FFS - females was appreciable.

Table 2 revealed that the households were made up of large numbers with the about extended family relations. Age – class distributions among the participating male and female household samples are in close proximity, although the male participant households were approximately 26% larger in terms of household membership.

The results showed that approximately one out of every four cocoa farmers interviewed were migrants (Table 3). Settler farmers are very important in cocoa farming in Ghana. These are people from other ethnic groups who settle as farmers in the cocoa producing regions. This category of farmers often practiced the shared cropping system. The sharecroppers in cocoa do not share the food crops intercropped with the cocoa with the land owner. The food crops serve as motivation for the sharecropper.

Land tenure system

There was no significant difference in the mode of land acquisition between the male and female FFS participants. However, there was a clear difference between the migrants and the indigenes. Approximately 75% of the migrants acquired their land rights through a "sharecropping" arrangement. 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 inputs needed, while the sharecropper provides the labour 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 the sharecropper becomes his/her remuneration for having developed the farm. In contrast, land acquisition by inheritance was cited by over 75% of the indigene cocoa farmers (Table 4). In the Ghanaian culture, the woman can use the family land for cash crop farming without the involvement of her husband. The husband has no ownership right over the wife's family land.

The most important agricultural factors of production in Ghana are land and labour. Land tenure concerning migrants has been and remains a contentious issue in many cocoa growing areas in Ghana. This turmoil has in recent times been relatively minor, perhaps due to the sharecrop or share land arrangement whereby migrant labour is mobilized to convert forest land to cocoa farm in exchange for use right to a share of land. To Kasanga and Kotey, (2000), this tenure institution is robust with sharecroppers wanting to sell or transfer lands to heirs. The survey found a high proportion of migrants acquiring their land rights through this fashion. The share crop arrangement may have negative influence on productivity since land owners tend to choose the better portion of the land during sharing. Overall, most FFS participants were natives and acquired their land rights through inheritance.

As reported by Gockowski and David (2007) the large majority of labour on cocoa farms is provided by the family household, the survey was no exception. Almost all FFS participants depended on family labour and rarely hired labour for reinforcement.

Farmers source of technical information

A significant proportion of FFS farmers indicated having no other source of technical information, although most FFS farmers had their technical information from family members and friends (Table 5). About 17% of respondents indicated that they had their technical information from extension agents, while only about 7% depended on the radio.

The frequency at which farmers have access to technical information is directly proportional to their level of knowledge and output. Most FFS farmers did not have any source of technical information and were depending on their traditional way of cocoa farming prior to the FFS programme. This supports the fact that the government extension is very insufficient and overburdened as asserted by David et al. (2006). Also, a comparison between the level of FFS participants' knowledge pre and post FFS showed that a better internalization and retention of knowledge could be attributed to the discovery of learning process. It was shown that the social benefits of FFS training justifies the

Table 5. Participating farmers' principal source of technical information

Source of technical information	FFS - Males (%)	FFS - Females (%)
Extension service	17	18
Radio	6	9
Family and friends	33	27
None	44	45
Total	100	100

Table 6. Participants' reasons for not spraying fungicides and insecticides

Reason	FFS - Males (%)	FSS - Females (%)
Fungicides	n = 18	n = 11
Lack of financial means	27.8	36.5
Lack of availability	0.0	0.0
High cost of fungicides	5.6	9.1
Black pod not a major problem on my farm	27.8	9.1
Benefited from government spraying programme	16.6	18.1
ICPM practices of FFS were effective	16.6	18.1
Does not have a sprayer for application	5.6	0.0
Young farm not requiring treatment	0.0	9.1
Insecticides		
Lack of financial means	33.3	27.4
Lack of availability	0.0	0.0
High cost of insecticides	22.2	9.1
Capsids not a major problem on my farm	11.1	18.2
Benefited from government spraying programme	11.1	18.1
IPM practices of FFS were effective	16.7	18.1
Does not have a sprayer for application	5.6	0.0
Young farm not requiring treatment	0.0	9.1

relatively high time, human and cost investments required to implement the FFS approach (Bennett, 1976; Godtland et al., 2003).

Pesticides application between FFS males and females

One–fifth of farmers, who had not sprayed fungicides, indicated that cocoa black pod disease was not a problem. The most common reason for not spraying insecticides and fungicides among FFS participants was lack of financial means (Table 6).

Pruning

Pruning is practices in order to: (a). remove the parasitic mistletoe plant which grows in the upper canopy of the cocoa tree; (b). improve airflow leading to lower disease pressure from black pod; (c). remove diseased or dead tree stock, and (d). improve the plant architecture to facilitate crop management (Winarto, 2004; Mull and Kirkhorn, 2005). FFS – males pruned their cocoa trees on an average of three times, versus two times for the FFS – females (Table 7). Both groups of farmers pruned their entire farm. The recommended period for pruning is when the tree is resting during the dry season. Half of the FFS – males participants implemented pruning during the dry season; which was substantially higher than that of FFS – females. However, it was also noted that about 61% males and 55% females implemented pruning during the wet season, which may not be a good practice depending on what the farmer pruned.

Table 7. Participants' Pruning practices by FFS cocoa farmers in 2009/2010

	FFS Males	FSS Females	All
Frequency and extent of pruning	n = 18	n = 11	n = 29
Average no. of pruning in 2009/2010	2.9	2.2	2.5
Average proportion of farm pruned.	87	84	85.5
Timing of pruning			
Rainy season (April, 2009 to September, 2009)	61.1	54.5	58.6
Dry season (October, 2009 to March, 2010)	50.0	36.4	44.8

Table 8. Type of pruning conducted by FFS cocoa farmers 2009/2010

Portion of tree pruned	% Freq.	
	FFS Males	FFS Females
Diseased branches	13.6	11.1
Chupons	31.8	29.6
Mistletoe	43.2	48.2
Healthy fan branches	11.4	11.1
Total	100	100

There would probably be little negative effect on production if the farmer pruned diseased branches, chupons or mistletoe during the wet season. If however healthy fan branches were pruned, there could be a negative effect on production. Approximately, one – ninth of FFS participants pruned healthy fan branches (Table 8).

Pest and disease cultural control

In the FFS, discovery learning protocols such as the disease diagnosis 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 shown in Table 9, 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, majority of farmers indicated that they now remove the infected pods from their cocoa farms after harvesting.

Farmers' perceptions about shade management

Another factor in the development of black pod is excess humidity. Farmers are led to an appreciation of the role of excessive

Table 9. Participants' response to black pod infections noted on cocoa pods 2009/2010

Actions taken	Participants (n = 29)	
	Pre – FFS (%)	Post – FFS (%)
None	38	0
Leave on tree and treat with fungicide	7	10
Remove and throw on ground	48	7
Remove and carryout (best practice)	3	3
Other actions	4	0

Table 10. Farmer perceptions of the advantages and disadvantages of shade in 2009

Shade benefits	FFS Males (%) n = 18	FSS Females (%) n = 11
Reduce capsid attacks	11	18
Promotes soil fertility	6	9
Provides timber, fruits and medicines to house	11	9
Provides environmental services	6	9
Conserves humidity during the dry season	60	55
No benefits	6	0
Disadvantages		
Increases incidence of black pod disease	61	55
Low cocoa yields	39	45

shade on humidity levels and subsequently the relative development of the black pod disease.

Approximately 60% of FFS participants associated the black pod disease with excessive shade in cocoa farm (Table 10). The FFS participants were knowledgeable on the ecological functions of upper canopy shade. The most commonly perceived beneficial function was conservation of humidity during the dry season (Table 10). While only small proportions of farmers recognized the positive role of shade in reducing capsid pressure, promoting soil fertility and providing environmental services, there was a greater recognition by FFS female participants.

Shade management practices

A significantly greater proportion of FFS participants practiced some form of shade management practice after they have received training (Table 11). Cocoa requires a certain amount of shade from seedling stage in order to protect the young plants from strong winds and direct rays of the sun.

Weeding effort depends on the maturity of the cocoa plantation. Once the canopy has closed, there is often very little weeding required (Gockowski and Mva, 2002). As most cocoa farms were old, less effort was required for weeding as compared to pruning. Most cocoa farmers after receiving training cleared the entire weeds in their farms three times during the 2009 growing season. An amount of 105 US dollars (US$105) was required to hire labourers to weed a hectare of land per day (Table 12).

Table 11. Participants' shade management practices on the cocoa farms 2008/2009

Shade management approach	Pre - FFS (%) n = 29	Post - FFS (%) n = 29
Conduct shade management	72	97
Trimming / pruning of shade trees.	24	59
Girdling of shade trees to kill	24	28
Cut down shade trees	62	55
Fire around base of trees	21	3
Adjusting cocoa shade by pruning	41	62
Planting fruit trees to provide long term shade	17	7
Planting timber trees to provide long-term shade	3	3

Table 12. Participants' weeding regimes by FFS cocoa farmers in 2008/2009

Weed management regimes	Pre – FFS (n = 29)	Post FFS (n = 29)
Mean weeding frequency	1.8	2.7
Area weeded		
Less than half a hectare	7	0
About half a hectare	3	3
Greater than half but less than one hectare	17	10
All of the trees	73	87
Time of Weeding		
January to March	17	10
April to June	41	48
July to September	44	41
October to December	34	34
Weed as required (no particular month)	10	55
Amount required for labourers per acre a day	US$36	US$42

One of the objectives of the farmer field school was to develop cultural control methods for addressing pest and disease problems as alternatives to pesticides (Sonii et al., 2006). Pruning was one of the technologies adopted by FFS participants. The objective of the disease diagnostic protocol is to lead farmers to discover the relationships between disease, humidity and black pod disease development. The understanding of disease protocol led farmers to the discovery of the importance of proper phyto-sanitary harvest of sporulating cocoa pods. Prior to FFS training, 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 now remove these sources of disease from the farm.

The protocols on shade management led the farmers to recognize situations where excessive shade maybe contributing to the development of black pod disease and where too little shade may be contributing to capsid infestation. Farmers' knowledge of these relationships was not appreciable for both FFS men and women.

Conclusion

The study provides empirical evidence on four issues in the farmer field school: the effectiveness of FFS training, the potential of social networking for technology diffusion to the scaling up process, the change in farm management practices and the social impact on child labour and school enrolment. The FFS provided farmers with new skills and knowledge of cocoa ICPM, especially pruning of cocoa trees, shade management, phyto-sanitary harvest and clearing of weeds. However, the study raised a question as to whether the knowledge gained by FFS farmers will be retained for a long time. In sum, it is clear that the farmer field school (FFS) approach is one of the extension approaches that gives value for money and therefore requires careful and frequent scrutiny so as to make critical recommendation to fill the gaps and improve the FFS approach.

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