Final Evaluation Report

CocoaLink Ghana[1]

MARCH/APRIL 2014

Background

CocoaLink is an agricultural extension tool that uses mobile technology to deliver timely and relevant farming, social, and marketing information to cocoa farmers in Ghana to improve their socio-economic and financial lifestyle. The CocoaLink project was introduced in 15 communities in the Sefwi Wiawso, Akontombra, and Juabo Districts in 2011 as part of World Cocoa Foundation's agricultural education programs. Program components in the pilot communities' include:

- Message delivery technology with extension feedback loop, including performance tracking
- Cocoa farmer information network of *local community facilitators* formed for 15 communities
- On-going community educational sessions held by the trained local community facilitators. An average of ~2,000 CocoaLink farmers per month from the 15 pilot communities participate in education sessions.
- Cocobod's CHED (Cocoa Health and Extension Division) and private company partner trainings for delivering the CocoaLink program.

Farmers outside of the pilot communities are able to register to use CocoaLink, and demand for the information services has soared to more than 45,000 registrants as of April 2014.

[1] Conducted by independent consultant Dr. Robert Aidoo, Dept. of Agric. Economics, Agribusiness & Extension, KNUST, Kumasi-Ghana, March 2014 by World Education, Inc.

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Executive Summary

Background: CocoaLink is an innovative two-way mobile phone based agricultural training and outreach program from 2011-2014. Over this three year pilot period, the program reached more than 3,000 farmers in fifteen communities with the agronomic and social reinforcement messaging and educational sessions, as well as equipping the national government's farmer training service to deliver the program alongside regular field work. Additionally, the program reached more than 45,000 farmers with mobile phone reinforcement information (voice and text messages) and the ability to ask questions via a two-way feedback loop.

About the Evaluation: The evaluation was coordinated over the three-year period with a baseline, mid-term, and an end-line evaluation to provide lessons learned towards the scale-up of CocoaLink. Panel data was collected from 271 cocoa farming households in nine CocoaLink communities and six non-CocoaLink, or control, communities through surveys, focus group discussions, and key informant interviews. A combination of descriptive statistics and inferential analytical tools were used for analysis of the data.

Evaluation Findings: The evaluation findings indicate that farmers in CocoaLink communities have more knowledge about good agricultural and social practices that lead to improved application, use, and adoption of good production practices. It is expected that with longer-term use of CocoaLink, farmers will improve their cocoa yield and income. Specifically, evaluation findings indicate the following findings in CocoaLink communities as opposed to the control communities:

- ***Access to and ability to use mobile phone equipment enables participation in CocoaLink, however voice messaging will reach more farmers.***
  The general availability and access to mobile phones is high in CocoaLink, despite reported decreases in one district, with an overall average of ~90% of farmers reporting access. The few cocoa farmers who did not own mobile phones used their family and friend's phones. More than 60% of CocoaLink farmers reported having the ability to use their mobile phones for basic call functions, and just over 50% report having ability to use their mobile phones to retrieve, delete, and compose messages. While the reported knowledge and ability indicates an enabling environment for mobile phone information exchange, low literacy rates likely indicate that farmers will be more impacted by voice messages than text. Overall, CocoaLink farmers' knowledge and ability for using mobile phones is higher than farmers in control communities. This may indicate that the CocoaLink educations sessions about mobile phone use contributed to enabling farmers to become more competent in using the devices.

- ***Farmers' knowledge level, attitudes, and practices in respect of Good Agricultural Practices (GAP) are significantly higher in CocoaLink communities compared to control communities.***
  Knowledge levels on GAP among cocoa farmers in both CocoaLoml and control communities were generally high. However, there are significant differences in the

knowledge levels of farmers in the CocoaLink communities as compared to control communities, indicating that reinforcement messages in these areas support improved knowledge. There were also significant differences in the practices of farmers in CocoaLink and control communities with respect to farm maintenance. CocoaLink farmers reported removing chupons, or unneeded branches, from their cocoa trees and periodically gathering and burying diseased cocoa pods much more than those in control communities.

- ***Farmers' knowledge level and attitudes in respect of socio-economic issues like child labor, girl-child education, and malaria control was also higher in CocoaLink communities.***
  Generally, farmers in CocoaLink communities had higher levels of knowledge on socio-economic issues than those in control communities, particularly in respect to child labor, school-age female education, and malaria. This is likely due to emphasis in training packages on child labor, education for school aged girls, and malaria prevention that took place in CocoaLink communities alongside reinforcement information exchange.

- ***Farmers' household expenditure was significantly higher in CocoaLink program communities as compared to control.***
  Household expenditure, used as a proxy for income, showed that cocoa households in CocoaLink communities spent more per capita per annum as compared to cocoa farmers in control communities. At the end of the CocoaLink pilot, per capita annual expenditure in CocoaLink communities had increased by 78% to GHC2, 179.63 (GHC5.97 per day; US$ 2.39). Further, results from the propensity score matching analysis (See Appendix 1), show that when bias is controlled for, the per capita expenditure in CocoaLink communities was still significantly higher than that in control communities.

Recommendations: CocoaLink has enhanced the capacities of cocoa farmers by reinforcing the periodic extension training packages in the program communities. Farmers' knowledge level and attitudes and practices in respect of Good Agricultural Practices (GAP) are significantly higher in CocoaLink communities than control communities. However, to have a greater influence, it is recommended that the next phase of CocoaLink concentrates on voice messages rather than text messages. Additionally, it is recommended that, because limited access to credit is a major hindrance to applying information shared through CocoaLink, it is integrated to the program so that inputs like fertilizer and spraying chemicals are accessible. This will eventually improve abilities of farmers to apply inputs as suggested in extension trainings and CocoaLink reinforcement information. Additionally, for field-level sustainability of CocoaLink vis a vis the national extension services, it will be important to assess level of agent effort in relation to carrying out the program.

1. INTRODUCTION

1.1 Background and Evaluation Objectives

CocoaLink was launched[2] at the start of 2011 in three pilot cocoa growing districts in Ghana (Wiawso, Juaboso, and Akontombra) as part of the World Cocoa Foundation's agricultural education programs. Its objective was to reinforce and strengthen farmer outreach and training outcomes through mobile technology. CocoaLink delivered timely and relevant farming, social and marketing information to cocoa farmers in Ghana to improve their socio-economic and financial lifestyle. Weekly education sessions allowed farmers to better understand the message content and take full advantage of their mobile phones. Farmers throughout Ghana could register to receive and send information using the platform. As of February 2014, more than 40,000 cocoa farmers registered on the CocoaLink platform and are receiving ongoing messages on planting, weeding, weedicides and pesticide application, fertilizer application, harvesting, and disease control, among others.

Additional CocoaLink activities included message delivery technology development (the technology platform); community needs assessments, community awareness campaigns, education on mobile phone usage, and trainings to equip Ghana's national extension agents to use CocoaLink within their regular farmer outreach.

Baseline and mid-term surveys were conducted to assess the backgrounds of farmers and track project achievements. The end-line evaluation assesses changes over the three-year project period in the pilot districts. The specific objectives of the end-line evaluation include:

- To assess farmers' access to and knowledge level on mobile phone functions and usage.
- To assess farmer-to-farmer and farmer-to-expert interaction (Experts such as extension officers, researchers, etc.)
- To assess farmers' knowledge level on good agricultural practices (GAP).
- To assess farmers' productivity in terms of cocoa yield and levels of income.
- To assess farmers' knowledge level on socio-economic and health issues with regards to child labor and malaria prevention.
- To examine the spillover effect of CocoaLink (i.e., Adult Literacy, increased access to education for children).

1.2 The case for ICT and mobile phone technology in agriculture

Over the past five decades, crop yields have grown at very different rates around the world, with farmers in developing countries recording very low productivity growth rates. Most smallholder farming systems are much less productive and profitable than they could be (Syngenta Foundation, 2011). For instance, Ghana's cocoa sector suffers from low productivity. Cocoa yields in Ghana are well below international averages, suggesting potential for productivity-driven growth (ICCO, 2007). Yield per hectare in Ghana is only 360 kg/hectare as

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[2] It is being implemented by World Education Inc. in partnership with local partners Center for Community Studies, Action and Development (CENCOSAD) and DreamOval. Through this project, farmers proactively obtain information to solve problems and improve farm production and sales through information sessions coordinated by Local Information Partners (LIPs).

compared to average cocoa yield of 1,800 kg/hectare in Malaysia, 800 kg/hectare in Côte d'Ivoire, and 1,000/hectare in Indonesia (Abekoe *et al.,* 2002; Anim-Kwapong and Frimpong, 2005).

Reasons for lower productivity include limited farmer access to productivity-enhancing inputs and credit, as well as limited ability among farmers to manage numerous risks associated with agriculture. Another major problem are the information and skills gaps that constrain the adoption of improved technologies and management practices to enhance technical efficiency in production (World Bank, 2007). Public farmer training and outreach programs (called agricultural extension) are often underfunded, suffer from weak scientific research support, and lack adequate contact with farmers.

In today's competitive global business environment, farming has become a time-critical and information-intense business. Increased productivity will require an information-based decision-making agricultural system (precision agriculture), designed to maximize agricultural production. Such a system is described as the "next great evolution" in agriculture (Surabhi and Tripathi, 2009). It requires that farmers get information at the right time if they are to improve crop productivity and reduce production cost. A study by De Silva and Ratnadiwakara (2008) in Sri Lanka found that information asymmetry is an important contributor to overall transaction costs in agriculture.

Information Communication Technology (ICT) and in particular, mobile technologies, are currently seen as a 'game changer' in smallholder agriculture. McNamara (2009) noted that potential benefits of mobile technologies in smallholder agriculture include productivity and income improvement for farmers, enhanced access to markets, promotion of agricultural innovations among smallholder farmers, and enhanced ability to manage risks in agriculture. Mobile phones in particular have been found to have a multi-dimensional positive impact on sustainable poverty reduction. However, accessibility has been identified as the main challenge in harnessing the full potential of the equipment (Silarszky, 2008). Mobile phones have the potential to provide solutions to the existing information asymmetry in agriculture as they promise new opportunities for reaching farmers with agricultural information in a timely manner.

Mobile phone usage in third world countries is playing a vital role in enhancing farming businesses (Chhachhar and Hassan, 2013). Farming communities appreciate mobile phones as an easy, fast and convenient way to communicate and get prompt answers to problems. The mobile phone has given new direction and approach to farmers to communicate directly, and share recent advances in farming, with each other. The devices creates new ways for farmers to make business decisions. For example, a study by Chhachhar and Hassan (2013) showed that mobile phones saved farmer's energy and time, enabling them to improve their incomes. However, issues regarding timely access to information is a critical factor, especially for inputs, for improving productivity. A study by Surabhi and Tripathi (2009) showed that although mobile phones can act as a catalyst to improving farm productivity and rural incomes, the quality of information, timeliness of information, and trustworthiness of information effect uptake.

1.3 Technology and innovation adoption

The standard innovation adoption curve of Rogers (1995) classifies adopters into categories based on the premise that some people are more open to adaptation than others. The model indicates that the first group of people to use a new product are *innovators*, followed *by early adopters, early majority adopters,* and *late majority adopters.* The last group to eventually adopt an innovation are called *laggards*. The concept of adopter categories is important for measuring technology adoption because it shows how innovations go through a natural, predictable, and sometimes lengthy process before becoming widely adopted within a population. A person's innovation adoption characteristic affects the rate of uptake of an innovation over time. Rogers (1995) revealed that successful innovation goes through a period of slow adoption before experiencing a sudden period of rapid adoption, and then a gradual leveling off. Rapid expansion of most successful innovations will occur when social and technical factors combine to permit the innovation to experience dramatic growth.

Given adoption characteristics, the introduction of CocoaLink into project communities was expected to be fully adopted by different categories of farmers at different stages or time periods depending on farmer characteristics, features of the innovation, and the general socio-economic and institutional environment.

2. APPROACH AND METHODOLOGY

Desk research and document review of relevant studies and literature on the use of ICT and mobile phones in agriculture, various reports and documents/manuals about CocoaLink, and the baseline and mid-term evaluation reports.

Data collection tool development of a comprehensive cocoa farmer survey instrument, and checklists for key informant interviews and focus groups. The survey used five-point Likert scales (*strongly agree=1; agree=2; Neutral=3; disagree=4; strongly disagree=5*) to assess farmers' Knowledge, Attitudes and Practices (KAP) with respect to some important agronomic practices and socio-economic issues such as child labor and malaria prevention.

Data collection was implemented in two phases of 1) key informant interviews with Cocoa Extension Agents, implementing partner staff, and other partners participating in the project; and 2) field surveys and focus groups that included a one-day training for carefully selected enumerators and supervisors[3]. The sample population for the survey comprised all cocoa farmers in all districts where CocoaLink is being implemented, and a panel survey approach was adopted to interview farmers from the baseline and mid-term evaluations. This ensured that project impact could be evaluated using the same sample. In total, 271 cocoa farmers (169 from nine treatment communities and 102 farmers from six control communities) were interviewed out of the original 277 baseline interviewees. This implies a dropout rate of ~2% which was recorded due to deaths and travels. The sample is statistically valid within in terms of program catchment area.

The limitation of the sampling approach adopted was the fact that panel members were likely to become more informed over time which may have resulted in their views becoming quite atypical. This limitation in sampling was corrected by adopting the propensity score matching approach for data analysis to take care of the likely biases.

Data entry, cleaning and analysis using SPSS (Statistical Package for Social Scientists) and Stata (an integrated statistical software package). Data entry clerks were recruited and trained to enter field data using a pre-defined template. A combination of descriptive and inferential analytical tools were employed to analyze the field data. Frequency distribution tables, graphs, arithmetic mean and standard deviations were used to summarize responses obtained from farmers. For the impact analysis, the Student t-test and Propensity Score Matching (PSM)[4] approaches were employed. These were used to test whether cocoa yield and income (as a proxy with per capita expenditure) obtained by farmers before the CocoaLink project were significantly different from those obtained by farmers after the project in both control and CocoaLink communities.

[3] Training participants were taken to *Ewiase* community in the Sefwi Wiawso District to practice the questionnaire administration under supervision.
[4] For a brief overview of PSM, see Appendix I.

3. EVALUATION FINDINGS

After three years, CocoaLink pilot communities that receive the full package of CocoaLink services – reinforcement messages, trained Local Community Facilitators, weekly education sessions, and national extension agent support – are benefiting in terms of their knowledge and practices related to cocoa production and social issues. All analysis is based on evaluation data collected during the end-line evaluation in 2013, unless otherwise noted.

3.1 Household Demographic Characteristics

Gender Distribution of Cocoa Farmers: When the pooled sample is considered, the majority (68%) of cocoa farmers interviewed were males. In each of the three study districts, females formed less than 50% of the farmers interviewed in both project and control communities (Figures 3.1*a* & *b*). This is a reflection of the general situation in Ghana where the majority of household heads are men. In most cocoa growing communities in Ghana, cocoa farms are usually owned and managed by the household head though proceeds are used to support the whole household.

Figure 3.1a: Gender distribution of farmers by District

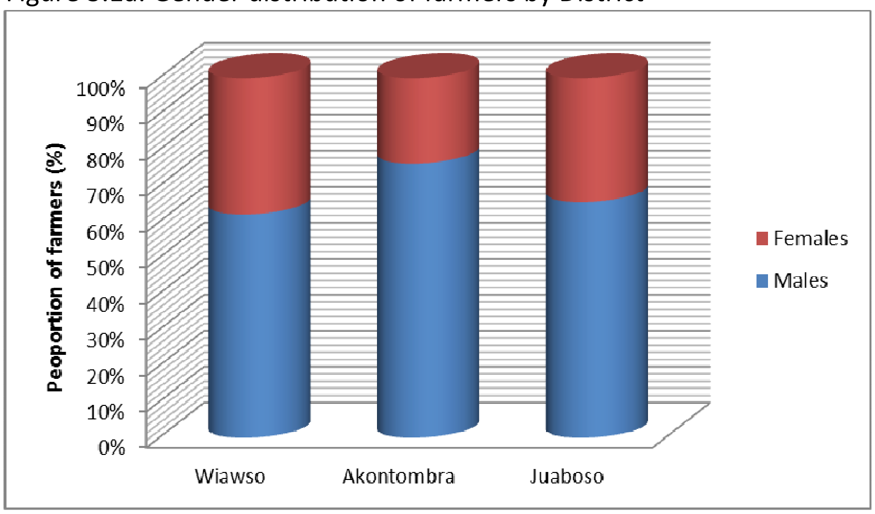
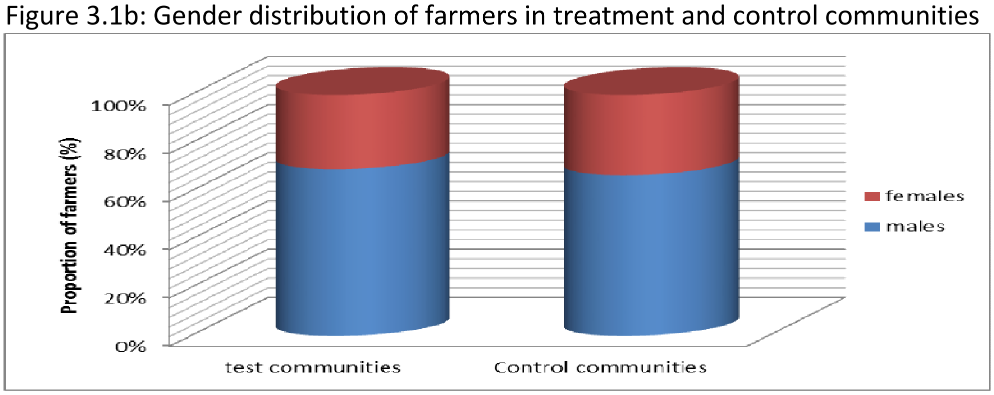


Figure 3.1b: Gender distribution of farmers in treatment and control communities



Literacy level of Cocoa Farmers: Educational levels of cocoa farmers surveyed was found to be generally low, also indicative of national averages in Ghanaian rural areas. Of the 271 cocoa farmer sample, 22% had no formal education and 68% had attained only basic level of education (Table 3.2). This implies that cumulatively, about 90% of cocoa farmers interviewed had very low literacy levels. This has serious implications for the mobile phone technology introduced by CocoaLink and improved agricultural technology dissemination and adoption in general. Farmers with low levels of education are more likely to have difficulties in reading text messages on phones. Also, low level of education has been associated with low level of technology adoption in agriculture, all things being equal. This finding should inform how new production technologies and training programs for cocoa farmers are packaged and the medium as well as the language used to disseminate them to ensure widespread adoption.

Table 3.2: Literacy level of cocoa farmers

Literacy level		**Sefwi Wiawso**	**Akontombra**	**Juaboso**	**Total**
None	Count	20	20	19	59
	% within District	24.4%	21.5%	19.8%	21.8%
Non-formal	Count	2	0	1	3
	% within District	2.4%	.0%	1.0%	1.1%
Basic	Count	57	63	63	183
	% within District	69.5%	67.7%	65.6%	67.5%
Secondary	Count	3	10	11	24
	% within District	3.7%	10.8%	11.5%	8.9%
Tertiary	Count	0	0	2	2
	% within District	.0%	.0%	2.1%	0.7%
Total (n)	Count	82	93	96	271
	% within District	100.0%	100.0%	100.0%	100.0%

Other Household Characteristics: Table 3.3 provides some characteristics of the households interviewed. Generally, most cocoa farmers in the project districts were in the middle age bracket. They are, therefore, active and capable of learning and implementing new agricultural technologies to enhance farm productivity. The average age of cocoa farmers interviewed was estimated at 46 years. Across all the three cocoa districts surveyed, the mean age was found to be highest for Sefwi Wiawso (50 years) and lowest for Juaboso (45 years).

On average, the number of years a typical cocoa farmer had been to school for formal classroom education was just eight (8) years. This suggests that a typical cocoa farmer in the project area has had at most basic level of education. The implication of this low level of education for technology adoption has been discussed already. Average household size for all the cocoa farmers put together was estimated at seven (7) persons; this is above the national average of five (5) persons per household in rural areas of Ghana (Ghana Living Standard Survey, Round 5). This large household size has adverse implications for per capita income and household food security, all things being equal.

Table 3.3: Household Demographic Characteristics

District		Age of Household Head (years)	Number of years of formal Education	Household size
Sefwi Wiawso	Mean	50	7	8
	Std. Deviation	36	4	4
Akontombra	Mean	46	8	7
	Std. Deviation	12	3	3
Juaboso	Mean	45	8	7
	Std. Deviation	13	4	4
Total	Mean	47	8	7
	Std. Deviation	23	4	4

3.2 Farmers' Access to, and Knowledge Level on Mobile Phone Functions and Usage

Availability and Access to mobile phone*:* From Figure 3.2*a* below, it may be quite evident that over 90% of cocoa households interviewed have mobile phones. The proportion of households with mobile phones in Sefwi Wiawso and Akontombra has improved over and above the baseline level. However, the proportion of households in Juaboso that owned mobile phone had reduced to about 96% from the baseline level of almost 99%. Considering the pooled sample, the proportion of cocoa farmers with personal mobile phones increased from 84% during the baseline period to 93% during the mid-term evaluation period and it now stands at about 87% (Figure 3.2*b*). This result indicates that access to mobile phone is very high among cocoa farmers. The few cocoa farmers who did not have personal mobile phones had other relations in the household who could always make their phones available to them for communication whenever there was the need. Availability of phones at the household level was a positive development for the CocoaLink project which relies heavily on mobile phones for information dissemination.

Figure 3.2a: Ownership of mobile phones by Cocoa Households

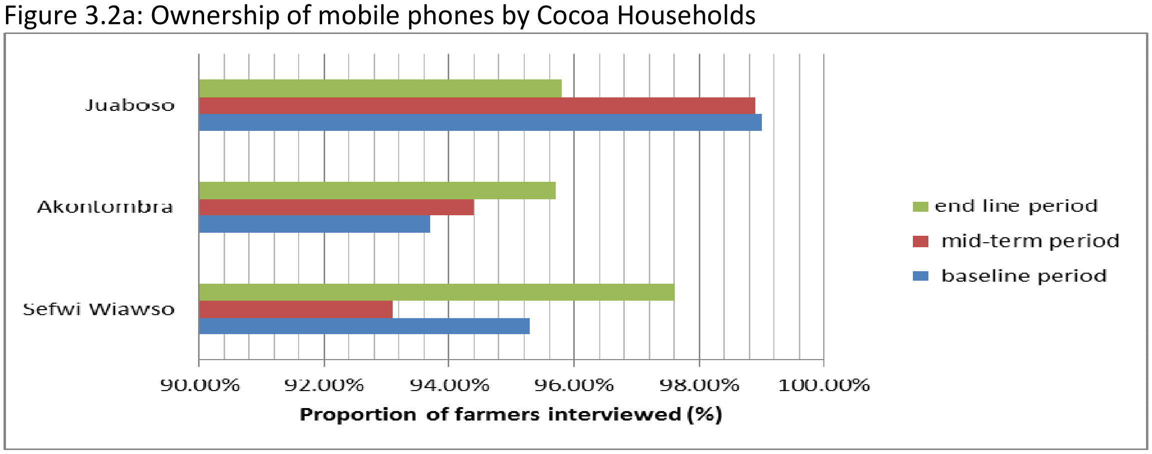


Figure 3.2b: Personal Mobile phone ownership by cocoa farmers

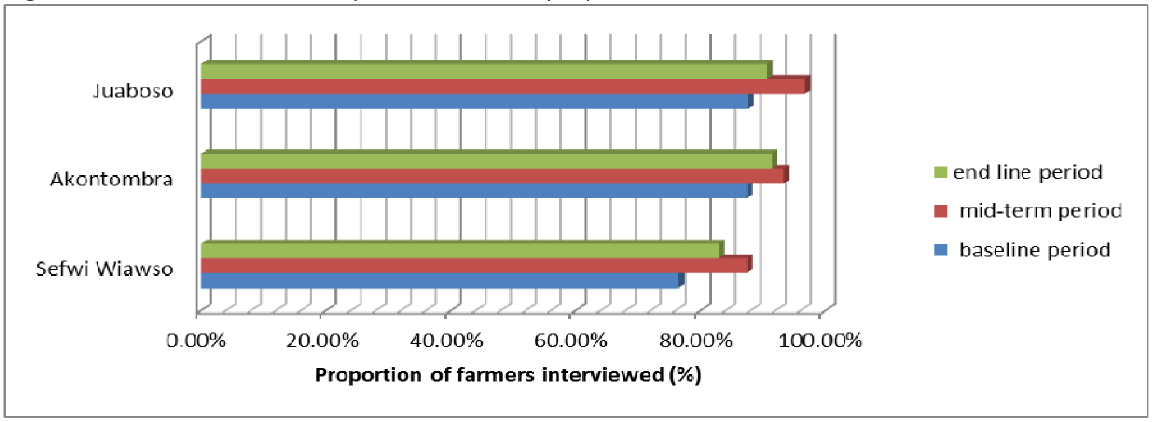


Table 3.4 shows that the average number of cell phones owned by households and by individual cocoa farmers has not changed from the situation during the baseline survey. On average, a household had three mobile phones whereas a typical cocoa farmer had one cell phone. However, the end-line survey has revealed that an average farmer owns two different networks/phone lines. This might be explained by the poor cell phone coverage in some communities in the study districts. Different mobile phone lines are used at different times depending on location and availability of service/network. On average, cocoa farmers have about five years experience with mobile phone usage, implying that farmers were using cell phones about two years before the introduction of the CocoaLink project. Due to unavailability of electricity in some communities, some farmers travelled a distance of about 1km to nearby communities to charge their mobile phone batteries periodically.

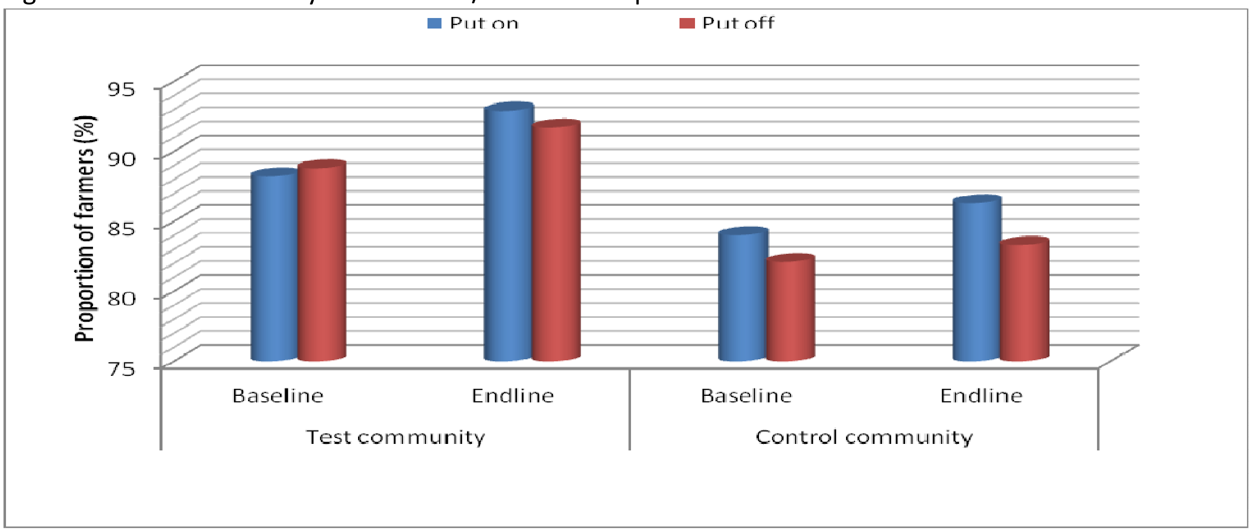
Table 3.4: Number of phones owned by households and Experience with mobile phone usage

District		number of phones owned by Household	number of phones owned by respondent	Number of networks owned	Number of years of phone usage	Distance to point of phone battery recharge (Km)
Sefwi Wiawso	Before	2.4146	1.0909	-	3.6636	2.9400
	After	3.0875	1.1000	1.6143	4.9930	0.0000
Akontombra	Before	2.6333	1.1446	-	3.6941	2.0824
	After	2.7778	1.1176	1.6824	5.2706	1.2500
Juaboso	Before	2.8969	1.1860	-	3.7045	2.6833
	After	2.7419	1.1573	1.4318	4.4663	0.2500
Total	Before	2.6617	1.1447	-	3.6891	2.3643
	After	2.8593	1.1270	1.5720	4.8980	0.9167

Source: Field Survey, 2011 & 2014.

Mobile phone operations/usage: Figure 3.3 shows that majority (more than 80%) of cocoa farmers in each district could put their mobile phones on and off in both project and control communities. In control communities, there appears to be no marked difference between farmer ability/behavior as far as switching on/off cell phones is concerned between the baseline period and the end-line evaluation period. However, in project/test communities, there is evidence that farmers' ability to switch on/off mobile phones has improved after the CocoaLink project.

Figure 3.3: Farmers' ability to switch on/off their cell phones before and after CocoaLink



Generated from Field Data, 2011 & 2014.

Figure 3.4 shows the distribution of respondents in project and control communities according to their ability to use mobile phones for communication. The key mobile phone functions that could be performed by many cocoa farmers included: making a call, receiving a call, ending a call, and retrieving contact numbers. At least 60% of respondents could perform these functions at the time of the survey. From the figure it may be evident that many farmers in project communities are able to perform key mobile phone functions compared to their counterparts in control communities. This could be as a result of the CocoaLink project which has exposed farmers in project communities to the use of mobile phones. However, it is important to point out that ability of cocoa farmers to use mobile phones for text messaging was still limited. Similar to the baseline situation, still less than 50% of farmers could compose, send, or read a text message. The situation is quite different for farmers in test communities, many of whom are able to use text messaging more than those in control communities. The general limited ability of farmers to use text messaging is not surprising since the literacy level among cocoa farmers has remained very low. This finding has implications for the CocoaLink project especially the text messaging component. Following the recommendation from the baseline and mid-term evaluation for an innovative approach to transmit agricultural information to cocoa farmers, project implementers have started sending voice messages to supplement the text messages. This is expected to further improve access to critical agricultural information by cocoa farmers.

Figure 3.4: Ability of Cocoa Farmers to perform key mobile phone functions

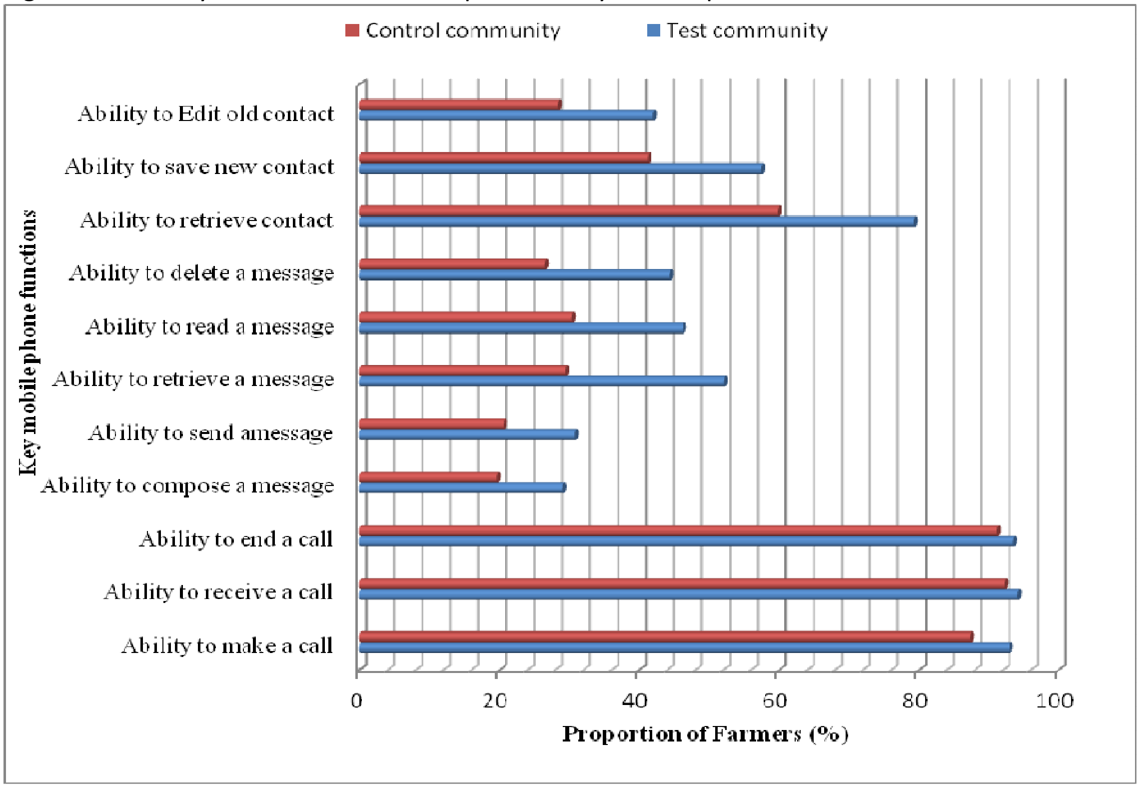


Figure 3.5 provides the various issues discussed on mobile phones by farmers in control and test communities. Generally, the level of mobile phone usage for calls and text messaging on different issues appeared to be higher in project communities compared to control communities. As was found during the baseline survey, the main issues farmers discussed on mobile phones were still identified to be family problems, funerals, love/relationships, religious matters and issues pertaining to school or education of children. However, the use of mobile phones to discuss agricultural production information has witnessed a substantial increase in project communities. For instance, about 70% of farmers in test communities reported that text messaging was the medium of communication on cocoa production issues compared to 17% in control communities. This marked improvement in agricultural communication via mobile phone could be attributed to the CocoaLink project.

Figure 3.5: Type of information sent/received/discussed on mobile phones

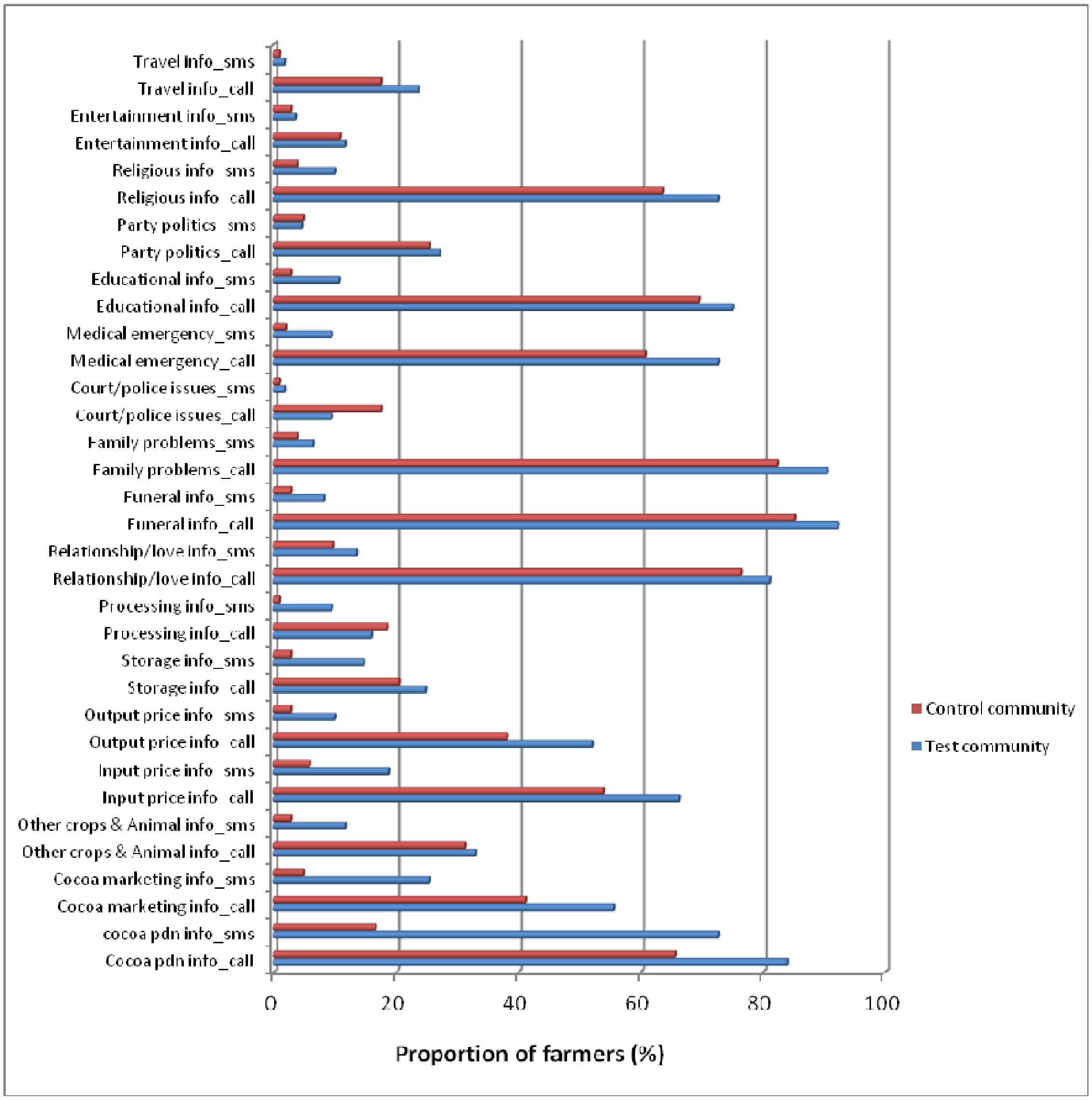


Table 3.5 and Figure 3.6 provide the frequency of conversation between cocoa farmers and extension agents via mobile phone. Results suggest that majority (71%) of cocoa farmers did not discuss any agricultural information on phone with Community Extension Agents (CEAs) in a typical month; 6% of farmers discuss agric information on phone with CEAs only once in a month and 9% had it twice a month. The frequency of conversation is very low. The mid-term evaluation result was an improvement on the baseline results; however, the frequency has slacked significantly.

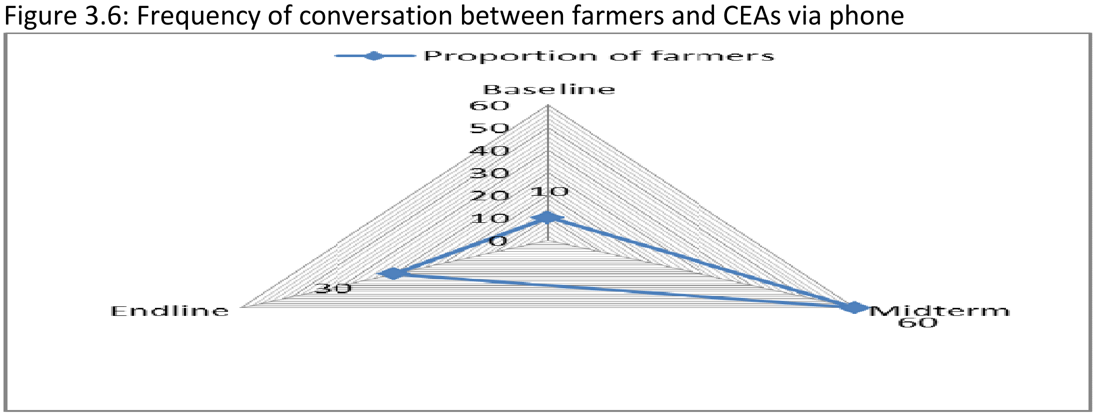
Table 3.5: Frequency of mobile phone conversation with extension agents

Frequency of conversation per month		**District**			**Total**
		Sefwi Wiawso	**Akontombra**	**Juaboso**	
Once	Count	6	7	2	15
	% within District	7.3%	7.5%	2.1%	5.5%
Twice	Count	3	14	6	23

	% within District	3.7%	15.1%	6.2%	8.5%
Trice	Count	5	6	8	19
	% within District	6.1%	6.5%	8.3%	7.0%
More than Trice	Count	9	9	4	22
	% within District	11.0%	9.7%	4.2%	8.1%
None	Count	59	57	76	192
	% within District	71.9%	61.3%	79.2%	70.9%
Total	Count	82	93	96	271
	% within District	100.0%	100.0%	100.0%	100.0%

For example, during the mid-term evaluation period, about 60% of farmers indicated that they had mobile phone conversation at least once a month with CEAs. The decrease in conversation could probably be as a result of the fact that farmers in project communities were able to get answers to most of their questions during the second year of the project (mid-term); and by the third year (end-line evaluation period), they felt confident in applying the pieces of advice obtained earlier and therefore did not have (many) questions for CEAs. Again, CEAs were visiting communities periodically (at least once every two weeks) to hold meetings with cocoa farmers and this could also account for the reduced frequency of conversation between farmers and CEAs via mobile phone.

Figure 3.6: Frequency of conversation between farmers and CEAs via phone



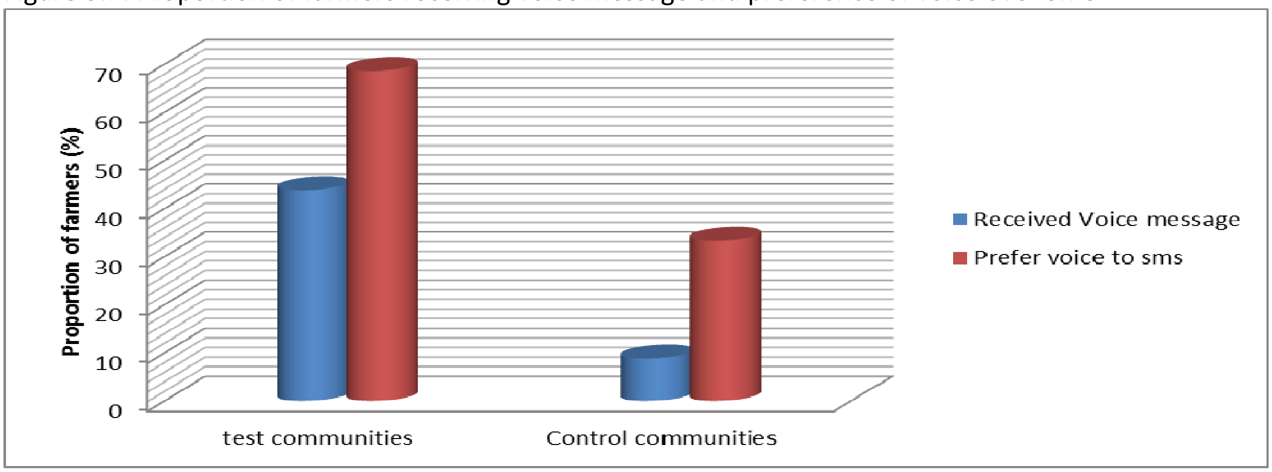
Source: Generated from Field data, 2011, 2012 and 2014.

The cost of mobile phone credit and sometimes unavailability of mobile phone credit cards in the village also contributed to the infrequent farmer-extension conversation through mobile phone. Efforts should, however, be made to encourage a lot more frequent conversation on phone between extension agents and farmers, especially those initiated from the AEA side to at least verify whether farmers are applying techniques they have been taught. Generally, information on fertilizer availability and cocoa disease and pest control were discussed between farmers and CEAs.

There was a lot of discussion between fellow cocoa farmers at the community level but most of this happened without the use of mobile phones. Farmers indicated that as part of the CocoaLink extension methodology, they are supposed to meet periodically (at least once every week) to discuss content of messages received and share experiences. There are also community facilitators who go round to explain the content of the SMS to some farmers. In communities where there are “information centers”, it was reported that periodic discussions of the SMS messages are done at such centers for the benefit of all cocoa farmers in the community (both project and non-project members). After such broad dissemination, a chain of discussions among cocoa farmers in the community is always triggered and non-project farmers are reported to approach some project members to explain issues further and to inquire about the possibility of joining the CocoaLink project.

Voice messages: From Figure 3.7, about 41% of cocoa farmers in test communities have started receiving voice messages on GAP and the number of times such voice messages have been received was estimated to be twice over the past one month. Generally, cocoa farmers reported that they prefer voice messages to text messages. Among farmers in test communities, about 69% prefer voice messages to text messages and 14% were indifferent. Even among cocoa farmers in control communities, voice message was preferred to text message. The high rate of voice message preference over text message could be due to the low level of education among cocoa farmers.

Figure 3.7: Proportion of farmers receiving voice message and preference of voice over SMS



3.3 Farmers’ Knowledge, Attitudes and Practices on Good Agricultural Practices (GAP)

Table 3.6 provides a summary of the results from farmers ranking of statements relating to their knowledge level on Good Agricultural Practices (GAP) in the cocoa sector on a 5-point Likert scale with one (1) denoting strong agreement and five (5) denoting strong disagreement. Knowledge levels on GAP among cocoa farmers in both test and control communities were generally high. However, in about eleven (11) out of 30 knowledge statements examined in the table, rankings show significant differences in the knowledge levels of farmers in test communities as against those in control communities. For instance, knowledge on correct planting time, varietal differences in cocoa, spraying regime and quantities of chemicals to be applied, precaution before, during and after spraying, pruning and general knowledge in cocoa production were found to be significantly higher among cocoa farmers in test communities compared to those in control communities. This means that cocoa farmers in CocoaLink communities are more knowledgeable on very important agronomic practices in cocoa production than their counterparts in non-project communities.

Table 3.6: Assessment of farmers' knowledge on GAP in the cocoa sector

Statement *(Key: 1=Strongly Agree; 2= Agree; 3=Neutral; 4= Disagree; 5=Strongly Disagree)*	**Test/Beneficiary Community**	**Control/Non-Beneficiary Community**	**Total**
General knowledge of cocoa production is improved, within the last 3 years	1.36	1.84	1.54***
No Knowledge of right time of planting cocoa seedlings	4.12	3.46	3.87***
No Knowledge of difference between hybrid and traditional cocoa varieties	4.01	3.67	3.88**
Has Knowledge of number of times to weed under cocoa farms and when to do it	1.87	1.61	1.77
Has Knowledge of number of times to spray (insecticides/fungicides) cocoa farms per annum	1.54	1.71	1.60*
Now I am well informed regarding time to spray insecticides/fungicides	1.64	1.99	1.77***
Not sure about the quantity of insecticides/fungicides to use per acre of cocoa farm	4.22	3.49	3.95*
Not sure about the quantity of insecticides/fungicides to mix knapsack/Mist blower full of water	4.47	3.55	4.13**
No Knowledge of how to effectively apply insecticides/fungicides	3.93	3.59	3.80**
I have been taught to wash down after spraying before eating /drinking water	1.31	1.74	1.47***
I know the number of times I have to apply fertilizer to my cocoa farm every season	1.57	1.95	1.72***
I know the type of fertilizer to apply to my cocoa farm	1.53	1.74	1.61**
I am now well informed regarding the right time to apply fertilizer to my cocoa farm	1.79	1.97	1.86
I still don't know how to apply fertilizer to my cocoa farm	4.18	3.97	4.10
I have adequate knowledge on how to prune cocoa farm	1.73	1.98	1.82*
I do not know when to prune my cocoa farm	3.57	3.74	3.63
I know the number of days to ferment cocoa beans	1.39	1.41	1.40
I am not sure about the right conditions/environment under which cocoa beans are to be stored	3.44	3.34	3.41
Black pod disease in cocoa is not caused by witchcraft	2.14	2.18	2.15

****, **, * denote significance at 1%, 5% and 10% respectively. Sample (n) =271*

Results on analysis of farmers' attitudes to GAP have been summarized in Table 3.7. Generally, farmers had positive attitudes and perceptions about some critical agronomic issues in the cocoa sector. However, there was significant difference in the rankings with respect to protection during spraying of chemicals on cocoa and spraying time. In both areas, farmers in test communities showed a more positive disposition towards wearing protective gear during spraying and the fact that spraying cannot be done at any time of the year or any hour during the day.

Table 3.7: Assessment of farmers' attitudes towards GAP

Statement	**Test/Beneficiary**	**Control/Non-**	**Total**

(Key: 1=Strongly Agree; 2= Agree; 3=Neutral; 4= Disagree; 5=Strongly Disagree)	**Community**	**Beneficiary Community**	
The use of fertilizer is waste of resources	3.91	3.93	3.92
Spraying of cocoa farms is necessary for good yield	1.49	1.67	1.55
It is not necessary to wear protective gear when spraying cocoa farms with chemicals	4.40	4.19	4.32*
One does not need to wash down after spraying cocoa farms before eating or drinking something	4.47	4.34	4.42
Spraying of cocoa farms can be done at anytime	4.46	4.25	4.38**
Pruning cocoa farms is not that necessary	4.50	4.40	4.46
Cocoa beans can be fermented for any number of days	4.77	4.35	4.61
Dry cocoa beans can be stored anywhere	4.41	4.35	4.39

***, * denote that mean difference is significant at 5% and 10% respectively. Sample (n) = 271*

Knowledge and positive attitudes are important pre-requisites for practice, but it is the practice or adoption that impacts on productivity and income. Table 3.8 summarizes results from the analysis of about 14 statements that indicate actual practice. Generally, farmers across both control and test communities are implementing most of the agronomic practices they have been taught. The rankings indicate that farmers in test communities agreed strongly to planting cocoa seedlings, applying agrochemicals, wearing of protective gear during spraying, pruning and weeding cocoa farms according to recommendations from experts compared with farmers in control communities who just agreed.

There were also significant differences in the practices of farmers in control and test communities with respect to farm maintenance in the areas of removal of chupons and periodical gathering of diseased pods to bury. Project farmers tended to maintain their farms better than non-project farmers. The improved knowledge level, positive attitudes and practices of farmers in project communities is expected to reflect in productivity and income levels, all things being equal.

Table 3.8: Assessment of farmers' Practices in Relation to GAP

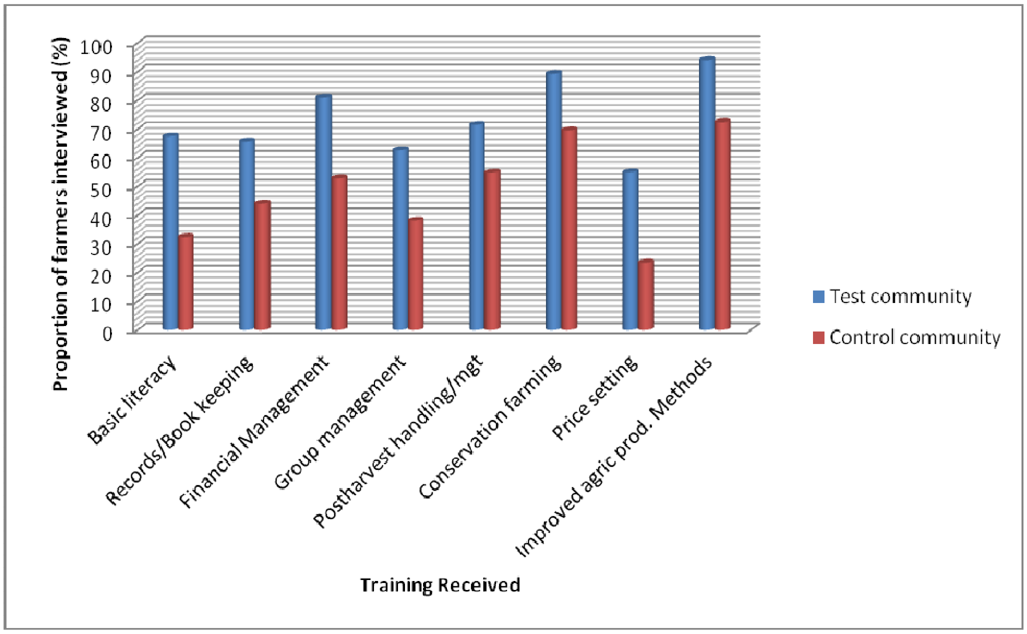
Statement *(Key: 1=Strongly Agree; 2= Agree; 3=Neutral; 4= Disagree; 5=Strongly Disagree)*	**Test Community**	**Control Community**	**Total**
I now plant my cocoa seedlings according to recommendations from experts	1.64	2.44	1.94***
I spray my cocoa farm 3 times a year /season	1.71	1.75	1.73
I do not use quantity of chemicals rec by experts to spray my cocoa farms	3.98	3.52	3.81**
I use protective gear during spraying of my farm with chemicals	1.63	1.88	1.73**
I wash down after spraying before i eat or drink something	1.45	1.46	1.45
I do not apply fertilizer according to recommendations from experts	4.03	3.70	3.90
I prune my cocoa farm regularly as recommended	1.54	2.05	1.73**
I weed my cocoa farm regularly as recommended	1.44	1.66	1.52**
I hardly cut or control mistletoe on my cocoa trees	4.16	3.94	4.08

I ferment my cocoa beans for 5-7 days	1.46	1.72	1.56
I dry my cocoa beans thoroughly before i bag	1.30	1.35	1.32
Generally, I maintain my cocoa farm better now than 3 years ago	1.36	1.74	1.50***
I remove chupons from my cocoa farms regularly as recommended	1.52	1.77	1.62***
I gather diseased pods to burry periodically as recommended	1.90	2.44	2.10***

***, * denote that mean difference is significant at 5% and 10% respectively. Samples (n) =271*

Capacity building/Training received by farmers: Figure 3.8 provides the distribution of cocoa farmers in project and non-project communities according to various training packages received between the baseline period and the end-line survey period. Compared to the baseline situation where less than 45% of cocoa farmers had received training in the core areas of basic management, records keeping and improved farming techniques, at the end of 2013, at least 55% of farmers in test communities had received training in the above core areas. It is evident from the Figure that in all subject areas, the proportion of farmers in project communities that had received training during the period under review was far more than those in control communities. This difference could be attributed to the CocoaLink project which had a training component. Some farmers in project communities keep some records on costs of production and cocoa sales. Quite a number of farmers (about 30%) claimed to be able to read the weight of their cocoa beans on the weighing scale during sales. About 65% of farmers indicated that they have been trained on proper fermentation process, proper spraying methods and frequency of spraying. So instead of spraying once a season, close to 50% of focus group discussants reported that they spray their cocoa farms about three times per season as recommended by CEAs. The training packages received by farmers could be the main drivers of the enhanced knowledge and positive attitudes and practices of GAP by farmers in CocoaLink communities.

Figure 3.8: Training packages received by Cocoa Farmers



3.4 Cocoa Productivity and Income Levels of Farmers

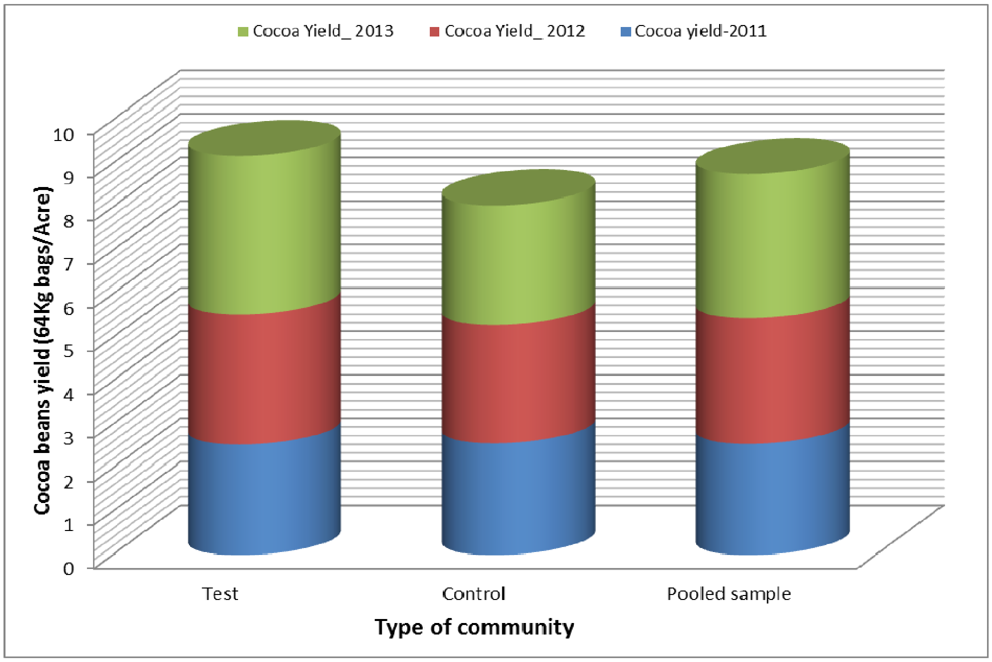
Cocoa Productivity: Table 3.9 and Figure 3.9 provide a summary of cocoa productivity information in project and control communities. Cocoa yield in project and control communities was not significantly different during the baseline and midterm evaluation periods. However, during the end-line period (2013), cocoa yield in CocoaLink communities was significantly higher than that recorded in control communities. On average, farmers in project communities harvested 232.95Kg (3.65bags) per acre compared with 175.85Kg (2.75bags) per acre in control communities.

Table 3.9: Cocoa productivity analysis before and after CocoaLink

Type of Community	**Cocoa yield-baseline (2011)** ***(64kg bags/acre)***	**Cocoa Yield_ Midterm (2012)** ***(64kg bags/acre)***	**Cocoa Yield_ End-line (2013)*** ***(64kg bags/acre)***
Test Community	2.5421	2.9971	3.6398
Control Community	2.5684	2.7272	2.7477
Total	2.5552	2.8954	3.3061

** Difference in yield in treatment communities before and after CocoaLink was statistically significant @10%*

Figure 3.9: Cocoa Productivity before and after CocoaLink project



** Difference in yield in treatment communities before and after CocoaLink was statistically significant @10%*

Source: Generated from Field Data, 2011-2014.

The trend from baseline through mid-term to end-line survey periods show a consistent improvement in cocoa yield in test communities, culminating in statistically significant difference in 2012/2013cropping season between control and test communities. In CocoaLink communities, cocoa productivity grew by 43% between baseline and end-line periods. This means that cocoa productivity within project communities grew from 162.69Kg (2.54bags) per acre before the start of the project to 232.95Kg (3.65bags) per acre in 2013 at the end of the pilot project. However, within control communities, cocoa yield grew by only 7% from 164.38Kg/acre to 175.85kg/acre between baseline and end-line evaluation periods.

After controlling for possible biases, results of the Propensity Score Matching (PSM) analysis confirm that CocoaLink has had a significant positive impact on cocoa yield during the 2012/2013 cropping season. However, the average treatment effect of CocoaLink on the yield of male farmers was higher than that of female farmers (Tables 3.10a&b); this could be due to differential access to resources/inputs between males and females. The results of the probit model that was used to predict the propensity scores and the associated graphs depicting the impact of cocoa link on male and female cocoa farmers are in Appendix II.

Table 3.10a: PSM Results for males on impact of CocoaLink on cocoa yield for 2012/2013 Cropping season

Sample	Treated	Control	Difference	S.E	T-stat
Unmatched	5.08855064	2.89275108	2.19579956	0.506283989	4.34***
ATT	5.08855064	3.07178889	2.01676176	0.438344579	4.60***

ATU	2.89275108	4.73600902	1.84325794	0.542548946	3.40***
ATE			1.9535721	0.441327148	4.43***

**** denotes significance @1% level. Panel Sample Size = 271*

Table 3.10b: PSM Results for females on impact of CocoaLink on cocoa yield in the 2012/2013 cropping season

Sample	Treated	Control	Difference	S.E	T-stat
Unmatched	2.8817725	1.72251238	1.15926012	0.401458626	2.89***
ATT	2.8817725	1.678362	1.20341049	0.384176677	3.13***
ATU	1.72251238	3.36960319	1.64709081	0.470051161	3.50***
ATE			1.36979061	0.396036987	3.46***

**** denotes significance @1% level. Panel Sample Size = 271.*

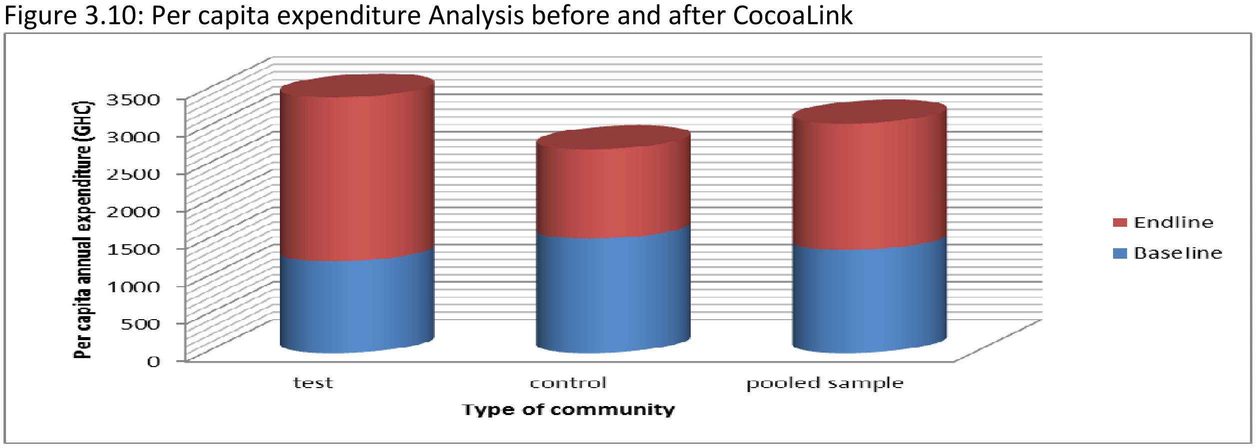
Income level of farmers: In this evaluation, household expenditure was used as a proxy for income. Table 3.11 and Figure 3.10 provide a summary of the per capita annual expenditure made by cocoa households in project and control communities. Before CocoaLink was introduced, cocoa households in control communities spent GHC1,522.53 per capita per annum compared to GHC1,221.62 for cocoa farmers in project communities. On daily basis, this translates to about GHC4.17 (US$1.67) and GHC3.35 (US$1.34) per capita per day for control and beneficiary households respectively. At the end of the CocoaLink pilot, per capita annual expenditure in test communities had increased by 78% to GHC2,179.63 (GHC5.97 per day; US$ 2.39).

Table 3.11: Per capita annual expenditure before and after CocoaLink project

Type of Community	Per capita expenditure per annum *(GHC)-Before CocoaLink*	Per capita expenditure per annum *(GHC)-After CocoaLink*
Test Community	1221.62	2179.63
Control Community	1522.53	1188.41
Total	1371.28	1685.17

Source: Estimated from field data, 2011 and 2014.

Figure 3.10: Per capita expenditure Analysis before and after CocoaLink



Results from the propensity score matching analysis show that when possible biases are controlled, per capita expenditure (used as a proxy for income) in test communities was still significantly higher than that in control communities (Tables 12*a*&*b*). This implies that CocoaLink has had a significant positive impact on cocoa farmers' income. The average treatment effect (ATE) of CocoaLink on the income of female farmers was higher than that of male farmers. The probit models that were used to predict the propensity scores for males and females as well as the associated graphs on per capita expenditure (income) before and after matching have been provided in Appendix II.

Table 3.12a: PSM Results for males on impact of CocoaLink on per capita expenditure (proxy for income) for 2013

Sample	Treated	Control	Difference	S.E	T-stat
Unmatched	1405.07594	766.197985	638.87795	191.974842	3.33***
ATT	1405.07594	787.922252	617.153683	188.23309	3.28***
ATU	766.197985	1456.13381	689.935823	189.766058	3.64***
ATE			643.660759	182.388256	3.53***

****denote significance at the 1% level.*

Table 3.12b: PSM Results for females on impact of CocoaLink on per capita expenditure (proxy for income) for 2013

Sample	Treated	Control	Difference	S.E	T-stat
Unmatched	2954.18186	1611.05932	1343.12254	617.181909	2.18**
ATT	2954.18186	1621.46135	1332.72052	541.146814	2.46**
ATU	1611.05932	2903.54152	1292.4822	597.645424	2.16**
ATE			1317.63115	541.848835	2.43**

***denote significance at the 5% level.*

3.5 Farmers' Knowledge Level on Socio-Economic and Health Issues

Table 3.13 summarizes results of the analysis of farmers' knowledge on socio-economic and health issues. Generally, farmers in test communities had higher level of knowledge on socio-economic issues than those in control communities. Knowledge level of farmers in test communities with respect to child labor, girl child education and malaria was significantly higher than that of farmers in control communities. This significant difference can be attributed to the CocoaLink project which had training packages on child labor, girl child education and malaria prevention.

Table 3.13: Assessment of farmers' knowledge on socio-economic and health issues

Statement	Test/Beneficiary Community	Control/Non-Beneficiary Community	Total
I have adequate knowledge about child labor	1.34	2.07	1.62***
I have been trained on child labor issues by the CocoaLink project	1.46	2.99	1.94***

The training I received on child labor was not adequate	3.52	3.20	3.41**
There is nothing wrong with using my own children to carry out any activity on my cocoa farm	4.15	3.80	4.02***
I do not use my children on my cocoa farm to the detriment of their health and education	1.57	1.67	1.61
I need further training on child labor	2.93	2.33	2.71
The cocoa link project has deepened my understanding of child labor issues	1.63	2.88	2.02***
Since the training from the CocoaLink project. I am know very careful with the type of activities I ask my children to carry out	1.73	2.82	2.07***
It is more beneficial to educate a boy child than a girl child	3.83	3.48	3.70**
I send both boys and girls in my household to school	1.45	1.55	1.49
Girls will definitely dropout of school if you enroll them	3.99	3.64	3.86**
The girl child is equally capable academically as the girl child	1.63	1.83	1.70*
I need Training on girl child education	2.47	2.41	2.45
I am aware of HIV/AIDS	1.61	1.55	1.59
I am not quite sure about the causes of HIV/AIDs	3.72	3.59	3.67
HIV/AIDS is Curable	3.91	4.03	3.96
HIV/AIDS is Preventable	1.73	1.74	1.73
People who get HIV/AIDS are cursed	3.95	3.94	3.95
Apart from HIV/AIDS, I have adequate knowledge on other sexually transmitted diseases	2.01	2.25	2.10*
I have adopted preventive measures to protect myself against STDs	1.69	1.85	1.75
I am not sure of the methods to adopt to control child birth	3.45	3.10	3.32
I know what brings about malaria	1.66	1.60	1.63
I have been equipped adequately by the CocoaLink project to take preventive measures against malaria	1.66	2.87	2.04***
I have applied most of the malaria prevention methods/strategies I learnt from the CocoaLink project	1.63	2.87	2.02***
The cocoa link project is more effective an extension delivery method than other modes of extension service provision	1.79	2.88	2.14***
I will be willing to pay for the services I am receiving under CocoaLink when the project ends	1.87	2.82	2.17***

Key: 1=Strongly Agree; 2= Agree; 3=Neutral; 4= Disagree; 5=Strongly Disagree

****, **, * denote significance at 1%, 5% and 10% respectively. Sample Size = 271*

3.6 Views of Partners, Other Farmers and Spillover Effect of CocoaLink Project

National Government Extension Agents: Community Extension Agents (CEAs) who, after being trained to administer CocoaLink activities as part of their regular farmer training and outreach work, reported that their role as very critical for the success of the project. Three CEAs who completed reported that the regular group meetings (called Education Sessions) are used to remind farmers about the reinforcing messages and discussed the agronomic practices information contained in the messages. They noted that some farmers do not attend meetings regularly, and when asked why, the farmers claim the messages are clear and provide ample information. They reported that many farmers are acquiring mobile phones to be part of the project. Poor mobile network coverage and high levels of illiteracy among farmers were identified as the major challenges faced by CocoaLink. CEAs consider annual increases in cocoa yield as the major success of the project. While recommending expansion of the project to cover many more communities, CEAs also called for enhanced motivation package to reward their efforts. This included supporting CEAs with fuel to enhance their operations.

National Government Extension Management: The Swollen Shoot Virus Disease (CSSVD) unit of COCOBOD is a strategic partner and a member of the national steering committee of the CocoaLink project and also a member of the Editorial Committee. Collective input was gathered from CSSVD. From their field-experience with CocoaLink, CSSVD noted that the project has enhanced knowledge level of farmers in cocoa production since specific problems of farmers are solved by the information. They did not see any major challenges during the implementation of the project except the need to have the manpower to do the initial registration, which takes time and effort to do. As a major success, CSSVD considers CocoaLink as an additional medium for accessing information particularly when the community extension agent may not be regularly available. On operational issues, it was recommended that future programs and pilots include top management, especially for understanding operational activities and budgetary considerations.

Overall, CSSVD sees the number of farmers registered and the calls to community extension agents to further offer clarifications on cocoa issues as ample evidence of success. They consider CocoaLink as a fast, cheap, and effective extension model to providing information to farmers. For example, one staff said:

> *"As an entity by itself it provides knowledge to farmers but short of skills in doing a specific task. As in all communication principles there is no single medium that runs tall above others. It is always complementary to existing systems, lifestyle of the people, education, etc."*

World Cocoa Foundation (WCF): WCF coordinated all implementing partners, stakeholder management, and provided monitoring support. WCF Ghana staff interviewed see the expansion from the initial target of 1,450 in fifteen communities to over 41,000 farmers as a major success. They reported that the establishment of a strong public-private partnership for digital extension delivery is also a major success. WCF inputted that the major challenges included platform scalability, phone display difficulties of local language characters, and securing a dedicated short code. Early expansion beyond the 15 pilot communities limits the lessons learned to inform a more strategic expansion. For them, expansion within the pilot defeated the purpose of the pilot.

Centre for Community Studies, Action and Development (CENCOSAD): CENCOSAD served as the local information partner of World Education in the three pilot districts of Sefwi Wiawso, Akontombra and Juaboso. They directly organized community educational sessions on mobile phone usage and supported COCOBOD field officers in providing education on agronomy to cocoa farmers. CENCOSAD trained CocoaLink Local Community facilitators to register cocoa farmers. CENCOSAD field officers visited each of the fifteen communities at least once every week. They reported that over 500 farmers contacted them every month for information and advice. Increased knowledge on best Cocoa farming practices among farmers, increased yield in cocoa production, and increased economic empowerment of women in cocoa production and decision making processes were considered to be some of the main successes of the CocoaLink project. The demand by farmers in project communities for expensive farm inputs such as fertilizers and agro-chemicals not easily available on the market was found to be the major challenge. On what could be done differently, it was pointed out that there should have been an attempt to get COCOBOD extension officers to visit each project community at least once on a weekly basis instead of the bi-weekly or sometimes monthly visits made to each project community. They concluded that CocoaLink provides other non-agronomy related information not provided by other modes of extension service provision, e.g. information on malaria and child labor.

DREAMOVAL: DreamOval was the technology partner for CocoaLink. They managed the sending of SMS messages (at least four times per month). The numbers of farmers enrolled on the platform has been one of the major successes given the project target over the 3 year period was 1,450 (farmers registered now are over 41,000). The ability to also get near real-time reports from field officers after farmer group meetings was also a major success. Message delivery to farmers and also the cost of delivering voice to the farmers after the enrolment exceeded the target 1,440. They noted that the approach for the pilot was perfect. There were lots of key lessons that can be applied to the project as it transitions from a pilot. The transition from pilot, however, needed to be more carefully considered at project inception especially with regards to the costing of technology and architecture to support large numbers for farmer enrollment.

WORLD EDUCATION INC. (WEI): WEI was the main implementing organization and they noted that the project has been implemented as planned and on-time. Most activities outlined per the work plan were carried out within budgeted costs. Funding for scale-up was provided as well to cater for technology costs. However, inaccessibility of the roads to some of the communities was very challenging. For them, the project has achieved its overall objective in delivering timely and relevant information to cocoa farmers to improve their farming practices and thereby improve their socioeconomic capacities. However, value added services such as farm inputs provision will help farmers to apply more of the information as shared in the reinforcement messaging. Enhanced motivation of field officers has the potential to enhance operations to reach more farmers. WEI reported that non-project communities that heard of CocoaLink were registering their farmers via the short-code, and therefore benefited from the weekly text messages. Some community extension agents usually shared their text messages with other non-project farmers in nearby project communities. The CocoaLink News which uses the community information centers to disseminate information in local sefwi and twi languages were listened to by other nearby communities as well.

Summary of focus group discussions with farmers: In addition to focus group discussions in six communities consisting of between 6 and 10 farmers per group, phone interviews were also conducted with about six cocoa farmers in Asamankese District. From the interactions it was clear that CocoaLink is a very useful and timely intervention from the perspective of the farmers. Almost every cocoa farmer contacted attested to the benefits they have derived from the project in the area of capacity building, improved cocoa yield and household income. On yield, some focus group discussants and telephone interviewees reported that CocoaLink has helped them to more than double their cocoa yield. Others reported at least 50% increase in cocoa yield. One farmer reported on phone that: "*I don't have money for fertilizer but just applying what they have taught us, I am able to increase yield by 50%*." The yield increases have brought about improvement in income.

The majority of the focus group discussants indicated that they now send both girls and boys of school-going age to attend because they are now able to pay their school fees with little or no difficulty. In almost all communities, focus group discussants revealed that the project has had a very positive spillover effect on non-members and non-project communities. This is because they share whatever they learn with their fellow farmers. Indeed, non-project members are allowed to sit in CocoaLink farmer group meetings when the extension agents visit communities. Also, community information centers are used to explain further the text message received periodically for the benefit of the whole community. On adult literacy, over 70% of focus group discussants indicated that though they have been trained, it is still difficult for them to read or write. However, they are happy they can now perform some functions on their mobile phones and can take preventive measures to deal with malaria.

4. SUMMARY AND RECOMMENDATIONS

The end-line evaluation survey covered three cocoa growing Districts (Sefwi Wiawso, Akontombra and Juaboso) in the Western Region of Ghana where World Education is implementing its CocoaLink Project. A total of 271 cocoa farming households were selected across project and non-project (control) communities.

Evidence from the survey has shown that the CocoaLink project has started yielding positive results in the lives and behavior of cocoa farmers. Even though knowledge on the use of the mobile phone equipment among cocoa farmers was found to be generally low, the proportion of cocoa farmers who can operate key functions on a cell phone was found to be much higher in project communities than control communities. The number of cocoa farmers who use mobile phones to discuss/communicate agricultural information (especially cocoa production issues) via calls and text messages has increased quite substantially in CocoaLink communities. The evaluation has shown that cocoa farmers prefer voice messages to text messages due largely to their low literacy level.

The cocoa link project has enhanced the capacities of cocoa farmers through periodic training packages. Farmers' knowledge level, attitudes and practices in respect of Good Agricultural Practices (GAP) have improved significantly in CocoaLink communities compared to control communities. As a result of the training received from the project, farmers in project communities generally maintained proper farm hygiene and that farm maintenance culture led to productivity improvement. Even though farmers in control communities generally managed significantly larger cocoa plantations than those in test communities, average cocoa beans yield in the 2012/2013 cropping season was found to be significantly higher in test communities than control communities. It is quite evident from the baseline, mid-term and this end-line survey that CocoaLink project has continued to make modest gains in terms of productivity improvement over time. Cocoa yield in project communities was found to have increased by 43% after three years of implementing CocoaLink. The current study has amply demonstrated that the project has had a significant positive impact on cocoa productivity. When data was corrected for possible biases through the Propensity Score Matching (PSM) approach, the project was found to have had a significant positive impact on cocoa yield and farmers' income which was proxied with per capita expenditure. This improvement in yield and income is expected to continue since farmers are yet to fully reap the full benefits of their investments in adopting GAP. The CocoaLink project has been implemented for only three short years. Given that adoption is a process and the fact that there is always a lag between adoption of a technology and the period of manifestation of project impact, it would be reasonable to wait for about two more years to witness the full impact of the project on the livelihoods of cocoa farmers.

The impact of the project on the knowledge level and attitudinal change of farmers in respect of socio-economic issues like child labor, girl-child education and malaria control is very significant, though difficult to quantify in economic and financial terms. Such social benefits of projects are very important to highlight since they have implications for the future well-being of households.

In conclusion, the CocoaLink project has had a significant positive impact on farmers' knowledge level, attitudes and practices relating to GAP in cocoa production, cocoa productivity, farmers' income level and their general knowledge on socio-economic issues such as child labor, girl-child education and malaria prevention.

Based on the finding from the survey, the following recommendations are made:

- Since many farmers have very low educational background and find it difficult to read text messages on mobile phones, the use of voice messages should be stepped up and the frequency per month increased to ensure that farmers understand the message being communicated.

- A stronger collaboration between COCOBOD and project implementers is recommended for the next phase of the project, especially in relation to fertilizer and other inputs distribution. A better collaboration will ensure that such critical inputs get to project farmers in good time so that they can practice what the project teaches them.

- Since limited income or limited access to credit is a major hindrance to adoption of almost all the GAP that the project has exposed farmers to, efforts to build the capacity of cocoa farmers to start group susu schemes or community cooperative credit union is recommended in the next phase to improve technology adoption.

- The project should be extended to a second phase to ensure that farmers get structured and consistent guidance and support to fully implement all that they have learnt under the ‘first’ phase. At this stage in the adoption process, all the fears and suspicion surrounding the technology/project have almost disappeared and non-project farmers in project communities have started showing interest due to the differences in yield they are seeing. At this critical stage when the early adopters have blazed the trail and the early majority are getting onboard, project extension is the best option to ensure sustainability. During the proposed second phase, proper structures should be put in place to ensure that various farmer groups can support the project in the future to ensure long-term sustainability.

The above recommendations, when implemented together with other administrative measures, will ensure that the CocoaLink project will not only improve cocoa yield and farmers’ income but their knowledge level on critical socio-economic issues that affect the future of their children and the household in general would also improve significantly.

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APPENDICES

I: Propensity score matching approach – An overview

Propensity score matching (PSM) is a statistical matching technique that attempts to estimate the effect of a treatment, policy, or other intervention by accounting for the covariates that predict receiving the treatment. PSM attempts to reduce the bias due to confounding variables that could be found in an estimate of the treatment effect obtained from simply comparing outcomes among units that received the treatment versus to those that did not. The possibility of bias arises because the apparent difference between these two groups of units may depend on characteristics that affected whether or not a unit received a given treatment instead of due to the effect of the treatment per se. In randomized experiments, the randomization enables unbiased estimation of treatment effects; for each covariate, randomization implies that treatment-groups will be balanced on average, by the law of large numbers. Unfortunately, for observational studies, the assignment of treatments to research subjects is, by definition, not randomized. Matching attempts to mimic randomization by creating a sample of units that received the treatment that is comparable on all observed covariates to a sample of units that did not receive the treatment. In normal Matching we match on single characteristics that distinguish treatment and control groups (to try to make them more alike). PSM employs a predicted probability of group membership e.g., treatment vs. control group—based on observed predictors, usually obtained from logistic regression to create a counterfactual group. A propensity score is the probability of a unit (e.g., person) being assigned to a particular treatment given a set of observed covariates. Propensity scores are used to reduce selection bias by equating groups based on these covariates. To overcome selection bias which usually distorts impact results Rosenbaum and Rubin (1983) suggested matching participant and non-participant solely on their propensity scores (PSM). The propensity score is predicted with either the logit or probit model. The propensity score $p(X_i)$ is defined as the conditional probability of participating in intervention (CocoaLink in this study), given pre-participation characteristics:

$$p(X_i) \equiv Pr(T_i = 1 | X_i) = E(T_i | X_i) \qquad (1)$$

From equation (1) let *Ti* be a binary indicator of program participation: *Ti*=1 for participation by subject *i* and *Ti*=0 for non-participation by subject *i* and then X_i denotes a vector of pre- participation characteristics.

The Average Treatment Effect (ATE), which is the most common treatment effect measured, captures the treatment effect for the whole sample:

$$ATE = E(\delta) = E(Y_1 - Y_0) \qquad (2)$$

where E(.) represents the average (or expected value).

Average Treatment Effect on the Untreated (ATU) measures the impact that the intervention would have had on those who did not participate:

$$ATU = E(Y_1 - Y_0 \mid T = 0) \qquad (3)$$

and

Average Treatment Effect on the Treated (ATT) is the difference between expected outcome values of participants and non-participants treatment for those who actually participated in the project.

$$ATT = E(Y_1 - Y_0 \mid T = 1) \qquad (4)$$

II: Probit estimates used to predict propensity scores in the PSM analysis

Table a: Probit model results for Male cocoa farmers surveyed

Logistic regression		Number of obs =	810
		LR chi2(14) =	177.07
		Prob > chi2 =	0.0000
Log likelihood =	-442.65951	Pseudo R2 =	0.1667

clink	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
m_age	.0158761	.0087579	1.81	0.070	-.0012891	.0330413
m_edu	-.0820698	.0289189	-2.84	0.005	-.1387498	-.0253898
hh_size	.0763464	.0329677	2.32	0.021	.011731	.1409619
yr_use	.047693	.0288266	1.65	0.098	-.0088061	.1041922
train	1.523334	.1723667	8.84	0.000	1.185501	1.861166
land	-.0449272	.0079857	-5.63	0.000	-.060579	-.0292755
fert	-.0001026	.0000762	-1.35	0.178	-.0002519	.0000467
pest	.0001904	.0003031	0.63	0.530	-.0004037	.0007845
bike	.3945045	.2062276	1.91	0.056	-.0096941	.7987031
moto	-.2152266	.2067705	-1.04	0.298	-.6204893	.1900361
sheep	.851228	.191648	4.44	0.000	.4756049	1.226851
goat	.0960454	.1870801	0.51	0.608	-.2706249	.4627156
akont	-.3437543	.1968652	-1.75	0.081	-.7296031	.0420944
wiaws	-.3448628	.2208933	-1.56	0.118	-.7778057	.0880802
_cons	-.3880893	.45047	-0.86	0.389	-1.270994	.4948158

Source: Model output from Stata, 2014.

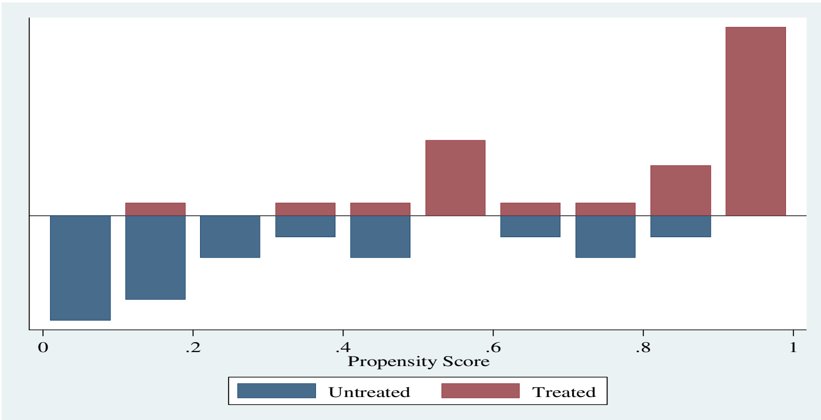
Table b: Probit model results for Female cocoa farmers surveyed

Log likelihood = -35.28752	LR chi2(14)	=	56.45
	Prob > chi2	=	0.0000
	Pseudo R2	=	0.4444

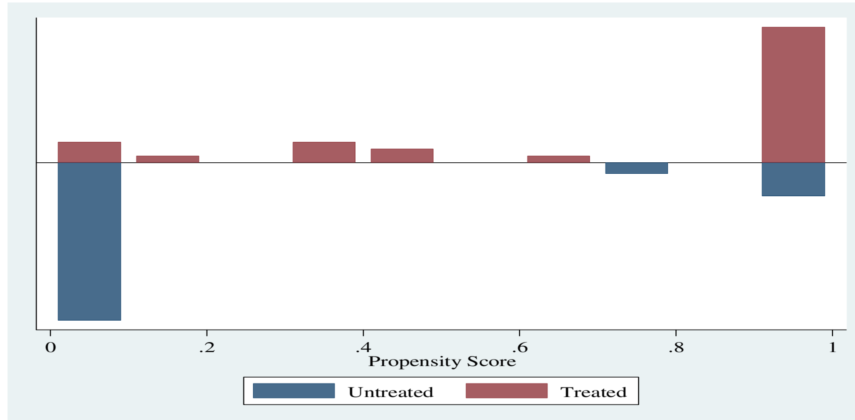
Var	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
f_age	.1625335	.0548041	2.97	0.003	.2699476	.0551195
f_edu	-.0501487	.1282866	-0.39	0.696	-.3015857	.2012884
hh_size	-.0656557	.0706836	-0.93	0.353	-.204193	.0728815
yr_use	.4914247	.1894537	2.59	0.009	.1201022	.8627472
netwk	3.009985	1.197642	2.51	0.012	.662649	5.357321
train	2.573086	.828485	3.11	0.002	.949285	4.196887
land	.0926744	.0848701	1.09	0.275	-.0736679	.2590167
bike	1.711478	.9184852	1.86	0.062	-.08872	3.511676
sheep	.3101601	1.108638	0.28	0.780	-1.86273	2.48305
goat	1.497622	1.058563	1.41	0.157	-.5771226	3.572367
fert	-.0024247	.0017026	-1.42	0.154	-.0057618	.0009123
pest	-.0037997	.0024454	-1.55	0.120	-.0085925	.0009932
akont	1.919458	1.019069	1.88	0.060	-.0778803	3.916796
wiaws	-1.872596	.8710448	-2.15	0.032	-3.579813	-.1653797
_cons	3.005154	1.908987	1.57	0.115	-.7363912	6.746699

Source: Model output from Stata, 2014.

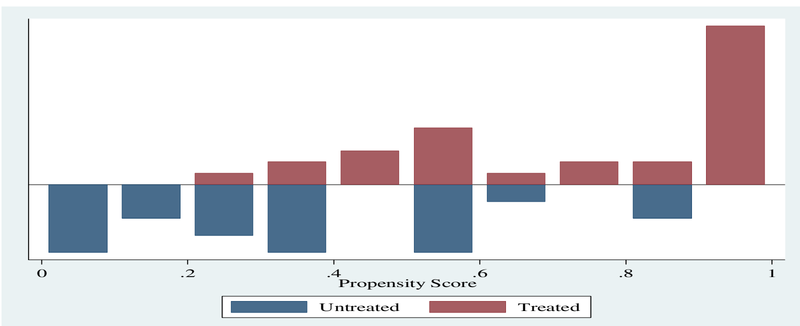
Figure A: PSM Graphs for productivity and per capita exp. For female farmers Before and after matching



a. cocoa productivity for females-after matching



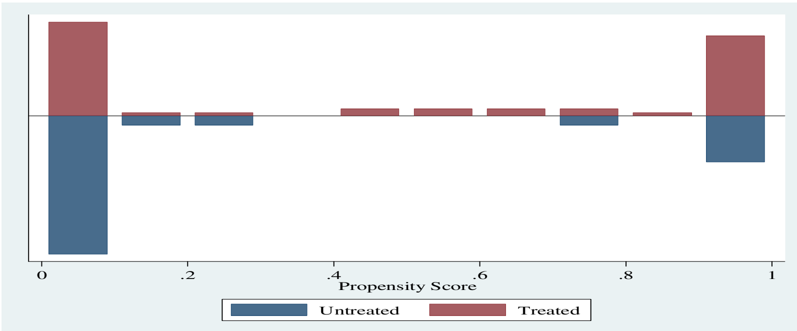
b. cocoa productivity for females-before matching



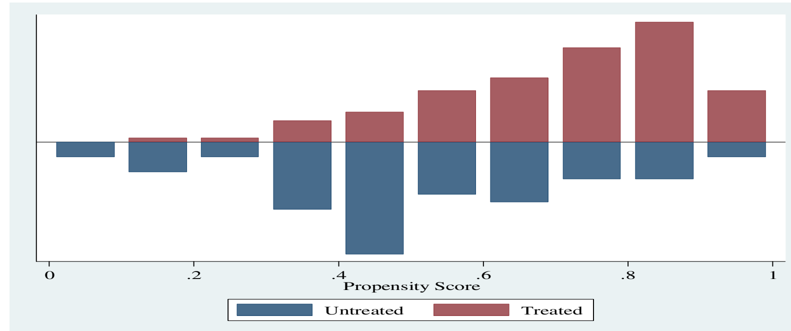
c. Per capita expenditure for females-after matching

d. Per capita expenditure for females-before matching

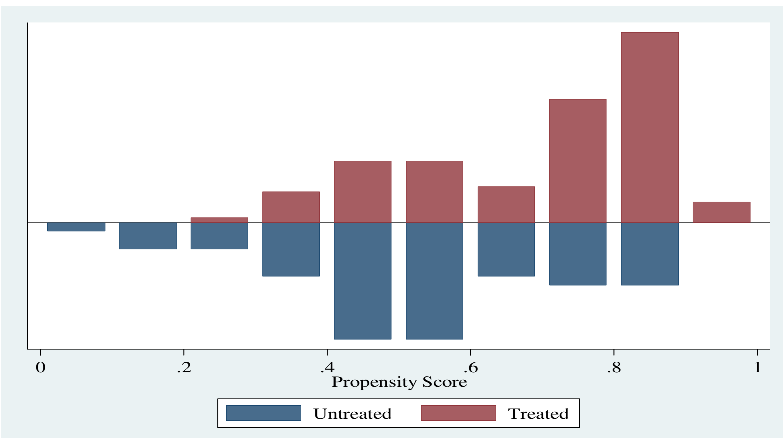
Figure B: PSM Graphs for productivity and per capita expenditure for male farmers before and after matching



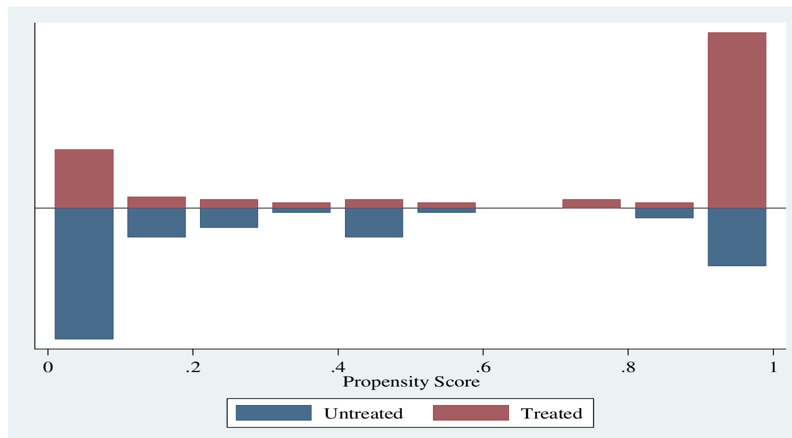
a. **Productivity for males (after matching)**



b. Productivity for males (before matching)



d. **Per capita income for males (after matching)**



d. Per capita income for males (before matching)