



Farmers' Perceptions of the Effectiveness of the Cocoa Disease and Pest Control Programme (CODAPEC) in Ghana and Its Effects on Poverty Reduction

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Authors' contributions

This work was carried out in collaboration between both authors. Author EK was involved in the study design, data collection and analysis. He managed the literature review as well as the writing up of the introduction and the first draft of the results of the manuscript. Author AJD was involved in the analysis, writing up of the discussion and the proof reading of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

The study examined the contribution of the Cocoa Disease and Pest Control Programme (CODAPEC), which is a cocoa production-enhancing government policy, to reducing poverty and raising the living standards of cocoa farmers in Ghana. One hundred and fifty (150) cocoa farmers were randomly selected from five communities in the Bibiani-Anhwiaso-Bekwai district of the Western Region of Ghana and interviewed using structured questionnaires. Just over half of the farmers (53%) perceived the CODAPEC programme as being effective in controlling pests and diseases, whilst 56.6% felt that their yields and hence livelihoods had improved. In some cases pesticides or fungicides were applied later in the season than recommended and this had a

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detrimental effect on yields. To determine the level of poverty amongst farmers, annual household consumption expenditure was used as a proxy indicator. The study found that 4.7% of cocoa farmers were extremely poor having a total annual household consumption expenditure of less than GH¢ 623.10 (\$310.00) while 8.0% were poor with less than GH¢ 801.62 (\$398.81). An amount of money ranging from GH¢ 20.00 (\$9.95) to GH¢ 89.04 (\$44.29) per annum was needed to lift the 4.7% of cocoa farmers out of extreme poverty, which could be achieved through modest increases in productivity. The study highlighted how agricultural intervention programmes, such as CODAPEC, have the potential to contribute to improved farmer livelihoods.

Keywords: Cocoa disease and pest control (CODAPEC); poverty reduction; standard of living; mirids; black pod disease; Ghana.

1. INTRODUCTION

Ghana is the second largest producer and exporter of cocoa beans, after Côte d'Ivoire. In 2012, cocoa accounted for about 30% of Ghana's total export earnings, 19% of agricultural Gross Domestic Product (GDP) and 3.0% of national GDP [1,2]. For Ghanaian cocoa farmers, the contribution of cocoa to annual household income is estimated between 70% to 100% and employs about 3.2 million workers representing 60% of the national agricultural labour force [3]. Smallholder farmers contribute to about 90% of global cocoa production and typically operate within a farm size of 1 to 5 hectares [4]. Similarly, in Ghana, smallholder farmers dominate cocoa production which therefore makes the crop an instrumental vehicle for employment creation and poverty reduction.

From 2003 onwards, the impressive growth performance and poverty reduction recorded in the Ghanaian economy is mainly attributed to the agricultural sector, which is largely driven by cocoa production. Between 2003 and 2007, economic growth rates in Ghana increased from 5.2% to about 6.3% which has resulted in an increase in average income from \$1,430 in 2008 to US\$2,500 in 2010 [5,6]. The growth in the agricultural sector has been underpinned by the sturdy output performance of the cocoa sector from 0.5% to 16.4% year-on-year growth in output between 2003 and 2012 [7]. However, Ghana's cocoa sector operates at lower yield productivity compared to their counterparts in some countries like Côte d'Ivoire, Indonesia and Malaysia [8]. Research has shown that cocoa farmers in Ghana have the potential to produce an estimated dry bean yield of 1000 kg ha⁻¹ or more [9] but currently the national average yield is estimated at 400 kg ha⁻¹. The relatively low yield in Ghana is attributed to factors such as high prevalence of pests and diseases, poor

agronomic practices, decline in soil fertility and the use of low yielding varieties [10].

Among the above factors, the impact of pests and diseases is one of the greatest challenges to farmers. In Ghana, common cocoa diseases include *Phytophthora* black pod caused by the species *Phytophthora palmivora* and *Phytophthora megakarya* and Cocoa Swollen Shoot Virus Disease (CSSVD) while that of pests include insects mostly of the bug or miridae family such as *Distantiella theobroma* and *Sahlbergella singularis*. Such diseases and pests can have devastating effects on the economies of cocoa production by reducing yields [11]. Although difficult to quantify, Acebo-Guerrero et al. [12] have argued that *Phytophthora megakarya* and mirids could cause an estimated 70%-90% annual crop loss if control measures are not taken and consequently significant economic loss to farmers. For example, between 2008 and 2010, an average estimated value of more than US\$300 million of annual crop loss in Ghana was attributed to black pod disease while loss due to mirids infection was estimated at US\$172 million [13]. The loss in productivity translates into low income which implicitly affects the standards of living of farming households. This invariably creates apathy on the part of farmers in making productive investments such as the use of fungicides, insecticides and fertilisers on their farms. Consequently, the long term growth and sustainability of the cocoa sector is threatened [14].

In addressing the challenges of the cocoa sector, a number of policies, programmes and interventions aimed at improving farm level productivity among farmers such as the Cocoa High-Technology Programme (Cocoa Hi-Tech) have been implemented over the years, with the aim of improving the livelihood of farmers [15]. In 2001 the government of Ghana initiated the Cocoa Disease and Pest Control Programme

(CODAPEC), a national cocoa spraying programme with the objective of facilitating increased production among farmers through the control of mirids and black pod disease. Over the years, yield improvements in the cocoa sector have been linked at least in part to CODAPEC. For example, the level of national cocoa output increased from 632,000 to 1,025,000 metric tonnes for 2009/2010 and 2010/2011 growing seasons respectively. This was accompanied by an increase in the farm gate producer price from GH¢ 2,400 to GH¢ 3,200 per metric tonnes of cocoa beans [16]. It has been argued that the increased production levels and the price incentive has led to an increase in farmers income and has therefore resulted in the reduction of poverty among cocoa-farming households [17].

In Ghana, poverty abounds especially among rural farming households, even though, poverty according to the Ghana Living Standard Survey 5 is said to have reduced at an unprecedented rate from 51.7% to 28.5% between 1991 and 2005 [18]. However, since the inception of CODAPEC in 2001, relatively little is known about the poverty levels and standards of living among cocoa farmers. This study was conducted in the Bibiani- Anhwiaso Bekwai District (hereafter, BABD) in the Western Region of Ghana. Poverty is a common phenomenon that is often experienced in the district as 35.1% of farmers are classified as extremely poor [19]. Similarly, Boon et al. [19] found that about 58% of the population of BABD lives under the national poverty line. This raises key research questions such as: Has the living standard of cocoa farmers improved since the implementation of CODAPEC? What percentage of farmers can be classified as living below the upper and lower poverty lines? What is the perception of cocoa farmers of their living conditions? Despite the previous studies on CODAPEC and cocoa production in Ghana, there is relatively little empirical research that focuses directly on assessing the effects of the programme on poverty reduction and standards of living among cocoa farming households in the context of Ghana.

This paper therefore attempts to analyse the poverty levels and standards of living of cocoa farmers in the BABD of the Western Region of Ghana by using farmers' household expenditure in 2012 as a proxy indicator in comparison with the national poverty lines set by the Ghana Statistical Service [20]. The paper also explores

farmers' perceptions of the CODAPEC programme and identifies policy gaps in the implementation of CODAPEC. We take cognisance of the fact that in taking an instrumental view of asking project beneficiaries or farmers directly about attribution or their perception of the programme, there is a possibility of confirmation bias [21] or what Copestake [22] calls 'project bias' where "someone consciously or otherwise conceals or distorts what they think they know about an activity in the hope that doing so will reinforce the case for keeping it going". Despite this potential, *ex post* consultation or econometric evaluations cannot be used as a substitute for cocoa farmers in whose name the programme was implemented. As Copestake [22] argues, it is ethically correct to involve at least some direct beneficiaries in project evaluation even if it presents methodological challenges.

Up to date, research on cocoa farmers and CODAPEC in Ghana is largely skewed towards quantitative approach which focuses mainly on an axiomatic view of the project while others have also focused on factors that influence the adoption of the programme by farmers [23]. In this paper, we argue that such a view is insufficient, thus creating a gap in knowledge about farmers subjective assessment of the programme. There is therefore little empirical research on the subjective evaluation of the programme with respect to farmers' perception and its effects on their households and standards of living in general. This research seeks to fill this scholarly gap. The novelty of the paper lies in its potential contribution in deepening our understanding about the effects of government agricultural policy initiatives on the livelihood of cocoa farming households of which little is known.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in the BABD located at the North-western part of the Western Region of Ghana. The district, which is located between latitude 6° N, 3° N and longitude 2° W, 3° W (Fig. 1) is an important cocoa producing area in Ghana and covers an estimated land area of 873 km². An estimated 62% representing 39,829 hectares out of the 54,240 hectares of the available total arable land is under cultivation for both cash and food crops such as cocoa, coffee, plantain and cassava [24,25]. Topographically,

the land rises from about 350m to 660m above sea level [26]. The district is located in the wet-semi equatorial rainforest zone which is marked by a bimodal rainfall pattern between March-August and September-October. Average annual rainfall is between 1200mm and 1500mm with the peak periods between June and October [27]. The dry season is between November and January. BABD has a uniform average temperature of around 26°C throughout the year with relative high humidity, daily averages being between 75% and 95% [24]. The favourable climatic conditions combined with the high fertility of forest ochrosols soil supports cocoa production and makes it the most important cash crop cultivated by farmers [20,27]. Furthermore, food crops like plantain, cassava, rice and black pepper are also cultivated on an average farm size of 1.5 hectares [25].

BABD is basically agrarian with an estimated 61% of the active labour force engaging in agricultural activities such as crop and mixed farming in addition to animal husbandry. Mining activities in gold and bauxite in Bibiani, Chirano and Awaso respectively dominates the industry sector. BABDA's population according to the 2010 Housing and Population Census of Ghana was estimated at 123,272 with 49.4% male and 50.6% female [24].

2.2 Sampling Procedure, Data Collection and Analysis

Purposive sampling was used in selecting the BABD for the study. Cluster sampling was also used in dividing the district into three zones: Bibiani Zone, Anhwiaso Zone and Bekwai Zone because of the expansive nature of the district. Simple random sampling was further employed in selecting five communities; Kwamekrom (6° N, 25° N, 2° W, 18° W), Dominibo No. 2 (6° N, 21° N, 2° W, 16° W), Tanoso (6° N, 20° N, 2° W, 18° W), Ntakam (6° N, 16° N, 2° W, 19° W) and Humjibre (6° N, 08° N, 2° W, 16° W) (Fig. 1). We then employed the random sampling technique in selecting 150 cocoa farming households, 30 from each community. The same sample size was used for the three zones because of similar population characteristics among cocoa farmers. Data for the study were obtained through the administration of structured questionnaires which were made up of both closed and open-ended questions. Open-ended questions were used to capture qualitative data representing the respondent's own views about their household

expenditure and standards of living while the closed-ended questions elicited information for the quantitative analyses [28]. The questionnaires were pre-tested in two communities; Domino No. 1 (6° N, 22° N, 2° W, 17° W) and Bibiani Old Town (6° N, 27° N, 2° W, 19° W) (Fig. 1). The pre-test survey was used to test the feasibility of the questionnaire [28]. Corrections were made to the questionnaire after the pre-test exercise in order to ensure that there was no ambiguity in the questions asked. A team of enumerators pre-tested and administered the questionnaires in the local dialect of respondents. Data collected included those on socio-economic characteristics and demographics, detailed household income and expenditure, the perception of farmers about their living standards and the effectiveness of CODAPEC in improving yield and income.

Descriptive statistics in the form of frequencies, percentages as well as pictograms such as pie charts and bar charts were used to present data whilst associations between socio-economic characteristics and yield were analysed by means of chi-square using the Statistical Product and Service Solutions (SPSS) package, version 20.0. Annual household expenditure in Ghana Cedis (GH¢) was converted into United States Dollars (US\$) based on the prevailing market exchange rate (US\$ 1= GH¢ 2.01) in June, 2013. The results were compared to the dollar equivalent of the upper and lower poverty lines set by the Ghana Statistical Service [18] and also from poverty lines calculated from the minimum wage index. The average interbank exchange rate for June, 2006 was at \$1= GH¢ 0.92.

3. RESULTS

3.1 Socio-economic Characteristics of Respondents

3.1.1 Gender profile, marital status and age of respondents

The results of the descriptive statistics of the socio-economic characteristics of 150 cocoa farmers are presented in Table 1. The results indicated a high ratio of male (62%) to female (38%) farmers. About 82.7% of respondents were married or had married before but are currently divorced, living in consensual union or widowed. The average age of respondents was about 40 years with the 31-40 years age bracket

being the modal age class. The age of farmers ranged from 18 to 70 years. The results demonstrated a fair distribution of ages across the population with majority of farmers (92.7%) being in their economically active age (18-64 years).

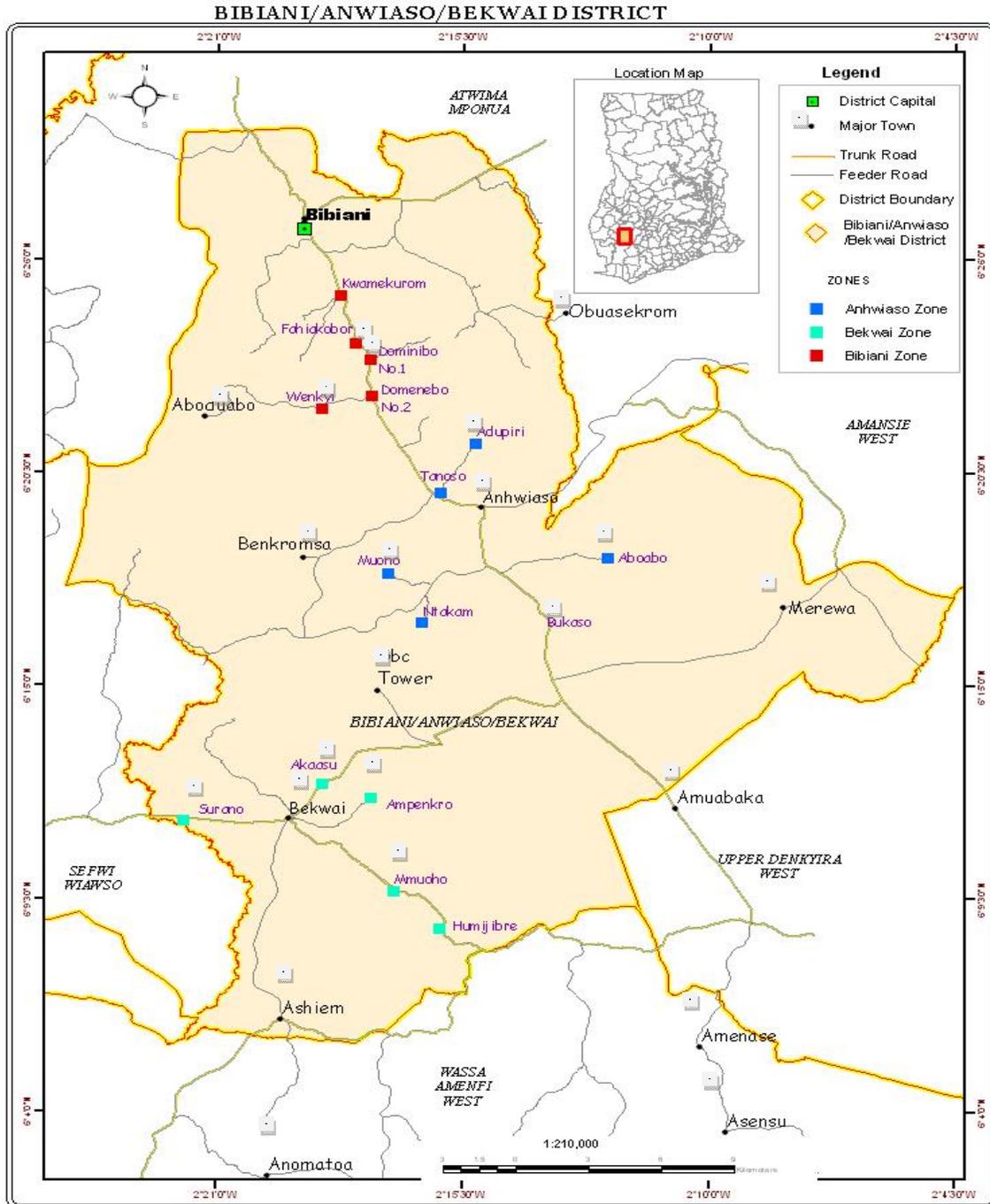


Fig. 1. Bibiani-Anhwiaso-Bekwai district showing location and selected communities for the study

Table 1. Descriptive statistics of the socio-economic characteristics of respondents (n=150)

Socio economic variable	Frequency	Percentage
1. Gender profile of respondents		
Male	93	62.0
Female	57	38.0
Total	150	100.0
2. Marital status of respondents		
Married	78	52.00
Single	26	17.3
Divorced	16	10.7
Widowed	27	18.0
Consensual Union	3	2.0
Total	150	100.0
3. Experience in cocoa cultivation		
Less than 5 years	25	16.7
5-10 years	33	22.0
11-20 years	47	33.1
21-30 years	27	18.0
Above 30+	18	12.0
Total	150	100.0
4. Educational level of respondents		
Basic (Primary and Middle School)	35	23.3
Secondary (Senior High School)	29	19.3
Tertiary	11	7.4
No education	44	29.3
Non formal education	31	20.7
Total	150	100.0
5. Household size		
1-5 member(s)	82	54.7
6-10 members	58	38.7
11-15 members	8	5.3
16-20 members	2	1.3
Total	150	100.0
6. Number of household members working on farm		
1-2 person (s)	100	66.7
3-4 persons	39	26.0
5-6	10	6.6
Above 6 persons	1	0.7
Total	150	100.0

Source: Field survey, 2013

3.1.2 Cocoa farmer's level of education and experience

The adult illiteracy rate (percentage of persons aged 15 years and over who cannot read and write) was found to be 29.3% although 23.3%

were educated to the basic school level while a few had attained tertiary education. The average working experience was about 15 years while the years of experience in cocoa farming ranged from 5 to 30 years (Table 1). There was a highly significant relationship between respondent's experience in cocoa cultivation and their yield ha^{-1} ($X^2 = 70.50$, $P < 0.01$). Farmers with more years of experience in growing cocoa had higher yield ha^{-1} compared to farmers with less experience.

3.1.3 Farm size and cocoa output

Fig. 2 presents the distribution of cocoa farm sizes as reported by farmers. About 68.7% of surveyed farmers claimed to have farm size between 1.0 and 4.0 hectares while a small proportion (2%) had above 10 hectares. Results indicate that smallholder farmers dominate cocoa farming in the study area. The average farm was 1.6 hectares, with the range being from 0.40 to 15 hectares.

Results on cocoa output (64 kg/Bag) and kg ha^{-1} produced by farmers are presented in Table 2. The results show that farmers had an average yield of 574 kg ha^{-1} , the range being from 300 kg ha^{-1} to 685 kg ha^{-1} .

Table 2. Descriptive statistics of the output of cocoa (Bags) and (Kg ha^{-1}) of the sampled cocoa farmers (n=150)

Variable	Frequency	Percentage
Output of cocoa (64 kg/ bag of dry beans)		
< 10	26	17.3
10.5 – 20	51	34
20.5 – 30	31	20.7
30.5 – 40	22	14.7
40.5 – 50	4	2.6
Above 50+	16	10.7
Total	150	100.0
Output of cocoa (Kg ha^{-1})		
Less than 300	12	8.0
300-400	15	10.0
401-500	34	22.7
501-600	61	40.7
Above 600	28	18.6
Total	150	100.0

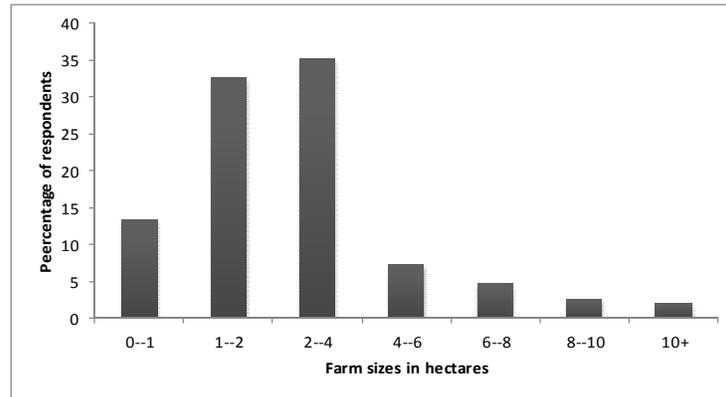


Fig. 2. Distribution of farm size hectares (n=150)

3.1.4 Variations in the first month of spraying

Fig. 3 presents the responses of farmers on the timing of the first pesticide/fungicide spray. A majority of respondents (94.7%) had their farms sprayed within the months of July, August, September and November, which is the recommended spraying period. However, a smaller proportion (5.3%) reported that their farms were sprayed beyond November. The results of the Chi-square tests statistic ($X^2 = 228.68$; $P=0.04$) on the association between the period of spray and yield ha^{-1} shows a statistically significant relationship at 5% level of significance. The highest yields were recorded for farms that were sprayed in the month of July while farms had lower yields when sprayed in November.

3.1.5 Farmers' perception on the effectiveness of the spraying process and economically important pests and diseases

A large proportion (53%) of farmers claimed that the spraying process was effective in controlling the incidence of pests and diseases. However, a much smaller proportion (14%) claimed spraying under COPAPEC was ineffective as the programme is faced with numerous institutional constraints.

Fig. 4 shows the pests and diseases reported by farmers in terms of economic importance. A large proportion of farmers identified mirids and black pod (45% and 23% respectively) as the most economically important pest and disease. Cocoa swollen shoot virus disease was cited by 17% of respondents as the most important disease, whilst 10% cited mistletoe growth in the cocoa canopy.

3.1.6 Inefficiencies and challenges facing CODAPEC

Fig. 5 illustrates the key inefficiencies and challenges of CODAPEC identified by farmers and spraying gangs. The untimely supply of insecticides and fungicides was cited by both by farmers (26%) and spraying gangs (50%) as the major challenge. The perception of sprayers on the programme was also sought since they are the workers on the ground. This helped in providing a deeper understanding of the challenges that confronts them in undertaking their spraying exercise. Their perception on the challenges facing CODAPEC is presented in Fig. 5.

3.2 Effect of CODAPEC on Crop Yield, Household Income and Standards of Living

3.2.1 Farmers perception on the effect of CODAPEC on crop yield

The perception of farmers on the effect of CODAPEC on crop yield was assessed by asking the respondents to compare their yield before and after the implementation of CODAPEC. The majority (56.7%) of respondents claimed the spraying exercise was effective in increasing the yields of cocoa. About 17.3% of respondents claimed there have been no significant variations in their yields, whilst 20% claimed their yields had decreased. A statistically significant relationship was found between month of first spray and farmer's perception of an increase in cocoa yields since the inception of CODAPEC ($X^2 = 59.59$; $P < 0.01$). Farmers who reported late spraying tended not to see a yield advantage ($X^2 = 23.6$; $P = 0.75$).

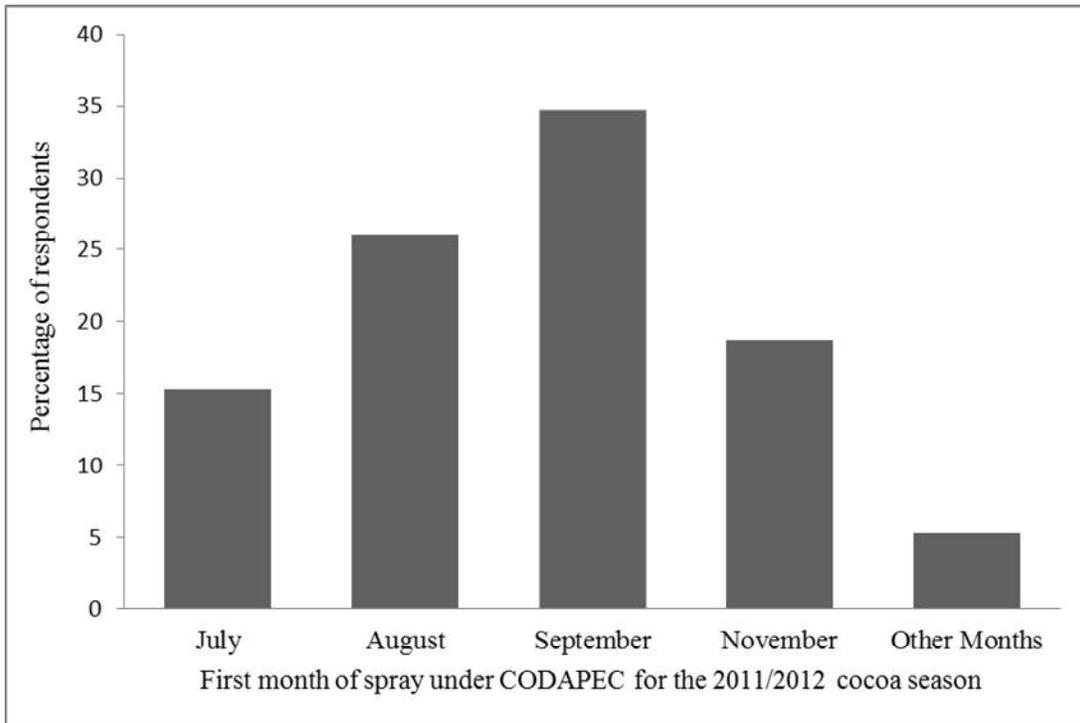


Fig. 3. Variation in the first month of spraying under CODAPEC for the 2011/2012 cocoa growing season (n=150)

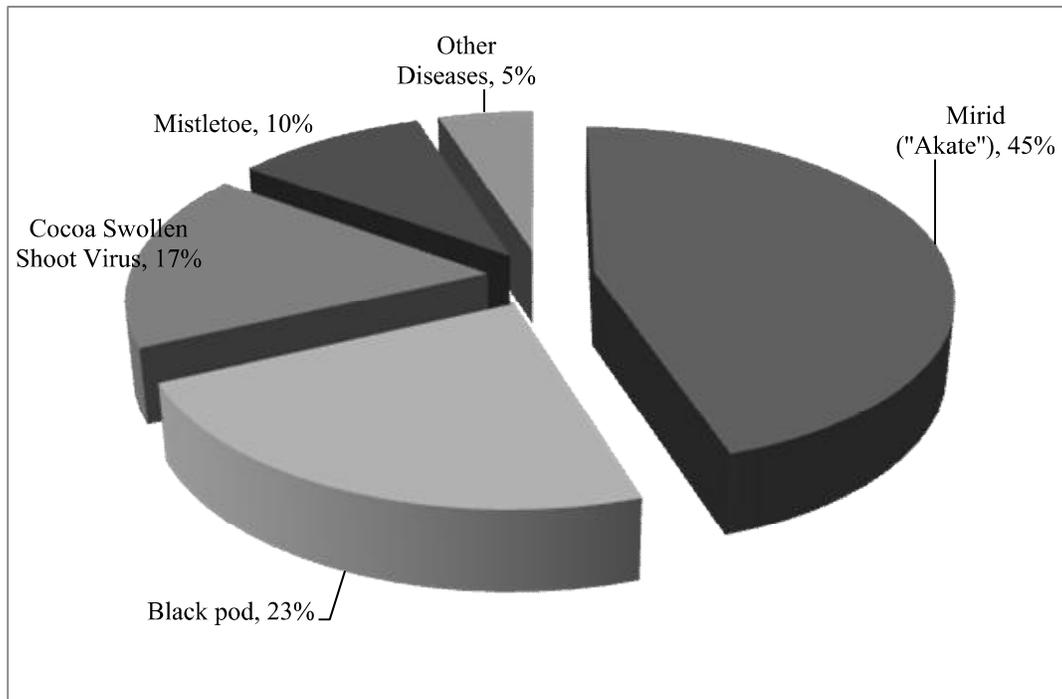


Fig. 4. Farmers' perception of the most economically important pests and diseases (n=150)

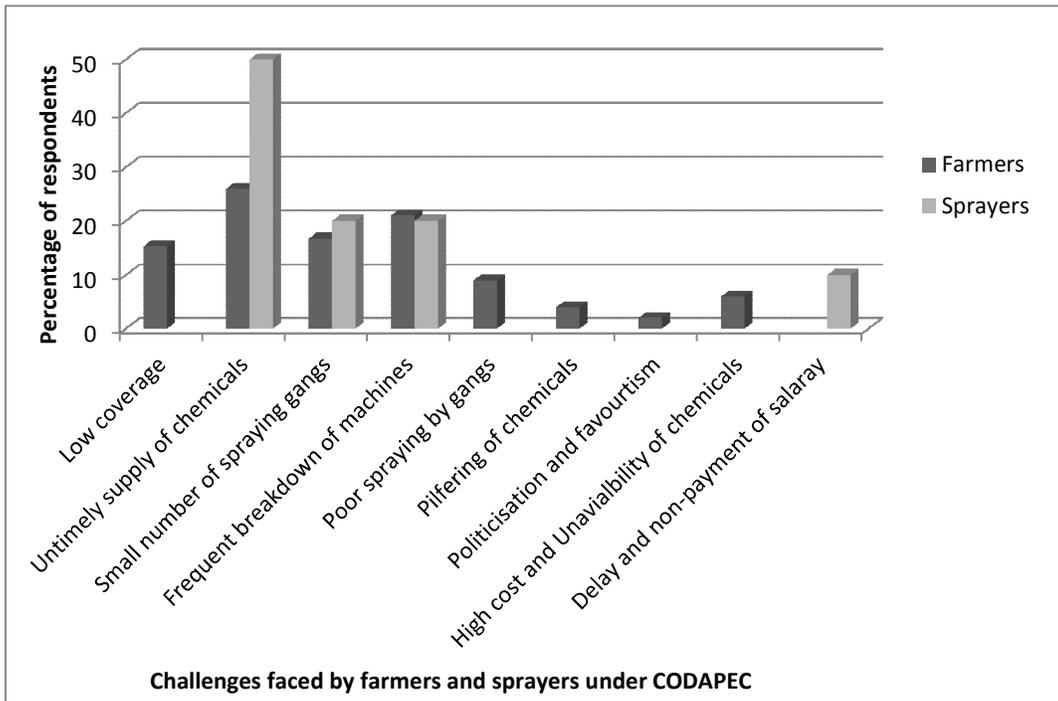


Fig. 5. Summary of farmers and sprayers response of the inefficiencies and challenges facing CODAPEC (n=160)

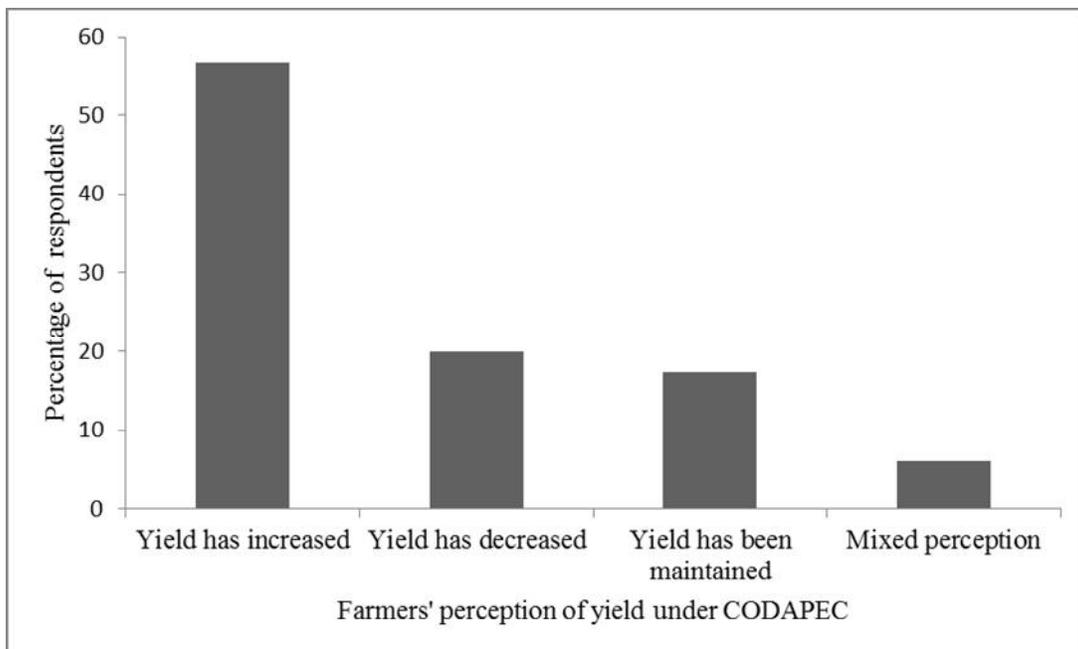


Fig. 6. Perception of farmers on the relationship between CODAPEC and yields (n=150)

3.2.2 Sources and proportion of household income from cocoa farming

The mean annual household income from cocoa was GH¢5,073.75 (\$2,525.25), the range being from GH¢ 615.00 to 16,400.00. Cocoa farming was the main occupation of respondents and accounting for 75.3% of total household income on average. Sales from cocoa beans were cited as the highest income source for farmers in addition to food crops (Table 3). Households were highly reliant on the income from cocoa.

3.2.3 Household consumption and expenditure

The household expenditure excluding on-farm expenditure level is presented in Table 4. Food expenditure accounted for a large proportion (45.2%) of the household total expenditure while a small proportion (6.1%) was spent on education and health.

3.2.4 Comparative analysis of average and total household consumption expenditure to Ghana living standards survey (GLSS 5)

Poverty levels of respondents were determined by using household consumption expenditure as a proxy indicator. The mean household expenditure from the study was compared to that of the Ghana Living Standard Survey (GLSS) 5 mean household expenditure GH¢ 1,918.00 (\$2,084.78) in 2006 (GSS, 2008). Results from Table 5 indicates that respondents could spend more money GH¢ 3,383.00 (\$1,683.08) and could be suggested that monetary wise, they are better off in 2013 than in 2006 in terms of Ghana Cedis (GH¢). The average expenditure is about 1.7 and 2.0 times more than the national and rural forest average household expenditure.

Table 6 presents the percentage of respondents living below the national poverty line computed from the upper and lower poverty lines which were GH¢ 370.90 and 288.50 per adult per year respectively in 2006 [29]. When these figures were inflated to 2013 levels by adjusting for the change in exchange rates, they were GH¢ 623.10 and GH¢ 801.62 respectively. Based on the annual household consumption expenditure, 4.7% and 8.0% of farmers are also classified as extremely poor and poor respectively in accordance with national poverty lines. When comparing the household consumption expenditure with the Minimum Wage Index used in Ghana, 14% of respondents were classified as

living in poverty. An amount of money ranging from GH¢ 20.00 to GH¢ 89.04 per annum is needed to lift the 4.7% of respondents out of extreme poverty to the poor line when using the poverty gap.

3.3 Farmers Perception about Their Poverty Level and Standards of Living

Fig. 7 illustrates the perception of farmers about their standard of living based on the multidimensionality of poverty approach (defining poverty in terms of non-income dimensions of human well-being and people’s own lived experiences). Respondents were asked about their poverty levels and living conditions on a scale of four, from very good standards to very poor standards of living.

The results illustrated in Fig. 7 suggest a higher level of perceived poverty than those presented in Table 6. About 11% and 6% of farmers considered themselves to be poor and extremely poor respectively.

Table 3. Proportion of household income from cocoa farming (n=150)

Sources of household income	Frequency	Percentage
Food stuffs (Plantain, Cassava, Yam, Cocoyam)	23	15.30
Cocoa Beans	113	75.30
Vegetables (Pepper, Tomatoes etc.)	14	9.30
Total	150	100.0

4. DISCUSSION

4.1 Socio-economic Characteristics of Respondents

The current study has demonstrated the dominance of an economically active farmer population in the production of cocoa in the BABD district of Ghana. Results from the present case study area are consistent with the findings of Danso-Abbeam et al. [30] who reported that about 61% of cocoa farmers in the BABD were aged between 20 and 50 years. The results are however in contrast with studies from other parts of the country that indicates an aging farming population [23,31,32]. As cocoa farmers are ageing, there is the need for a replacement by younger farmers to ensure the sustainability of

the cocoa sector. Programmes that are geared towards improving farmer yields such as CODAPEC have a potential role in encouraging future generations to continue cocoa farming.

Table 4. Household annual expenditure (GH¢) for the 2012/2013 cocoa growing season (n=150)

Expenditure Item	Number of farmers	Minimum	Maximum	Mean	Median	Std. deviation
Root & tuber crops	150	50.00	5,000.00	1,188.41	864.00	1,176.34
Bread and cereals	150	15.00	900.00	150.50	100.00	175.29
Meat and fish	150	30.00	980.00	160.23	100.00	170.02
Oil, fats, vegetables	150	5.00	120.00	30.53	25.00	22.43
Clothing & footwear	150	10.00	1,500.00	257.94	150.00	264.95
Charcoal & gas	150	10.00	300.00	49.34	37.50	41.64
Water & electricity	150	20.00	750.00	168.31	100.00	164.02
Rental & housing	150	10.00	700.00	173.36	137.50	122.34
Toiletries	150	10.00	500.00	141.76	100.00	110.91
Funerals	150	10.00	2,000.00	248.06	150.00	287.30
Transport & Comm.	150	10.00	1,700.00	194.63	110.00	259.37
Church	150	10.00	1,000.00	168.48	120.00	164.24
Health	150	10.00	540.00	91.52	70.00	82.76
Education	150	10.00	600.00	116.50	100.00	98.68
Miscellaneous	150	10.00	4,500.00	243.43	120.00	427.42
Total	150	220	24,090.00	3,383.00	2,284.00	3,567.71

Table 5. Comparison of mean total expenditure between GLSS 5 (2006) and field data (2013)

Household expenditure	GLSS 5 (June, 2006)*	Field survey (June, 2013)**
Mean household expenditure in Ghana	GH¢ 1,918.00 (\$2,084.78)	-
Mean expenditure for rural forest zone	GH¢ 1,629.00 (\$1,770.65)	-
Mean household expenditure (field survey)	-	GH¢ 3,383.00 (\$1,683.08)

Source: Authors' calculation using data from the GLSS 5 and Field Survey.

* The average interbank exchange rate for June, 2006 was at GH¢1=\$ 0.92.

** The average interbank exchange rate for June, 2013 was at GH¢1=\$ 2.01

Table 6. Percentage of respondents living below the national poverty line in 2013 based on computed and updated from the national living standard survey 2006 (GLSS 5)

GLSS 5 poverty lines (2006) ⁺ per equivalent adult (GH¢) GH¢ 1 = \$0.92	Computed GSS poverty lines in 2013 ⁺⁺ (GH¢)	Percentage of respondents living below poverty lines (field survey, 2013) ⁺⁺⁺	Minimum wage index as at June 2013 GH¢ 5.24 /day * 264 working days per year (GH¢) ⁺⁺⁺⁺	Percentage of population below minimum wage in 2013
Extremely poor 288.50	630.29 (288.50/0.92) *2.01	4.7%	GH¢ 1, 383.36	14%
Poor 370.90	810.33 (370.90/0.92) *2.01	8.0%		

Source: Authors' calculation using data from the GLSS 5 and Field Survey, 2013.

+ Two poverty lines used in the GLSS 5. ++ Inflated value of GLSS 5 Upper and Lower poverty lines at the exchange rate as at June, 2013 (\$1 = GH¢ 2.01).

+++ Percentage of respondents living below computed the national poverty lines based on farmers income.

++++ Workers in Ghana work for 5 days a week so it is assumed that there are 22 working days in a month for each of the 12 months in a year (264 working days)

The current study has demonstrated that a large proportion of cocoa farmers are literate with a majority attaining basic education and thus is consistent with the observations of Baah et al. [10] and Aneani et al. [31] who found an increasing literate population among cocoa farmers. Despite this improvement, the proportion of farmers with qualifications above secondary level was found to be low. The results presented here are consistent with the claim by Asamoah et al. [33] that cocoa farmers with qualifications above secondary level is less than 5% in Ghana. The situation may have implications on the efficient and effective use of innovations including pests and diseases control measures. It was notable that more experienced farmers achieved higher yields. Cocoa cultivation in Ghana provides an important income source to farmers thereby helping to improve the standard of living and reducing poverty among farming households. However, productivity among cocoa farms in Ghana is relatively low [34] and thus the potential income of cocoa farmers is not always realised. The average cocoa yield of 574 kg ha⁻¹ presented in this study is higher than the 378.81 kg ha⁻¹ reported by Danso-Abbeam et al. [30] in the same study area and the national average of 400 kg ha⁻¹ [10].

4.2 Farmer's Perception on CODAPEC

Farmers perceived mirids to be the most economically important group of pests that threaten cocoa cultivation in the study area followed by black pod disease and Cocoa Swollen Shoot Virus Disease (CSSVD). Mirids (*Sahlbergella* and *Distantiella*) are reported to cause considerable damage to cocoa production

resulting in loss of yield of about 25% whereas losses from blackpod can sometimes reach 70-90% in Ghana if appropriate measures are not taken [10]. In the Western Region of Ghana, CSSVD can cause complete crop loss when infection is severe [35]. Mistletoe infestation is also gaining prominence as an impediment to cocoa production as it causes reduced yields and deterioration of farms through canopy damage and the promotion of mirid pockets [36].

Timing of pesticide application is critical to maximise its effectiveness in controlling mirids. The mirid population in West Africa, starts to build-up in July and reaches its peak between August and September while black pod occurrence increases from June with peaks in August and October. Consequently, it is recommended that cocoa farms in Ghana are sprayed between July and September. As indicated in this study, the majority of farmers had their farms sprayed between July and September but a significant proportion received their first spraying under CODAPEC in September when the population of *Sahlbergella singularis* would have been at its peak and therefore already caused damage to the crop. Surprisingly, some farmers had their farms sprayed in November. In these cases pod loss due to mirids would have already peaked before farms were sprayed. The results from the present study mirror the situation in the Ahafo-Ano and Upper Denkyira districts of Ghana where Abankwah et al. [11] and Anang et al. [27] found that 59% and 30% of farmers respectively had their farms sprayed in September and beyond due to delay in the supply of chemicals.

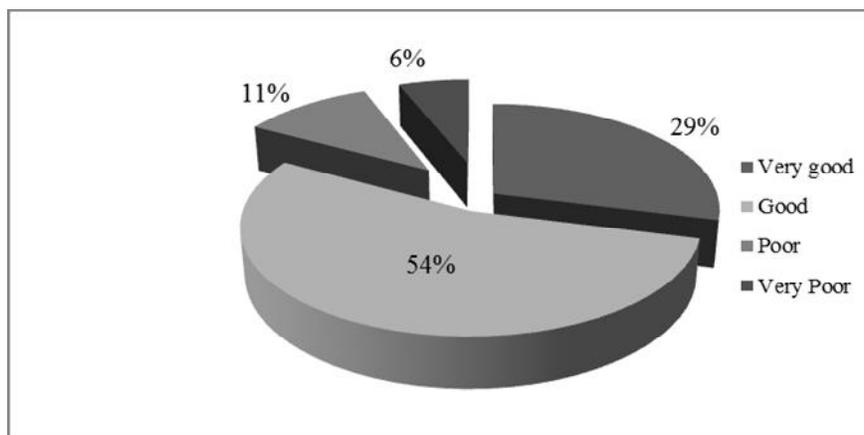


Fig. 7. Farmers perception about their poverty level and standards of living (n=150)

The effective implementation of CODAPEC in the control of pests and diseases was shown to be hindered by several challenges among which include the untimely supply of chemicals, as also shown by Aneani et al. [31] and Helmsing and Vellema [37]. Additionally, farmers cited the inadequate spraying personnel as a major challenge that confronts all the community in the study areas. Farmers maintained that this situation resulted in delays to spraying; furthermore, 10% of farms were not covered at all. This suggests that greater attention needs to be focused on employing more spraying personnel for the effective implementation of the programme in the study area. Moreover, pilfering of chemicals and poor spraying by spraying gangs was also a concern to farmers. The findings here also illustrate administrative lapses in the monitoring and evaluation aspects of the programme in the district.

This assertion by farmers confirms that of desk and extension officers who acknowledged that financial, logistical and infrastructural constraint limit their ability in carrying out effective monitoring. Nevertheless, sprayers are monitored through field visits, engagement with farmers and the submission of reports by gang leaders. Similar results have been found by Teal et al. [38] in the Western region. The results presented here highlight the importance of strengthening the monitoring and evaluation component of CODAPEC at the district and community level.

4.3 Effect of CODAPEC on Crop Yield, Household Income and Standards of Living

A large proportion (56.7%) of farmers perceived that CODAPEC has led to an increase in their productivity (yield) over the years as a result of the reduction in the incidence of pests and diseases. Thus, a majority of farmers had a positive impression about the programme. However, a significant proportion of farmers did not perceive a yield advantage (20% of farmers thought that yields had actually decreased). It would appear that in these cases late application of pesticide resulted in little or no yield advantage. It is important to state that spraying is not the only factor that improves farm productivity; other factors such as husbandry practices also influence productivity as well as year-to-year changes in climate. The findings here are broadly consistent with observations by Opoku et al. [39] that since the inception of

CODAPEC, the majority of farmers in Ghana have testified that cocoa yields have increased on their farms. Adu-Ampomah et al. [35] found that yields of cocoa increased from 266 kg ha⁻¹ to 434 kg ha⁻¹ between 2001 and 2003 and attributed the success to CODAPEC. Farmers report and the literature agrees that cocoa production has continued to be the primary source of income for most cocoa farming household in Ghana [38]. A large proportion of households (75.3%) were mostly reliant on the income from the sale of cocoa beans for their upkeep. Daniel et al. [40] stated that cocoa income often serves as the only readily available income source for farming households especially when household needs such as food, education and social contributions such as those on funerals and church activities are to be met.

However, over dependence on cocoa income during the off-season periods could have negative consequences on household income levels in the event that yields and/or the cocoa price fall. As a risk averting strategy, farmers have diversified their income sources through the growing of other crops (e.g. palm) and non-farm activities such as trading. This indicates the importance of income diversification to household livelihoods especially in the rural areas of Ghana [41]. It is frequently asserted that farmers are expected to be food secured at the household level as they meet a large proportion of their consumption through subsistence production [42].

However, the results indicated that cocoa farmers spend a greater proportion of their income on food expenditure. This raises some concern about the household level food security as an increase in food prices might affect households that purchase the majority of their food from the market pushing more farming households into food shortage, deprivation and poverty [43]. Surprisingly, expenditure on health and education constituted a smaller proportion of household total expenditure. Claims were made by some farmers that the social intervention programmes by the central government such as the National Health Insurance Scheme (NHIS), Free Compulsory Universal Basic Education and the School Feeding programmes have lessened their social household expenditure.

Defining and measuring the concept of poverty is a complex task. While there are several indicators for measuring poverty, they are not without problems. A widely acceptable measure

of household welfare (poverty levels and standard of living) has been the consumption expenditure [44]. Household consumption expenditure was used as a proxy indicator of poverty levels because of the difficulties involved in measuring farmers' income. Based on the computed poverty line in 2013 (Table 6), the finding indicates that 4.7% and 8.0% of respondents can be classified as being "extremely poor" (living below the lower poverty line) and "poor" (living below the upper poverty line) respectively. Thus, the percentage of farmers who were classified as 'extremely poor' and 'poor' in relative terms had an annual household consumption expenditure below the national poverty lines of GH¢ 801.62 and GH¢ 623.10 respectively. In monetary terms when using the Minimum Wage Index in determining the levels of poverty, 14% of respondents can be considered to be living in poverty.

From a monetary perspective, poverty in Ghana has been decreasing such that the number of people defined as living in poverty fell by 1.6 million between 1992 and 2006 [45]. The country is said to be on track to achieving the Millennium Development Goal (MDG One) of halving the poverty rate by 2015. This is backed by the growth of the economy which has been aided by an increase in world commodity prices of exports including that of cocoa over recent years [46,47,48]. Economic growth trends in terms of real Gross Domestic Product recorded an increase from 4.7 to 5.9 between 2008 and 2010 [45]. The increased growth is often assumed to have translated into improved standard of living and wellbeing. The reduction in poverty is a result of a number of policies such as Ghana Shared Growth and Development Agenda and the Growth and Poverty Reduction Strategy (GPRS) I and II. Through these policies among many others, the national poverty rate was halved from 51.7% to 28.5% between 1999 and 2005 although with persistent inequality across regions [6,49,50].

When considering specifically rural poverty, the current findings support those of Coulombe and Wodon [51] who found a reduction in rural poverty headcount by 39.2% between 1998/99 and 2005/06 especially in coastal and forest areas. The result from the study confirms the declining poverty trends among cocoa farming households in Ghana. A similar observation has been reported by the Ghana Statistical Service [18] that poverty levels among rural households especially those in forest areas declined from

64% to 28.5% between 1991 and 2005. Similarly, declining poverty levels have been observed among cocoa farmers in the BABD [18]. From the current study, an analysis of the poverty gap (the distance that separates the population from the poverty line) indicates that an amount of money between GH¢ 20.00 (\$9.95) to GH¢ 89.04 (\$42.29) is needed to lift the 4.7% of farmers to the lower poverty line. Such an uplift in income could be achieved by strengthening yield enhancing programmes such as CODAPEC and Cocoa Hi-Tech so as to increase farm productivity among farmers. It is important to acknowledge that using only income or consumption dimension as a proxy measure of economic well-being and standards of living can be limiting. People experience poverty in different ways, some which cannot be captured in monetary terms, such as access to running water and to electricity [52].

Multidimensional poverty goes beyond the economic well-being measurement and defines poverty in terms of human well-being and people's own lived experiences. The study therefore sought to find out farmers perception about their poverty levels and living standards since they are the people who can really define their own poverty [53,54]. The non-income dimension measurements revealed that about 17% of farmers considered themselves to be poor. This finding reinforces the point made by Whelan et al. [55] about the empirical mismatch between income poverty and people's perception of their own poverty levels and living standards. A similar finding has been reported by Mitra et al. [56] who found in South Africa that living standards are associated with multidimensional poverty rather than income. Furthermore, the study supports the premise that poverty is multidimensional and has many correlates that include both income and non-income aspects of well-being such as assets owned and services received by households [57].

We acknowledge that it might be difficult to establish causality between CODAPEC, poverty reduction and improved living standards among cocoa farmers because of other external factors (agronomic and socio-economic). Nonetheless, since the interest of the study was on the subjective evaluation of farmers, there is evidence to suggest that for a significant proportion of farmers, CODAPEC in addition to other socio-economic and agronomic factors has led to a reduction in poverty through an increase in the farm productivity (yields) of cocoa which

reflects the higher incomes earned by farmers. A complement of this finding was seen in the large proportion of respondents who claimed their living standards were good and very good respectively. The higher number of people who claim to have witnessed an improvement in their living conditions could also in part be as a result of the provision of public goods such as scholarship and also bonuses supplied by COCOBOD as a way of attracting farmers into cocoa production.

5. CONCLUSION

To conclude, a large proportion of smallholder farmers in Ghana are heavily dependent on the sale of their cocoa beans for their livelihoods. Thus agricultural intervention programmes such as the CODAPEC initiative explored here can partially contribute to reducing poverty and improvements in the living standards cocoa farmers.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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