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Implementation Evaluation of Cocoa Hand Pollination Program in Ghana

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Abstract

Ghana's agricultural landscape, dominated by lush cocoa plantations, has long relied on cocoa production as a cornerstone of its economy. However, a crisis has emerged as evidence points to insufficient natural pollination, resulting in a decline in cocoa yields. The study examines the Cocoa Hand Pollination Program (CHPP) and its potential to revolutionise cocoa farming in Ghana's cocoa industry. The study employed an exploratory research design, collecting primary data through structured questionnaires from 367 cocoa farmers, 159 pollinators, and 30 extension staff. Data were analysed descriptively. It was revealed that cocoa farmers have a relatively low level of knowledge about CHPP's objectives but perceive these goals as highly important. Farmers have successfully increased cocoa yield per hectare but face challenges in boosting overall cocoa production. Farmers exhibit a good understanding of CHPP activities and consider them crucial for program success. Pollinators have successfully enhanced natural pollination but are less positive about their contributions to socioeconomic livelihood improvement and entrepreneurship skills. Extension staff perceive the program as successful in helping farmers increase yield per hectare. However, the goals of integrating hand pollination into routine good agricultural practices (GAP) activities have faced challenges. The efforts and goals of CHPP are generally valued by extension administrators who are committed to the program. Organisational and community characteristics generally favoured the program, but there were inconsistencies in the timely delivery of essential tools. This study offers valuable insights into the program's challenges and opportunities, providing essential information for policymakers and researchers working to improve cocoa production, uplift farmer livelihoods, and address similar agricultural contexts. Addressing challenges, enhancing knowledge sharing, and optimising program elements can ensure cocoa farming's long-term sustainability and success, benefiting local farmers and the cocoa industry as a whole.

Keywords: Artificial pollination, cocoa farming, community involvement, organisational, community characteristics

INTRODUCTION

In the heart of Ghana lies a verdant landscape known for its lush cocoa plantations- a cornerstone of the nation's agricultural economy. Cocoa production in Ghana has a long history of boosting the nation's economy. However, there is growing evidence that insufficient pollination has become a crisis in cocoa production (Claus *et al.,* 2018). Wongaa *et al.* (2021) contend that approximately 90% of cocoa tree flowers drop after blooming, resulting in only around 10% of trees receiving effective natural pollination. These factors have led to a decline in cocoa yields over the years. In response to this issue, the Cocoa Hand Pollination Program (CHPP) was introduced, offering a ray of hope for Ghanaian cocoa farmers. Cocoa hand pollination, also known as artificial pollination, refers to a mechanical process involving human intervention to pollinate cocoa plants. It is employed when natural pollination is limited, to increase both the quantity and quality of pods on cocoa trees (Forbes & Northfield, 2017). Ghana Cocoa Board (COCOBOD) introduced CHPP in 2017 in response to decreases in the economic insects responsible for the natural pollination of cocoa. This was due to bushfires, deforestation, and the frequent spraying of cocoa farms with unapproved chemicals by some farmers. According to reports, the introduction of cocoa hand pollination intervention has complemented the already existing natural means of production and has led to increases in yield (Forbes *et al.,* 2019; Nyamekye, 2021). Hand pollination significantly improves pod production efficiency. Wongnaa *et al.* (2021) discovered that artificial pollination positively affects the well-being of cocoa farmers, underscoring its importance in addressing their welfare concerns. According to Toledo-Hernández *et al.* (2020), cocoa hand pollination can increase yields, benefiting global production and farmers' income. Forbes *et al.* (2019) assert that artificial pollination, irrespective of its level of adoption, leads to a significant cocoa yield increase. Gupta *et al.* (2017) also reported increased yields, improved pod quality, and a faster maturation period as a result of artificial pollination. Sánchez-Estrada & Cuevas (2020) observed that during the season when most trees have abundant flowers, artificial pollination led to a remarkable increase in final pod production, resulting in higher yields and profits.

The future of cocoa production in Ghana hangs in the balance, and the Wassa Amenfi Central District serves as a microcosm of the challenges faced nationwide. The implementation of the CHPP is a critical response to the declining productivity of cocoa farms, and its success or failure will have far-reaching consequences. However, there is a scanty of implementation evaluation studies on agricultural interventions, particularly in the cocoa sector. Again, since its inception in 2017, there is no known implementation evaluation study assessing the progress of CHPP. Hence, the current study seeks to fill this knowledge gap by examining the effectiveness of CHPP and its potential to revolutionise cocoa farming. Specifically, the study seeks to (i) determine farmers knowledge of the goals and objectives of CHPP and how they perceive these to be important, (ii) how cocoa farmers, pollinators and program staff have achieved the goals and objectives of CHPP (iii) the expertise of program staff in operationalising CHPP and (iv) organisational and community characteristics in operationalising CHPP. This research delves into the heart of the CHPP to evaluate its influence on both the Wassa Amenfi Central District and the broader Ghanaian cocoa industry. The findings of this study may hold the key to not only improving the livelihoods of local farmers but also ensuring the sustainability of cocoa farming in Ghana.

The study employs an implementation evaluation framework to assess CHPP as detailed by Abell *et al.* (2015). According to Cummings (1999), five distinct implementation factors come into play: conceptual design, participants, staff, organisational climate, and community. The conceptual design serves as an unverified blueprint of the program, encompassing aspects like the research foundation, objectives, target audience, desired outcomes, vital and adaptable features, procedures, resources, and evaluation plan (Abell *et al.,* 2015). The process of turning the conceptual design into practical program actions is influenced by participants and their alignment with program objectives. Another implementation factor is the program staff. Within this factor, it's important to consider (a) the background of staff members and how it influences their interactions with program participants, (b) the staff's capability to carry out program activities, and (c) the attention given to the professional growth and recognition of the staff. The organizational climate encompasses the overall quality of the work environment for program personnel and the relationships between the program and its sponsoring organisation. Community-level factors are believed to influence the effective implementation of the program. When scrutinising a program's intended objectives within the context of community traits like local values, norms, and behavioural patterns, it becomes possible to gauge whether these factors might pose potential challenges to the program (Abell *et al.,* 2015).

MATERIALS AND METHODS

The study was conducted at Wassa Amenfi Central District of the Western Region of Ghana. The primary economic activity in the district is agriculture. Cocoa is the major cash crop grown in the district, though other cash crops, including rubber and oil palm, are also cultivated in the district. Aside from cash crops, other food crops including tomatoes, garden eggs, rice, maize, plantain, and cassava are produced in the district. Generally, food production is on a subsistence basis with low output per yield. This is mainly a result of the usage of traditional and old farming methods predominated by the usage of holes and cutlasses with minimal mechanization (GSS, 2018). Amenfi Central District is situated in the northern part of the western region and lies between longitudes 2^0 9' W and 2^0 27' W and latitudes 5^0 20' N and 6^0 7' N. The natural vegetation of the district is moist-deciduous agroeco-logical zone. The area experiences two rainfall patterns. The major rainfall (wet season) occurs in May-July and the minor rainfall occurs in September-October. There is a dry spell starting from November to March. The mean annual rainfall ranges between 1200–1500 mm. The mean maximum temperature of the district is 30 ^{0}C and the mean minimum temperature is 22 ^{0}C. The relative humidity is generally high with an annual mean of 80-90% (GSS, 2018).

The current study followed an exploratory research design. The population for the study comprised all cocoa farmers (4570) involved in the cocoa hand pollination program (CHPP), all cocoa hand pollinators (264), and all program staff (30) from COCOBOD in the district. Using the Yamane (1956) formula, 367 cocoa farmers, and 159 pollinators were selected. All the 30-program staff from COCOBOD were selected. The study employed the multistage sampling technique to select the respondents. In the first stage, the district was purposely selected. This is because it is one of the few districts actively implementing CHPP in Ghana (COCOBOD, 2022). This was followed by a simple random sampling of five out of the

ten communities participating in the CHPP. The farmers and the cocoa hand pollinators were sampled using simple random sampling.

Primary data were collected from cocoa farmers, cocoa hand pollinators, and the program staff using structured questionnaires through face-to-face interviews from March to May 2022. Five field assistants who were fluent in the local dialect (Asante Twi) were chosen to support data collection. Before the actual data collection, the questionnaire was pre-tested with thirty (30) cocoa farmers in Wassa Amenfi East Municipal. This helped to test respondents' understanding of the questions. Questions which were seemingly difficult to understand were refined. This study ensured anonymity. Hence, respondents' identity was not disclosed in any form. Moreover, respondents' consent was sought before their participation. Since respondents' participation was voluntary, they had the right to exclude themselves from the study at any point in time they deemed fit. Information was gathered across various aspects, including demographic details of farmers (such as age, sex, educational background among others), farmers' knowledge, their perceived significance, and the degree of agreement on CHPP. The data collection also encompassed the achievements of farmers, pollinators, and extension staff concerning CHPP objectives, the expertise of program staff in managing CHPP, as well as organizational and community characteristics in CHPP operations. A three-point Likert scale was used to measure knowledge (i.e., 1 = no knowledge, 2 = low knowledge and 3 = high) and importance (i.e., 1 = not important, 2 = lowly important and 3 = highly important). Data was analysed using mean and standard deviation. The chi-square test was used to assess the relationship between knowledge and farmers' demographic features. Cocoa farmers, pollinators and extension staff achievements of CHPP goals and objectives; program staff expertise in CHPP operation; and organisational and community characteristics in CHPP operations were all measured on a 5-point likert scale from 1 = strongly disagree to 5 = strongly agree. Mean and standard deviation were used to analyse the data.

RESULTS AND DISCUSSION

Characteristics of Respondents

Table 1 provides a demographic profile of respondents for three different groups: "Farmers," "Pollinators," and "Program Staff". The study showed that 70.9% of the cocoa farmers were more than 40 years old, 92.4% of the pollinators were below 40 years and 73.3% of the program staff were below 40. The working nature of extension activities necessitates the youthful age of the program staff. Activities of the cocoa extension involve farm visits, and field demonstrations, among others, which require strength. Danso-Abbeam *et al.* (2018) reported that extension services provided to farmers include proper way of pruning, pest and disease management, nursery raising, proper use of agrochemicals and artificial pollination. This explains why the cocoa extension personnel are dominated by the youth. The higher age among the farmers can be attributed to the fact that in rural cocoa farming communities, land usually belongs to the elderly, hence their dominance in the study (GSS, 2014). For the farmers, 48.2% have a household size between 5 and 10 while 18.5% have more than 10. Of the program staff, 70% have a household size of less than 5 and 6.7% have more than 10. Of the farmers, 49.0% have 5–10 acres and 8.2% have more than 20 acres. The results further showed that the majority (75.5%) of the cocoa farmers were males. Similar findings were found for the pollinators (67.3% were males) and the

Table 1. Demographic profile of respondents

Variable	Farmers		Pollinators		Program Staff	
	Freq.	%	Freq.	%	Freq.	%
Age						
21 – 30 years	46	12.5	104	65.4	9	30
31 – 40 years	61	16.6	43	27	13	43.3
41 – 50 years	89	24.3	12	7.6	5	16.7
> 50 years	161	46.6	0	0.0	3	10
Household size (persons)						
Less than 5	122	33.3	-	-	21	70
5-10	177	48.2	-	-	7	23.3
More than 10	68	18.5	-	-	2	6.7
Farm size (acres)						
Less than 5	2 2	6.0	-	-	-	-
5-10	180	49.0	-	-	-	-
11-15	102	27.8	-	-	-	-
16-20	33	9.0	-	-	-	-
More than 20	30	8.2	-	-	-	-
Gender						
Male	277	75.5	107	67.3	29	96.7
Female	90	24.5	52	32.7	1	3.3
Education						
No formal education	79	21.53	13	8.20	0	0
Formal education	288	78.47	146	91.80	30	100
Marital status						
Others	85	23.16	114	71.70	6	20.00
Married	282	76.84	45	28.30	24	80.00
Extension access						
Yes	367	100	—	—	—	—
No	0	0				
Access to credit						
Yes	144	39.24	—	—	—	—
No	223	60.76				

Source : Field Data (2022).

program staff (96.7% were males). Two reasons can be attributed to the higher number of male respondents among the farmers. Firstly, males' domination in cocoa production may be attributed to the laborious nature of cocoa production that requires strength (Ankuyi *et al.,* 2023). The male dominance in cocoa production could also be explained by the fact that men traditionally own lands and have easier access to land in most rural communities (GSS, 2014). Regarding education, 78.47% of the farmers, 91.80% of the pollinators, and all (100%) of the program staff have formal education. In addition, a greater number of the farmers (76.84%) and program staff (80.00%) were married, while only 28.30% of the pollinators were married. The higher number of unmarried respondents of the pollinators shows their youthful nature, as more than half (65.40%) were 30 years and below. Every single farmer (100%) has access to extension services, but only 39.24% of them have access to credit.

Farmers' Knowledge and Their Perceived Importance of CHPP

Table 2 presents insights into how well respondents understand the objectives of the CHPP and how important they perceive these objectives to be. The first objective, aimed at increasing yield per hectare from 450 kg to 1000 kg, has a low knowledge score of 1.80, indicating that respondents possess a limited understanding of this objective.

Table 2. Farmers' knowledge and their perceived importance of CHPP

Knowledge			Importance	
Mean	SD		Mean	SD
		Objectives of hand pollination		
1.80	0.35	To increase yield/ha from 450 kg to 1000 kg	2.90	0.47
2.07	0.40	To complement natural pollination by wind and insects	2.84	0.54
		Goals of hand pollination		
2.13	0.42	To increase the overall production volume of cocoa beans	2.81	0.51
2.15	0.40	To improve the socio-economic livelihoods of cocoa farmers	2.54	0.58
1.32	0.53	To increase entrepreneurship among pollinators to offer pollination services to cocoa farmers at a fee	2.32	0.62
1.14	0.61	To encourage ownership of CHPP by the farmers as part of routine farming activities	2.54	0.52
		Activity schedule		
		January		
2.67	0.46	Selection of farms not affected by diseases, not older than 20 years and younger than 7 years	2.61	0.48
		February		
2.71	0.43	Weeding of selected farms	2.70	0.44
		March		
2.70	0.39	Pruning of farms	2.58	0.52
		April		
2.52	0.36	Application of both granular fertilizers and flower-inducing liquid fertilizers	2.75	0.46
2.28	0.51	Provision of logistics (i.e., forceps, PPEs, chemicals, etc.)	2.54	0.51
2.31	0.45	Recruitment of pollinators	2.50	0.44
2.35	0.39	Training of pollinators	2.52	0.56
		May		
2.54	0.38	Commencement of program	2.38	0.62
		June-November		
2.63	0.49	Program continues	2.52	0.57
2.33	0.62	Application of insecticides and fungicides to protect cherelles/pods	2.75	0.47
		December		
2.72	0.43	End of program	2.47	0.48
2.04	0.48	Program evaluation, i.e., feedback from pollinators, farmers and supervisors; farm assessment	2.53	0.47
1.69	0.45	Grand mean	2.70	0.52

Source : Field Data (2022).
Notes : Knowledge scale: 1 = no knowledge, 2 = low knowledge and 3 = high; Importance scale: 1 = not important, 2 = lowly important and 3 = highly important.

Despite this, the perceived importance of this objective is relatively high, with a mean score of 2.90, suggesting that the respondents see enhancing cocoa yield per hectare as crucial for the success of CHPP. Similarly, the objective to complement natural pollination carried out by insects and wind also exhibits a low knowledge score of 2.07, but it is considered important, as reflected by a mean score of 2.84, highlighting the significance of this aspect in the CHPP. The first goal, focused on increasing the overall production volume of cocoa beans, exhibits a low knowledge score of 2.13, suggesting that respondents generally lack awareness of this objective. However, the perceived importance of this goal is relatively high, with a mean score of 2.81, indicating that respondents consider enhancing cocoa bean production to be crucial for the success of CHPP. Conversely, the fourth goal, which aims to encourage cocoa farmers to integrate the intervention as part of routine good agricultural practices (GAP) activities, has the lowest knowledge score of 1.14, signifying a significant lack of awareness among respondents regarding this goal. In a related study, Boyabatlý *et al.* (2019) studied the process evaluation

of agricultural programs and reported that most farmers abandoned agricultural programs, for which they do not get funding. Despite the low knowledge score, the perceived importance of this goal remains high, as reflected in a mean score of 2.54, underscoring the significance of integrating the CHPP into routine farming practices.

The findings reveal that farmers have a strong grasp of the various activities within the CHPP, with mean knowledge scores ranging from 2.28 to 2.75, indicating a high level of understanding. Simultaneously, the "Importance" section demonstrates that respondents, on average, perceive these activities as crucial for the success of CHPP, as indicated by mean importance scores ranging from 2.38 to 2.75. Although the grand mean for knowledge stands at 1.69, suggesting an overall low knowledge level among respondents regarding CHPP objectives and goals, the grand mean for importance is notably higher at 2.70. This implies that while respondents may have limited knowledge about these objectives, they generally recognize and value them as significant components of the program. In sum, these results shed light on the farmers' understanding of CHPP's objectives, goals, scheduled activities, and their perception of their importance, highlighting the importance-focused perspective despite the knowledge gap. From Table 2, the study revealed that the cocoa farmers have low knowledge of the cocoa hand pollination program. This low level of knowledge on the artificial pollination program can be attributed to inadequate information dissemination and inadequate sensitization on artificial pollination carried out by the extension staff. Danso-Abbeam *et al.* (2018) assert that the approach of extension service delivery involves the mode of teaching, training, information dissemination (doctrine), sensitization and demonstrations of improved farming practices.

Association Between Farmers' Demographic Profile and Knowledge of CHPP

From Table 3, there was a significant association between the farmer's education and knowledge of the implementation of cocoa hand pollination ($p = 0.014$). This shows that the farmers with higher education had a higher knowledge of cocoa hand pollination as compared with farmers with low educational levels. Education can expose individuals to best practices in agriculture, which might include the latest techniques for crop management, such as CHPP. Higher education can enhance an individual's capacity to learn and absorb new information. People with more education often have better research skills and a greater ability to understand and apply complex concepts. The finding highlights the importance of addressing the knowledge gap among farmers with lower educational levels through tailored educational and training programs to enhance cocoa farming practices and improve agricultural productivity. Agreeing with this study, Akrofi-Atitianti *et al.* (2018) in their study underlined that lack of education is one hindering factor preventing farmers from adopting and implementing agricultural policies or programs. The study further showed a significant relationship between respondent's farm size and knowledge of the implementation of cocoa hand pollination ($p = 0.022$). The finding suggests that respondents with larger cocoa farms are more likely to have greater knowledge of CHPP. This could be because larger farms often require more advanced farming techniques to maintain and increase productivity. Farmers with smaller farm sizes on the other hand may not take the cocoa hand pollination seriously as they assume that due to their smaller farm sizes, the program may not have any substantial impact on their cocoa production levels. Similar results were found by Simtowe *et al*. (2016) who reported

Table 3. Association between the farmer's demographic profile and knowledge of CHPP

Demographic profile	Knowledge of CHPP	
	Chi^2	Sig
Age	2.644	0.136
Gender	2.110	0.128
Education	8.603	0.014 **
Marital status	2.751	0.104
Farm size	8.114	0.022 **
Household size	7.672	0.030 **
Access to extension service	2.161	0.216
Access to credit	7.461	0.032 **

Source : Author Construct (2022); ** is significant at 5% level.

in their study that farmers with bigger farm sizes tend to have knowledge and further participate in agricultural innovation.

In addition, household size had a significant association with farmers' knowledge of CHPP ($p = 0.030$). The finding may suggest that farmers from larger households are more likely to have greater knowledge of CHPP. The cocoa hand pollination requires labor and farmers with larger household sizes are more capable of providing labor for the program, hence, they will be keener on the program, thereby increasing their knowledge level. The study showed that there was a significant association between the farmer's access to credit and knowledge of the implementation of CHPP ($p = 0.032$). This shows that farmers who have access to credit are capable of hiring pollinators to pollinate their farms for them. This will enable the farmer to be aware of the program goals, objectives and activity schedule. Asigbaase (2019) reported that when farmers have access to credit, they can pay for agricultural innovation.

Cocoa Farmers' Achievement

Table 4 revealed that the cocoa farmers had achieved an increase in cocoa yield per hectare (mean = 4.11). This can be attributed to the fact that one hectare of the cocoa farms of each farmer was pollinated by the cocoa health and extension division (CHED) for free, thereby increasing the cocoa yield per ha of the cocoa farmers. However, the cocoa farmers have not been able to increase their overall cocoa production (mean = 2.38). This can be because the cocoa farmers did not carry out pollination on their farms as a routine GAP activity after CHED officers pollinated one hectare of their cocoa farms for them. In the case of artificial pollination, the farmers after the program demonstration are to pay pollinators for their farms to be pollinated and they (farmers) are also to carry out the artificial pollination as routine GAP activity. The farmers could not do the above, mainly due to the cost involved. In rural areas, farmers hardly pay for agricultural innovation, thereby sticking to their old practices (Levis *et al.,* 2017). The assessment of activity schedules reveals that farmers weed (mean = 4.38) and prune (mean = 4.22) their farms before the commencement of CHPP indicating their commitment to these practices. The overall mean index for achievement is 3.38, indicating a moderate level of success. This suggests that, on average, farmers have achieved the program's goals and objectives to a reasonable degree, although there is room for improvement in certain areas.

Pollinators' Achievement

Table 5 provides an assessment of pollinators' achievement of CHPP goals, objectives, and activities. Regarding the program's objectives, pollinators indicate that they feel they have been successful in adding to natural pollination by insects and wind, aligning

well with the program's objective (mean = 4.18). In contrast, they disagreed with the goals related to socioeconomic livelihood improvement (mean = 2.17), the enhancement of entrepreneur skills (mean = 2.37) and offering pollination services to cocoa farmers at a fee (mean = 2.14). This could be due to the lack of interest, potential drawbacks or challenges associated with CHPP among the participants. The assessment of activity schedules shows that pollinators were trained before commencing pollination (mean = 4.42) and they were provided with logistics before the program's commencement (mean = 4.23). The overall mean index for achievement across all objectives and activities is 3.41. This suggests that, on average, pollinators agree that they have achieved the program's objectives and activities reasonably well, with stronger performance in logistics provision and training, while goals related to socioeconomic improvement and entrepreneurship skills exhibit room for improvement.

Program Staff Expertise in Managing CHPP

Table 6 offers an overview of the specialisation of extension staff in CHPP operations. The statement with the highest rating in the social context category is "I am committed to the program objectives" (mean = 4.65). Consequently, program staff strongly affirm their dedication to the program objectives,

Table 4. Cocoa farmers' achievement of CHPP goals and objectives

Achievement of program goals, objectives and activities	Mean	SD
Objectives		
I have been able to increase yield per hectare	4.11	0.53
Goals of the hand of hand pollination		
I have increased my overall production of cocoa	2.38	1.02
I can carry out pollination on my farm as a routine farming activity	2.14	1.31
Activity schedule		
I only allow pollination on my farms that are aged 7-20 years	2.55	1.08
I do not allow pollination on my CSSVD-infected farms	3.42	0.85
I weed my farms before the commencement of the program	4.38	0.41
I prune my farm before the commencement of the program	4.22	0.44
Both granular fertilisers and flower-inducing liquid fertilisers are applied before commencement of the program	3.62	0.87
I apply insecticides and fungicides to protect cherelles and pods	4.01	0.45
Farm assessment is done by the program supervisors	2.96	1.14
Overall mean index	3.38	0.81

Source : Field Data (2022).
Note : Strongly disagree = 1, Disagree = 2; Neutral = 3, Agree = 4, Strongly agree = 5.

Table 5. Pollinators' achievement of CHPP goals and objectives

Achievement of program goals, objectives and activities	Mean	SD
Objectives		
I have been able to add up to natural pollination by insects and wind	4.18	0.37
Goals of hand pollination		
My socioeconomic livelihood had improved through hand pollination	2.17	1.24
My entrepreneurial skills in pollination have increased	2.37	1.04
I offer pollination services to cocoa farmers at a fee	2.14	1.27
Activity schedule		
I am provided with logistics (i.e., forceps, PPEs, chemicals, etc.) before the commencement of the program	4.23	0.35
I was trained as a pollinator before the commencement of the program	4.42	0.28
Forceps are collected back at the end of the program	4.35	0.30
Overall mean index	3.41	0.69

Source : Field Data (2022).
Note : Strongly disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly agree = 5.

highlighting the critical role of commitment in CHPP's success. Following closely is the statement "I am aware of farmers' strengths and challenges" (mean = 4.55). Once again, extension staff express strong agreement in their awareness of farmers' strengths and challenges within CHPP. This heightened awareness of these factors is pivotal in delivering effective support and guidance. Additionally, program staff emphasise their substantial professional experience in implementing CHPP (mean = 4.85). This statement indicates that extension staff believe they possess the necessary experience for their roles. This is a positive sign as relevant experience is crucial for effective program implementation. With regards to staff-program match, the statement with the highest mean is "I am committed to the artificial pollination program" (mean = 4.75). This high mean rating indicates the extension staff's strong commitment to the success of the artificial pollination program, which is a key aspect of their work. This is followed by "I am made aware of the impact of my work on artificial pollination" (mean = 4.58). Quality Working Relationships [cooperation (mean = 4.38), division of labor (mean = 4.29) and decision making (3.94)] indicate positive working relationships and cooperation among staff, which is essential for efficient program management. The overall mean index (mean = 4.05) is relatively high, indicating that, on average, extension staff have a positive perception of their specialisation in CHPP operations.

Extension Staff Achievement

Table 7 presents the achievement of program goals and objectives by extension staff in the context of CHPP. Extension staff perceive that the program has been relatively successful in helping farmers increase their yield per hectare (mean = 4.11). This is a positive result, as it aligns with one of the primary objectives of CHPP. "Pollinators have been able to add up to natural pollination carried out by insects and wind" (mean = 2.41)

Table 6. Specialisation of extension staff in CHPP operations

Statements	Mean	SD
Social context		
I have relevant professional education	4.46	0.44
I have a relevant level of professional experience	4.48	0.43
I am committed to the program's objectives	4.65	0.52
I know the community	4.33	0.67
I know the participants' values and beliefs	4.01	0.61
I respect participants' values and beliefs	4.26	0.59
I am aware of farmers' strengths and challenges	4.55	0.53
I listen and respond to the needs and inputs of participants	4.38	0.76
Staff-program match		
I am committed to the artificial pollination program	4.75	0.41
I have quality working relationships in terms of cooperation	4.39	0.46
I have quality working relationships regarding the division of labor	4.29	0.41
I have quality working relationships in terms of decision-making	3.94	1.03
I persist in my efforts when encountered with discouraging events	4.09	0.31
I provide job performance feedback	4.03	0.72
I am made aware of the impact of my work on the artificial pollination	4.58	0.64
There are rewards for the accomplishment of my -work	2.43	1.35
I receive sufficient and regular training on artificial pollination	2.52	1.28
I offer regular and sufficient training to pollinators and farmers	2.85	1.07
My professional growth is enhanced by the program	3.98	0.94
Overall mean index	4.05	0.69

Source : Field Data (2022).
Note : Strongly disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly agree = 5.

received a lower mean rating, indicating that extension staff have a less positive view of the pollinators' contribution to augmenting natural pollination. The lower rating may suggest that this objective has not been as successfully achieved. Both of the statements concerning goal achievement received low mean ratings, indicating challenges in meeting the program's objectives. Specifically, the goal of increasing overall cocoa production (mean = 2.39) has not been effectively realised, and the effort to establish hand pollination as a routine Good Agricultural Practices (GAP) activity (mean = 2.25) has faced difficulties. On the activity schedule, the statement "pollinators are provided with logistics before the program (mean = 4.19)" and "pollinators are trained on hand pollination before the program (mean = 4.12)" received relatively high mean ratings, indicating that logistics provision and training for pollinators are well-implemented. The statement "pollination is done on farms aged 7-20 years" received a relatively high mean rating of 4.01, indicating that extension staff believe that pollination is being carried out effectively within the specified age range of farms. This suggests adherence to program guidelines. As per the findings of Toledo-Hernández *et al.* (2017), cocoa farms exhibit better health and yield optimal results when they fall within the age range of 7-20 years. This, in turn, enhances the effectiveness of artificial pollination. The statements "farmers are compelled to weed their farms before the program (mean = 4.14)" and farmers are compelled to prune their farm before the program (mean = 4.02)" indicate that extension staff believe that farmers are complying with weeding and pruning requirements. This is important for preparing farms for effective pollination. The overall mean index of 3.67 suggests that, on average, extension staff perceive some level of achievement in the program's goals and objectives.

Table 7. Extension staff achievement of CHPP goals and objectives

Achievement of program goals, objectives and activities	Mean	SD
Objectives		
Farmers have been able to increase yield per hectare	4.11	0.68
Pollinators have been able to add up to natural pollination carried out by insects and wind	2.41	0.95
Goals of the hand of hand pollination		
Farmers have increased their overall production of cocoa	2.39	1.05
Farmers carry out pollination as a routine farming activity	2.25	1.14
Activity schedule		
Pollination is done on farms aged 7-20 years	4.01	0.71
CSSVD farms are excluded from artificial pollination	4.12	0.64
Farmers weed their farms before the commencement of CHPP	4.14	0.61
Farmers prune their farms before the commencement of CHPP	4.02	0.70
Farmers apply both granular fertilisers and flower-inducing liquid fertilisers before commencement of CHPP	3.82	1.08
Pollinators are provided with logistics (i.e. forceps, PPEs, chemicals, etc.) before the commencement of CHPP	4.19	0.57
Pollinators are trained on hand pollination before the commencement of CHPP	4.12	0.71
Farmers apply insecticides and fungicides to protect cherelles/pods	3.61	1.01
Farm assessment is carried out by extension officers after the hand pollination program	4.17	0.61
Forceps are collected back from the pollinators at the end of CHPP	4.05	0.78
Overall mean index	3.67	0.80

Source : Field Data (2022).
Note : Strongly disagree = 1, Disagree = 2; Neutral = 3, Agree = 4, Strongly agree = 5.

Organisational Characteristics in CHPP Operations

Table 8 provides the program staff's overview of various organisational characteristics in the context of CHPP operations. The high mean score for "Efforts/goals of CHPP is valued by the CHED office" (mean = 4.33, SD = 0.64) reflects a strong consensus that the efforts and goals of CHPP are valued by the CHED office. The high mean score for "Extension administrators are committed to the program" (mean = 4.24, SD = 0.68) implies that extension administrators are generally committed to the CHPP program. The low mean score and high standard deviation for "There are monetary rewards for staff" (mean = 2.37, SD = 1.28) indicate a lack of consensus on the presence of monetary rewards for staff. This suggests that some employees may not feel adequately compensated for their work. The overall mean index of 3.72, is relatively positive, indicating that, on the whole, the organisational characteristics within CHPP operations are favourable. Maffioli *et al.* (2013) argue that not providing job performance feedback always and at the appropriate time by institutions can slow down any agricultural innovation technology including artificial pollination.

Community Characteristics in CHPP Operations

Table 9 provides valuable insights into various community characteristics related to the CHPP operation. It was agreed that there is diversity in the program (mean = 4.42, SD = 0.58). The strong agreement suggests that the program is successful in including people from different ethnic groups, which can enhance diversity and inclusivity. Respondents disagreed that cocoa should be pollinated naturally (mean = 2.14, SD = 1.24). The study further revealed that there is strong agreement that labor for cocoa hand pollination is readily available (mean = 4.17, SD = 0.71), indicating a positive aspect of the program. There's disagreement regarding whether pollen cups and forceps are delivered on time (mean = 2.73, SD = 0.96). Disagreement on the timely delivery of essential tools such as pollen cups and forceps can indicate potential inefficiencies in the supply chain or logistical aspects of the CHPP program. If tools are not delivered on time, it can disrupt the pollination process and impact cocoa production. In program implementation, unavailability and late arrivals of program materials and equipment restrict the successful implementation of the program (Krishnan & Patnam, 2014). Community members are generally aware of and concerned about CHPP (mean = 3.56, SD = 0.98; mean = 3.34, SD = 1.04), indicating their engagement and

Table 8. Organisational characteristics in CHPP operations

Statements	Mean	SD
Workplace issues are handled professionally	4.12	0.71
Job performance feedback is provided always	3.94	1.01
Staff are rewarded through promotion	2.48	1.25
There are monetary rewards for staff	2.37	1.28
The regional extension office is involved in the CHPP	4.07	0.72
Efforts/goals of CHPP are valued by the CHED office	4.33	0.64
There are efforts to improve or build relationships among staff	3.82	0.94
Local extension office shows support for the program	4.16	0.70
Extension administrators are committed to the program	4.24	0.68
Overall mean index	3.72	0.88

Source : Field Data (2022).
Note : Strongly disagree = 1, Disagree = 2; Neutral = 3, Agree = 4, Strongly agree = 5.

Table 9. Community characteristics in CHPP operation

Statements	Mean	SD
Taboos, beliefs and diversity		
Cocoa hand pollination is not done on some taboo days	2.51	1.15
Farmers generally believe that cocoa should be pollinated naturally	2.14	1.24
The program comprises people from different ethnic groups	4.42	0.58
The program comprises people from different geographical locations	2.44	1.08
The program comprises people from different social class	2.75	0.92
The program faces challenges due to the diversity of people	2.86	1.21
Religious worship days (such as Fridays for Muslims and Saturdays for Adventists) affect CHPP	2.61	1.01
Resources		
There are enough pollen cups and forceps for the transfer of pollen grains	2.82	1.05
Pollen cups and forceps come on time	2.73	0.96
Labor for the cocoa hand pollination is readily available	4.17	0.71
Cocoa rehabilitation program (CRP) competes with the CHPP for funding	3.55	1.01
Community members' participation in other additional livelihood activities (i.e. mining, livestock production, etc.) affects CHPP	3.12	1.08
CRP compete with CHPP for extension officers	3.65	0.96
CRP program competes with CHPP for labor and participants	3.08	1.14
Community involvement		
The beneficial communities value/support the goals of the program	3.60	0.95
The program addresses the concerns of the community	3.26	1.20
Community members are aware of the goals of CHPP	3.56	0.98
Community members are concerned about the goals of CHPP	3.34	1.04
Community members actively engaged with the goals of CHPP	3.61	0.96
Community leaders advocate for resources for CHPP	2.17	1.32
Community leaders make an effort to promote CHPP	2.38	1.15
Community leaders influence public opinion on CHPP	2.31	1.20
The climate (high temperature and low rainfall) influences people to participate in the hand pollination	3.25	1.12
Low cocoa production influences participation in CHPP	3.70	0.81

Source : Field Data (2022).
Note : Strongly disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly agree = 5.

support. There's disagreement with the active involvement of community leaders (mean = 2.17, SD = 1.32; mean = 2.38, SD = 1.15; mean = 2.31, SD = 1.20), suggesting they may need more encouragement to support CHPP. The variations in responses also indicate that community leaders' influence varies. In the rural settings in most Ghanaian communities, opinions of community leaders influence people's participation in innovative programs, hence their low level of involvement in artificial pollination is an indication that the program will not yield the anticipated results (Teye, 2012). The responses show a tendency towards agreement (mean = 3.25, SD = 1.12; mean = 3.70, SD = 0.81), indicating that environmental factors, including high temperature and low rainfall, influence people's participation in hand pollination, and low cocoa production influence CHPP participation.

To further enhance the Cocoa Hand Pollination Program's effectiveness and achieve its broader goals, it is imperative to prioritise raising awareness and knowledge among cocoa farmers about CHPP's objectives. This can be achieved through organised training sessions and workshops designed to educate farmers on the program's benefits, particularly its capacity to increase cocoa yields. Recognizing the correlation between farmers' education levels and their understanding of CHPP, tailored educational initiatives should be introduced to target those with lower educational backgrounds, enhancing their comprehension of the program's potential advantages. Additionally, there is a need to improve communication and information dissemination regarding CHPP, ensuring farmers are well informed about its comprehensive scope and objectives. The

demonstrated commitment of program staff should be both nurtured and incentivized to sustain the program's success. Timely delivery of essential tools and materials, such as pollen cups and forceps, must be prioritised to prevent supply chain inefficiencies from disrupting the pollination process.

CONCLUSIONS

The research has shown that while there is a significant lack of awareness among cocoa farmers about the objectives and goals of CHPP, they overwhelmingly recognise the importance of these objectives for the success of the program. Additionally, the study reveals that cocoa farmers have experienced notable increases in cocoa yield per hectare, and there is evidence of successful implementation of CHPP activities such as weeding and pruning. Pollinators, who play a key role in the CHPP, have contributed effectively to the goal of supplementing natural pollination, though the program's socio-economic goals and fee-based pollination services face challenges. On the other hand, extension staff exhibit a strong commitment to the program's objectives and activities, with a focus on their awareness of farmers' strengths and challenges. The organizational and community characteristics related to CHPP operations appear relatively favourable, emphasising the value of diversity in the program but also revealing issues with the timely delivery of essential tools and the limited involvement of community leaders. The study highlights the significance of education, farm size, household size, and access to credit in influencing farmers' knowledge of CHPP, which could inform targeted interventions to enhance understanding among farmers.

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