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## FARMERS' ACCESSIBILITY AND USE OF HYBRID COCOA SEEDLINGS FOR COCOA REHABILITATION: EMPIRICAL RESULTS FROM AMENFI CENTRAL DISTRICT, GHANA

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### ABSTRACT

The introduction of hybrid seedlings of cocoa by the Ghana Cocoa Board (COCOBOD) was intended to replace old and diseased trees which were less productive. We conducted a study to investigate the accessibility and use of hybrid cocoa seedlings (Series II, the Modified Series II, Inter Amazon, Trinitario, Clones, Criollo and Nacional) for the cocoa rehabilitation exercise. Working with 385 cocoa farmers selected from the Amenfi Central District using the multi-stage sampling technique, we analyzed the data with statistical tools such as the mean, standard deviation, frequency, percentage, multiple linear regression and chi-square test of independence. Based on the general perception of the cocoa farmers (PI=3.71), we found that they had positive perceptions of the improved hybrid cocoa seedlings. Cocoa farmers' access to all the hybrid cocoa seedlings is significantly associated with their use ( $P \leq 0.05$ ). We also found that cocoa farmers who were highly experienced and had small farm sizes had more access to and used hybrid cocoa seedlings ( $P \leq 0.05$ ). While, access to labour and ownership of lands had influence on access to hybrid cocoa seedlings ( $P \leq 0.05$ ), high yields and membership of cooperatives had influence on the use of hybrid cocoa seedlings ( $P \leq 0.05$ ). The lack of access to credit is indicated by farmers as their most severe challenge in accessing and using hybrid seedlings. The outcome of the study suggests that the cost of the hybrid seedlings must be subsidized and the distribution of the seedlings must be done through the farmer cooperatives to enhance accessibility and use.

### KEY WORDS

Accessibility, cocoa farmers, Ghana, hybrid cocoa seedlings, rehabilitation.

Over the years, the cocoa industry has benefitted from a variety of government initiatives that have aided in its expansion. The Cocoa Rehabilitation Program which was established in 1984 to offer farmers improved seeds or seedlings are a typical example. Hybrid seeds were introduced, which provide better yields in less time while also having the ability to fend off diseases that affect cocoa trees when good agronomic practices are followed (AsokoInsight, 2021). Therefore, pulling down sick trees, treating farms, and establishing disease-tolerant, early-bearing, high-yielding cocoa types are all steps in the rehabilitation of cocoa (Ghana Cocoa Board, 2020). Due to the importance of cocoa in the country, rehabilitation of cocoa is usually executed nationwide through the direct enforcement of COCOBOD to cut-down all diseased cocoa trees for the replanting of new hybrid cocoa seedlings (Oppong, 2015). By implementing more pragmatic policies and programs to assist the efficient production and distribution of cocoa seedlings to farmers, the government has been working diligently over time to enhance the distribution of free cocoa hybrid seedlings (Attipoe et al., 2021).

The illness known as the Cocoa Swollen Shoot Virus Disease, which has affected cocoa plants nationally throughout the years, was one of the major issues in the cocoa business that required the rehabilitation of cocoa (CSSVD). In 2020, nationally about 315,886 hectares out of total of 1.9 million hectares of cocoa was lost to Cocoa Swollen Shoot Virus Disease (CSSVD), and production was seriously affected such that production



declined especially in the major producing areas in the country (Ghana Cocoa Board, 2020). Hence, farmers' easy access and use of improved varieties of cocoa seedlings such as hybrid cocoa seedlings can help to mitigate some of the challenges facing cocoa production.

One of the most significant agricultural inputs is seed or seedlings. Because of this, access to high-quality seed or seedlings is one of the resources that have the greatest impact on agricultural output, hence enhancing the sustainable production of food (Asare, 2010; Asare et al., 2016). Before 2012, many cocoa trees in Ghana were 50 years old, which seriously reduced the output of the growers (Laven and Boomsma, 2012). A program to provide 20 million hybrid seedlings was started by COCOBOD in 2012 with the goal of replacing 20% of the cocoa trees on each farm (Kolavalli and Vigneri, 2018). The Ghana Cocoa Board's Seed Production Division successfully cultivated 92 million hybrid cocoa seedlings for the 2020–2021 cocoa season. All of these efforts in the rehabilitation process are intended to ensure that farmers can harvest their beans for sale and as well as to boost the nation's production capacity to fulfil the 1 million metric tonne production target (Ghana Cocoa Board, 2020). The introduction of hybrid seed or seedlings was intended to replace old trees which were susceptible to disease and were less productive. The ultimate aim was to improve production and livelihood of cocoa farmers through the cocoa rehabilitation (Ghana Cocoa Board, 2020; Asare, 2010).

Despite government efforts in reaching out to cocoa farmers in order to have access and use various hybrid varieties or seedlings, access to these planting materials still remains a challenge among cocoa farmers (Asare et al., 2016; Aikpokpodion and Adeogun, 2011). Since most farmers in West Africa (including Ghana) obtain the majority of their seeds or seedlings from unofficial sources, poor access to and usage of improved seeds has jeopardised agricultural yields and productivity. The utilisation of seeds from farmers has typically led to substantial seedling mortality, which presents difficulties for cocoa rehabilitation programs throughout the subregion (Asare et al., 2016).

The expected utility theory suggests that farmers would opt to utilise an upgraded technology if they believe it will be more advantageous than a traditional technology. Farmers' decisions about the deployment of hybrid seedlings will be influenced by their subjective judgements of its benefits and risks (Tinh et al., 2019). The theory of access is another lens for analysing the mechanism of control, power, and access of the seed. This access theory states that one can access resources or services thanks to their power or authority.

The extant literature abounds with various studies on factors influencing the adoption of technologies. Vekua (2013) found that the access and use of cocoa hybrid seedlings are influenced by socio-economic characteristics in Ghana, which are also a key determining factors for the success of cocoa rehabilitation. The adoption of cocoa technology is influenced by gender, household sizes, age of cocoa farms, as well as access to extension services and funding (Djokoto et al., 2016), education level, information source (Ilesanmi and Afolabi, 2020; Bosompem, 2019), experience, income, secondary occupation, proximity to an agro-input shop (Avane et al., 2021), size of the farm, farmers' visits to demonstration sites, farmers' location and membership in a farmer-based organization (Avane et al., 2021, Kehinde et al., 2021), farmers' age and level of farming expertise (Akinwale and Folarin, 2018).

Asare et al., (2016) looked at the access to improved hybrid seeds in Ghana but rather concentrated on the survival rate of the hybrid seedlings and the factors that influenced it. Wiredu et al., (2011) discovered that those who adopted hybrid cocoa types had an increase in output of 320 kg per hectare. Axmann et al., (2020) in Uganda also looked at the access and adoption of hybrid seeds and found that 16% of those who were offered hybrid seeds averaged adoption of hybrid seeds by 8% compared to those who did not receive that offer.

In developing countries such as Ghana access and use of various hybrid seedlings or seeds remains a big challenge in the agricultural sector such as the cocoa industry (Gakpo, 2019) affecting the productivity and/or livelihood and diseases control. Despite the availability of the aforementioned studies, there is no or very limited studies on farmers' access and use cocoa hybrid seedlings with specific reference to the cocoa rehabilitation program in Ghana.



It is on this premise that this study is being conducted to access smallholder farmers' perception of improved hybrid cocoa seedlings accessibility, assess the relationship between accessibility to and use of hybrid cocoa seedlings, determine the factors that contribute to cocoa farmers' access to and use of hybrid cocoa seedlings and ascertain the constraints smallholder cocoa farmers faces in accessing and using improved hybrid cocoa seedlings. This will be necessary to improve the accessibility to hybrid cocoa seedlings and farmers' use of the seedlings for a successful rehabilitation of cocoa farms.

## METHODS OF RESEARCH

The Amenfi Central District in Ghana's Western Region served as the study's location. The Wassa Amenfi West District is one of the twenty-two (22) Districts in the Western Region of Ghana. It is surrounded by the districts of Bibiani - Ahwiaso Bekwai to the north, Prestea Huni Valley to the south, Wassa Amenfi West to the south-west, Aowin to the west, and Upper Denkyira West to the north-east. The district's administrative centre is at Manso-Amenfi. The district's primary economic activity is agriculture. The bulk (77.4%) of the economically active labour force is employed by this sector. The main cash crops cultivated are rubber, oil palm, and cocoa. The main food crops produced are tomatoes, cassava, plantains, maize, and rice. The Amenfi Central District is among the wettest regions of the nation, with annual rainfall averages between 1500mm and 2200mm.

The plan that guided the researchers to sample, collect, analyse and interpret the data involved quantitative research design (Park and Park, 2016). The population of this study included all cocoa farmers within the Amenfi Central District of the Western Region. A multi-stage sampling method was used in this study, thus, at the first stage, a simple random sampling technique was used to select the study area. Secondly, a purposive sampling technique was used to select three (3) communities (Nkwantanang, Bonuama and Amuni) in the district. The purposive sampling of these three (3) communities is because they serve as areas very far from the production sites of hybrid cocoa seedlings within the Amenfi District. At the third stage, a simple random sampling technique was used to select the individual respondents in the three selected communities.

With the use of the Cochran's formula, the sample size for the study was determined since the number of cocoa farmers in the district is unknown. Thus:

$$n = \frac{Z^2 pq}{e^2} = \frac{(1.96)^2 (0.5)(0.5)}{(0.05)^2} = 385 \text{ farmers}$$

Where: n =the sample size; z= desired confidence level; p= maximum variability; q = 1-p; e = desired level of precision (95%).

As shown in the calculation above, a total of 385 cocoa farmers were covered in the study. The researcher utilized only primary data in achieving the objectives of the study. The primary data were obtained using structured questionnaire focusing on the objectives of the study. Prior to the administration of the questionnaire, the objectives of the study were intensively explained to the cocoa farmers in local language (Twi) and their informed consent was obtained. This was done to get reliable responses on different variables that were collected.

Completed questionnaires were coded and processed and subjected to various statistical analyses tools using STATA and Microsoft Excel. This study defined access as the ability to benefit from hybrid seedlings while use was defined as the actual application of the hybrid seedlings (Ribot and Peluso, 2003). Descriptive statistics such as frequencies, percentages, means and standard deviations were used. The chi-square test of independence, multiple linear regression (ordinary least square) and Kendall's coefficient of concordance were used to test for statistical significant relationships and associations. The Kendall's Coefficient of Concordance was used to constraints and is given as:

$$W = \frac{12(\sum D^2)}{m^2(N)(N^2-1)}$$



Where:  $D = R - A$ ;  $N$  = total number of challenges being ranked;  $M$  = total number of respondents;  $R$  = sum of ranks given to a particular challenge;  $A = \frac{\sum R}{n}$ .

## RESULTS AND DISCUSSION

Table 1 displays the results of the findings on the demographic characteristics of the farmers.

Table 1: Demographic Characteristics of Respondents

Variable	Description	Mean	Std. Dev.	Min	Max
Sex	1 if respondent is male and 0 otherwise	.743	.437	0	1
Marital Status	1 if respondent is married, 0 otherwise (single, divorced, widowed)	.701	.458	0	1
Age	Age of respondent in years	35.73	1.6	30	69
Household size	Number of household members	6.903	3.831	2	34
Years of formal education	Number of years in formal education	5.598	4.745	0	30
Access to land	1 if respondent has access to land, 0 otherwise	.985	.121	0	1
Land tenure system	1 if respondent owns land, 0 if otherwise (rent, inheritance, sharecropper)	.728	.445	0	1
Experience in farming	Years of experience in farming	2.474	.95	1	14
Cocoa farm size (ha)	Land size of cocoa farm in hectares	6.437	3.246	1	27
Number of bags harvested	Number of bags of cocoa beans harvested last season	7.263	5.361	1	27
Cooperative member	1 if respondent is a member of a cooperative, 0 otherwise	.905	.293	0	1
Extension access	1 if respondent has access to extension, 0 otherwise	.819	.385	0	1
Credit access	1 if respondent has access to credit, 0 otherwise	.017	.129	0	1

Source: Field Data, 2022.

The majority of the respondents are males (74.3%). This may be indicative of the gender and family dynamics in the cocoa farming district. Traditionally, males dominate cocoa production in Ghana unlike women (Avane et al., 2022). Also, this could be due to male farmers embarking on almost all activities in the farm and the female farmers mostly involved in selling the finished goods. According to Awunyo-Vitor *et al.*, (2016), the women are mostly involved in reproductive roles or domestic roles such as child caring, cooking of meals, washing and cleaning and others, thereby reducing their time available for the production purposes. Also, a limited number of women in a lot of countries (Ghana included) have access and control production resources such as land, credit, technical services and information (Boateng, 2016). The result is in line with Awudzi et al., (2016), and Hainmueller et al., (2011) who found the majority of cocoa farmers to be males.

Hainmueller et al., (2011) estimated that 76% of all cocoa growers in Ghana are married. This is consistent with the study's findings, which show that 73.8% of respondents are married. The fact that most cocoa farmers are married is seen as a sign of responsibility and the capacity to work the land to provide for the family's food needs and other domestic needs (Naamwintome and Bagson 2013).

The average age of the respondents is 35.73 years, with a standard deviation of 1.6 and a range from 30 to 69 years. With the respondents having a relatively low average age and a wide range of ages, which could indicate that cocoa farming is a career pursued by people of various ages. The average household size of the respondents is 6.903, with a standard deviation of 3.831 and a range from 2 to 34. The relatively large average household size and a wide range in household sizes suggest that cocoa farming is a significant source of income for many families. The average household size in this study is comparable to the average size of 6.3 obtained by Wongnaa et al., (2022) in their survey of Ghanaian cocoa growers. In Oyo State, Nigeria, Adebiji & Okunlola (2013) stated that 76.7% of cocoa growers have households with six or more members, which is largely consistent with this finding. This suggests that because the respondents' households were relatively large, there is a strong likelihood that labour will be available for both on- and off-farm activities, lessening the labour problems associated with cocoa production (Wongnaa et al., 2022).

The average number of years of formal education for the respondents is 5.598, with a standard deviation of 4.745 and a range from 0 to 30. The relatively low average number of years of formal education and a wide range in educational attainment gives indication that formal education is not necessarily a requirement for success in cocoa farming. This can however have an impact on how they make decisions, gather and use information because



educated people are assumed to be more capable at performing certain tasks and roles with greater competency, as well as gathering and transforming available information and differentiating between favorable and unfavorable investment areas (Adeniyi and Ogunsola, 2014).

Almost all of the respondents (98.5%) have access to land. The majority of the respondents (72.8%) own their land. The high proportion of respondents with access to land suggests that land availability may not be a significant barrier to cocoa farming in the study area. This may also indicate a higher level of security and control over their farming operations. The average number of years of experience in farming for the respondents is 12.474, with a standard deviation of 0.95 and a range from 1 (one) to 14. The relatively high average number of years of experience in farming and a wide range in farming experience, could indicate that there is a mix of experienced and new farmers in this group.

The average cocoa farm size for the respondents is 6.437 hectares, with a standard deviation of 3.246 and a range from 1 (one) to 27 hectares. The average number of bags of cocoa beans harvested by the respondents in the last season is 7.263, with a standard deviation of 5.361 and a range from 1 to 27 bags. The relatively small average cocoa farm size (6.437 hectares) and number of bags harvested (7.263) gives an indication that the respondents are mostly small-scale farmers, but the relatively wide range in farm sizes could suggest that there are both small-scale and larger-scale cocoa farms.

The majority (90.5%) of the cocoa farmers were members of cooperatives. The high proportion of respondents who are members of a cooperative (90.5%) indicates that cooperatives may play a significant role in the cocoa farming community. Majority of the respondents (81.9%) have access to extension services. The majority of respondents has access to extension services, may indicate that extension services are widely available and utilized in the study area. Farmers having access to extension services would help to provide farmers with technical advice, supplying them with the necessary inputs and services to support their production, providing information and disseminating to farmers new improved farming techniques from researchers, and generally, providing indispensable components needed to improve upon the productivity of farmers and regular access to extension service will help farmers in accessing information in a cost-effective and timely manner, and getting precise information (Avilesh et al., 2017). Only a small percentage (1.7%) of the cocoa farmers had access to credit and this could suggest that credit may be a limited resource for cocoa farmers in the district.

Table 2 presents the findings on the perceptions of the farmers regarding the use of improved hybrid cocoa seedlings in comparison to the traditional varieties. The table includes responses to 11 statements about hybrid cocoa seedlings, with each statement having five possible responses ranging from "strongly agree" to "strongly disagree." The table also includes the percentage of respondents who chose each response option and the mean score for each statement.

Smallholder farmer's access to improved seed varieties is critical in boosting production (Ayamga, 2018). This is why it is crucial to assess cocoa farmers' perception on the hybrid cocoa seedlings. For the statement "Hybrid cocoa seedlings increase the number of pods per plant", 32.2% of respondents strongly agreed with this statement, while 66.9% agreed. Only 0.8% were neutral and there were no respondents who disagreed or strongly disagreed. This suggests that the majority of farmers surveyed believe that hybrid seedlings lead to an increase in the number of pods per plant. The mean score for this statement was 4.31, meaning farmers agreed.

With respect to the statement that hybrid cocoa seedlings increase the number of seeds per fruit, 29.7% of respondents strongly agreed with this statement, while 66.9% agreed. This suggests that the majority of farmers surveyed believe that hybrid seedlings lead to an increase in the number of seeds per fruit. The mean score for this statement was 4.26, meaning, farmers agreed.

For the statement that hybrid cocoa seedlings increase cocoa farm yields, it was found that 24% of respondents strongly agreed with this statement, while 71.6% agreed. This suggests that a majority of farmers surveyed believe that hybrid seedlings lead to an increase in cocoa



farm yields. The mean score for this statement was 4.19. Aikpokpodion and Adeogun (2011) agree that a lack of access to improved planting materials will compromise yields of cocoa. For the statement that hybrid cocoa seedlings increase farmers' income, the results show that 15.2% of respondents strongly agreed with this statement, while 78.9% agreed. This suggests that the majority of farmers surveyed believe that hybrid seedlings lead to an increase in their income. The mean score for this statement was 4.08. The use of hybrid cocoa seedlings is much better than the traditional varieties been adopted over the years: 8% of respondents strongly agreed with this statement, while 33.1% agreed and 36.6% were neutral. 21.7% disagreed and 0.6% strongly disagreed. This suggests that there is not a strong consensus among farmers surveyed on whether hybrid seedlings are superior to traditional varieties. The mean score for this statement was 3.26.

Table 2 – Perception of farmers regarding improved hybrid cocoa seedling

Perception	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Mean
Hybrid cocoa seedlings increases the number of pods per plant	153 (32.2%)	318 (66.9%)	4 (0.8%)	0 (0.0%)	0 (0.0%)	4.31
Hybrid cocoa seedlings increases the number of seeds per fruit	141 (29.7%)	318 (66.9%)	16 (3.4%)	0 (0.0%)	0 (0.0%)	4.26
Hybrid cocoa seedlings increases cocoa farm yields	114 (24.0%)	340 (71.6%)	19 (4.0%)	0 (0.0%)	1 (0.2%)	4.19
Hybrid cocoa seedlings increases farmers income	72 (15.2%)	375 (78.9%)	24 (5.1%)	4 (0.8%)	0 (0.0%)	4.08
The use of hybrid cocoa seedlings are much better than the traditional varieties been adopted over the years	38 (8.0%)	157 (33.1%)	174 (36.6%)	103 (21.7%)	3 (0.6%)	3.26
The use of hybrid seedlings reduces the potential attacks of pest and disease	8 (1.7%)	231 (48.6%)	154 (32.4%)	77 (16.2%)	4 (0.8%)	3.34
Hybrid seedlings can be seen to be used by other farmers	48 (10.1%)	348 (73.3%)	74 (15.6%)	5 (1.1%)	0 (0.0%)	3.92
Hybrid seedlings boost aggregate cocoa production.	52 (10.9%)	356 (74.9%)	64 (13.5%)	2 (0.4%)	0 (0.0%)	3.96
It is relatively easy to adopt or use the hybrid seedlings	37 (7.8%)	226 (47.6%)	105 (22.1%)	107 (22.5%)	0 (0.0%)	3.41
It is relatively cheap to use hybrid seedlings on my cocoa farm	26 (5.5%)	288 (60.6%)	113 (23.8%)	46 (9.7%)	2 (0.4%)	3.61
The use of hybrid seedlings motivates cocoa farmers to increase their farm size	22 (4.6%)	263 (55.4%)	100 (21.1%)	81 (17.1%)	7 (1.5%)	3.44
Perception Index						3.79

Source: Field Data, 2022.

The use of hybrid seedlings reduces the potential attacks of pest and disease. For this statement, only 1.7% of respondents strongly agreed with this statement, while 48.6% agreed and 32.4% were neutral. 16.2% disagreed and 0.8% strongly disagreed. This suggests that there is not a strong consensus among farmers surveyed on whether hybrid seedlings are more resistant to pest and disease attacks. The mean score for this statement was 3.34. Hybrid seedlings can be seen to be used by other farmers: 10.1% of respondents strongly agreed with this statement, while 73.3% agreed and 15.6% were neutral. 1.1% disagreed and 0% strongly disagreed. This suggests that the majority of farmers surveyed believe that other farmers are using hybrid seedlings. The mean score for this statement was 3.92.

Hybrid seedlings boosts aggregate cocoa production: 10.9% of respondents strongly agreed with this statement, while 74.9% agreed and 13.5% were neutral. 0.4% disagreed and 0% strongly disagreed. This suggests that the majority of farmers surveyed believe that hybrid seedlings lead to an increase in aggregate cocoa production. The mean score for this statement was 3.96.

The overall perception index is 3.79, indicating a generally positive perception of hybrid cocoa seedlings among the farmers surveyed. Generally, the results suggest that the majority of farmers have a positive perception of improved hybrid cocoa seedlings. Farmers believe that hybrid seedlings have a positive impact on the productivity of their cocoa farms.

Table 3 shows a chi-square test of independence to determine the association between level of access and level of use of the respective varieties.



Table 3 – Cross Tabulation of Level of Access and Level of Use of Cocoa Varieties

Access to Varieties	Use of Varieties			Total	Chi <sup>2</sup>
	Low	Moderately	High		
<b>Modified Series I</b>					
Never/Rarely (Low)	425	11	0	436	
Sometimes (Moderate)	8	26	0	34	
Often/Always (High)	0	2	3	5	
Total	433	39	3	475	521.81***
<b>Modified Series II</b>					
Never/Rarely (Low)	291	13	1	305	
Sometimes (Moderate)	6	131	16	153	
Often/Always (High)	0	11	6	17	
Total	297	155	23	475	415.01***
<b>Inter Amazon</b>					
Never/Rarely (Low)	2	2	4	8	
Sometimes (Moderate)	1	174	34	209	
Often/Always (High)	1	14	243	258	
Total	4	190	281	475	350.32***
<b>Trinitario</b>					
Never/Rarely (Low)	3	6	0	9	
Sometimes (Moderate)	2	365	25	392	
Often/Always (High)	0	26	47	73	
Total	5	397	72	474	253.09***
<b>Clones</b>					
Never/Rarely (Low)	456	4	460		
Sometimes (Moderate)	11	1	12		
Often/Always (High)	3	0	3		
Total	470	5	475		6.29**
<b>Criollo</b>					
Never/Rarely (Low)	3	1	1	5	
Sometimes (Moderate)	3	103	51	157	
Often/Always (High)	0	28	285	313	
Total	6	132	337	475	314.34***
<b>Nacional</b>					
Never/Rarely (Low)	429	6	1	436	
Sometimes (Moderate)	6	22	6	34	
Often/Always (High)	3	2	0	5	
Total	438	30	7	475	297.24***

Source: Field Data, 2022.

The chi-square test of independence was used to determine the association between level of access and level of use of the respective varieties. The varieties investigated included Series II, the Modified Series II, Inter Amazon, Trinitario, Clones, Criollo and Nacional. The findings reveal that farmers' access to all the hybrid cocoa seedling types including Series II, Modified Series II, Inter Amazon, Trinitario, Clones, Criollo and Nacional is significantly associated with their use of these hybrid seedling types at the 1% level except for Clones which is significant at the 5% level.

Table 4 shows the results of a multiple linear regression analysis that sought to identify the factors that contribute to cocoa farmers' access to hybrid cocoa seedlings. The R-squared value of 0.175 indicates that the model explains about 17.5% of the variance in access to hybrid cocoa seedlings. This means that the independent variables in the model are able to explain some of the differences in access to hybrid cocoa seedlings, but there may be other factors that are not accounted for in the model. The F-test value of 7.201 and a probability of 0 ( $p < 0.000$ ) indicate that the model is significant overall.

Based on this table, we can see that the following variables significantly influence access to hybrid cocoa seedlings ( $p < 0.01$ ): experience in farming, cocoa farm size and number of bags harvested. The variable "experience in farming" significantly influences access to hybrid cocoa seedlings, with a positive coefficient of 0.253. This means that cocoa farmers with more experience in farming are more likely to have access to hybrid cocoa seedlings. The variable "cocoa farm size" significantly influences access to hybrid cocoa seedlings, with a negative coefficient of -0.057. This means that farmers with small cocoa farms are more likely to have access to hybrid cocoa seedlings. The variable "number of bags harvested" is significantly related to access to hybrid cocoa seedlings, with a negative coefficient of -0.076. This means that farmers who harvest more bags of cocoa are less likely to have access to hybrid cocoa seedlings.



We can also see that access to labour and land tenure system used by farmers are significantly related with access to hybrid cocoa seedlings ( $p < 0.05$ ). The variable "access to labour" significantly influences access to hybrid cocoa seedlings, with a positive coefficient of 0.782. This means that farmers with access to labour are more likely to have access to hybrid cocoa seedlings. The variable "land tenure system" is significantly related to access to hybrid cocoa seedlings, with a positive coefficient of 0.301. This means that farmers who own their lands are more likely to have access to hybrid cocoa seedlings.

Table 4 – Socio-economic Factors Influencing Access to Hybrid Seedling

Access	Coef.	Std. Err.	t-value	p-value	[95% Conf	Interval]
Sex	.156	.125	1.25	.213	-.09	.402
Marital Status	.082	.115	0.71	.476	-.145	.309
Age	-.078	.057	-1.35	.176	-.19	.035
Household size	.024	.019	1.28	.202	-.013	.061
Years of formal education	0	.012	-0.01	.995	-.023	.023
Access to labour	.782*	.463	1.69	.092	1.692	.128
Land tenure system	.301**	.134	2.24	.026	.037	.565
Experience in farming	.253***	.096	2.63	.009	.064	.443
Cocoa farm size (ha)	-.057***	.02	-2.77	.006	-.097	-.016
Number of bags harvested	-.076***	.012	-6.42	0	-.099	-.053
Cooperative member	-.25	.197	-1.27	.204	-.637	.137
Extension access	.144	.139	1.04	.3	-.128	.416
Credit access	.313	.395	0.79	.428	-.463	1.09
Constant	12.812***	.496	25.83	0	11.837	13.787
Mean dependent var	11.921		SD dependent var		1.171	
R-squared	0.175		Number of observations		385.000	
F-test	7.201		Prob > F		0.000	
Akaike crit. (AIC)	1371.131		Bayesian crit. (BIC)		1428.785	

Source: Field Data, 2022.

Table 5 shows the results of a multiple regression analysis that sought to identify the factors that contribute to cocoa farmers' use of hybrid cocoa seedlings. The R-squared value of 0.156 indicates that the model explains about 15.6% of the variance in use of hybrid cocoa seedlings. This means that the independent variables in the model are able to explain some of the differences in access to hybrid cocoa seedlings, but there may be other factors that are not accounted for in the model. The F-test value of 6.277 and a probability of 0 ( $p < 0.000$ ) indicate that the model is significant overall.

Table 5 – Socio-economic Factors Influencing Use of Hybrid Seedling

Use	Coef.	Std. Err.	t-value	p-value	[95% Conf	Interval]
Sex	.162	.129	1.25	.211	-.092	.415
Marital Status	.192	.119	1.62	.106	-.041	.426
Age	-.082	.059	-1.39	.165	-.198	.034
Household size	.026	.019	1.35	.178	-.012	.064
Years of formal education	.004	.012	0.37	.709	-.019	.028
Access to labour	-.213	.477	-0.45	.655	-1.15	.724
Land tenure system	.225	.138	1.63	.104	-.047	.497
Experience in farming	.285*	.099	2.87	.004	.089	.48
Cocoa farm size (ha)	-.068**	.021	-3.22	.001	-.109	-.026
Number of bags harvested	.064**	.012	5.23	0	.087	-.04
Cooperative member	.382*	.203	1.88	.06	.78	.017
Extension access	.052	.143	0.37	.715	-.228	.333
Credit access	.561	.407	1.38	.169	-.239	1.36
Constant	12.395	.511	24.26	0	11.391	13.399
Mean dependent var	12.018		SD dependent var		1.192	
R-squared	0.156		Number of obs		385.000	
F-test	6.277		Prob > F		0.000	
Akaike crit. (AIC)	1397.783		Bayesian crit. (BIC)		1455.436	

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ .

Source: Field Data, 2022.

Based on this table, we can see that the following variables significantly influence the use of hybrid cocoa seedlings ( $p < 0.05$ ): experience in farming, cocoa farm size, number of bags harvested, and cooperative membership. The variable "experience in farming" significantly influences use of hybrid cocoa seedlings, with a positive coefficient of 0.285.





This means that farmers with more experience in farming are more likely to use hybrid cocoa seedlings. Having farming expertise increases the likelihood that hybrid cocoa seedlings will be adopted. The likelihood that cocoa producers will adopt hybrid seedlings increases with their level of experience. Experienced farmers may readily adapt and manage the growing of hybrid cocoa seedlings since they have used a variety of methods in cocoa production throughout the years (Wongnaa et al., 2022).

The variable "cocoa farm size" significantly influences the use of hybrid cocoa seedlings, with a negative coefficient of 0.068. This means that farmers with small farm sizes are more likely to use hybrid cocoa seedlings. The variable "number of bags harvested" significantly influences the use of hybrid cocoa seedlings, with a positive coefficient of 0.064. This means that farmers who harvest more bags of cocoa are more likely to use hybrid cocoa seedlings. The variable "cooperative membership" significantly influences the use of hybrid cocoa seedlings, with a positive coefficient of 0.382. This means that farmers who are members of cooperative societies are more likely to use hybrid cocoa seedlings. Cooperative membership and use of technological information have positive influences on the intensity of adoption of hybrid cocoa seedlings. This implies that farmers who are member of farmer groups have a high probability of allocating more farmlands to the cultivation of hybrid cocoa (Wongnaa et al., 2022; Djokoto et al., 2016). The use of structured learning group-based approaches may influence farmers' readiness to adopt innovations (van Huis et al., 2007).

Table 6 shows the challenges faced by cocoa farmers in accessing and using hybrid cocoa seedlings.

Table 6 – Challenges Cocoa Farmers Face in Accessing and Using Hybrid Cocoa Seedlings

Challenge	Mean Rank	Rank
Lack of access to credit	11.66	1st
High cost of seedlings	11.35	2 <sup>nd</sup>
Inadequate supply of seedlings	10.16	3 <sup>rd</sup>
High cost of fertilizer and pesticides	9.40	4 <sup>th</sup>
Complexity of the technology	6.65	5 <sup>th</sup>
Lack of adequate information	6.58	6 <sup>th</sup>
Poor extension visits	6.40	7 <sup>th</sup>
Lack of training on use	5.51	8 <sup>th</sup>
Inadequate land	5.37	9 <sup>th</sup>
Pest and disease	5.22	10 <sup>th</sup>
Low quality	5.09	11 <sup>th</sup>
Soil infertility	4.10	12 <sup>th</sup>
Seedling mortality	3.51	13 <sup>th</sup>
N	385	
Kendall's W	0.497825	
Chi-Square	2837.603	
Df	12	
Asymp. Sig.	0	

Source: Field Data, 2022.

In terms of lack of access to credit, this challenge had the highest mean rank, indicating that it is perceived as the most significant constraint to accessing and using improved hybrid cocoa seedlings. This suggests that smallholder cocoa farmers who face challenges in obtaining credit may struggle to adopt and use improved hybrid cocoa seedlings. High cost of seedling had the second highest mean rank, indicating that it is also perceived as a significant constraint to accessing and using improved hybrid cocoa seedlings. According to Smale et al., (2011), the cost of the seeds is a significant barrier for farmers who are interested in hybrids and has far-reaching effects. Farmers who cannot raise the money will have to rely on subsidies or credits. Inadequate supply of seedlings had the third highest mean rank, indicating that it is also perceived as a significant constraint to accessing and using improved hybrid cocoa seedlings. This suggests that smallholder cocoa farmers who face challenges in obtaining sufficient numbers of improved hybrid cocoa seedlings may be unable to fully adopt and use these seedlings on their farms.

High cost of fertilizer and pesticides had a relatively high mean rank, indicating that it is perceived as a moderate constraint to accessing and using improved hybrid cocoa seedlings. This suggests that smallholder cocoa farmers who face high costs for inputs such as fertilizer



and pesticides may struggle to afford the necessary inputs to support the use of improved hybrid cocoa seedlings. Complexity of the technology had a relatively low mean rank, indicating that it is perceived as a moderate constraint to accessing and using improved hybrid cocoa seedlings. This suggests that smallholder cocoa farmers who find the technology associated with improved hybrid cocoa seedlings to be complex may struggle to adopt and use these seedlings.

Lack of adequate information had a relatively low mean rank, indicating that it is perceived as a moderate constraint to accessing and using improved hybrid cocoa seedlings. This suggests that smallholder cocoa farmers who lack sufficient information about improved hybrid cocoa seedlings may struggle to adopt and use these seedlings. High cost of seedlings had a relatively low mean rank, indicating that it is perceived as a moderate constraint to accessing and using improved hybrid cocoa seedlings. This suggests that smallholder cocoa farmers who face high costs for improved hybrid cocoa seedlings may struggle to afford these seedlings and may be unable to adopt and use them on their farms. Poor extension visits had a relatively low mean rank, indicating that it is perceived as a moderate constraint to accessing and using improved hybrid cocoa seedlings. This suggests that smallholder cocoa farmers who receive infrequent or poor-quality extension visits may struggle to adopt and use improved hybrid cocoa seedlings. Lack of training on use had a relatively low mean rank, indicating that it is perceived as a moderate constraint to accessing and using improved hybrid cocoa. Seedling mortality had the lowest rank. However, Padi et al. (2013) discovered that the high seedling death rate during the establishment phase has plagued efforts to restore and expand the cocoa industry as a result of the usage of farmer-produced seeds.

The higher the Kendall's coefficient of concordance ( $W$ ) value, the greater the agreement among the rankings. In this case, the  $W$  value is 0.497825, which indicates a moderate level of agreement among the rankings. The "Chi-Square" and "Asymp. Sig." columns show the results of a chi-square test for the  $W$  value, which tests the hypothesis that the rankings are random. The  $p$ -value of 0.000 in the "Asymp. Sig." column suggests that the challenges are not ranked randomly and that there is some pattern in the rankings with a significant relationship among the challenges.

Based on the mean rank values, it appears that the challenges that smallholder cocoa farmers face most frequently in accessing and using improved hybrid cocoa seedlings are lack of access to credit, high cost of seedlings and inadequate supply of seedlings. These challenges have the highest mean ranks, indicating that they are perceived as the most significant constraints.

## CONCLUSION

Seedlings are one of the most important agricultural inputs and the availability of quality seedlings is among the most resources that greatly influence agricultural productivity thereby boosting sustainable production of food. The introduction of hybrid seed or seedlings of cocoa was intended to replace old trees which were susceptible to disease and less productive, improve production and also livelihood of cocoa farmers through the cocoa rehabilitation. There is a general positive perception by cocoa farmers about the hybrid cocoa seedlings which suggest that they believe the newly introduced hybrid seedlings of cocoa are able to produce superior outcomes in comparison to the traditional cocoa varieties. The availability and ease of access of the hybrid seedlings promote their adoption and use by farmers such that when farmers are exposed to these hybrid seedlings tend to cultivate them and those who are not exposed to the hybrid seedlings tend not to cultivate them. This gives an indication of the importance of making the hybrid seedlings easily accessible to farmers. Years of experience in cocoa farming, size of cocoa farm, number of bags of cocoa harvested in previous season and cooperative membership influenced the access and use of hybrid seedlings by farmers. Cocoa farmers are constrained to a large extent in their access and use of hybrid seedlings as a result of lack of access to credit, poor road network, and inadequate supply of seedlings.



The outcome of the study suggests that the cost of the hybrid seedlings must be subsidized and the distribution of the seedlings must be done through the farmer cooperatives to enhance accessibility and use. It is also recommended that efforts be made to increase the availability and accessibility of the hybrid cocoa seedling to farmers in order to promote the use and cultivation by cocoa producers. This is because of the finding that access to the hybrid cocoa seedling is associated with use. It was also found that the farmers for the most part had positive perception about the hybrid cocoa seedlings. Secondly, it is recommended that the authorities involved in cocoa production especially COCOBOD and its associates make concerted efforts to address the key challenges expressed by farmers which include the lack of access to credit, poor road network, and inadequate supply of seedlings. These are very critical limiting factors which seriously affect cocoa production. With these challenges addressed, cocoa farmers will be in better position to obtain higher yields to boost economic development in the country. Finally, the study recommends that initiatives such as the outgrowers scheme used in other crops can be introduced for cocoa farmers in order to increase the accessibility and use of hybrid cocoa seedlings.

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