

## Performance of Rehabilitated Cocoa Farms in the Assin North Municipality of Ghana

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### ABSTRACT

Although Ghana is a highly recognised country in the global cocoa industry, average production per ha is described among the lowest in the world; a situation which is blamed on aging tree stocks and other factors. Through sector policy reforms, government instituted and supported activities including gradual rehabilitation of over-aged cocoa farms with improved variety with the aim of boosting productivity and overall cocoa production. Although the rehabilitation of the cocoa farms is ongoing, research has not covered much on the performance of the rehabilitated cocoa farms. The study assessed the yield performance of rehabilitated cocoa farms in the Assin North municipality. The study involved a descriptive survey in which data was obtained with questionnaires and administered by interviewers. A total of 115 farmers were purposively drawn from 5 communities in the district. It was found that the rehabilitated cocoa farms (RCFs) were planted with hybrid varieties and starts yielding in the 3<sup>rd</sup> year. Recorded average yield of 533kg/ha in the 4<sup>th</sup> year and 742kg/ha in the 5<sup>th</sup> year are 33% and 85% higher than the national average of 400kg/ha. Productivity was positively correlated with age of trees and tree survival rate but negatively correlated to farm size. Farmers described growth rate, general appearing (vigour), pest and disease resistance, and yield to be significantly better than the old crop.

KEY WORKS: performance, rehabilitated, cocoa, productivity, hybrid

### Introduction

#### *Overview*

The cocoa tree known as *Theobroma Cacao* belongs to the family *sterculiniacea*. It is a concentrated food with high nutritive value in carbohydrate, protein, fat and minerals. Again it is usually used for making beverages, wine chocolate, cream and livestock feed. (Amos, 2007) It is among the world's most important tree crops with an important history in Ghana.

Between 1910 and 1964, the country was the world's leading producer, holding between 30–40% of the global market. Despite Ghana's position, production declined between 1964 and 1984 (Edwin & Masters, 2005). Production volumes dropped from 580,500 tons in 1964 to a low of 293,355 tons in 1990 (FAO, 2011 in Mahrizala, et al., 2013).

The decline is partly a result of decreasing areas under cultivation, the incidence of pests and diseases, low producer price, and non-adoption of research recommendations, and lower low yields per ha (Dormon, et al., 2004). Mahrizala, et al., (2013) estimates Ghana's average annual cocoa yield over 30 years (330 kg/ha) to be among the lowest in the world which compares unfavourably to leading producers such as Cote d'Ivoire (580 kg/ha) and Indonesia (770 kg/ha). They cited aging tree stocks as the main reason for diminishing or lower productivity. According to them, cocoa trees can yield fruits up to 50 years but yields get highly diminished after 25 years. Rehabilitation is thus necessary for maintaining farm profitability. However, impoverished cocoa producers find it difficult to forgo immediate income for enhance long-run revenue potential because they value revenue stability as much as they value revenue potential. It is in consequence a bit more difficult to encourage farmers to rehabilitate their cocoa farms; but through a series of economic and sector-specific policy reforms, such as the multiplication and distribution of new varieties and government backed cocoa farm rehabilitation programmes since 1984 has impelled recovery and now reversed almost the entire previous decline in the cocoa industry (Abdulai and Reider, 1996 in Edwin & Masters, 2005, Baah & Anchirinah, 2011).

### Problem statement

Ghana has about 1,400,000 ha area of land cultivated to cocoa. The target of Government is to increase production from 700,000 to 1.0 million MT by the year 2012 and to about 1.2 million MT per year by 2015. Key among the strategies was the rehabilitation of old cocoa farms using new and improved planting materials (Asare, et al., 2010; Mahrizala, et al., 2013). It is estimated that the full adoption of the new cocoa hybrid varieties developed in Ghana has the potential for about 50% productivity gains (Edwin & Masters, 2005; Asare, et al., 2010). Despite the ongoing cocoa farm rehabilitations, Asare, et al., (2010) stated that there are many old and abandoned cocoa farms in the Assin North municipality, that require rehabilitation. And we are with the view that knowledge of the performance of farmer rehabilitated cocoa farms (RCF) can be key to motivating farmers to submit especially their old and abandoned cocoa farms to rehabilitation, and also helping to forecast what to expect from the sector in the near future. Literature is however silent on the subject matter.

### Objectives of the study

This study was thus designed with the objectives of:

- Assessing the yield performance (the productivity i.e. yield/ha) of the RCF.
- Estimating the relationship between the productivity of the RCF and selected farm factors.
- Assess farmer perception of the growth and yield performance of their RCF.

### Materials and Methods

#### Study area

According to The Assin North Municipal is among the twenty (20) Metropolitan, Municipal and District Assemblies (MMDA's) in the Central Region of Ghana. It is situated in the northern corner of the region and lies within Longitudes 1° 05' East and 1° 25' West and Latitudes 6° 05' North and 6° 04' South. The municipality shares common boundaries with Adansi East in the Ashanti Region, to the North, Upper Denkyira to the North-West, Assin South to the South, Twifo Atti Morkwah to the West and Birim South in the Eastern Region to the East; and covers a total land area of about 1,150 sq.km and comprises about 500 settlements.



Figure 1: Map of Assin North municipality (Source: GSS 2014)

The population of Assin North Municipality according to the 2010 Population and Housing Census is 161341 representing 7.3 percent of the region's total population. Males constitute 49.7 percent and females represent 50.3 percent. About 63.1 percent) of the population reside in rural localities. As high as 74.4 percent of households in the municipality are engage in agriculture.

Assin North Municipal falls within the moist tropical forest, mainly deciduous forest. The area has an annual rainfall between 1500mm and 2000mm. Annual temperatures range between 30°C from March to April and about 26°C in August. Average relative humidity is high ranging from 60 to 70 percent. (GSS, 2014)

#### *Study design and Data Collection:*

Data for the study was mainly primary data obtained through descriptive survey from interviewer administered structured questionnaires interviews. The study was targeted at cocoa farmers with RCF in the municipality. Sampling of farmers involved multistage sampling technique. The first part involved a purposive selection of 5 cocoa growing communities within the district with rehabilitated cocoa farms; and the second stage also involved purposive sampling of farmers with RCFs. The consent and willingness of the farmers to participate in the survey was first sought by explaining the purpose and objectives of the study to them before the interviews were conducted. In all, 115 farmers were interviewed from 5 communities including Assin Donpim, Assin Adiambra, Assin Adubiasie, Assin Fosu, Assin Nyankumasi.

Data collection was done from 5-18<sup>th</sup> February 2015. Data was collected on the following parameters: demography of the farmer respondents, farm characteristics and yield performance, farmer perception on growth and yield of crop.

#### *Analytical methods*

The data collected was analysed using stata IC 11.2 after careful examination and data cleaning. The yield performance of the RCF was determined by descriptive statistics on age-by-age basis and expressed as yield in kg/ha/age. The relationship between three farm factors (i.e. age of trees, size of farm, and survival rate of replanted cocoas) on the productivity (Yield/ha) of RCF; while controlling for other factors using the linear log semi-log model expressed as:

$$\ln(Yld_i) = \beta_0 + \beta_1 trAge + \beta_2 surviveR + \beta_3 fsize$$

Where:

$\ln(Yld_i)$  = natural log of productivity of RCF measured in yield in kg of dried cocoa beans per hectare

trAge = age of the cocoa trees measured in years after planting/transplanting

surviveR= tree survival rate which measures proportion of replanted trees alive/remaining on field.

fsize = size of farm measured in hectares.

The semi-log was chosen empirically based on goodness of fit test by which it yielded superior  $R^2$  and far lower rmse compared to linear functional form.

Farmer perception on the growth and yield was assessed by comparing to the previous crop or variety on a five point likert scale comprising of: far worse than (-2), worse than (-1), same as (0), better than (1), and far better than (2). The factors assessed include growth rate, general appearing and vigour, pest and disease resistance, and yield. Two "one sample t-tests" were run using test value of 1 (i.e. " $X_i$ " ==1) and 2 (i.e. " $X_i$ " ==2), where " $X_i$ " is response variables of interest (i.e. growth rate, crop outlook and vigour, pest and disease resistance, and yield). The hypotheses tested were:

- |     |          |   |              |              |
|-----|----------|---|--------------|--------------|
| i)  | t-test 1 | → | Ho: mean = 1 | Ha: mean > 1 |
| ii) | t-test 2 | → | Ho: mean = 2 | Ha: mean < 2 |

## Results and Discussion of Results

### *Results of the study*

#### Demography of respondents

The demographic information covers gender, education, age, and years of cocoa farming experience. A total of 115 farmers were interviewed from 5 communities within the municipality, out of which 15 (13%) were females. The numbers entailed Assin Donpin 25 (21/4), Assin Adiabamba 20 (18/2), Assin Adubiasie 20 (17/3), Assin Fosu 20 (23/2), and Assin Nyankumasi 25 (21/4). See table 1 for details.

Table 1: Summary of demographic information on respondents (source: survey data)

Communities	Gender of respondents		Total
	female	male	
Assin Donpim	4	21	25
Assin Adiabamba	2	18	20
Assin Adubiasie	3	17	20
Assin Fosu	2	23	25
Assin Nyankumasi	4	21	25
Total	15(13%)	100(87%)	115 (100%)

  

Highest educ. attained	Frequency	Percent	Cumulative Percent
Nil	13	11.3	11.3
Primary school	3	2.6	13.9
Middle sch.(JSS/JHS)	60	52.2	66.1
SSS/SHS/O&A level	38	33.0	99.1
Post Sec training	1	.9	100.0
Total	115	100.0	

  

	Obs	Mean	SD	Minimum	Maximum
Age of respondents	115	44.4435	5.86125	24.00	60.00
Cocoa farm. experience	115	17.5826	8.14559	4.00	40.00

Source: Author(s) from survey data

The ages of the farmers ranged from 24 to 60 years, with an average of 44 years. On the highest formal educational level attained, 13 (11.3%) of them did not have formal education, 3(2.6%) had only primary school education, 60 (52.2%) had up to middle school level education, 38 (33%) had senior secondary school level education, and only 1 person had education beyond Secondary school level. The cocoa farming experience among the respondents was ranged from 4 to 40 years with an average of about 17 years.

#### Characteristics of the rehabilitated cocoa farms

The sizes of the RCF of the respondents range from 0.2ha to 2.8ha and the average was about 1ha. The variety of cocoa plant was hybrid cocoa supplied through the cocoa rehabilitation project. The planting density was 1087 plants per ha. The survival rate of the planted trees was between 91% and 100% and average of 98%. The summary of the yield information indicated that the trees started bearing from the 3<sup>rd</sup> year with an average reported yield of the year of 193.3kg/ha and maximum yield of 533.3kg/ha. Average yield for the 4<sup>th</sup> year was 574.8kg/ha and maximum of 960kg/ha; and the average yield of the 5<sup>th</sup> year was 742.4kg/ha and maximum of 960kg/ha.

Table 2: Summary of results on rehabilitated cocoa farms

Factors	Variables				
	Obs	Mean	Std. Dev.	Min	Max
Farm size (ha)	115	.9874783	.5897871	.2	2.8
Cocoa variety	115	Hybrid			
Planting density	115	1087	0	1087	1087
Tree survival rate	115	97.79686	2.155429	90.8046	100
Yield (kg/ha)					
2	11	0	-	0	0
3	25	193.28	101.1054	106.67	533.33
Tree age (yrs)	4	574.80	166.4988	266.67	960.00
5	24	742.43	130.8941	4880.00	960.00
Total	115	1510.51	-	-	-

Source: Author(s) from survey data

#### Factor influence on yield performance

Table 3 shows summary of the regression results on the correlation between productivity and tree age, farm size and tree survival rate. Productivity was expressed as elasticity estimates in relation to the farm factors. Model 1 shows the effect of tree age alone on productivity; model 2 shows the effect of tree age and farm size, and model 3 shows the effect of tree age, farm size and survival rate. From model 3, all the variables have significant effect on the productivity of the RCFs. The  $\beta$  coefficients of tree age and survival rate indicate positive correlation with productivity while that of farm size indicates negative correlation. The  $\beta$  coefficient for tree age (0.759) was the highest, followed by farm size (-0.217) and then tree survival rate (0.0508). The  $R^2$ ,  $adj R^2$ , and  $rmse$  were .681, 0.672, and 0.338.

Table 3: Summary of regression results on relation between farm factors on farm productivity

	(1) Yld	(2) LgYld
SurviveR	20.90* (8.835)	0.0508** (0.0184)
fsize	-65.44* (28.58)	-0.217*** (0.0598)
trAge	296.2*** (17.87)	0.759*** (0.0556)
_cons	-2634.3** (893.0)	-1.658 (1.907)
N	115	114
$R^2$	0.631	0.681
adj. $R^2$	0.621	0.672
rmse	149.6	0.338

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Source: Author(s) from survey data

Farmer perception about the performance of the RCF

Two t-tests were run on the farmer perception about the performance of the RCFs and the summaries of the results presented in tables 4a and 4b. The first t-test (t-test 1) was run with the test value of ‘1’ to assess if farmers perceive the parameters on the current crop as better than the previous crop. The descriptive details of the responses results as presented in table 4a indicates that ‘growth rate’ had the highest average score (1.78) followed by ‘yield performance’ (1.54), ‘pest and disease resistance’ (1.53) and ‘general plant outlook and vigour’ (1.49). The t-statistic (t) and P-values (Pr (T > t)) point out that all the variables are significantly greater than the test value as such each of the parameters is adjudged to be significantly better on the current crop than on the previous crop. And as all the parameters were rated as significantly higher than the test value of “1”, a second t-test was run with a test value of “2” to assess if any of the parameters could be described as far better than on the current crop. The t-statistic and p-values in table 4b suggests that all the mean values are significantly less than “2” which suggests that each of the values although rated as significantly better than the previous crop, are not far better than the previous crop.

Table 4a: summary of one sample t-test analysis with test value of “X”==1

Variable	Obs	Mean	Std. Err.	Std. Dev.	95% Conf. Interval	t	Ha: mean > 1 Pr(T > t)
g.R.rate	115	1.782609	.0405579	.4349351	1.702264 1.862954	19.2961	0.0000
Vigour	115	1.486957	.0468134	.5020173	1.39422 1.579693	10.4021	0.0000
Pest/dis.	115	1.530435	.0483468	.5184616	1.43466 1.626209	10.9715	0.0000
Yield	115	1.53913	.0498464	.5345429	1.440385 1.637876	10.8158	0.0000

Ho: mean = 1    Ha: mean > 1    DF = 114    Pr(T > t) = 0.0000    . ttest “X” == 1  
 Source: Author(s) based on survey data

Table 4b: summary of one sample t-test analysis with test value of “X”==2

Variable	Obs	Mean	Std. Err.	Std. Dev.	95% Conf. Interval	t	Ha: mean < 2 Pr(T < t)
g.R.rate	115	1.782609	.0405579	.4349351	1.702264 1.862954	-5.3600	0.0000
Vigour	115	1.486957	.0468134	.5020173	1.39422 1.579693	-10.9593	0.0000
Pest/dis.	115	1.530435	.0483468	.5184616	1.43466 1.626209	-9.7124	0.0000
Yield	115	1.53913	.0498464	.5345429	1.440385 1.637876	-9.2458	0.0000

Ho: mean = 2    Ha: mean < 2    DF = 114    Pr(T < t) = 0.0000    . ttest “X” == 2  
 Source: Author(s) based on survey data

### *Discussion of results*

The average age of the farmers (44 years) suggests that the farmers are slightly older compared to 40 years basis used by Mahrizala, et al., (2013). According to Amos (2007), farmers' age is a good representation of experience since most of the farmers start farming at an early age. A mean cocoa farming experience of 17 years represents a good enough experience among the farmers understand issues within the industry and for the daily management of the farm activities. And in relation to the study, farmers are well placed to give informed answers. With only a third of the farmers attaining education up to Secondary School education and above, education among the farmers can be described as low, which supports the general assertion that formal education among farmers is generally low.

Fruiting started at the 3<sup>rd</sup> similar to what is reported by Mahrizala, et al., (2013). With a hybrid variety planted yield was expected to be high as expressed by Edwin and Masters (2005) who reported a yield differential of 199kg/ha higher than old/traditional variety (497 kg/ha hybrid - 298 kg/ha hybrid). Recorded average yields of 574.80 kg/ha and 742.43kg/ha for the 3<sup>rd</sup> and 4<sup>th</sup> years are higher than 400kg/ha national average (Onumah, et al., 2013; Aneani & Ofori-Frimpong, 2013), and the 497 kg/ha for hybrids as reported by Edwin & Masters, (2005). All things being equal, yield is expected to increase up to the 13-15<sup>th</sup> year when it peaks before stabilizing and declining (Mahrizala, et al., 2013; Edwin and Masters, 2005).

The positive relation between productivity and farm age (tree age) realized is consistent with the explanation that cocoa yields is expected to increase till it peaks around the 15<sup>th</sup> year. The negative relation found by Edwin and Masters (2005), can be understood because the average age of the farm was 20 years which was beyond the peak for fruiting as such yield was in decline. The negative relation between farm productivity and farm size suggests that bigger RCFs are relatively less productive (efficient) compared to the smaller ones. This is consistent with the suggestion of Masterson (2007). However the productivity-farm size relationship is criticised for comparing only total output to the size of the farm, and ignoring other factors of production and inputs. As such land productivity was described as an incomplete measure of efficiency as it places too much emphasis on one factor – land. However, as the subject matter of this study is not directly assessment of farm efficiency. According to him, possible explanations for the observed inverse relationship are possible characteristics of small farms themselves: better quality land or soil resulting from natural differences occurring in soil types or climate, or man-made differences due to investments in fertilizers and soil conservation practices; production method; more technically efficient and positive differential in factor use intensity (for instance, greater intensity of family labour among small holders). The farmers' assessment of all the farm factors as significantly better than previous crop signifies positive performance of the rehabilitated cocoa farms.

### *Conclusion*

The RCFs starts yielding in the 3<sup>rd</sup> year. Recorded average yield of 533kg/ha in the 4<sup>th</sup> year as well as 742kg/ha for the 5<sup>th</sup> year are 33% and 85% higher than the national average of 400kg/ha. Productivity in is positively correlated to age of trees and tree survival rate but negatively correlated to farm size. Farmers described growth rate, general appearing (vigour), pest and disease resistance, and yield as significantly better than the old crop.

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