Revamping Ghana's coffee production: smallholder perceptions, viability and constraints

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ABSTRACT

Coffee contributes substantially to the economic wellbeing of smallholder farmers in Sub-Saharan Africa, but the production of this crop in Ghana remains underdeveloped and its great potential for enhancing the livelihoods of smallholder farmers remains unrealized. This study analyzed the viability of coffee plantation establishment to ascertain whether observed low coffee production in Ghana is because the production of the crop is financially and economically not viable. The primary data was collected from 133 coffee farmers and 150 non-coffee farmers using structured questionnaires. The analysis was conducted using the Perception index, discounted measures of project worth as well as Kendall's coefficient of concordance. The results indicated that both coffee and non-coffee farmers have negative perceptions about coffee production in the country. Furthermore, coffee production in Ghana would be both financially [net present value (NPV) of GH₵ 1,437.19, benefit-cost ratio (BCR) of 1.39, and internal rate of returns (IRR) of 29.15%] and economically (NPV of GH₵ 697.86, BCR of 1.16, and IRR of 25.38%) viable at a discount rate of 30%. Finally, a poor marketing system was ranked as the major constraint to coffee production in Ghana. The study makes the following recommendations: Firstly, farmers and potential investors are encouraged to invest in coffee production in Ghana as an option to enhance their livelihoods. Secondly, policies aimed at addressing the challenges of coffee farmers in Ghana should be targeted more at establishing a viable internal coffee marketing system as well as lowering lending rate to farmers.

Keywords: Financial, economic, net present value, internal rate of return, benefit-cost ratio, payback period

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INTRODUCTION

Coffee in many years has been ranked the second most traded commodity next to crude oil (Sereke-Brhan, 2010). Coffee as a non-traditional crop in Ghana has a great potential to supplement export earnings to the country through diversification since the country cannot solely rely on earning from its traditional crops like cocoa. In 2007 and 2008 for example, Ghana realized US$1,331,308.36 and US$2,767,378.00, respectively from coffee exports (Zaney, 2011) even though recent values are extremely low (MOFA, 2018). Many types of coffee do exist and are produced in many countries but Arabica and Robusta are the two main popular types of coffee produced by most producing countries on a commercial basis (International Trade Centre, 2016). Coffee Robusta is cultivated in almost all

regions in Ghana but mainly cultivated in six out of the sixteen regions, viz. Bono, Eastern, Volta, Ashanti, Central, and Western regions (COCOBOD, 2019). The commodity is characterized by a unique advantage, given the crop's resilience to harsh weather conditions and ability to strive better on marginal lands compared to other cash crops like cocoa and cashew (Kwasi-Kumah, 2012). The crop is even believed to have been the first commodity exported from Ghana before the arrival of cocoa (Traoré, 2009).

Despite the economic benefits to be derived from coffee production, the crop has not managed to thrive in Ghana. The quantity of coffee produced and exported from the country has been significantly low in recent years coupled with diminishing output, thus inhibiting the country from earning a substantial income from exports (Traoré, 2009; Harris *et al*., 2012). Bellachew (2011) stated that Ghana among other African countries is one of the big losers of foreign earnings from coffee production and export because its annual production has gone down drastically despite the enormous potential that the country owns for coffee production. The liberalization system allowed by Ghana Cocoa Board (COCOBOD) in 1991 has not improved the coffee industry in Ghana as expected. To this end, the liberalization era has been followed by a decrease in the production and increase in the importation of coffee (Traoré, 2009; Crumley, 2013; Amanor, 2017). According to International Coffee Organization's (ICO) data (ICO, 2018), Ghana's coffee bean production was booming up until the early 2000s, but output levels exhibited a downward trend thereafter (Figure 1). The figure also shows how Ghana's coffee imports have rather increased over and above production over the period. No wonder Harris *et al*. (2012) predicted in 2011 that Ghana's annual coffee production would continue to decrease in the next 5 years. This prediction has manifested as production levels consistently decreased from 918 metric tons in 2013 to 0.1 metric tons in 2018 (MOFA, 2018). The prevailing situation has compelled farmers to destroy their coffee plantations and use their lands for the cultivation of other crops like cocoa and cashew (Adu-Gyamerah, 2015). Ghana has not been able to take massive advantage of the potential of coffee production in helping to grow the economy. The need to revive the coffee industry in Ghana can therefore not be overemphasized. However, strategies aimed at reviving Ghana's coffee industry can only be devised after a thorough analysis of the current status of Ghana's coffee production. With some suggestions for revamping Ghana's coffee sector made in previous studies, they are limited as they are silent on information about the perception of farmers on coffee production as well as the viability of coffee production in Ghana. This study uses data from the Dormaa Municipality, the hub of coffee production in Ghana, to help propose appropriate interventions that will help revamp the coffee industry in Ghana. Given the prospects and economic importance of the crop, the main objective of the study was to find out whether observed low coffee production in Ghana is because the production of the crop is financially and economically inviable. Specifically, the study examined the perception of farmers on coffee production, determined the financial and economic viability of coffee production, and finally, identified the constraints to coffee production.

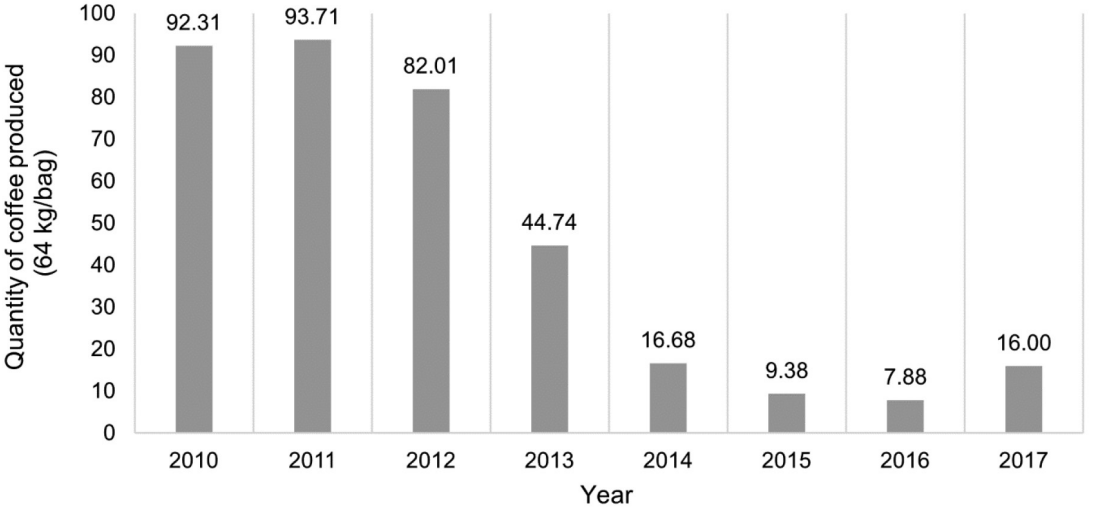

Figure 1 Trend of Ghana's coffee bean production from 2010 to 2017

The need to carry out an analysis on the production of crops which have great potentials in job creation to serve as a source of livelihood for citizens and can contribute significantly to the development of the nation is very desirable (Krishnan, 2017). The paper provides vital information concerning the financial and economic viability of coffee production in Ghana to potential investors. The financial analysis evaluated the farmer's resources placed in the project at market values, which resulted in the net benefits for the project's duration. On the other hand, the economic analysis considered values that represent the opportunity cost of input resources and measured the project's impact on the national economy (Alvarado, 2013). The paper also helps unfold the causes of low coffee production in the Dormaa Municipality and Ghana as a whole. Unveiling the key elements restricting the production of coffee in the country will serve as a guide to producers and stakeholders, particularly the government and processors in planning and making decisions in an attempt to help revamp the coffee industry in Ghana. The country will be able to massively take advantage of the global demand gap of the commodity through export when factors limiting the production of the products are being identified and dealt with. According to van Rijn and Ingram (2016), more credible research is needed on coffee production in the world to ensure more effective ways of improving the sustainability and continuous supply of coffee beans in the world. This study adds to the limited literature on global coffee production.

MATERIALS AND METHODS

Study Area

The study was conducted in the Brong Ahafo Region of Ghana, specifically in the Dormaa Municipality, with Manteware, Kyeremasu, Suromani, Antwirifo, and Nsuhia as the selected communities. Dormaa was selected because the municipality is the hub of coffee production in Ghana, whereas the selected communities are active and contribute a major share of coffee produced in the study area (Ghana Statistical Service, 2010). Dormaa Municipality is one of the twenty-seven (27) administrative districts within the Brong Ahafo Region of Ghana. It is regarded as one of the oldest districts in the region. It lies within longitudes 3° West and 3°30' West and latitudes 7° North and 7°30' North. Dormaa Ahenkro is the municipal capital, located about 80 km west of the regional capital, Sunyani.

The total land area of the district is 1,210.28 km^2, which is about 3.1% of the total land area of the former Brong Ahafo Region (Ghana Statistical Service, 2010). The mean annual rainfall of the district is between 125 mm and 175 mm due to its location within the wet semi-equatorial climate region coupled with a double maxima rainfall regime. Relative humidity of 75–80% during the two rainy seasons and 70–72% during the rest of the year is mostly experienced in the district. The maximum mean temperature is about 30°C and occurs between March and April and the minimum is about 26.1°C in August.

The population of Dormaa Municipality is at 112,111 comprising 52,589 (47.8%) males and 58,522 (52.2%) females. In relation to density, with a land surface area of 1,210.27 km^2, the population density of the district is 92.6 persons/km^2. The total dependency ratio of the district is 75.2 meaning every 100 persons within the economically active population ages (15–64 years) have about 75 persons (under age 15 and over age 64 years) to take care of. The total household population is 109,965 and the average household size is 4.3. Dormaa Municipality has a majority of its population having a low level of education. The proportion of the district's population who attended senior secondary school/senior high school (9.8%) and tertiary (3.7%) in the past is higher than the proportion of the population currently attending senior secondary school/senior high school (8.6%) and tertiary (1.4%). In the district, out of every 10 male persons, only 2 (11.3%) and about 3 persons in every 10 females (14.4%) can read and write in English only. The backbone of the municipality's economy is agriculture, and it employs 68.4% of the total populace of the municipality. This highlights the agrarian nature of the economy. Out of this number, 73% are found in rural areas while 27% live in urban communities. This illustrates that most of the agricultural activities take place in rural areas.

Data Collection

The study used primary data which was collected from coffee and non-coffee farmers in the Dormaa Municipality of Ghana using a structured questionnaire in January 2018. From a population of 199 farmers belonging to the coffee growers' association in the Dormaa Municipality, 133 coffee farmers were selected for this study. A two-stage sampling technique was employed to select the respondents for this study. First, five communities namely: Suromani, Manteware, Kyeremasu, Antwirifo, and Nsuhia were purposively selected. About 90% of the smallholder coffee farmers in the study area are found in these selected communities, hence the reason for their selection. Second, a simple random sampling technique was employed to select the 133 coffee farmers from these five selected communities based on the proportion of coffee farmers in each of the communities. A simple random sampling technique was also used to select 150 non-coffee farmers based on the proportion of the populations in each community. The 150 farmers were selected to ascertain reasons for not considering coffee production in the study area. Table 1 presents the number of coffee and non-coffee farmers that were selected from the various communities in the Dormaa Municipality of Ghana.

Table 1 Communities and number of respondents selected

Communities	Coffee farmers	Sample size	Non-coffee farmers
Suromani	32	(32/182) × 133 = 23	35
Manteware	50	(50/182) × 133 = 37	20
Kyeremasu	39	(39/182) × 133 = 29	25
Nsuhia	25	(25/182) × 133 = 18	40
Antwirifo	36	(36/182) × 133 = 26	30
Total	182	133	150

Methods of Analysis

Descriptive statistics were used to present the socioeconomic characteristics of the respondents. Frequency tables, mean and standard deviation were the specific descriptive tools employed. The Likert scale was also used to analyze coffee farmers' perception of coffee production. Cronbach's alpha was employed to test the internal consistency and content validity of the perception statements in the questionnaire.

The study employed discounting methods, viz. net present value (NPV), benefit-cost ratio (BCR), and internal rate of returns (IRR) to analyze the financial and economic viability of coffee production in Ghana at a discount rate of 30%. These methods have been employed in analyzing the viability of similar tree projects (Wongnaa and Awunyo-Vitor, 2013; Adams *et al*., 2019; Wongnaa *et al*., 2021). Sensitivity analysis was also used to ascertain the changes in the viability measures given changes in some key variables in coffee production. Decisions concerning viability were made based on these concepts.

The NPV of an enterprise is the present worth of the net cash flow. Net cash flow is the difference between the present values of cash inflows and cash outflows (Björnsdóttir, 2010). The NPV simply describes the present worth of the income stream from an investment. In NPV analysis, a discount rate is required. Usually, the opportunity cost of capital is used as the discount rate. This is the rate that results after the utilization of all capital in the economy if all possible investments undertaken in the economy generate that much or more. In other words, the opportunity cost of capital is the return on the last or marginal investment made that exhausts the last available capital. There exists a problem in the practical application of the opportunity cost of capital. The exact value is usually unknown and is usually assumed to be equivalent to lending rates of commercial banks within a project's locality (Gittinger, 1982). Mathematically, NPV is given by:

$$0 = NPV = \sum_{n=0}^{N} \frac{CF_n}{(1+IRR)^2} \qquad \text{------- (1)}$$

The NPV was computed by subtracting the total discounted present worth of the cash outflows from the discounted present worth of the cash inflows. The selection criterion was to accept all independent projects with NPV of zero or greater, at a specified discount rate. A negative NPV implies that at the assumed opportunity cost of capital, the present worth of the benefit stream is less than the present worth of the cost stream, rendering the enterprise unable to recover its investments. One problem of the NPV is that it cannot be calculated without a satisfactory estimate of the opportunity cost of capital. It is preferred in choosing among mutually exclusive projects. This was estimated by first assessing the various cost items and associated benefits. The costs included pre-planting, planting, and post-planting operations including harvesting. The benefits included revenue from the sale of a 60 kg bag of dried coffee. These benefits and costs were discounted taking into consideration inflation and time value of money to give the discounted cost and the discounted benefits. This assessment was done for coffee farmers over a 30-year period.

The internal rate of return is known as the rate of discount which applies to an investment's cash flow and produces a zero NPV. Mathematically, it is given as:

$$IRR = LDR + (HDR - LDR)\frac{NPV^{LDR}}{NPV^{LDR} + \left|NPV^{HDR}\right|} \qquad \text{------- (2)}$$

where LDR is the lower discount rate, HDR is the higher discount rate, and NPV is the net present value.

The guiding principle is that a project should be undertaken if the IRR is above the interest rate charged by the lending bank or prevailing in the open market. Calculating the IRR is quite involving, as it is usually done via trial and error. Different discount factors were tried until one obtains a value that renders the net present value almost zero. The general rule when estimating the IRR by trial and error is that; if at a given discount rate the net present value is positive, the discount factor is increased, and if at a given discount rate the net

present value is negative, the discount factor is reduced. The true discount factor, however, will usually lie between these two discount factors.

The BCR is normally used if we are interested in comparing alternative investments. It naturally compares costs and benefits, recognizing the need to take account of different time streams of alternative projects by means of discounting. Using BCR to determine the profitability of any given investment generally will give the same results as those found using the NPV method. However, different rankings can be obtained when BCR is used because it measures relative profitability rather than total net benefits. The BCR often is preferred over the NPV when all acceptable investment opportunities cannot be undertaken because it gives a measure of the generated amount for a cedi invested (Beierlein *et al*., 2013). Mathematically, the BCR is given by:

$$BCR = \frac{\sum_{t=1}^{t=n} \frac{B_t}{(1+r)^t}}{\sum_{t=1}^{t=n} \frac{C_t}{(1+r)^t}} \qquad \text{------- (3)}$$

According to Saltelli *et al*. (2008), sensitivity analysis can be defined as the study of how uncertainty in the output of a model (numerical or otherwise) can be apportioned to different sources of uncertainty in the model input. A sensitivity analysis is an important constituent of any solution methodology (Pannell, 1997). It is easy to do, understand and communicate. It could be the most useful and widely used technique open to agricultural economists (Pannell, 1997). Sensitivity analysis was done to determine the responsiveness of the cash outflows and cash inflows associated with estimating the NPV. This implies if the NPV is positive the sensitivity shows how much the estimated cost or revenue will change to alter the NPV to be negative. A lower rate of sensitivity implies that the estimate is more sensitive. The assumptions made would relate to the economic and financial view point of analysis of coffee production. In this study, the sensitivity analysis was done for 10% increase in cost of harvesting, 10% increase in weeding cost and 10% decrease in price of 60 kg bag of dried coffee.

Calculations of the NPV, BCR, IRR and the payback period were based on key assumptions which included the following: all amounts are quoted in Ghana Cedis (Gh₵) (1US$ = Gh₵5.20). Costs and revenues are projected over a 30-year period (average economic life of coffee). The opportunity cost of capital is given as 30% (current commercial bank rate). Producers operate at an optimal level, making use of every strength and opportunity. Yield occurs from year 3 with fluctuating output annually till the 30-year period. Percentage loss after drying fresh coffee harvested is about 44%. Thus, dried coffee is 56% of the number of fresh coffee berries harvested. Revenue is dependent on the number of 60 kg bags of dried coffee sold with the current average rate of GH₵ 225.

Generally, the financial analysis of the project compared benefits and costs to the coffee enterprise while the economic analysis compared the benefits and costs to the whole economy. Also, while the financial analysis used market prices to check the balance of investment and the sustainability of the project, the economic analysis used economic price converted from the market price by excluding tax, profit, subsidy, etc. This measured the legitimacy of using national resources for certain projects.

Finally, the constraints to coffee production were identified and ranked using the mean ranking approach of Kendall's coefficient of concordance. Kendall's coefficient of concordance (W) measures the agreement on the scale of zero to one (0–1), with a value close to one (1) indicating greater agreement in rankings and a value close to zero (0) representing lower ranking agreement. Respondents ranked the constraints to coffee production based on their experiences and decisions. These rankings were used to obtain the W between the respondents, given as:

$$W = \frac{12\sum T_j^2 - 3k^2N(N+1)^2}{k^2N(N^2-1)} \qquad \text{------- (4)}$$

where T_j is column totals, N is the number of constraints ranked and k is the number of respondents doing the ranking.

The following quantity is approximately normally distributed as a chi-square on N – 1 degree of freedom:

$$\chi^2_{(N-1)} = K(N-1)W \quad \text{------- (5)}$$

Chi-Square (χ^2) estimation and asymptotic significance level were therefore used to determine the level of agreement in the ranking of the constraints.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 2 presents the socioeconomic characteristics of coffee farmers interviewed in the study. The results showed that 61.65% of the coffee farmers were males, while 38.35% were females. This is in line with the findings of Hill and Vigneri (2014) as well as Onumah *et al*. (2013) who reported that coffee production is dominated by males. The majority of the respondents fall within the age bracket of 45–54 representing 35.34% and 50% of coffee farmers and non-coffee farmers, respectively (Table 2), an indication of aging population of coffee farmers in the study area. The findings corroborate the studies of Asamoah (2015) and Omari (2014) who reported that coffee farming in Ghana is dominated by the aged with low youthful participation. Less youth participation in coffee production presents a bleak image of the future of the coffee industry in the Dormaa Municipality of Ghana. The results also indicate that 46.62% of coffee farmers have no formal education. On the contrary, 42.10% either had a middle school or junior high school certificate. This finding is consistent with Kleemann *et al*. (2014) who observed that most coffee farmers in Ghana are uneducated. The low educational background of farmers may have negative implications for the adoption of improved technologies since previous studies have shown a positive correlation between education and technology adoption among smallholder farmers (Jari, 2009; Xaba and Masuku, 2013). For marital status, most of both coffee farmers (82.71%) and non-coffee farmers (86%) were married.

Generally, farm sizes of both coffee and non-coffee farmers ranged from 2–5 acres. This suggests that crop production in Ghana, especially coffee is generally a smallholder activity. The small coffee farms may be a key contributing factor for the declining coffee production in the country. Such smallholder farmers use rudimentary agricultural technologies such as hoe and cutlass with no or minimal fertilization for production activities compared with other coffee producing countries (Tumusiime-Mutebile, 2013). For instance, Ruben and Fort (2012) reported that most coffee farmers in Peru operate farms up to 12–15 acres and this could have accounted for high annual coffee production in Peru.

Perception of Coffee and Non-Coffee Farmers about Coffee Production

The Cronbach's alphas were 0.816 and 0.801 for coffee and non-coffee farmers respectively. These indicate a high level of internal consistency for the scale and the sample used for this study (George and Mallery, 2016). Results of coffee farmers' perceptions and marketing activities are given in Table 3. About 82.70% of the coffee respondents reported that coffee production received low governmental support. Similarly, 77.44% of the coffee farmers opined that coffee has a poor marketing system compared to other crops like cocoa, although both commodities are controlled by the same marketing board (COCOBOD). As to whether coffee production is tedious, the mean for the coffee farmers was 1.87 which implies that coffee production is very challenging. This perception could be true because Kleemann and Abdulai (2013) reported that coffee farmers in West Africa complained about the difficulties experienced in coffee production. Meanwhile, with a mean of 3.38, most of the coffee farmers (59.40%) believed that coffee production was profitable. Generally, the perception index was 2.50, indicating a negative perception towards the production of the commodity.

Table 2 Socioeconomic characteristics of coffee and non-coffee farmers

Variable	Coffee farmers		Non-coffee farmers	
	Frequency	%	Frequency	%
Sex				
Male	82	61.65	69	46.00
Female	51	38.35	81	54.00
Total	133	100.00	150	100.00
Age group (years)				
18–44	40	30.07	38	25.33
45–54	47	35.34	75	50.00
Above 55	46	34.59	37	24.67
Total	133	100.00	150	100.00
Educational level				
No formal education	62	46.62	97	64.67
Primary school	14	10.53	13	8.67
Middle school/junior high school	56	42.10	33	22.00
Senior secondary school/senior high school	1	0.75	7	4.66
Training college/tertiary	0	0	0	0
Total	113	100.00	150	100.00
Marital status				
Single	8	6.01	2	1.33
Married	110	82.71	129	86.00
Widow/widower	14	10.53	19	12.67
Divorced	1	0.75	0	0
Total	133	100.00	150	100.00
Farm size				
Below 2 acres	32	24.06	49	32.67
2–5 acres	94	70.68	95	63.33
Above 5 acres	7	5.26	6	4.00
Total	133	100.00	150	100.00

The results on the perceptions of non-coffee farmers about coffee production are presented in Table 4. With a mean of 2.31 and about 74% agreeing to the statement, non-coffee farmers also were of the view that coffee received low governmental support. Most of them (84.67%) were also of the view that coffee production was very tedious. Although a greater percentage of them (76.66%) disagreed that coffee production was unprofitable, they are not likely to engage in coffee production because, to them, coffee berries take a long time to mature, it requires a huge start-up capital and has a poor marketing system aside other reasons discussed above (Table 4). The reasons for farmers not being willing to engage in coffee production in this study are in line with the results of Adu-Gyamerah (2015) which give reasons on why coffee farmers abandon their coffee farms to cultivate other crops like cashew and cocoa. The perception index for non-coffee producers was 2.20, also indicating a negative perception the farmers have about coffee production. The implication is that most farmers in general have a negative perception of coffee production. The need to ascertain why coffee farmers are not considering coffee production can therefore not be underestimated.

Table 3 Perception of coffee farmers on coffee production

Perception statements	(1) Strongly agree	(2) Agree	(3) Neutral	(4) Disagree	(5) Strongly disagree	Mean
Coffee berries take a long time to mature	6 (4.51%)	15 (11.28%)	14 (10.53%)	55 (41.35%)	43 (32.33%)	3.86
Coffee production is very tedious	52 (39.10%)	61 (45.86%)	9 (6.77%)	7 (5.26%)	4 (3.01%)	1.87
Coffee production is not profitable	21 (15.79%)	18 (13.53%)	15 (11.28%)	47 (35.34%)	32 (24.06%)	3.38
Coffee production requires huge capital to start up	53 (39.85%)	62 (46.62%)	4 (3.01%)	9 (6.77%)	5 (3.76%)	1.88
Coffee has poor marketing system	48 (36.09%)	55 (41.35%)	15 (11.28%)	8 (6.02%)	7 (5.26%)	2.03
Coffee production has low governmental support	50 (37.59%)	60 (45.11%)	4 (3.01%)	17 (12.78%)	2 (1.50%)	1.95
Perception index						2.50

Note: Cronbach's alpha = 0.798, Cronbach's alpha based on standardized items = 0.816, number of items = 6

Table 4 Perception of non-coffee farmers on coffee production

Perception statements	(1) Strongly agree	(2) Agree	(3) Neutral	(4) Disagree	(5) Strongly disagree	Mean
Coffee berries take a long time to mature	42 (28.00%)	37 (24.67%)	8 (5.33%)	27 (18.00%)	36 (24.00%)	2.85
Coffee production is very tedious	108 (72.00%)	19 (12.67%)	12 (8.00%)	4 (2.67%)	7 (4.67%)	1.55
Coffee production is not profitable	62 (41.33%)	53 (35.33%)	13 (8.67%)	11 (7.33%)	11 (7.33%)	2.04
Coffee production requires huge capital to start up	43 (28.67%)	56 (37.33%)	27 (18.00%)	15 (10.00%)	9 (6.00%)	2.27
Coffee has poor marketing system	67 (44.67%)	21 (14.00%)	45 (30.00%)	6 (4.00%)	11 (7.33%)	2.15
Coffee production has low governmental support	44 (29.33%)	67 (44.67%)	7 (4.67%)	14 (9.33%)	18 (12.00%)	2.30
Perception index						2.20

Note: Cronbach's alpha = 0.764, Cronbach's alpha based on standardized items = 0.801, number of items = 6

Financial and Economic Viability of Coffee Production

Initial investment cost

This involved the start-up cost incurred at the beginning of the production period (year 0) before operational and maintenance costs were incurred in subsequent years. It included cost of fixed assets and other costs necessary before actual production. The initial investment cost covered the cost of land, land preparation, lining and pegging as well as the cost of seedlings and planting. Table 5 presents the start-up cost for a one-acre coffee plantation in the Dormaa Municipality of Ghana.

The results show that the average start-up capital for establishing a one-acre coffee plantation from the financial point of view is GH¢1,517 and GH¢1,867 from the economic point of view. The cost of fixed asset (land), land preparation, and coffee seedlings formed the largest components of the total start-up capital from the economic point of view whereas, from the financial point of view, the cost of fixed asset (land) and land preparation constituted the major costs. It can be deduced that the investment outlay for the establishment of an acre of coffee plantation from the economic point of view far outweighs that of the financial point of view.

Table 5 Investment costs for one acre of coffee plantation

Investment	Quantity	Financial analysis		Economic analysis	
		Cost per unit (GH¢)	Total cost (GH¢)	Cost per unit (GH¢)	Total cost (GH¢)
Land (rent one acre)	7 year	100.00	700.00	100.00	700.00
Land preparation	6 laborers	100.00	600.00	100.00	600.00
Lining and pegging	7 laborers	20.00	140.00	20.00	140.00
Coffee seedlings	700 seedling	-	-	0.50	350.00
Cost of planting	700 stands	0.11	77.00	0.11	77.00
Total			1,517.00		1,867.00

Operational costs

Tables 6 and 7 present the major costs incurred per acre during the production period for a projected 30-year period for the financial and economic analyses respectively. The results revealed that fertilizer application, clearing of weeds, and cost of harvesting made up a chunk of the costs followed by pesticides application, jute sacks, and rent of knapsack in both the financial and economic analysis. It was realized from the financial analysis that the cost for fertilizer and pesticide application was lower with regards to cost estimated from the economic point of view. The reason for the difference according to stakeholders was that fertilizer and pesticides are given for free to farmers as a government incentive to encourage the production of coffee in the country. A detailed breakdown of the various operational costs is presented in Table 8.

Table 6 Operational costs for an acre of coffee plantation for a 30-year period (financial analysis)

Operation/year	1	2	3	4	5	6	7	8	9	10–29	30
Clearing of weeds	240	240	240	240	240	240	240	240	240	4,560	240
Rent of knapsack	14	14	14	14	14	14	14	14	14	266	14
Fertilizer[1]	-	-	-	-	-	-	-	-	-	-	-
Fertilizer application	-	-	-	60	-	-	60	-	-	360	-
Pesticides[1]	-	-	-	-	-	-	-	-	-	-	-
Pesticides application	60	60	60	60	60	60	60	60	60	1,140	60
Cost of harvesting	-	-	72	180	216	240	216	-	-	2,772	-
Jute sacks	-	-	12	30	36	40	36	-	-	462	-
Total	314	314	398	584	566	594	626	314	314	9,560	314

Note: [1] Farmers received fertilizers and pesticides for free thus costs of fertilizer and pesticides were not captured in the financial analysis

Table 7 Operational costs for an acre of coffee plantation for a 30-year period (economic analysis)

Operation/year	1	2	3	4	5	6	7	8	9	10–29	30
Clearing of weeds	240	240	240	240	240	240	240	240	240	4,560	240
Rent of knapsack	14	14	14	14	14	14	14	14	14	266	14
Fertilizer	-	-	-	240	-	-	240	-	-	-	-
Fertilizer application	-	-	-	60	-	-	60	-	-	1,800	-
Pesticides	28	28	28	28	28	28	28	28	28	-	-
Pesticides application	60	60	60	60	60	60	60	60	60	1,672	88
Cost of harvesting	-	-	72	180	216	240	216	-	-	2,772	-
Jute sacks	-	-	12	30	36	40	36	-	-	462	-
Total	342	342	426	852	594	622	894	342	342	11,532	342

Table 8 Labor costs for farm operations of an acre of coffee plantation

Activities	Quantity	Cost per unit (GH¢)	Total cost (GH¢)
Clearing of weeds	4 times a year, 2 laborers	30 per laborer	240
Fertilizer application at years 4 and 7	2 times a year, 3 laborers	10 per laborer	60
Harvesting cost for year 3	360 kg (6 bags)	0.20 per kg harvested	72
Harvesting cost for year 4	900 kg (15 bags)	0.20 per kg harvested	180
Harvesting cost for years 5 and 7	1,080 kg(18 bags)	0.20 per kg harvested	216
Harvesting cost for year 6	1,200 kg (20 bags)	0.20 per kg harvested	240
Pesticides application	Once a year, 2 laborers	30 per laborer	60

Note: 1 bag = 60 kg

Cash inflows (revenue)

Cash inflows from coffee production represent the stream of income generated by investing in coffee production. Higher unit prices are attached to the commodity as it moves from one processing state to another. Producers sell their products after drying the freshly harvested berries due to the inaccessibility of hulling machines to further process them for optimum income. Table 9 presents the projected yield and cash flows over the 30-year production period. The results showed that yield and income were low in the early stages of production vis-à-vis subsequent years. This is because in the early stages, the coffee plant will still be growing and canopies will now be forming to be able to bear more fruits.

Table 9 Projected yields and cash inflows (revenue) for an acre of coffee plantation

Year	Number of bags of fresh coffee harvested (60 kg/bag)	Number of bags of dried coffee sold (60 kg/bag)	Price per unit (GH¢)	Total price (GH¢)
1	-	-	-	-
2	-	-	-	-
3	6	3.50	225	787.50
4	15	8.50	225	1,912.50
5	18	10	225	2,250.00
6	20	11	225	2,475.00
7	18	10	225	2,250.00
8	-	-	225	-
9	-	-	225	-
10–29	231	129	225	29,025.00
30	-	-	225	-

Financial and economic analyses

Tables 10 and 11 present the undiscounted and discounted costs, revenues, and cash flows for the financial and economic analyses respectively. The analysis recorded an NPV of GH¢48.57, BCR of 1.02, and IRR of 29.15% from the financial point of view whiles the economic analysis recorded an NPV of GH¢540.09, BCR of 0.85, and IRR of 25.38% at a discount rate of 30%. The results from the financial analysis clearly show that the production of coffee is capable of supplementing domestic and export earnings in Ghana. Several studies including Loureiro *et al*. (2005), Poudel *et al*. (2009) as well as Rahn *et al*. (2014) among others have also reported that coffee production is financially viable in Africa. This corroborates the findings of Philpott *et al*. (2007) that also reported that coffee production is economically viable in Africa. Table 12 summarizes the NPV, BCR, and IRR calculated from the financial and economic analyses.

Table 10 Undiscounted and discounted costs, revenue, and cash flow per acre of coffee plantation for a 30-year period (financial analysis)

Year	Investment (GH¢)	Operational cost (GH¢)	Gross cost (GH¢)	Gross benefit (GH¢)	Cash flow (GH¢)	Discounted gross cost (GH¢)	Discounted gross benefit (GH¢)	Discounted cash flow (GH¢)
0	1,517.00	-	1,517.00	-	-1,517.00	1,517.00	-	-1,517.00
1	-	314.00	314.00	-	-314.00	214.47	-	-241.54
2	-	314.00	314.00	-	-314.00	185.89	-	-185.80
3	-	398.00	398.00	787.50	389.50	181.09	358.39	177.29
4	-	584.00	584.00	1,912.50	1,328.50	204.40	669.38	465.14
5	-	566.00	566.00	2,250.00	1,684.00	152.25	605.25	453.55
6	-	594.00	594.00	2,475.00	1,881.00	122.96	512.33	389.70
7	-	626.00	626.00	2,250.00	1,624.00	99.53	357.75	258.81
8	-	314.00	314.00	-	-314.00	38.62	0	-38.49
9	-	314.00	314.00	-	-314.00	29.52	0	-29.61
10–29	-	9,560.00	9,560.00	29,025.00	18,837.00	2,992.28	473.05	316.64
30	-	314.00	314.00	-	-314.00	0	0	0
Total	1,517.00	14,212.00	15,729.00	38,700.00	22,971.00	2,929.86	2,978.43	48.57

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Table 11 Undiscounted and discounted costs, revenue, and cash flow per acre of coffee plantation for a 30-year period (economic analysis)

Year	Investment (GH¢)	Operational cost (GH¢)	Gross cost (GH¢)	Gross benefit (GH¢)	Cash flow (GH¢)	Discounted gross cost (GH¢)	Discounted gross benefit (GH¢)	Discounted cash flow (GH¢)
0	1,867.00	-	1,867.00	-	-1,867.00	1,867.00	-	-1,867.00
1	-	342.00	342.00	-	-342.00	263.08	-	-263.08
2	-	342.00	342.00	-	-342.00	202.37	-	-202.37
3	-	426.00	426.00	787.50	361.50	193.90	358.44	164.54
4	-	852.00	852.00	1,912.50	1,060.50	298.31	669.62	371.31
5	-	594.00	594.00	2,250.00	1,656.00	159.98	605.99	446.01
6	-	622.00	622.00	2,475.00	1,853.00	128.86	512.76	383.90
7	-	894.00	894.00	2,250.00	1,356.00	142.47	358.57	216.10
8	-	342.00	342.00	-	-342.00	41.93	0	-41.93
9	-	342.00	342.00	-	-342.00	32.25	0	-32.25
10–29	-	12,216.00	12,216.00	29,025.00	17,151.00	188.25	473.05	284.80
30	-	342.00	342.00	-	-342.00	0	0	0
Total	1,867.00	16,972.00	18,839.00	38,700.00	19,861.00	3,518.53	2,978.43	-540.09

Table 12 Summary of financial and economic viability indicator

Measures of project worth	Financial analysis	Economic analysis
Net present value (GH¢)	48.57	540.09
Benefit cost ratio	1.02	0.85
Internal rate of return (%)	29.15	25.38

Sensitivity analysis

A sensitivity analysis was conducted on some key or sensitive variables on the production of coffee from both the financial and economic points of view to ascertain how changes in such variables will affect the viability indicators, viz. NPV, BCR, and IRR. The analysis was carried out based on the assumptions. These included a 10% decrease in the interest rate and a 10% increase in the price of a 60 kg bag of dried coffee. An assumption of a 10% increase in coffee price was based on the fluctuating price of dried coffee in the world market. A 10% reduction in the discount rate resulted in positive indicators from both financial (NPV of GH¢1,437.19, BCR of 1.39, and IRR of 29.15%) and economic (NPV of GH¢697.86, BCR of 1.16, and IRR of 25.38%) analysis point of view, indicating the viability of coffee production in Ghana. Table 13 shows that coffee production is financially and economically viable when the aforementioned assumptions are implemented, indicating great potentials for coffee production in Ghana.

Table 13 Results of sensitivity analysis

Stimulus	Financial analysis			Economic analysis		
	NPV (Gh¢)	BCR	IRR (%)	NPV (Gh¢)	BCR	IRR (%)
10% Decrease in discount rate	1,437.19	1.39	29.15	697.86	1.16	25.38
10% Increase in coffee price	346.42	1.12	33.91	239.60	0.17	27.93

Note: NPV = net present value, BCR = benefit cost ratio, IRR = internal rate of return

Constraints to Coffee Production

From the survey, various constraints were identified and ranked using Kendell's coefficient of concordance to ascertain the degree to which the various constraints affect the coffee farmers. A Kendall W of 0.694 which is significant at the 1% level, implies that there is 69.4% agreement in the ranking of the constraints by the coffee farmers. The analysis revealed a poor marketing system, difficulty in harvesting coffee berries, weak extension services, and low governmental support as the most pressing constraints to coffee production, as they ranked first, second, third, and fourth respectively. The findings are in line with Bellachew (2011) who reported that a poor internal marketing system is the most critical problem facing coffee farmers in Ghana. Mujawamariya *et al*. (2013) also made a clear statement in their study that harvesting coffee berries is difficult and therefore harvesters should be well compensated. Difficulty in accessing credit, high cost of labor, and difficulty in raising capital were also ranked as the less pressing constraints being ranked as fifth, sixth, and seventh respectively. Table 14 presents the constraints according to their severity to the coffee farmers.

Table 14 Constraints to coffee production

Constraints	Mean	Rank
Poor marketing system	2.46	1st
Difficulty in harvesting coffee berries	2.88	2nd
Weak extension services	3.35	3rd
Low governmental support	3.85	4th
Difficulty in accessing credit	4.09	5th
High cost of labor	5.74	6th
Difficulty in raising capital	7.27	7th

Note: Kendall's W = 0.694, chi-square = 738.426, df = 8, significance level = 0.0001

CONCLUSIONS

The study analyzed the viability of coffee plantation establishment to ascertain whether observed low coffee production in Ghana is because the production of the crop is financially and economically not viable. The study revealed that both coffee and non-coffee producers have negative perceptions about coffee production and therefore, as it stands now, not many people will want to go into its production despite its proven potential as an avenue for creating jobs in the country. Generally, the study found coffee production to be both financially and economically viable at a discount rate that is not higher than 30%. This will however require government intervention to help keep the bank rate at desired levels. In fact, the viability indicators estimated in this study are significant and thus give indications that coffee production is a promising venture in Ghana especially when interest rates are low. This is good news for Ghana since an increase in its production will increase the incomes of producers and therefore a positive contribution to Ghana's foreign exchange earnings. Coffee production could therefore join other viable cash crops like cocoa and cashew in the fight against the high rate of unemployment in Ghana if the populace especially job seekers are encouraged to consider coffee production as a business. The viability indicators estimated in this study are for relatively small coffee plantations. If the farm is larger, the rate of return would be expected to be higher due to economies of scale, making large scale coffee production to be even more promising. Finally, the study revealed that the major constraints to coffee production include poor marketing system, difficulty in harvesting the coffee berries, weak extension service, and low governmental support.

The government, non-governmental organizations, and other potential investors are encouraged to consider coffee production especially, the Dormaa Municipality of Ghana as a business. Also, there should be an establishment of a viable internal coffee marketing system to specifically handle coffee marketing issues in Ghana. The coffee price fluctuates and therefore there is the need for government intervention through COCOBOD to adjust and fix the product price of coffee upwards to encourage many people to go into cotton production. In addition, there should be an establishment of a viable extension system for coffee producers through setting up of a coffee extension service unit under COCOBOD, solely responsible for providing basic extension services to coffee farmers. Finally, it is encouraged that coffee farmers are supplied with coffee hulling machines to help them easily process the coffee berries after the drying stage. This is because most of them sell their coffee after drying and are therefore unable to earn substantial income from the commodity. It is therefore important to supply farmer groups or associations at least with small hullers to carry out proper hulling and bean grading for a premium price. This will make

it attractive for job seekers, especially unemployed youth to consider coffee production as an option for meeting their livelihoods. In fact, farmers should be educated about the prospects of coffee production. This will help do away with the negative perception most farmers have about the production of the crop which in a way discourages them to think of cultivating it.

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