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Seedling production and choice among cashew farmers in Ghana: a profitability analysis

Richard Kwasi Bannor and Helena Oppong-Kyeremeh
Department of Agricultural Economics, Agribusiness and Extension, University of Energy and Natural Resources, Sunyani, Ghana
Steffen Abele
University of Applied Forest Sciences, Rottenburg, Germany, and
Frank Osei Tutu, Samual Kwabena Chaa Kyire and Dickson Agyina
Department of Agricultural Economics, Agribusiness and Extension, University of Energy and Natural Resources, Sunyani, Ghana

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Abstract

Purpose – The unavailability and inadequate use of cashew seedlings for propagation are part of the challenges facing the cashew sub-sector in Ghana. However, promoting investment into cashew seedling production should be based on the analysis of the profitability and viability of such a venture as well as the respective determinants of farmers' demand for the planting material.

Design/methodology/approach – This study used gross margin/contribution, net margin and contribution ratios to analyse the profitability of cashew seedling production under four different business models. Also, the determinants of choice of planting material for cashew plantation among farmers was analysed via a multinomial probit regression.

Findings – The study revealed that cashew seedling production is profitable with a gross margin of \$8,474, \$2,242, \$1,616 and \$1,797 and contribution to sales of 31–53% for the various business models. The positive determinants of the use of cashew seedlings were off-farm job participation and extension contact, whereas farm size and age of plantation negatively influenced the use of seedlings. Land acquisition method also influenced the use of both seedlings and seeds negatively.

Practical implications – The findings provide empirical evidence of the viability and profitability of cashew seedling production as a viable business venture and off-farm opportunity in rural areas. The information from the study will help major stakeholders in cashew production to understand the type of farmers who use seeds and seedlings as well as the reasons for using or otherwise.

Originality/value – Significant research in the cashew value chain had focussed on the profitability of cashew plantation with little literature on profitability and viability analysis of cashew seedling production. Similarly, this study provides a significant value chain job opportunity as well as literature on the choice of cashew seedlings among current and prospective end-users.

Keywords Cashew, Profitability, Seeds, Seedlings and agripreneurs

Paper type Research paper

1. Introduction

The world's cashew production has been increasing steadily and, as a result, in 2014, the total world production of cashew was 3,713,467 tonnes with Ghana contributing 50,000 tonnes (1.35%) to the total production. Ghana has also witnessed a steady increase in production of

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Availability of data and materials: The dataset used in this study is available from the corresponding author on reasonable request.

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cashew with increases in total production from 9,000 tonnes in 2002 to 50,000 tonnes in 2014 represented by a compound growth rate of 15.36% (FAOSTATS, 2017). Studies have shown that cashew was brought to Ghana in the late 1960s, but the interest was subsequently rekindled through the introduction of the Economic Recovery Programme and Cashew Development Plan in 1983 and 2002 respectively (Evans *et al.*, 2015). Consequently, agricultural land in most parts of Bono and Bono East Regions of Ghana – where it is now grown at the highest density has been shifting from the production of food crops towards increased cashew nut cultivation in recent years. These areas used to be forest zones but have been gradually metamorphosing into savannah and transitional zones as a result of deforestation (Bezerra *et al.*, 2007). Even worse, Ghana has recently recorded the highest rainforest loss, with about 60% increases in the country's primary rainforest loss in 2018 compared to 2017 (World Economic Forum, 2019). Negative implication as it may seem, however, this has revived interest in cashew plantation as it can grow in harsh, semiarid climatic and soil conditions as well as serve as climate change and afforestation crop (Mensah, 2017; De Alencar *et al.*, 2018). As a result, cashew has over the years become the number one non-traditional export earner in Ghana's agriculture sub-sector, contributing approximately $196.7 million in 2016 (GEPA, 2017; Bannor *et al.*, 2019).

Consequently, the economic importance of cashew production has been dramatically acknowledged by small-scale farmers who are currently growing it at an exponential rate (Das and Arora, 2017; De Alencar *et al.*, 2018). It suggests that, intrinsically, investment in the cashew sub-sector is crucial for a country that is over-dependent on cocoa as her major exporting crop (Bannor *et al.*, 2019). Besides, future demand for cashew seedlings is also expected to be high in the Bono and Bono East Regions which house most of the commercial cashew plantations (Moreira da Silva *et al.*, 2017). However, at variance to the common practice of the use of nursery-grown seedlings for tree establishment, most cashew plantations are planted using seeds (Dedefo *et al.*, 2017). This culture could be a threat to the economic potential and benefits of the cashew sub-sector, mainly because orchards planted with seeds have low establishment rate ranging between 62 and 64% (Martin *et al.*, 1997). Besides, the propagation of cashew with seed results in differences in the plant species phenotypically, low productivity and increased costs, which inhibits its commercial exploitation (Azam-Ali and Judge, 2001). However, grafted cashew seedlings have a shorter period of maturity (Government of Ghana, 2018b). Additionally, the use of cashew seedlings ensures successful establishment and rapid growth after transplanting (Pinto *et al.*, 2011).

The unavailability and inadequate use of cashew seedlings for propagation is one of the fundamental agronomic challenges faced by the cashew industry in Ghana (Dendena and Corsi, 2014; Moreira da Silva *et al.*, 2017). Besides, most farmers who use seeds do not have enough knowledge on the selection of good and quality nuts for propagation. Also, seed collection by these farmers is commonly based on opportunistic strategies that only consider availability and distance to seed sources, but not seed quality (Luna-Nieves *et al.*, 2019). Additionally, there is a growing sense of inertia among farmers to use seedlings for the propagation of orchards. Beyond these, there is also an imbalance in the supply and demand of seedlings which has further promoted the use of seeds for cashew propagation (Moreira da Silva *et al.*, 2017). Consequently, as part of the strategy to battle this problem, creating jobs for the unemployed youth in the country, modernise and transform Ghana's cashew sector; the Government of Ghana has initiated efforts to distribute improved seedling planting materials to current and prospective cashew farmers via its flagship10-years Cashew Development Plan (Government of Ghana, 2018a; Ali, 2018). Further, various agripreneurs, especially women and the youth, have been encouraged to establish cashew nurseries to cash on the benefits and opportunities emanating from the sub-sector (Business and Financial Times, 2018).

Notwithstanding the initiatives of the Government of Ghana and other major stakeholders in the cashew sub-sector, investment into cashew seedling production should be grounded on the analysis of the profitability and viability of such venture. Meanwhile, there is also a need to understand the type of farmers who use seeds and seedlings as well as the reasons for using them or otherwise. This will assist in removing the sense of inertia in some farmers to the use of seedlings via extension education as well as targeting those farmers who are willing to use the cashew seedlings (Government of Ghana, 2018b). Besides, given the importance of seedlings to the establishment of cashew plantations and its effect on productivity, it is imperious that the factors influencing its usage are critically examined and the necessary recommendation professed (Dedefo *et al.*, 2017).

Moreover, domestic as well as international studies on cashew production and the cashew seedling situation are few, with only a few information sources about the Ghana situation. Among the few scientific approaches is the recent study by Bannor *et al.* (2019), which endeavoured to close the knowledge gap on the comparative advantage of cashew production in Ghana, however, does not deal with the seedling production. The African Cashew Initiative (2010) provides a fundamental value chain analysis with basic quantitative data as well as qualitative assessments, with little reference to the seedling sector. Sarpong (2011) provides a meso-economic assessment of wealth generation from the cashew sector in Western Ghana; however, no business-based profitability assessment was done. Von Freyhold (2013) provides another sectoral overview on cashew production in Ghana without going deeper into profitability of cashew production or even inputs like seedlings. On the profitability of cashew plantations, Wongnaa and Awunyo-Vitor (2013) also analyse the profitability of cashew plantation but did not consider seedlings production. Thus, there is a significant research gap on the profitability of seedling production and its determinants.

2. Materials and methods

2.1 Study area

Multi-stage sampling technique was employed to select 120 farmers who own cashew plantations from three districts namely Jaman North, Techiman North and Techiman Municipal for the study (refer to the Appendix for detail descriptive information on the cashew farmers interviewed). Firstly, Bono and Bono East Regions were selected purposively because of their known high intensity of cashew production in Ghana. Secondly, the five major cashew producing districts (Techiman Municipality, Wenchi, Jaman South, Jaman North and Nkoranza South Districts) in the regions were purposively selected (Mensah, 2017; Bannor *et al.*, 2019). Three districts out of the five districts were selected randomly. Four communities known to be high in the production of cashew were selected purposively from each of the three districts. Finally, relying on the sampling frame from the Ministry of Food and Agriculture (MOFA) extension officers, 10 cashew plantation farmers were selected from each of the communities. From the central limit theorem, a sample of $\geq$30 is suitable for empirical analysis, especially in this case where the total population of cashew farmers in the two regions were not readily available and hence the sample size of 120 farmers was right for analysis. Besides, the Cashew Farmers Association had about 4,900 registered farmers during the time of interview even though currently, they are about 7,000 farmers. Given this, even if the Yamane (1967) approach for sample size determination were adopted (About 98 farmers were representative of the total population with a margin of error of 10%) implying that the sample size of 120 farmers is appropriate. In this study, cashew farmers were defined as any farmer with equal or more than one acre of cashew farm.

Furthermore, the snowball sampling technique was used to interview thirty-seven (37) cashew seedling producers spread all over the five (5) cashew producing districts in the region. The total number of cashew seedling producers is not documented; hence, the authors had to interview available producers which were more than 30. The seedling producers were interviewed to solicit for information on the cost and margins of seedling production; hence, a sample size of 37 was adequate for the financial analysis.

2.2 Gross margin analysis

Gross margin/contribution and gross margin percentage was used to estimate cashew seedling production profitability on 100 m^2 of land, 50 m^2 and 25 m^2 of land. These land sizes were used as business models. Detailed analyses of the various business models under the three areas of land size are presented in Tables 1–4. Additionally, in each model, the detailed unit cost and quantity of various items and activities, as well as the percentage cost of that item from the total cost for producing seedlings, are presented. Land (400 m^2) is rented per year at the same price for all the models used in this study. However, the production of seedling is not done on the entire land as gathered from the interviews of seedling producers.

In this study, gross margin (GM) otherwise known as the contribution was modelled as the differences between total revenue (TR) and total variable cost (TVC) using the empirical model below:

$$\text{Gross Margin(GM)} = \text{Total Revenue(TR)} - \text{Total Variable Cost(TVC)} \quad (1)$$

It is instructive to note that the price values of various items used in the business models were collected in the local currency of Ghana cedis (GH¢). The exchange rate at the time of the study was US$ 1 = GH¢ 5. Gross Margin Analysis of cashew seedling production was preferred to other investment appraisals such as Net Present Value (NPV), Internal Rate of Return and discounted cash flow because cashew seedlings are ready for transplanting and the market by three months after nursery. Besides, fixed costs are not under the control of the cashew seedling producer at least within the first year of production; therefore, an analysis of variation in the costs and revenue is required for the various business models. Also, gross margin has the added advantage of measuring the efficiency of farm enterprise or comparing two agribusinesses of different sizes and as consequence has been used widely for investment appraisal of annual crops productions (Semerci *et al.*, 2014; Cheng and Rosentrater, 2017; Wongnaa *et al.*, 2019a, b; Demir and Gözübüyük, 2020)

2.3 Multinomial probit regression

From this study, the choice of seeds only, seedlings only and both seeds and seedlings as planting material for cashew plantation propagation are dependent on the satisfaction that a farmer gets from the cashew planting material. In such instances, multinomial logit (MLM) and multinomial probit models (MPM) are widely used by many studies in Ghana ((Tsinigo and Behrman, 2017; Danso-Abbeam *et al.*, 2017; Alhassan *et al.*, 2019; Badu-Gyan *et al.*, 2019). The preference for the two models is mainly based on their consistency, efficiency and normality (Dow and Endersby, 2004). Intuitively, the two models are similar but are different in the error term distribution (Kropko, 2008). However, MLM is suitable when the regressors vary across individuals. The MLM is commonly used under such circumstances mainly because it is easy to estimate and interpret notwithstanding a large number of regressors (Cheng and Long, 2007; Gujarati, 2015). Nevertheless, the dependent errors of MLM impose an assumption called the independence of irrelevant alternatives (IIA) (Dow and Endersby, 2004). Fundamentally, IIA requires that a farmer's evaluation of an alternative relative to another alternative should not change if a third (irrelevant) alternative is added or dropped to the analysis. In this instance, suppose a farmer is twice as likely to choose cashew seeds for propagation to the choice of seedlings, under MLM the farmer should remain twice as likely to choose seeds over seedlings even if the choice of both seeds and seedlings are a worthwhile option. As such, this assumption is not the best in this study (Train, 2003). Accordingly, the choice of both seeds and seedlings may become eminent for a farmer when there are no seeds available, thus violating IIA. With the violation of IIA, MLM will be a mis-specified model with coefficient estimates biased and inconsistent (Kropko, 2008). In contrast, however, MPM does not assume IIA hence gave a better and more accurate estimates (Dow and Endersby, 2004; Kropko, 2008).

Item/Activity	Quantity	Frequency (days or months)	Unit price ($)	Total cost ($)	% of total cost
Income					
Seedlings sold	40,000		0.4	16,000	
Variable cost					
Hired labour					
Nursery structure construction	4	5	4	80	1.00
Filling of the poly bags	40,000		0.008	320	3.98
Land clearing	3	3	3.6	32.4	0.40
Porting/Planting	5	8	3.6	144	1.79
Foliar fertiliser application	1	2	6	12	0.15
1st weeding	2	2	3.6	14.4	0.18
2nd weeding	2	2	3.6	14.4	0.18
Watering of seedlings	5	54	3.714	1002.78	12.49
Harvesting	3	3	3.6	32.4	0.40
Input cost					
Seeds (kg)	400		1.4	560	6.97
Foliar fertilizer (litres)	2		8	16	0.20
Insecticide/pesticide (1 L)	2		5	10	0.12
Polybags	40,000		0.014	560	6.97
Soil (trips of sand)	10		56	560	6.97
Miscellaneous cost					
Cost of water (1,000 L)	1		167.2	167.2	2.08
Grafting	40,000		0.08	3,200	39.84
Scion	40,000		0.02	800	9.96
Total variable cost				7,526	93.70
Fixed cost					
Cost of Land	1		40	40	0.50
Cost of wooden poles	60	1	1	60	0.75
Cost of wooden bars	30	1	1	30	0.37
Cost of palm fronds	500	1	0.1	50	0.62
Equipment					
Cutlasses	2		5	10	0.12
Hoes	2		6	12	0.15
Knapsack sprayers	1		16	16	0.20
Axes	1		4	4	0.05
Baskets	3		3	9	0.11
Watering can	4		7.2	28.8	0.36
Watering DRUM	1		20	20	0.25
Polysheet	80		2	160	1.99
Gloves	10		3	30	0.37
Pick axe	1		6	6	0.07
Shovel	3		5	15	0.19
Hand trowel	5		3	15	0.19
Total fixed cost				505.8	6.30
Total cost				8031.38	100.00

Source(s): Authors' computation based on field data, 2019

Table 1. Profitability assessment of model 1

Item/Activity	Quantity	Frequency (days or months)	Unit price ($)	Total price ($)	% Of total cost
Income					
Seedlings sold	18,000		0.4	7,200	
Variable cost					
Hired labour					
Nursery structure construction	4	5	4	80	1.50
Filling of the poly bags	18,000		0.008	144	2.70
Land clearing	3	3	3.6	32.4	0.61
Porting/Planting	5	8	3.6	144	2.70
Foliar fertiliser application	1	2	6	12	0.23
1st weeding	2	2	3.6	14.4	0.27
2nd weeding	2	2	3.6	14.4	0.27
Watering of seedlings	5	54	3.6	972	18.26
Harvesting	3	3	3.6	32.4	0.61
Input cost					
Seeds (kg)	200		1.4	280	5.26
Foliar Fertilizer (kg)	1		8	8	0.15
Insecticide/pesticide	1		5	5	0.09
Polybags	18,000		0.014	252	4.73
Soil (trips of sand)	5		56	280	5.26
Miscellaneous cost					
Cost of water (1,000 L)	1		167.2	167.2	3.14
Grafting	18,000		0.12	2,160	40.57
Scion	18,000		0.02	360	6.76
Total variable cost				4957.8	93.12
Fixed cost					
Cost of Land	1		40	40	0.75
Cost of wooden poles	30	1	1	30	0.56
Cost of wooden bars	15	1	1	15	0.28
Cost of palm fronds	300	1	0.1	30	0.56
Equipment					
Cutlasses	2		5	10	0.19
Hoes	1		6	6	0.11
Knapsack sprayers	1		16	16	0.30
Axes	1		4	4	0.08
Baskets	2		3	6	0.11
Watering can	2		7.2	14.4	0.27
Watering drum	1		20	20	0.38
Polysheet	60		2	120	2.25
Gloves	10		3	30	0.56
Pick axe	1		6	6	0.11
Shovel	2		5	10	0.19
Hand trowel	3		3	9	0.17
Total fixed cost				366.4	6.88
Total cost				5,324	100.00

Source(s): Authors' computation based on field data, 2019

Table 2. Profitability assessment of model 2

Item/Activity	Quantity	Frequency (days or months)	Unit price ($)	Total price ($)	% Of total cost
Income					
Seedlings sold	9,000		0.4	3,600	
Variable cost					
Hired labour					
Nursery structure construction	2	3	4	24	1.09
Filling of the poly bags	9,000		0.008	72	3.28
Land clearing	2	1	3.6	7.2	0.33
Porting/Planting	2	3	3.6	21.6	0.98
Foliar fertiliser application	1	1	6	6	0.27
1st weeding	1	1	3.6	3.6	0.16
2nd weeding	1	1	3.6	3.6	0.16
Watering of seedlings	1	54	2	108	4.91
Harvesting	1	2	3.6	7.2	0.33
Input cost					
Seeds (kg)	100		1.4	140	6.37
Foliar fertilizer (litres)	1		8	8	0.36
Insecticide/pesticide (1 L)	1		5	5	0.23
Polybags	9,000		0.014	126	5.73
Soil (trips of sand)	2		56	112	5.09
Miscellaneous cost					0.00
Cost of water (1,000 L)	1		80	80	3.64
Grafting	9,000		0.12	1,080	49.13
Scion	9,000		0.02	180	8.19
Total variable cost				1984.2	90.26
Fixed cost					
Cost of Land	1		40	40	1.82
Cost of wooden poles	15	1	1	15	0.68
Cost of wooden bars	9	1	1	9	0.41
Cost of palm fronds	200	1	0.1	20	0.91
Equipment					
Cutlasses	1		5	5	0.23
Hoes	1		6	6	0.27
Knapsack sprayers	1		16	16	0.73
Axes	1		4	4	0.18
Baskets	1		3	3	0.14
Watering can	1		7.2	7.2	0.33
Watering drum	1		20	20	0.91
Polysheet	20		2	40	1.82
Gloves	4		3	12	0.55
Pick axe	1		6	6	0.27
Shovel	1		5	5	0.23
Hand trowel	2		3	6	0.27
Total fixed cost				214.2	9.74
Total cost				2198.4	100.00

Source(s): Authors' computation based on field data, 2019

Table 3. Profitability assessment of model 3

Table 4.
Profitability assessment of model 4

Item/Activity	Quantity	Frequency (days or months)	Unit price ($)	Total price ($)	% Of total cost
Income					
Seedlings sold	9,000		0.4	3,600	
Variable Cost					
Family labour					
Food for all nursery management activities	2	54	3	324	16.06
Transportation for family labour	2	54	1	108	5.35
Input cost				0	0.00
Seeds (kg)	100		1.4	140	6.94
Foliar fertilizer (1 L)	1		8	8	0.40
Insecticide/pesticide (1 L)	1		5	5	0.25
Polybags	9,000		0.014	126	6.25
Soil (trips of sand)	2		56	112	5.55
Miscellaneous cost					
Cost of water (1,000 L)	1		80	80	3.97
Grafting	9,000		0.08	720	35.69
Scion	9,000		0.02	180	8.92
Total variable cost				1803	89.38
Fixed cost					
Cost of Land	1		40	40	1.98
Cost of wooden poles	15	1	1	15	0.74
Cost of wooden bars	9	1	1	9	0.45
Cost of palm fronds	200	1	0.1	20	0.99
Equipment				0	0.00
Cutlasses	1		5	5	0.25
Hoes	1		6	6	0.30
Knapsack sprayers	1		16	16	0.79
Axes	1		4	4	0.20
Baskets	1		3	3	0.15
Watering can	1		7.2	7.2	0.36
Watering drum	1		20	20	0.99
Polysheet	20		2	40	1.98
Gloves	4		3	12	0.59
Pick axe	1		6	6	0.30
Shovel	1		5	5	0.25
Hand trowel	2		3	6	0.30
Total fixed cost				214.2	10.62
Total cost				2017.2	100.00

Source(s): Authors' computation based on field data, 2019

In this study, suppose

$Y_{ig} = 1$, if the individual I chooses alternative g ($g = 1$, 2, and 3 in this study) where 1 = seeds only, 2 = seedlings only and 3 = both seeds and seedlings.

$$\text{Further, let}: \quad \alpha_{ig} = \Pr(Y_{ig} = 1), \quad \text{Where Pr stands for probability} \tag{2}$$

Therefore, $\alpha_{i1}, \alpha_{i2}\, \alpha_{i3}$ represent the probabilities that an individual i chooses alternative 1, 2 or 3 respectively – that alternatives an individual face, then, obviously,

$$\alpha_{i1} + \alpha_{i2} + \alpha_{i3} = 1 \tag{3}$$

This is because the sum of the probabilities of mutually exclusive and exhaustive events must be 1. The αs are known as the response probabilities.

The multinomial probit regression can be written as:

$$\alpha_{ig} = \frac{e^{\sigma_g} + \beta_g X_i}{\sum_{g=1}^{3} e^{\sigma_g} + \beta_g X_i} \tag{4}$$

The subscript g on the intercept and the slope coefficient indicate that the values of the coefficients can differ from choices. In other words, a farmer who does not use seedlings will attach a different weight to each explanatory variable than a farmer who uses only seeds or both seeds and seedlings (Gujarati, 2015).

Table 5 shows the variables in the multinomial probit regression analysis. About 10 variables were considered for this analysis. The variables were placed under three main sub-headings, namely, household, farm and marketing and institutional characteristics. The dependent variables were the planting materials used by farmers in establishing cashew plantations. The planting materials were seeds, seedlings and both seeds and seedlings. It is worthwhile to note that in the model, the use of seeds for propagation was used as the baseline reference or comparison group in the analysis. Age of the farmer, age of plantation, farm size, land acquisition type, marketing outlet were expected to positively influence the preference for seeds only to seedlings only or both seeds and seedlings. However, education, experience, type of labour, extension contact and off-farm job participation were hypothesised to influence the use of seeds only negatively.

Moreover, from Table 5, the mean age distribution of the farmers interviewed was approximately 42 years. Also, the number of years of education was recorded as 8 years, which suggests that majority of the farmers have had at least a basic level of education of either Junior secondary school or the old middle school (look for details in Appendix, Table A1). The average cashew farming experience was 14 years. An average value of 0.32 indicates that hired labour is mostly used in the management of cashew plantations. Averagely (0.52), most farmers use farm gate as the marketing outlet. The average age of cashew plantation, however, was approximately 18 years, whereas the mean size of the farms was approximately 5.1 ha (12.5 acres). Extension education received on cashew farming was low, hence an average value of 0.31. The results further reveal that cashew plantation lands were mainly acquired via inheritance (0.74). Off-farm job participation was a little above the average (0.58) among interviewed farmers.

3. Results and discussion

3.1 Description of cashew seedling producers

From Table 6, the results show that majority of the seedling producers in the region (62.1%) are between 20 and 40 years with the majority as males (81.1%), indicating male dominance in

Variable	Description	Measurement	Expected sign	Mean	Std. Dev	Relevant literature
Dependent variables						
Propagation material used	Choice of propagation material used by farmers	1 = Seeds only 2 = Seedlings only 3 = Seedlings and seeds		1.41	0.74	
Independent variable						
Household characteristics						
Age	Age of the respondent	Number	+	42.00	14.57	Njeru *et al.* (2019)
Education	Highest formal education level attained	Number of school years	–	8.88	4.61	Mwololo *et al.* (2019) and Njeru *et al.* (2019)
Experience	Number of years in cashew farming	Number	–	14.64	10.00	Kasonga (2018)
Labour used	Type of labourers used	1 = Family labour 0 = Otherwise	–	0.34	0.48	Nandi *et al.* (2012)
Farm and marketing characteristics						
Age of plantation	Number of years of cashew plantation	Number	+	17.93	9.41	Chandio and Yuansheng (2018)
Farm size	Land size of the cashew farm	Acres	+	12.51	17.09	Bannor *et al.* (2019)
Marketing outlet	Major marketing outlet for cashew raw nuts	1 = farm gate 0 = otherwise	+	0.52	0.50	Bekele (2006); Nandi *et al.* (2012)
Institutional characteristics						
Extension contact	Farmer receive extension services on cashew production	1 = Received 0 = Otherwise	–	0.31	0.46	Kasonga (2018)
Land acquisition	Acquisition of cashew land	1 = Inheritance 0 = Otherwise	+	0.74	0.44	Chimoita *et al.* (2019)
Off-farm	Participation in an off-farm job	1 = Yes 0 = otherwise	–	0.58	0.50	Bannor *et al.* (2019)

Source(s): Authors' own, 2019

Table 5.
Description of variables to be used in the multinomial probit regression

the seedling sub-sector. This phenomenon in the cashew sub-sector is consistent with Martin *et al.* (1997) who revealed that cashew activities are mainly carried out by adult males. The results could be attributed to the variations in laws, culture, ethnic groups and religious beliefs grounded on the ideologies of female seclusion (Bannor and Sharma, 2015). The results further reveal that most of the farmers are middle-aged and hence could work optimally to increase cashew productivity (Bannor and Sharma, 2015). Intrinsically, the involvement of the youth in the cashew seedling production has a positive outlook for the cashew industry and the seedling sub-sector. On education, only 2.7% of the cashew seedling producers had no formal education with other producers having formal education between primary and tertiary level. Most of the seedling producers (54.1%) have a household size ranging from 1 to 5 members with 45.9% of the households having 6–10 members. From the results, about 70.2% of the producers' main occupation is farming with about 29.6% involved in other non-

Variables	Cashew seedling producers Frequency (n = 37)	Percentages
Age of respondents		
20–30	10	27.0
31–40	13	35.1
Above 40	14	37.8
Gender		
Female	7	18.9
Male	30	81.1
Educational level		
No formal education	1	2.7
Basic	16	43.2
Secondary/Vocational	11	29.7
Tertiary	9	24.3
Household size		
1–5	20	54.1
6–10	17	45.9
Economic activities		
Farming	26	70.2
Trading	3	8.1
Others	8	21.6
Growing of other seedlings		
No	19	51.4
Yes	18	48.6
Years of experience in other seedlings		
0–10	32	86.5
11–20	5	13.5
Years of experience in cashew seedlings production		
1–5	30	81.1
6–10	5	13.5
11–15	2	5.4
Sources of Scion		
Bole	1	2.7
Co-farmers	3	8.1
WARS	33	89.2
Sources of Seed		
Cashew buyers	2	5.4
Co-farmers	8	21.6
Own seeds	2	5.4
Unity afforestation (U.A)	1	2.7
Wars	24	64.9

Source(s): Authors' own field survey, 2018

Table 6. Description of cashew seedling producers

farming activities such as trading in electronic appliances, agricultural produce and handicraft as their primary occupation. An estimated result of 48.6% of the producers was into the production of the seedlings of other crops such as mango and citrus. The majority (81.1%) had experience between 1 and 5 years with about 18.9% having more than five years' experience. The study further revealed that about 8.1% produced non-grafted seedlings, hence did not use scion.

3.2 Production data of cashew farmers

The results from Table 7 reveal that an average of 400 kg of seeds were used on land area of 100 m^2 to produce about 40,000 seedlings. The results further reveal that most of the cashew producers (represented by 74.16%) used seeds in propagating their cashew farms, whereas about 15% used both seedlings and seeds for the production. Only few, represented by approximately 10.8%, used seedlings.

The major source of planting material (represented by 60.83%) is co-farmers with only 25% who had planting materials from seedling producers. However, very few (8.33%) had the planting materials from diverse sources. Out of the two cashew scion banks located in Ghana, 81.1% of the seedling producers had the scion from the Wenchi Agricultural Research Station (WARS), whereas only one producer had his scion from Cocoa Research Institute of Ghana (CRIG) Sub-station at Bole. However, about 8.1% of the sampled producers had scion from other producers. Similarly, most of the cashew producers had their seeds from WARS; however, about 21.6% had their cashew seeds from co-farmers. The revelation of co-farmers as the primary source of planting material reiterates that colleagues of farmer significantly remain a vital channel in the supply chain of cashew planting materials. As such emphasis should be placed on farmer-led extension on the use of seedlings (Kiptot *et al.*, 2006).

3.3 The choice of cashew planting materials among farmers

From Table 8, an increase in one acre of a cashew farm, the multinomial log-odds for using seedlings for propagation relative to the use of seeds would be expected to decrease by 0.061 units. Similarly, the use of both cashew seedlings and seeds in comparison to the use of seeds only decreases by a unit of 1.324 when the age of a cashew producer increases by one year. The results on age corroborate Danso-Abbeam *et al.* (2017) who revealed that older farmers are used to conventional ways of production hence are risk-averse to new and modern technology compared to their contemporary younger ones who are risk loving. The results, however, contrast with Langyintuo and Mungoma (2008) who revealed that, the probability of adopting a new planting material by farmers is positively influenced by age. They also

Item	Frequency	Percentage
Kilograms of seeds per acre		
Average kilogram of seeds for 100 m^2 of land	400	
Price per kg of seed (2019)/$		
Average price/kg of seeds/$	1.40	
Number of seeds per kg		
Average number of seeds/kg	108	
Type of planting material		
Seed	89.00	74.16
Seedling	13.00	10.83
Both	18.00	15.00
Sources of planting material		
Own	12.00	10.00
Seedling producers	25.00	20.83
Co-farmers	73.00	60.83
Others (traders, extension officers etc)	10.00	8.33

Source(s): Authors' own field survey, 2018

Table 7. Planting materials used in the production of cashew

Variable	Seedlings Coeff.	Robust Std. Err	Z	p value	Seedlings and seeds Coeff.	Robust Std. Err	Z	p value
Household characteristics								
Age	−0.373	0.046	−0.82	0.413	−1.324	0.085	−14.80	*0.000
Education	−0.065	0.094	−0.69	0.491	−8.841	0.353	−25.08	*0.000
Experience	−0.035	0.075	−0.46	0.644	0.150	1.390	0.11	0.914
Labour used	0.625	0.906	0.69	0.490	7.924	2.637	3.01	*0.003
Farm and marketing characteristics								
Age of plantation	−0.192	0.103	−1.86	***0.063	−19.248	1.120	−17.18	*0.000
Farm size	−0.061	0.022	2.79	*0.005	−5.280	0.193	−27.41	*0.000
Marketing outlet	1.040	1.008	1.03	0.302	3.598	2.486	1.45	0.148
Institutional characteristics								
Extension contact	2.617	0.968	2.70	*0.007	90.488	4.773	18.96	*0.000
Land acquisition	−0.700	1.826	−0.38	0.701	−45.831	3.921	−11.69	*0.000
Off-farm job	1.532	0.859	1.78	***0.101	104.832	8.974	11.68	*0.000
Constant	−2.487	4.961	−0.50	0.616	118.074	8.773	13.46	*0.000
Wald chi^2 (20)	2553.77							
Prob > chi^2	0.0000							
Pseudo R^2	0.529							
Log pseudo likelihood	22.63							

Source(s): Author's computation based on field data
Note(s): NB: Significance; 1% = *, 5% = **, 10% = ***

Table 8. Factors influencing the choice of planting materials in the production of cashew

argued that, farmers with large farms would be more willing to dedicate percentage of their land to a new planting material compared with those with smaller farms. The different result could be attributed to the inadequate and non-availability of cashew seedlings in the country. Hence a farmer with large farm size will be more likely to use the planting material available which is mainly seed compared to seedlings (Shiferaw *et al.*, 2008). In contrast, a level increase in the educational level of a farmer increases the probability of using both seeds and seedlings by 8.841 units in comparison to the use of seeds only. The result is consistent with Weir and Knight (2000); Mutanyagwa *et al.* (2018) and Bannor *et al.* (2020) who revealed that educated farmers are generally open to innovative ideas and new technologies, hence, are most likely to accept current planting materials.

Further, the use of seedlings decreases by 0.192 in comparison with the use of seeds with an increase in the age of a cashew plantation. Likewise, the probability of using both seeds and seedlings decreases by 19.25 units compared to the seeds only. Interestingly, the result on the age of cashew plantations relative to seedling usage is consistent with studies by Abdulai (2016) and Chandio and Yuansheng (2018), however, in contrast with the findings by Bannor *et al.* (2020). On the contrary, an increase in the experience of a farmer decreases the probability of using seedlings compared to seeds. One plausible reason could be that, farmers who had good yields when seeds were used as planting material or who did not get the expected results from the propagation of cashew plantation with seedlings will be prone to the use of seeds for cultivation, no matter the frequency of extension contact. Therefore, the adage "experience is the best teacher" explains this as well. Besides, farmers' anticipation of achieving similar yield performance from seeds to seedlings vis-à-vis the cost of seedlings to seeds could be attributed (Martin *et al.*, 1997). The results, however, are consistent with Bernaldez and Mangaoang (2008) who noted that seeds are used for propagation by farmers in variance to recommendation by extension agencies mainly because the former is perceived to be highly effective. The log odds of using seedlings decrease with an increase in farm size by 0.061. Moreover, as expected, the log odds of using seedlings increases by 2.617 units compared to the use of seeds when a farmer has an extension contact. Also, the multinomial log-odds of using both seeds and seedlings increase by a colossal 90.488 units compared to the use of only seeds when a farmer has contact with extension officers. One conceivable reason for the use of both seedlings and seeds by farmers who have contact with extension officers could be that, even though extension officers advised farmers to use seedlings, there is always a shortage and mostly non-availability of cashew seedlings for planting. Consequently, farmers are advised to use all obtainable seedlings and complement with best of seeds accessible. Further, the high probability of using family labour to hired labour in propagation is mainly because the availability of family labour means farmers can undertake planting with seedlings at no extra cost (Moreira da Silva *et al.*, 2017). As a result, most farmers who have adequate family labour for activities such as transplanting, watering and weeding will prefer the use of seedlings to only seeds (Martin *et al.*, 1997). Inheritance land tenure system limits the business orientation of farmers, and hence, expectedly, farmers who inherited their lands are more likely to use seeds to seedlings (Drechsel *et al.*, 2006). Lastly, the multinomial log-odds for the farmers involved in off-farm job to use seedlings and both seedlings and seeds for the propagation of cashew plantation increase by 1.532 units and 104.83 units respectively compared to the use of seeds only. One credible reason why a farmer who is involved in off-farm job is likely to use both seedlings and seeds to only seeds could be that, farmers who are involved in other off-farm jobs are business-oriented. They are also equipped with enough information on the best practices for cashew production, unlike others who are solely into farming activities. Besides, many of the farmers involved in other jobs are motivated into cashew production because of the economic benefits the sector gives and promises. As such, they are willing to get everything right with the right use of planting materials inclusive.

3.4 Financial profitability and viability cashew seedling production

From Table 9, to identify the cost and expense structure per different land sizes of 100, 50 and 25 m^2, the study reveals that the costs included expenses for land rent, hired labour and family labour, inputs cost, miscellaneous cost (cost of water, grafting and scion) and equipment costs. Broadly, these cost and expenses were grouped under variable and fixed costs. Details of the variable and fixed cost can be found in Tables 1–4 at the materials and methods. From the results, the major cost in cashew production is the variable cost. This suggests that, the total cost in the production of cashew seedlings is primarily driven by the number of seedlings to be produced. The high variable cost is further complicated with the inadequacy of cashew seedling grafters which mostly increases the lead time in the cashew supply chain, thereby cutting producers off the available margins when demand is high; especially during April to September. Furthermore, the results suggest that, to reduce the cost of production, the cost of scion and grafting should be managed even though the quality of these activities should not be compromised as the success of grafting is mostly hooked on the size of the scion and quality of the grafting (Puthra and Anil, 2002). However, interestingly, currently in Ghana, there are only two scion banks: one at the CRIG Sub-station at Bole in the Savannah Region of Ghana and the other in WARS at Wenchi of the Bono East Region (Opoku-Ameyaw *et al.*, 2007; Bannor *et al.*, 2019). Eventually, demand overshadows supply hence the high cost of scion. With grafting, the field survey revealed that only few technicians have the skills of grafting cashew seedlings. As a result, the cost of accessing their services is high. This presents an opportunity for job creation in seedling grafting along the cashew value chain, as the demand for cashew seedling grafters has increased explicitly.

The results reveal the four different business models used in the cashew seedling production in Ghana. Model One is based on land area of 100 m^2; Model Two was on 50 m^2;

Item/Activity	Model 1 $	Model 1 $	Model 2 $	Model 2 $	Model 3 $	Model 3 $	Model 4 $	Model 4 $
Income								
Seedlings sold		16,000		7,200		3,600		3,600
Variable cost								
Hired labour								
Nursery structure construction	80		80		24			
Filling of the poly bags	320		144		72			
Land clearing	32.4		32.4		7.2			
Porting/Planting	144		144		21.6			
Foliar fertiliser application	12		12		6			
1st weeding	14.4		14.4		3			
2nd weeding	14.4		14.4		3			
Watering of seedlings	1002.78		972		108			
Harvesting	32.4		32.4		7.2			
Family Labour								
Food for all nursery management activities							324	
Transportation for family labour							108	
Input cost								
Seeds (kg)	560		280		140		140	
Foliar Fertiliser (litres)	16		8		8		8	
Insecticide/pesticide (1 L)	10		5		5		5	
Polybags	560		252		126		126	
Soil (trips of sand)	560		280		112		112	
Miscellaneous cost								
Cost of Water (1,000 L)	167.2		167.2		80		80	
Grafting	3,200		2,160		1080		720	
Scion	800	−7,526	360	−4,958	180	−1,984	180	−1,803
Gross/Contribution margin		8,474		2,242		1,616		1,797
Fixed cost								
Cost of land	40		40		40		40	
Cost of wooden poles	60		30		15		15	
Cost of wooden bars	30		15		9		9	
Cost of palm fronds	50		30		20		20	
Equipment								
Cutlasses	10		10		5		5	
Hoes	12		6		6		6	
Knapsack sprayers	16		16		16		16	
Axes	4		4		4		4	
Baskets	9		6		3		3	
Watering can	28.8		14.4		7.2		7.2	
Watering drum	20		20		20		20	
Polysheet	160		120		40		40	
Gloves	30		30		12		12	
Pickaxe	6		6		6		6	
Hand trowel	15		10		6		6	
Shovel	15	−506	9	−366	5	−214.2	5	−214.2
Net profit/Margin		7,968		1,876		1,402		1,583

Source(s): Author's own computation based on field data, 2019
Note(s): US$ 1 = GH¢ 5

Table 9. Financial viability of four different business models for cashew seedling production

25 m^2 land size for Model Three and 25 m^2 land size with the use of family labour instead of hired labour for the nursery management practices as Model Four. From Model One, the average revenue from the total cashew seedlings produced was $16,000 (find detail analysis in Table 1) with the average total variable cost as $7,526 and $506 as the average fixed cost. Likewise, total revenue of $7,200 was recorded for Model Two and approximately $3,600 for both Models Three and Four. From the analysis, Model Two's total cost of production was $5,324 with a contribution percentage of variable cost as 93.12% (find detail analysis in Table 2) and approximately 6.9% fixed cost. Similarly, the major cost in Model Three was the variable cost of $1,984. Likewise, Model Four which had only family labour also had a higher variable cost of $ 1,803. The results suggest that, the major cost in cashew seedling production is the variable cost. In detail, the major costs within the variable are from cost of scion and grafting of seedlings. With a unit price of $0.08 per a seedling and 40,000 seedlings under 100 m^2 of land area (Model 1), the percentage of grafting and scion contribute approximately 50% of the total cost. Likewise, the total contribution percentage of scion and grafting together in Models 2, 3 and 4 were approximately 47.33, 57.32 and 44.61%, respectively.

The evidence presented in Table 10 reveals that, gross or contribution margin were $8,474, $2,242, $1,616 and $1,797 for Models 1, 2, 3 and 4 respectively. All the models for cashew production were profitable with average returns ranging from a minimum of $1,402 to a maximum of $7,968. The results suggest that, within the first year of seedling production, one can generate enough money to even cover fixed cost. Further, a contribution ratio of about 53, 31, 45 and 50% for models 1, 2, 3 and 4 respectively are highly appreciable as it indicates an expectation of higher profit, all things being equal. The results reveal that, for each one US dollar ($1) revenue generated by a cashew seedling producer, he/she retains a profit under all the business models even though the initial cost of production is very high. From the contribution ratio results, for each One US dollar ($1) revenue generated by a cashew seedling producer, he/she retains $0.50 in Model One. However, $0.31 and $ 0.45 were generated in Models 2 and 3 respectively. Interestingly, when a producer used family labour instead of hired labour, he/she will retain $0.50 of each One US dollar ($1) revenue. Generally, in all the models, once fixed cost is covered, the contribution or margin is wholly profitable. Remarkably, it is still highly profitable compared to maize or vegetable production on the same size of land which is the opportunity cost of producing cashew seedlings. Accordingly, the gross margin of maize is reported to be $41.3 whereas that of vegetable is $345.71 per 400 m^2 of land (Wongnaa *et al.*, 2019b). From the results, various agripreneurs could consider the four models relative to their initial equity before venturing into the production. For a small and medium scale business or for starters in the cashew seedling business, model four is recommended to cut down variable cost but at the same time yielding the same benefit close to capital-intensive Model One.

Table 10.
Summary of profitability analysis

Item	Model 1 $	Model 2 $	Model 3 $	Model 4 $
Total Revenue	16,000	7,200	3,600	3,600
Variable cost	7,526	4,958	1,984	1,803
Gross/Contribution margin	8,474	2,242	1,616	1,797
Fixed cost	506	366	214.2	214.2
Net profit/Margin	7,968	1,876	1,402	1,583
Contribution to sales	53%	31%	45%	50%

Source(s): Author's computation based on field data, 2019

4. Conclusions

The research revealed that, even though cashew seedlings are very important and promote increased yield, only a few farmers use the cashew seedlings for cultivation with the majority practising planting at stake with seeds. The primary sources of planting materials were co-farmers. The factors that influence the use of seedlings positively were off-farm job and extension contact. Likewise, the positive determinants of the use of both seedlings and seeds were extension contact, family labour used and off-farm job. Farm size and age of plantation negatively influenced the use of seedlings. Age and land acquisition method also affected the use of both seedlings and seeds negatively. This implies that there are difficulties with investing in plantations, particularly for larger farmers, who then use less costly seeds rather than seedlings. Such financial restrictions should be overcome by providing respective means to the farmers, i.e. through credit schemes.

The positive gross margin value obtained from the financial viability concludes that seedling production is very lucrative and needs to be patronised by agripreneurs. However, the positive net margin obtained from various models of production indicate that, the use of family labour for raising seedlings on 25 m^2 of land has a higher net margin than using hired labour. Therefore, this land size is believed to be ideal for current and prospective small-scale cashew seedling producers. However, the Model One (100 m^2 land size which is capital intensive) is recommended for large-scale cashew seedling agripreneurs.

Grounded on the outcomes of the study, to promote the practice of using cashew seedlings for establishment of plantations, extension officers and the Ministry of Food and Agriculture's extension information systems should be activated and directed principally to educate farmers. This is more likely to influence the use of cashew seedlings in the region. Also, farmers with other off-farm jobs and prospective cashew farmers who are willing to buy new lands for cashew plantations should be targeted for extension education on the use of cashew seedlings as they might be more receptive to the idea. It is also recommended that, the District, Municipal, Metropolitan assemblies and international partners and stakeholder in conjunction with the Wenchi Agricultural Research Station should train the youth in seedling grafting to reduce the lead time in seedling production while at the same time providing job opportunities for the teeming unemployed youth in Ghana. Further, the Wenchi Agricultural Research Station should endeavour to increase the production of healthy scions for potential seedling producers, especially the youth, to benefit from the opportunity in seedling production. Also, training on seedling production and grafting should be encouraged under the Youth in Afforestation project currently run by the Government of Ghana.

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Corresponding author
Richard Kwasi Bannor can be contacted at: richard.bannor@uenr.edu.gh

Appendix

Variables	Cashew farmers (N = 120) Frequency	Percentage
Gender		
Male	89	74.4
Female	31	25.6
Marital status		
Married	68	56.7
Single	48	40.0
Divorced	1	1.1
Widowed	3	2.2
Age		
15–30	41	34.4
31–40	23	18.9
41–50	19	15.6
≥50	37	31.1
Off-farm job		
No	61	51.1
Yes	59	48.9
Household size		
1–5	87	72.3
6–15	28	23.3
≥16	5	4.4
Farm size		
1–10	87	72.3
11–20	24	20.0
21–30	0	0
31–40	4	3.3
≥41	5	4.4
Level of education		
No. formal education	20	16.7
Primary	4	3.3
MSLC/JSS	53	44.4
SSCE/O-Level/WASSCE	32	26.7
Tertiary	11	8.9
Years of experience		
1–10	55	45.6
11–20	40	33.3
21–30	9	7.8
31–40	13	11.1
≥41	3	2.2

Source(s): Author's own based on field data and Bannor *et al.* (2019)
Note(s): NB; MSLC = Middle School Leavers Certificate, JSS = Junior Secondary School, SSCE = Senior Secondary Certificate Examination, WASSCE = West African Senior School Certificate Examination

Table A1. Household characteristics of sampled farmers