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Growing Cashews: Exploring the Socio-demographic Drivers in the Practice of Cashew Agroforestry in the Bono Region of Ghana

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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Original Research Article

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Abstract

Socio-demographic factors play a vital role in the practice of cashew agroforestry, where cashew is intercropped concurrently with food crops. This study explored the socio-demographic drivers of cashew agroforestry practice. The study employed a semi-structured questionnaire survey involving 401 randomly selected farmers across three districts in the Bono Region of Ghana between July 2022 and December 2023, using a quantitative method approach and quantitative research design. For sample selection, the study adopted stratified random and simple random sampling techniques. Data analysis involved the use of SPSS to analyse selected socio-demographic characteristics of cashew farmers in the three districts. Since the overall KMO value for the dataset was 0.728 (> 0.5) and Bartlett's test of sphericity was significant ($p < 0.001$), the data were deemed appropriate for factor analysis. The total variance explained was 61.78%. The practice of agroforestry was male-dominated (67%). Many practitioners had formal education (64%). Many years of general farming experience (77% up to 30 years) and cashew farming experience (98% up to 30 years) were observed in the study. The study depicted an ageing population. Exploratory factor analysis identified demographic factors that mostly influenced the practice of cashew agroforestry. Four main demographic factors (Farming Expertise, District of Existence of Cashew Farm, Household Characteristics and Personal Relationships and Status) mostly influenced the practice of cashew agroforestry. Factor analysis, which identified key factors influencing cashew agroforestry, was valuable. Policy recommendations involve credit interventions for females and attractive packages for youth in cashew agroforestry.

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Keywords: Cashew agroforestry; socio-demographic characteristics; exploratory factor analysis; principal component analysis; smallholder farmers; farming experience; household characteristics; technology adoption; Bono Region.

1. Introduction

At the global level, cashew accounted for 17% of tree-nut production in 2019/2020, ranking third behind almonds and walnuts (International Nut and Dried Fruit Council Foundation, 2020; Otálora *et al.*, 2024). Cashew is among Africa's major high-income crops, ranking second to tobacco (Monteiro *et al.*, 2017). In 2020, Africa led raw cashew nut (RCN) production with 58.4%, followed by Asia with 37.9% and the Americas with 3.7% (FAOSTAT, 2022). Growing international demand for cashew, cocoa, mango and shea has prompted farmers to cultivate these high-value crops in addition to arable crops (Boafo *et al.*, 2019). In 2020, Ghana exported $340.7 million worth of raw cashews, with India and Vietnam being the top destinations (Ghana Export Promotion Authority, 2020).

Cashew nut production is predominantly carried out by smallholder farmers in Africa, including Ghana (Costa & Delgado, 2019). Cashew is commonly intercropped with cultivated food crops such as cassava, maize and beans, thus providing a buffer against the failure of rain-fed annual crops in a context of climatic uncertainty (Mitchell, 2004). In a developing country such as Ghana, value addition in the cashew sector holds significant potential to contribute to the achievement of the Sustainable Development Goals (SDGs) through poverty reduction, job creation and rural development (Carolina & Wijayanti, 2020; United Nations Conference on Trade and Development, 2021). In addition, the commercialisation of cashew by-products, such as cashew apples, which are often discarded as agricultural waste, can help diversify revenue sources and generate greater value, employment and business opportunities in communities involved in cashew production and/or processing (United Nations Conference on Trade and Development, 2021). This can improve agricultural productivity, diversify livelihoods and increase farmers' incomes (Atangana *et al.*, 2014; Coulibaly *et al.*, 2017; Mkonda & He, 2017).

Socio-demographic characteristics have been found to influence agricultural practices in several studies. These characteristics include age (Ojo & Ogunyemi, 2014; Kimbi *et al.*, 2021), gender (Amaegberi & Oyintonbra, 2023b; Gebre *et al.*, 2021), educational level (Mwalongo *et al.*, 2020; Toma *et al.*, 2018; Danso-Abbeam *et al.*, 2021), years of farming experience (Oyewole *et al.*, 2023), religion (Knight *et al.*, 2016), marital status (Oyewole *et al.*, 2023; Gupta & Kashyap, 2018), household size and number of children (Amaegberi & Oyintonbra, 2023b; Toma *et al.*, 2018), and economic/livelihood activities (Toma *et al.*, 2018; Läpple *et al.*, 2015; Kallas *et al.*, 2010). Evidence from studies of agroforestry and agricultural technology adoption also indicates that household and farm characteristics can influence farmers' adoption decisions (Oladele *et al.*, 2020; Panta *et al.*, 2023).

Few studies have examined the influence of farmers' socio-demographic characteristics on cashew agroforestry. Binam *et al.* (2017) investigated how local governance institutions govern natural resource access and use in Burkina Faso, Mali and Niger, focusing on farmer-managed natural regeneration (FMNR). Zerihun (2020) analysed agroforestry practices in the Eastern Cape Province of South Africa, emphasising only household membership in social organisations and levels of trust, without including farmers' socio-demographic characteristics. Bannor *et al.* (2022) investigated land tenure, harvest time and cashew farmers' marketing behaviour, with Tain, one of the study districts, included in the analysis. Recent studies further show that the socioeconomic determinants of agroforestry adoption vary across farming contexts, underscoring the importance of location-specific assessment (Ahmad *et al.*, 2023; Fané *et al.*, 2024). In Ghana, recent evidence from Jaman North also identifies socioeconomic characteristics as relevant to the adoption of climate-smart practices among smallholder cashew farmers (Baffour-Ata *et al.*, 2025).
The hypotheses for the study were:

Null hypothesis (H_0): The socio-demographic characteristics of farmers across the districts have no significant influence on the practice of cashew agroforestry.

Alternative hypothesis (H_1): The socio-demographic characteristics of farmers across the districts have significant influence on the practice of cashew agroforestry.

Investigating the socio-demographic drivers will help to identify bottlenecks that could be addressed to scale up cashew production in Ghana.

However, the literature reviewed in this manuscript provides limited evidence on how multiple socio-demographic characteristics jointly structure the practice of cashew agroforestry across the selected districts of the Bono Region, particularly when these characteristics are examined using factor analysis to identify their underlying dimensions.

This study explores the socio-demographic drivers of the practice of cashew agroforestry in the Bono Region of Ghana. Specifically, the study addresses the following objectives: (1) to identify the demographic characteristics of cashew farmers in three selected districts; and (2) to identify, using factor analysis, the factors that most influence the practice of cashew agroforestry.

2. Material and Methods

2.1 Description of Study Area

The study was conducted in three districts: Tain and Jaman North Districts and Wenchi Municipality, located within the Bono Region of Ghana. The geographical location lies between latitudes 7° 05^1 and 7º 40^1 and longitudes 2º 17^1 and 2º 60^1. The study enclave has a total population of 242,888 (Ghana Statistical Service, 2014). The temperature regime ranges between 21.2ºC and

31.9ºC. The economically active population in the study area is mostly involved in agriculture as a source of employment, with cashew being a prominent crop (Ghana Statistical Service, 2014). The area experiences average annual rainfall ranging from 1,200mm to 1,780 mm. The dry season is marked by harmattan winds, with average monthly temperatures fluctuating between 21.2°C and 31.9°C (Ghana Statistical Service, 2014).

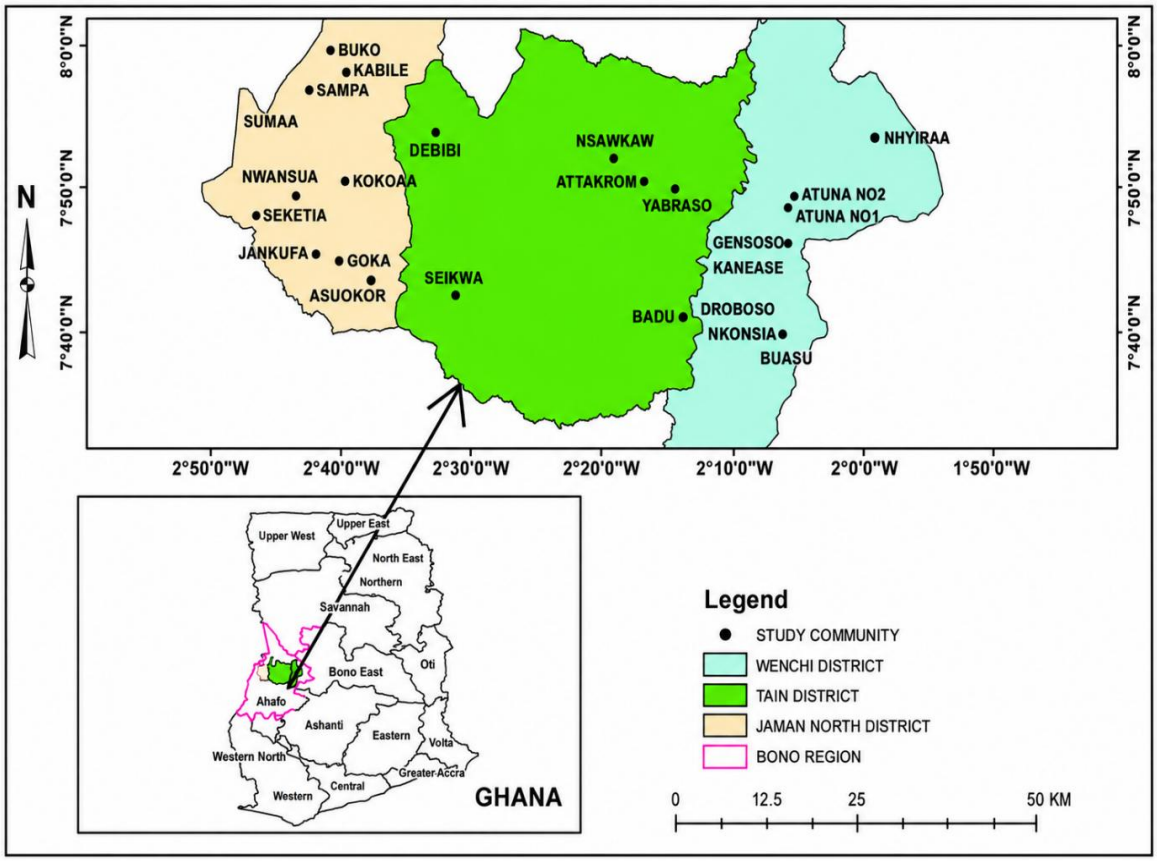

Fig. 1. Map of Ghana showing the Bono Region, Selected Districts and Communities in the study Area

The districts of Tain, Jaman and Wenchi are located within two primary vegetation zones: the moist semi-deciduous forest and the Guinea savannah woodland. The latter is suitable for growing food crops such as yam, cassava, rice, beans and groundnut. Additionally, it predominantly supports cashew production, with approximately 80% of the population engaged in agricultural activities (Ghana Statistical Service, 2014). Details of the geographical location of the study area are provided in Fig. 1.

2.2 Data Collection

The study commenced in April 2021 with a reconnaissance visit to the study area and a call on the District Assembly to introduce the research and the researcher. The district planning officers of the Assemblies subsequently furnished the researcher with the 2021 District Development Plan and provided the sampling frame (population) of cashew farmers.

In June 2022, a visit was undertaken to each of the district offices (Jaman North, Wenchi Municipality and Tain) to familiarise the researcher with the district Directors of Agriculture, field staff and other office staff, and to collect general information on cashew production activities in the districts.

Pilot testing was carried out in July 2022, and data collection began in the same month and ended in December 2023 for cashew farmers. The research approach employed in this study involved quantitative data collection using a structured questionnaire. The research design utilised was a quantitative research design.

To ensure the validity of the questionnaire, the researcher sought feedback from three senior agroforestry research experts. These experts evaluated the content, construct and face validity of the questionnaire. The researcher incorporated the feedback and made the necessary adjustments to refine the instrument's content. The revised questionnaire was pilot-tested by administering 15 questionnaires in a comparable agrarian community within each of the three districts. This pilot testing facilitated the identification of inconsistencies within the instrument, prompting necessary modifications to certain questions. The modified survey instrument was then used in the field to collect data. Respondents were assured of the confidentiality of all information they provided. The interview was conducted in the local language and lasted between 45–60 min per person.

Qualitative and quantitative data were collected from both primary and secondary sources. Primary data collection involved a field survey in which questionnaires were administered to 403 randomly selected cashew farmers. The secondary sources included a review of existing literature from scholarly journals, books and periodicals on the topic under consideration, as well as government documents.

2.3 Sampling Procedure and Sample Size

The target population of the study was cashew farmers. The Bono Region of Ghana was selected as the target region because the nature of the research required data from a large number of perspectives, and the region was noted as one of the largest cashew nut production centres in Ghana (Bannor & Oppong-Kyeremeh, 2018).

The accessible population comprised cashew farmers in Tain District, Wenchi Municipality and Jaman North District. These three districts were among the predominant cashew-producing districts in the Bono Region (Ghana Statistical Service, 2014), and cashew farmers and other value-chain actors were considered to have greater insight into cashew production. The populations of cashew farmers in Jaman North, Wenchi Municipal and Tain Districts were 50,596, 32,130 and 19,707, respectively. In this study, Jaman North District was categorised as a high-growing area (50,596 cashew farmers), Wenchi Municipal as a medium-growing area (32,130 cashew farmers) and Tain District as a low-growing area (19,707 cashew farmers). The total population of cashew farmers in the three districts was 102,433 (Ghana Statistical Service, 2014). According to Krejcie and Morgan (1970), an ideal sample size for the population of cashew farmers is expressed by the equation:

$$S = \frac{X2NP\ (1 - P)}{d^2(N - 1) + X^2P\ (1 - P)}$$

X^2: means the table value of the chi-square value for 1 degree of freedom at the desired confidence level; N: population size of cashew farmers in the study area; P: population proportion; d: degree of accuracy expressed as a proportion.

The computation from the equation yielded a sample size of 383. To account for an expected attrition buffer of 20 participants, the sample size was increased to 403. Each district was stratified into high-growing and low-growing communities (Table 1). The selection of the actual communities from each stratum involved simple random sampling to ensure fair representation. A simple random sampling technique was used to select the actual participants for the survey. The number of cashew farmers randomly selected for interview in each community was set in proportion to the rough estimate of cashew farmers in each community (Table 2). The response rate was 99.50%.

Table 1. Actual Communities selected from each strata in the study Districts

District	High growing communities	Low growing communities
Wenchi municipal	Nkonsia, Nchiraa, Droboso, Buasu	Gensoso, Kanease, Atuna I, Atuna II
Tain District	Nsawkaw, Seikwa, Debibi	Badu, Attakrom, Yabraso
Jaman North	Asuokor, Nwansua, Seketia, Goka, Jankufa	Kabile, Suma, Kokoa, Sampa, Buko

Table 2. Number of Cashew farmers selected for interview and the corresponding responses

District	Number of Cashew farmers selected for interview	Number of Respondents
Tain	78	77
Wenchi	126	125
Jaman North	199	199
Total	403	401

2.4 Data Analysis

The data were cleaned, processed, analysed and interpreted into useful information. All statistical analyses were carried out using IBM Statistical Package for Social Sciences (SPSS) software, version 29. The entire dataset was subjected to content analysis.

A chi-square analysis was conducted in this research, typically at a significance level, or alpha value, of 0.05 to show differences in socio-demographic characteristics among farmers in the three selected districts. If the p-value is less than or equal to alpha ($p \leq 0.05$), it is considered statistically significant, indicating that there is evidence to reject the null hypothesis. If the p-value is greater than 0.05, it is considered not significant, and there is insufficient evidence to reject the null hypothesis.

Exploratory factor analysis was employed to group related socio-demographic characteristics into common factors that mostly influenced the practice of cashew agroforestry. The Kaiser-Meyer-Olkin (KMO) test was used to determine sample-size adequacy for factor analysis (Kaiser, 1970). KMO is expressed by the equation:

$$KMO = \frac{\Sigma\Sigma r_{ij}^2}{\Sigma\Sigma r_{ij}^2 + \Sigma\Sigma a_{ij}^2}$$

r_{ij} symbolises the estimated pairwise association of simple correlation between the i-th and j-th variables, while a_{ij} represents the estimated pairwise association of partial correlation between the i-th and j-th variables (partial covariance matrix).

The KMO value determines whether the sample size of 401 was adequate for factor analysis. The calculated KMO value should be greater than 0.5. The KMO value obtained for this research was 0.728, which was greater than 0.5. The sample size of 401 was therefore considered adequate for factor analysis.

Bartlett's test of sphericity determines the suitability of data for factor analysis (Tabachnick & Fidell, 2013). This is expressed by the equation:

$$x^2 = -\left(n - 1 - \frac{2p+5}{6}\right)\ln|R|$$

n is the total sample size; p is the number of variables; and R is the correlation matrix of variables.

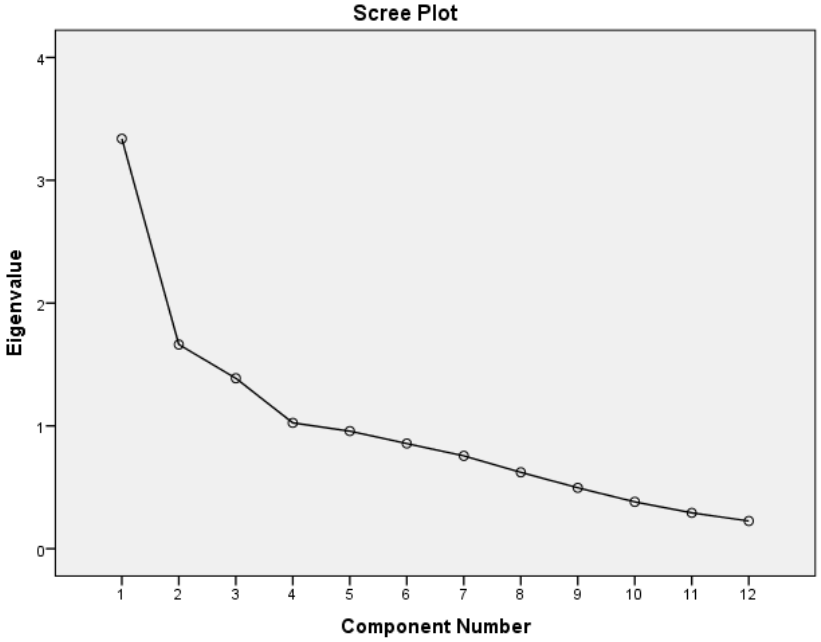

Fig. 2. The Scree Plot Graph Showing relationship between Eigenvalues and component Number

Table 3. Eigen values (EV) and Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.338	27.820	27.820	3.338	27.820	27.820	2.800	23.332	23.332
2	1.663	13.856	41.676	1.663	13.856	41.676	1.628	13.565	36.897
3	1.388	11.564	53.240	1.388	11.564	53.240	1.572	13.099	49.996
4	1.025	8.539	61.778	1.025	8.539	61.778	1.414	11.782	61.778
5	0.957	7.979	69.757						
6	0.856	7.136	76.893						
7	0.756	6.301	83.193						
8	0.622	5.185	88.378						
9	0.496	4.133	92.511						
10	0.381	3.179	95.690						
11	0.292	2.430	98.120						
12	0.226	1.880	100.000						

Extraction Method: Principal Component Analysis (PCA). Four components with eigenvalues greater than 1.00 were retained, accounting for 61.78% of the total variance. Rotation Method: Varimax with Kaiser Normalization

Bartlett's test of sphericity is significant at $p < 0.001$. The statistical analysis run by the factor analysis model for Bartlett's test of sphericity in this research yielded a p-value of 0.000. Since this value was significant, the data for the research were considered suitable for factor analysis. Since the overall KMO value for the dataset was 0.728 (> 0.5) and Bartlett's test of sphericity was significant ($p < 0.001$), the data were deemed appropriate for factor analysis.

To address objective two of this research, principal component analysis (PCA) with varimax rotation was used (Ayuni & Sari, 2018; Shrestha, 2021). After the survey data were obtained, PCA with varimax rotation and Kaiser normalisation was used to examine the survey items. A cut-off criterion of 0.5 and a significance level of 0.05 were used to interpret the solutions. Questionnaire items that did not meet the cut-off criteria were eliminated. In this study, eight items out of the twelve were removed, while four were retained. Moreover, the analysis produced four components with eigenvalues greater than one, accounting for 61.78% of the total variance (Table 3.). To identify the actual components to be included in the factors, the scree plot was used (Fig. 2.). In the scree plot, eigenvalues were plotted as dots within the graph, and a line connected successive values. Factor extraction stopped at the point where the graph began to level off, or form an 'elbow' (Shrestha, 2021).

3. Results and Discussion

3.1 Demographic Characteristics of Cashew Farmers in the Three Selected Districts

The demographic Characteristics of Cashew Farmers in the three selected districts are presented in Table 4. The results indicated that 49.63% of the cashew farmers interviewed were in Jaman North District, 31.17% in Wenchi Municipality and 19.20% in Tain District all in the Bono Region of Ghana (Table 4). Respondents' ages ranged from 15 to over 60 years. Females made up 32.92% and males 67.08 %. About 64.09% had at least basic education (primary, JSS, SHS, MSLC, and Commercial), 17.21% were apprentices, and 29.18% had no formal education. Only 4.99% had tertiary education (Table 4). Around 78.80% had up to 30 years of farming experience, with 98.00% having up to 30 years experience in cashew cultivation (Table 4). The study indicates an ageing farming population. Only a few farmers represented the energetic youth likely to influence cashew agroforestry. Wongnaa (2013) noted that, youth involvement in cashew farming signals the future of the industry. The industry's future appears uncertain unless more young people are encouraged to take up cashew farming (Wongnaa, 2013; Nhantumbo et al., 2017). Younger farmers are more open to new technologies and long-term investments, unlike older, risk-averse farmers (Ojo and Ogunyemi, 2014; Adesina and Zinnah, 1993). However, older farmers possess greater knowledge and experience with cashew technologies (Kimbi et al., 2020).

Female involvement in cashew agroforestry was low, indicating a male-dominated field, as seen in Dekina, Nigeria (Amaegberi and Oyintonbra, 2023). Cashew agroforestry involves strenuous tasks like pruning, weeding and nut collection and bagging which may require labour from the male head cashew farmer and the family (Midamba et al., 2024). Males generally have greater access to information, education, and resources increasing their likelihood of practising cashew agroforestry, as found by (Gebre et al.,2021; Nhantumbo et al., 2017; Martey et al., 2014).

Formal education boost technical efficiency, reduces conservationism and help farmers better understand the socio-economic conditions affecting their farming (Ojo and Ogunyemi, 2014; Mwalongo et al., 2020; Toma et al., 2018; Danso-Abbeam et al., 2021, Nhantumbo et al., 2017).

Farmers' extensive experience can enhance the practice of cashew agroforestry by improving skills in integrating cashew trees with food crops (Oyewole et al., 2023; Weyessa, 2014). The high mean farming experience and cashew farming experience align with Oyewole et al. (2023), who observed that greater experience indicates professionalism and efficiency, leading to high productivity. Marriage may create a stable family and support farming activities (Oyewole *et al.*, 2023). The high proportion of married respondents could indicate a stable population with positive implications for sustainability (Oyewole *et al.*, 2023). Amaegberi and Oyintonbra (2023b) reported a similar pattern, citing an earlier finding that 98.3% of cashew farmers in Ibarapa East, Oyo State, were married. Strong family ties and cohesion among farmers from the districts and communities where their farms were located can promote the practice of cashew agroforestry (Midamba *et al.*, 2024).

Engaging in other livelihood activities might reduce the seriousness with which farmers approach cashew farming, as cashew agroforestry demands significant attention for tasks such as raising nursery seedlings, pruning, weeding, and pest and disease control (Amaegberi & Oyintonbra, 2023a; McBride & Greene, 2009). This finding aligns with an Irish study showing that off-farm work negatively affects farmers' innovativeness (Läpple *et al.*, 2015). However, it contrasts with Kallas *et al.* (2010), who found that other livelihood activities can act as insurance for farmers engaged in risky production such as cashew, where price fluctuations are common.

The chi-square analysis of socio-demographic variables showed statistically significant differences between the districts in relation to sex, age, educational background, years of experience in farming, years of experience in cashew farming, religion, economic/livelihood activity and ethnic origin (Table 4). Marital status, household size and number of children showed no significant differences between the districts. However, education, cashew farming experience and ethnic origin differed significantly (p-value = 0.000**).

3.2 Factor Analysis of Socio-demographic Characteristics of Cashew Farmers

3.2.1 Correlation Matrix of Socio-demographic Variables of Cashew Farmers

The correlation matrix of socio-demographic variables of cashew farmers is presented in Table 5. Age and years of farming experience are strongly positively correlated (r = 0.725), indicating that older cashew farmers tend to have more farming experience (Table 5). Farming experience and cashew farming experience also have a strong positive correlation of 0.644, suggesting that general farming experience enhances cashew farming skills. Age and cashew farming experience have a moderate positive correlation of 0.512, showing that cashew farming experience increases with age. These correlations were significant. However, the correlation between the number of children and ethnic origin is only 0.013, indicating no significant relationship.

Table 4. Differences in socio-demographic characteristics of cashew farmers in the Wenchi Municipality, Tain and Jaman North Districts in the Bono Region of Ghana

	Districts						
Socio-demographic characteristic	**Wenchi Municipality Number (N = 125)**	**Tain (N = 77)**	**Jaman North (N = 199)**	**Total respondents (N=401)**	**% of respondents**	**X^2 value**	**Significance**
Sex							
Male	96	50	123	269	67	$X^2 = 8.012$	S
Female	29	27	76	132	33	df = 2	
	(31.2)	(19.2)	(49.6)			p-value = 0.018	
Age							
21-30 years	6	4	22	32	8.0	$X^2 = 19.111$	S
31-40 years	20	28	50	98	24.4	df = 8	
41-50 years	46	18	57	121	30.2	p-value = 0.014	
51-60 years	39	16	46	101	25.2		
Above 60 years	14	11	24	49	12.2		
Educational Background							
No formal Education	41	33	43	117	29.2	$X^2 = 43.387$	
Primary	15	9	11	35	8.7	df = 14	S
MSLC	31	7	41	79	19.7	p-value = 0.000**	
JHS	21	15	29	65	16.2		
Apprenticeship	0	1	6	7	1.7		
SHS	11	8	50	69	17.2		
Commercial/	1	1	7	9	2.2		
Technical/ Vocational Tertiary	5	3	12	20	5.0		
Years of Experience in farming							
1-10	19	21	33	73	18.2	$X^2 = 119.125$	
11-20	35	21	59	115	28.7	df = 90	
21-30	51	16	53	120	29.9	p-value = 0.022	S
31-40	17	9	44	70	17.5		
41-50	2	8	9	19	4.7		
51-60	1	2	1	4	1.0		
Years of Experience in cashew farming							
1-10	75	59	74	208	51.9	$X^2 = 116.980$	
11-20	37	16	73	126	31.4	df = 64	
21-30	12	2	45	59	14.7	p- value = 0.000**	S
31-40	1	0	3	4	1.0		
41-50	0	0	4	4	1.0		
Religion							
Christianity	105	70	162	337	84.0	$X^2 = 11.484$	S
Islamic	11	6	32	49	12.0	df = 4	
Traditional	9	1	5	15	3.7	p-value = 0.022	
Marital Status							
Single	9	6	11	26	6.5	$X^2 = 0.314$	NS

	Districts						
Socio-demographic characteristic	**Wenchi Municipality Number (N = 125)**	**Tain (N = 77)**	**Jaman North (N = 199)**	**Total respondents (N=401)**	**% of respondents**	**X^2 value**	**Significance**
Married	107	62	163	332	82.8	df = 8	
Co-habiting	0	1	0	1	0.2	p-value = 0.256	
Divorced	6	2	14	22	5.5		
Widowed	3	6	11	20	5.0		
Household size							
Small (1-4) people	35	30	48	113	28.2	X^2 = 7.059	
Medium size (5-10) people	76	40	121	237	59.1	df = 4	
Large size (above 11) people	14	07	30	51	12.7	p- value = 0.133	NS
Number of children							
0	1	1	2	4	1.0	X^2 = 9.397	
1	7	7	11	25	6.2	df = 10	NS
2	19	16	26	61	15.2	p-value = 0.495	
3	15	12	43	70	17.5		
4	30	16	42	88	21.9		
More than 4	53	25	75	153	38.2		
Other economic /livelihood activity							
None	63	32	49	144		X^2 = 33.30	
Trading	32	30	85	147		df = 14	
Carpentry	3	1	10	14		p-value = 0.003	
Public service	3	3	17	23			S
Hunting	7	2	13	22			
Others	8	5	13	26			
Masonry	7	4	11	22			
More than one economic activity	2	0	1	3			
Ethnic Origin						X^2 = 54.639	
Yes	83	66	192	341	85.0	df = 2	S
No	42	11	7	60	15.0	p-value = 0.000**	

Source: Field Survey, August 2022; (JHS-Junior High School, SHS-Senior High School, MSLC-Middle School Leaving Certificate); NS – Not Significant; S - Significant

Table 5. Correlation matrix of socio-demographic variables of cashew Farmers

Correlations	Age	Sex	Education	Yrs of farming experience	Yrs of cashew farming experience	Religion	Marital Status	Household size	No of Children	Livelihood Activity	District the farmer has cashew farm	Ethnic origin
Age	1.000	-0.103	-0.300	**0.725**	**0.512**	0.103	0.243	0.398	**0.576**	-0.134	-0.104	-0.046
Sex	-0.103	1.000	-0.071	-0.151	-0.100	-0.099	0.229	-0.116	-0.132	-0.222	0.137	-0.160
Education	-0.300	-0.071	1.000	-0.350	-0.158	-0.072	-0.027	-0.137	-0.259	0.055	0.217	-0.075
Yrs of farming experience	**0.725**	-0.151	-0.350	1.000	**0.644**	0.111	0.191	0.411	**0.534**	-0.100	0.018	-0.042
Yrs of cashew farming experience	**0.512**	-0.100	-0.158	**0.644**	1.000	0.089	0.154	0.290	0.349	0.057	0.227	-0.235
Religion	0.103	-0.099	-0.072	0.111	0.089	1.000	0.009	0.143	0.161	0.096	-0.009	0.046
Marital Status	0.243	0.229	-0.027	0.191	0.154	0.009	1.000	0.170	0.194	-0.072	0.080	-0.099
Household size	0.398	-0.116	-0.137	0.411	0.290	0.143	0.170	1.000	**0.650**	-0.075	0.066	0.059
No of Children	**0.576**	-0.132	-0.259	**0.534**	0.349	0.161	0.194	**0.650**	1.000	-0.093	-0.026	**0.013**
Livelihood Activity	-0.134	-0.222	0.055	-.100	0.057	0.096	-0.072	-0.075	-0.093	1.000	0.093	0.019
District the farmer has cashew farm	-0.104	0.137	0.217	.018	0.227	-0.009	0.080	0.066	-0.026	0.093	1.000	-0.366
Ethnic origin	-0.046	-0.160	-0.075	-.042	-0.235	0.046	-0.099	0.059	0.013	0.019	-0.366	1.000

a. Determinant Score = .038

Table 6. Rotated Component Matrix (Loading Factor after rotation)

Rotated Component Matrix[a]				
Variable	**Component**			
	1	**2**	**3**	**4**
Years of farming experience	***0.870**	0.061	0.204	-0.009
Age of Respondents	***0.811**	-0.035	0.249	0.102
Years of cashew farming experience	***0.726**	0.425	0.090	-0.144
Educational background of respondents	-0.576	0.363	0.172	-0.119
District where the cashew farm is located	-0.090	***0.816**	0.102	0.008
Ethnic Origin	-0.146	-0.720	0.233	-0.119
Household size of respondents	0.359	-0.004	***0.730**	0.109
Number of Children	0.564	-0.066	***0.615**	0.112
Religion	-0.031	-0.027	***0.550**	-0.200
Gender	-0.147	0.176	-0.202	***0.743**
Economic / livelihood activity (ies) aside cashew	-0.119	0.206	0.071	-0.650
Marital status	0.112	0.218	0.327	***0.561**

** The factor loadings > 0.5 in the four components ; Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalisation[a]; Rotation converged in 5 iterations*

Table 7. Grouping variables into Key Factors

No	Factor	Variable
1	Farming Expertise	Years of Farming Experience Age of respondents in Years Years of cashew farming Experience
2	District of existence of cashew farm	The district where cashew farm is located
3	Household Characteristics	Household size No. of children of farmers Religion of the respondents
4	Personal Relationships and status	Sex of cashew farmers Marital status of respondents

3.2.2 Identification of Key Factors that Mostly Influence Practice of Cashew Agroforestry by the Use of Rotated Component Matrix (Loading Factor after Rotation)

The rotated component matrix identified four components as the key factors influencing cashew agroforestry, with variables loading significantly (loading > 0.5) onto these components (Table 6). In Component 1, Years of Farming Experience, Age of respondents (in years), and Years of cashew farming experience loaded at 0.870, 0.811 and 0.726, respectively, forming the 'Farming Expertise' factor. Similar groupings occur for Components 2, 3 and 4 (Table 7). The variables within each component were consolidated into a factor (Table 7). Overall, the factor analysis reduced the socio-demographic characteristics of cashew farmers to nine factors, which were further consolidated into one factor per component, yielding four dimensions—Farming Expertise; District of cashew farming existence; Household characteristics; and Personal relationships and status.

'Farming Expertise' encompasses the specialised knowledge, skills and abilities of cashew farmers, aiding them in various cultivation and management tasks, including marketing (Oyewole *et al.*, 2023). 'District of existence of cashew farm' refers to the specific geographical area, such as Wenchi Municipality, Tain District and Jaman North District of the Bono Region, where respondents live. Districts used for administrative purposes may influence information dissemination, and location may influence farmers' decisions regarding the practice of cashew agroforestry (Jha *et al.*, 2021; Lukurugu *et al.*, 2022). 'Household characteristics' describe household composition, structure and conditions, which are important for cashew agroforestry research, policymaking and market analysis (Menashe-Oren *et al.*, 2023). For example, a large household size could influence the adoption of labour-demanding agroforestry technologies. However, several studies, including Midamba *et al.* (2024), Massresha *et al.* (2021) and Zegeye *et al.* (2022), posited that as household size increases, the dependency ratio correspondingly rises, leading to greater allocation of financial resources towards household needs and thereby reducing farmers' propensity to adopt sustainable and modern technologies. 'Personal relationships and status' refers to individuals' personal connections and social standing within a community. The dynamics of personal relationships and status are complex and interconnected, significantly shaping identity, happiness and overall well-being, which can greatly influence the practice of cashew agroforestry (Brobbey *et al.*, 2021).

4. Conclusion

The study explored the socio-demographic drivers of the practice of cashew agroforestry in the Bono Region of Ghana. The practice of agroforestry was male-dominated. Many practitioners had formal education, which could boost their technical efficiency and reduce conservatism. Many years of general farming and cashew farming experience were observed in the study. This could contribute to skill improvement, professionalism and efficiency. The study depicted an ageing population, with only a few farmers representing young people likely to influence cashew agroforestry practice. Factor analysis revealed four key factors influencing the practice of cashew agroforestry in Wenchi Municipality, Tain District and Jaman North District in Ghana's Bono Region. These were Farming Expertise, District of farm location, Household characteristics, and Personal Relationships and status. The study

recommends designing cashew agroforestry policies with packages attractive to young people to promote the practice. Credit policies targeted at females could help deepen their involvement in cashew agroforestry. The design and implementation of interventions addressing factors influencing the practice of cashew agroforestry could focus on a few manageable factors rather than a large number of variables.

5. Limitation

The study focused on selected socio-demographic characteristics. Variables such as sources of finance, extension-agent contact, available farm size and pruning were not included. Farm size was excluded because respondents were considered likely to provide inaccurate estimates. Accordingly, the factor structure reflects only the variables measured in the survey and should be interpreted within the three study districts. These limitations define the empirical scope of the findings and indicate areas for future investigation of cashew agroforestry in the Bono Region.

Consent

As per international standards or university standards, respondents' written consent has been collected and preserved by the author(s).

Ethical Approval

"All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee (KNUST/UESD Ethics Committee) and with the 1964 Helsinki declaration and its later amendments".

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Declaration of AI Use

This manuscript was prepared through the intellectual contributions of the author(s) to the study design, data analysis, interpretation of results, and scholarly content. Grammarly and ChatGPT were used solely to assist with grammatical refinement and reference formatting during manuscript revision. The author(s) accept full responsibility for the accuracy, integrity, and final content of the manuscript.

Competing Interests

Author has declared that no competing interests exist.

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