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Research article

Economic viability of value-added cashew products processed in Southeast zone, Nigeria

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ABSTRACT

The "Agricultural Promotion Policy (2016–2020)" is an initiative of Nigeria's government, designed to create jobs and wealth for participants in the agricultural value chains through value addition to export crops such as cashew. However, it is not known how cashew processors have exploited this opportunity to improve their economic returns from value-added cashew products, processed in the Southeast zone, Nigeria. Consequently, this study analysed the economic viability of value-added cashew products processed in the Southeast zone of Nigeria. Specifically, the objective was to determine the cost-benefit analysis, rate of return on investment, net income, and variability of value-added cashew products processed in the Southeast zone, Nigeria. A descriptive research design involving a cross-sectional survey of 353 randomly sampled participants was administered with a structured questionnaire. Ratio statistics, gross margin, benefit-cost ratio analysis, rate of return and ANOVA were applied to analyze the data. The results show that variable cost constitutes >96 but ≤98% of the total cost of cashew value addition. The average net income from 1 kg of value-added cashew products is profitable with cashew kernel yielding the highest net income (N2,724.4 (US $7.6) > cashew nut (N2,547.9 (US $7.1)) > both cashew products (N2,340.4 (US $6.5)). The benefit-cost ratios for 1 kg of value-added cashew nut and cashew kernel were slightly higher (1:1.4) respectively than that of both cashew products (1:1.3), suggesting that value-added cashew products deliver positive net income to the processors. Equally, the rate of returns (RORs) for 1 kg of value-added cashew products yield the highest (38.1%) in cashew kernel > cashew nut (37.4%) > both cashew products (34.1%). The coefficient of dispersion (COD) in revenue and cost of value-added products shows the least risk in cashew kernel (0.097) and the highest risk in both cashew products (0.122). The study provides empirical evidence for potential small and medium-scale investors to make an informed investment decision about value addition to cashew products. It is recommended that government should encourage people to engage in value addition to cashew products because of its high rate of return, and assist processors with credit to procure modern processing equipment to enhance profitability and income generation.

1. Introduction

Cashew has been cultivated primarily for its food and medicinal importance, which involves the use of whole cashew fruit, i.e., the

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apple, kernel as well as a nut for various industrial purposes [1]. Currently, there is a huge market for cashew products [2]. estimated the global value of the cashew market in 2017 to be in the neighbourhood of US $5.26 billion. Although it is difficult to assess the exact production outputs in the various cashew-producing countries, the [3] estimate, shows that the output of raw cashew nuts (RCN) which stood at 0.29 million tonnes in 1961, grew to 2.60 million tonnes in 2013 and later rose to 4.9 million tonnes in 2016. At the continental level, African countries contribute 56.5% to the global cashew output while Asian countries account for approximately 44% in 2018 [4]. The share of West Africa in cashew production has also risen over the years to 1.62 million tonnes representing 42% of world cashew output in 2017 [2]. This makes West Africa the leading cashew-producing region in the world.

Available statistics show that the major cashew-producing countries in the world and their respective outputs in 2017 were Vietnam (1,221,070 MT), Nigeria (982,530 MT), India (671,000 MT) and Ivory Coast (607,300 MT) [5]; Salau, Popoola and Nofiu, 2017). This shows that Nigeria is the major cashew-producing nation in Africa and second in the world [3,5,6]. In the past four decades, cashew production in Nigeria has grown geometrically from 30,000 tons in 1990 to 466,000 tons in 2000, and further rose to 791,726 in 2010 and later 982,530 tons in 2017 [7]. Cashew grows in almost every part of Nigeria although commercially, it is largely produced in the southern and the middle belt zones of the country. The major cashew producing States are Abia, Enugu, Anambra, Ekiti, Benue, Kwara, Kogi, Oyo, and Imo [6,8,9]. Interestingly, the Southeast zone of Nigeria is renowned for cashew production and four of the five States in the zone - Abia, Enugu, Anambra and Imo States are listed among the main cashew producing-States.

Interestingly, cashew contributes substantially to the Nigerian Gross Domestic Product and foreign exchange earnings. Earnings from cashew nut exports amount to seven to eight per cent of non-oil export earnings in Nigeria [10]. The estimated export value from cashew nuts ranges from US$ 25 to 35 million per annum (Adeigbe et al., 2017). Cashew production and processing activities in Nigeria, provide employment and livelihood for smallholder farmers especially women [11,12]. Cashew provides a livelihood for over 300,000 households and sustains 600,000 jobs across the value chain activities as harvesters, transporters, processors, marketers, and exporters (Adeigbe et al., 2017). Value addition in the agriculture context is the process of enhancing income generation, in addition to extending the product's shelf-life [13]. The demand for value-added cashew products is growing in the global market arena [14]. Nigeria and other African countries, which grow over 50% of the global cashew are losing out on this booming wealth of opportunities as a result of low-value addition [15]. For instance, recent statistics show that only about 20% of cashew produced in Nigeria receives value addition while the rest are exported in their raw form [16]. Nevertheless, there is still a high incentive for more local processors to tap into the booming wealth of opportunities offered by the increasing global demand for value-added cashew products.

Economic viability establishes the profitability of an enterprise [17]. The use of cost-benefit ratios as measures of an enterprise's economic viability has been documented [18]. Economic viability represents the capability of cashew processors to profit from value-added cashew products; which is critical to the survival and sustainability of their enterprise [19]. Evidence of economic viability could provide the basis for the possible participation of non-participants in cashew value-addition activities and also provides evidence of the long-term sustainability of the enterprise [19]. Economic viability involves the assessment of different components of the enterprise such as operating costs, investment capital and the amount of value an agent is creating and capturing along the value chain node.

Research has shown that cost is an essential element of profit. Components of costs in the agro-processing enterprise include labour costs, cost of inputs, transaction costs and marketing costs, among others. For instance Ref. [6], examined cashew nut marketing in Kwara State, Nigeria and found a positive and significant correlation between costs associated with raw cashew acquisition, transportation, agent fee and storage and profit margin of cashew nut marketing. Cost is, therefore, a critical element of profit [20], and cost efficiency is vital to achieving higher profit. Some other factors also determine profit margin [21]. identified investment capital and variable costs as important variables influencing the profitability of agricultural commodities [22]. found investment capital to be positively correlated with the net profit of maize production in Northern Benin. Higher investment capital enables participants to achieve economies of scale, which improves income yield [23]. Equally, the proportion of functionaries in the cashew market determines the profit margin accruing to the individual participant. Market functionaries include producers, collectors, retailers, wholesalers and exporters participating in the marketing of cashew nuts [24]. [25] reported that market actors in the cashew industry have a positive and significant effect on the net profit of cashew nuts marketing. Furthermore, the risk-profit trade-off fundamentally describes the proportion of profit due to risk [26]. argues that profit is a reward for risk decisions in business enterprises [27]. found a positive correlation between risk and profit. Thus, without risk, there can be no reasonable profit for the cashew processor while higher risk yields a higher profit.

Nigeria's government has at different times, initiated a number of policies targeted at the development and growth of the agricultural sector. Under the current President Buhari-led government, the government introduced the "Agricultural Promotion Policy (2016–2020)", designed to create jobs and wealth for participants in the agricultural value chains through value addition to export crops such as cashew. However, it is not clearly known how cashew processors have exploited this opportunity to improve economic returns from value-added cashew products, processed in the Southeast zone, Nigeria. More so, empirical evidence suggests that scholars have given extensive attention to the agronomy of cashew production (Asogwa et al., 2008 [5]; and the marketing of raw cashew nuts (Hammed et al., 2008; [6,25,28], with little or no attention given to economic viability and variability of value-added cashew products.

It is in light of the foregoing that this study analysed the economic viability of value-added cashew products, processed in the Southeast zone, Nigeria. Specifically, the objective was to determine the cost-benefit analysis, rate of return on investment, net income, and variability of value-added cashew products processed in the Southeast zone, Nigeria. The findings of this study offer processors evidence of economic benefit from value-added cashew products. It also provides evidence of variability across the various components of cashew products receiving value addition, which is critical for deciding the components of cashew to add value to. This will enhance investors' confidence in value addition to cashew products and open a window of opportunities for greater investment and job

creation in the cashew value chain industry, which is important for the eradication of poverty and social vices while meeting the Sustainable Development Goal (SDG) of ending poverty. Equally, the findings will be helpful to potential investors in making informed investment decisions particularly, the small & medium-scale investors. The complexity, cost and time resources associated with carrying out a feasibility study often make it difficult for many small and medium-scale investors to undertake [29] and may rely on existing data such as the ones provided in this study. However, relying on these data requires potential investors to seek additional information on the opportunity cost options (i.e., the value created in other possible exchanges of cashew relating to subcategories of actors in the value chain nodes) and hypothesized on how the competition unfolds amongst these actors. Diverse choices in each of these subsets have serious implications for the processors in terms of accruing costs of input transformation to valuable output as well as the competition for value capture with agents working together across the supply chain nodes, in appropriating the value created – profit.

1.1. Research hypothesis

H0: There is no net income differential across cashew processors adding value to cashew products processed in the Southeast zone, Nigeria.

2. Theoretical framework

The framework upon which this study is anchored is the value-based theory of strategy. The concept behind this theory as propounded by Refs. [30,31] is conceptualised in the context of a theory of value addition and value capture. The concept has turned out to be a unifying framework for theorising heterogeneity of firms and competition in strategic management studies. The theory jointly analyses value addition and value capture, offers a framework for relating a firm's performance to characteristics of demand [32] and provides fresh insights on how value is attained in a competitive climate [33]. The value-based theory conceives the problem associated with a firm's profitability depends largely on the extent of value addition, happening because of the conversion of costly inputs into invaluable output by participants jointly working across the supply chain nodes, as well as value capture, which is the result of competition amongst participants in appropriating the created value – profits. The level of value an agent/participant appropriates in the prevailing supply chain nodes is a fundamental issue, that the value-based framework addresses [30]. This theory emphasises that value capture analysis involves information on the value creation options (i.e., the value created in entire possible exchanges requiring the subcategories of actors in the supply chain nodes) and hypothesized on how the competition unfolds among these actors.

The application of this theory suggests that a processor can appropriate a share of the profit if and only when value is created. Interestingly, since every input is measured at its economic cost, appropriating value amounts to earning economic rents (profits) for suppliers' equity capital, and the residual income arising due to value addition goes to the processors. Specifically, any suppliers,

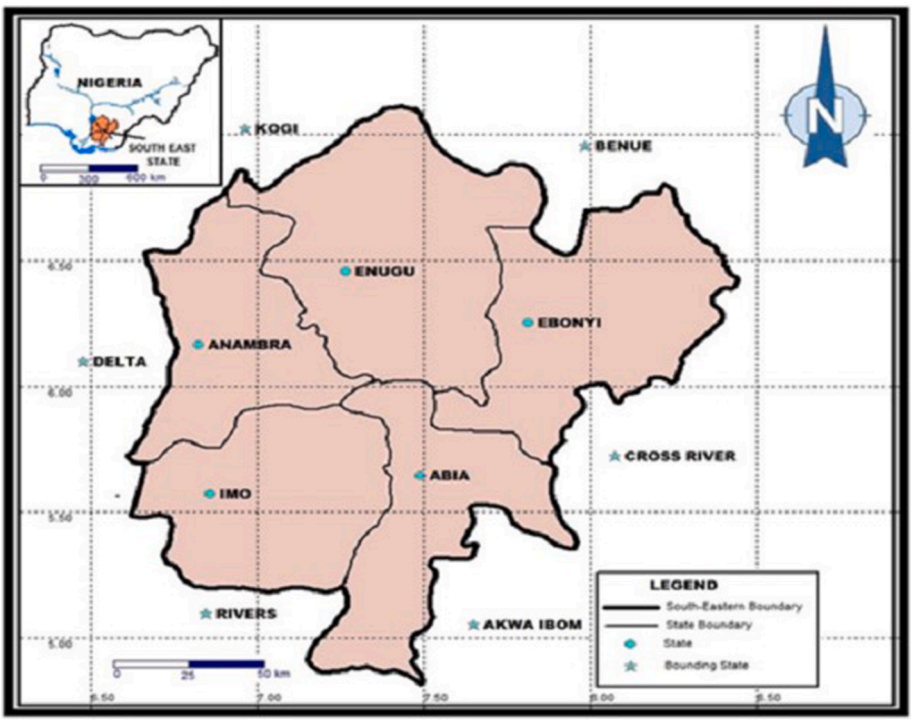

Fig. 1. Map of Southeast zone, Nigeria.

processors, or buyers that create any sort of value earn commensurate economic rents or profits. To be guaranteed a share of the value-added, the processor has to create a higher value by exploiting a sustained supplier-processor-consumer alliance that offers consumers or suppliers at best a superior deal that far exceeds what they receive in the present alliance (Moreton, 2004). The main characteristic of a processor that sufficiently measures up with this condition is his ability to convert inputs into products that sufficiently meet either the inputs of the suppliers or satisfy the desires of the consumers to always guarantee his/her participation in the alliance that allows him to reap certain portions of the economic rents.

Empirical evidence has shown that value-based theory has been tested on a number of assumptions. For instance Ref. [34], studied buyer-supplier relationships and found that suppliers' value capture differs from value addition [35]. examined factors linked with a participant's ability to bargain and found that a participant's ability to bargain has a significant influence on transaction prices, as well as value capture. Other scholars such as [36–38] employed the value-based theory to test associations between proxies of value addition and response variables (e.g., profit, survival) that are usually considered in management strategic research. The application of this framework offers profound insights into the nature of economic benefits and returns from value-added cashew products amongst the group of processors adding value to different components of cashew.

3. Methodology

3.1. Study area

The location of this study was the Southeast zone of Nigeria. The Southeast zone has five States, viz; Abia, Anambra, Ebonyi, Enugu and Imo (Fig. 1), and is located in the Southern part of the country. The zone is populated by 16.4 million people, mainly of Igbo-extraction [39]. The area occupies a landmass of approximately 58,214.7 km^3 and lies on longitude 6° 50^I and 8° 30^I E latitude 4° 30^I and 7° 5^I N. It shares a boundary with Cross-River State in the east, in the north by Benue and Kogi States, in the south by Akwa-Ibom and Rivers States and bounded to the west by Delta State. The area experiences two major weather seasons, viz: dry and rainy seasons. It is situated in the derived savannah and rainforest regions of the country.

This area was selected and considered suitable for this study because of its designation as a leading cashew-producing zone in Nigeria. Reports show that four of the five States in the zone are among the main cashew-producing States [28,40]. Historic evidence shows that the Portuguese merchants were the first to introduce cashew into Southeast, Nigeria, which then was to mitigate the erosion menace [5]. However, the status of cashew has since changed from an erosion-controlled crop to an economic crop with a significant potential for income and livelihood growth.

3.2. Study population

The study population comprised all the people who are engaged in cashew value addition as at the time of this study in the Southeast zone of Nigeria. The specific population was sampled from the records of cashew processors gotten from the Agricultural Development Programme (ADP) in the selected States which are mostly within the category of small-scale cashew processors. This classification conforms with of [41]; that Lagos, Kwara, Ogun and Kaduna States are hosts to major large cashew processing companies in Nigeria. The State-by-State population of cashew processors as contained in the ADP record is as follows: Anambra State – 8,261, Abia State – 13,221, Imo State – 15,735 and Enugu State – 23,820. The total population of cashew processors in the study area corresponds to 61,037.

3.3. Sample size determination

This study employed the proportional sample size formula of [42] to ensure an unbiased and equal chance of selection for every member of the population. Given that the sample frame is known, this approach is considered very suitable for this study because critical parameters for sample size determination such as the specific margin of error, and the desired confidence interval were taken into consideration. The formula as developed by Krejcie and Morgan is stated thus:

$$n = \frac{X^2 x N x P\ (1-P)}{ME^2 x\ (N-1)) - (X^2 x P x\ (1-P))} \quad 1$$

Where:

n = Sample size
X^2 = Chi-square for the specified confidence level at 1° of freedom
N = Population size
P = Population proportion
ME = Desired Margin of Error (expressed as a proportion)

Substituting into the formula, we have

$X^2 = 3.84$

N = 61,037
P = 0.5
ME = 5.2%

$$n = \frac{3.84\ x\ 61,037\ x\ 0.5\ (1-0.5)}{(5.2\%^{2*}(61,037-1) + (3.84\ x\ 0.5\ (1-0.5))}$$

$$n = \frac{58,595.52}{165.961344}$$

n ≈ 353
Based on the foregoing, the sample size of 353 was established for the study.

3.4. Sampling technique

This study employed a descriptive-type of quantitative research design, involving a cross-sectional survey. The quantitative research design involves the collection of numerical data about a sample population, which is used to make a generalization about the population or explain a particular phenomenon [43]. This present study involves purely numeric data – revenue, cost and income from value-added cashew products – which are intrinsically quantitative, and justifies the use of quantitative design. More so, the cross-sectional survey approach involving the use of a questionnaire aided the gathering and analysis of data from the sample respondents at a specific time period. To eliminate the possible shortcomings that the use of a structured questionnaire would pose to adequate collection of data, a reconnaissance was carried out among 30 cashew processors. The observed shortcomings were taken into consideration and used to modify and improve the questionnaire. This approach also enabled the researcher to carry out a thorough statistical analysis that combined the data such as mean, averages, and percentages and compare aggregated data across categories of cashew processors [44]. Based on the foregoing, multistage random and purposive sampling procedures were used for this study. The stages involve, firstly, the purposive selection of four States renowned for cashew production from the five States in the Southeast zone of Nigeria. This was based on the hypothesis that States having high volumes and clusters of cashew activities will experience higher value-added activities. Accordingly, Anambra, Abia, Imo and Enugu States were selected. This aligns with the cashew categorization in Nigeria by Refs. [9,40]. The second stage involved the purposive selection of one agricultural zone from each of the four States earlier sampled, totalling four (4) agricultural zones. This was based on the result of the preliminary survey carried out to identify and delineate the zone into clusters based on the volume and concentration of cashew processing activities in each of the States. In the third stage, three hundred and fifty-three (353) cashew processors were randomly selected from the lists of cashew processors gotten from the ADP in the selected States (Table 1).

Bowley's proportionate allocation method (equation (2)) was also applied to ensure that the share of participants drawn from each State corresponds to its population. This technique enabled us to determine the appropriate share of the sample size by each State, and the number of questionnaires to be allocated to each of the sampled States relative to their population. Based on this, the States and the number of respondents sampled are as follows: Abia – 76, Anambra – 48, Enugu – 138, and Imo – 91 respondents. The technique is stated thus [45]:

$$nh = \frac{nNh}{N} \quad (2)$$

Where:
nh = Number of questionnaires assigned to each State
Nh = Population size of each State
n = Total sample size obtained (353)
N = Total population (61,037)

3.5. Source of data and method of data collection

Primary data were used for this study. A structured questionnaire, administered physically by the researcher and his assistants was used to generate the data. The questionnaire was designed to gather information connected to the objective of the study. The

Table 1
Distribution of population and sampled respondents.

State	Sample frame of processors	No. of sampled respondents
Abia	13,221	76
Anambra	8,261	48
Enugu	23,820	138
Imo	15,735	91
Total	**61,037**	**353**

Source: Compilation of the ADP record in the sampled States.

information captured with the questionnaire includes the direct costs associated with the purchase of raw cashew nuts and roasted kernel, labour, tax, storage fee, packaging materials such as bottles and cellophane bags, and transportation constituted the variable cost, while the costs of assets such as frying pan, bowls, trays, jute bags make up the fixed cost, and the revenue represents earnings from sales of value-added cashew products. These costs and revenues were obtained from the cashew processors in their local currency – the naira but were converted to US dollars. The costs of packaging and marketing the products were also captured. The expenditure and sale values were obtained to cover an average monthly quantity of cashew products that value was added to by the respective processors.

The data were collected within a period of three months – November 2020 to January 2021. To ensure rapid distribution and recovery of the research instrument, four experienced research assistants were recruited and given the relevant training pertaining to the administration of the questionnaire. The knowledge and previous participation of the research assistants in research activities were well considered before recruiting and accepting them for the exercise. Each research assistant was assigned to each State while the lead researcher supervised their activities. The respondents' consent was sought through a letter of introduction, which states that the respondents are free to accept or decline his/her participation in this study and at any time free to withdraw from the study.

3.6. Data analysis

The survey data were analysed using ratio statistics, benefit-cost ratio, gross margin and rate of return on investment. One-way ANOVA was used to test the hypothesis on whether there were means income differences between the three categories of cashew processors; while F-test was considered significant when the p-value <0.05. Based on the overall statistically significant difference shown between the means income of the processors, the LSD post hoc test was carried out to ascertain where the differences occurred between the category of the cashew processors' means.

3.6.1. Determination of cost-benefit analysis

To achieve the cost-benefit analysis as a result of value-added to cashew products, cashew processors were delineated into three categories as follows:

Category 1 …. …. …. …. …. … Processors, adding value to cashew nut

Category 2 …. …. …. …. ….. Processors, adding value to cashew kernel

Category 3 …. …. …. …. ….. Processors, adding value simultaneously to both cashew products

Gross margin (GM) was applied to determine the discrepancy between the total revenue (TR) and total variable cost (TVC) of cashew processing [6]. GM enabled us to determine the costs, revenues and net profit of value-added cashew products in the area.

$$GM = TR - TVC \tag{3}$$

Where:

TR = Quantity of output (Q_i) × Price (P_i); and

TVC = Quantity of Input (X_j) × Price (P_j)

GM = Gross margin, TR = Total revenue, TVC = Total variable cost.

Hence,

$$GM = \sum_{i=1}^{n} P_i Q_{ij} - \sum_{j=1}^{n} P_j X_j \tag{4}$$

The net return represents the total profit which is calculated thus:

Net return = TR – TC.Where: TR = Total revenue, TC = Total cost, and

$$\text{Rate of return on investment (ROR)} = \left(\frac{TR - TC}{TC}\right) \text{ x } 100 \tag{5}$$

3.6.2. Determination of the benefit-cost ratio

The benefit-cost ratio is the ratio of revenue over the cost for every naira invested in adding value to cashew products [46]. Thus, BCR is calculated as:

$$BCR = TR/TC \tag{6}$$

Where:

BCR = Benefit-cost ratio

GR = Total revenue

TC = Total cost

3.6.3. Determination of net income owing to value addition

To determine the net income from value-added to cashew products, the fixed cost (that is cost of equipment and machineries) was determined by subtracting total costs (fixed and variable costs) from Total revenue [47]. Net income from value-added cashew products is:

$$NIVA = GM - TFC \quad (7)$$

Where:

NIVA = Net income from value addition
GM = Gross margin
TFC = Total fixed cost

3.6.4. Ratio statistics

Ratio statistics provides a complete list of summaries for describing the ratio between two scale variables. In other words, it describes the variability between two scale variables. Its application here is to enable us to determine the ratio of variability between revenue and cost among a group of processors adding value to cashew products.

$$\text{Ratio } (Ri) = \frac{A_i}{S_i}, = i = 1, \ldots, n \quad (8)$$

Where:

n = Number of observations
Ai = Numerator of the I-th ratio ($i = 1, \ldots, n$). This represents the revenue (N).
Si = Denominator of the i-th ratio ($i = 1, \ldots, n$). This represents the cost (N).
Ri = The i-th ratio ($i = 1, \ldots, n$).
fi = Case weight associated with the i-th ratio ($i = 1, \ldots, n$).

3.6.5. Coefficient of dispersion (COD)

COD measures the variability in the ratios. Note, the larger COD value indicates greater variability.

$$COD = 100\% \text{ x } \frac{AAD}{R} \quad (9)$$

Where:

COD = coefficient of dispersion; AAD = average absolute deviation; R = ratio

3.6.6. Average absolute deviation (AAD)

$$\sum_{i=1}^{n} f_i |Ri - \hat{R}| \setminus / \sum_{i=1}^{n} f_i \quad (10)$$

3.6.7. Coefficient of concentration (COC)

COC is a report of the percentage of values within a certain percentage of the median. The variable with the highest COC suggests no variability while the group with the least COC value indicates the presence of variability. Given a percentage of 100% x g, the coefficient of concentration is the percentage of ratios falling within the interval $[(1 - g)\hat{R}, (1 + g)\hat{R}]$

Decision: The higher this coefficient, the better uniformity.

Table 2
Benefit-cost analysis of 1 kg of value-added cashew products.

Items	Amount of value addition to 1 kg of cashew nut (N & US $)	Amount of value addition to 1 kg of cashew kernel (N & US $)	Amount of value addition to 1 kg of both cashew products (N & US $)
A. Total Variable Cost	6,671.7 (18.5)	6,899.0 (19.2)	6,632.7 (18.4)
B. Total Fixed Cost	133.3 (0.4)	256.4 (0.7)	233.1 (0.6)
C. -Total Cost	6,805.0 (18.9)	7,155.4 (19.9)	6,865.8 (19.1)
D. Total Revenue	9,352.9 (26.0)	9,879.8 (27.4)	9,206.2 (25.6)
E. Gross Margin = D – A	2,681.2 (7.5)	2,980.8 (8.3)	2,573.5 (7.1)
Net income = E – B	2,547.9 (7.1)	2,724.4 (7.6)	2,340.4 (6.5)
Benefit Cost Ratio = D/C	1:1.4	1:1.4	1:1.3
ROR = $\left(\frac{D-C}{C}\right)$ x 100	37.4%	38.1%	34.1%
% of TVC	98.0%	96.4%	96.6%
% of TFC	2.0%	3.6%	3.4%

Note: Figures in parenthesis are in USD ($1 equivalent to N360).

4. Results and discussion

4.1. Gross margin, benefit-cost ratio and rate of return on investment

Table 2 shows that the average total cost of adding value to 1 kg of cashew products was slightly higher among processors adding value to cashew kernel (N7,155.4 ($19.9)) than those adding value to both cashew products (N6,865.8 ($19.1)) and least among those adding value to cashew nut (N6,805.0 ($18.9)). The variable costs range from >96% in cashew kernel and both cashew products to ≤98% in cashew nut while the total fixed costs are <4%. The finding shows that variable cost accounts for over 90% of the total cost used for adding value to cashew products in the Southeast zone of Nigeria. This suggests that the processors are still stuck to the traditional method of cashew value addition. Again, the processors lack ownership of assets like modern processing equipment and machines. The implication is that the processors are unlikely to access credit facilities from a financial institution because of a lack of ownership of valuable processing assets that could serve as collateral. Thus, any cost reduction measures must explore ways of cutting down on items that constitute variable costs that will free funds for fixed assets acquisition.

The average revenues accruing as a result of value addition to 1 kg of cashew products exceed the respective total costs with processors adding value to cashew kernel achieving the highest revenue of N9,879.8 ($27.4), followed by those adding value to cashew nut – N9,352.9 (26.0), and least among those adding value to both cashew products (N9,206.2 ($25.6)). Meanwhile, processors adding value to cashew kernel obtained the highest net income of N2,724.4 (US $7.6)/1 kg, followed by those adding value to cashew nut with net income of N2,547.9 (US $7.1) and least, are processors adding value to both cashew products (N2,340.4 ($6.5)). These figures indicate that value addition to cashew products yields a high monetary reward, suggesting that the enterprise is economically viable [19]. It is important to note that ordinarily, it is expected that processors adding value to both cashew products ought to achieve a higher net income because they are utilizing a combination of inputs. Obviously, this turns out not to be the case going the findings. The reason could be that processors adding value to a single cashew product – kernel or nut may have developed special skills that enable them to utilize resources in a way that enhances a higher profit than those adding value to both cashew products.

The benefit-cost ratios for adding value to 1 kg of cashew nut and cashew kernel were slightly higher (1:1.4) respective as against 1:1.3 obtained for those adding value to both cashew products. These ratios are above 1.0, suggesting that value-added cashew products deliver positive net income to the processors. This, further buttresses the profitability of value-added cashew products with returns of 0.4, 0.4, and 0.3 kobos for every N1.0 invested in adding value to both cashew products, cashew kernel and cashew nut respectively. The finding is in tandem with that of Lawal, Oduwole, Shittu and Muyiwa (2010) who reported that cashew nut processing enhances household revenue and income in Nigeria.

The analysis further shows the rate of return (ROR) for 1 kg of value-added cashew kernel was highest (38.1%), followed by that of cashew kernel (37.4%), and cashew nut (34.1%). This implies that the processors adding value to cashew nut, cashew kernel, and both cashew products recoup returns of 37.4, 38.1 and 34.1% respectively from their capital investment. This finding is justified by Food and Agriculture Organization [48] that most small-scale agro-entrepreneurs prefer investing in enterprises with a minimum rate of return exceeding 30%. Conclusively, the finding shows that there is a higher monetary reward for adding value to a single cashew product – kernel or nut than combining both cashew products. By implication, processors of single cashew products – cashew kernel and cashew nut – are creating a higher value, probably because they have achieved a higher degree of specialization, which enables them to appropriate higher profits than those adding value to both cashew products. From the theoretical perspective, the findings also align with the theoretical postulation that the amount of profit each agent in the value chain appropriates is a function of the degree of value it is able to add or create along the value chain nodes. Obviously, the processors of cashew nut and cashew kernel appropriate higher profits because they are able to create better values than those adding value to both cashew products. Thus, justifying the use of value-based theory for this study.

4.2. Income differential among processors adding value to cashew products in Southeast zone, Nigeria

The test result indicates that there was a significant difference between the means income of the processors adding value to cashew products (Table 3). The LSD shows that incomes from processors adding value to cashew nut, kernel and both cashew products were significantly different ($P < 0.05$), suggesting unequal income generation among the three categories of processors, adding value to cashew products. Based on this, the null hypothesis was rejected and the alternative hypothesis accepted that there is a significant difference between the incomes of processors adding value to cashew products in Southeast, Nigeria. A closer look at the mean values of the cashew processors suggests that those adding value to both cashew products with N45,414.63 earn the highest income while

Table 3
ANOVA result of income differential among processors adding value to cashew products in Southeast zone, Nigeria.

Value-added cashew product	N	Mean	Std. Devi
Cashew nut	173	20,959.54[a]	6,614.25
Cashew kernel	139	37,223.02[b]	31,362.08
Both cashew products	41	45,414.63[c]	32,386.71

F-value = 29,402; *P*-Value = 0.000.
Means on the same column with different superscripts are significantly different. Mean separation was done using LSD tested at a 5% level of significance (P < 0.05).

those adding value to cashew nuts with N20,959.54 earn the least income. Apparently, processors adding value to both cashew kernel, and cashew nut are into finished products when compared to those adding value to cashew nut who process intermediate products. Processed finished products enjoy greater price stability than intermediate products; therefore, may increase higher market opportunities and income generation [49]. This offers a plausible reason for the higher incomes accruing to processors of both cashew products, and cashew kernel.

4.3. Ratio statistics

The ratio statistics procedure provides a complete list of summary statistics for describing the ratio between two scale variables. This tool is used to determine the uniformity ratio between revenue and cost among the three categories of cashew processors – cashew nut, cashew kernel and both cashew products to establish the degree of variability in each of the enterprises.

The result shows that cost and revenue distribution ratios vary across the cashew processors (Table 4). The coefficient of dispersion (COD) in revenue/cost of value-added cashew products shows the least variability in cashew kernel (0.097) and the greatest in both cashew products (0.122). The extent of variability depicts the degree of risk inherent in the enterprise [50]. Thus, it is least risky to add value to cashew kernel and riskier to add value to both cashew products. More so, the result of within 20% of the median coefficient of concentration (COC) which reports the percentage of values within a certain percentage of the median equally confirms that the revenue/cost of value-added cashew kernel with the highest percentage (78.4) has the least risk when compared to both cashew products (68.3%) and cashew nut (73.4%) enterprises which have higher variability. The finding provides a useful strategy for evaluating the economic viability of value-added agricultural commodities with alternate perspectives.

5. Conclusion and recommendations

This study analysed the economic viability of value-added cashew products processed in the Southeast zone of Nigeria. The findings of this study led to the conclusion that there was a significant difference ($P < 0.05$) in the incomes of processors adding value to cashew products in the Southeast zone, Nigeria with processors adding value to cashew kernel netting the highest income. Equally, the study shows that value-added cashew products are not just profitable but economically viable with over 30% return on investment. Meanwhile, the variable cost of adding value to cashew products accounts for over 90% of the total cost. This suggests the over-reliance of processors on traditional processing techniques and their lack of ownership of modern cashew processing equipment. The implication is that many of the processors lack valuable assets that could serve as collaterals for credit acquisition. The study provides useful insight for evaluating the economic viability of value-added cashew products with alternate perspectives. The findings also offer empirical evidence to support the theoretical foundation that the amount of profit processors appropriate is the function of the degree of value they can create/add. We conclude that value-added cashew products deliver positive net income and high monetary rewards to processors as indicated by the values of benefit-cost ratios and rate of returns. Thus, the study advocates the involvement of more individuals, particularly, unemployed people in adding value to cashew products because of its high rate of returns on investment.

This study was limited to the Southeast zone of Nigeria even though cashew is grown in almost every part of the country for time and other resource constraints. Nevertheless, the findings of this study can be extrapolated because of the robust methodology which involves the use of a cross-sectional survey and adequate sample representation. This helped to eliminate elements of biases in the study. Again, cashew nut and kernel are not the only components of cashew that value can be added. Therefore, further research is needed to identify factors and constraints to value addition to cashew apples and other by-products and wastes such as cashew butter, broken nuts, and CNSL. This will pave the way for the entry of new investors and open a new frontier for more job opportunities, income generation and greater participation of rural households in Nigeria's cashew value chain industry.

The study recommends that government should assist processors with credit facilities to procure modern processing equipment to enhance income generation. Equally, the government should organise training for processors on ways of minimising costs associated with variable items to free funds for the acquisition of modern processing equipment and machineries that could serve as security for credit acquisition for enhancing income generation from value-added cashew products. More so, the government should design a programme that will encourage more people to engage in cashew value-addition activities because of its high rate of return on investment. This is in line with the government policy of job and wealth creation for reducing unemployment.

Conflict of interest

The authors hereby declare that there is no conflicting interest among them.

Table 4
Ratio statistics result for revenue/cost of value-added cashew products.

Group	Mean	Median	Coefficient of Dispersion	Coefficient of Concentration	
				Per cent between 1 and 3 inclusive	Within 20% of the Median inclusive
Cashew nut	1.340	1.427	0.115	98.8%	73.4%
Cashew kernel	1.377	1.427	0.097	100.0%	78.4%
Both cashew products	1.292	1.389	0.122	97.6%	68.3%
Overall	1.349	1.427	0.109	99.2%	73.9%

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References

[1] B. Dendena, S. Corsi, Cashew, from seed to market: a review, Agron. Sustain. Dev. 34 (4) (2014) 753–772.
[2] International Nut & Dried Fruit Council (INDC), Nuts & Dried Fruits Statistical Yearbook 2017/2018, 2018. Retrieved from, www.nutfruit.org. (Accessed 10 May 2019).
[3] FAO, Food and Agriculture Organization Statistics, 2018. Available online @, http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567#ancor.
[4] Mordor Intelligence, Cashew Market - Growth, Trends, COVID-19 Impact, and Forecasts (2021 - 2026, 2021. Retrieved from, https://www.mordorintelligence.com/industry-reports/global-cashew-kernel-market-. (Accessed 9 September 2021).
[5] O.O. Adeigbe, F.O. Olasupo, B.D. Adewale, A.A. Muyiwa, A review on cashew research and production in Nigeria in the last four decades, Sci. Res. Essays 10 (5) (2015) 196–209.
[6] S.A. Salau, G.O. Popoola, B.N. Nofiu, Analysis of cashew nuts marketing in Kwara State, Nigeria, FUOYE J. Agric. Hum. Ecol. 1 (1) (2017) 34–44.
[7] FAOSTAT, FAO country statistics; Crop, 2019. Available @, http://www.fao.org/faostat/en/#data/QC. (Accessed 28 March 2019).
[8] W. Ezeagu, Nigeria: Assessment of the Situation and Development Prospects for the Cashew Nut Sector. A report of Nigerian Export Promotion Council (NEPC), submitted to International Trade Centre UNCTAT/WTO (ITC) and funded by the ITC Global Trust Fund under project INT/W3/69, 2002, p. 37.
[9] Morgan, Nigeria's Unrealised Agricultural Prowess: the Case of Cashew, 2016. Retrieved from, www.sbmintel.com. (Accessed 14 November 2018).
[10] P.A. Nugawela, R. Oroch, Cashew Sub-sector Strategic Framework. Promoting Sub-sector Strategic Framework. Promoting Proper Opportunities through Commodities and Service Markers, Department for International Development, UK) – Nigeria, 2005.
[11] T.O. Akinwale, Cashew apple juice: its use in fortifying the nutritional quality of some tropical fruits, Eur. Food Res. Technol. 211 (2000) 205–207.
[12] C.P. Topper, P.D.S. Caligari, M. Camara, S. Diaora, A. Djaha, F. Coulibay, A.K. Asante, A. Boamah, E.A. Ayodele, P.O. Adebola, West African Regional Cashew Survey Report (Guinea, Guinea Bissau, Cote D'Ivore, Ghana and Nigeria), vol. 1, Sustainable Tree Crop Programme (STCP) and Biohybrids Agrisystem Ltd. U.K., 2001, p. 110.
[13] J.O. Lawal, C.O. Jaiyeola, Economic analysis of cocoa wine produced from cocoa powder, J. Agric. Food Econ. 5 (2007) 76–77.
[14] K. Jeyavishnu, D. Thulasidharan, M.F. Shereen, A. Arumugam, Increased revenue with high value-added products from cashew apple (*Anacardium occidentale* L.)—addressing global challenges, Food Bioprocess Technol. 14 (6) (2021) 985–1012.
[15] UNCTAD, Cashing in on Cashews: Africa Must Add Value to its Nuts, 2021. Retrieved from, https://unctad.org/news/cashing-cashews-africa-must-add-value-its-nuts. (Accessed 9 September 2021).
[16] F. Muktar, Nigeria's cashew sector challenges remain despite new facilities, Premium Times (May 25, 2021). Available online @, https://www.premiumtimesng.com/news/top-news/463770-nigerias-cashew-sector-challenges-remain-despite-new-facilities.html.
[17] L. Latruffe, Y. Desjeux, Common agricultural policy support, technical efficiency and productivity change in French agriculture, Rev. Agric. Food Environ. Stud. 97 (2016) 15–28.
[18] K. Schubert, J. Mason, Cost-Benefit Analysis of USAID/Nigeria's MARKETS II Program, Final Draft, Prepared for Nigerian Mission U.S. Agency for International Development, Abuja, Nigeria, 2015.
[19] J. Spicka, T. Hlavsa, K. Soukupova, M. Stolbova, Approaches to estimation the farm-level economic viability and sustainability in agriculture: a literature review, Agric. Econom.– Czech 65 (6) (2019) 289–297, https://doi.org/10.17221/269/2018-AGRICECON.
[20] A. Skarżyńska, Factors determining profitability of production of selected agricultural products by 2020, Problems of Agricultural Economics 342 (1) (2015) 55–71.
[21] N.T. Dossou, S. Akdemir, Analysis of the determinants of the profitability of cashew nuts in Benin: case of the communes of Parakou and N'dali, Sci. Papers Seri. Manag. Econom. Eng. Agric. Rural Develop. 20 (1) (2020) 181–186.
[22] R.N. Yegbemey, J.A. Yabi, D.G.B. Aïhounton, A. Paraïso, Modélisation simultanée de la perception et de l'adaptation au changement climatique: cas des producteurs de maïs du Nord Bénin (Afrique de l'Ouest), Cah. Agric. 23 (2014) 177–187, https://doi.org/10.1684/agr.2014.0697.
[23] Y.E. Miassi, F.K. Dossa, I.A. Labiyi, S. Dossouhoui, J.A. Yabi, Contract farming and cashew production in north Benin: socio-economic importance and determinants of profitability, J. Agric. Res. Adv. 1 (1) (2019) 29–38.
[24] P.Y. Adegbola, A.S. Adekambi, C.O. Ahouandjinou, Analyse de la performance des chaines de valeurs de la filière anacarde au Benin, 2011, Institut National des Recherches Agricoles du Bénin, Rapport technique, 2011, p. 79 [Online] Available: http://www.insae-bj.org/etudes-commerce-exterieur.html?file=files/publications/commerceext/Dynamique_4_Filieres_Export.pdf.
[25] D.G.B. Aïhounton, J.A. Yabi, F.X. Bachabi, R.N. Yegbemey, A.O. Kindemin, I.A. Labiyi, Socio-economic determinants of the economic profitability of cashew nuts marketing in North-Eastern- Benin: case study of Tchaourou municipality, Int. J. Innov. Sci. Res. 21 (1) (2016) 212–219.
[26] M. Boianovsky, Hawley, frederick barnard (1843–1929), in: Palgrave Macmillan (Ed.), The New Palgrave Dictionary of Economics, Palgrave Macmillan, London, 2008, https://doi.org/10.1057/978-1-349-95121-5_2261-1.
[27] A. Jeyachitra, M. Selvam, J. Gayathri, Portfolio risk and return relationship — an empirical study, Asia Pac. Bus. Rev. 6 (4) (2010) 57–63, https://doi.org/10.1177/097324701000600406.
[28] J.O. Lawal, O.O. Oduwole, T.R. Shittu, A.A. Muyiwa, Profitability of value addition to cashew farming households in Nigeria, Afr. Crop Sci. J. 19 (1) (2011) 49–54.
[29] P. Katimuneetorn, Feasibility Study for Information System Projects, 2008. Retrieved from, https://www.umsl.edu/~sauterv/analysis/F08papers/Katimuneetorn_Feasibility_Study.html. (Accessed 9 September 2021).
[30] A. Brandenburger, J.H.W. Stuart, Value-based business strategy, J. Econ. Manag. Strat. 5 (1) (1996) 5–24.
[31] A. Brandenburger, J.H.W. Stuart, Biform games, Manag. Sci. 53 (4) (2007) 537–549.
[32] R. Adner, P. Zemsky, A demand-based perspective on sustainable competitive advantage, Strat. Manag. J. 27 (3) (2006) 215–239.
[33] G. MacDonald, M.D. Ryall, How do value creation and competition determine whether a firm appropriates value? Manag. Sci. 50 (10) (2004) 1319–1333.
[34] O. Chatain, Value creation, competition, and performance in buyer-supplier-relationships, Strat. Manag. J. 32 (1) (2011) 76–102.
[35] V. Bennett, Organization and bargaining: sales process choice at auto dealerships, Manag. Sci. 59 (9) (2013) 2003–2018.
[36] J.A. Adegbesan, M.J. Higgins, The intra-alliance division of value created through collaboration, Strat. Manag. J. 32 (2) (2011) 187–211.
[37] T. Obloj, L. Capron, Role of resource gap and value appropriation: Effect of reputation gap on price premium in online auctions, Strategic Management Journal 32 (2011) 447–456.
[38] D.W. Elfenbein, T. Zenger, Creating and Capturing Value in Repeated Exchange Relationships: Managing a Second Paradox of Embeddedness, 2014. Available at: SSRN 1649464. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1649464.
[39] National Population Commission (NPC), The official census report of Southeast, Nigeria, No 2, Vol. 96,Abuja: NPC (2006).

[40] United States Agency for International Development (USAID)-Nigeria, Industry Action Plan Nigerian Cashews, Chemonics International Inc, NW Washington DC, 2002.
[41] SBM Intelligence, Nigeria's Unrealised Agricultural Prowess: The Case of Cashew. A Report by SBM Intelligence, 2016. Retrieved from, www.sbmintel.com. (Accessed 7 January 2019).
[42] R.V. Krejcie, D.W. Morgan, Determining sample size for research activities, Educ. Psychol. Meas. 30 (3) (1970) 607–610.
[43] E.R. Babbie, The Practice of Social Research, twelfth ed., Wadsworth Cengage, Belmont, CA, 2010.
[44] D. Coghlan, M. Brydon-Miller, The SAGE Encyclopedia of Action Research, s. vols. 1–2, SAGE Publications Ltd, London, 2014, https://doi.org/10.4135/9781446294406.
[45] O.F. Onwubiko, A. Asmuni, K. Idris, J. Othman, The causes, effects and potential solutions to the deep-rooted Niger Delta oil crisis, Int. J. Soci. Behav. Sci. 1 (6) (2013) 122–129.
[46] S. Noonari, I.N. Memon, A.A. Jatoi, A. Memon, S.A. Wagan, A.A. Sethar, G.Y. Kalwar, M.A. Bhatti, A.S. Korejo, G.M. Panhwar, Analysis of rice profitability and marketing chain: the case study of Taluka Pano Akil district Sukkur Sindh Pakistan, Glob. J. Agric. Res. 4 (3) (2016) 29–37.
[47] M.S. Hoq, S.K. Raha, N. Sultana, Value addition in vegetables production, processing and export from Bangladesh, Bangladesh J. Agric. Res. 37 (3) (2012) 377–388.
[48] Food and Agriculture Organization (FAO), Farm Management Extension Guide 1: Economics For Market-Oriented Farming, Food and Agriculture Organization of the United Nations (FAO), Rome, 2008.
[49] N.S. Owoo, M.P. Lambon-Quayefio, The agro-processing industry and its potential for structural transformation of the Ghanaian economy, in: R. Newfarmer, J. Page, F. Tarp (Eds.), Industries without Smokestacks: Industrialization in Africa Reconsidered, online edn, Oxford Academic, Oxford, 2018, https://doi.org/10.1093/oso/9780198821885.003.0010. (Accessed 2 December 2022). accessed.
[50] J.F. Healey, Statistics: A Tool for Social Research, tenth ed., Cengage Learning, Stamford, 2015, pp. 91–121.