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Profitability and Determinants of Palm Oil Processing in Delta State, Nigeria

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Abstract

This research examined the profitability of palm oil processing, the determinants influencing the net income of processors, and the challenges encountered in Delta State, Nigeria. In 2026, data were gathered from 108 processors chosen through a multistage method among nine Local Government Areas within the state's three agricultural zones. Budgetary analysis, multiple regression, and a four-point Likert scale were employed in achieving the set objectives. The mean total income amounted to ₦632,506, juxtaposed with a total expenditure of ₦270,918, resulting in a net profit of approximately ₦361,588, a benefit-cost ratio (BCR) of 2.33, and a gross ratio of 0.43. Fresh fruit bunches (FFB) comprised 84% of the overall expenditure, while palm oil represented 83% of the total income. Net profit rose markedly with the volume of palm oil processed,

the market price of palm oil, the use of contemporary processing methods, and processing expertise, whereas it diminished with the proximity to the nearest buyer, labour costs, capital expenses, and fuel expenditures ($R^2 = 0.82$). Inadequate upkeep and repair of mills, insufficient governmental assistance, restricted access to financing, elevated transportation costs, the exorbitant price of milling equipment, inconsistent availability of fresh fruit bunches, and a deficiency of capital constituted significant obstacles. Processors received somewhat lower compensation than producers, however not markedly more than marketers. It is advised to provide credit, local manufacturing and maintenance of mills, as well as rural transportation and storage infrastructure.

Keywords: Palm Oil Processing, Profitability, Net Profit Determinants, Constraints, Benefit-Cost Ratio, Delta State

1. Introduction

Nigeria generated around 1.5 million tonnes of palm oil during the 2023/24 and 2024/25 marketing years, accounting for nearly 2% of global production (U.S. Department of Agriculture, Foreign Agricultural Service [USDA FAS] 2024) ^[15]. In contrast, Indonesia and Malaysia are projected to provide around 83% of the anticipated 80.7 million tonnes globally in 2025/26 (Union zur Förderung von Öl- und Proteinpflanzen [UFOP], 2026) ^[14]. Domestic production is insufficient to satisfy demand: the USDA anticipates 1.5 million tonnes of supply compared to 1.95 million tonnes of consumption in 2026, with the shortfall addressed by imports (Ecofin Agency, 2026) ^[2]. A national initiative initiated in April 2026 seeks to achieve self-sufficiency by 2050 and include the enhancement of processing infrastructure (Ecofin Agency, 2026) ^[2]. The profitability of processing at the small-business scale, along with the factors that constrain that profitability, presents a pertinent inquiry for policymakers.

Processors serve as the intermediary component in the palm oil supply chain. They procure or gather fresh fruit bunches (FFB) and process them into palm oil, kernel nuts, and kernel shells for distribution to marketers and consumers. Processing units vary from conventional hand-pressing methods to small-scale mechanical systems capable of handling around two tonnes of fresh fruit bunches per hour, as well as larger mills (Poku, 2002) ^[12]. Contemporary profitability analyses in Nigeria concur that processing is lucrative, yet they present varying margins and distinct factors. Net returns in Kogi State were superior with mechanised processing compared to manual processing (Adejo *et al.*, 2023) ^[1], as were those in Osun State (Jimoh *et al.*, 2024) ^[7], and a benefit-cost ratio of 2.40 was documented for processing in Southeast Nigeria (Onu *et al.*, 2026) ^[11].

Delta State ranks among the nation's foremost regions for palm oil production (Obokare *et al.*, 2024) ^[9]. Previous research on its processors indicated substantial profitability in conjunction with limitations related to cost, credit, and governmental assistance (Gunn, 2014) ^[4], while a more recent analysis of 240 processors highlighted the significance of technical and resource utilisation efficiency (Obokare *et al.*, 2024) ^[9]. There is limited understanding of how net profit collectively reacts to

input expenses, processing methods, and proximity to consumers, as well as the severity of the primary limitations. This study therefore examined the profitability of palm oil processing in Delta State. The objectives were to (i) estimate the costs and returns of palm oil processing; (ii) determine the factors affecting the net profit of processors; (iii) identify the constraints faced by processors.

2.1 Theoretical Framework

This research is based on two interrelated economic frameworks: the Neoclassical Theory of the Firm (Profit Maximization Theory) and the Induced Innovation Theory. Collectively, these theories establish the theoretical basis for assessing how smallholder palm oil processors distribute operational resources, implement processing technologies, manage market limitations, and optimize net returns in Delta State, Nigeria. The Theory of the Firm posits that production entities (processors) aim to optimize net profit by effectively allocating resources and minimizing costs. In the realm of palm oil production, net profits are limited by fluctuating input costs, primarily Fresh Fruit Bunches (FFB), along with constant overhead expenses. In addition, the Induced Innovation Theory (Hayami & Ruttan, 1971) [5] asserts that market dynamics compel agricultural stakeholders to adopt technical advancements.

2.2 Empirical Review

Recent research on palm oil processing in Nigeria consistently indicates favourable outcomes, with mechanized or contemporary processors yielding higher profits compared to their manual or traditional counterparts. In Delta State, Gunn (2014) [4] indicated an annual profit of ₦839,260 across 164 processors, while Obokare *et al.* (2024) [9] noted a monthly gross margin of ₦930,852 across 240 processors. In Kogi State, the net profits for processors amounted to ₦52,188 for manual processing, ₦142,079 for semi-mechanized processing, and ₦365,965 for mechanised processing (Adejo *et al.*, 2023) [1]. In Osun State, the aggregate benefit-cost ratio (BCR) was 1.42, increasing from 1.25 for conventional processing to 1.5 for contemporary processing (Jimoh *et al.*, 2024) [7], while another study indicated an annual net income of ₦140,384 (Idris-Adeniyi *et al.*, 2024) [6]. Onu *et al.* (2026) [11] indicated a gross margin of ₦562,402 and a benefit-cost ratio of 2.40 for Southeast Nigeria. The absolute naira values in this research cannot be compared due to variations in years, time units, and cost definitions, alongside a significant increase in naira prices over that time; thus, the BCR serves as a more adaptable metric.

Expenditure factors and technology consistently emerge as influencers. In Kogi State, the price of oil palm fruit, transportation expenses, and depreciation adversely affected processors' net returns, but extraction costs and the utilisation of processing machinery had a favourable impact on it (Adejo *et al.*, 2023) [1]. In Osun State, the level of education, cooperative affiliation, and processing techniques enhanced the volume of oil generated (Jimoh *et al.*, 2024) [7]. In Delta State, an analysis of resource-use efficiency indicated that FFB were not utilised to their full potential, whilst labour was over employed (Obokare *et al.*, 2024) [9]. Not all findings are consistent: Idris-Adeniyi *et al.* (2024) [6] identified positive coefficients for the expenses associated with bunches, firewood, kerosene, and grinding in a gross-

margin regression, indicating that the direction of an input-cost impact is contingent upon the model specification and operational scale.

Processors in Delta State have indicated elevated processing expenses, insufficient access to finance, and a deficiency in governmental assistance (Gunn, 2014) [4], along with contemporary challenges such as exorbitant rental costs (82.1% of respondents) and the steep price of fresh fruit bunches (67.1%) (Obokare *et al.*, 2024) [9]. In Osun State, insufficient funding and the exorbitant expense of processing machinery were the primary obstacles (Jimoh *et al.*, 2024) [7]; in Kogi State, price volatility, inadequate infrastructure, and a deficiency of capital and equipment were noted (Onoja & Ogali, 2015) [10]; while in Anambra State, issues related to technology, productivity, and socio-economic elements were recognised (Nwalieji & Ojike, 2018) [8]. The macroeconomic environment is also significant. In 2023, the petrol subsidy was abolished and the exchange-rate mechanisms were consolidated, leading the World Bank to anticipate a transient increase in prices, particularly for petrol, transport and electricity generation (Sienaert *et al.*, 2023) [13].

3. Methodology

3.1 Area of the study

The research was carried out in Delta State, Nigeria. The research region was chosen due to a significant segment of the local populace depending on palm oil-related enterprises for their sustenance. The state was established on August 27, 1991, from the previous Bendel State, bordered by Bayelsa State to the south, Edo State to the north, Anambra and Rivers States to the east, and the Bight of Benin to the west, encompassing around 160 km of coastline. The State comprises 25 local government districts, with Asaba, the capital, located along the northeastern border by the River Niger, and Warri, the commercial hub, positioned on the southwestern coast. Delta ranks as the twelfth most populated and the twenty-third largest by area, housing about 5.6 million residents as of 2016. The state is geographically divided, with Nigerian lowland woods predominantly in its interior, Central African mangroves along the southwestern coastline, and a little region of Niger Delta swamp forests in the southernmost part. It is located at latitudes 502859.7 N and longitude 5044.04.60 E, including an approximate land area of 1,722 km². It is located in the mangrove swamp forest of Delta State, characterized by an average yearly precipitation ranging from 2500 to 2800 millimetres. Agricultural products such as maize, plantains, and vegetables are cultivated as a component of the region's economic endeavours.

3.2 Study area and sampling

The research was conducted in Delta State, Nigeria, which comprises 25 Local Government Areas (LGAs) in three agricultural zones. A multistage sampling method was employed. Three Local Government Areas (LGAs) were intentionally chosen from each zone due to the prevalence of palm oil operations; three communities were randomly selected from each LGA (totaling 27 communities); and four processors were randomly chosen from each community, resulting 108 were chosen from identical communities and Primary data were gathered in 2026 with a systematic questionnaire.

3.3 Analytical Techniques

Costs and returns were estimated with budgetary analysis:

$$\begin{aligned} TC &= TVC + TFC & GM &= TR - TVC & NP &= GM - TFC \\ BCR &= TR / TC & GR &= TC / TR \end{aligned}$$

Where the symbols represent total cost, total variable cost, total fixed cost, total revenue, gross margin, net profit, benefit-cost ratio, and gross ratio, all expressed in naira. Fixed expenses comprised the depreciation of machinery, determined using the straight-line approach over a lifespan of 5 to 10 years with no residual value. A BCR exceeding 1 and a gross ratio falling below 1 signify profitability.

The elements influencing net profit were assessed using ordinary least squares multiple regression. Linear, semi-logarithmic, double-logarithmic, and exponential models were applied, with the linear model selected as the primary equation due to its R^2 value, the relevance of its F-statistic, and the count of relevant explanatory variables.

$NP = \beta_0 + \beta_1 QTY + \beta_2 TRN + \beta_3 DIS + \beta_4 PRC + \beta_5 LEV + \beta_6 RNT + \beta_7 WAG + \beta_8 COM + \beta_9 PKG + \beta_{10} AGE + \beta_{11} FUL + \beta_{12} COC + \beta_{13} TEC + \beta_{14} EXP + \mu$, where NP denotes net profit (₦); QTY signifies the volume of palm oil processed (litres); TRN represents transportation expenses (₦); DIS indicates the distance to the closest buyer (km); PRC refers to the price per litre of palm oil (₦); LEV is the market levy (₦); RNT denotes rental costs (₦); WAG signifies wages (₦); COM represents communication expenses (₦); PKG r.

Constraints were evaluated using a four-point Likert scale (strongly agree = 4, agree = 3, disagree = 2, very disagree = 1); any constraint with a mean score of 2.5 or higher was deemed significant.

4. Results and Discussion

4.1 Profile of the processors and their enterprises

The average age of the 108 processors was 46 years, with almost 75% being under 55. Males represented 59.3%, 65.4% were wed, and the average family had eight individuals. The average processing experience amounted to eight years. The level of educational achievement was moderate: 37.0% possessed secondary education, 28.4% had primary education, and 22.2% attained tertiary education, whilst 12.3% were uneducated. Table 1 illustrates the attributes that most directly influence profitability. Merely 17.3% secured financing from cooperative organizations, while 58.0% depended on personal resources, thereby constraining the volume and technology of processing. The majority of processors (59.3%) sourced FFB from wild palms, 17.3% procured bunches, 13.6% cultivated their own farms, and 9.9% leased palm plantations, indicating that supply is predominantly reliant on wild and seasonal sources. One-third of the processors (33.3%) utilized solely contemporary equipment, while two-thirds (66.7%) employed a combination of modern and old techniques; none depended exclusively on traditional procedures. Each processor marketed palm oil, with 55.6% sold at the farm gate and 44.4% at a local market, while merely 23.5% opted to keep their product.

Table 1: Socioeconomic Characteristics of Palm Oil Processors (n = 108)

Variables	Frequency	Percentage (%)	Mean / Mode
Age (Years)			
25 – 34	28	25.9	46 years
35 – 44	21	19.8	
45 – 54	32	29.6	
55 – 64	17	16.0	
65 – 74	9	8.6	
Sex			
Male	64	59.3	Male
Female	44	40.7	
Marital Status			
Single	17	16.0	Married
Married	71	65.4	
Divorced	20	18.5	
Household Size (Persons)			
1 – 4	12	11.1	8 persons
5 – 8	52	48.2	
9 – 12	29	27.2	
13 – 16	15	13.6	
Processing Experience (Years)			
3 – 8	69	64.2	8 years
9 – 14	29	27.2	
15 – 20	5	4.9	
21 – 26	3	2.5	
27 – 32	1	1.2	
Level of Education			
No Formal	13	12.3	Secondary education
Primary School	31	28.4	
Secondary School	40	37.0	
Tertiary	24	22.2	
Sources of Fund			
Personal Savings	63	58.0	Personal savings
Cooperative Society	19	17.3	
Microfinance	15	13.6	
Friends and Family	12	11.1	
Sources of Raw Material (FFB)			
Wild Palm	64	59.3	Wild palm
Purchased	19	17.3	
Own Farm	15	13.6	
Leased	11	9.9	
Processing Techniques			
Modern Only	36	33.3	Modern and traditional
Modern and Traditional	72	66.7	

Source: Field survey, 2026.

4.2 Costs and returns of palm oil processing

The financial allocation for the typical processor is presented in Table 2. Total revenue amounted to ₦632,506, with palm oil accounting for 83.2% (₦526,473, approximately 613 litres at ₦859.14 per litre), kernel nuts contributing 14.8%, and kernel shell representing 2.0%. The overall expenditure amounted to ₦270,918, resulting in a gross margin of ₦367,428 and a net profit of ₦361,588. Variable expenses constituted 97.8% of the overall expenditure, with the cost of FFB alone amounting to

₦227,635, representing 84.0%. Remuneration (₦11,727), loading and unloading (₦5,869), gasoline expenses (₦4,749), and rental costs (₦4,319) were the other significant items. Fixed expenses (equipment depreciation) constituted merely 2.2% of total expenditures, thereby necessitating working capital for the procurement of FFB instead of substantial investment in machinery.

The BCR of 2.33 indicates that every naira expended yielded ₦2.33 in revenue, resulting in a net gain of ₦1.33, while the gross ratio of 0.43 signifies that expenses consumed 43 kobo of each naira generated. The processing of palm oil in the sample proved to be exceedingly lucrative. The BCR aligns with the 2.40 documented for processors in Southeast Nigeria (Onu *et al.*, 2026) ^[11] and significantly exceeds the 1.42 noted for Olorunda LGA in Osun State, where the majority of processors employed conventional techniques (Jimoh *et al.*, 2024) ^[7]. The elevated ratio in

Delta State aligns with the reality that all processors in this region utilized contemporary technology. Kernel nuts and shells contributed around 17% of sales, indicating that by-products are significant for profitability. The cost framework elucidates why FFB supply and credit accessibility are perceived as limitations: a processor unable to fund bunches cannot operate the mill.

The profitability of processors is constrained by timing. Merely 23.5% retained their product, with the majority selling shortly after extraction, while 86.1% of merchants preserved palm oil. In the rural market of Oshimili North LGA, Delta State, palm oil prices were diminished during the harvest compared to post-storage, with merchants benefiting more financially than producers (Emaziye & Ovharhe, 2020) ^[3]. Seasonal price increases mostly benefit stockholders, suggesting that storage may be a viable strategy for enhancing processor profitability.

Table 2: Costs and Returns of Palm Oil Processing per Processor (₦)

Item	Amount (₦)	% of total cost
Variable costs		
Fresh fruit bunches	227,635	84.0
Wages	11,727	4.3
Loading and offloading	5,869	2.2
Cost of fuel	4,749	1.8
Rent	4,319	1.6
Transportation	3,897	1.4
Advertisement	2,525	0.9
Cost of capital	1,966	0.7
Communication	1,316	0.5
Market levy	1,074	0.4
Total variable cost (TVC)	265,078	97.8
Fixed costs (depreciation)		
Gallon	1,564	0.6
Wash tub	1,254	0.5
Pumping machine	1,125	0.4
Filter	976	0.4
Milling machine	781	0.3
Axe	72	0.0
Shovel	68	0.0
Total fixed cost (TFC)	5,840	2.2
Total cost (TC)	270,918	100.0
Returns		
Palm oil (about 613 litres at ₦859.14)	526,473	83.2 of revenue
Kernel nuts	93,406	14.8 of revenue
Kernel shell	12,627	2.0 of revenue
Total revenue (TR)	632,506	
Gross margin (TR – TVC)	367,428	
Net profit (GM – TFC)	361,588	
Benefit-cost ratio (TR/TC)	2.33	
Gross ratio (TC/TR)	0.43	

Note. Source: Field survey, 2026.

4.3 Factors affecting the net profit of processors

The primary equation was the linear function (Table 3). The R^2 value of 0.818 (adjusted $R^2 = 0.778$) indicates that almost 82% of the variability in net profit is accounted for by the model, and the F-value (20.81) is noteworthy. Eight variables were noteworthy.

Quantity processed, price and experience: The volume of palm oil refined ($\beta = 243.81$), the cost of palm oil ($\beta = 36.38$), and the duration of processing experience ($\beta = 6.996$) significantly increased net profit at the 1% significance level. Increased volumes distribute overhead costs, elevated prices enhance revenue directly, and

seasoned processors optimize the procurement, extraction, and sales of raw materials more effectively.

Processing technique: The methodology variable was both positive and statistically significant at 1% ($\beta = 4.396$), indicating that processors utilizing contemporary equipment outperformed those employing a mix of modern and old techniques. This aligns with the superior net returns of mechanized processors in Kogi State (Adejo *et al.*, 2023) ^[1] and the elevated BCR of contemporary processing in Osun State (Jimoh *et al.*, 2024) ^[7], hence endorsing broader access to mechanized mills. The coefficients for technique (2.01) and experience (7.00) are minimal in value; hence their

statistical significance should not be interpreted as a substantial impact on profit.

Distance, wages, cost of capital and fuel: Proximity to the closest purchaser ($\beta = -51,798$), remuneration ($\beta = -0.356$), and capital expenses ($\beta = -97.57$) diminished profitability at a significance level of 1%, while gasoline expenses ($\beta = -139.76$) affected it at 5%. Remote processors face significant transportation and handling expenses, while

reduced pricing, elevated salaries, and interest rates compress profit margins, necessitating fuel for sterilization and mill operations. Transport expenses were a considerable adverse element in Kogi State (Adejo *et al.*, 2023) ^[1]; however, in this context, it was not substantial, yet distance, which influences it, was. Transportation expenses, market charges, rental fees, communication costs, packaging, and age were not substantial.

Table 3: Linear Regression Estimates of the Determinants of Net Profit of Palm Oil Processors

Variable	Coefficient	Std. error	t	p	Significance
Constant	4,086.59	401,899.70	0.01	.992	ns
Quantity processed (X_1)	243.81	32.37	7.53	<.001	1%
Transportation cost (X_2)	-3.90	7.48	-0.52	.604	ns
Distance (X_3)	-51,798.34	7,618.04	-6.80	<.001	1%
Price of palm oil (X_4)	36.38	6.90	5.27	<.001	1%
Market levy (X_5)	0.75	28.76	0.03	.979	ns
Store rent (X_6)	8.34	11.96	0.70	.488	ns
Wages (X_7)	-0.356	0.082	-4.35	<.001	1%
Communication (X_8)	9.42	23.86	0.39	.694	ns
Cost of packaging (X_9)	0.039	0.741	0.05	.959	ns
Age (X_{10})	-3,312.21	2,821.64	-1.17	.245	ns
Cost of fuel (X_{11})	-139.76	65.32	-2.14	.035	5%
Cost of capital (X_{12})	-97.57	25.93	-3.76	<.001	1%
Processing technique (X_{13})	2.01	1.11	3.97	<.001	1%
Experience (X_{14})	7.00	0.69	10.11	<.001	1%

Source: Field survey, 2026. *Note.* Dependent variable: net profit (₦). $F = 20.81$; $R^2 = 0.8176$; adjusted $R^2 = 0.7783$; ns = not significant at 10%.

4.4 Constraints faced by processors

Table 4 indicates that seven out of the ten constraints surpassed the threshold of 2.5: inadequate repair and maintenance of mills (3.05), insufficient government support (3.04), restricted access to credit (2.89), elevated transport costs (2.81), high expenses for milling machinery (2.80), inconsistent supply of FFB (2.68), and insufficient capital (2.62). Processors in various regions of Nigeria frequently cite credit, capital, and equipment expenses as their primary restraints (Jimoh *et al.*, 2024; Onoja & Ogali, 2015) ^[7, 10], while Delta State processors have previously indicated a deficiency in credit and governmental assistance a decade prior (Gunn, 2014) ^[4]. Ineffective repair services result in mills being non-operational, and when machinery and spare components are imported, a depreciated naira increases their costs. Processing requires substantial working capital (Table 2), and novice processors are unable to secure loans without collateral. The inconsistent supply of FFB arises from reliance on wild stands (Table 1) and seasonal variations, as fruit availability diminishes and oil outputs decrease during the rainy season. Elevated transportation costs stem from fuel expenses, spare parts pricing, and the cumbersome nature of cargo; the elimination of the petrol subsidy in 2023 is expected to have exacerbated these costs (Sienaert *et al.*, 2023) ^[13].

Theft (2.35), high cost labour (2.35), and absence of an accessible market (2.19) were not significant impediments. Processors mitigate theft by employing security staff to oversee batches, while the demand for palm oil remains elevated due to its numerous applications. Remuneration considerably diminished profit (Table 3) despite labour expenses not being deemed a substantial limitation, perhaps due to salaries constituting merely 4.3% of total costs and the prevalent utilization of household work. Obokare *et al.* (2024) ^[9] identified rent as a key limitation for processors in Delta State; however, it constituted just a modest expense

here (1.6% of total cost) and was not statistically relevant in the regression analysis.

Table 4: Constraints Faced by Palm Oil Processors ss

Constraint	SA	A	D	SD	Mean	Decision
Poor repair and maintenance of mills	32	27	16	6	3.05	Constraint
Poor government support	29	32	14	6	3.04	Constraint
Limited access to credit	28	27	15	11	2.89	Constraint
High transport fare	27	26	14	14	2.81	Constraint
High cost of milling machines	27	24	17	13	2.80	Constraint
Irregular supply of fresh fruit bunches	27	17	21	16	2.68	Constraint
Lack of capital	22	20	25	14	2.62	Constraint
Theft	16	18	25	22	2.35	Not a constraint
High cost of labour	12	24	25	20	2.35	Not a constraint
Lack of ready market	19	10	19	33	2.19	Not a constraint

Note. SA = strongly agree (4), A = agree (3), D = disagree (2), SD = strongly disagree (1). Cut-off = 2.5. Source: Field survey, 2026. Means are computed from the frequencies shown; theft (2.35) is therefore not a serious constraint.

5. Conclusion

This study was conducted in Delta State utilizing primary data for the investigation. The study indicates that palm oil production in Delta State yields significant profits, with an approximate net income of ₦361,588 and a benefit-cost ratio of 2.33 for each processor. FFB constitutes 84% of the expenses, thus making working capital and the provision of financing important. Profit increases with the volume processed, the price of palm oil, the use of contemporary methods and expertise, while it decreases with the proximity to purchasers, labour costs, capital expenses, and fuel prices.

Inadequate mill repair and upkeep, insufficient governmental assistance, restricted credit access, elevated transportation costs, costly milling equipment, inconsistent FFB supply, and capital shortages are the primary limitations.

6. Recommendations

It is recommended that (a) the Bank of Agriculture and the Bank of Industry should extend low-interest credit to local fabricators of milling machines, so that machines and spare parts become cheaper and repair services are available near processors, in line with the modernization of processing infrastructure in the 2026 national strategy (Ecofin Agency, 2026) [2]; (b) processors should be encouraged to join cooperatives to access funds without collateral, since cooperative membership was associated with higher output in Osun State (Jimoh *et al.*, 2024) [7]; (c) government should provide rural roads and subsidized transport for farm produce; (d) support should be given to the establishment of plantations and collection centres so that FFB supply is more regular; and (e) processors should be helped to build shared storage so that seasonal price gains are not lost to marketers (Emaziye & Ovharhe, 2020) [3].

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