Groundnut Value Chain in Nigeria: Positioning to alleviate Supply Chain Crisis in Global Edible Oil Markets

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Abstract

Shortage of edible oils resulting from disruptions in the global food supply chains opens an opportunity for Nigeria to contribute to bridging the gap in the international edible oil markets through its groundnut production. However, the groundnut sub-sector has suffered setbacks over the years. Reviving the subsector is hinged on a good understanding of current realities in the value chain, its participants and their activities, the markets, as well as decision making at the key nodes. We therefore assessed groundnut value chain activities, marketing, and traits preferences at key value chain nodes in Northern Nigeria – the top producing zone. We examined the determinants of engagement in the value chain and unfolded the opportunities for development and constraints in the value chain. In a three-stage sampling procedure, we randomly selected 546 value chain participants from communities across three states in Northern Nigeria where groundnut production is prominent. We analysed data using descriptive statistics, probit regression, Hyperbolic Cosine Unfolding Quasi-Rasch model, Qualitative Content Analysis, and Semantic differential scale. We found that 37.42% of the respondents were youthful, presenting the groundnut value chain with opportunities to drive innovation. The average household size of the respondents was 14 individuals. There is upto 94% association membership and 69.6% phone ownership among the actors. The large-scale processing node was grossly underrepresented in the value chain with energy deficit, financing, and insecurity/insurgency fingered as why medium scale processors failed to upscale. Skills capacity, adoption rates, and diffusion of groundnut innovation from R&D were abysmally low indicating a weak linkage between government, research, and industry. Some of the key determinants of decision to engage in production by men and women in the value chain include: (+) proximity to off-takers, aaccess to improved seeds, household income, peer effect, (-) secondary occupation involvement, and insurgency ($p<0.05$) whereas there were other determinants that affected men and women differently. Key traits commonly sought after are kernel size, storability and colour. Major constraints in the system were limited infrastructural support and poor linkage to input and out markets. We conclude that there are opportunities for Nigeria to ramp up on its production, value addition, and export. We recommend cash and non-cash aids in form of inputs to groundnut producers. Breeding initiatives should incorporate the gendered traits preferences while the existing clustering models can be leverage for training and trade facilitation.

Keywords: Edible oil, Groundnut, Gender, Market Development, Traits preference, Value chain
JEL code: Q02, Q12, Q13

Background

The COVID-19 pandemic underscored the high level of interconnectedness that exists among countries around the world as the global food supply chains became noticeably disrupted. In the wake of the Russia-Ukranian war in 2022, vulnerabilities in the agri-food chains became more prominent as the two countries imposed trade decisions ranging from export quotas to outright bans. These are raising global trade concerns especially in food grains and edible oils, for which the warring countries are leading world exporters. With crop failures in many countries hitting record high while the world embattles climate change, food security crisis may advance from bad to worse especially for food-importing countries like Nigeria. Albeit, the situation also presents market opportunities for producers of alternatives to such commodities of global interest — perhaps with many consumers, for instance, eager to substitute groundnut oil for sunflower oil, given its global shortage.

Groundnut (*Arachis hypogaea*) is a key oil seed, food crop, and in fact a cash crop in Nigeria. According to Godfrey et al. (2020), the uses of groundnut plant over the years make it an excellent cash crop for domestic markets as well as foreign trade in several developing and developed countries. Clearly, Nigeria has been a leader in groundnut production over the years, maintaining first position in Africa with 39% of total production in the continent with the aggregate effort of subsistence and commercial producers. Between 2015 and 2019, Nigeria's total production increased from was 3, 467,446 mt to 4,500,050mt (NEPC, 2020). This increased production is however better linked to expansion in hectarage rather than to improvements in efficiencies. Suffice to say that the production has not sufficiently improved technically over the past decades.

Prior to the discovery of petroleum, groundnut was a main contributor to the Nigerian economy. Then, the "Groundnut pyramids" of Northern Nigeria were iconic tourist attractions and a symbolism of wealth however resource curse eroded the pyramids as agriculture became neglected. There are efforts to revive the sector with the Nigeria's Economic and Growth Plan (ERGP) 2017-2020 strategy document having strong outlooks on agricultural transformation and food security with groundnut as one of the focus value chains. Currently, Nigeria ranks as the fourth largest producer of groundnut globally, yet it ranks as the 63rd largest exporter in 2021 (FAO, 2022; OEC, 2022). This is an indication that there are yet abounding potentials for Nigeria to outperform its current levels of exports if given the required attention. The departure points for reviving the groundnut subsector are hinged on a good understanding of the value chain, its participants and their activities, the markets, as well as decision making at the key nodes on the value chain.

This research was therefore carried out to assess groundnut value chain activities, marketing, and traits preferences at key value chain nodes in Kano, Niger, and Kaduna states in Northern Nigeria. The study area was selected based on their prominence which stands at over 40% of national production. This research is motivated by the global shortages of edible oils for which groundnut oil is a major substitute. It has become important to leverage on the market opportunities that have

re-emerged consequent upon the recent disruptions to the global food supply chains. Apart from contributing to economic recovery of the nation, this will also be supporting pro-food security efforts targeted at Sustainable Development Goal 2 to end hunger.

We designed the research to first assess the groundnut value chain activities in the study area. Secondly, we examined the factors that influence farming households' decision to engage in groundnut production in the study area. Thirdly, we sought to unfold the traits preferences of groundnut value chain participants in the study area. Fourthly, we assessed the input-output market opportunities for groundnut value chain actors and lastly, we investigated the constraints to groundnut value chain activities in the study area. The novelty in our research however lies in our holistic scope which looks beyond the groundnut value chain into its market system development.

Methodology

Conceptual Framework

Our study draws from Porter (1985) and Gereffi et al. (2005) who outlined how firms achieve competitive advantages by adding value through producing, marketing and delivering goods and services. Though the value chain concept has no unifying theoretical foundation, the global commodity framework is supported by the World Systems Theory and the Organizational Theory. We build on the framework of Jordaan et al (2014) which is a hybrid VCA developed for the analyses of the agri-food chains within which smallholder farmers operate. The integrated framework by Jordaan et al. (2014) incorporates other players into the value chain beyond the actors directly involved in the production. Other actors included are those involved in linkage of products to consumers, those that dictate the rules and regulations (value chain influencers) and those that provide support services (value chain supporters) to players in the value chain. The new integrated framework as proposed by Jordaan et al. (2014) is presented in Figure 1.

According to Jordaan et al. (2014), this new integrated framework extends the value chain influencers to include the social and physical environment that influences the behaviour of the farmers. The framework presented in Figure 1, shows the macro level which contains the value chain influencers. In the context of this research, they include the influencers at the Federal, State, and Local Government levels, the apex regulatory bodies. On the whole, social capital can be observed to be playing very significant, albeit informal, roles in the value chain which therefore places social embeddedness at the next higher level after the value chain influencers in the framework. Social embeddedness refers to customs, traditions and societal norms (Williamson, 2000). Social capital consists of observable but non-contractual elements such as trust, shared norms and social networks (Slangen, 2005; Milagrosa, 2007; Jordan,2014).

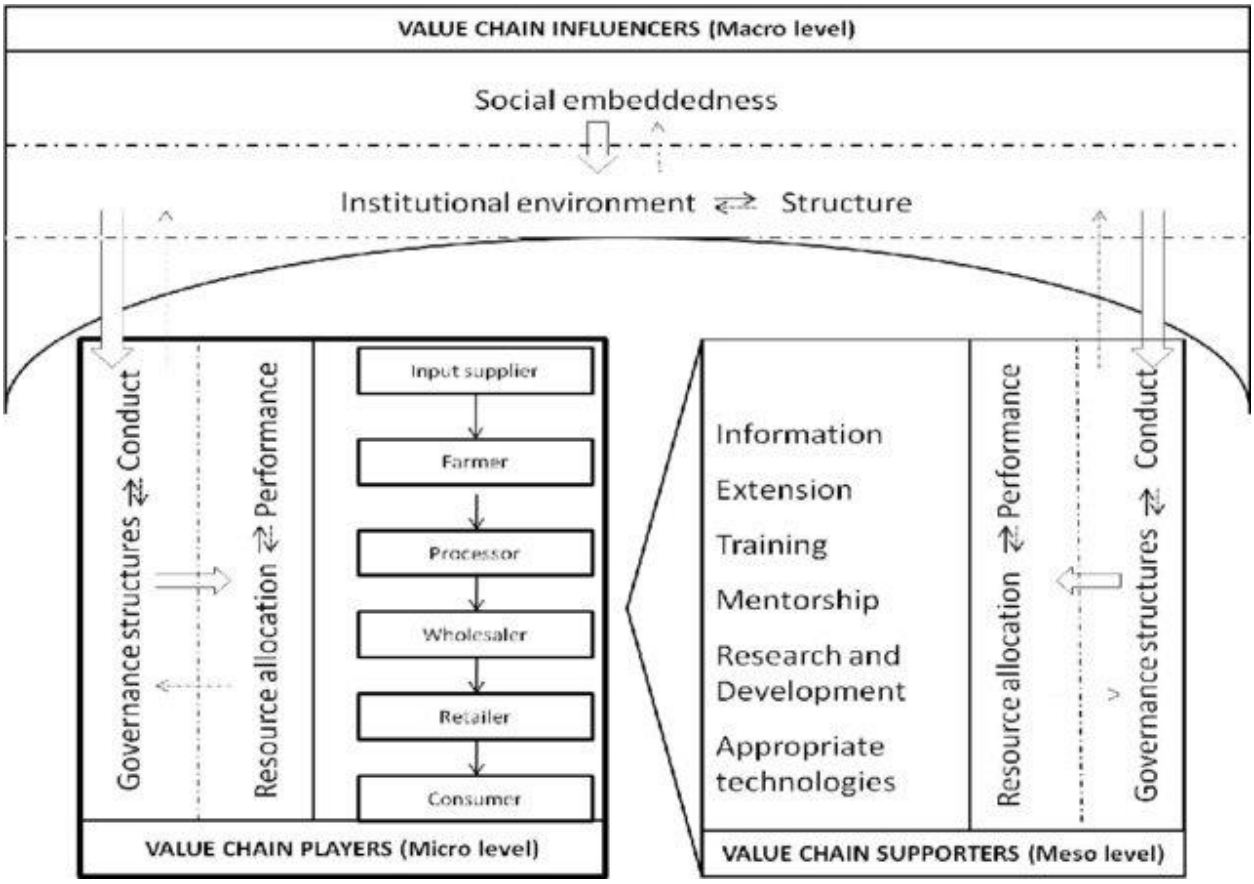


Figure 1: Conceptual Framework for the Analysis of Agri-food Value Chain (Adapted from Joordan et al., 2014)

To a large extent, such observable social interactions have tendencies to influence how cohesive the value chain can be and how harmoniously the activities in the chain can run. Social embeddedness becomes very critical especially in rural context of developing countries considering the observable weaknesses failures that prevent government from adequately filling existing gaps in the systems. Several studies have agreed that social capital is a key factor in economic development given that trust, norms and social networking boosts economic and institutional machineries. In addition, it drives long term economic development if well harnessed at the various strata of the economy (Putman, 1993; Beugelsdijk and Schaik, 2001; Ostrom and Ahn, 2001; Milagrosa and Slangen, 2005).

We consider group membership and societal ties in the context of social embeddedness in the groundnut value chain. Players in the research and development of the groundnut – Institute for Agricultural Research, (IAR) Samaru, Zaria, National Agricultural Extension Research and Liaisons Services (NAERLS), and International Crop Research Institute for the Semi-Arid Tropics (ICRISAT). These institutes have various mandates in seed production systems, extension support services, and training features etc at the meso-level. At the micro level, we considered input

supplies, groundnut producers, processors, wholesalers, exporters, assemblers, resellers, retailers, and consumers. Our consideration of activities in the groundnut value chain across all levels presented in the framework provides us with a robust insight into the value chain.

Analytical procedure

We selected the sample for this study in a three-stage sampling procedure. We purposively retained four (4) Local Government Areas which do not have significant security challenges in Kaduna (Birnin Gwari, Giwa, Chikun, Lere) and Niger states (Kontagora, Bida, Agaie, Shiroro) and four (4) Local Government Areas prominent for groundnut production in Kano State (Tsanyawa, Dawakin Kudu, Shanono, Kankia). We selected three (3) villages from each LGA taking into account where there are clusters of groundnut production. Lastly, in a proportionate and random process, we selected 546 groundnut value chain participants from the selected communities. We overlaid the random sampling with stratification to ensure female inclusiveness in our sample. We collected data with a semi-structured questionnaire which was designed to capture information on socio-demographic information about the respondents, information on engagement in groundnut production, market information flow, groundnut value chain activities, marketing opportunities, and challenges in their activities.

In a preliminary step, we assessed the groundnut value chain activities in the study area using descriptive statistics. In order to examine the factors that influence farming households' decision to engage in groundnut production in the study area, we fitted the probit model. The model predicts the probability of the farming household deciding to engage in groundnut production (i.e. dichotomous farming decision, taking 1 if engaged and 0 otherwise). The dependent variable, y, depends on k observable variables x_k where k=1,…k. given a set of predictor variables. In terms of probability of occurrence, the Probit model may be given as follows:

$$Prob(y = 1) = \varphi\left[\sum_{k=1}^{k} \beta_k b_k\right] \quad \ldots\ldots\ldots \quad (i)$$

Whereas, the probability of non-occurrence may be stated as:

$$Prob(y = 0) = 1 - \varphi\left[\sum_{k=1}^{k} \beta_k b_k\right] \quad \ldots\ldots\ldots \quad (ii)$$

Where φ is the cumulative standard normal distribution function and β is the coefficient i.e effect of a unit change in a regressor x on quantile z, holding constant all other k−1 regressors while b are the modelled variables.

The farming household's decision to engage in groundnut production is dependent on the criterion function stated as:

$$y^* = \gamma Z_i + U_i \quad \ldots\ldots\ldots\ldots (iii)$$

Where,

Y^* is the underlying index reflecting the difference between engaging and not engaging in groundnut production,

γ is the vector of parameters to be estimated,

Z_i is the vector of the predictor variables explaining the household's decision to engage in ground nut production in their farming activities,

U_i is the normally distributed error term,

It is important to note, however, that the concept of Y^* is unobservable in the real sense which necessitates defining Y_i which is a sort of shadow of the unobservable and may be defined as follows:

Y_i= 1 if Y_i^* > 0 (i.e. engagement in groundnut production)

$Y_i = 0$ if otherwise (in this case non-engagement)

The model for estimating the probability of a farming household engaging in groundnut production can be stated as:

$$P\left(Y_i = \frac{1}{X}\right) = \varphi(X\beta) = \int_{-\alpha}^{X\beta} \frac{1}{\sqrt{2\pi}} exp\left(\frac{-z^2}{z}\right) dz \quad \ldots\ldots\ldots (iv)$$

Where,

P represents the probability that the i[th] farming household is engaged in groundnut production

X equals K $\times$ 1 vector of the predictor variables

Z is the normally distributed standard variables $z \sim N(0, \delta^2)$

β equals K $\times$ 1 vector of the estimated coefficients

The probit model may be generally specified as:

$$Y_i^* = X_i\beta + \varepsilon_i \quad \ldots\ldots\ldots (v)$$

$$Y_i = \begin{cases} 1 \quad if\ Y_i^* \geq 0 \\ 0\ if\ Y_i^* < 0 \end{cases}$$

Where, Y_i is the observed dichotomous endogenous variable, taking on the value 1 for households that are engaged in groundnut production and 0 otherwise

Y_i^* is the underlying latent or unobservable variable which represents the farming household's decision to engage in groundnut production, X_i is the row vector of values of k regressors for the i[th] household, β equals the K $\times$ 1 vector of parameters to be estimated, while ε_i is the error term, satisfying the assumption that this is normally distributed.

Thirdly, we sought to unfold the traits preferences of groundnut value chain participants in the study area using the Hyperbolic Cosine Unfolding Quasi-Rasch model which can be stated as:

$$\Pr\{X_{VCAi} = 1\} = \frac{1}{1 + Cosh(\beta_{VCAi} - \delta_i)} \quad \ldots\ldots\ldots (vi)$$

where, β_{VCAi} is the perception of value chain actor *VCA* on varietal trait *i*, δ_i is the weighted relevance of trait *i*, at the value chain node and $Pr\{X_{VCAi} = 1\}$ is the probability that value chain actor, *VCA* recognizes the actual relevance of the preferred trait.

Fourthly, we assessed the input-output market opportunities for groundnut value chain actors using qualitative and quantitative content analysis building on Berelson, 1952; Krippendorff, 2004; and Neuendorf, 2002. Content analysis examines textual data for patterns and structures. The methodology singles out salient features to which attention must be paid, develops categories, and aggregates them into perceptible constructs to gain insight into text meaning (Gray and Densten 1998, Shoemaker and Reese 1996). The technique aims at describing, with optimum objectivity, precision, and generality, what is said on a given subject in a given place at a given time by the people being researched (Lasswell, Lernerand, Pool, 1952).

Content analysis is enriched by its ability to capture a richer sense of concepts within the data due to its qualitative basis and, at the same time, can be subjected to quantitative data analysis techniques (Insch and Moore,1997). Content analysis as a method of gathering information requires correct codifying of qualitative and quantitative information into predefined categories in order to derive patterns in the analysis and reporting of information (Thia and Ross, 2011). Quantitative content analysis provides clear methodological reasoning based on the assumption that the most recurring theme in the text is the most important to whoever is being surveyed. It also incorporate testable scientific methods such as design, reliability, validity, generalizability, replicability, and hypothesis testing (Neuendorf 2002, Vitouladiti 2014).

We investigated the constraints to groundnut value chain activities in the study area using the Semantic differential scale. Our choice of this rating scale is informed by the fact that it allows us to gain insight into the emotive perception which our respondents try to communicate on the research subject matter in different contexts.

Results and Discussion

We present the socio-economic and demographic statistics of the sampled respondents in Table 1. As shown, about 37.42% of the respondents were youthful. The mean age of the respondents was 42years. He youthful population presents the groundnut value chain with opportunities to drive innovation. About 76% of the value chain actors were male. When we disaggregated the data, we found that less than 14% of the actors on the production node were female however they were more prominent (78%) on the node of artisanal scale processing. This is a major concern as it implies women are missing at the nodes with higher economic gains.

Table 1: Socio-economic and demographic features of the Respondents

Category	Freq	Percent
Age		
Young adult (18-35)	204	37.42
Middle aged (36-55)	231	42.32
Older adults (>55)	111	20.46
	546	100.00
Min (yrs)		18.5
Max (yrs)		77.5
Mean (yrs)		42
Gender Respondent		
Male	415	76.01
Female	131	23.99
Marital status		
Married	396	72.53
Single	86	15.75
Widow(er)	47	8.61
Divorced	17	3.11
Total	546	100.00
Household size		
1-5	37	6.86
6-10	184	33.66
11-15	106	19.44
16-20	86	15.69
21-25	34	6.21
26-30	45	8.17
>30	54	9.97

	546	100.00
Mean		14
Education		
Primary	109	19.96
Secondary	130	23.81
Tertiary	42	7.69
Adult education	20	3.66
Qur'anic only	114	20.88
No formal	126	23.08
Others	5	0.92
Total	546	100.00
Main Occupation		
Farming	425	77.78
Non-farming	121	22.22
Total	546	100.00
Secondary Occupation		
Animal rearing	44	21.57
Trading	26	12.75
Public service	73	35.78
Mining	1	0.49
Craftsmanship	21	10.29
Others	39	19.12
	204	100.00
Membership of association		
Member	512	93.77
Non-member	34	6.23
Total	546	100.00
Type of association		
Farmer group	264	51.55
Cooperative	19	3.66
Grain marketer	9	1.69
Input supplier	3	0.56
Community based seed production	48	9.30
Savings and credit cooperative	127	24.79
Others	43	8.45

	512	100.00
Benefit derived from membership*		
Labour supply	161	29.27
Credit/finance	101	18.36
Information access	53	9.64
Marketing opportunity	38	6.91
Seed supply	25	4.55
Other input supply	76	13.82
Skills/training opportunities	57	10.36
Others	39	7.09
Total	550	100.00
Groundnut Production Purpose*		
Home Consumption	516	59.45
Market	224	25.81
Seed supply	14	1.61
Livestock feeds	8	0.92
Processing	102	11.75
Others	4	0.46
	868	100.00
Respondent's Value Chain Node		
Producer	251	45.97
Consumer	65	11.90
Marketer	46	8.42
Artisanal Processor	135	24.73
Medium Scale Processor	7	1.28
Input Supply	10	1.83
Aggregators	22	4.03
Trade Facilitators	8	1.47
Exporters	2	0.37
Total	546	100.00
Ownership of mobile phone		
Yes	380	69.60
No	166	30.40
Total	546	100.00

Source: Field survey 2022 *multiple responses allowed

Majority (73%) of the respondents were married with the average household size standing at 14individuals. This is well above double of the national average. While this can be an opportunity for household labour supply, it also presents a threat to household welfare and food security. Within households, disaggregating the members by gender indicated there were almost equal number of male (48.44%) and female (51.56%). Up to 51% of the respondents had a form of formal education. This is quite impressive given the national literacy level in the Nigeria averages 5.2years as reported on UNDP's Human Development Reports and UNESCO Institute of statistics as 2013 estimates. Close to 78% of the respondents were into farming as their main occupation with about 36% of them engaged in the civil service as their secondary occupation.

We found about 94% association membership among the actors. This finding deviates from what was observed by Baba *et al*. (2022) in their study where they found that only 35% of groundnut producers belong to association. We attribute this disparity to the fact that the author's work is more limited, covering only one Local Government Area in Niger state and we have a broader definition of association with cooperative societies being a component. Membership of association is critical as it is a proven strategy for extending supports and advisory services to members (Shuaibu 2018). Among the actors we surveyed, we found that the key benefits that endeared them to associations are centered on labour supply (29.27%), access to finance (18.36%), input supply (13.82%), and skills/training opportunities(10.36%). This is a clear indication that value chain actors are actively seeking out opportunities to improve on their businesses. Our findings on access to finance is in tandem with that of Baba *et al.* (2022) which was carried out in Niger state where they found that only about 24% of groundnut farmers benefit from access to finance suggesting low access.

We found that about 70% of the value chain actors owned mobile phones, in which case we considered both feature phone and smart phone. We found the nodes of interest on groundnut value chain to be input supply, production — seeds and grains, artisanal processing, medium scale processing, aggregators and trade facilitators, marketers, exporters. The large-scale processing node was grossly underrepresented in the value chain with energy deficit, financing, and insecurity/insurgency fingered as the culprit by 85.7% of the medium scale processors who have principally failed to upscale.

In our reconnaissance survey on market system development, we found prominent support functions played by the government Agricultural Development Project states offices, ministries at the national and local levels whereas research and development needs are met by research institutions like Institute for Agricultural Research, (IAR) Samaru, Zaria, National Agricultural Extension Research and Liaisons Services (NAERLS), and International Crop Research Institute for the Semi-Arid Tropics (ICRISAT). Surprisingly, skills capacity, adoption rates, and diffusion of groundnut innovation from R&D were abysmally low indicating a weak linkage between government, research, and industry.

Informal rules and norms towards setting and enforcing rules appeared to be commendably efficient even where standardized regulations and laws were not adequately structured. We found support functions for financial services to be significantly low with underlining inequalities in inclusion. There are very strong informal networks especially in business memberships organization that have the capacity to strengthen the system at the marketing nodes through their coordinated activities with clear opportunities for better inclusivity, decent work creation, higher economic gains, and hence poverty reduction.

Determinants of Farming Households' Decision to engage in Groundnut Production

Scaling the groundnut value chain in Nigeria requires ramping up production. This motivated our curiosity to understand the factors that influence farming households to take decision to engage in groundnut production. We disaggregated the data to understand the gender dynamics in this decision making. Our findings are presented in the following section, with Table 2 summarizing the statistics.

Specifically, we found that certain factors significantly drive women's decision to engage in groundnut production unlike how their male counterparts are influenced. For instance, the Age and marital status of a female increased the probability that she would decide to engage in groundnut production ($p<5\%$). This may be because of the attendant responsibilities that come with these characteristics in the household. Interestingly, the gender of the individual next-in-hierarchy to the woman within the household also shown to positively influence their decision to be involved in groundnut production, in the event that this individual is a male. We observed that remittance income to a female household head is also a determinant in their decision to be involved in groundnut production. This may a pointer to the fact that women are more open to invest their incomes into a cause that will prove beneficial to the entire household rather than self alone.

Women's access to mechanization in their activities as well as their prior involvements in demonstration plots and on-farm trial activities also positively influences their decision to be engaged in groundnut production. We found that among the men, access to finance and extension advisory services had significant influence on their decision to engage in groundnut production. It is important to mention that we attribute these two factors not having significant impact on women's decision to the fact that women in our study area are often culturally prevented from freely interacting with male. This suggest that extension services provider may need to start looking to build capacity of more women to take on the tasks of extension advisory services delivery within the region. This will help breakdown some of the barriers and nuances that currently prevents women from fully accessing such services.

Table 2: Determinants of Farming Households' Decision to engage in Groundnut Production

VARIABLES	Male Headed Households	Female Headed Households
Gender_Next_in_Heirarchy	5.411 (6.114)	2.911** (1.324)
Age	9.392 (4.277)	8.174** (3.349)
Marital_Status	3.902 (8.169)	4.350** (7.600)
Household_Size	2.110** (1.651)	2.764** (1.163)
Household_Income	3.155** (2.691)	5.052** (1.091)
Educ_Level	2.334** (4.650)	-5.97** (5.596)
Years_of_Exp	1.742 (2.300)	2.811 (1.584)
Hectarage	0.013** (0.000)	0.011** (0.000)
Land_Ownership	2.225** (1.044)	3.271** (2.474)
Assoc_Membership	1.111** (2.438)	1.315** (3.102)
Access_to_Finance	1.152** (3.272)	1.014 (4.064)
Remittance_Income	6.163 (3.408)	7.302** (2.433)
Secondary_Occup	-2.134** (0.850)	-2.225** (1.059)
Extension_Adv_Serv	1.202** (1.043)	1.780 (1.105)
Mechanization_Accs	3.70 (1.925)	3.026** (1.454)
Proximity_to_Offtakers	0.678** (1.595)	0.811** (1.473)
Distance_to_Mkts	0.011** (0.002)	-0.021** (0.000)
Access_Imprvd_Seeds	2.21** (1.472)	2.63** (1.683)
Ownership_Mobile_Phone	2.64 (1.07)	3.112 (2.66)
Peer_Effect	2.174** (1.408)	3.688** (2.951)
Insurgency_Index	-2.350** (3.555)	-3.632** (4.278)
Participation_Demo_Plots	2.764 (1.473)	3.334** (2.353)
Eligibility_Govt_Spons_Proj	2.052** (1.196)	4.660** (3.741)
Expectation_Demand	1.401** (0.817)	1.72** (1.211)
Quality_AccessRoad_Index	0.012 (0.002)	0.017 (0.011)
Constant	-8.110** (6.598)	-9.423** (5.699)
McFadden Rsquared	0.625	0.3921
Log-likelihood	-89.458	74.214
Schwarz criterion	116.025	204.912
Akaike criterion	104.719	113.602
Hannan-Quinn	124.006	165.244

Data Analysis: 2022

Across gender, at 5% significance level, we found that household size and household income positively influence the actors' decision to engage in groundnut production. Surprisingly, we found that educational level significantly influenced the actors' decision to engage in groundnut production. Albeit, the direction of influence differs for both gender. For female actors, their decision to engage in groundnut production was negatively influenced by educational level whereas the direction was positive for men. We perceive that it may be that women opt for other nodes of the value chain or even other economic activities when they are more educated whereas a men leverage education to scale their activities in the value chain especially as we have found they have better access to finance and extension services which are crucial to value chain activities.

We found that available hectarage, land ownership and membership of association significantly influenced both men and women to engage more in groundnut production. Having a secondary occupation negatively influenced men and women's decision to engage in groundnut production. We assume that this secondary occupation status has a two-pronged effect in that the alternative income source may be motivating enough to dissuade them from deciding to produce groundnut. On the other hand, the secondary occupation may be competing for their time hence preventing them to take such production decision.

Our results suggests that proximity to off-takers significantly influences men and women's decision to engage in ground nut production. The distance to market also significantly determines the actors' decision to engaged in production but this influence is positive for men and negative for women. This is expected because men are more able to access farther markets than their female counterparts. Women are often inundated with household activities, child rearing, care and support for the elderly to mention a few. Some of these activities will require a trade-off in women's ability to participate in markets that are outside their localities.

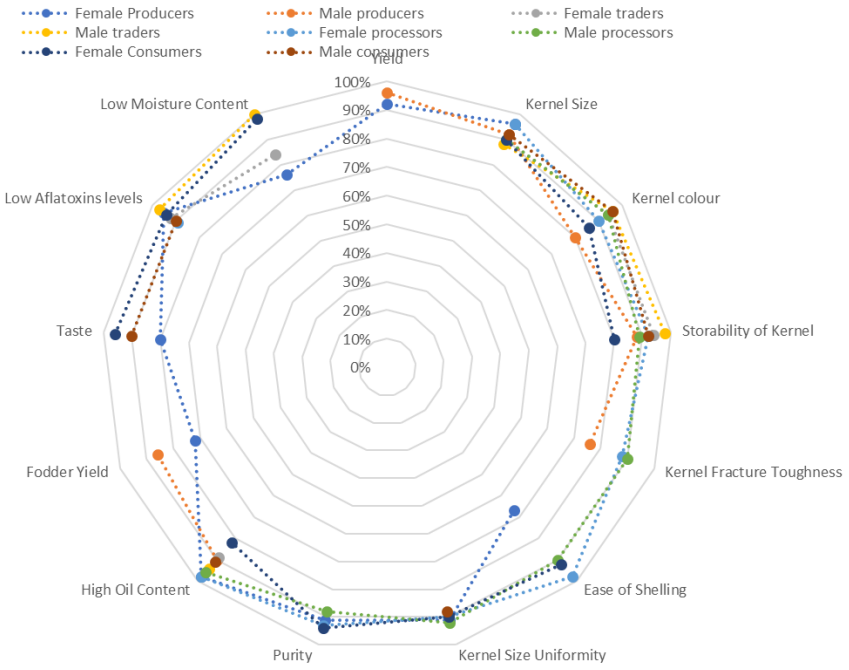
We found that women and men's access to improved groundnut varieties that are high yielding have strong influence on their decision to go into production activities. Similar findings were also made regarding expectations that there will be assured markets, increased demands, and or higher rewards for groundnut in the next season. Such expectation positively influenced the men and women's decision to engage in production activities. It is expected that such speculations that promises economic gains will positively influence rational decisions in the direction of production activities.

Men and women that were potentially eligible for government and developmental agencies sponsored programmes with ADPs were found to have higher likelihood of taking decision to engage in groundnut production. At 5% significance level, insurgency challenges negatively influenced actors' decision to engage in production. We also found that peer effect has a positive influence on men and women's decision to engage in groundnut production. This may be linked to our earlier submission on membership of association since association often have key individuals who may be referred to as influencers in that regards.

Traits Preferences of Groundnut Value Chain Participants

We unfolded the traits preferences of groundnut value chain actors through the gender lens. Our interest lies at the production, marketing, processing, and consumption nodes on the value chain. We visualize the result in the radar chart in Figure 2. For both gender across the entire value chain, the traits preferences is the groundnut kernel size. The kernel storability and colour were also significant traits sought after along the entire value chain except at the node of women producers. We suspect this might be because most women at that node of the value chain are practicing at a subsistent level and would mostly dispose of their output soon after harvesting hence not needing the attribute on storability and colour.

FIG 2: GENDERED TRAITS PREFERENCES OF GROUNDNUT VALUE CHAIN ACTORS



Men at the production node of the value chain as well as male and female at the processing node place a premium on kernel fracture toughness. Across the production, processing, and consumption nodes of the value chain, only women highlighted their preference for varieties that are easy to shell. We found that the kernel size and purity of the groundnut mattered most to female producers and both gender at the processing and consumption node of the value chain. Male consumers were however not keen on the purity. High oil content and low aflatoxins contamination levels were ranked highly by both gender across the value chain nodes, except among male processors who did not rank aflatoxins level highly. Men and women at the production node of the value chain rated the fodder yield highly probably because they usually compost this in their farmland during

cultivation for the next planting cycle. Some of our findings are in tandem in what was found in a study by Abba *et al*., 2021.

Assessment of the Existing Input-Output Market Opportunities in the Value Chain

We assessed the input-output market opportunities in a qualitative content analysis using the Atlas.ti. Our findings are presented in the word cloud in Figure 3. We found the existence of poor linkages of groundnut farmers to input required at the appropriate time. Seed production activities were significantly low as majority of the farmers focused on grain production. This has obvious impact on production as the use of improved varieties as planting materials was almost non-existent across the study area. The issue of adoption and diffusion of improved varieties developed in R&D begs questions that may remain unanswered without ramping up seed production and multiplication at scale.

Figure 3: Exploring the Input-Output Market Opportunities in the Groundnut Value Chain

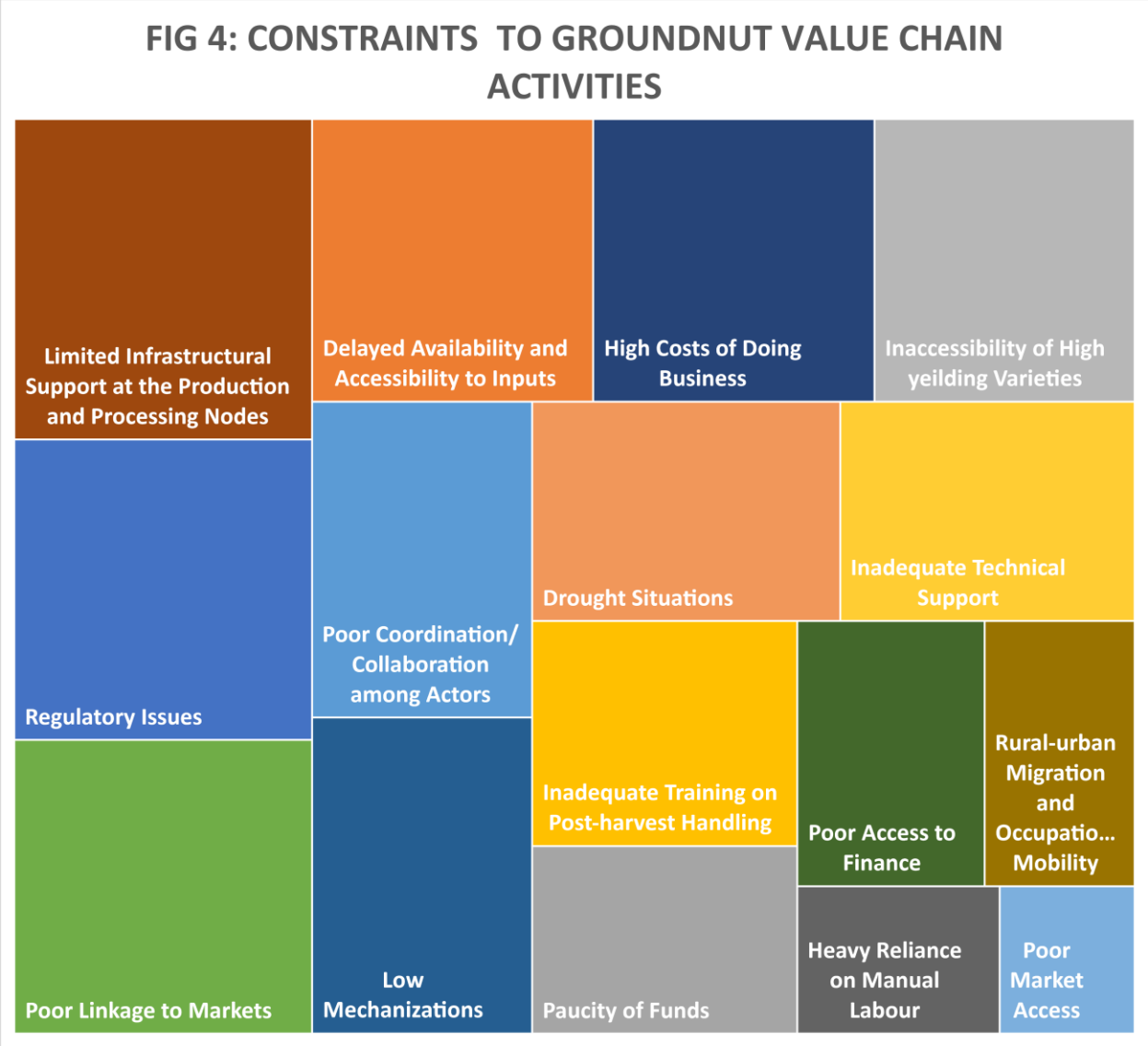
Logistic activities of seed companies and agrochemicals distributors are generally lagging resulting in longer distribution turnaround-time. Transportation logistics poses a threat to trading activities in the study area impacting on farmers' linkage to aggregators and other output markets.

Insurgency is a major threat to production activities in the study area. Trading activities in the groundnut value chain is grossly underreported due to the high levels of uncaptured cross-border trading. As can be inferred from the qualitative content analysis presented in the word cloud, it is important to address the challenges bothering on accessibility to improved seeds, access to inputs, linkage to markets, and insurgency as these are key to developing the groundnut value chain.

Constraints to Groundnut Value Chain Activities in the Study Area

We investigated the constraints to actors' activities in the groundnut value chain and present the results in the tree map on Figure3. The most significant constraint we found in the value chain is the limited infrastructural support at the production and processing nodes. Value chain actors were also concerned about regulatory issues which affects some of their activities especially in (certified) seed production. Actors at this node of the value chain suggested that if they had opportunity to freely produce seed at the community level, it would go along way in increasing accessibility to improved varieties. Seed production at the community level is highly regulated and many of the actors are disenfranchised, being unable to meet the conditions that would qualify them to engage in seed multiplication within their communities.

The constraint of limited access to improved planting materials is a long-standing issue. For Instance, Ibrahim *et al.* (2013) in the study in Kaduna state, found that over 63% of the farmers do not use improved seeds and 75.95% source their seeds from local markets. The authors attribute the cost of improved seeds and lack of awareness on the benefit of improved seeds to the perpetual usage of groundnut grains and local varieties as planting materials. However, we found that value chain actors at the production node were aware and open to using improved varieties but are more often challenged with accessibility. Similarly, Baba *et al.* (2022) found that up to 91% of groundnut producers in Niger state do not plant improved varieties. We consider this a major challenge with its effects observable in the sub-optimal yields that producers continue to record in the value chain. It is more worrisome that several improved varieties have been developed in the past in breeding initiatives by ICRISAT yet adoption appears to be extremely low.



Ibrahim *et al.* (2013) also reported that farmers do not apply fertilizers during groundnut production because of unavailability, inability to afford it and lack of technical knowledge on fertilizer requirements of groundnut. This is in tandem with our findings on the constraints faced by actors on the production node particularly. We found that the poor linkage to market (input and output) is another major constraint to actors at some of the value chain nodes. Similarly weighted constraints were high cost of doing business and delayed access to needed input for production.

Poor coordination and collaboration among actors as well as low mechanization ranked next on the constraints. Heavy reliance on manual labour which, in the face of rural-urban migration and growing occupational mobility, continues to drive production and processing costs higher, discouraging value chain activities. We also found that, specifically at the production node of the value chain, drought was a major constraint to value chain activities. This calls for the need for

infrastructural support that will enable farmers produce outside rain-fed conditions. Prioritization of drought tolerance as a trait in groundnut breeding activities also becomes very important.

Conclusion and Policy Implications

We conclude that there are opportunities for Nigeria to ramp up on its value addition and increase its exports of groundnuts to strengthen its role in the global edible oil market if it addresses the existing challenges and harness its identified and potential strengths. Based on the findings from this study, we recommend that government and other humanitarian agencies provide financing and non-cash aids to farmers in form of improved seed, fertilizers, and agrochemicals such as to assist in boosting production in the groundnut value chain as this is fundamental to successfully scaling in value addition. We recommend that groundnut breeding initiatives should be targeted at addressing traits preferences on yields, oil content, and grain sizes.

Likewise, training supports should be provided in production and handling processes to achieve lowered aflatoxins incidences considering its cruciality in export quality standardization, certification systems, control, and regulatory procedures. With the high adoption of mobile phones among value chain participants, mobile technology may be leveraged for market integration and information asymmetry dissolution at all levels. The low levels of mechanization in production, post-harvest handling, and processing presents National Centre for Agricultural Mechanization in Nigeria and private sector innovators with a gap to address. With the well-developed clustering systems in the VC, community-level processing centers may be strengthened for up-scaling. Policymakers should focus on improving the input market linkages for availability and easier accessibility of farm inputs by farmers.

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