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PRODUCTION CONSTRAINTS AMONG SMALLHOLDER ROSELLE PRODUCERS IN SELECTED STATES OF NORTH-WESTERN NIGERIA

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Abstract
This study assessed the constraints limiting roselle production in Kano, Katsina and Jigawa States, Nigeria. A multi-stage sampling technique was employed, involving the purposive selection of the three states and selected Local Government Areas based on the intensity of roselle production. A total of 195 roselle producers, comprising 138 males and 57 females, were randomly selected for the study. Primary data were collected through the administration of structured questionnaires and analysed using descriptive statistics and the Garrett Ranking Technique (GRT). The findings revealed that roselle production in the study area were predominantly male dominated, with male adults and youths constituting the majority of producers, while female participation remained relatively low. Most of the producers were married, had attained at least secondary education, belonged to cooperative societies and operated as smallholder farmers with considerable farming experience. The Garrett ranking results identified the high cost of farm inputs as the most severe production constraint across the study area. Other major constraints included insecurity and the unavailability of improved roselle varieties, whereas labour scarcity was ranked as the least severe challenge. The study concluded that these constraints significantly limit roselle productivity in the study areas. Consequently, the study recommended improving producers' access to affordable farm inputs, strengthening cooperative societies to enhance collective action and market participation and expanding access to agricultural credit and institutional support services for roselle producers.

Keywords: Garrett ranking technique; gender differentiation; north-western Nigeria; production constraints.

1.0 Introduction

Roselle (*Hibiscus Sabdariffa* L.) belongs to the family Malvaceae and is among the widely cultivated flowering plants across the world. The crop is well known for its ornamental value due to its diverse flower forms and colours (Pablito & Alangelico, 2022). More than 300 species of Hibiscus have been identified globally, many of which occur as tropical herbs and shrubs (Heywood, 1978). Important species include H. *sabdariffa*, H. *cannabinus*, H. *tiliaceus*, H. *surattensis*, H. *acetosella*, H. *physaloides*, H. *lunarifolius* and H. *scotellii* (Falusi et al., 2014). The majority of these species originated from the warmer regions of Central and Eastern Africa, while others are native to tropical areas of America, Asia and Australia (Schippers, 2000).

Roselle possesses wide economic and industrial importance. The crop is utilized as food, livestock feed, medicinal preparation, industrial raw material and natural colouring agent. Its calyces are commonly processed into beverages, jams, jellies, syrups, sauces, salads and flavouring materials. According to Mohamed (2020), calyx colour is an important quality attribute in roselle because it influences consumer acceptance and suitability for food processing and natural food colouring. Roselle is considered an ideal crop for many developing countries due to its drought tolerance, adaptability to mixed cropping systems and relatively low production requirements, although it remains labour-intensive during processing (Food and Agriculture Organization [FAO], 2004). Beyond its nutritional and industrial uses, roselle also contributes to household income generation and foreign exchange earnings through local and international trade. Its extracts are increasingly utilized in cosmetic and medicinal products, including remedies for hair fall and dandruff (Pablito & Alangelico, 2022).

Globally, major roselle-producing countries include China, Sudan and Thailand, while Nigeria, Mexico, Egypt, Senegal, Tanzania, Mali and Jamaica are recognized as important suppliers to the international market (Albert andrew, & Meredith, 2018; FAO, 2004). Sudan and Nigeria are particularly noted for producing high-quality roselle. The global roselle market was valued at approximately USD 122.8 million in 2020 and is projected to increase to about USD 252.6 million by 2030, reflecting growing global demand for roselle-based products (Allied Market Research, 2024).

Roselle yield levels vary considerably across countries due to differences in climatic conditions, agronomic practices and resource utilization. Average yields of dry calyces generally range from 1.5 to 3.0 tonnes per hectare globally. Reported average yields range from 1.5–2.8 tonnes per hectare in Egypt, 1.5–2.5 tonnes in Sudan, 1.0–2.5 tonnes in Mexico, 1.5–3.0 tonnes in Thailand and 1.0–2.0 tonnes in India (FAO, 2019; Oyeleke, 2021). In contrast, roselle yield in Nigeria remains relatively low, averaging between 0.5 and 1.5 tonnes per hectare (Akinyele & Olatunde, 2020). This disparity highlights the significant potential for improving roselle productivity in Nigeria through enhanced agronomic practices, improved varieties and better production management.

In Nigeria, the roselle industry constitutes an important agricultural enterprise with growing economic and cultural significance. Roselle is cultivated almost throughout the year, although peak production occurs during the dry season between November and April. In Northern Nigeria, major production areas include Jigawa, Katsina, Bauchi, Kano, Borno, Kebbi and Sokoto States, with Jigawa recognized as one of the leading producing states. Roselle calyces may occur in green, red, or dark red forms (Awad & Shokry, 2019). Udom, Igwe and Osinowo (2001) identified three major roselle varieties commonly cultivated in Nigeria, two of which are red while one is green. The green variety is more common in Southern Nigeria, whereas the red varieties dominate Northern Nigeria. Among the red varieties, one possesses dark red to nearly black calyces, while the other exhibits bright red calyces. In the present study area, four major varieties were identified based on local classifications: dark red almost black (*Baki* or *Maikwalli*), dark red (*Janbaki* or *Dankanya*), red (*Ja*) and white (*Fari*).

Despite the substantial economic potential of roselle as a food, industrial and export crop, its production and processing systems

in Nigeria remain largely underdeveloped. Production is predominantly undertaken by smallholder farmers who often cultivate roselle as a supplementary or boundary crop for household consumption, local beverage preparation such as *zobo* and limited commercial sales. Although sole cultivation exists in some parts of North-western Nigeria, production practices remain largely traditional with minimal adoption of improved technologies and modern agronomic techniques. In addition, value addition within the roselle industry remains weak, as most industrial processing activities occur outside Nigeria. Local processing is generally limited to pre-cleaning, sorting and grading for export markets, thereby restricting the ability of domestic producers to capture greater economic benefits associated with value addition.

Previous studies have examined the classification and importance of roselle (Pablito & Alangelico, 2022), its economic efficiency (Ehirim et al., 2022) and its suitability for beverage production (Serifat & Anthony, 2020). However, limited empirical attention has been directed toward the production constraints confronting roselle producers particularly in North-western Nigeria. Understanding these constraints is essential for improving roselle production and productivity of the producers. It is against this background this study was designed to attempt at providing answer to the research question:

What are the production constraints faced by the roselle producers in Kano, Katsina and Jigawa states?

The objective of the study was to analyse the production constraints facing roselle producers in Kano, Katsina and Jigawa States, Nigeria. The findings from the study are expected to provide useful information for policymakers, development agencies and other stakeholders in designing targeted interventions aimed at improving roselle production and productivity in the region.

UNDERPINNING THEORY

This study is anchored on the Theory of Constraints (TOC), a management philosophy developed by Goldratt (1984). The theory posits that every production system is constrained by at least one limiting factor, commonly referred to as a constraint or bottleneck, which restricts the system from achieving its maximum potential. According to Goldratt (1984), improving the overall performance of a production system requires identifying, managing and ultimately overcoming the most critical constraint rather than attempting to improve all components of the system simultaneously. TOC therefore emphasises continuous improvement through the systematic identification and elimination of the factors that impede productivity and efficiency. The TOC views a production system as an interconnected chain of activities whose overall performance is determined by its weakest link. The theory argues that the capacity of the entire system is constrained by the activity or resource with the lowest performance (Goldratt, 1990). These constraints may be physical, such as shortages of land, labour, machinery, improved seed, or other production inputs; financial, including inadequate capital and limited access to credit; market-related, such as poor access to markets and unstable prices; institutional, including weak extension services and unfavourable government policies; or behavioural, such as low adoption of improved technologies and inadequate managerial skills (Rahman, 1998; Watson et al., 2007). Unless these binding constraints are properly identified and addressed,

improvements in other components of the production system are unlikely to result in substantial gains in overall productivity and profitability (Mabin & Balderstone, 2003).

Goldratt (1990) proposed the Five Focusing Steps as the operational framework for implementing TOC. These include: (i) identifying the system's constraint, (ii) exploiting the constraint by maximizing its efficient use, (iii) subordinating all other activities to support the constraint, (iv) elevating the constraint through appropriate investments or policy interventions and (v) repeating the process once the existing constraint has been resolved. These steps provide a structured and continuous improvement process for enhancing the performance of production systems.

The TOC is particularly relevant to agricultural production, where multiple factors simultaneously influence productivity. In smallholder roselle production systems, constraints such as inadequate access to improved seed varieties, limited availability of credit, high input costs, pest and disease incidence, labour shortages, poor extension services, inadequate rural infrastructure and weak market linkages often limit production performance. Although several constraints may exist concurrently, TOC suggests that one or a few of these constraints exert the greatest influence on productivity and should therefore receive priority attention (Rahman, 1998; Watson et al., 2007).

METHODOLOGY

This study was conducted in Kano, Katsina and Jigawa states in North-western Nigeria. These states were purposively selected based on their significance in the roselle production.

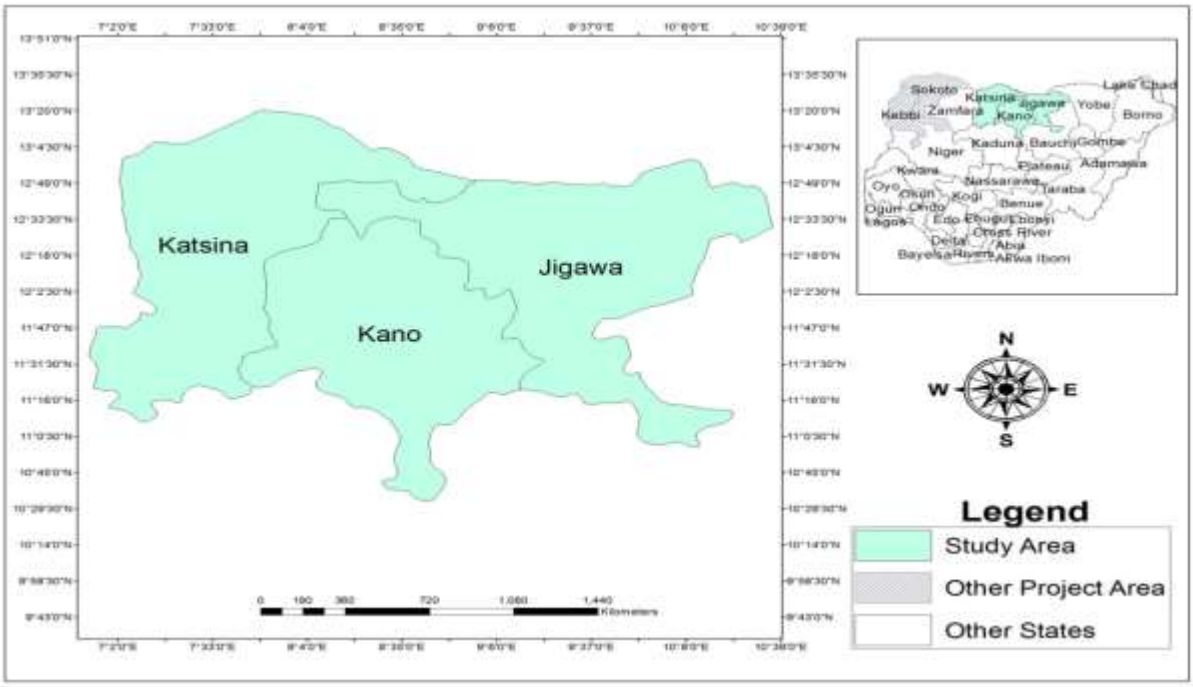

Figure1: Map of the study area
Source: ICRISAT Kano office

Sampling Techniques

This study employed a multi-stage sampling technique.

First Stage: Kano, Katsina and Jigawa States were purposively selected based on their significance in roselle production. Additional factors considered include proximity to the researcher, familiarity with the area and time limitation. These states are strategically relevant due to their key roles in roselle agriculture.

Second Stage: In each of the selected states, three (3) Local Government Areas (LGAs) were purposively selected, based on their high levels of roselle production.

Selection of Producers: A total of 195 roselle producers were randomly selected from the list of registered producers (serve as our sampling frame). This includes 138 males (75 male adults and 63 male youths) and 57 females (41 female adults and 16 female youths). The distribution across the states is as follows:

- Kano: 25 male adults, 23 male youths, 15 female adults and 8 female youths.
- Katsina: 19 male adults, 24 male youths, 14 female adults and 2 female youths.
- Jigawa: 31 male adults, 16 male youths, 12 female adults and 6 female youths.

Table 1: Summary of Sampling for Roselle Producers

States	**LGAs**	**Registered Producers**							
		Male Adult		Male Youth		Female Adult		Female Youth	
		Sample Frame	Sample Size	Sample Frame	Sample Size	Sample Frame	Sample Size	Sample Frame	Sample Size
Jigawa	Taura	14	14	07	07	03	03	02	02
	Babura	11	11	04	04	03	03	01	01
	Gumel	06	06	05	05	06	06	03	03
Sub-total		**31**	**31**	**16**	**16**	**12**	**12**	**06**	**06**
Katsina	Mashi	05	05	07	07	05	05	-	-
	Kaita	04	04	10	10	06	06	02	02
	Maiaduwa	10	10	07	07	03	03	-	-
Sub-total		**19**	**19**	**24**	**24**	**14**	**14**	**02**	**02**
Kano	Danbatta	09	09	07	07	05	05	02	02
	Ajingi	08	08	05	05	04	04	01	01
	Gabasawa	08	08	11	11	06	06	05	05
Sub-		**25**	**25**	**23**	**23**	**15**	**15**	**08**	**08**

total

Total	**75**	**63**	**41**	**16**

Source: Field work, 2025; Youth age 15-35 years; Adult 36 years and above adopted from African Union Commission (2012).

Method of Data Collection

Primary data utilized for this study were gathered through the use of a structured questionnaire. The questionnaire was administered to the selected roselle producers within the targeted Local Government Areas (LGAs). The data collection process was conducted by the researcher, with assistance from field staff of the Agricultural Development Programs (ADPs) in the respective areas who assisted in the data collection process.

The data collected encompassed various gender characteristics of the actors, including age, sex, income, years of experience in their respective enterprises, household size, level of formal education and constraints to the roselle production.

ANALYTICAL TOOLS

Data collected for this study were analysed using a combination of Descriptive Statistics (DS) and Garrett Ranking Technique (GRT).

Descriptive Statistics Tools

Descriptive statistics included the use of frequency distributions, percentages, means, minimum and maximum values. These tools helped in summarising and describing the socio-economic characteristics and other relevant variables in the study. The descriptive tools used in the study were frequencies and percentages and are explained below:

Arithmetic mean (X): The arithmetic mean was calculated by summing a given set of scores and dividing by the total number of observations. Symbolically, the mean is represented as:

$$X = \frac{\Sigma X_i}{n} = \frac{X_1 + X_2 + X_3 + X_4 + X_5 + X_6 \ldots\ldots\ldots\ldots X_N}{n} \quad \ldots\ldots\ldots\ldots (1)$$

Where:

X = Arithmetic mean

Σ = Summation

X_1 = Individual observation

I = 1, 2, 3, 4, 5, 6……..n

Percentage (%): The percentage was applied to determine the sampled population of respondents for each given response. It was calculated using the following formula:

$$\text{Percentage (\%)} = \frac{X}{n} \times 100 \quad \ldots\ldots\ldots\ldots (2)$$

Where:

% = percentage, X = Individual observation and n = Total observation

Garrett's Ranking Technique

Garrett's Ranking Technique (GRT) was applied to rank the constraints faced by roselle producers using Garrett's conversion table (see appendix I). This technique helped identify the top-ranking constraints and their corresponding percentage positions. The percentage positions were then be converted into scores using a table provided by Garret and Woodworth (1969).

Different researches applied GRT in describing the order of different factors that influence the respondents' particular practice. Kuldeep, Abhishek and Jhade (2023) applied Garrett's ranking technique in ranking of major agricultural risks in Jabalpur district of India. Also, Mehazabeen, Srinivasan and Radhakrishnan (2021) applied Garrett's Ranking Technique in their study "A Constraint Analysis on Production and Marketing of Banana in Andhra Pradesh, India". Arnab, (2017) applied

Garrett's Ranking Technique in their assessment of economic and profitability potential of poultry farming in West Bengal. Also, Meena, Meena, and Sankhala, (2016) in their research, "Livestock diseases in sub-Himalayan temperate region" used Garrett's ranking in their analysis. Similarly, Zalkuwi, Singh, Bhattarai, Singh, and Rao, (2015) used Garrett's Ranking Technique to analyse the constraints influencing sorghum farmers; A comparative study of India and Nigeria.

The formula for calculating the percentage position is given as:

$$\text{Percent Position} = \frac{100 * (Rij - 0.5)}{Nj}$$

Where;

Rij = Rank given for the ith variable by jth respondents

Nj = Number of variable ranked by jth respondents.

Results and Discussions

Gendered Characteristics of Roselle Producers

The socio-economic variables used for this research include; gender, marital status, educational status, cooperative membership, land ownership, use of formal banking facility and access to credit in table 2.

Table 2: Gender, marital status, educational status, cooperative membership and land ownership of roselle producers

Variables	Kano n=71 F(%)	Katsina n=59 F(%)	Jigawa n=65 F(%)	Pooled Results F(%)
Gender				
Male Adult	25 (35.2)	19 (32.2)	31 (47.7)	75 (38.5)
Male Youth	23(32.4)	24 (40.7)	16 (24.6)	63 (32.3)
Female Adult	15 (21.1)	14 (23.7)	12 (18.5)	41 (21.0)
Female Youth	8(11.3)	2(3.4)	6(9.2)	16(8.2)
Marital Status				
Single	19 (26.7)	11 (18.6)	10(15.4)	40 (20.5)
Married	35 (49.3)	26 (44.1)	38 (58.5)	99 (50.8)
Divorced	10 (14.1)	9 (15.3)	8(12.3)	27 (13.8)
Widowed	7 (9.9)	13 (22.0)	9 (13.8)	29 (14.9)
Educational status				
Non-formal education	13 (18.3)	8 (13.6)	12 (18.5)	33(16.9)
Primary education	24 (33.8)	11 (18.6)	16 (24.6)	51 (26.2)
Secondary education	31 (43.7)	26 (44.1)	31 (47.7)	88 (45.1)
Tertiary education	3 (4.2)	14 (23.7)	6 (9.2)	23 (11.8)
Cooperative membership				
Member	58 (81.7)	43 (72.9)	59 (90.8)	160 (82.1)
Not a member	13 (18.3)	16 (27.1)	6 (9.2)	35 (17.9)
Land ownership				
Purchased	21 (29.6)	15 (25.2)	20 (30.8)	56 (28.7)
Inherited	33 (46.5)	23 (39.0)	28 (43.1)	84 (43.1)
Gift	8 (11.3)	6 (18.2)	6 (9.2)	20 (10.3)
Rented	5 (7.0)	8 (13.5)	11 (16.9)	24 (12.3)

Communal	-	-	-	-
Household owned	4 (5.6)	7 (11.7)	-	11 (5.6)
Use of formal bank facility				
Used	49(69.1)	42(71.2)	42(64.6)	133(68.2)
Not used	22(30.9)	17(28.8)	23(35.4)	62(31.8)
Access to credit				
Had access	45(63.4)	36(61.0)	35(53.8)	116(59.5)
Had no access	26(36.6)	23(39.0)	30(46.2)	79(40.5)

Source: Field survey, 2025, F=Frequency and %=Percentage

Gender and Socio-economic Characteristics of Roselle Producers

The results in table 2 revealed a clear gender imbalance in roselle production across the study area, with male producers constituting the majority of participants. Pooled findings showed that male adults accounted for 38% of producers, while male youths represented 32%. Female participation was considerably lower, comprising 21% female adults and 8% female youths. Jigawa State recorded the highest proportion of male adult producers (48%), whereas Katsina had the highest share of male youths (41%). The dominance of men in roselle production reflects the broader structure of agricultural systems in northern Nigeria, where socio-cultural and religious norms often restrict women's participation in field-based agricultural activities and major production decisions. Men are generally more involved in land preparation, crop management, input utilization and marketing activities, thereby increasing their access to productive resources. Conversely, the relatively limited participation of women may constrain their access to land, extension services and farm decision-making, thereby reducing their productivity. This finding corroborates the reports of Yadeta and Abashula (2019), who observed that men dominate key farming decisions and productive activities, limiting women's effective participation in agriculture. Similar gender disparities among crop producers were also documented by Oluwalana, Okeleke and Akinbosoye (2019) in their study of vegetable farmers in Ogun State, Nigeria.

The marital status distribution showed that most roselle producers were married, accounting for 50.8% of the pooled sample. Jigawa recorded the highest proportion of married producers (58.5%), followed by Kano (49.3%) and Katsina (44.0%). Approximately 15% of respondents were widowed, with Katsina reporting the highest proportion of widows (22.0%). The predominance of married producers suggests the availability of family labour, which is particularly important in smallholder agricultural systems where household members contribute substantially to farm operations. Marital status is therefore an important socio-economic characteristic because it influences labour availability, household decision-making and farm management efficiency. The relatively higher proportion of widowed producers in Katsina may partly reflect the socio-economic disruptions associated with insecurity in parts of northern Nigeria, which can affect household structure and farming participation. This finding is consistent with Achichi, Sennuga, Osho-Lagunju and Alabuja (2023), who similarly reported a predominance of married farmers among smallholder producers in Abuja, Nigeria.

The educational profile of roselle producers indicated relatively high literacy levels among respondents. About 45.1% of producers had completed secondary education, while 26.2% possessed primary education. Jigawa recorded the highest proportion of producers with secondary education (47.7%). Although relatively few respondents attained tertiary education, Katsina had a comparatively higher proportion (23.7%) than Kano and Jigawa. The relatively high literacy level among producers may enhance their ability to adopt improved production technologies, access extension information and make informed production decisions. Education has been widely associated with improved managerial capacity, technology adoption and farm productivity among smallholder farmers. This finding agrees with the study of Moses, Ekpo and Ogah (2024), who reported that most smallholder farmers possessed at least secondary education.

Results further showed a high level of cooperative participation among roselle producers. Overall, 82.1% of respondents belonged to at least one cooperative society, with Jigawa recording the highest membership level (90.8%). The high level of cooperative membership may reflect increasing awareness among producers regarding the benefits of collective action, including improved access to agricultural credit, extension services, market information and input procurement. Cooperative participation can therefore enhance producers' bargaining power, reduce transaction costs and improve market efficiency, ultimately contributing to increased productivity. This finding supports the observations of Akinwale and Okunola (2022), who reported that cooperative participation significantly improves farmers' access to productive resources and market opportunities.

Land ownership patterns revealed that inherited land constituted the dominant means of farmland acquisition among roselle producers, accounting for 43.1% of respondents, while 28.7% acquired land through purchase. Only a small proportion relied on rented farmland. Secure land ownership through inheritance or purchase may encourage long-term investment in agricultural production and facilitate adoption of improved farming practices. Since land remains a critical production resource in smallholder agriculture, secure tenure arrangements can positively influence farm expansion, productivity. This finding aligns with the observations of Semin and Namyatova (2019), which identified land ownership as a major determinant of agricultural productivity and production efficiency.

The study also revealed relatively high levels of financial inclusion among roselle producers. About 68.2% of respondents utilized formal banking facilities, while 59.5% reported access to agricultural credit. Katsina recorded the highest use of formal banking services (71.2%). Increased utilization of formal financial institutions may be linked to recent financial inclusion policies and the growing adoption of cashless financial transactions in Nigeria. Access to formal banking and credit facilities enhances farmers' ability to finance farm operations, purchase inputs and adopt improved technologies, thereby improving production and. This finding corroborates Yakubu and Musa (2023), who reported that financial inclusion improves farmers' access to agricultural investment resources and enhances production performance.

Constraints to Roselle Production

This section presents the constraints to the roselle producers. The constraints were identified and scored by the different producers in the study areas were summarised and presented in table 3 and 4.

Table 3: Constraints to roselle production in Kano and Katsina

Factors	Percentage position		Garette Table	Kano Total Mean	Rank	Katsina Total Mean	Rank
High cost of farm inputs	100(1-0.5)/10	5	82	72.43	1st	69.63	1st
Inadequate storage facility	100(2-0.5)/10	15	70	49.03	5th	45.77	7th
Poor access to credit	100(3-0.5)/10	25	63	43.50	8th	41.37	9th
Poor prices of produce	100(4-0.5)/10	35	58	57.90	3rd	57.90	3rd
Incidences of pests and diseases	100(5-0.5)/10	45	52	52.83	4th	48.63	5th
Poor road networks	100(6-0.5)/10	55	48	47.13	6th	51.40	4th
Unavailability of improved roselle varieties	100(7-0.5)/10	65	42	63.70	2nd	46.93	6th
Labour scarcity	100(8-0.5)/10	75	36	39.50	9th	39.10	10th
Poor access extension services	100(9-0.5)/10	95	29	44.40	7th	44.00	8th
Insecurity	100(10-0.5)/10	95	18	36.50	10th	58.23	2nd

Source: Field survey, 2025.

Table 4: Constraints to Roselle Production in Jigawa and pooled results

Factors	Percentage position		Garette Table	Jigawa Total Mean	Rank	Pooled Result Total Mean	Rank
High cost of farm inputs	100(1-0.5)/10	5	82	67.33	2nd	69.80	1st
Inadequate storage facility	100(2-0.5)/10	15	70	45.10	7th	46.63	6th
Poor access to credit	100(3-0.5)/10	25	63	47.20	6th	44.02	9th
Poor prices of produce	100(4-0.5)/10	35	58	71.30	1st	62.70	2nd
Incidences of pests and diseases	100(5-0.5)/10	45	52	57.73	3rd	53.06	4th
Poor road networks	100(6-	55	48	51.97	4th	50.17	5th

	0.5)/10						
Unavailability of improved roselle varieties	100(7-0.5)/10	65	42	49.20	5th	53.28	3rd
Labour scarcity	100(8-0.5)/10	75	36	43.30	9th	40.63	10th
Poor access extension services	100(9-0.5)/10	95	29	38.73	10th	42.30	7th
Insecurity	100(10-0.5)/10	95	18	44.53	8th	46.42	8th

Source: Field survey, 2025. Note: *Represents the value of responses for Jigawa and number in parenthesis represents the responses for the pooled results,

Constraints to roselle production

The constraints faced by roselle production across the study states are presented in Table 3 and 4. Results from the Garrett ranking analysis indicate that the high cost of farm inputs was the most critical constraint to roselle production in the study area. Specifically, producers in Kano and Katsina ranked high input cost as the 1st most pressing constraint with a total Garrett mean score of 72.43% and 69.63% respectively, while it was ranked 2nd in Jigawa State (67.33%). However, the pooled results confirmed high input cost as the foremost constraint to roselle production overall in the study area with total average scores of 61.80%. The second most important constraint varied across states. In Kano State, the unavailability of improved roselle varieties (63.70%) ranked 2nd. In contrast, producers in Katsina and Jigawa States identified insecurity (58.23%) and high cost of inputs (67.33%) respectively as the 2nd most important constraints, reflecting the increasing influence of security challenges on agricultural activities in parts of northern Nigeria. Regarding the least severe constraints, labour scarcity was ranked lowest (10th) by producers in Katsina and Jigawa States, with mean Garrett scores of 39.1% and 41.3%, respectively. Although labour scarcity ranked 9th in Kano State (39.50%), it was not considered a major production bottleneck compared to other constraints. Instead, insecurity emerged as the least constraint in Kano, with a mean score of 36.50%, ranking 10th. This suggests relative differences in the severity of insecurity across states, possibly due to variations in local security conditions and farming arrangements.

Overall, the pooled Garrett ranking results identified labour scarcity as the least important constraint to roselle production in the study area, ranking 10th with Garrett average mean scores of 40.63%. This finding may be attributed to the availability of family labour and seasonal hired labour in rural communities. The results imply that roselle producers face heterogeneous constraints along the production process which may limit farmers' productivity and reduce output levels. This is in line with Ibrahim, Bello and Sadiq (2022) who also reported that, production related constraints limits farmers' productivity and reduce output.

Conclusion

The study concluded that the high cost of farm inputs is the most significant constraint to roselle production across the study area. Other important challenges varied by state, including the unavailability of improved roselle varieties in Kano and insecurity in Katsina. Labour scarcity was generally considered the least severe constraint. The findings underscore the need for interventions aimed at reducing input costs, improving access to improved roselle varieties, and addressing location-specific production challenges to enhance roselle

productivity and profitability in North-Western Nigeria.

Recommendations

1. Improve access to affordable farm inputs: High input costs are the primary constraint to production. Facilitating access to subsidized or bulk-purchased seeds, fertilizers and agrochemicals can reduce production costs, increase profitability and enhance overall welfare. This could be achieved via input credit facilities or cooperative led procurement systems which can ensure smallholder farmers acquire inputs at lower costs and in sufficient quantities.
2. Leverage cooperative membership effectively: Producers are encouraged to participate actively in cooperative societies; this can improve bargaining power, access to production credits and provision of information among members. This could be achieved by encouraging active participation in cooperative decision-making, joint marketing and group savings which can help producers translate cooperative membership into tangible financial benefits, including reduced transaction costs and higher market returns.
3. Enhance credit access and institutional support: Strengthening cooperative societies, banks and microfinance institutions to provide accessible and scalable financial services tailored to smallholders and women entrepreneurs can improve production capacities.

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Appendix I

Garrett ranking conversion

Percent	Score	Percent	Score	Percent	Score	Percent	Score
0.09	99	11.03	74	52.02	49	90.83	24
0.2	98	12.04	73	54.03	48	91.67	23
0.32	97	13.11	72	56.03	47	92.45	22
0.45	96	14.25	71	58.03	46	93.19	21
0.61	95	15.44	70	59.99	45	93.86	20
0.78	94	16.69	69	61.94	44	94.49	19
0.97	93	18.01	68	63.85	43	95.08	18
1.18	92	19.39	67	65.75	42	95.62	17
1.42	91	20.93	66	67.48	41	96.11	16
1.68	90	22.32	65	69.39	40	96.57	15
1.96	89	23.88	64	71.14	39	96.99	14
2.28	88	25.48	63	72.85	38	97.37	13
2.69	87	27.15	62	74.52	37	97.72	12
3.01	86	28.86	61	76.12	36	98.04	11
3.43	85	30.61	60	77.68	35	98.32	10
3.89	84	32.42	59	79.17	34	98.58	9
4.38	83	34.25	58	80.61	33	98.82	8
4.92	82	36.15	57	81.99	32	99.03	7
5.51	81	38.06	56	83.31	31	99.22	6
6.14	80	40.01	55	84.56	30	99.39	5

Percent	Score	Percent	Score	Percent	Score	Percent	Score
6.81	79	41.97	54	85.75	29	99.55	4
7.55	78	43.97	53	86.89	28	99.68	3
8.33	77	45.97	52	87.96	27	99.8	2
9.17	76	47.98	51	88.97	26	99.91	1
10.06	75	50	50	89.94	25	100	0

Source: The conversion of orders of merits into units of amount of "scores" adopted from Asrat, et al. (2022)